INTERNATIONAL
CONTINENCE
SOCIETY

VIIIth INTERNATIONAL CONTINENCE SOCIETY MEETING

31 August - 2 September 1978

Held at

THE MEDICAL SCHOOL
MANCHESTER

Pergamon Press

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Printed on behalf of the Organisers
by
PERGAMON PRESS LTD.
Headington Hill Hall, Oxford

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PREFACE

As a society grows its interests diversify, which make it increasingly difficult for these to be covered in single scientific sessions at the Annual Meeting. However at this stage in the development of the I.C.S. it seems to us that the advantage of single sessions in which the corporate experience of the Society is brought to the discussion outweighs the disadvantage of restriction of subjects. This year's meeting follows this pattern. We hope it will provide good discussion and that the programme is a reasonable compromise between the many interests of the Society and those of the local organisers.

We, the local members of the I.C.S. welcome you to Manchester and wish you an enjoyable stay and a worthwhile meeting.

D. W. WARRELL
MANCHESTER 1978

INCONTINENCE IN OLD AGE

Chairmen: B. ISAACS
J. C. BROCKLEHURST

THE PREVALENCE OF INCONTINENCE IN THE COMMUNITY

Thelma M. Thomas*, Kay R. Plymat*, Janet Blannin and T. W. Meade***

**Epidemiology and Medical Care Unit, Northwick Park Hospital, Watford Road, Harrow, Middlesex*
***Dept. of Urology, Ham Green Hospital, Pill, Bristol*

ABSTRACT

A postal survey of incontinence in 8,740 people aged five and over has been carried out. In males, prevalence figures for incontinence occurring twice or more a month at the ages of 5-14, 15-64 and 65 or over were 5.6%, 1.7% and 7.6% respectively. Corresponding figures for females were 4.5%, 7.6% and 12.5%. In addition, less severe degrees of incontinence were reported by about 12.5% (all ages). Urinary incontinence on its own accounted for 80% of those incontinent.

INTRODUCTION

Although several estimates have been made of the prevalence of incontinence in selected groups of different ages (Refs. 1-7) there has not previously been a comprehensive study in a general population. We have therefore studied the prevalence of urinary and faecal incontinence in those over five years of age on the practice lists of eleven general practitioners in the London Boroughs of Harrow and Brent, and in Bristol and South Wales. This report deals with the main findings in the first five practices included, i.e. one in Harrow and four in Bristol.

METHODS

The general practitioners sent a letter to each of those on the practice list aged 16 and over, explaining the study and asking for the completion of a questionnaire. Parents were asked to reply for children aged over five but less than 16 (though results in children are shown for those less than 15). Individual names were used in the letter and on the children's forms. Up to two reminders were sent to those who did not reply initially. Incontinence was recorded as "Never", "Occasionally, but not as often as twice a month", or "Yes, twice or more a month". The questionnaire had previously been tested and validated in another general practice in Harrow (Ref. 8).

RESULTS

Replies were received for 8,740 (91.9%) of those who had not moved from the address shown in the practice records.

Tables 1 and 2 show the numbers and proportions in each age group who were

incontinent. There were rather more women and rather fewer men aged 65 and over incontinent twice or more a month in Bristol than Harrow, but in general the figures for the two areas are very similar. In those incontinent twice or more a month, urinary incontinence accounted for 80.7% of positive answers, faecal for 7.0% and double incontinence for 12.4%.

TABLE 1 Numbers and Percentages of Incontinent Males by Age Group

Age groups	5 - 14 (N.186)		15 - 64 (N.872)		65+ (N.261)	
Harrow	A	B	A	B	A	B
No. incontinent	7	28	15	36	25	28
% incontinent	3.8	15.1	1.7	4.1	9.6	10.7
Age groups	5 - 14 (N.588)		15 - 64 (N.1949)		65+ (N.355)	
Bristol	A	B	A	B	A	B
No. incontinent	36	87	34	90	22	39
% incontinent	6.1	14.8	1.7	4.6	6.2	11.0

A = Incontinent, twice or more a month
B = Incontinent, occasionally but less than twice a month

TABLE 2 Numbers and Percentages of Incontinent Females by Age Group

Age groups	5 - 14 (N.168)		15 - 64 (N.898)		65+ (N.347)	
Harrow	A	B	A	B	A	B
No. incontinent	9	17	72	185	34	60
% incontinent	5.4	10.1	8.0	20.6	9.8	17.3
Age groups	5 - 14 (N.474)		15 - 64 (N.2187)		65+ (N.455)	
Bristol	A	B	A	B	A	B
No. incontinent	20	55	162	398	66	74
% incontinent	4.2	11.6	7.4	18.2	14.5	16.3

A = Incontinent, twice or more a month
B = Incontinent, occasionally but less than twice a month

DISCUSSION

At all ages our prevalence figures based on incontinence recorded as occurring twice or more a month are lower than those reported by other investigators. However, if our figures for those reporting "Occasional" incontinence (i.e. less than twice a month) are included, our results are comparable with those of other studies.

In middle-aged women, Osborne reported a prevalence of troublesome stress incontinence of 26% (Ref. 5), and in a sample of women aged 45-64 studied by Brocklehurst et al (Ref. 2), 57% reported stress incontinence. Other studies

(Refs. 3, 4) have suggested a prevalence of stress incontinence as high as 50% in nulliparous young women. In the light of these findings, it seems surprising that 72% of the women aged 15-64 in our study said they were never incontinent. One possible explanation, for which we have some evidence, is that women who had had only one or two episodes of stress incontinence in their lives recorded a "Never" answer on the grounds that these episodes are very rare and happen to everyone at some stage.

In children and in those aged 65 and over, our findings are similar to those of other surveys if the "Occasionally" responders are included with those reporting "Twice or more a month".

It is clear that prevalence estimates of incontinence depend on the definition of incontinence, and probably also on the method used to elicit them (e.g. postal survey, direct questioning).

In the Harrow practice, only three (5.1%) of those aged 65 and over who reported incontinence twice or more a month had previously been identified in a study of incontinence in those known to health and social services other than the general practitioner. Even allowing for some underreporting in the latter survey, it seems likely that there is a substantial group of incontinent patients of 65 or more who are not receiving services from which they might benefit.

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ACKNOWLEDGMENTS

We thank Dr. F. Hicks, Drs. K. M. and E. M. Townend, Dr. I. A. Hawkins and Dr. J. du Heaume for their help with this study and also Mr. R. C. L. Feneley and the staff of the Clinical Investigation Unit, Ham Green Hospital, Bristol.

? How many pregnant?

Any genuine ones.

URODYNAMIC STUDIES IN THE VERY ELDERLY

H. D. H. Eastwood

Department of Geriatric Medicine, Southampton General Hospital, Southampton

The types of patients in the over 80 age range presenting to a Geriatric Unit with incontinence problems, who benefit from urodynamic investigation, are described. Comment is made on some altered clinical features of incontinence problems in the very elderly from other age groups.

INTRODUCTION

The majority of communications to this Society have been concerned with incontinence problems in adults and children; this paper outlines experience with urodynamic studies in the very elderly, namely those over 80. It is with this age group that Departments of Geriatric Medicine in the United Kingdom are mainly involved. Brief details of the urodynamic methods are given, the main patient types investigated outlined and examples are mentioned where different clinical pictures have been found, these probably being age related. Selection for investigation was on the basis that helpful information from the studies to guide clinical management was anticipated. Results on 150 patients are reported.

METHOD

The basic urodynamic investigations were medium flow supine cystometry and urethral closure pressure profile, using an Elcomatic EH270 chart recorder to record pressures. Radiological investigation was performed as a seperate procedure when necessary.

TYPES OF PATIENTS

Sixty-six patients with Neuropathic bladders

Patients with chronic brain failure and cerebrovascular disease formed the majority. Cases were selected for investigation on the basis of the failure of the incontinence levels to respond to conventional management, levels out of proportion to the evidence of overt neurological damage and the presence of abnormal clinical features.

Fourteen cases out of the forty-six patients with these diagnoses were found to have areflexic bladders not anticipated clinically. Communication problems and the decline in bladder sensation accompanying ageing might be part of the explanation for the absence of clinical pointers to this condition in this age

group.

Eight out of seventeen elderly patients with Parkinson's disease also had areflexic bladders. A small prospective investigation confirmed again that clinical symptoms were no pointer to the findings on urodynamic investigation. A case is made for the routine investigation of Parkinsonian patients with incontinence problems, in view of the difficulty in predicting the nature of the bladder disturbance and as drugs used to treat incontinence can precipitate retention in patients with undiagnosed areflexic bladders.

Twenty-one patients with stress incontinence

In view of the high incidence of detrusor instability in this age group and the potential risks of operation, all patients suspected of outlet weakness should be investigated before treatment is embarked upon.

Thirty patients over 80 with incontinence as their sole symptom

Such patients fall into three groups, firstly those with a history suggestive of bladder instability which worsens with ageing or the development of an additional disability makes them less able to cope with their symptoms, those who develop instability de novo in old age and those whose instability is the first sign of progressive neurological disability. An interesting sub-group of the second are those patients whose symptoms develop suddenly.

Seven cases with post-operative incontinence

This follows either operations on the bladder outlet or extensive pelvic operations. Urodynamic investigation is called for in order to determine the cause and lead to rational treatment.

Eight elderly women with retention with overflow

The type of urodynamic disturbance demonstrated can guide management.

Fourteen elderly men with marked frequency and poor stream

Elderly men with marked urinary frequency disturbing sleep can pose diagnostic problems. The evaluation of a poor urinary stream is a similar problem to that in younger patients, again sometimes requiring urodynamic study.

DISCUSSION

Elderly patients are not as a group tolerant of invasive procedures but these simple urodynamic investigations were performed without difficulty in the frailest of elderly subjects. In the majority of cases the information obtained was adequate for clinical management and where more sophisticated studies were necessary as in the occasional case of stress incontinence the successful co-operation with the simple procedure, was encouragement to procede with further investigation. A case can be made for geriatric units provided adequate staffing levels allow for enough time to be set aside for the studies, to have their own simple urodynamic facilities. In conclusion it should be emphasised that only a small proportion of the total number of elderly patients managed by an active geriatric unit benefit from urodynamic study. The large numbers of patients referred to an interested geriatric department reflects the size of the challenge of incontinence of urine in the elderly.

Simplest approach to the B... — Know that neuro-...
UPP not much use ... A-tonic Conscious / unconscious
Capacity
NG - 50% over 65. No useful information

LARGE CAPACITY BLADDERS IN OLD AGE

Professor J. C. Brocklehurst

University of Manchester, Department of Geriatric Medicine, University Hospital of South Manchester, Nell Lane, Manchester, M20 8LR

During urodynamic screening of old people who were incontinent or under treatment for incontinence, a group of bladders with capacity in excess of 60 ml was encountered and these are analysed here. The 25 patients included 22 women and three men, and while the age range was from 60 to 95 years, 68% were aged 75 and over. The abnormally high bladder capacities were as follows:-

650 - 750 ml	- 7
800 - 1,000 ml	- 11
1,050+ ml	- 7

Residual urine of 30 ml and more was present in 23 patients (not measured in the other two, both of whom had indwelling catheters). Figure 1. shows that in four patients residual urine coincided with capacity. They may be regarded as having chronic retention with overflow incontinence. In the remainder the residual was considerably less than the capacity.

Cystometry revealed 15 patients with unstable bladders, six with normal bladders and four in whom the cystometrogram may be interpreted as an atonic neuropathic bladder inasmuch as there was absence both of sensation and of uninhibited bladder contractions. The maximal bladder pressure in these four patients showed a mean level of 28 cm of water (range 18 to 40 cm of water) which may be compared with a maximal bladder pressure of 32 cm of water (range 20 to 45 cm of water) in the six normal cases.

CLINICAL DIAGNOSIS

The principal diagnosis in the 25 patients falls into three main groups, 12 with hemiplegia, seven with dementia and six with 'other' diagnoses. 75% of the hemiplegic patients had unstable bladders and they formed the largest group of patients with the lower capacities (650 to 750 ml). Patients with dementia had the highest capacities and only 41% of them had unstable bladders.

The group with other principal diagnoses had capacities predominantly within the middle range and 33% of them had unstable bladders. This group included two diabetics (one with peripheral neuropathy and recurring retention for three years) but both had normal bladders on cystometry. The third patient had osteomyelitis

of the spine with abscess at the level T9 - T10 and an unstable bladder (he was one of the three males in the series). This bladder may correctly be diagnosed as a reflex neuropathic bladder since it showed uninhibited contractions and absence of sensation. The autopsy report showed demyelinisation of the dorsal column and associated necrosis with fibrous thickening of the dura and chronic inflammatory cells. The fourth patient had a fractured femur together with severe constipation and a normal bladder of very high capacity (1,100 ml). The fifth had Parkinsonism and was on anticholinergic drugs (capacity (1,200 ml). The sixth had hypochondriasis as the main diagnosis but she also suffered from vaginitis, cervical polyp and diverticular disease, diarrhoea and faecal incontinence. For the latter she was taking Lomotil (a drug containing atropine of which she was consuming about 0.15 milligrams a day over a long time).

Altogether 23 (92% of the patients had disease of the central nervous system.

CYSTOMETRIC DIAGNOSIS

The six cystometrically normal bladders included three demented patients, two diabetics (one with peripheral neuropathy and one with Paget's disease who was also on treatment with frusemide) and one right hemiplegic. Their capacities tended to be very high (three were over 1,050 ml). Two of these patients were on anticholinergic drugs and three were very constipated. One of these also had an impacted vaginal pessary and another had recurring retention since a silver wire operation for rectal prolapse five years previously. The sixth showed no obvious cause for the large capacity except that she was on frusemide and was a mild diabetic.

The four patients wth atonic neuropathic bladders did not show evidence in the central nervous system to support any underlying cause for such a diagnosis and it is probable therefore that the lack of bladder sensation was due to impaired awareness and difficulty in communication. Since these patients also had maximal bladder pressures similar to those with the normal cystometrograms it is probably more satisfactory to regard them as normal. Two were associated with right hemiplegia, one with Parkinsonism and the fourth had a femoral fracture and an embedded ring pessary. All were incontinent, two were on anticholinergic drugs and two were very constipated.

The 15 unstable bladders cluster at the lower end of capacity and comprise, of the 12 patients with capacity below 800 ml, nine of whom had a hemiplegia. Six of the 15 unstable bladder patients were on anticholinergic drugs (two of whom were not incontinent and in them the large capacity may reflect successful drug treatment). Three other patients in this group also on anticholinergic drugs had residual urine in excess of 250 ml and in them the drugs may have been causing a degree of retention with no therapeutic benefit. All other patients in this group were constipated. Although the diagnosis of bladder instability in these 15 patients rests on the presence of unprovoked uninhibited contractions, in fact in 13 of them these contractions only occurred beyond a capacity of 500 ml.

OUTCOME

Improved - 5 (2 with distigmine)
Improved but later recurred - 3 (1 on distigmine)
No change - 3 (1 on distigmine, 1 on urecholine)
Died - 7
Not known - 7 (5 of these had been on anticholinergic drugs or were constipated and probably improved after recommended treatment but were not followed up).

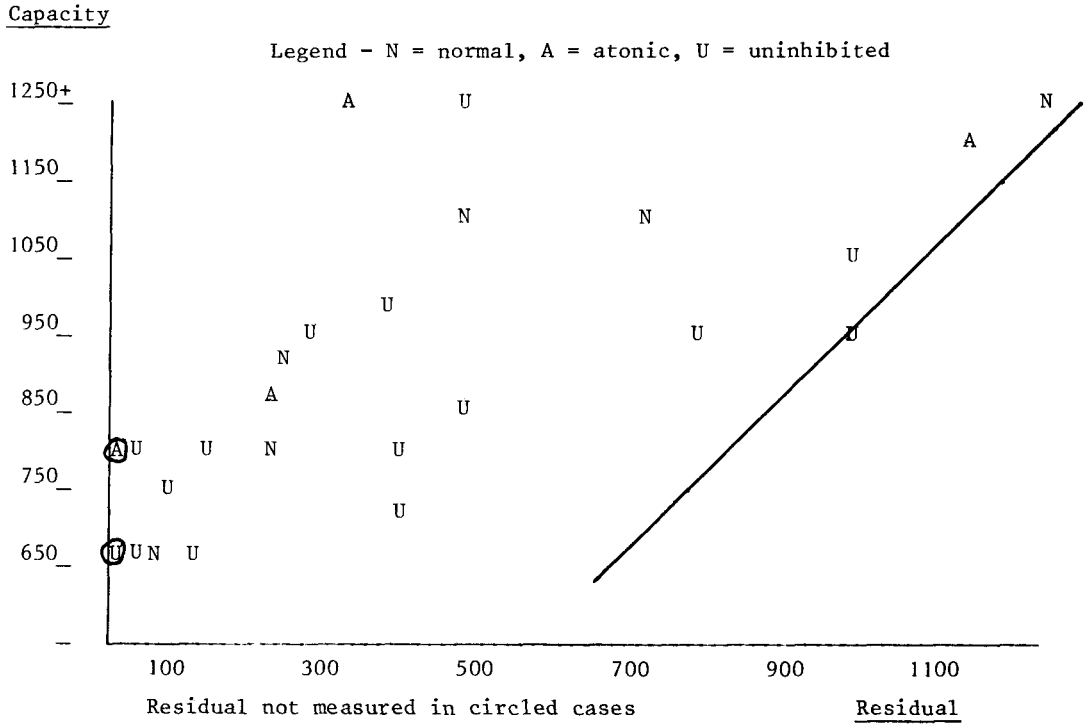

Fig. 1.

CONCLUSIONS

A number of conclusions may be derived from this series. The first is in relation to cystometric diagnosis. The diagnosis of an atonic neuropathic bladder in four is not supported by the clinical findings and it may be concluded that these are normal bladders of large capacity with absence of sensation due to impaired cortical awareness rather than involvement of the peripheral nerves or posterior columns. This conclusion is strengthened by the fact that maximal intra-vesical pressure in these patients was the same as in the normal bladders. On this basis therefore 40% of the patients would seem to have normal cystometrograms and 60% uninhibited bladders. Secondly, do ininhibited contractions occurring only at an abnormally high volume of bladder filling (e.g. beyond 500 ml capacity) have the same significance as those occurring within what is generally regarded as the normal capacity? Thus, only four of the 15 patients with unstable bladders showed uninhibited contractions at a volume of filling of less than 600 ml. (The method of cystometry did not allow provocation of uninhibited contractions by change of posture or by coughing).

Thirdly, in the majority of cases either the effect of anticholinergic drugs (44% of cases) or of constipation associated with immobility (64% of cases) were probably the most important underlying causes. Altogether one or other of these two factors could account for 88% of the series.

The two diabetics (in one of whom peripheral neuropathy was present) both had bladders which were cystometrically normal. Would the presence of intact sensation rule out the likelihood of autonomic neuropathy as a cause of the large

capacity? In two patients with normal bladders, outlet obstruction due to impacted pessary and Thiersch wire operation for rectal prolapse may have played some part.

Previous studies of patients with large bladder capacities have emphasised the importance of drug effects (1) and of bladder neck stenosis (2). Hysteria and psychological causes have also been suggested (1) and (2). In this series there were no good reasons to suggest either hysteria or psychological factors as being important and it was not possible to comment on the histology of the bladder outlet. It may be concluded, however, that in these elderly patients, abnormally high bladder capacities are of multi-factorial origin with immobility, constipation and the effect of anticholinergic drugs (either in the treatment of incontinence or of depression) the most important causes.

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Caldwell. Normal bladder Capacity.
Constipation / Faecal removal not proven improvement.

FW Atonic Bladder Bad filling + voiding must be considered.

M.S.T. Hyposensitive bladder.
Compliance - filling phase.

Defining of Continence.

THERAPEUTIC DISTENSION FOR DETRUSOR INSTABILITY IN THE ELDERLY

F. L. Willington

Department of Clinical Gerontology, University Hospital of Wales, Heath Park, Cardiff

INTRODUCTION

The unstable bladder is one of the commonest causes of incontinence in the elderly (1). The decreasing vitality and multiple pathology often found in the elderly sometimes make surgical treatment difficult or impossible. Drug therapy is not yet reliable, and there are often unpleasant side-effects.

Wilson (2) showed that the bladder distension involved in cystometry could be useful in cases with unstable bladders when combined with a "feed back" technique. The present report reviews the results in elderly patients using a modification of Wilson's technique.

It has been reported (3) that by modifying the open-ended manometer to become an inverted u-tube (fig. 1) connected directly with the bladder on the proximal side, and with the outflow waste on the distal, this technique could be successfully used over a longer time, using the height of the u-tube as the increased resistance to evacuation causing bladder distension.

Holm and Egleblad (4) described the use of a disposable apparatus for bladder irrigation, the Cystomat, which can be used for cystometry.

METHOD

Cystometry is an essential first stage using an inflow rate of 50 mls/minute. A two-channel balloon catheter is used.

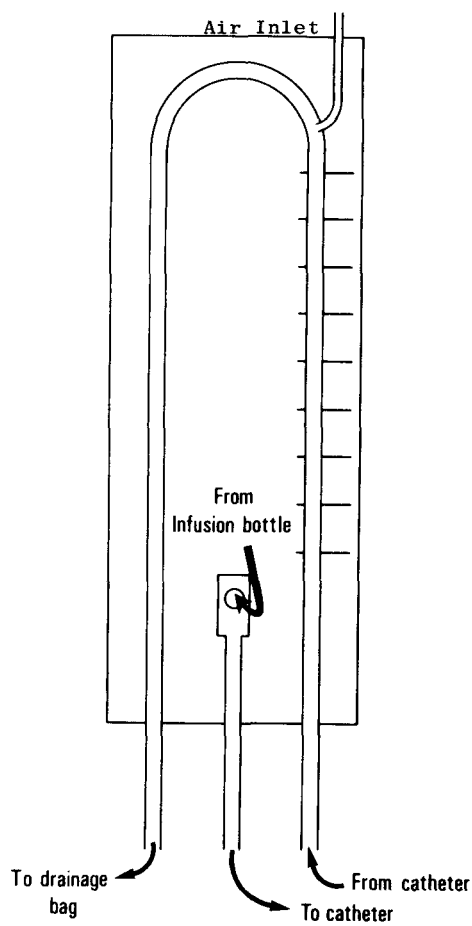

Figure 1

The height of the u-tube is measured against the level of the symphesis pubis. Eighty centimetres is a common height for cystometry. The usual measurements can be made for volume, pressure and time, but for bladder capacity the outflow tube must be clamped. During this procedure reassurance, instructions to relax, and to take deep breaths, etc. are given to the patient, who is asked to indicate any sensations relating to the bladder.

For therapeutic distension the inflow is clamped, but left in position. The height of the u-tube is usually reduced to a level at which evacuation is possible with just a little discomfort (usually about 20 cms less than for cystometry). The principle of Comarr's excretory cystometry (5) is used to achieve the distension, so a fast acting diuretic is given (e.g. Frusemide, 60-80 mgs) and repeated in 12 hours, thus enabling many episodes of distension to take place. The procedure is continued for 18-24 hours. Cystometry after distension session may be performed merely by unclamping the inflow tube.

MATERIAL

Thirty cases comprising all those seen with unstable bladders during April, 1976 to January 1978.

Female 17, mean age 80 years, range 66-92.
Male 13, mean age 74 years, range 55-84.

Concommitant disabilities

Confusion	4
Old C.V.A.	6
Parkinsonism	2
Old prostatectomy	2

Symptomatology before and after treatment is given in Table 1.
The cystometrical data before treatment is shown in Table 2.

Table 1 Symptoms

Before Treatment		After Treatment	
Urgency	29	Clear	18 (62%)
		Improved (postponement 10-15 mins)	15
		Unchanged	4
Frequency		Reduced	15
Day time	24	Unchanged	3
Nocturia (more than twice nightly)	19	Clear	16
		Unchanged	6
Incontinence		Continent	19 (63%)
Urge	30	Improved	10 (34%)
Nocturnal	22	Unchanged	2

RESULTS

Number of treatment sessions

1 session	20
2 sessions	9
3 sessions	1

19 cases became continent (62%)
10 improved (34%)
2 unchanged

Complications of Treatment

Very few occurred.

Discomfort or pain during treatment. This is most likely to be encountered if there is a small contracted bladder in spasm, or if the height of the u-tube is too high during distension. During the series it was found that 100 mgs of Flavoxate given with the Frusemide greatly improved the comfort of those patients with hyper-reflexic bladders.

This was used in five patients during the treatment session.

Table 2 Cystometrical data, before treatment

Volume at first sensation of need

50 mls 8
mean 95 mls (range 10-350)
sensory urgency 4

Pressure and volume at first contraction

Pressure mean 60 cm H_2O
Range 10-100 cms
Volume mean 210 mls
Range 20-350 mls
(12 cases less than 50 mls)

Bladder capacity

Mean volume 170 mls
Range 10-100 mls

Residual urine (20 cases)
Mean 107 mls

Uninhibited neurogenic contractions

Number of cases 17
Mean volume at occurrence 95 mls

Urinary tract infection. Cases with urinary tract infection were treated before cystometry. Three cases occurred early in the series. A screen of Co-trimoxazole, two tablets twice daily, was given from the day of treatment to three days afterwards. No further cases occurred.

Blood urea. No alteration was recorded.

FOLLOW-UP RECORD

In this age range strict follow-up arrangements are often not practicable, likewise follow-up cystometry is often declined. It was not found that repeat cystometry at the end of the distension session was successful.

The pattern of events following removal of the catheter was often an immediate period of incontinence before they achieved their ultimate clinical state over a period of 1-3 days.

Follow-up History

Nineteen cases were followed over a period of 1-14 months.

Continent	7
Continence improved	3

Frequency and urgency

Improved	4
No change	2
Deaths for unrelated reasons on subsequent admissions	3

Those not followed up comprised:

Discharged themselves when continence regained	2	
Declined outpatient clinic	1	
Transferred to mental hospital		1
Died in first six months from unconnected causes		2
Could not be traced		5

DISCUSSION

The principles in this treatment are not clear. Three might be involved.

Neurophysiological

The fact that the detrusor muscle contracts unsuccessfully to its accustomed stimulus thereby necessitating a greater distension of the bladder before evacuation is achieved, suggests a neurological adaptation involving inhibitory influences.

Muscular

It is possible that this practice may induce changes in the bladder muscle function. The precise functional changes resulting from bladder distension, and reported by many workers, have been reproduced experimentally on isolated animal detrusor muscle fibres by Alexander (8,9), who considers that these phenomena may represent the rupture of some type of labile chemical bonding in the structure.

Psychological

Attention has been drawn to the importance of the "feed back" principle in treating incontinent patients by many authors. The fact that this treatment is preceded by cystometry and then perpetuated through 24 hours gives the patient plenty of practice at relaxing when bladder contractions become troublesome. This 'cortical effect' can be shown during cystometry to enable a greater capacity of the bladder to be achieved and is a simple and effective means of building up a patient's confidence that some degree of 'postponement' can be achieved.

The fact that so many patients had only one session of treatment before achieving continence suggests that better results might have been achieved by a more determined regimen. It is felt that the frailty of many of the patients could well result in an increase in the complication rate.

This method of treatment is presented, because of its simplicity, flexibility and lack of adverse side effects. It is suggested that it is suitable for use as a preliminary treatment to separate those patients who do not require more sophisticated investigation or surgery.

ACKNOWLEDGEMENTS

The author wishes to thank Edwin Burgess Limited, Middlesex, for technical advice concerning the Cystomat.

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TRIAL OF LONG TERM CATHETERISATION IN THE ELDERLY — INITIAL FINDINGS

N. J. R. George, R. C. L. Feneley and N. Slade

Clinical Investigation Unit, Ham Green Hospital, Bristol, England

INTRODUCTION

Despite the widespread use of long term urethral catheterization there are few objective studies of the physical characteristics and cost-effectiveness of the catheters available in relation to the requirements of the individual patient. A recent report (1) has confirmed the need for further study. This trial was designed in an attempt to answer these questions.

METHODS

44 patients, average age 69, residing in the community, have been included in a trial of long term catheterization. Three types of catheter have been assessed, the "Simplastic" (Searle, 60p), the "Dover" (Searle, £2.40 ea. - solid silastic) and the "Silastic" (Dow Corning Corp., £4.85 ea. - coated silastic).

The catheters are changed for each patient in strict rotation at 28 day intervals by the same nurse in the same catheter clinic.

At each change objective measurement is made of any internal blockage and external encrustation on the catheter. The comments of patient and nurse, urine culture result and urine PH are recorded on the trial proforma.

RESULTS

134 changes have taken place to date. Manufactured catheter tolerance was found to vary widely, as was the drainage capacity of the catheters. The "Silastic" catheter was found to have the worst drainage potential. 80% of "Simplastic" catheters had severe external encrustation on removal and these catheters caused trigono-urethral pain in 50% of men and 70% of women patients. The "Dover" and "Silastic" catheters were found to be equally comfortable by the majority of patients of either sex. 10% of the patients persistently blocked their catheters irrespective of type or internal diameter. This has been observed by other workers (2). Further investigation of these patients is considered essential and a separate scheme of management is being devised.

These initial results show that, for the majority of patients, the advantages of the more expensive catheters are debatable, and a more cost-effective solution should be sought. There are a minority of patients who consistently block their catheter and these require an alternative regime.

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We acknowledge the invaluable work performed in this trial by Sister J.P. Blannin and Sister J. Hobden and the staff of the catheter clinics.

[illegible] Contract!

Anticholinergic drugs in bladder leakage.

Furring up.

Flow Rate doesn't matter.

Thomas. Sheffield. Aetiology. leakage around.

10 ccs / ? too much.

Glen - OK for [illegible].

This work is supported by a Grant from the Medical Research Council.

EVALUATION OF A FEMALE URINARY INCONTINENCE DEVICE

Linda D. Cardozo and Stuart L. Stanton

Urodynamic Unit, Department of Obstetrics and Gynaecology, St. George's Hospital, London

ABSTRACT

A new silicone rubber inflatable vaginal pessary has been evaluated in thirty-three patients with stress incontinence, due to urethral sphincter dysfunction (genuine stress incontinence), confirmed by urodynamic assessment. Nine out of twenty patients who used the device for one month were subjectively improved and two have continued to use it. Urodynamic changes include a marked increase in maximum urethral closure pressure, and elevation of the bladder neck.

INTRODUCTION

A mechanical device, designed by Bonnar (1977), for the control of incontinence in women, has recently been marketed in this country. It is moulded in soft silicone rubber to fit the shape of the vagina with the two horns seated in the lateral fornices on either side of the cervix. Following insertion of the device the balloon, which lies anteriorly, is inflated by means of a small finger pump with a one way non-return valve. The pump may then be removed leaving the device in situ. The other end of the pump is used to deflate the balloon prior to micturition or removal. Continence is produced by elevation of the bladder neck and compression of the urethra by the balloon, the volume being altered to suit the individual's requirements.

METHODS AND PATIENTS

Thirty-three patients attended the Urodynamic Unit with a primary complaint of stress incontinence. Their average age was 53 years (range 30 - 79) parity 2.6 (range 0 - 6) and they had undergone an average of 0.3 (range 0 - 3) previous vaginal operations. A full history was taken and a clinical examination performed. A midstream specimen of urine was sent for culture and sensitivity and an independent peak flow rate was measured. Videocystourethrography with pressure and flow studies (Bates and Corney, 1971) was performed and a diagnosis of urethral sphincter dysfunction (genuine stress incontinence) was made if there was demonstrable stress incontinence in the absence of detrusor contractions, and with a detrusor pressure rise of less than 15 cm of water during the provocative tests

of fast bladder filling, coughing, passive posture change, catheter withdrawal and coughing when erect. If stress incontinence was not demonstrated on videocystourethrography a Urilos nappy test (Stanton and Ritchie, 1977) was performed.

Whilst waiting for surgery, those patients with objective evidence of stress incontinence due to urethral sphincter dysfunction attended the Urodynamic Unit for assessment of the incontinence device. Urethral closure pressure measurements were made using a micro-tip pressure transducer (Gaeltec.) The probe was withdrawn and reintroduced into the urethra three times to ensure consistency of results. The first measurements were taken with the bladder empty. It was then filled with 300 ml of 0.9% saline at body temperature and the urethral pressure measurements repeated. The incontinence device was then introduced into the vagina and the urethral pressure measured before and after inflation. Simultaneous intravesical pressure measurements were not made but all the patients had undergone videocystourethrography with provocative tests and had been shown to have stable bladders.)

Twenty of the patients, all of whom were manually dextrous, were instructed on the use of the device. They were allowed to take it home and to use it daily (removing it at night) for one month, after which they returned to the Urodynamic Unit for review. This included questionnaires completed by the patient, on the usefulness of the device, and by the doctor on any problems encountered. If the device had been useful the patient was encouraged to keep it and was reviewed after a further two months.

Ten of the patients, with postive Urilos nappy tests had the tests repeated with the device in situ.

RESULTS

Table 1 shows the changes in mean maximum urethral closure pressure before and after the device was inserted.

TABLE 1 Changes in Maximum Urethral Closure Pressure (cm H_2O)

	MEAN	S.D.	RANGE
Bladder empty	55.6	17.4	29-93
Bladder full (300 ml 0.9% saline)	58.7	17.3	26-102
Device deflated	77.3	25.6	30-155
Device inflated	107.1	56.2	45-320

The outcome of the home trial of the device is shown in Table 2. The device was easy to insert in all but two of the patients, both of whom found the device uncomfortable to wear. One was a nulliparous women with no previous surgery and the other had undergone three anterior repairs. After one month none of the devices had broken and all the pumps still worked. There was no vaginal excoriation, but one women had an offensive vaginal discharge.

Two of the patients chose to keep the device, one because she was unwilling to have further surgery, and the other because she was looking after an invalid relative whom she felt she could not leave for a hospital stay. Both said that the device completely cured their stress incontinence and found find no faults with it. Four

TABLE 2 Results of the Home Trial of the Incontinence Device

	NAME	AGE	PARITY	*P.OPS.	EFFECT ON INCONTINENCE	PROBLEMS
1	J.S.	50	1	0	Cured	Nil
2	P.P.	65	2	1		
3	J.W.	45	4	0	Helpful	Always "aware" of device.
4	E.S.	50	3	0		Nuisance inflating/deflating.
5	O.C.	56	2	0		Difficult to insert/remove.
6	A.C.	41	2	0		Aesthetic objections
7	O.D.	48	1	0	Some help	Made urgency worse.
8	P.P.	45	3	0		Uncomfortable after 3-4 hours.
9	D.W.	48	4	0		Backache.
10	E.S.	79	1	0	No help	
11	C.M.	41	6	0		
12	J.C.	43	5	0		Device too small (fell out).
13	C.C.	30	4	2		
14	E.S.	56	1	0		
15	I.W.	59	0	2		
16	F.S.	51	0	0		Device too large (uncomfortable).
17	D.S.	62	1	3		
18	M.R.	59	1	1		Device "distasteful".
19	E.R.	60	1	1		
20	M.D.	41	2	0		Nil.

*P.OPS. = Previous vaginal operations

other patients found that the device cured their incontinence but that it had various drawbacks. In the other fourteen patients the problems encountered outweighed the usefulness of the device.

All ten patients in whom the Urilos nappy test was repeated with the device in situ (some of whom had previously lost up to 50 ml of urine on coughing alone) proved to be completely dry in spite of vigorous exercises during the test.

DISCUSSION

Stress incontinence due to urethral sphincter dysfunction may be treated by surgery, drugs or appliances. Various operations exist which seek to elevate the bladder neck and render the urethral pressure higher than the intravesical pressure even in stressful situations. The results are good, suprapubic procedures producing a higher cure rate than vaginal repairs (Hodgkinson, 1970). However a group of patients exists in whom surgery is inappropriate or has failed. Antispasmodic preparations and oestrogens have been tried and the latter have been shown to be beneficial in some postmenopausal women (Caine and Raz, 1973). The commonly used anticholinergic preparations are of more value in the management of incontinence due to detrusor instability.

Various types of devices have been invented to control incontinence. They are either electrical or mechanical. The former comprise anal plugs and vaginal pessaries which are thought to work by stimulating the striated portion of the urethral sphincter mechanism to contract. Up to 50% of incontinent patients have been improved by an anal plug (Hopkinson, 1972). Vaginal pessaries come in different shapes: ring, Hodge and the Vitalograph Continator which is cyclindrical with a narrow middle, for better retention. The latter device has been found to be the most successful, producing an improvement in 53% of patients (Doyle et al 1974). Pelvic floor stimulator implants have been tried, but are no longer commonly used as the long-term results have not proved satisfactory, and they produce morbidity due to infection and fibrosis and are prone to mechanical faults.

Mechanical devices are though to act by compression of the urethra and elevation of the bladder neck. Edwards and Malvern (1973) found a 70% improvement using a pubovaginal spring, with only one attendant complication - a vaginal ulcer (Edwards 1971). Crowley et al (1971) claimed a 96% improvement using a suction device, however most of the patients in whom it was tried had normal bladder function. Neither device seems to be in widespread use at present.

In X-ray studies the Bonnar device has been shown to produce continence by elevation of the bladder neck which is maintained during stressful actions. It also produces a marked increase in the maximum urethral closure pressure. In many cases the urethral pressure was sufficiently elevated by the device before inflation to produce continence, and when varying amounts of air (20 - 40 ml) had been introduced into the balloon the urethral closure pressure was increased in all cases. Objective evidence of continence was produced by the Urílos nappy test which was negative in all ten patients.

The advantages and disadvantages of this silicone vaginal incontinence device are enumerated in Table 3.

TABLE 3 Advantages and Disadvantages of the Incontinence Device

Advantages	1. Effective in producing continence. 2. Easy to use. 3. Free from complications. 4. Moderately well tolerated.
Disadvantages	1. Made in one size only. 2. Needs to be deflated and re-inflated for micturition and removed regularly for cleaning. 3. Requires manual dexterity. 4. Aesthetically distasteful to some patients. 5. Unsuitable for patients in whom previous vaginal surgery has markedly altered the vaginal shape or size.

CONCLUSION

This device has a place in the management of female urinary incontinence due to urethral sphincter dysfunction. It is likely to be of mose use in those patients who are unfit for surgery (but still have good use of their hands), those who are unwilling to undergo an operative procedure and as an immediate solution for those patients with severe stress incontinence who are on a long waiting list for surgery. The device would have further potential if it were available in a range of sizes.

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These are available on request from Dr. Linda Cardozo.

Ilse loss. One size only.

FAILURE IN THERAPY OF INCONTINENCE IN OLD AGE

Eckhard Petri, Helmut Heidler, Udo Jonas

Departments of Obstetrics/Gynecology and Urology, University of Mainz Medical School, Mainz, West Germany

Introduction

Each of the diverse forms of urinary incontinence encountered in women can be traced to a variety of causes.The fact of incontinence is still frequently considered to be sufficient indication for surgical intervention.This has resulted in therapy failures,as only incontinence associated with pelvic floor insufficiency has prospects for successful operative correction.The failures are then referred to urodynamic centers.The urodynamic examination produces a large percent of well-known findings,such as urge,overflow and reflex incontinence.After exclusion of one of these causes,a considerable number of patients remain for whom the indication for surgery was basically correct,but nevertheless resulted in therapy failures. These were principally older women in the menopause.An attempt will be made herein to elucidate additional factors which may undermine the success of therapy.

Material and Results

Since 1976,1000 combined examinations were performed at our urodynamic center.Pressure recordings of bladder,urethra and rectum were obtained under videographical control(cystofluoroscopy),as well as EMG registration of the pelvic floor musculature and flow- and voided volume recordings.

75 % of the patients were women between the ages of 2 and 76, with about 1/3 of them over 50 years of age. 92 of these post-menopausal women were referred for clarification of urinary incontinence , 56 for recurrent incontinence.

As could be expected, motoric urge incontinence was the most frequent cause (25%).It was combined with stress incontinence in 9 % . Infravesical obstruction (anatomic and fuctional) was found in 10 % .
A detrusor-sphincter-dyssynergia was the first symptom of a previously unrecognized multiple sclerosis . In 2 patients, 7-8 earlier operations had resulted in denervation of the bladder, which made the implantation of a Merrill-Bladder-Pacemaker necessary in 1 patient.The lower urinary tracts of 3 women who had undergone multiple preoperations (in each case an alloplastic sling had been implanted) showed such a degree of destruction that a urinary diversion had to be performed (2 colon conduits , 1 Ureterosigmoidostomy).
In the course of analysis of the large number and variety of previous operations, it became evident that in 59 % of the women, the uterus had not been removed.In 40 % a cystocele had not been corrected (abdominal surgery) or recurrency was observed.
An oestrogen deficiency could only be established in 40 % of the women. Surprising was the large number of obese patients. 50% were more than 10 % overweight, 27% of these more than 20% .

Discussion

No discussion is necessary of those neurogenic bladders which underwent useless operations owing to deficient pre-diagnoses; this has been the subject of numerous publications.Postoperative failures (50% reported by DREHER) are analysed after exclusion of neurogenic factors, several findings become apparent which probably played a decisive role, although they may seem rather simple.
Three factors which may undermine the success of therapy have been selected and will be discussed herein, as we feel they have received too little attention in the literature:

1. obesity
2. uterus not removed
3. iatrogenic infravesical obstruction

ad 1. 50 % of the women in their menopause(35% of our patient material) were overweight, 27% of them by more than 20% (e.g. 158 cm - 82 kg). In these patients, the pelvic floor , as the region of minor resistance, is subject to high intra-abdominal pressure which leads to a static insufficiency followed by recurrent cystocele,Douglas hernia,rectocele, or divergence of the levator muscles.If the urethral pressure is normal,pharmacotherapy is useless. In combination with the usually

present hypertension, treatment with alpha-sympaticomimetica (Midodrin) or adrenalin-derivatives (Synephrine) have a limited effect. Oestrogen therapy, which has proven effective in very few women when administered alone, can only be considered for isolated cases in older women owing to the thromboembolic and cardiovascular risks. When the forensic problems involved in a preexisting carcinoma of the breast or the corpus uteri are taken into account, then this mode of treatment must be evaluated critically. The variety of pessaries developed in the last years (EDWARD's clamp, mushroom of ENDSLEY, BOLOGNA's intersecting plastic rings) either cannot find support in the presence of large masses of prepubic fat or divergence of the levator muscles, or they are not tolerated by existing colpitis senilis. The results of pelvic floor stimulation by means of various vaginal or anal plugs have been disappointing.

ad 2. A uterus not removed during previous surgery seems to be a decisive factor in recurrence of incontinence. FRIEDBERG (1975) demonstrated the poorer results of incontinence surgery obtained when the uterus is left in place. Having learned from this experience, we have made hysterectomy (performed previously or simultaneously) a sine qua non condition. In 59% of the recurrent incontinencies referred to us, the uterus had not been removed. Particularly in the sling plasties that are frequently performed in Germany, leaving the uterus in place means a higher risk of steady traction on the urethra under stress conditions. In 6 patients with alloplastic slings, the urethra had been cut through completely. Keeping in mind that the uterus has no physiological function in older women and there is a relatively high risk of carcinoma, hysterectomy should always be performed.

ad 3. Pre-existing diabetes mellitus can effect the failure of treatment due to various reasons: Abcess formation, sequestration and fistula formation have been seen in numerous cases after alloplastic slings. Apart from circulatory disturbances, diabetes causes micturition disorders in the form of incomlete lesions: Motoric and in particular sensory lesions (imbalanced sensory cystoneuropathy - FRIMODT-MØLLER) may lead to decompensation of the bladder following incontinence surgery, if surgery was not restricted to reconstruction of the pathological situs. If compression of the urethra is induced by the operation, an infravesical obstruction results leading to residual urine and urine retention.

Summary

Older women in the menopause form a large entity of therapy failures in the treatment of urinary incontinence. Aside from those causes which are also important in other age groups (overlooked neurogenic bladder disturbance, choice of wrong surgical procedure, surgical mistakes), factors such as obesity, uterus left in place and iatrogenic infravesical obstruction are of great importance. Possibilities of a pharmacotherapy or treatment with a pessary are limited because of general medical or anatomical causes. Treatment performed disregarding these factors includes the calculated risk of failure .

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? Women / why remove post menopausal uteri

General disagreement

SDH / little evidence that at removed helps prevent stress incont.

Wt. gain / little diff.

Pre-op. / Obesity. does not appear influence result.

IAV Prob related to particular type of surg operation.

THE UNSTABLE BLADDER

Chairmen: U. JONES
A. D. G. BROWN

THE ASSESSMENT OF THE CONTRACTILITY OF THE URINARY BLADDER

R. van Mastrigt, D. J. Griffiths and W. A. van Duyl

Erasmus University Rotterdam, Dept's Urology and Biological and Medical Physics. P.O. Box 1738. Rotterdam. The Netherlands

ABSTRACT

In order to develop a method of measuring clinically the contractility of the urinary bladder, measurements of the contractile properties of bladder strips were done. They are in accordance with a traditional model of the active properties of muscle.

INTRODUCTION

The aim of urodynamic research is to develop methods to evaluate objectively the normal or pathological behaviour of the urinary system. Since the urinary bladder works in two different phases, collection and evacuation, two different kinds of tests are relevant.

In the collection phase the behaviour of the bladder is usually investigated by cystometry. The bladder is passively filled and the resulting pressure is measured. A cystometrogram measured in this way can be interpreted in terms of mechanical models (Ref. 1), so yielding objective parameters which describe the urinary bladder in the collection phase.

In the evacuation phase, the urinary bladder is usually investigated by uroflowmetry. In this case too a model can be used to interpret the resulting curves (Ref. 2), but the interpretation is complicated because properties of both the urinary bladder and the urethra are involved. It may therefore be useful to develop a method for evaluating the contractility of the urinary bladder separately. Such a method would utilise the information contained in an isometric contraction of the urinary bladder, as proposed by Van Duyl et al (Ref. 3). In order to understand how this can be done, and which assumptions are made, a model which describes the contractility of the bladder is necessary.

THEORY

In 1938 Hill (Ref. 4) published a model which describes the active behaviour of skeletal muscle. Recently the applicability of the

model to smooth muscle has been investigated (Ref. 5,6). The model consists of a contractile element (CE) in series with an elastic element (SE), see Fig. 1. The parallel elastic element (PE) describes passive properties and is not relevant here. In fact it should be replaced by the more refined combination of elements described elsewhere (Ref. 7). According to the model, during the development of an isometric contraction the contractile element shortens, so extending the series elastic element. The discrete elements in the model do not represent structures in the muscle, but mathematical relations describing muscle properties. The contractile element is characterized by a relation between its velocity of shortening and the force it exerts. When the muscle carries higher loads, it contracts more slowly. This relation is called Hill's equation. The series elastic element is characterized by a relation between extension and force.

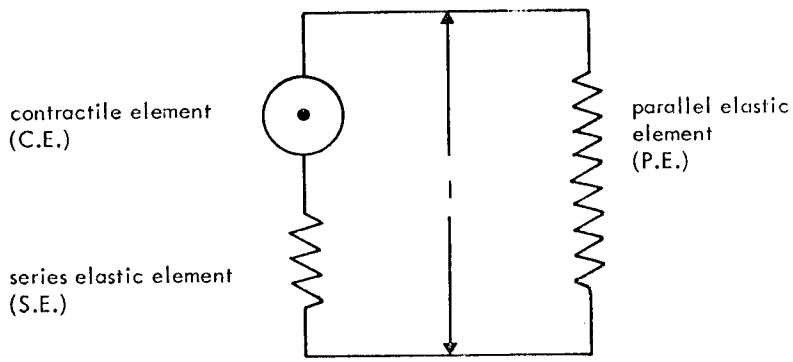

Fig. 1. Hill's mechanical model

METHODS AND PRELIMINARY RESULTS

Various methods were applied in order to determine these two characteristic relations. Only two methods and typical results will be discussed here, to illustrate the properties of the relations involved. The Hill equation (Fig. 2) was determined by the method published by McPherson (Ref. 8). In this method two isometric contractions, one with and one without an added series compliance are compared. The measurements were performed on strips stimulated electrically. In Fig. 2 the crosses represent measured data, while the line is a hyperbolic curve, as specified by Hill, fitted to the data by computer. A good fit is obtained. The relation characteristic of the series elastic element (Fig. 3) was obtained by the quick-release method, which is based on quick shortenings of a stimulated muscle. As in the case of the passive model (Ref. 1) this elasticity can be described mathematically by an exponential elastic modulus.

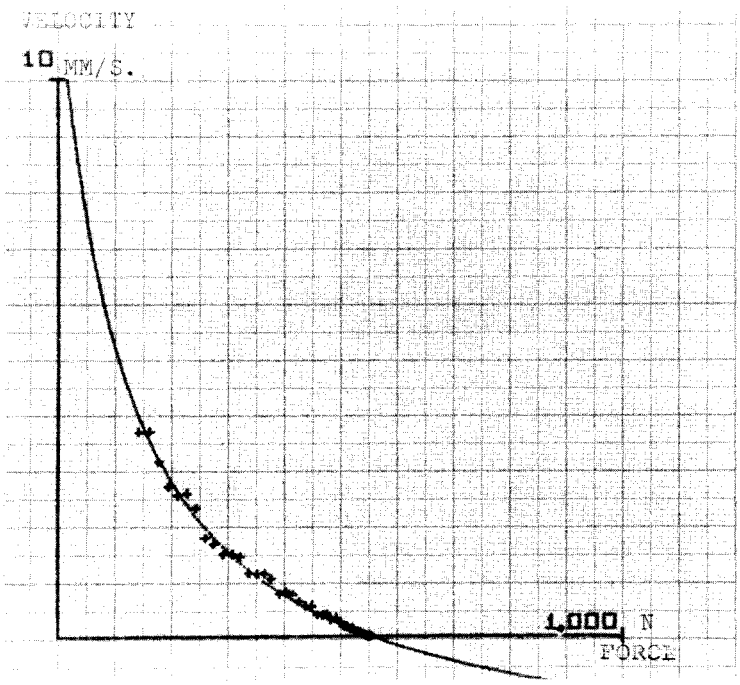

Fig. 2. Contraction velocity as a function of force for the contractile element.

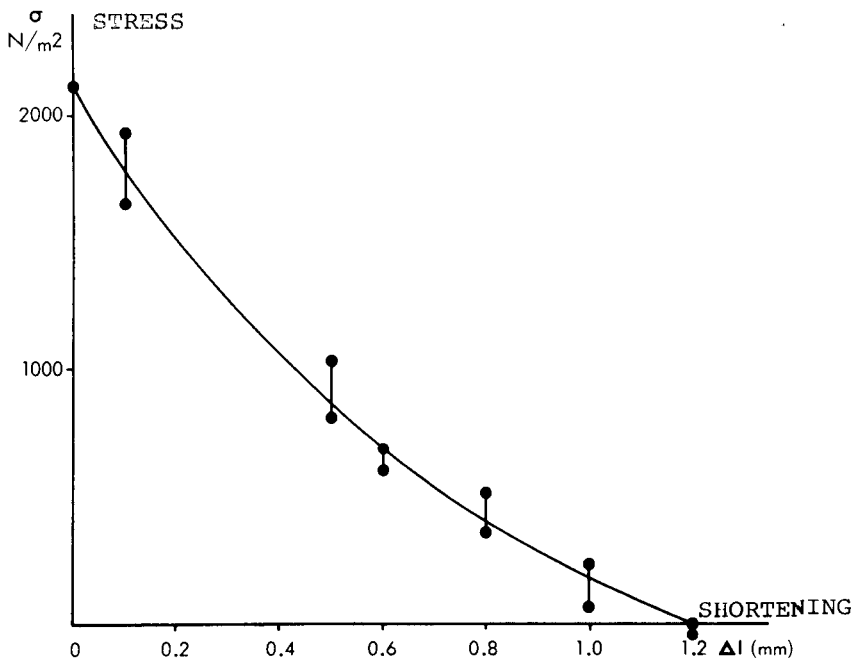

Fig. 3. Stress as a function of shortening for the series elastic element.

CONCLUSION AND DISCUSSION

In conclusion we state that the model outlined above describes the measured data adequately. The important questions now are, whether the model parameters are clinically significant, and how they can be determined. It turns out that if one of the two relations mentioned above is known, the other can be determined just from the rising part of an isometric contraction. This rising part can be measured with a bladder catheter and pressure transducer at the start of micturition after ordinary cystometry. In this way it is possible to obtain information about the contractility of the urinary bladder without having to make assumptions about the behaviour of the urethra.

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THE FUNCTIONAL ABNORMALITY OF 'NON-PROVOCATIVE' BLADDER INSTABILITY IN CHILDREN

Hans Palmtag, Harald Heering and Gerhard Ziegler

Department of Urology, Surgical Center, University of Heidelberg, 69 Heidelberg, West Germany

The clinical importance of so-called unstable bladder reaction is still unclear. Although a lot of investigators demonstrated some relations of clinical importance between bladder instability and incontinence (4) and discussed this symptomatic cystometric finding as an important factor for future therapy in these patients, the etiology of this symptom is still in discussion (3, 4, 10). It is most imposing that many people talk of 'unstable bladder' and no one really knows what it means because of a lack of a precise definition. This results from our inability to get more detailed information about this abnormality in spite of our complicated and at the same time rather simple methods of urodynamic investigations for evaluation of the very differentiated act of micturition, bladder filling and continence (4, 5, 6, 9). Under the aspect of this confusing situation, a review of urodynamic findings in children was done. Results were compared with the findings in adults to evaluate factors and formulate questions relating to unstable detrusor behaviour.

MATERIAL AND METHODS

The analysis was made of a review of the last 1000 patients, 216 children and 784 adults, who attended our urodynamic unit. Patients with a definite diagnosis of neuropathic disorder of lower urinary tract were excluded from this analysis. The technique of urodynamic investigation has been described elsewhere (6).

All of the children got a suprapubic catheter for intravesical pressure measurement in full anaesthesia the day before urodynamic investigation was performed. At the same time endoscopic investigation of lower urinary tract was performed. We were especially interested in comparing detrusor function with local detrusor alterations in respect to age and history. Filling cystometry was always performed with a low filling rate and in supine position; micturition was performed in sitting position; all of the patients who demonstrated uncontrolled waves during the filling cysto-urethrogram with a differential pressure increase of more than 15 cmH_2O, were selected for the 'unstable group'.

RESULTS

Age

The incidence of uncontrolled detrusor contraction was found in 29 % of all children of the selected group, aged 1/2 - 14 years. In adults we found bladder instability in 8 % of all patients. It was most interesting to see that children aged less than one year didn't necessarily demonstrate bladder instability although they were completely wet.

Enuresis

Enuresis, according to the definition - a normal reflex act of micturition occuring while the patient is asleep - could be observed in 1/3 of all children, whereas only 29 % of the enuretics demonstrated unstable bladders.

Urodynamics

In 50 % of the children with bladder instability increased detrusor-pressures were found (average value 64 cmH_2O in this group), whereas flow rate was within normal range. At the same time 60 % of uncontrolled detrusor contractions were combined with the symptoms of so-called aftercontraction. The differential-pressure-increase during this aftercontraction was three-to fivefold as much as could be measured during the act of voiding.

This fact seems to be important as it shows the tremendous reserve capacity of detrusor-reaction in childhood and especially in the children with bladder instability. This could also be found, when investigations were done to look for characteristics of compensative voiding mechanism in adults and children (7).

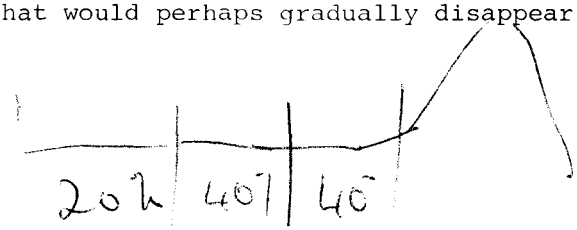
It seems, that non-provocative bladder instability demonstrated in an earlier stage of bladder filling is of a greater clinical relevance than unstable contraction only demonstrated in the cases where the bladder is filled to at least 75 % of maximal bladder capacity and where extremely provocative methods were applied. Perhaps a clear cut urodynamic staging of the symptom 'unstable bladder' will lead to more comparable results of different authors. Bladder capacity (effective or maximal) had no influence on the occurance of instability and unstable bladder reactions could also be found in patients with a megacystis.

Urinary Tract Infection

Two thirds of the children with unstable bladders suffered from recurrent urinary tract infection and in 60 % bacteriuria was found in the days of urodynamic evaluation (in most cases the bacteriuria had already been treated). Sometimes the bacteriuria was the only pathological finding in combination with an unstable bladder reaction (in 30 %), leading to the conclusion, that bladder inflammation may induce unstable detrusor reaction. This became more probable, as we learned that the bladder wall is able to develop a real immunological reaction to bacterial infection (8) which may at the same time alterate the neuronal modulation.

CONCLUSION

Summarizing, it is impossible to derive a definite pattern of bladder instability and inducing factors from this analysis, but it can be concluded, that non-provocative bladder instability is demonstrated at a lower incidence in adults than in children. Nevertheless instability is not only a question of physical development that would perhaps gradually disappear with age.



Bladder instability was found in combination with enuresis, with mechanical outflow obstruction and following hyperactivity or reduced compliance. It was also found in different combinations with other detrusor reactions as pre- or aftercontraction and it was found in the combination with a bacterial induced bladder inflammation. Therefore it seems to be important to reduce the term 'unstable bladder' to a cystometric finding and to a symptom of irritated lower urinary tract and to prevent 'unstable bladder' from being considered as a diagnosis. Furthermore the finding of an unstable bladder should engage us to use our full diagnostic possibilities to look for the reason that instability exists. The treatment of causative factors can change unstable bladder to a stable state (1, 2, 3, 10). Unsatisfactory results of treatment will be obtained in cases were no cause for unstable bladder can be found.

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♂ ♀. No big difference in terms

Stable v. Contejant ? after contraction ?

ADULT ENURESIS

J. R. Hindmarsh*

University of Newcastle
**Present address Western General Hospital, Edinburgh*

ABSTRACT

Sixty five patients (33 females and 32 males) with adult enuresis have been assessed cystometrically. In primary enuresis two types occur. Those with nocturnal enuresis alone and those with day symptoms. Abnormal cystometric patterns were present in a high percentage of cases in both types of enuresis. There was a significant correlation between the presence of day symptoms and bladder instability, and nocturia and instability.

INTRODUCTION

Definition

Enuresis is defined by Ashton Miller(1) as a normal reflex act of micturition occuring while the patient is asleep and Linderholm(2) adds in the absence of organic pathology. This definition requires modification for adults who persist in bed wetting, as a high percentage have diurnal symptoms of frequency, frequency and urgency or frequency, urgency and urge incontinence. It is proposed that enuresis simply implies a reflex act of micturition and that nocturnal and diurnal be used to indicate the time of day the incontinence occurs. When night time incontinence occurs with diurnal symptoms of frequency, urgency or urge incontinence, the presenting symptom is nocturnal enuresis.

Enuresis persisting in to adult life continues to present a difficult clinical problem particularly when resistant to simple methods of treatment. This paper presents information on the symptomatology and cystometric findings and their relationship in adult enuresis.

Patients and Methods

A series of 65 consecutive patients of 15 and over referred for treatment of nocturnal enuresis were assessed by history, physical examination and cystometry.

Of the 65 cases, 13 were primary nocturnal enuretics, 35 had primary enuretic syndrome, and 16 were recurrent enuretics.

Micturating cystometry was performed by recording the bladder, rectal, subtracted and flow rate on a 4 channel Watanabe Recorder. Filling cystometry was performed in the supine position through an 8F catheter at 100mls/minute using normal saline at 37°C. A Watson Marlow Infusion Pump was used. Voiding pressure was recorded in a 16 gauge epidural cannula.

Results

1. Age Sex relationship.

The age and sex distribution of cases referred are listed in Table 1.

TABLE 1

SEX	AGE					
	15-20	21-25	26-30	31-35	36-40	41+
MALE	11	10	7	1	1	2
FEMALE	14	6	7	2	2	2
TOTAL	25	16	14	3	3	4

The majority of cases were under 30 years of age. There being an apparent regression of enuresis in up to that age. After 30 there was no further regression although the numbers were small.

All primary nocturnal enuretics were under 25, while the majority of recurrent enuretics were older than 25.

2. Nocturnal Enuresis

The incidence of nocturnal enuresis was assessed for the month prior to referral (Table 2).

TABLE 2

SEX	NIGHTS WET/WEEK						
	¼-1	2	3	4	5	6	7
MALE	7	5	4	3	3	1	9
FEMALE	6	4	2	4	0	4	13
TOTAL	13	9	6	7	3	5	22

There was no sex bias toward severe or mild nocturnal enuresis although 34% had wet the bed nearly every night of their life. Of these patients with severe enuresis (7 night/week), 31% were noturnal enuretics alone, 44% had the enuretic syndrome and 12.5% were recurrent enuretics. Nocturia was a regular occurence in 26% of patients, however the number arising more than 2 times/night was small 7/65 (11%). 75% described themselves as deep sleepers. There was no sex bias.

3. Diurnal symptoms were present in 14/16 (77%) of recurrent enuretics and 36/49 (74%) of primary enuretics. Frequency of micturition (less than 2 hourly) was the most common diurnal symptom occuring in 57% of all cases.

Urgency of micturition was present in moderate or severe forms in 48% of cases. Of the 12 cases with severe urgency 9 were females. Urge incontinence occuring everyday was experienced by 8 patients, 7 females and 1 male. However 43% of all patients had experienced

incontinence regularly.

4. The results of cystometry are similar to those obtained by Torren and Collins (3) who found 70% of their cases showed cystometric abnormality. In this series 68% were cystometrically abnormal. Three patterns were found (Table 3).

1) Hypertonic bladder, with a bladder pressure higher than 15cms H_2O at capacity in the supine position.
2) Spontaneous instability on supine filling.
3) Induced instability on standing, coughing or stepping on the spot.

TABLE 3

	Stable	Hypertonic	Unstable Spontaneous	Unstable Induced
TOTAL	21	8	25	11
%	32	12	39	17
MALE	8	2	17	6
FEMALE	13	6	8	5

9/13 (69%) patients with nocturnal incontinence alone had cystometrically abnormal bladders. Four of these cases were hypertonic. 61% of patients with the enuretic syndrome had cystometrically abnormal bladders. However over half of the females in this group (54%) were stable whereas only 14% of the males showed stability. 81% of recurrent enuretics were unstable. It is surprising that 5 patients who claimed to have no day symptoms had unstable bladders on cystometry and a further 4 were hypertonic.

Symptoms related to instability

1. Frequency of micturition less than 2 hourly was present in 57% of cases, instability was present in 26/37 (Table 4).

TABLE 4

	Hours between voids					
	1	2	3	4	5	6
TOTAL	17	20	11	9	5	3
UNSTABLE	13	13	6	2	2	0
%UNSTABLE	76	65	55	22	40	0

There is a significant correlation between frequency and instability using the Chi squared test, contrary to the findings of Torrens and Collins(3).

2. Urgency was defined as the length of time patient was able to postpone before voiding, delay beyond 15 minutes was regarded as normal.

TABLE 5

	Minutes delay			
	0-5	5-10	10-15	15+
TOTAL	12	19	14	20
UNSTABLE	8	15	6	7
%UNSTABLE	67	79	43	35

Of the 23 females with urgency 11 were stable whereas only 5 of 22 males were stable. In this series there was no statistical

relationship between urgency and instability.
3. Urge incontinence was divided into 3 groups. Those who were incontinent every day, those who were incontinent 2-3 x/week and those who were only occasionally incontinent (Table 6).

TABLE 6

	Every day	2-3 x/week	occasionally	never
TOTAL	8	4	16	37
UNSTABLE	5	3	13	15
%UNSTABLE	63	75	81	43

There is a significant relationship (using Chi sq ared test) between incontinence in the female and instability, there was no such relationship found in males. This reflects the ability of males to prevent incontinence by contracting the distal urethral sphincter complex.

4.Nocturnal enuresis and nocturia
There was no relationship between nocturnal enuresis and instability. There was however a significant relationship between nocturia and instability.

DISCUSSION

The incidence of enuresis presisting into adult life can only be assessed by a longitudinal study. These results can only suggest trends in the atural history.

From the age of presentation it appears as if spontaneous remission occurs up to 30 years of age after which a small number of cases persist primarily with nocturnal and diurnal symptoms. No cases of nocturnal enuresis presented after the age of 25 suggesting that those with a primary sleep problem resolve earlier than those with added diurnal symptoms. However the cystometric studies of nocturnal enuretics showed that abnormality occured as frequently as in the enuretic syndrome. A common abnormality was bladder hypertonicity with a greater than normal bladder capcity. This suggests a deficiency of detrusal tension receptors firstly causing a failure of reflex receptive relaxation of the smooth muscles and secondly a failure of apparent impulses to reach conscious levels. There does not appear to be a failure of motor power as these patients voided at normal pressures with normal flow rates.

Patients with the enuretic syndrome remit by either controlling their fluid intake during the evening to prevent nocturnal incontinence or by being awakended by bladder fullness which results in nocturia. Their diurnal symptoms persist.

A large number of these patients found they were enuretic after increased fluid intake 2-3 hours before going to bed. In males beer was the most frequent cause.

There is a direct correlation between frequency and urge incontinence and bladder instability as is to be expected. The frequency is related to the reduction in functional bladder capacity and urge incontinence to the spontaneous detrusal contractions which open the bladder neck. The female has difficulty in preventing incontinence because of the weakness of her distal sphincter complex. Some

patients are quite incapable of preventing the total content of the bladder from being voided inappropriately. Males maintain continence better because of the powerful distal sphincter complex muscles. However the problem in so doing is that the isometric pressure rises producing further hypertrophy of the muscle. The detursor may then become powerful enough to overcome the voluntary obstruction and produce incontinence. The cystometric findings are difficult to explain in some groups. The occurence of a stable bladder in a male patient with day symptoms may reflect the failure of our cystometric methods to stress the bladder sufficiently (4). In the female a stable bladder with severe day symptoms probably reflects an over inhibited sphincter mediated through S4 (3).

Primary persistent enuretics unless very deep sleepers with poor arousal mechanisms will have bladder or outlet dysfunction. With current cystometric methods we are able to detect 70% of abnormalities but are unable to identify the cause in the other 30% although urethral dysfunction is the most likely candidate.

For noturnal enuresis to occur the bladder must reach its functional bladder capacity and there is a failure of appreciation of distension while asleep.

Most people can recall an episode of nocturnal incontinence at some stage of their life, particularly if it occured away from home. If the bladder is hypaesthetic or overactive and sleep is deep, enuresis will occur. It is surprising that enuretics sleep 3-4 hours in a urine sodden bed without stirring. Sleep shortens and lightens with increasing age, so that enuresis has usally resolved by adulthood, frequently at puberty. Those therefore who persist beyond 15 have a combination of deep sleep and bladder dysfunction. Those with severe bladder dysfunction retain their diurnal symptoms, the nocturnal incontinence being converted to nocturia. Incontinence recurrs with tiredness and beer consumption. This remains a difficult group to treat.

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Importance of p.H. of Enuresis.
dreaming over 60 yrs.
Mech. for switching on + off (Frewen & Biofeedback).
Voiding at supernormal rate.

URINARY INCONTINENCE IN THE FEMALE. THE VALUE OF DETRUSOR REFLEX ACTIVATION PROCEDURES

Jørgen Nordling, Hans-Henrik Meyhoff, Jens Thorup Andersen and Steen Walter

Urological Laboratory, Department of Urology, Herlev Hospital, University of Copenhagen, DK 2730 Herlev, Denmark

ABSTRACT

One hundred consecutive female patients with urinary incontinence were investigated with CO_2-cystometry including detrusor reflex activation procedures such as postural change and ability to suppress volitionally elicited detrusor contractions. Detrusor hyperreflexia were seen in 20% during bladder filling in the supine position, and in an additionally 35% after detrusor reflex activation procedures. Four different types of detrusor hyperreflexia are described based on the cystometric findings. 38 patients were treated with parasympatholytics (Cetiprin®) and 66% experienced good effect, independent of the type of detrusor hyperreflexia.

INTRODUCTION

The incidence of detrusor hyperreflexia in women with urinary incontinence varies from 10-50% (1, 2, 3). Using rapid fill CO_2-cystometry including detrusor reflex activation procedures as a routine, we found that the incidence of detrusor hyperreflexia increased significantly, compared with previous used medium fill water cystometry. This prompted us to evaluate in retrospect the cystometric findings in 100 consecutive female patients with urinary incontinence.

MATERIAL AND METHODS

100 consecutive incontinent female patients referred for cystometry entered the study. 17 patients had had one or more previous operation for incontinence. 37 patients had the symptom stress incontinence, 20 patients the symptom urge incontinence, while the rest claimed to have both stress and urge incontinence. The mean age was 51 years with a range from 18 to 90 years.

Cystometry was performed with CO_2 as filling medium at a filling rate of 200 ml per minute through a transurethrally inserted 18 F Foley catheter. Urethral sphincter electromyography was routinely registered with a ring electrode mounted on the catheter (4). Cystometry was first performed with the patient in the supine position.

The patient was asked to inform when first sensation of fullness was felt and was instructed to suppress micturition during filling of the bladder. The volume at which the patient felt uncomfortable or bladder pain was registered as the cystometric bladder capacity. At this volume the CO_2 flow was stopped and the patient instructed to cough. After coughing the patient was asked to void without straining. If a detrusor contraction was elicited, the patient was again instructed to suppress micturition and the intravesical pressure normally decreased to prevoiding level within 5o seconds. (Fig. 1). After emptying the bladder, the cystometric procedure was repeated with the patient standing.

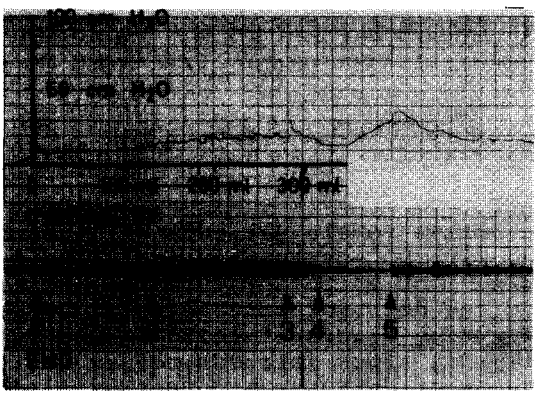

Fig. 1 Normal Cystometry.
1. Start of bladder filling. 2. First sensation of fullness. 3. Patient coughing followed by stop of bladder filling. 4. Patient asked to void. EMG activity ceases completely. 5. Patient asked to inhibit voiding.

All patients showing uninhibited detrusor contractions during bladder filling were classified as detrusor hyperreflexia type 1. Patients without uninhibited detrusor contractions but unable to suppress a volitionally elicited detrusor contraction within 5o seconds were classified as detrusor hyperreflexia type 2.

Patients demonstrating detrusor hyperreflexia in the supine position were classified as type 1A or type 2A, whereas patients first demonstrating detrusor hyperreflexia in the standing position were classified accordingly as type 1B or 2B.

All patients were furthermore evaluated with micturition cystourethrography in the straight lateral projection (5), and vaginal examination. If the patient claimed to have urgency, cystoscopy was performed.

Patients with detrusor hyperreflexia were primarily treated with anticholingergic drugs (emepronium bromide (Cetiprin ^{R}) 200 mg q.i.d.), unless they had prevailing symptoms from genital prolapse, and/or infravesical obstruction which was treated surgically.

The effect of pharmacological treatment was subjectively estimated after one month of therapy.

RESULTS

Detrusor hyperreflexia was found in 55% of the patients (95% confidence limits 44-65%). The frequency of the different types is outlined in Table I.

		Number of patients
Detrusor hyperreflexia	Type 1A	20
	Type 2A	6
	Type 1B	22
	Type 2B	7
Detrusor hyperreflexia total		55

Table I. Cystometric finding of detrusor hyperreflexia in 100 consecutive female patients with urinary incontinence.

11 of the patients with detrusor hyperreflexia had the symptom stress incontinence, 14 the symptom urge incontinence and the rest both stress and urge incontinence. 11 patients were primarily submitted for surgery: 9 had genital prolapse, one had urethral diverticulum and one had a urethral stricture.

Parasympatholytics	38
Surgery	11
No treatment	5
Bladder installation of silver nitrate 0.2%	1
Total	55

Table II. Primary treatment of 55 patients with detrusor hyperreflexia.

38 patients were treated with emepronium bromide (Cetiprin ^{R}) 200 mg q.i.d. (Table II). We found an overal improvement rate of 66% (95% confidence limits 48-81%). In the groups 2A and 2B, where the patients showed no uninhibited detrusor contractions but only inability to suppress the volitionally elicited detrusor contraction within 50 seconds, the improvement rate was 88% (95% confidence limits 47-100%).

DISCUSSION

The finding of deficient control of detrusor reflex contraction in 55% of female patients with urinary incontinence is rather high in comparison with previous cystometric studies in such patients. (1). In a prospective study of 303 patients by Walter (3), detrusor hyperreflexia was found in 15% of the patients using medium fill water cystometry in the supine position. It has been shown that medium fill water cystometry and rapid fill CO_2 cystometry has the same diagnostic specificity (6), so it seems unlikely that the different filling medium and filling rate are responsible for the difference. On the other hand the technique used by Walter revealed only the type of detrusor hyperreflexia in this paper referred to as detrusor hyperreflexia type 1A. Type 1A we found in 20%, which is in accordance with Walter. The same incidence was found by others, 18% (2) and 29% (7) during filling cystometry in the supine position. Therefore, the higher frequency found in this study is ascribed to the use of

detrusor reflex activation procedures and the testing of the patients ability to suppress volitionally elicited detrusor contraction. A frequency of detrusor hyperreflexia of 55% corresponds well to the frequency of detrusor instability of 48% and 71% found by Arnold et al. (2,7).

The significance of the inability to suppress a volitionally elicited detrusor contraction within 50 seconds is indicated by the good results of treatment with parasympatholytics in patients not presenting uninhibited detrusor contractions during bladder filling (type 2A and 2B).

The finding of detrusor hyperreflexia in more than half of the female patients with urinary incontinence means that many patients will present with bladder suspension defects as well as detrusor hyperreflexia.

In these cases either drug treatment or surgical treatment might be considered. In the past we have been very reluctant to operate on patients with detrusor hyperreflexia. This might be due to the many cases seen with numerous, previous, unsuccesful surgical procedures before a cystometric investigation revealed detrusor hyperreflexia. However, these patients do not indicate, that patients having both detrusor hyperreflexia and bladder suspension defects might not benefit from an operation. On the other hand to operate patients with detrusor hyperreflexia demands very confident methods of diagnosing bladder suspension defects, and in this respect we find the micturition - cysto - urethrography in the lateral projection indispensable.

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THE UNINHIBITED BLADDER CAUSED BY PHASIC DETRUSOR CONTRACTIONS?

Karl-Ulrich Laval, Josef Hannappel and Wolfgang Lutzeyer

Department of Urology, Med. Fac., RWTH Aachen, West Germany

ABSTRACT

In the contractile activity of the detrusor muscle a phasic and a tonic component can be differentiated. A blockade of the p-system in man does not lead to a stabilisation of an uninhibited bladder. Therefore, bladder instability in man is not caused by activation of the p-system.

INTRODUCTION

Other investigators have shown that the electromechanical coupling of smooth muscle cells is induced by a Ca-ionic spike (2, 5, 6). Two different Ca-activating systems in the membrane of smooth muscle cells have been isolated using so-called Ca-antagonistic drugs (1, 3). 1. The p-system, 2. The t-system. The p-system is characterised by fast phasic contractions which can be blocked selectively by Nifedipin. The t-system is characterised by slow tonic contractions which cannot be suppressed by Nifedipin but can be lowered by Nitroprussid. Tonic activity mainly is found in organs with reservoir function (4).

The intention of our studies was to investigate if there is any phasic component in the detrusor contraction and to find out how it shares in the total activity of the bladder muscle. At least, we tried to find out if the bladder instability in man is the result of phasic detrusor activation and if the blockade of the p-system has any effect in treatment of bladder instability.

METHODS

Bladder muscle strips were taken from 5 pigs. In these muscle strips, put into an organ bath, the spontaneous activity and the reaction after addition of Nifedipin and Adrenaline was studied. The isometric contractions of the strips were measured by a force transducer and directly drawn.

The investigations in man were done in supine position using water cystometry. The bladder was filled with 45 ml/min. The abdominal pressure was recorded simultaneously through an anal catheter. Nifedipin was sublingual applicated in the total of 30 patients. The first group of 15 patients got 10 mg Nifedipin, the other 15 patients got 20 mg Nifedipin, according to the medical prescription of the producer. Before application of the drug, we did 1 or 2 cystometries in all patients. All of them suffered from an uninhibited bladder, either they had an urge- or a reflex-incontinence. 30 minutes after application of Nifedipin cystometry was reproduced. To control the detrusor reaction, another cystometry was done in a few patients 10 minutes after intramuscular injection of 60 mg Hyoscin-N-Butylbromid (Buscopan®), an anticholinergic drug.

RESULTS

In all prepared muscle strips we saw a spontaneous rhythmic activity. About 15 minutes after application of Nifedipin this spontaneous activity disappeared completely (Fig. 1).

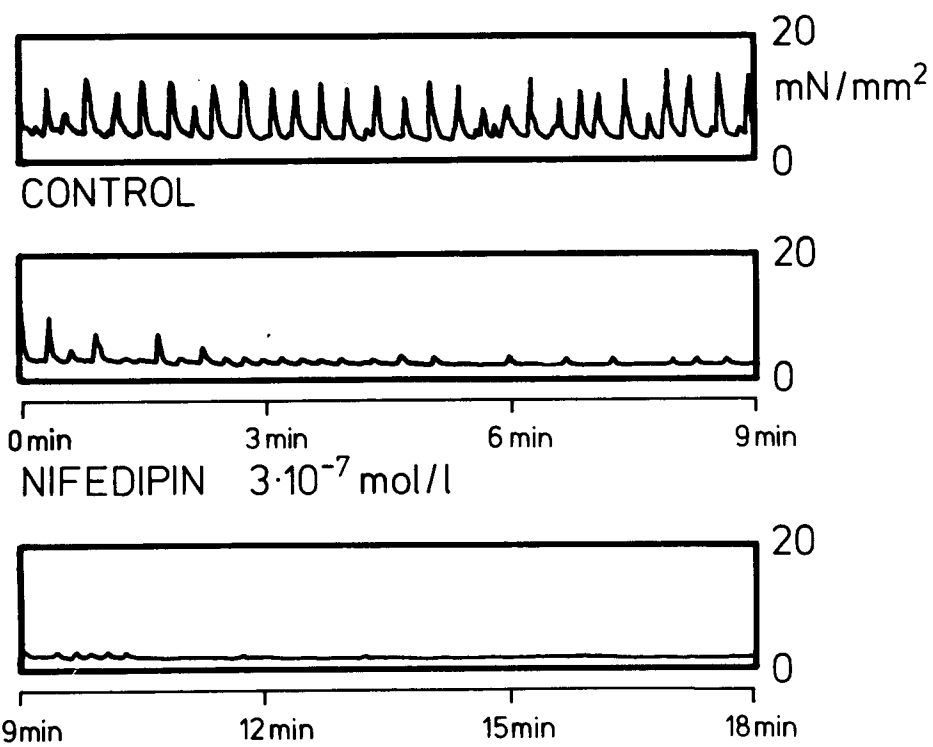

Fig. 1. Effect of Nifedipin on the detrusor muscle strip of the pig. Spontaneous activity is blocked within 15 minutes.

Adrenaline induced an increase in frequency of contractions and in muscular tension, similar to tetanic contraction in skeletal muscle. When the spontaneous activity was blocked by Nifedipin a significant increase of muscle tension was registrated after addition of Adrenaline. Singular contractions could not be differentiated.

The reference points in our clinical examination were the first uninhibited contraction of the detrusor and the unvoluntary loss of urine. After application of Nifedipin 10 mg or 20 mg, a significant increase of bladder capacity never could be obtained. In contrast, after application of anticholinergic drugs no uninhibited contractions could be seen and, at the same time, the bladder capacity increased distinctly (Fig. 2).

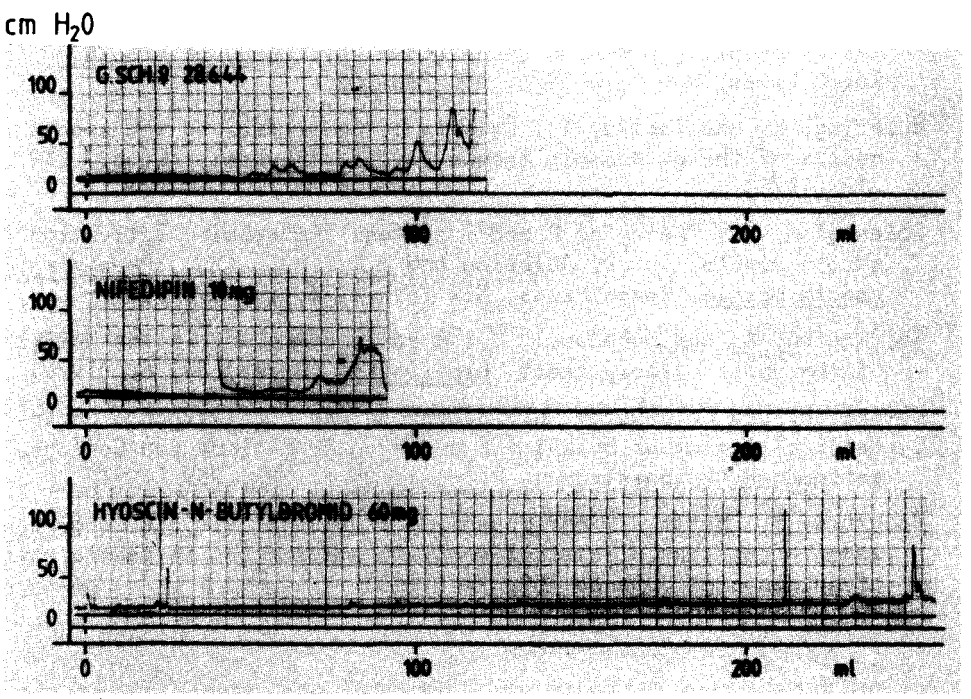

Fig. 2. Effect of Nifedipin on the cystometric bladder capacity. In contrast to the parasympathetic drug Hyoscin-N-Butylbromid, Nifedipin does not lead to an increase of capacity.

DISCUSSION

The contraction of the detrusor in vitro seems to be the result of simultaneous phasic and tonic contractions. The possibility to block the spontaneous rhythmic contractions of the muscle strip selectively by Nifedipin proves that this spontaneous activity of the detrusor belongs to the p-system. The

increase in tension of the detrusor strip to Adrenaline after blockade of the p-system by Nifedipin demonstrates pure t-system activity of the bladder muscle. In our opinion, these in vitro findings demonstrate that bladder instability seems to depend on p-system activation.

To prove this, we performed our clinical investigations. In contrary to our in vitro findings, there was no similar reaction in man. After application of Nifedipin there was no increase of bladder capacity, i.e. uninhibited detrusor contractions are not caused by p-system activation. Bladder instability, therefore, seems to be not a pure myogenic but a neuro-muscular problem.

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EFFECTS OF CALCIUM ANTAGONISTS IN WOMEN WITH UNSTABLE BLADDER

Torkel Rud*, Karl-Erik Andersson and Ulf Ulmsten*****

**Gynaecological Department, the Norwegian Radium Hospital, Oslo, Norway*
***Department of Clinical Pharmacology, University Hospital, Lund*
****Department of Obstetrics and Gynaecology, Malmö General Hospital University of Lund, Sweden*

ABSTRACT

Fifteen patients with motor urge, aged 10 to 76 years, were investigated by simultaneous urethro-cystometry before and after treatment with nifedipine or terodiline. Forty-five minutes after intake of nifedipine 10 to 30 mg orally, uninhibited detrusor contractions and urge incontinence were elicited at larger bladder volumes than before drug intake in 9 of 10 investigated patients. Subjective improvement after 1 week of continuous therapy with nifedipine was reported by 8 of 10 patients. After treatment with terodiline 25 or 50 mg daily for 1 week, all 5 investigated patients reported symptomatic improvement. Pressure recordings revealed that during therapy uninhibited detrusor contractions and urge incontinence were elicited at larger bladder volumes than before treatment in each patient. Side effects of the drugs were few and tolerable. It is concluded that drugs with calcium antagonistic effects might be useful in the treatment of motor urge.

INTRODUCTION

Anticholinergic drugs are generally accepted as a pharmacological treatment of unstable bladder. However, this therapy is not always effective and disturbing side effects are common. Other therapeutic alternative are therefore desired.
In a previous study (1), it was shown that the calcium antagonist nifedipine effectively inhibited contractile activation of the isolated human bladder produced by agents with different modes of action. In vivo, the drug had no effects on intravesical and intra-urethral pressures at rest. Further testing of this drug in a condition with hyperactivity of the bladder seemed motivated.

Terodiline has been used for several years as an antianginal drug, but its mode of action has not been established. The drug is known

Anticholinergic

to have anticholinergic properties. However, recent studies (2) have shown that terodiline also has a calcium antagonistic effect. This profile of action made its effects on bladder activation of particular interest.
The present preliminary report concerns the effects of nifedipine and terodiline in women suffering from uninhibited detrusor contractions and urge incontinence.

MATERIAL AND METHODS

Patients

Fifteen women suffering from urge incontinence were investigated. They were divided into two groups.

Group I consisted of 10 patients. Their mean age was 43 years (range 10 to 76 years), and their mean weight 56 kg (36 to 76 kg). Patients in this group received nifedipine (Bayer AG) orally in a dose of 10 to 30 mg depending on body weight.

Group II consisted of 5 patients. Their mean age was 41 years (12 to 68 years), and their mean weight 49 kg (38 to 71 kg). Depending on body weight, the patients received terodiline (Bicor®, Recip AB, Sweden) 25 or 50 mg daily for 1 week.

Before the study, all 15 patients had been investigated by repeated uro-gynaecological examinations comprising bimanual palpation, urethro-cystography, and intravenous pyelography.

Each patient was carefully informed of the procedures involved in the study and gave their consent to it.

Technique of investigation

For accurate evaluation of the diagnose urge incontinence, all patients were subjected to a simultaneous urethro-cystometry including measurement of the urethral pressure profile with a previously described technique (3). The recording technique is based on measurements of the intra-urethral and intravesical pressures by means of micro-transducers. The intra-abdominal pressure was simultaneously recorded by a micro-transducer introduced 6 to 10 cm into the rectum.

Experimental procedure

The investigation was carried out with the patients in the semi-lithotomy position. By means of a transurethrally introduced tap catheter, residual urine was measured. The bladder was then filled with 50 ml body warm saline. The tap catheter was removed and the recording catheter (outer diameter 2.1 mm), was introduced into the bladder. Three consecutive urethral pressure profile measurements were carried out. The pressure transducer in the urethra was located at the maximum intra-urethral pressure area. Saline was infused into the bladder at a rate of 75 ml per min.; simultaneously, maximum intra-urethral pressure and intravesical pressure were measured. After each 50 ml saline infused, the patient was requested to cough (producing a momentarily increase in the intra-abdominal and intra-vesical pressures of more than 50 cm H_2O). The presence of abnormal

pressure variations within the bladder and urethra was ascertained. Further, the bladder volume at which the patient felt a desire to micturate, and that at which incontinence occurred were recorded.

After removing the catheter, the patients of Group I were given 10, 20, or 30 mg nifedipine orally (depending on body weight). They were requested to chew the capsules and then to swallow the contents immediately. Heart rate and blood pressure (auscultation) were recorded before and every 15 minutes after intake of the drug for 2 hours. About 45 min. after intake of nifedipine, the urethro-cystometry was repeated as described above.
The patients were then given nifedipine 10 to 20 mg twice a day for a week. Their subjective evaluation of drug treatment were recorded.

In the Group II patients, the pressure recording procedure was carried out as in the Group I patients. However, before the second measurement the patients were treated for 1 week with terodiline given orally in a dose of 12.5 mg 2 or 4 times daily. At the second investigation, the patients opinion on the effectiveness of the treatment was noted. The amount of residual urine was also estimated.

RESULTS

Group I

Before treatment. From the three consecutive urethral pressure profile measurements, the maximum intravesical and intra-urethral pressure, and the closure pressure at rest were calculated. The numerical values were in close agreement with those reported in a previous investigation of patients suffering from urge incontinence (4). In all patients infusion only, or infusion together with cough, elicited uninhibited detrusor contractions (amplitude exceeding 15 cm H_2O), starting at a mean bladder volume of 120 ml (range 60 to 200 ml). Incontinence, including a decrease of closure pressure below zero, occurred at a bladder volume of 150 ml (75 to 350 ml).
No patient had residual urine, i.e., the bladder volume after micturation did not exceed 50 ml.
After treatment. After administration of nifedipine, detrusor contractions were elicited at larger bladder volumes than before drug intake in every patient except one (mean 200 ml, range 150 to 250 ml). The contractions had a lower amplitude and a shorter duration than before nifedipine intake. The intra-urethral pressure was not affected. This resulted in a positive closure pressure at larger bladder volumes. Thus, urge incontinence occurred at a mean bladder volume of 225 ml (150 to 500 ml).

After one week of treatment, 8 of the 10 patients reported subjective improvement of their symptoms. Above all, the presence of nycturia was decreased. In the young patients, this was confirmed by their parents. The patient who had no positive immediate effect of nifedipine, as judged form the recordings, and one patient with moderate effect reported no improvement during the week of daily drug intake. Both these patients received 10 mg twice daily (body weight 42 and 48 kg, respectively).

Side effects of nifedipine were well tolerated. Flush occurred within 15 to 30 min. after drug intake in most patients, and there was a mean increase in heart rate from 72 to 86 beats per min. No decrease in blood pressure was recorded except in 2 patients with hypertension. In one, blood pressure decreased from 200/100 to 180/100, in the other from 210/115 to 150/90. In no patient, residual urine was found.

Group II

Before treatment. The numerical values of bladder pressure, urethral pressure, and closure pressure at rest were within the same range as those of the patients in Group I. Residual urine was not found.

Uninhibited detrusor contractions were elicited at a bladder volume of 120 ml (100 to 175 ml). Urge incontinence occurred in all patients before a bladder volume of 200 ml was reached (mean 150 ml, range 125 to 190 ml).
After treatment. All patients reported improvement of their symptoms. The episodes of incontinence had markedly decreased after 1 week of treatment. At the pressure recordings, it was found that in each patient the uninhibited detrusor contractions were elicited at a larger bladder volume than before treatment, i.e., at a mean volume of 200 ml (175 to 240 ml). In addition, the contractions had a lower amplitude and a shorter duration after therapy. Incontinence also occurred at a larger bladder volume in all patients after terodiline (mean 240 ml, range 150 to 450 ml). The maximum urethral pressure was not affected. In no case residual urine was found.
There were no effects on blood pressure or heart rate. Two patients complained of dryness in the mouth, and 2 "felt tired" when on therapy.

In both groups of patients, urine bacterial cultures were negative before as well as after the treatment.

DISCUSSION

There are reasons to believe that in many types of smooth muscle including the detrusor there is an inflow of calcium into the cell from the extracellular medium during activation. This inflow is of great importance for the contractile activity; consequently, the responses will be reduced if calcium entrance is blocked. Calcium antagonists (5) selectively inhibit transmembrane calcium movements, and have also been shown to relax different types of smooth muscle. Nifedipine, one of the most potent of these drugs, has been widely used in the treatment of angina pectoris, and its effectiveness can most probably be attributed to its vasodilating actions. Nifedipine was also found to markedly inhibit uterine hyperactivity and to reduce pain in women suffering from primary dysmenorrhoea (6). Further, the drug was very effective in inhibiting the contractile activation of isolated human bladder by different agents such as carbacholine, prostaglandin $F_2\alpha$, potassium and barium (1). In vivo, the drug had no effect on the pressures within the bladder and urethra at rest, possibly because smooth muscle tone in these structures is not immediately depending on extracellular calcium, but is maintained through release of intracellular calcium (7). The present results, showing a positive effect of nifedipine in women with motor urge, are consonant with current

views on the mode of action of the drug.

Studies on electrically evoked contractions of human bladder have suggested that acetylcholine is the predominant, but not the sole motor transmitter in this tissue (8). This finding; and the actions of nifedipine, made the effects on the bladder of a drug with combined anticholinergic and calcium antagonistic properties particularly interesting. Terodiline was shown to have these effects in isolated rabbit and human bladder preparations, and to markedly reduce response to carbacholine, potassium, and field-stimulation (2). The present preliminary result suggest that terodiline can be effective as a treatment of unstable bladder and urge incontinence, and motivate further investigations of the drug.

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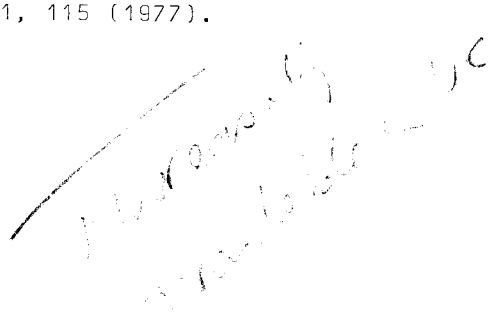

A COMPARISON BETWEEN BROMOCRIPTINE AND INDOMETHACIN IN THE TREATMENT OF DETRUSOR INSTABILITY

Linda D. Cardozo and Stuart L. Stanton

Urodynamic Unit, Department of Obstetrics and Gynaecology, St. George's Hospital, London

ABSTRACT

Thirty-two patients suffering from urinary symptoms due to detrusor instability (either primary, or secondary to an upper motor neurone lesion) have completed a clinical trial of bromocriptine and indomethacin. Each drug was administered for one month, a single blind crossover method being employed. The patient's symptoms and any side-effects were assessed by means of a questionnaire prior to entry into the trial, after the first drug, and at the end of the trial. The improvement in both diurnal and nocturnal frequency due to indomethacin was shown by McNemar's test to be statistically highly significant.

INTRODUCTION

Detrusor instability may cause the symptoms of urinary incontinence, frequency and urgency of micturition. Its aetiology is uncertain; it may be secondary to an upper motor motor neurone lesion such as multiple sclerosis, and in men it has been found to be secondary to outflow obstruction. In these cases relief of the obstruction may cure the instability (Turner Warwick et al 1973). Many different forms of treatment have been tried with poor results. Drugs are still the commonest form of treatment and include anti-cholinergic preparations (eg propantheline hydrochloride), ganglion blockers (eg emepronium bromide), β adrenergic stimulators (eg orciprenaline) and a musculotrophic agent (flavoxate hydrochloride).

Prostaglandins are released during nervous stimulation of the bladder, and studies have shown they cause increased detrusor activity (Abrams and Feneley 1976), (Bultitude et al 1976). For this reason it has been hypothesised that reduction in circulating prostaglandin levels may help to diminish abnormal detrusor activity. Indomethacin is a prostaglandin synthetase inhibitor, and should therefore produce this effect. Ghoneim et al (1976) have shown that indomethacin can block the reduction of urethral resistance observed during vesical distension.

Bromocriptine has been shown to cause an improvement in symptoms in patients with detrusor instability (Farrar and Osborne 1976). Although its exact mode of action is unknown it may act by reducing the circulating prolactin level, which in turn reduces the production of prostaglandins. Alternatively its action as a dopamine agonist may reduce detrusor muscle activity either by modulating adrenergic transmission, or by a direct action.

METHODS AND PATIENTS

All patients entering the trial were first diagnosed as having detrusor instability by means of videocystourethrography with pressure and flow studies (Bates and Corney 1971). A detrusor pressure rise greater than 15 cm of water during fast bladder filling or provocative testing (such as coughing, passive posture change, catheter withdrawal and coughing while standing erect) was taken to be diagnostic of detrusor instability. Twenty-eight of the patients who completed the study exhibited abnormal detrusor contractions whereas the other four had a steep detrusor pressure rise. A cystoscopy was performed to exclude organic bladder pathology and a neurological opinion was sought for those patients without overt neurological signs.

A single blind crossover trial was employed. Each patient being randomly allocated to one drug and then the other; treatment in each instance lasting for four weeks with one tablet-free week between the two drugs. To make the two treatments as similar as possible, the same instructions were given with each drug. The dosage regimes are shown in Table 1. Patients were advised to take both types of drug with food.

TABLE 1 Dosage Regimes for Bromocriptine and Indomethacin

	Bromocriptine (2.5 mg tablets)	Indomethacin (50 mg capsules)
Days 1 & 2	1.25 mg nocte	50 mg nocte
Days 3 & 4	2.5 mg nocte	100 mg nocte
Days 5 & 6	2.5 nocte + 1.25 mg mane	100 mg nocte + 50 mg mane
Days 7 to 28	2.5 mg B.D.	100 mg B.D.

Assessment of the patient's symptoms was by questionnaire, and was carried out prior to entry, after treatment with one drug, and on completion of the study. Serum prolactin estimations were made on all the patients prior to entry into the trial to exclude pituitary adenoma.

For the purpose of this study frequency is taken to be the passage of urine seven or more times during the day and twice or more at night. Urgency is a strong and sudden desire to void and urge incontinence is involuntary loss of urine associated with urgency. Stress incontinence is the involuntary loss of urine when exercising physically. (International Continence Society 1977).

RESULTS

Thirty-two female patients completed the trial out of an initial forty. Of the eight who failed to complete the trial, two offered social reasons, two forgot to take the tablets and four felt the drugs were not helpful. The average age was 53 years. The aetiology of detrusor instability in those patients who finished the trial is shown in Table 2.

Table 3 shows the symptom changes for the whole group of thirty-two patients, using both drugs. The symptom changes according to the aetiology of instability are shown in Table 4.

Although using either drug there was a decrease in the incidence of all symptoms (namely frequency, urgency, urge incontinence and stress incontinence) by the application of McNemar's test the decrease in durnal and nocturnal frequency of micturition due to indomethacin is statistically highly significant. Analysis of the patient's symptoms according to the aetiology of instability has shown that the re-

duction in diurnal frequency and nocturia due to indomethacin is still significant in the patients with primary detrusor instability. The group of patients with secondary detrusor instability is too small to show statistical significance. None of the changes due to bromocriptine are statistically significant.

The incidence of side-effects was high with both drugs, although slightly greater with indomethacin. However, no patient had to stop treatment because of side-effects, although two patients on bromocriptine and one on indomethacin were forced to halve the final dose.

All serum prolactin levels fell within the normal range apart from the one patient with Parkinsonism whose serum prolactin was elevated.

TABLE 2 Aetiology of Detrusor Instability

Aetiology	Number	Percentage
Total patients	32	100
Primary detrusor instability	21	66
Multiple sclerosis	6	19
Cerebrovascular accident	3	9
Other upper motor neurone lesion	2	6

TABLE 3 Symptom Changes in all 32 Patients

Symptoms	Prior to treatment	Indomethacin	Bromocriptine
Frequency: Dirunal	26 (81%)	17 (53%)	20 (63%)
Nocturnal	17 (53%)	9 (28%)	17 (53%)
Urgency	31 (97%)	28 (88%)	28 (88%)
Urge incontinence	30 (94%)	25 (78%)	23 (72%)
Stress incontinence	18 (56%)	12 (38%)	11 (34%)

TABLE 4 Symptom Changes in Patients with Primary Detrusor Instability and those with an upper Motor Neurone Lesion

Symptoms	Prior to treatment		Indomethacin		Bromocriptine	
	1^{o} DI (21)	UMN (11)	1^{o} DI (21)	UMN (11)	1^{o} DI (21)	UMN (11)
Frequency: Diurnal	18 (86%)	8 (73%)	12 (57%)	5 (45%)	15 (71%)	5 (45%)
Nocturnal	9 (43%)	8 (73%)	3 (14%)	6 (55%)	10 (48%)	7 (63%)
Urgency	20 (95%)	11(100%)	18 (86%)	10 (91%)	18 (86%	10 (91%)
Urge Incontinece	19 (90%)	11(100%)	15 (71%)	10 (91%)	15 (71%)	8 (72%)
Stress Incontinence	12 (57%)	6 (55%)	8 (38%)	4 (36%)	9 (43%)	2 (18%)

DISCUSSION

The efficacy of drug therapy in the treatment of detrusor instability is very variable. Although Moolgoaker et al 1972 reported good results other studies have not been as favourable (Brown et al 1973) (Stanton 1973). The subjective evaluation of drug treatment is hampered by the fact that detrusor instability is a changeable condition and many patients are subject to spontaneous temporary remissions in their

symptoms. Although objective evaluation (by means of cystometry) is preferable for drug studies we felt that in view of the invasive techniques required it was unjustified in this pilot study, especially for patients with multiple sclerosis in whom urinary tract infections present a greater hazard. However it should be noted that the incidence of urinary tract infection following urodynamic investigations is low (Walter and Vejlsgaard 1978), and objective as well as subjective assessment is underway in an in-depth study of the value of prostaglandin synthetase inhibitors in the treatment of detrusor instability. A double blind crossover trial is a preferable method of assessment but could not be used in this study because of the difficulty and expense involved in making bromocriptine tablets and indomethacin tablets look alike.

Farrar and Osborne (1976) have reported encouraging results using bromocriptine in a preliminary study. They found that 14 out of 24 patients responded symptomatically to a dose the same as, or less than ours. They also found that bromocriptine was less well tolerated by their patients than those described in other series, and concluded that patients with detrusor instability may be particularly sensitive to the drug. In this study bromocriptine was well tolerated in the dose prescribed; this is probably due to the slow initiation of therapy, allowing patients six days to become used to the drug before full dosage was administered.

There are no other reports on the use of indomethacin (or any other type of prostaglandin inhibitors) in the management of detrusor instability. We have found marked improvement in both diurnal and nocturnal frequency using this drug, and feel that it has a place in the treatment of this disorder. This will require long-term assessment and confirmation by cystometry. The incidence of side-effects was high, but no patient had to stop therapy because of this and it may be possible to reduce these problems by an alteration in the dosage regime and ensuring that the drug is always taken with food.

CONCLUSIONS

In the treatment of urinary symptoms due to detrusor instability bromocriptine was not helpful, but indomethacin produced improvement in both diurnal and nocturnal frequency of micturition and therefore warrants further evaluation.

ACKNOWLEDGEMENTS

We would like to thank the Multiple Sclerosis Society for their generous funding in respect of Dr. Linda Cardozo. Helpful advice regarding statistical analysis of the results was given by Mr. Martin Bland. Our thanks are due to Miss Rosemary Lyndon-Haynes for typing the manuscript.

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These are available on request from Dr. L. Cardozo.

URISPAS

EFFECT OF FLAVOXATE* ON HYPERACTIVE DETRUSOR MUSCLE

U. Jonas, E. Petri and J. Kissel

Department of Urology, University of Mainz Medical School, Mainz, W. Germany

Flavoxate is a papaverine-like smooth muscle relaxant (4). In comparison with papaverine, it has a lower acute toxicity and, in many preparations, a higher antispastic activity. Its use in urology has been well-accepted (2,5), and it was found - on the basis of double blind studies - to be highly effective on the urinary tract (1,3,6) with only slight side effects. It therefore was of interest to objectivate the effect of flavoxate, especially by means of urodynamic evaluations.

MATERIAL AND METHOD

Within a period of 15 months, 37 patients (24 female = 64.8 % and 13 male = 35.2 %), ranging between 7 and 75 years of age (mean: 39 years) were treated with Flavoxate (oral dosage 3 x 200 mg in adults, 3 x 100 mg in children). The follow-up period was between 2 weeks and 14 months (mean: 3.2 months).

36 of these 37 patients (including 3 children under 14 years of age) were studied urodynamically at least once:

	n=
Urodynamic evaluation only prior to Flavoxate:	13
only following Flavoxate:	1
before and after Flavoxate:	22

11 of the 22 patients received Flavoxate i.v. during the examination in a dosage of 100 mg in adults, 50 mg in children. The urodynamic study was done before and 2 - 5 - 10 - 20 minutes following the injection.

INDICATION

The indication for the administration of Flavoxate was:

	n=
motoric urge and urge incontinence:	22
neurogenic bladder (upper motor neuron lesion):	12
sphincter-detrusor-dyssynergia:	3

+) SPASURET^{R}, URISPAS^{R}

RESULTS

61 % (19/31) of the patients stated improvement of the complaints, while 39 % (12/31) found no change. It became obvious, however, that of these 12 patients, 10 were of the neurogenic bladder group, and the rate of failures in motoric urge patients therefore diminished to 9.1 % (2/22).

Frequency

The analysis of frequency during the day (Table 1) made evident that 23/29 (79.3 %) patients had frequency before treatment and 15/29 (= 51.7 %) showed no change following administration of Flavoxate.

Frequency	before Flavoxate		after Flavoxate	
< 5 x (normal)	6		14	
6 - 10 x	11	23	6	15
11 - 15 x	8		8	
> 15 x	4		1	

Table 1. Frequency (n = 29)

Nocturia

Nocturia (Table 2) was found in 13/27 (= 48.1 %) before and 9/27 (= 33.3 %) after Flavoxate therapy.

Frequency	before Flavoxate	after Flavoxate
0 - 1 (normal)	14	18
2 x	2	3
3 x	4	1
4 x	3	2
5 x	4	3

Table 2. Nocturia (n = 27)

Enuresis

23/28 (82.2 %) patients complained of daily enuresis which improved or normalised following Flavoxate in 67.8 %. Enuresis nocturna was found in 17/28 (60.7 %), which ceased after treatment in 64.3 %.

Urodynamics

Of even greater interest is the objective data obtained from urodynamic evaluation:

1. uninhibited detrusor contractions,
2. bladder capacity.

1. Uninhibited Detrusor Contractions

Table 3 shows the incidence of uninhibited detrusor contractions before and after the administration of Flavoxate: the first analysis seems to be quite disappointing since 68.2 % of the patients still showed contractions following therapy.

	before Flavoxate	after Flavoxate
⊕	19 (86.4 %)	15 (68.2 %)
⊖	3 (13.6 %)	7 (31.8 %)

Table 3. Uninhibited Detrusor Contractions (n = 22)

However, the correlation of pressure amplitude and bladder capacity at the onset of the contraction - measured before and after i.v. administration of the drug (n = 11) - proved that pressure amplitude diminished by almost 50 % from a mean of 52.3 to 26.4 cm H_2O, and the onset of the contraction was delayed by 80 % from a mean of 74.5 to 134.5 ml bladder capacity (Table 4).

Contractions	before Flavoxate	after Flavoxate
Amplitude cm H_2O	25 - 52.3 - 85	ø - 26.4 - 40
Bladder volume ml	40 - 74.5 - 150	40 - 134.5 - 200

Table 4. Uninhibited Detrusor Contractions (n = 11 i.v.)

2. Bladder Capacity

Bladder capacity increased from mean 231 ml to 284, indicating a mean increase of 18.4 %.

In essence, the subjective and objective results can be summarized as follows:

subjective "improvement"	61.3 %
daily frequency normalized or improved	47.8 %
nocturia normalized or improved	50.0 %
daily enuresis normalized or improved	67.8 %
nocturnal enuresis normalized or improved	41.2 %
uninhibited detrusor contraction:	
diminishing of mean pressure amplitude by	49.5 %
delay of onset in correlation with bladder capacity	80.5 %
increase of bladder capacity	18.7 %

DISCUSSION

The study revealed that it was possible to significantly influence bladder hyperactivity by use of Flavoxate. However, the influence on bladder capacity was markedly lower than reported in the literature (3,4). It can be concluded that Flavoxate offers the possibility of diminishing and delaying uninhibited detrusor contraction, but it should be mentioned that, in general, contractions still existed.

It became clear that the effect on the neurogenic bladder is markedly worse in comparison to the motoric urge group, which should therefore be the main target of this therapeutic approach.

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A COMPARISON OF FLAVOXATE HYDROCHLORIDE, EMEPRONIUM BROMIDE AND PROPANTHELINE FOR THE TREATMENT OF FEMALE URINARY INCONTINENCE DUE TO BLADDER INSTABILITY

R. Gaudenz and A. Weil

Universitäts-Frauenklinik, 4000 Basel, Switzerland

ABSTRACT

The comparison of three parasympatholytic drugs indicates,that Flavoxate hydrochloride probably is,everything considered,the most effective and best tolerated drug for treatment of bladder instability,closely followed by Emepronium bromide. None of the drugs however is capable of abolishing uninhibited detrusor contractions in a significant number of cases,leaving it a symptomatic therapy.

142 female patients with motor urge incontinence,which is associated with uninhibited detrusor contractions exceeding 20.cmH2O with the shape of waves,have been documented by cystometry using an open end fluid filled catheter system or the micro-tip transducer technique in the supine and erect position.The filling rate was 100 ml/min.

Patient characterization

1.0. The average age was 51 years (SD:12.8 years).The youngest patient was 17,the oldest 79 years old. 45% were postmenopausal and over the age of 50. 83% were over the age of 40.
2.0. The mean weight was 68 kg (SD 11.2 kg).
3.0. 18% have had vaginal or abdominal surgery for urinary incontinence prior to the diagnosis of detrusor instability. Probably they have had the detrusor disorder at the time of surgery already, predisposing and predestinating for recurrence or persistence of urinary incontinence.

4.0. Symptomatology: 91% complained of urinary incontinence, 82 % of urinary frequency, 53% of urgency, 49% of nocturia and 38% of nocturnal enuresis. Patients with detrusor instability are not able to interrupt voluntarily the urinary stream and, after micturition they do not have the sensation of an empty bladder.

5.0. Cystometry:
5.1. The mean bladder capacity was 430 ml with a SD of 161 ml and a range of 150-700 ml. 12% of the patients had a capacity of less than 300 ml. This was compared with a group of 48 patients with

sphincter incontinence and a stable bladder. Their mean bladder capacity was 600 ml with a SD of 164 ml and a range of 350-900 ml. No patient with a stable bladder had a capacity of less than 300 ml.

5.2. Uninhibited detrusor contractions:
In 26% detrusor instability was of the following pattern: multiple contractions with an average duration of 8-16 seconds and an average amplitude of 20-90 cmH2O with full pressure regression after each contraction. Fig.1.
In 63% however the detrusor contractions occured in a salvo and were cumulative, exceeding the maximal resting urethral pressure in two thirds of the cases. Fig.2.
Detrusor dyssynergia is characterized by a urethral relaxation synchronuously with the bladder pressure rise due to uninhibited detrusor contractions. Fig.3.
5.3. The registration of a useful urethral pressure stress profile was impossible in 33% due to continuous interference with uninhibited contractions.

Treatment

1.0. Treatment of detrusor instability is fastidious since the etiology is not usually known. The subjective and objective effect of three parasymaptholytic drugs recommended for treatment of bladder instability was to be compared.
The patients were all females, the diagnosis was verified cystometrically and the etiology was psychogenic or idiopathic in most cases. Frank neurological diseases have been excluded.

1.1. 52 patients were treated with Emepronium bromide (Cetiprin) 3x200 mg p.o. for 6 weeks. Control cystometry was done after completion of therapy.

1.2. 70 patients have been treated at a randomized schedule with one of four drugs for 12 weeks. Control cystometry was performed while on medications.

- Emepronium bromide (Cetiprin) 3x200 mg p.o. N = 20 + 5
- Flavoxate hydrochloride (Urispas) 3x200 mg p.o. N = 17 + 5
- Propantheline (Pro-Banthine Biplex) 3x 30 mg p.o. N = 18 + 5
- Placebo for 4 weeks followed by one of the three drugs N = 15

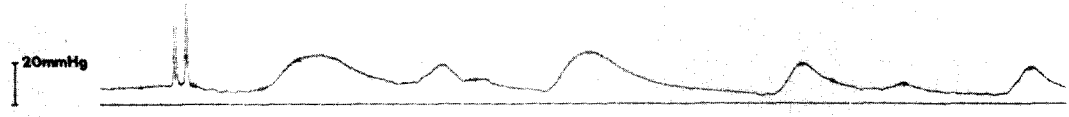


Fig.1. bladder pressure
abdominal pressure

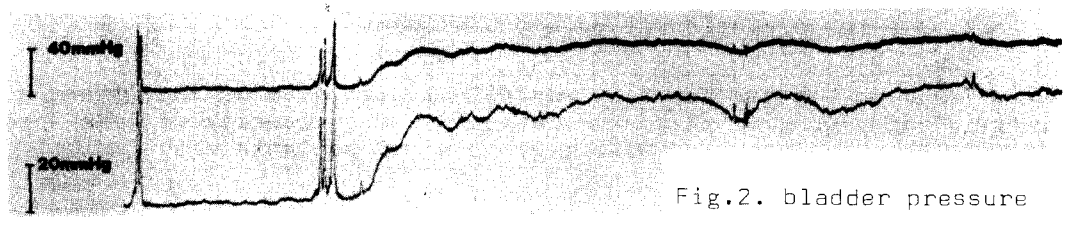


Fig.2. bladder pressure

Results

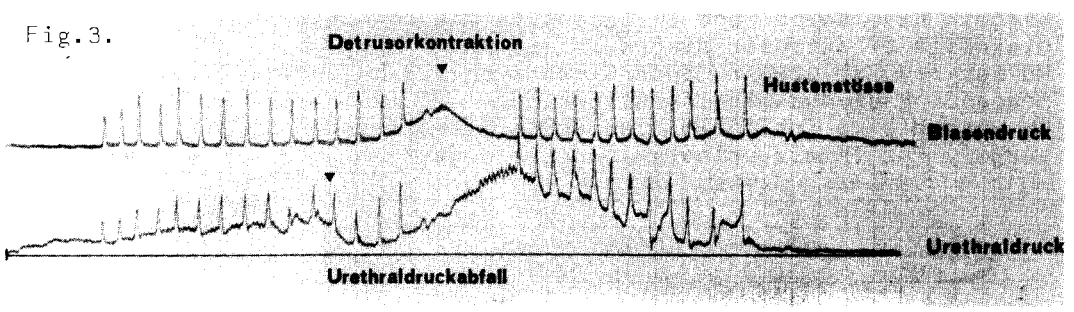
	Flavoxate	Emepronium	Propantheline	Placebo
2.1. side effects	25 %	58 %	44 %	22 %
discontinued	0 %	8 %	11 %	0 %
2.2. subjective assessment of global treatment response:				
very satisfied	50 %	34 %	15 %	0 %
some improvement	33 %	32 %	28 %	78 %
no improvement	17 %	34 %	57 %	22 %
2.3. urinary incontinence:				
cured	37 %	34 %	0 %	0 %
improved	50 %	32 %	50 %	86 %
no improvement	13 %	34 %	50 %	14 %
2.4. urinary frequency, nocturia and urgency:				
cured	19 %	46 %	16 %	0 %
improved	62 %	32 %	32 %	68 %
no improvement	19 %	22 %	52 %	32 %
2.5. bladder capacity				
increased	50 %	50 %	44 %	0 %
mean increase	83 ml	39 ml	28 ml	0 ml
2.6. uninhibited detrusor contractions:				
abolished	14 %	8 %	14 %	22 %
unchanged	86 %	92 %	86 %	78 %

2.7. residual urine between 20-100 ml was found in 11 % while on drug; only in one patient was it 100 ml and in no patient more.

2.8. Looking at the first group of 52 patients treated with Emepronium bromide it was evident, that the chance of objective cure, i.e. normalization of the cystometric curve, was significantly higher when the detrusor contractions had been short, low and not cumulative and when the bladder capacity had been in the normal range. Responders have had a cumulative pattern in 17% versus 63 % where uninhibited detrusor contractions persisted after therapy.

2.9. The subjective response was better in the responder group (detrusor contractions abolished). 77 % versus 63 % cure and improvement of all symptoms.

Fig.3.



Conclusions and recommendations

3.1. Bladder instability contributes significantly to incontinence. In 17 % of our new patients admitted for urodynamic investigation urinary incontinence stemed from motor urge incontinence with demonstrable uninhibited detrusor contractions. Bladder instability with urge incontinence is a manifestation of a chronic disease of the middle aged women characterized by remissions and exacerbations.

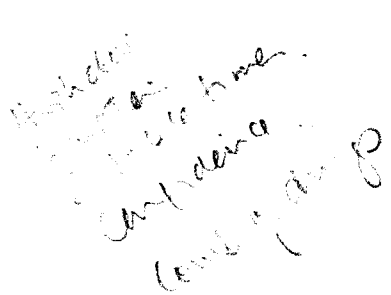
3.2. The comparison of three parasympatholytic drugs indicates, that Flavoxate hydrochloride probably is, everything considered, the most effective and best tolerated drug for the treatment of bladder instability, (83 % cure or improvement of all symptoms), closely followed by Emepronium bromide (66 %).

3.3. None of the drugs however is capable of abolishing detrusor contractions in a significant number of cases. Selfhealing occurs and some placebo effect of these drugs seems probable.

3.4. The objective and subjective response to anticholinergic drugs depends on: total bladder capacity, onset of first uninhibited contraction during bladder filling, maximal amplitude, pattern, provocation necessary to trigger detrusor contractions and maximal closure pressure.

3.6. For an optimal success with parasympatholytic drugs the following points have to be kept in mind:
The administration of the medication at a high dose, to the limit of side effects and for a long duration (months) seems to be important.
The gastrointestinal resorption of some of the drugs is not ideal and the effect is more symptomatic and ameliorating while on medication and for some time thereafter, than curative.
Patients with nocturia and nocturnal enuresis should take the drug at night.
Repeated treatment sessions, a continuity of care and confidence between patient and doctor are essential. Psychotherapeutic support is useful.
Combinations of drugs and alternative treatment modalities, generally less effective than the three anticholinergic drugs discussed, are necessary.
Surgery for incontinence however should be avoided even in cases of mixed urinary incontinence (37 %) because bladder instability and urge incontinence will recur in 84 %, as has been our experience in a dozen of cases.

3.7. Closing the following has to be stressed:
Efforts have to be made to intensify the objective cystometric diagnosis of detrusor disorders.
No surgery for urinary incontinence should be performed without preceeding urodynamic investigation.
An unstable or irritable bladder is a contraindication for any surgery for female urinary incontinence.



urethral ~~dilatation~~ stimulation
desire to micturate detrusor

INFLUENCE OF LIGNOCAINE ON BLADDER INSTABILITY

N. J. R. George

Clinical Investigation Unit, Ham Green Hospital, Bristol, England

INTRODUCTION

The finding of bladder instability on inflow cystometry offers no explanation as to the processes responsible for the abnormality; malfunction may exist at cerebral, spinal or local level. We have used a standardized lignocaine test in an attempt to detect whether local vesical factors are of importance and to determine whether these factors might be influenced by local anaesthetics.

METHODS

26 patients (24 male) with cystometric findings of phasic instability have been studied; instability is defined as a rise in subtracted bladder pressure greater than 20 cm water.

Cystometry was performed in the sitting position. Both filling (8 FG Harris) and pressure (16 gauge epidural) catheters were introduced per urethram. A rectal pressure line enabled subtracted pressures to be recorded. Normal saline at 37°C was introduced at a constant rate of 1 ml per second by infusion pump. Pressure measurements were recorded by Elema Schonander EMT 34 transducers onto a M 81 polygraph.

The capacity at which the patient would normally micturate was noted (invariably this corresponded to the appearance of the phasic wave).

Following the phasic unstable wave the bladder was emptied. 40 - 50 cc air followed by 8 ml 2% plain lignocaine hydrochloride was then injected through the filling catheter into the bladder. This ensured that the lignocaine was located in the posterior urethra and bladder neck zone whilst the main detrusor mass was held away by the air bubble. Filling was repeated and the volume at which the patient expressed a desire to urinate again noted.

It is important to consider that the act of refilling the bladder may in itself affect the instability and capacity tolerated. This possibility was investigated in a separate study. Cystometrograms were performed on 19 patients in the manner described above; however on this occasion no air and lignocaine was inserted prior to refilling.

Of 13 patients initially unstable 12 remained unstable on the second fill. In 6 patients initially stable 3 became unstable on refilling. Decreased capacity on repeat cystometrogram was seen in only 4 of 19 patients, the mean increment being 22 ccs (range - 80 cc to + 110 cc).

RESULTS

Following the instillation of lignocaine, of 26 patients initially unstable, 8 patients (32%) became stable on refilling. Of these 5 patients had become sore during previous sphincterometry, 1 patient was later shown to have a small bladder calculus, 1 patient was diagnosed as mild prostatitis and 1 patient remains under investigation. None of these patients normally experienced the motor urge encountered during the first cystometrogram nor were they subsequently shown to have conditions commonly associated with bladder instability.

Of the 18 patients who remained unstable all recognised the urge waves as a common occurrence. 5 patients had enuretic-associated frequency, 6 patients had obstructive symptoms associated with benign prostatic hypertrophy and the remaining 7 patients had symptoms suggestive of long term instability.

Capacity in those remaining unstable was increased by a mean of 25 cc (range 0 cc to 120 cc). However in those patients becoming stable increase in capacity averaged 180 cc (range 110 cc to 240 cc).

COMMENT

The act of refilling the bladder per se causes a small increment in tolerated volume. Instability for whatever reason rarely disappears. However it is common for instability to appear in a previously stable bladder, perhaps because of the interference caused in performing the test.

Refilling after lignocaine does not remove instability associated with enuresis and prostatic obstruction, and the increase in capacity noted during the test is no greater than in the control group. However in "superficial" bladder problems - catheter soreness, bladder calculus and mild prostatitis, instability may be removed and physiological bladder capacity increased significantly.

It is suggested that failure to appreciate these facts may lead to misleading reports of instability. It is possible that superficial sensory receptors capable of initiating bladder instability may be present in the urethra and trigonal area; activity in these receptors may be annulled by lignocaine. Instability demonstrated in enuresis and prostatic obstruction is evidently initiated by a separate mechanism.

This work is supported by a Grant from the Medical Research Council.

AN ANALYSIS OF FIRST TIME PROLONGED BLADDER DISTENSION IN 65 PATIENTS WITH IDIOPATHIC DETRUSOR INSTABILITY

R. H. Higson, J. C. Smith, P. D. Ramsden and G. M. Ardran

Department of Urology and University Department of Radiology, The Radcliffe Infirmary, Oxford, England

ABSTRACT

The results of first time prolonged bladder distension in 65 patients, with urinary symptoms thought to be due to idiopathic detrusor instability, are presented in this paper. Prolonged bladder distension is shown to decrease the severity of frequency, nocturia, enuresis, urgency and urge incontinence of urine, both on subjective patient assessment and on objective symptom scoring, in 77% of patients at 1 month, 65% of patients at 6 months and 47% of patients at 1 year. In a small group of patients, however, the beneficial effect of distension continues for 4 years. No factors are identified which predict the outcome of prolonged bladder distension in any particular patient.

INTRODUCTION

It is now five years since prolonged bladder distension (PBD) was introduced in this centre in the treatment of urgency and urge incontinence of urine. Dunn (1) described favourable early results and a further interim report by Ramsden (2) confirmed this encouraging trend. In this paper we report a larger series of patients and examine (a) the long term results after 4 years follow-up and (b) possible factors which may predict the outcome of PBD.

PATIENTS AND METHODS

65 patients with urinary symptoms which were thought to be due to detrusor instability (shown on cystometry) who have consecutively undergone PBD from 1973 - 1978 have been studied. All patients had idiopathic detrusor instability for which no underlying neurological or urological cause could be identified.

Patient assessment

This was made in two ways:-

1. The patients' subjective assessment of their symptoms according to the three arbitrary categories: (a) Symptom free (b) Improved (c) the same, were recorded.

2. The symptoms of frequency, nocturia, enuresis and urgency/urge incontinence were scored according to their severity and recorded before and after PBD as follows:-

Daytime frequency	3 hours	1
	2-3 hours	2
	1-2 hours	3
	30-60 minutes	4
	10-30 minutes	5
Nocturia	0-1/ night	1
	1-2/ night	2
	3-4/ night	3
	5-5/ night	4
	6/ night	5
Enuresis	none	1
	1-9 nights/month	2
	10-19 nights/month	3
	> 20 nights/month	4
	every night	5
Urgency/urge incontinence	none	1
	Subjective urgency, occasional incontinence	2
	Urge incontinence several times per day	3
	Wet all the time	4

Urodynamic investigations were performed on all patients to establish the diagnosis of detrusor instability (which was defined as a rise in detrusor pressure at any time during the filling phase of the cystometrogram, either spontaneously or on provocation by coughing or straining, of 15 cm. H_2O or more), to estimate bladder capacity and to exclude bladder outflow obstruction.

All patients have been assessed after PBD at 1 month or 3 months and thereafter at 6 monthly or yearly intervals. Both symptomatic and cystometric assessment was made on as many patients as possible, but those unwilling or unable to attend for interview and undergo cystometry were asked to complete a questionnaire.

Prolonged Bladder Distension Technique

The standard technique described by Dunn (1) of an intermittent distension to systolic blood pressure with an additional 15 cm H_2O (to overcome the elasticity of the balloon) for 4 periods of ½ hour was used in all patients.

RESULTS

Of the 65 patients studied, 45 attended for interview and cystometry, 9 returned completed questionaires, the remaining 11 being lost to follow-up. Data on all 65 patients has however been used as all these patients have at some time attended for follow-up. The results following first distension at different follow-up intervals on the basis of subjective patient assessment are shown in Table 1.

Table 1. Results of first Prolonged Bladder Distension in 65 patients

	Follow-up interval months						
	1	3	6	12	24	36	48
Number of patients reviewed	65	59	49	45	32	20	13
Number symptom free	15	11	11	8	4	3	3
% symptom free	23	19	22	18	12	15	23
Number improved	35	31	21	13	13	9	7

%	improved	54	52	43	29	41	45	54
Number	the same	15	17	17	24	15	8	3
%	the same	23	29	35	53	47	40	23
Number	symptom free + improved	50	42	32	21	17	12	10
%	sympton free + improved	77	71	65	47	53	60	77

PBD is seen to give relief of symptoms in more than 70% of patients for 3 months but in only 47% for 1 year. The surprising increase in the proportion of patients in whom PBD is effective at follow-up from 1 - 4 years is discussed later.

Analysis of the objective results obtained by symptom scoring also shows that PBD is an effective treatment. The % reduction in (a) total frequency score (derived by adding together the frequency score of all patients at a given follow-up interval and comparing this with the pre-PBD score), (b) total nocturia score, (c) total enuresis score and (d) total urgency/incontinence score is shown in Table 2.

Table 2. The Percentage Reduction in scores for Each Symptom Following Prolonged Bladder Distension.

	Follow-up interval						
	1	3	6	12	24	36*	48
Frequency score reduction %	52	30	33	25	38	-	19
Nocturia score reduction %	34	10	47	22	27	-	18
Enuresis score reduction %	18	27	35	0	31	-	13
Urgency/incontinence score reduction %	32	22	12	30	34	-	27

*Reliable figures for this follow-up interval are not available.

This objective patient assessment is a method of gaining quantitative information about the effect of PBD. The severity of all symptoms is reduced (except enuresis at 12 months) to a variable extent. No single symptom is most effectively reduced by PBD and the trend appears to show a gradual reduction in the effect of PBD with time.

If the number of patients in whom each sympton is improved at each follow-up interval is examined (Table 3) it is seen that PBD reduces the score of individual symptoms and the total score of all symptoms in a high percentage of patients at each follow up, and the figures derived in this way are higher than those derived solely by asking patients for an overall subjective impression of their symptoms.

Table 3. The Proportion of Patients in Whom Individual and Total Sympton Scores were Reduced by PBD

	Follow-up interval (months)						
Symptom	1	3	6	12	24	36	48
Frequency	69	71	73	53	61	-	40
Nocturia	45	71	60	60	39	-	50
Enuresis	69	60	87	0	33	-	100
Urgency/incontinence	55	57	60	71	55	-	70
Total symptoms	92	72	83	94	83	-	80

Numbers refer to the % of patients in whom the symptom score is reduced.

Prognostic Factors

We considered that the following factors might influence the outcome of PBD in a particular patient:

(a) The patient's age at the onset of symptoms
(b) The patient's total symptom score at the time of distension.
(c) Individual sympton scores - e.g. did those patients with predominent frequency respond better than those with predominent urgency?

(d) The patient's age at distension
(e) Bladder capacity at cystometry

No positive correlation was found however between any of these factors and a successful PBD.

DISCUSSION

Detrusor instability remains an enigmatic and difficult condition to treat. No effective, safe or long lasting method of treatment has yet been found. Prolonged bladder distension has now been used for more than 4 years in this centre and results now show that it is effective in a large number of patients but its effect may only last for 6 months in the majority of these patients. There appears however to be a small group of patients in whom the effect is lasting much longer. The paradox of the increasing effectiveness of PBD after 12 months (Table 1) may be explained on the basis that a group of patients who underwent PBD early in the series achieved a much better symptomatic improvement than any group since. These good results are masked in the short term follow-up figures by the larger number of patients studied who achieved an indifferent result from PBD, but become more apparent when the early patients form the majority group in the long term (1 to 4 years) follow-up series.

We have failed to identify any prognostic factors associated with this group which could be used to predict the outcome of PBD and enable it to be used more selectively: for this method of treatment is time consuming, depends upon a skilled anaesthetic service to provide effective epidural anaesthesia and carries a 5% risk of bladder rupture (Ref. 3). It is possible that within the idiopathic group of patients with detrusor instability there are several subgroups whose instability may have a different pathological basis and thus a different response to PBD.

CONCLUSIONS

1. Prolonged bladder distension is an effective treatment for detrusor instability and the effect lasts for 12 months in nearly 50% patients.

2. It is not yet possible to identify those patients who will respond favourably to prolonged bladder distension.

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DETRUSOR INSTABILITY FOLLOWING SURGERY FOR GENUINE STRESS INCONTINENCE

Linda D. Cardozo*, Stuart L. Stanton* and John E. Williams**

**Urodynamic Unit*
***Department of Radiology, St. George's Hospital Medical School, London*

ABSTRACT

Ninety-two female patients with genuine stress incontinence, and with otherwise normal bladder function, were treated by a colposuspension operation. Pre. and postoperative clinical and urodynamic assessments were performed on all patients. Following surgery seventeen of them were found to have detrusor instability.

INTRODUCTION

It is now widely accepted that incontinence due to a sphincter weakness alone (genuine stress incontinence) can, in the majority of cases, be cured by surgery; whereas that due to detrusor instability is resistant to surgery. (Arnold et al 1973). Many operations exist for the correction of genuine stress incontinence and they may be divided into two broad categories; vaginal and suprapubic. Both types are commonly performed although most of the reports available suggest that the cure rates achieved by a suprapubic approach are higher than those for vaginal surgery (Morgan 1973). The colposuspension operation, first described by Burch (1961), has been shown to produce objective evidence of a cure in 88.6% of a group of 35 patients at four months postoperatively (Stanton et al 1976). The reasons for failure of this operation have been assessed (Stanton et al 1978) and include increased age, previous surgery for urinary incontinence, preoperative symptoms of urgency and frequency, and detrusor instability.

METHOD AND PATIENTS

Ninety-two patients attending the Urodynamic Clinic with a primary complaint of stress incontinence had a full history taken and underwent examination of their gynaecological, urological and neurological systems. A midstream specimen of urine was sent for culture and sensitivity and an independent peak flow rate was measured. Videocystourethrography (V.C.U.) (Bates and Corney 1971) was performed and a dianosis of genuine stress incontinence (urethral sphincter dysfunction) was made if there was demonstrable stress incontinence in the absence of detrusor contractions and with a pressure rise of less than 15 cm of water during the provocative tests of fast bladder filling, coughing, passive posture change and catheter withdrawl. If neither stress incontinence nor detrusor instability was demonstrated on V.C.U. a Urilos nappy test (Stanton and Ritchie 1977) was performed. All patients with objective evidence of incontinence due to urethral sphincter dysfunction were treated by a modified colposuspension (Stanton et al 1976) preceded by a cystoscopy.

Two months after surgery all patients were reassessed in the Urodynamic Clinic and a month later a further V.C.U. and Urilos nappy test were performed. Thereafter all patients have been followed up annually by history, clinical examination and Urilos nappy test, and in those exhibiting postoperative detrusor instability a further V.C.U. has been performed one year later. For the purposes of this study frequency is taken to be the passage of urine seven or more times during the day or twice or more at night. The other definitions comply with the "Standardisation of terminology of lower urinary tract function" (I.C.S. 1977).

RESULTS

Ninety-two patients with genuine stress incontinence and stable bladders underwent a colposuspension operation. Postoperative urodynamic assessment showed that 75 (81.5%) had stable bladders (Group 1) and 17 (18.5%) had unstable bladders (Group 2). The ages, parities and number of previous operations for incontinence are shown in Table 1.

TABLE 1 Group 1/2 Patients - Stable/Unstable Postoperatively

	Group 1 (75 Patients)			Group 2 (17 patients)		
	Mean	Range	S.D.	Mean	Range	S.D.
Age	49.8	28-77	(11.4)	48.8	27-72	(12.6)
Parity	2.6	0-7	(1.8)	2.7	1-6	(1.4)
Previous Operations for Incontinence	0.7	0-3	(0.8)	1.2	0-3	(0.9)

Group 2 - Divided into three sub-groups according to the V.C.U. findings.

Group 2a - Five patients with detrusor contractions greater than 15 cm of water during bladder filling (P1).

Group 2b - Six patients with a pressure rise on standing (P2) greater than 15 cm of water without detrusor contractions. Five of these patients had a normal P1 rise - the other had a steep P1 rise of 30 cm of water.

Group 2c - Six patients with a P1 rise greater than 15 cm of water without detrusor contractions with a normal P2 rise.

Table 2 shows the pre. and postoperative clinical findings. The V.C.U. results before and after surgery are shown in Table 3.

TABLE 2 Pre. and Postoperative Clinical Findings

% OF PATIENTS	GROUP 1 (75)		GROUP 2 (17)		Group 2a (5)		Group 2b (6)		Group 2c (6)	
	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
FREQUENCY - D.	61	36	70	35	60	60	66	50	100	0
- N.	36	19	41	29	60	60	33	17	33	33
URGENCY	61	33	76	64	40	80	100	66	66	50
U.I.	51	19	70	47	40	60	83	50	66	50
S.I.	100	16	100	29	100	20	100	33	100	50
CYSTOCOELE	77	37	77	35	80	20	83	33	66	33

D = Diurnal, N = Nocturnal, U.I. = Urge Incontinence, S.I. = Stress Incontinence

TABLE 3 Pre. and Postoperative V.C.U. Findings

	GROUP 1 (75)		GROUP 2 (17)		Group 2a (5)		Group 2b (6)		Group 2c (6)	
	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop	Preop	Postop
Res. (ml)	5	49	23	33	13	28	33	10	21	57
F.S. (ml)	242	244	190	200	200	234	178	156	188	216
Cap. (ml)	497	488	493	463	460	430	535	514	479	438
$P.R._1$ (cm H_2O)	4.3	5.1	6.7	17.1	7.6	24.8	5.2	4.7	7.6	23
$P.R._2$ (cm H_2O)	3.5	3.2	3.6	14.0	5.6	11.0	4.5	22.8	0.9	7.8
M.V.P.	32	40	38	40	42	35	39	48	34	36
P.F.R.	20	17	24	15	25	18	30	14	17	12
S.I.	100%	13%	100%	47%	100%	40%	100%	50%	100%	50%

Res. = Residual, F.S. = First Sensation, Cap. = Capacity, $P.R._1$ = Pressure Rise on Filling, $P.R._2$ = Pressure Rise on Standing, M.C.P. = Maximum Voiding Pressure, P.F.R. = Peak Flow Rate, S.I. = Stress Incontinence.

Twelve of the 17 patients with postoperative detrusor instability had a V.C.U. performed a year later. Of these, 11 remained unstable but in some the type of instability had changed.

DISCUSSION

In women detrusor instability is an important cause of urinary incontinence as well as urgency and frequency of micturition. Although in the majority of cases detrusor instability is idiopathic it may be due to an upper motor neurone lesion. In men detrusor instability may be secondary to outflow obstruction and is often reversed by its relieft (Turner-Warwick et al 1973). This reversal has not been observed in women (Farrar et al 1976) but outflow obstruction is rare in the female. The colposuspension is thought to produce continence by elevation of the bladder neck and possibly compression of the urethra. It would therefore seem reasonable to hypothesise that in our patients who have developed postoperative instability, excessive urethral compression has led to outflow obstruction and consequent detrusor instability. This is not the case, however, as one can see by examining the changes in peak flow rate and maximum voiding pressure in the two groups following surgery. In Group 1 the mean increase in maximum voiding pressure and the mean decrease in peak flow rate are probably significant (t - test), whereas in Group 2 the decrease in peak flow rate is significant but the mean maximum voiding pressure is virtually unaltered. From these results one can infer that on average the patients in Group 1 have had their urethras in some way "tightened" by the operation, whereas those in Group 2 may not have, and a change in bladder function may be partly responsible for the altered pressure studies postoperatively. This could be due to damage to the nerve supply to the bladder at operation, when the bladder is dissected medially off the vaginal fascia. If this was the case, though, instability would be transient, and we have found that only one patient had reverted to detrusor stability a year afterwards. One noticeable difference between the Group 1 and Group 2 patients is the number of previous operations for incontinence. The mean for Group 1 is 0.7 and for Group 2 is 1.2. There is no obvious reason for this discrepancy, as all the patients exhibited stable bladders prior to colposuspension.

The finding of detrusor instability following incontinence surgery has been previously documented. It has been noted following the implanatation of an artificial sphincter (Hald 1975) and after a colposuspension (Worth 1978). In neither of these cases has a cause been suggested. Many women date their symptoms of urgency

and frequency of micturition back to a hysterectomy, although the incidence of detrusor instability is not increased following either abdominal or vaginal hysterectomy (Brown 1974). There are no adequate reports on pre. and postoperative urodynamic studies in patients undergoing other forms of pelvic surgery such as colporrhaphy.

We have divided the Group 2 (Unstable) patients into types, as shown in our results. The numbers in these groups are too small for statistical evaluation. Group 2a is the most typical form of detrusor instability, exhibiting contractions greater than 15 cm of water. Four out of five of the patients in this group complain of urgency, urge incontinence and frequency of micturition. The group 2b patients exhibit a rise of detrusor pressure only on posture change. Symptomatically and objectively they are more similar to Group 2a than Group 2c. This is borne out by the fact that three of these patients exhibited detrusor contractions when they returned for investigations one year later.

The Group 2c patients have an abnormally high detrusor pressure rise during filling. Although they complain of less urgency and frequency than the other two unstable groups, they have the highest incidence of stress incontinence postoperatively. We feel that these patients shown "non-compliance" of the detrusor, and that it is a form of detrusor instability. Their bladders are not indistensible (Torrens et al 1975) as the mean postoperative capacity is not significantly lower than preoperatively. In our experience the results of incontinence surgery were equally unsatisfactory in all three sub-groups. This is contrary to the findings of Osborne (1978) who found, in a small series of patients with detrusor instability undergoing incontinence surgery, that almost all patients exhibiting detrusor contractions failed to be cured by incontinence surgery whereas the success rate of the operation in the non-compliant patients was much higher; although they usually continued to complain of urgency and frequency. Another reason for classifying the non-compliant patients along with the other unstable ones is that at the later follow-up V.C.U. one of them had altered to show an abnormal P2 rise and one of the patients at first exhibiting detrusor contractions has developed non-compliance.

We cannot speculate as to the reason for the variable manifestations of detrusor instability but it is interesting to note that although the type of instability may change, only one of the patients who underwent further V.C.U. reverted to stability at a later date.

CONCLUSIONS

In view of the paucity of urodynamic data before and after other types of incontinence surgery it is impossible, at this stage, to incriminate the colposuspension operation as a cause of detrusor instability. Our study does, however, underline the need for full urodynamic investigations in all patients in whom an incontinence procedure has failed.

ACKNOWLEDGEMENTS

We are most indebted to Dr. D. Griffiths for his helpful advice and guidance regarding our findings. Our thanks are also due to the Departments of Radiology and Physics in this Hospital for their help with our investigations. Dr. Linda Cardozo has been generously funded by the Multiple Sclerosis Society.

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These are available on request from Dr. Linda Cardozo.

URETHRAL FUNCTION

Chairmen: T. HALD
J. A. GOSLING

THE NEUROPHYSIOLOGICAL BASIS OF BLADDER INHIBITION IN RESPONSE TO INTRAVAGINAL ELECTRICAL STIMULATION

Magnus Fall, Björn-Erik Erlandson, Carl-Axel Carlsson and Sivert Lindström

Department of Urology, Sahlgrenska sjukhuset, Department of Applied Electronics, Chalmers University of Technology, Department of Neurosurgery, Sahlgrenska sjukhuset and Department of Physiology, University of Göteborg, Göteborg, Sweden

ABSTRACT

Clinical and experimental studies have shown that intravaginal electrical stimulation (IVS) may cause bladder inhibition. This effect is due to spinal reflexes utilizing the hypogastric and pelvic nerves. In the present study direct registrations of nervous activity were obtained from microfilaments of the hypogastric and pelvic nerves. At a low intravesical pressure, IVS induced a reflex activation of the hypogastric efferents resulting in bladder inhibition. At a high intravesical pressure, IVS caused complete inhibition of the spontaneous pelvic efference, with a concomitant bladder inhibition. The ability of IVS to cause bladder inhibition is of great clinical significance, since it offers a possibility to treat patients with severe detrusor instability.

INTRODUCTION

Previous clinical and experimental studies have shown that electrical stimulation of the pelvic floor may cause bladder inhibition, registered as a bladder volume increase or abolition of abortive detrusor contractions (ref. 1.2.3.4). In experiments performed on adult female cats, bladder inhibition could not be obtained at a low superimposed bladder pressure (<5 cm H_2O) after bilateral transection of the hypogastric nerves, while at high bladder pressures (>10 cm H_2O) bladder inhibition was registered after this procedure (ref. 3). It was assumed that the inhibitory effect of IVS on the bladder was caused by an activation of two different spinal reflex mechanisms. The following postulates could also be proposed:

1) IVS activates efferent fibres in the hypogastric nerves with an inhibitory action on the bladder.

2) IVS inhibits the pelvic efferent outflow (representing the excitatory input to the bladder).
3) The absence of response to IVS at a low intravesical pressure (5 cm H_2O) after transection of the hypogastric nerves is due to the fact that there is no pelvic efferent activity to be inhibited at such a low pressure.

The experiments presented in this paper were performed to test the validity of these hypotheses.

METHODS

Experiments were performed on 14 adult female cats. The animals were anaesthetized with Nembutal(R) (Abbott), 30 mg/kg b.w. intraperitoneally, with supplementary intravenous doses as required. Bladder responses were recorded by means of an isotonic volume registration technique. In brief, the bladder is connected to a vessel with a large surface area. This means that volume changes can be registered at practically constant hydrostatic pressures. Direct registrations of nervous activity were obtained from dissected microfilaments of the hypogastric and pelvic nerve branches to the bladder.

RESULTS

The spontaneous activity of the hypogastric nerves increased with increasing bladder pressure. IVS of sufficient intensity to cause bladder relaxation induced a reflex activation of the hypogastric efference with a latency of 35-40 ms. The reflex discharges were optimally developed at an IVS frequency below 10 Hz. This hypogastric activation was not influenced by changes of the intravesical pressure.

There was no spontaneous nervous activity in the pelvic efferents at superimposed bladder pressures below 7 cm H_2O. At higher pressures there was a gradual increase of the spontaneous pelvic efferent activity with increasing bladder pressure. The pelvic activity appeared as bursts of 5-20 s duration, immediately followed by abortive bladder contractions. At all levels of pelvic activity, IVS caused complete inhibition of the efferent pelvic outflow and, consequently, also a profound bladder relaxation (Fig. 1).

DISCUSSION

At intravesical pressures below 7 cm H_2O, bladder inhibition in response to IVS is elicited via hypogastric efferents. At pressures above 7 cm H_2O, spontaneous pelvic efferent activity can be registered. Now, IVS may inhibit this pelvic outflow, with concomitant bladder relaxation (Fig.2). According to de Groat and Saum (5), sympathetic inhibition of the bladder is caused by direct inhibition of vesical smooth muscle (β-adrenergic effect) and by inhibition of transmission in vesical parasympathetic (pelvic) ganglia (α-adrenergic effect). In our experiments registration of pelvic efference was done centrally to the pelvic ganglia. Thus, the inhibition of the pelvic efference occurred centrally to the pelvic ganglia. Consequently, a sympathetic inhibition of pelvic ganglia did not seem to occur in response to IVS. The bladder inhibition via the hypogastric route at low intravesical pressure was evidently due to direct inhibition of the vesical smooth muscle and not to inhibition of pelvic ganglia, since in this situation there was no pelvic efference to be inhibited.

The experimental studies have shown that inhibition of pelvic efference during IVS is most important for bladder relaxation. It seems reasonable to assume that this is also the main mechanism for the clinical effect of IVS. This is in agreement with the current concept of the sympathetic system playing a minor role in the regulation of the human bladder. The inhibitory effect of IVS on the bladder is of great clinical significance. Recent clinical trials have revealed that IVS can control and even cure severe, drug-resistant urge incontinence due to detrusor instability (ref. 6). The curative effect of IVS on urge incontinence is difficult to explain. It is possible that detrusor instability is elicited from easily excitable neuronal chains in the spinal cord and that repeated stimulation may disrupt such systems and eventually restore the normal reflex pattern.

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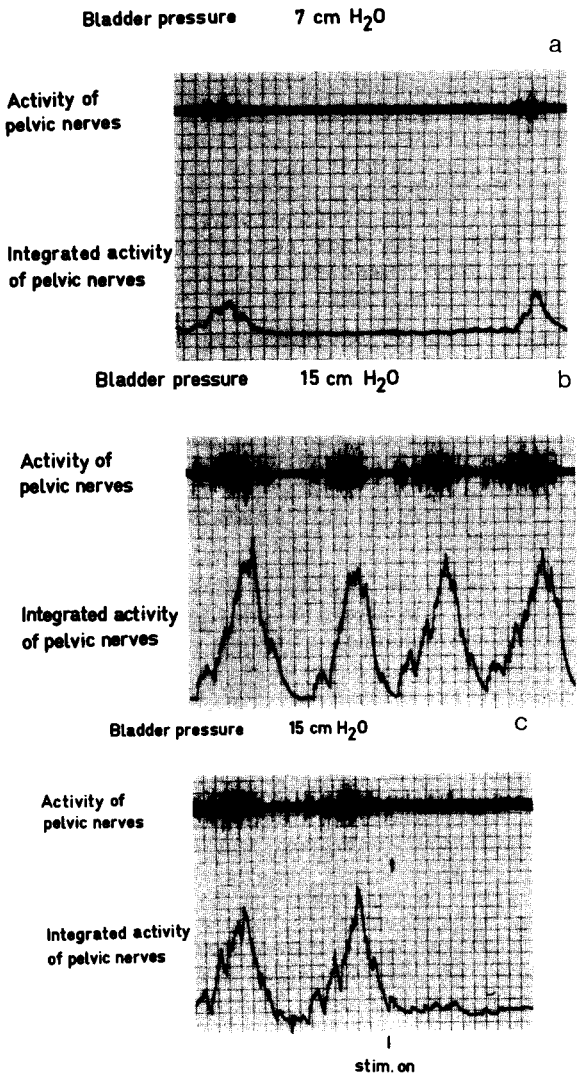

Fig. 1. Spontaneous, pelvic efferent activity at an intravesical pressure of 7 cm H_2O (a) and 15 cm H_2O (b). Pelvic activity in response to IVS, integrated signals (c).

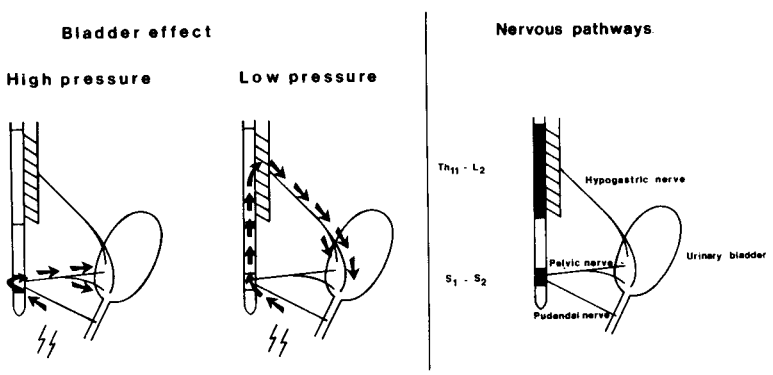

Fig. 2. The nervous pathways utilized for bladder inhibition in response to IVS.

ALPHA-ADRENOCEPTOR BINDING SITES IN THE URINARY BLADDER OF THE RAT

D. Jonas*, S. Jenner and H. G. Baumgarten****

**Department of Urology, University of Frankfurt Medical School Frankfurt, GFR*
***Department of Anatomy, University of Hamburg, GFR*

ABSTRACT

The distribution of ^{3}H-ST-1059, 2-^{3}H[alpha-(2,5-dimethoxyphenyl)-ß-aminoethanol], a newly developed directly acting sympathomimetic drug with strong and prolonged effects on the smooth musculature of the bladder neck, has been analyzed in the lower urinary tract of the rat using high speed and conventional autoradiography. Low doses of ^{3}H-ST-1059 (0.1 mg/rat) - given to rats that underwent ligation of their abdominal ureters prior to iv injection of ^{3}H-ST-1059 - caused a rather selective localization of silver grains in the bladder neck superimposed to the plasmalemmata of smooth muscle cells and fibroblasts. This selective accumulation of radiolabel was attenuated by phentolamine but not by propranolol indicating that alpha-adrenoceptor sites might have been involved in the binding of ^{3}H-ST-1059. Thus, visualization of alpha-adrenoceptor binding sites in tissue appears feasible through autoradiography of ^{3}H-labelled agonists.

INTRODUCTION

The availability of rather selective beta- and alpha-adrenoceptor agonists and antagonists with high affinity for their respective binding sites has stimulated the development of quantitative radioligand assay procedures for these receptors (Lefkowitz, 1978). The application of such substances to autoradiographic or fluorescence microscopic demonstration of adrenoceptor binding sites has been limited to beta-antagonists (cf.e.g. Lane et al., 1977; Atlas et

al., 1977). We now report findings which suggest that a cellular demonstration of alpha-adrenoceptor binding sites in a tissue known to have functionally important alpha-receptors (i.e. the lower urinary tract) is possible.

MATERIALS AND METHODS

32 Female Sprague-Dawley rats, 150-180 g body weight, were injected iv with o.1 mg ^{3}H-ST-1059 (side chain 2-^{3}H; 1.6 Ci/mmol; Chemie Linz AG, Linz, Austria) with or without pretreatment of the animals with phentolamine (10mg/rat ip) given 15 min before ST-1059 and every 30 min thereafter, or propranolol (2mg/rat ip) given as a single dose 30 min before ST-1059, or both. Before iv injection of ^{3}H-ST-1059, the abdominal ureters were ligated in barbiturate anaesthesia. 30 or 60 min after ^{3}H-ST-1059, the urinary tract tissue was fixed in situ by intracardiac infusion of cold phosphate buffered glutaraldehyde (3%) following a 60 sec preperfusion of the animals with ice-cold Ringer containing 0.5% procaine. Small pieces of the detrusor, bladder neck and proximal urethra were dissected out and postfixed for 2 h in cold phosphate buffered OsO_4 (1%) containing o.2 M sucrose. The specimens were then dehydrated and embedded in Epon 812 according to Luft (1961). 1 μ sections were cut from the polymerized blocks, mounted onto glass slides and coated with Ilford L4 emulsion (dipping technique). Part of the sections were then dipped into Instafluor (Packard) for 3 min and exposed in darkness for 5 days in a CO_2 atmosphere at -80°C. The sections not treated with Instafluor were exposed at 4-8°C for 12 days in darkness. All sections were developed in Kodak b 19, fixed with sodium thiosulphate and mounted.

RESULTS

Autoradiograms of bladder neck tissue from rats injected with ^{3}H-ST-1059 exhibited silver grains superimposed to smooth muscle and connective tissue cells and relatively few grains located over striated muscle, fat cells and erythrocytes. The grains associated with smooth muscle and connective tissue cells were exclusively confined to the plasmalemmata of the cells. Propranolol had no effect on the distribution of silver grains (Fig.1) whereas phentolamine and phentolamine plus propranolol reduced the number of grains located over smooth muscle and connective tissue cells. In the phentolamine treated rats, randomly distributed grains were

found superimposed to the various tissue components (unspecific background activity).

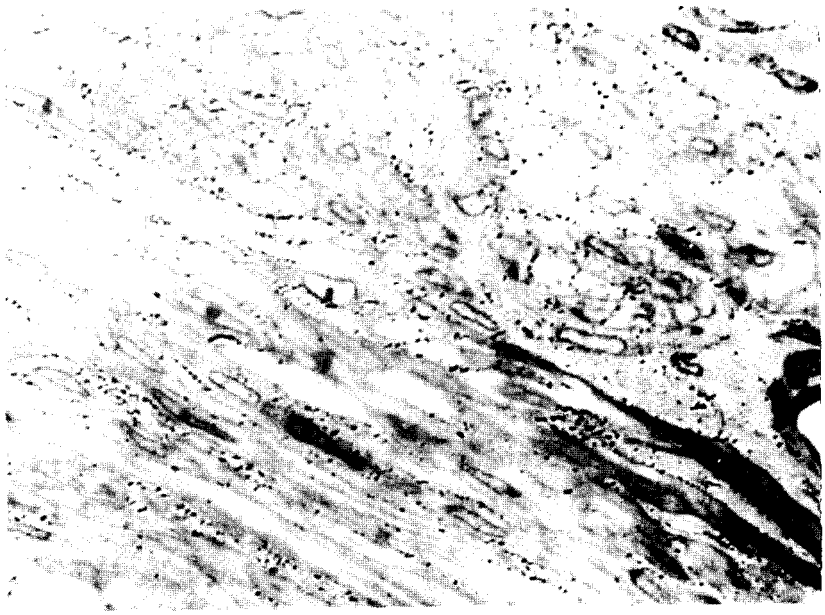

Fig. 1. Smooth musculature of the bladder neck. Note silver grains localized over the plasmalemmata of smooth muscle cells and fibroblasts.

DISCUSSION

ST-1059 has been characterized as a directly acting sympathomimetic drug with predominant affinity for alpha-adrenoceptors in the rat (Pittner et al., 1976). This drug appears to exert its major alpha-stimulatory effects in the urinary tract of man following oral intake with little or no side effects on the cardiovascular system (Jonas, 1977). The preferential action of ST-1059 on the lower urinary tract may be due to accumulation of high amounts of the metabolically rather inert drug in the subepithelial wall of the urinary bladder by transepithelial transport of ST-1059 from the bladder lumen (Jonas, Baumgarten and Jenner, unpublished findings; Lassmann and Stockinger, 1976).

The autoradiographic observations reported here may be interpreted to indicate that ST-1059 labels alpha-adrenoceptor binding sites

in the urinary tract tissue, since the accumulation of grains at the cell membranes of smooth muscle cells and fibroblasts was partially antagonized by phentolamine but not by propranolol. It is as yet unknown whether part of the grains localized over the membranes of smooth muscle cells and fibroblasts reflect the potential affinity of ST-1059 for membrane-bound carriers, such as uptake II according to Iversen (1975). To prove or disprove this possibility, studies using selective inhibitors of this transport system would have to be performed.

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Phentolamine
& Blocker

EFFECT OF THE α-ADRENERGIC BLOCKING AGENT THYMOXAMINE ON THE URETHRA AND BLADDER STUDIED BY URETHRAL PRESSURE PROFILE AND CYSTOMETRY

Ejner Pedersen, Jesper Tørring and Benny Klemar

Neurological Laboratory, Department of Neurology, Aarhus Kommunehospital, 8000 Aarhus C, Denmark

ABSTRACT

The α-adrenergic blocking agent thymoxamine has by intravenous administration demonstrated an effect on human spastic striated skeletal muscle. The effect on the urethra and urinary bladder of thymoxamine was studied in neurological patients with an uninhibited neurogenic bladder by means of urethral pressure profile and cystometry. The urethral closure pressure was reduced in all patients studied, in average 4o%, and in the cystometrograms a shift to the right was observed. The effect is discussed in relation to α-adrenergic receptors of the urethra and bladder and to feed-back mechanisms from bladder neck and/or external sphincter to the detrusor.

INTRODUCTION

The existence of α-adrenergic receptors in the proximal urethra is now generally accepted. This can be demonstrated by the relaxation caused by α-adrenergic blocking agents, for example shown by reduction of the urethral pressure profile. The existence of α-adrenergic receptors in the normal and uninhibited neurogenic bladder is on the other hand still open to discussion.

The effect of the α-adrenergic blocking agents so far used, namely phentolamine and phenoxybenzamine for intravenous and peroral administration, respectively, is generally ascribed to a peripheral effect on smooth muscle. Such relaxation of the smooth muscle may improve some voiding disorders, but the striated external urethral sphincter also contributes to the urethral resistance and may compromise the voiding in neurogenic bladder dysfunction. A spastic external sphincter may not only obstruct the outflow of urine, but possibly also influence the detrusor by feed-back mechanisms.

Thymoxamine is an α-adrenergic blocking agent, which by intravenous administration has demonstrated an interesting effect on the spastic striated muscle. It is able to depress most proprioceptive reflex parameters, for example, dramatic reductions in tendon jerks and clo-

nus, probably caused by an action in the central nervous system. Many of these studies have been performed in our laboratory (Ref. 1).

Our most recent studies with thymoxamine were undertaken to investigate the effect, if any, on the human urethra and bladder in patients with an upper motor neurone lesion. It was thought its effect like other α-adrenergic blocking agents may be peripheral, however, according to thymoxamines demonstrated effect on spastic striated muscle an effect on the external urethral sphincter may also be possible.

MATERIAL AND METHODS

11 patients were included, all had an uninhibited neurogenic bladder as demonstrated by cystometry. 7 patients had multiple sclerosis, the remaining 4 had other neurological diseases, but traumatic paraplegics were not included. 7 were females and 4 males, ranging from 26 to 57 years, with an average of 39. Patients with significant bacteriuria were excluded.

The urethral pressure profile was studied before and after intravenous injection of thymoxamine. 2 cystometries were performed - a period of a week or more generally elapsing between them. The first acted as a control for the second which was performed after injection of thymoxamine.

The urethral pressure profile was investigated with a plastic catheter (No. 8 Fr.) which was introduced via the urethra into the bladder. The catheter had two side holes placed opposite each other at a distance of 5 cm from the closed tip. The side holes were perfused with saline at a constant rate of 1.5 ml per second by means of an infusion pump and the catheter was withdrawn with a constant speed of 5 mm per second by a motor-operated device. The pressure in the catheter was constantly recorded enabling measurement of the closing pressure along the length of the urethra. The method gave highly reproducible values in the individual patient and more measurements were undertaken both before and after injection of thymoxamine. We found it necessary, however, to keep the catheter outside the urethra between the investigations in order to obtain reproducible values.

Cystometry was performed by a 3-way Foley balloon catheter introduced via the urethra into the bladder. Isotonic saline was infused at a rate of approximately 2o ml per minute and the intravesical pressure was continuously recorded. The infusion was, with some limitations, stopped during 'spasms' to allow isometric conditions. The intrarectal pressure was also continuously recorded by a thin plastic catheter placed in the rectum and kept open by a very slowly perfusion of saline. A Rikadenki Multi-pen recorder was used for recording of the amount of saline infused, intravesical pressure, intrarectal pressure and the electronically calculated difference between the pressures.

Thymoxamine was given intravenously in a previously established venous drop in a dose of o.1 mg per kg body weight. From previous investigation it was known that the effect could be expected to be evident 1 minute after the injection, and continue for a duration of 3o minutes or more.

RESULTS

The urethral pressure profile before and after injection of thymoxamine was studied in 8 patients including 5 females and 3 males. The maximum urethral closure pressure was reduced in all patients, in average 4o%, namely from 63 (SD 2o.7) to 38 cm H_2O (SD 11.7), which is significant ($P < o.oo5$). The duration of the effect was studied in some of the patients by repeated investigations until the pressure reached the pre-injection value. A duration of approximately one hour was found.

All 11 patients included were studied with cystometries. The cystometrographic changes showed great variations from patient to patient. An analysis of the various cystometrographic parameters after thymoxamine injection as compared with the control cystometry gave result as follows:

The first desire to void showed a shift to the right in 8 of the 11 patients - in average from 56 to 126 ml, which is significant ($P < o.o1$). The threshold of the first uninhibited contraction was increased in 9 of the 11, in average from 72 to 128 ml, which is significant ($P < o.o25$). Maximum pressure of the uninhibited contraction was reduced in 9 of 11 - in average from 2o4 to 16o cm H_2O, insignificant. Mean pressure of first 3-4 uninhibited contractions reduced in 8 of 11 - in average from 16o to 125 cm H_2O, insignificant. Bladder capacity increased in 8 of 11, in average from 438 to 439 ml, insignificant.

The heart rate was unchanged or slightly increased and the blood pressure was unchanged or slightly reduced after the injection of thymoxamine. There were no side effects.

DISCUSSION

Intravenous administration of thymoxamine reduced the urethral closure profile in all the patients. This effect is similar to that which has been demonstrated after administration of phentolamine and phenoxybenzamine (Ref. 2, 3, 4 and others).This effect is in accordance with the generally accepted fact that α-adrenergic receptors exist in the human proximal urethra (Ref. 5) and that a pharmacological blocking results in relaxation. Our results do not require effect on other structures than smooth muscle, but do on the other hand not exclude its effect on the striated muscle.

From previous investigations and from the studies of the urethral pressure profile the effect of the injection of thymoxamine can be expected to continue for a period of 3o to 6o minutes. This may be too short to cover a cystometry and in the continuation of our studies a higher dose will be considered.

By double cystometry great 'spontaneous' variations may be expected (Ref. 6). We found such variations but cystometrograms after thymoxamine compared with control cystometrograms showed a marked tendency of shift to the right. This was significant for some parameters, insignificant for others, but with a uniform tendency. Such effect by α-blocking agents on cystometry was not found in normal

subjects (Ref. 7) but in patients with lower motor neurone lesion (Ref. 4, 8).

The effect demonstrated in our study may be caused by influence on bladder α-receptors, which have been demonstrated by pharmacological in-vitro studies of detrusor muscle strips (Ref. 9, 1o). In contrast, others (Ref. 4, 5) were not able to demonstrate the existence of α-receptors except in patients with lower motor neurone lesions in histochemical and in-vitro studies of bladder strips.

The changes in the cystometrograms after α-blockade might also be explained as secondary to the relaxing effect on the bladder neck and/or an effect on the spastic external urethral sphincter. Such an effect on the hyperactive bladder is known after surgical intervention on the prostatic gland and a shift in the cystometrograms to the right has been demonstrated in the uninhibited neurogenic bladder after resection of the bladder neck (Ref. 11).

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EFFECT OF CLONIDINE ON URETHRAL PRESSURE

J. Nordling*, H. H. Meyhoff* and N. J. Christensen**

**Urological Laboratory, Urological Department H and*
***Department of Medicine F, Herlev Hospital, University of Copenhagen, Denmark*

ABSTRACT

The effect of clonidine (Catapresan^{R}) on the urethral closure pressure profile were investigated and correlated to effect on plasma noradrenaline. A pronounced fall in maximum urethral pressure were significantly correlated to fall in plasma noradrenaline. This finding is discussed in relation to known effects of the drug on peripheral alpha-adrenoceptors of the sympathetic system as well as spinal alpha-adrenoceptors involved in somatic reflexes. Some possible clinical implications of the relaxing effect on urethra are discussed.

INTRODUCTION

Clonidine (Catapresan^{R}) is an alpha adrenoceptor stimulating agent, mainly acting on presynaptic and prejunctional alpha receptors, thereby inhibiting noradrenaline release. The effect on the sympathetic system is therefore inhibitory (1). Furthermore, the decrease in plasma noradrenaline concentration will directly reflect the depression in sympathetic activity. Treatment of acutely spinalized rats with clonidine induces a marked increase in flexor reflex activity (2). These reflex changes are inhibited by the alpha adrenoceptor blocking agent phenoxybenzamine. That somatic spinal reflexes are influenced by drugs with specific alpha adrenoceptor effect, rises the question if the drop in urethral pressure after alpha adrenoceptor blocking agents (3,4) is due to blockade of sympathetic tonus of smooth muscle in urethra or blockade of spinal alpha adrenoceptors influencing tonus of the striated urethral muscle. The present study was therefore undertaken to evaluate the effect of clonidine on the urethral closure pressure profile. If spinal alpha adrenoceptors were involved in the tonus of the striated urethral sphincter an increase in urethral pressure might be expected according to the increase in flexor reflex activity in acutely spinalized rats. If sympathetic tonus on urethral smooth muscle was upholding urethral pressure a fall should be found and furthermore this fall should be correlated to fall in plasma noradrenaline.

MATERIAL AND METHODS

5 female patients with minor urological complaints (2 light stress-in-

continence, 2 frequency without incontinence and 1 frequency with urge incontinence) entered the study. None of the patients had any history of neurological or systemic disease. They had never had any operation and they received no medication. They all gave their informed concent to the study. The median age was 38 years (range 33-64). Urethral closure pressure profile (UCPP) was registered with the method of Brown and Wickham using a 8 F catheter with 2 small side holes 6 cm from the closed tip. The catheter was perfused with a constant flow of 2 ml/min and redrawn automatically with a constant speed of 0.33 cm/sec. Bladder volume was 100 ml. The patient was placed in the supine position, an indwelling catheter placed in a cubital vein and constantly perfused with saline. 20 ml blood samples for the measurement of plasma noradrenaline (NA) and adrenaline (A) were withdrawn via a three-way connector, care being taken that the blood sample did not contain perfusate. Plasma NA and A were determined using a double-isotope derivative technique, which is highly specific and sensitive (5). Blood pressure was measured by Sphygmomanometer, heart rate manually from the radial pulse. After a 30 minutes rest the empty bladder was filled with 100 ml saline, 3 UCPPs were registered and a blood sample obtained for NA and A determination, 300 µg clonidine was injected intravenously over 10 min. 15, 30, 45 and 60 minutes after starting the infusion of clonidine a blood sample was obtained for NA and A determination. At the same time 3 UCPPs were registered and the maximum urethral pressure (MUP) calculated as the mean value from these 3 events. The bladder was emptied in each 15 minutes interval and refilled with 100 ml saline immidiately before a new series of UCPPs to avoid a changing bladder volume due to diuresis. Blood pressure and pulse rate were measured every five minutes.

RESULTS

A significant decrease in MUP was registered in all patients (fig. 1) after clonidine 300 µg i.v. The MUP had a mean value at rest of 75 cm H_2O (table I) with a range from 64-94 cm H_2O. 30 minutes after clonidine MUP was on the average 40 cm H_2O with a range from 21-46 cm H_2O, which indicates a decrease to 54% of the resting MUP with a range from 27-68%. The MUP was rather constant 15, 30 and 45 minutes after clonidine. After 60 minutes it began to rise although the initial level was not reached at this time.

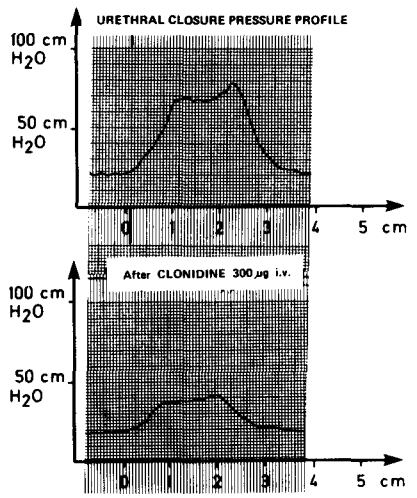

Fig. 1
Effect of clonidine 300 ug i.v. on urethral closure pressure profile. The upper tracing shows the profile at rest and the lower tracing 30 minutes after 300 ug clonidine i.v.
Bladder is to the left with 0 at the level of the bladder neck.

Table I. Effects in five patients of clonidine 300 µg i.v.

		MAXIMUM URETHRAL PRESSURE mean ± SD (cm H_2O)	PLASMA NORAD-RENALINE mean ± SD (ng/ml)	PLASMA AD-RENALINE mean ± SD (ng/ml)	BLOOD PRES-SURE mmHg	HEART RATE
RESTING VALUE		75±12	43±11	3±2	124/75	74
AFTER CLONIDINE 300 µg i.v.	15 min.	43±9	14±9	3±3	103/68	70
	30 min.	40±16	15±9	3±2	97/64	64
	45 min.	42±14	15±9	1±2	100/66	64
	60 min.	52±20	21±13	1±2	101/70	64

A consistent decrease in plasma NA was seen with exactly the same pattern as for the MUP, low and almost constant values 15, 30 and 45 minutes after clonidine and rising values in some patients after 60 minutes (Table I). The values found in the single patients show a strong correlation between the relative fall in MUP and plasma NA (fig. 2).

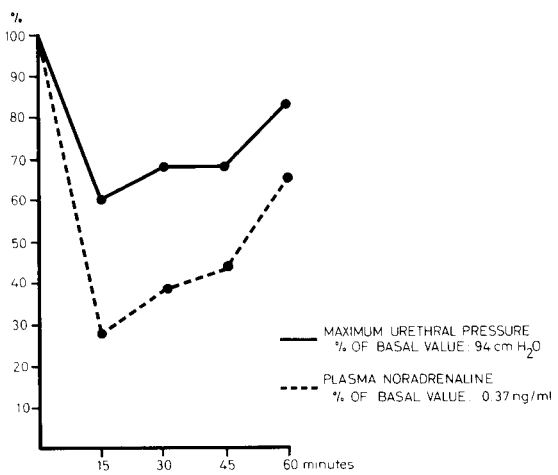

Fig. 2
Changes in one patient of maximum urethral pressure and plasma noradrenaline after clonidine 300 µg i.v. The variation is statistically significantly correlated ($r=0.9958$, $p<0.001$)

A significant fall in blood pressure and a smaller fall in heart rate were found in all patients (table I).

DISCUSSION

In healthy subjects the effect of clonidine on urethral pressure parallels the level of plasma NA closely. This might be due to a direct effect of plasma NA on urethral pressure. This seems unlikely since plasma NA reflects only overall sympathetic activity-mainly in the vessels- and plasma NA concentrations necessary to cause physiological effects must be much higher (8). It seems more likely that the intimate correlation is due to a direct sympatholytic effect on urethral pressure, and that the changes simply reflects a decrease in sympathetic tonus.

A possible action on alpha receptors involved in striated urethral sphincter tonus is not likely from this study, although such a theory can not be completely excluded. The threshold dose for increasing

flexor reflex activity of the hindlimb of spinal rats was 0.1 mg/kg i.p. with a maximal effect at a dose of 0.4 mg/kg i.p. (2) which is much higher doses than used in this study.

Clonidine is used in the clinic in the treatment of hypertension. Urinary incontinence as a complication of this treatment has never been reported despite the fact that the drug, as shown in this study, lowers urethral pressure. Other drugs with this effect has been reported to cause incontinence i.e. phenothiazine. The drug might on the other hand be clinically useful in the treatment of functional infravesical obstruction, especially since postural hypertension is less frequently seen than with adrenergic alpha blocking agents, which have already a place in the treatment of functional infravesical obstruction (8).

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THE EFFECTS OF EPIDURAL ANESTHESIA ON THE URETHRAL CLOSURE PRESSURE PROFILE IN PATIENTS WITH PROSTATIC ENLARGEMENT

R.A. Appell, H. R. England, A. R. Hussel and E. J. McGuire

From the Departments of Urology and Anaesthesia, the London Hospital, London, England and the Section of Urology, Department of Surgery, Yale University School of Medicine, New Haven, Connecticut

ABSTRACT

In ten patients with urinary obstruction due to prostatic enlargement, the urethral closure pressure profile was observed before and after epidural anesthesia. While epidural anesthesia significantly decreased urethral closure pressure, considerable profile responses still remained in these patients. This finding suggests that prostatic tissue bulk is responsible for bladder outlet obstruction since urethral closing pressure persists despite urethral smooth and skeletal muscular relaxation as a result of epidural anesthesia. Following transurethral resection of the prostatic tissues, the urethral closure pressure did fall to zero.

BACKGROUND

The precise cause of urinary retention associated with prostatism is not clear (1). Some workers have suggested that the sympathetic nervous system has a significant role in the determination of urethral wall tension (2-3). Treatment of patients with prostatic obstruction with alpha-adrenolytic agents has been of clinical benefit (4-5). Although obstructive urinary symptoms can be modified by drug therapy that does not alter prostatic size, the question remains as to how prostatic tissue bulk and sympathetic tonus interrelate. To study this, urethral closing pressure profiles, (UPP), were performed in patients scheduled for prostatectomy before and after epidural anesthesia, and immediately following transurethral resection of the prostate.

PATIENTS AND METHODS

Ten patients with prostatic enlargement were studied at the time of transurethral prostatic resection. Six of these had been admitted in urinary retention, while the remaining four patients had clinically overt prostatic symptoms. None of the patients were taking any medication and none received pre-operative medication. None of the patients demonstrated any neurologic deficit.

Cystometry and UPP were performed in the supine position prior to the induction of epidural anesthesia. A constant 2 ml/min flow was induced in a 12F catheter, with a syringe pump with 2-1 mm lateral perfusion apertures. The catheter was manually withdrawn so that the perfusion apertures traversed the entire functional profile length. All profiles were performed with the bladder empty. Manual withdrawal was performed in centimeter steps, with ten seconds allowed at each step for pressure equilibration. The method is identical to that of Brown and Wickham (6). For purposes of comparison, urethral pressures measured at 1 to 2 cm distal to the onset of the profile response, or the anatomical bladder neck, were used in an effort to obtain a pressure principally resultant from smooth muscular urethral activity exerted in the mid-prostatic urethra. The major pressure effect of the skeletal muscular component of urethral resistance is exerted distal to this point (7). Perfusion pressures were monitored by a standard side-arm transducer and displayed on an X-Y recorder. Medium-fill water cystometry was then performed using the same catheter.

Under sterile conditions, a single injection epidural anesthetic was administered via a 20-gauge spinal needle using plain 0.5% bupivacaine (Marcain) was performed. Following a confirmed T_6 level of anesthesia, a repeat UPP was performed prior to transurethral resection of the prostatic adenoma, and a third UPP was performed at the conclusion of the prostatic resection. All UPP's were performed with the bladder initially empty.

RESULTS

Histologic examination of the resected prostatic tissue revealed benign hyperplasia in all cases and all pre-operative urine cultures showed no growth of bacteria. Cystometry revealed detrussor hyper-reflexia in 4/6 patients with urinary retention and in 2/4 patients with prostatism. Detrussor hyper-reflexia was defined as a detrussor reflex evoked at low bladder volumes which could not be voluntarily suppressed.

Table I Maximum Urethral Closure Pressure and Prostatic Weight

PATIENT	STATUS	PRE-EPIDURAL Pressure (cm H_2O)	POST-EPIDURAL Pressure (cm H_2O)	PROSTATE WEIGHT (grams)
D.T.	Retention	80	40	35
H.F.	Retention	60	40	38
F.C.	Retention	70	50	19
A.S.	Retention	60	30	16
H.J.	Retention	60	40	18
P.D.	Retention	90	50	22
A.C.	Prostatism	60	20	15
R.S.	Prostatism	70	40	38
R.SY.	Prostatism	80	60	30
T.B.	Prostatism	90	30	24

The UPP results were analyzed according to the recommendations of the International Continence Society (8). The values for urethral closing pressure measured at 1.5 to 2 cm from the vesical outlet obtained before and after epidural anesthesia are tabulated in Table I and are accompanied by the wet weight of resected prostatic adenomata. Epidural anesthesia effectively reduced the maximum UCP an average of 44%. Urethral closing pressure profiles performed immediately at the conclusion of prostatic resection showed no urethral closing pressure profile responses (Fig. 1).

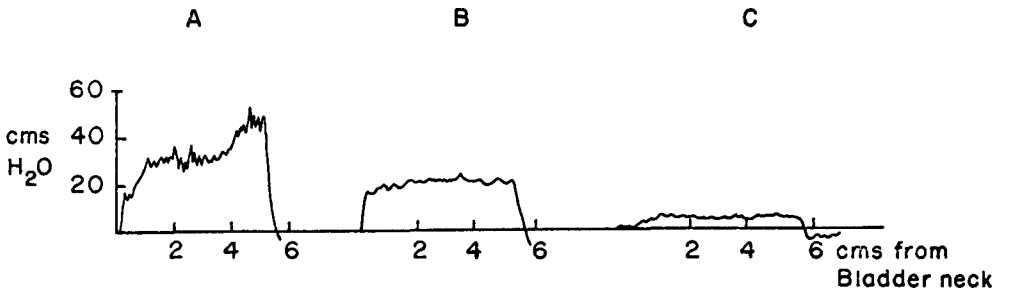

Fig. 1 Urethral closing pressure profiles before (A), after epidural anesthesia (B) and after transurethral prostatectomy (C). There is loss of peak profile pressure response after epidural anesthesia but preservation of some urethral closing pressure. Virtually total loss of urethral closing pressure immediately after prostatectomy.

DISCUSSION

Both smooth and skeletal musculature participate in urethral closure, and loss of function of either of these elements decreases functional profile length and urethral closing pressure (9). Complete sacral rhizotomy results in a loss of skeletal muscular activity and diminition of profile pressure, but it leaves intact urethral smooth muscular closing function (10). However, spinal, or epidural anesthesia virtually eliminates UPP responses if the level of the anesthetic effect includes the thoracolumbar sympathetic outflow as well as the sacral cord segments (10).

In the patients studied, epidural anesthesia sufficient to induce a T_6 sensory level did not obviate urethral pressure. It did diminish pressures measured 2 cms from the bladder outlet, on the average, by 44%. However, after transurethral prostatectomy, virtually no urethral closing pressure was measurable. These findings suggest that prostatic tissue bulk contributes to urethral resistance in patients with prostatic obstruction. Experimentally after curarization, a marked diminution in urethral pressure has been shown to precede and accompany reflex detrussor contractile activity, or bladder filling to capacity (11). These findings suggest that urethral smooth muscular relaxation, with a consequent fall in urethral resistance, occurs with voiding. Since urethral smooth and skeletal muscular relaxation result from epidural anesthesia, but total loss of urethral closing pressure profile responses in these patients did not occur, it seems reasonable to conclude that prostatic obstruction is, in part, due to prostatic tissue mass which constitutes a barrier to low-pressure urinary flow which is unaffected by maximal urethral relaxation. However, both prostatic tissue mass and sympathetic tone are involved in urethral resistance. Urinary retention in patients with occult prostatic hypertrophy treated with alpha-adrenergic agents is relatively common, and urinary retention associated with prostatic obstruction has been successfully treated by alpha-adrenolytic agents (5). Apparently, the interaction of smooth

muscular tonus of the prostatic capsule and urethra and prostatic tissue mass are involved in production of outlet obstruction in this patient group. This may explain why patients with a lesser degree of prostatic hypertrophy develop retention while others with massive hypertrophy do not. It has been previously reported that UPP's in patients with prostatic obstruction were not significantly higher than normal, but the functional profile length was increased (12). UPP measurements alone, however, do not reflect urethral activity during detrussor contraction when UCP should markedly decrease. In patients without urinary retention, there is no certain method to quantitate vesical outlet obstruction. Even in patients with retention, one cannot always be certain that obstruction due to prostatic tissue is the cause. It may be useful in a few patients in whom a certain diagnosis of prostatic obstruction cannot be made to administer an epidural anesthetic. If urethral closing pressure diminishes markedly over the entire functional profile length, bladder outlet obstruction by prostatic tissue is unlikely.

Finally, the results of cystometry in this group of patients are similar to those reported by others showing a high incidence of detrussor hyper-reflexia (12).

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TREATMENT OF DELAYED ONSET OF SPONTANEOUS VOIDING FOLLOWING INCONTINENCE SURGERY

Stuart L. Stanton and Linda D. Cardozo

Urodynamic Unit, Department of Obstetrics and Gynaecology, St. George's Hospital Medical School, London

ABSTRACT

A preliminary study on 40 female patients who had undergone colposuspension surgery, was carried out using four drugs in an attempt to reduce the time taken to void spontaneously following surgery, and to define the cause of delay. Oral diazepam given as night sedation, was found to be the most effective drug.

INTRODUCTION

Delay in resuming spontaneous voiding is a known complication following corrective surgery for urinary incontinence. This leads to recurrent catheterisation, an increase in the incidence of urinary tract infections and an extended hospital stay. After exclusion of pre-existent bladder dysfunction, three causes remain, which have been investigated in this study.

METHOD AND MATERIALS

Forty women with urinary incontinence due to urethral sphincter dysfunction underwent pre. and postoperative videocystourethrography with bladder pressure and urine peak flow measurements, and were treated by a colposuspension operation. Following surgery, the bladder was drained by a Bonanno suprapubic catheter until the sixth postoperative day, after which the catheter was clamped daily until spontaneous voiding occurred with two consecutive residual urines of less than 100 ml. The patients were allocated to the drug study according to when they entered hospital, each study being completed before the next started. Postoperative analgesia and nursing management were the same for all groups.

Group 1 Oral Diazepam

10 mg of oral diazepam was given as night sedation from the day prior to surgery, until spontaneous voiding occurred. No other day or night sedation or tranquillizers were given.

Group 2 Oral Phenoxybenzamine

Oral phenoxybenzamine was given from the second postoperative day, starting at a dose of 10 mg nocte for three nights, and then 10 mg bd for three days, and then 10 mg tds thereafter. Prior to surgery, each patient had a preoperative ECG and

lying and standing blood pressure measurements were taken. Any patient with evidence of coronary artery insufficiency, arrhythmia or postural hypotension was excluded. Twice daily blood pressure readings were taken during therapy and the dose of phenoxybenzamine was either reduced or curtailed if side-effects such as hypotension were encountered.

Group 3 Intravesical Prostaglandin E_2

After an initial test dose, intravesical PGE_2 1-5 mg bd in solvent was instilled from day five onwards, via the Bonnano suprapubic catheter, with full sterile precautions. Patients with asthma or glaucoma were excluded.

Group 4 Oral Bethanechol Chloride

Oral bethanechol chloride 25 mg tds was given from the fifth postoperative day. Patients with asthma and coronary artery insufficiency were excluded.

RESULTS

The results are shown in Table 1 and indicate that oral diazepam is the most effective of the four drugs, in promoting earlier spontaneous voiding. In an earlier study, the average time taken to void spontaneously was 14 days (Stanton et al 1976). There were only minor side-effects. One patient on diazepam had dizziness, two patients taking phenoxybenzamine had faintness and one had visual defects, two patients taken prostaglandin had abdominal pain and one patient taking bethenechol chloride had nausea: no drug required to be withdrawn.

TABLE 1 Drug Action on Spontaneous Voiding Time Following Surgery

	ORAL DIAZEPAM		PHENOXY-BENZAMINE		INTRAVESICAL PGE_2		BETHANECHOL CHLORIDE	
	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.	MEAN	S.D.
Age (years)	50.9	12.2	51.4	13.1	45.7	9.1	48.0	8.8
Peak flow rate (ml/sec.)	28.5	9.5	32.6	6.5	24.3	8.6	27.5	9.9
Spontaneous voiding (days)	10.1	2.4	12.1	5.2	12.2	6.03	12.2	5.1
Total dosage (mg)	97.0	40.0	278.0	236.7	37.2	34.3	570.0	393.0

DISCUSSION

The small numbers of patients investigated and the variation in spontaneous voiding times and total dosage of drugs given, emphasizes that this is a preliminary study.

Before entering the study, all patients were screened using clinical and urodynamic methods, to exclude pre-existent bladder dysfunction, which is a potent cause of postoperative retention (Stanton et al 1978). This may be diagnosed by the complaint of a slow urinary stream, straining to void, incomplete bladder emptying, finding of a residual urine after voiding and a peak flow rate of less than 15 ml per second.

Four different drugs were chosen in an attempt to see which factors were operative in the production of delay. Because of the difficulty of performing invasive investigations in the immediate postoperative period, direct urethral pressure measurements and cystometry, which would have been helpful, were not made.

Oral diazepam reduces anxiety through its central depressant action on the brain stem reticular system. It is also believed to have a relaxant action on the striated muscle, although little objective evidence exists for this.

The bladder neck and urethra are rich adrenoreceptors and their blockage by an blocking agent, such as phenoxybenzamine is likely to decrease outlet resistance. However, Gosling et al (1977) have demonstrated sparse distribution of these receptors in the female and this would seem to be confirmed by the effects of phenoxybenzamine on this study. Phenoxybenzamine has a slow onset of action and therefore requires to be given soon after surgery. As postural hypotension is a serious side-effect, lying and standing blood pressures were taken before administration, to exclude susceptible patients.

Stimulation of detrusor muscle may be achieved by various drugs, including prostaglandins and choline esters. Abrams and Feneley (1976) were the first to describe the stimulant effects of PGE_2 and F_2 series on detrusor muscle, using human strips in organ bath preparations. They found that both PGE_2 and F_2 were effective in producing contractions of the detrusor. We found PGE_2 to be of little benefit because the large size of the PGE_2 molecule may prevent it penetrating the transitional epithelium which lines the detrusor.

Oral bethanechol chloride is known to stimulate bowel and bladder and is often given to overcome urinary retention. Its action is muscarinic-like in contrast to carbachol, which has in addition a nicotinic effect. Bethanechol was the second most effective drug tried here and had minimal side-effects.

CONCLUSION

We believe that anxiety is a potent cause of delay in resumption of spontaneous voiding and that diazepam can be effective in reducing this. Its main action is likely to be on the brain stem reticular formation with additional relaxant action on the striated muscle of the urethral sphincter mechanism.

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URETHRAL PRESSURE DISTRIBUTION

Christos E. Constantinou and Duncan E. Govan

Stanford University Medical Center, Division of Urology, Stanford, California 94305

ABSTRACT

The intraluminal urethral pressure was simultaneously recorded at four points in the urethra of healthy female volunteers. Using a specially designed perfusion catheter, the distributive properties of urethral pressure were evaluated in the supine and upright positions. The dynamic alterations of intraluminal urethral pressure distribution due to coughing and pelvic floor contraction were also recorded and related to the EMG of the rectal sphincter. Preliminary results are presented indicating that the reflection of pelvic floor pressures is differentially distributed along the urethral lumen.

INTRODUCTION

Early attempts to assign reliable diagnostic significance to the numerical values obtained in a urethral pressure profile (UPP) proved to be of limited clinical significance as an index of continence. Correction factors such as the shape of the profile curve and age of the patient were not sufficient in deriving a practical formula. A well-accepted limitation of the current practice of the UPP is the fact that the dynamic events of incontinence are related to the static pressures obtained with a single sensing device. The present study is designed to produce dynamic information of the pressure distribution within the urethra by relating urethral pressure at one point to those simultaneously occurring in adjacent and more distant points.

METHODS

Clinical Material

Studies were undertaken on healthy female volunteers, nulliparous, free of urinary tract infection and in the age group of 18 to 21.

Pressure Detection System

For the measurement of urethral pressures, a 4-component catheter was used. Figure 1 shows the principal characteristics of the catheter. Fluid is pumped through four internal teflon tubes, P1-P4. These are encased in silicone sleeves with four lumens. Each tube is successively longer from the preceeding, terminating at distances D1, D2, D3. A cross-section at each point is also shown in the upper

segment of Fig. 1. Thus, fluid entering P1 exits at the first junction and can flow circumferentially in the form of a ring at that point. The spacing between each segment is approximately 1 mm. The distances between recording areas are variable from a minimum of 4 mm to a maximum of 30 mm, depending upon experimental conditions.

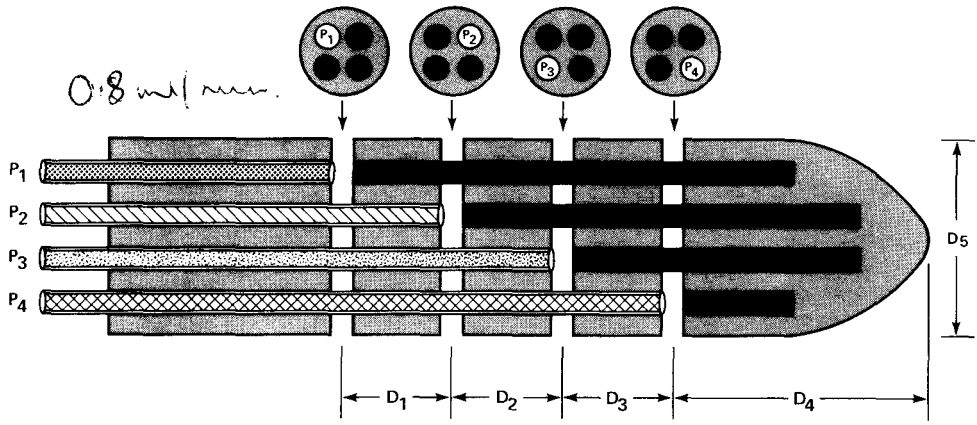

Fig. 1.

The remainder of the recording system consists of a peristaltic pump with four independent channels and four balanced pressure transducers. Figure 2 shows the configuration of the measuring apparatus with a multichannel recorder.

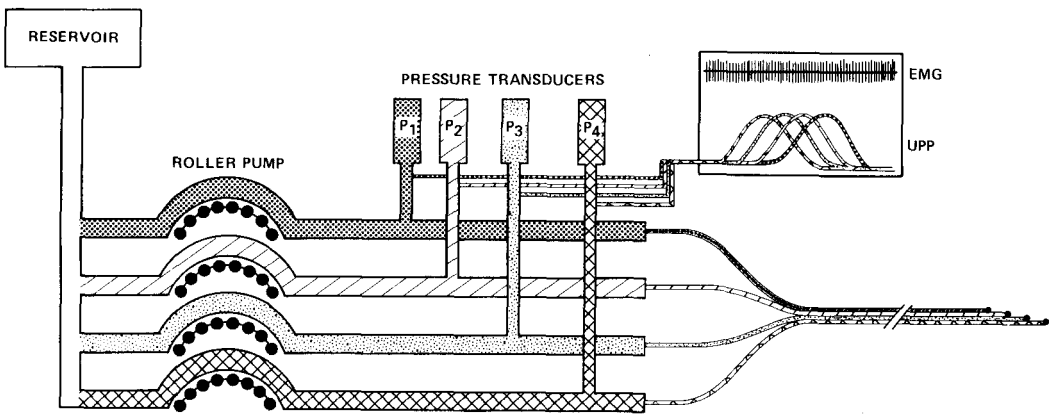

Fig. 2.

Procedure

Voiding flow rates were obtained from all subjects prior to any instrumentation. Subsequently, the subject was placed in the lithotomy position and catheterized with the 4-lumen catheter and residual urine noted. Electrodes were inserted in the anal sphincter for the measurement of pelvic floor EMG activity. Profile system was filled with warm saline and corrected for baseline pressure. With the four pressure sensors in the bladder and a flow rate of approximately 0.5 mL/min per lumen in the profile catheter, the subject was asked to cough and contract

perineal muscles. The catheter was subsequently moved at a velocity of approximately 1 cm/min to provide urethral pressure distribution along the entire length of the urethra. When all four pressure sensors have scanned the entire urethral length, the catheter was reinserted into the bladder. This procedure was again repeated by moving the catheter stepwise, stopping at 5 mm intervals. The subject was asked on each occasion to cough and contract perineal muscles, thus obtaining a record of these dynamic events for the entire urethra. The entire procedure was subsequently repeated standing and sitting.

RESULTS

A typical recording of urethral pressure distribution obtained using this method is shown in Fig. 3. As shown in the left hand side of this illustration, all lumens are in the bladder and are recording bladder pressure. The low amplitude oscillations produced by the pump can be readily identified. Bladder pressure is indicated as 14 cmH_2O. At the top of this tracing the EMG is shown.

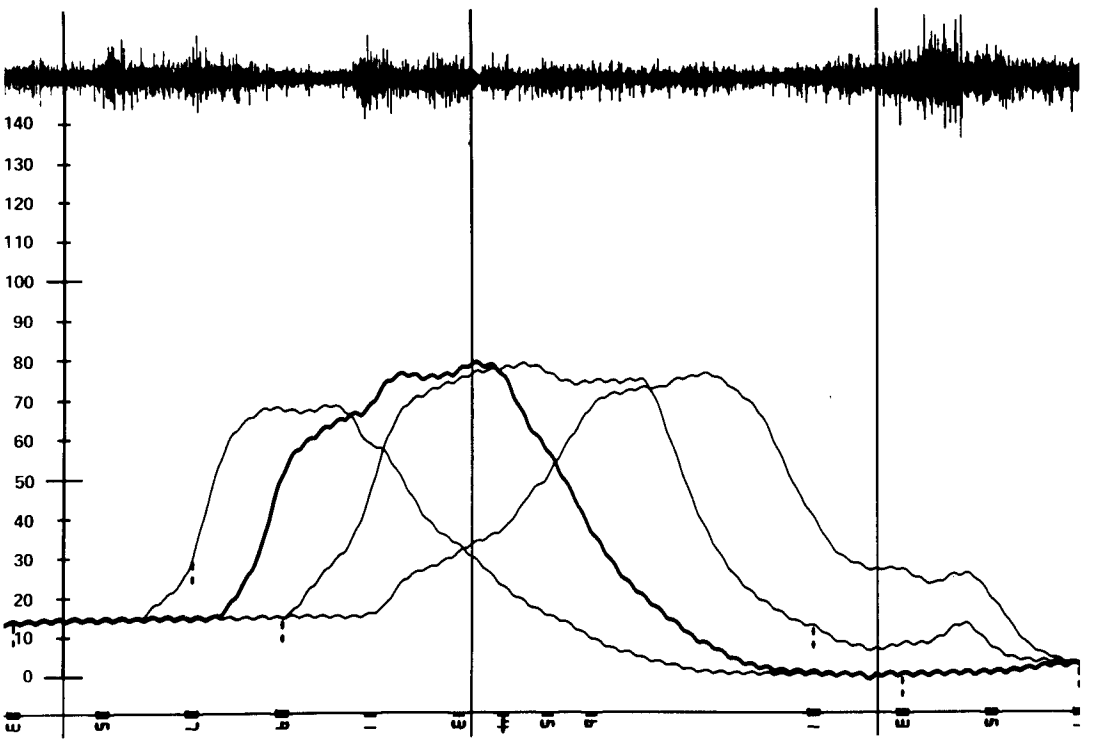

Fig. 3.

As the catheter is moved, lumen P1 starts entering the urethra while the other three are in the bladder. Subsequently, lumen P2 enters the bladder while P1 is in the proximal urethra. As lumen P3 enters the bladder, P1 is at the external sphincter 1.8 cm from the bladder while P1 starts to decrease in pressure as it exits towards the external meatus. These four profiles can be obtained with the one withdrawal of the catheter. Close examination of the relative amplitude of the four profiles indicates that these are not identical. This may be explained by careful examination of the EMG which shows that as the P2 approaches the area of peak urethral pressure the pelvic floor contraction increases. Similarly, pelvic floor contraction towards the extreme right hand side of this illustration

is indicated by an elevation in the EMG and trace P3 and P4. Finally, its noted that as the catheter exits the urethra and thus P1-P4 are out the recorded pressures are all zero.

The distributive properties of urethral pressure distribution due to elicited coughing of subject are shown in Fig. 4.

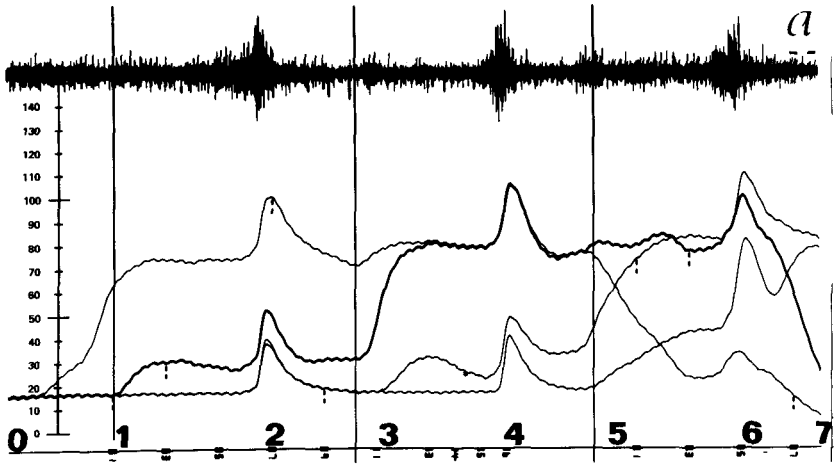

Fig. 4a

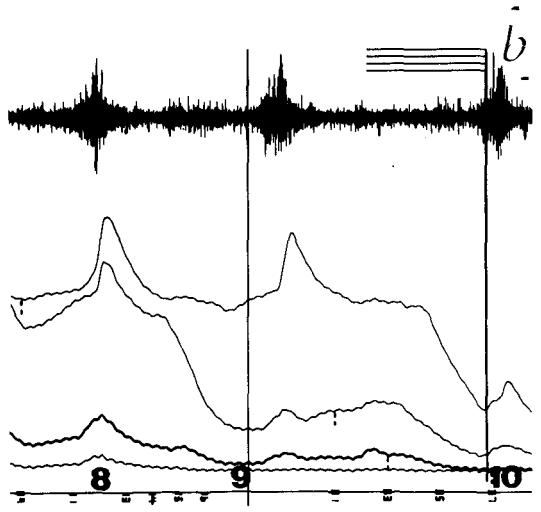

Fig. 4b

In position 0 all recording lumens are in the bladder with a pressure of 16 cmH_2O. Between positions 1 and 2, recordings of peak urethral, bladder neck and bladder pressure can be recorded as shown. A cough is indicated with the corresponding rise in pressure in all recordings. Similarly, cough pressures can be seen in position 4 to 6 of Fig. 4a. In Fig. 4b, the remainder of the recording is shown with cough in position 8, 9, and 10.

SHORT AND LONG TERM REPRODUCIBILITY OF URETHRAL CLOSURE PRESSURE PROFILE PARAMETERS

H. H. Meyhoff, J. Nordling and S. Walter

Urological Laboratory, Urological Department H, Herlev Hospital, University of Copenhagen, Denmark

ABSTRACT

In ten incontinent female patients the reproducibility of urethral closure pressure profile parameters obtained with the Brown and Wickham technique in two consecutive measurements and in measurements with one month interval was assessed. Variances within parameters obtained with one month interval were statistically significant larger than variances within consecutive measurements. For each parameter mean values obtained with one month interval did not differ statistically significant.

INTRODUCTION

Pressure measurements within the resting urethra with a fluid perfused catheter was introduced by Brown and Wickham in 1969 (1). Other techniques for urethral closure pressure profile (UCPP) measurements are available (2,3), but most widely used today is the Brown and Wickham method.

Several reports concerning the interpretation of parameters and sources of error in this measurement have been published (3,4,5,6), but little attention has been paid to the reproducibility of the results (4,5). The aim of the present study was to evaluate the reproducibility of the UCPP in consecutive and repeated measurements within one month using the Brown and Wickham technique.

MATERIAL AND METHOD

A total of ten female patients suffering from urinary incontinence entered the study.

In all patients UCPP-measurement was undertaken as the first investigation in a urodynamic evaluation. Patients were examinated in the supine position. 100 ml 38°C saline was instilled into the empty bladder through a single lumen polyethylene profile catheter, Charriere 8, closed in the end and with two opposite sideholes 5 cm from the tip. The catheter was constantly perfused from a mechanical pump with saline 2 ml per minute. The UCPP catheter was firmly fixed to a

mechanical retractor allowing no axial rotation and pulled with a speed of 0.33 cm/sec. Manometerlines were 1.5 m with an inner diameter of 1.2 mm.

Patients were instructed to avoid abdominal straining and squeezing of the external urethral sphincter during the examination.

In all patients two consecutive UCPP measurements without obvious artefacts were secured, and the investigation was repeated exactly the same way after one month to exclude as far as possible changes due to different serum oestrogen levels (7).

No medication was started or altered during this month, and no operations were undertaken in any patient.

All pressures (intravesical pressure (Pves), maximum urethral closure pressure (MUCP) and maximum urethral pressure (MUP)) were measured to the nearest cm H_2O, and functional profile length and the distance from bladderneck to MUCP was recorded to the nearest mm.

RESULTS

In order to establish the reproducibility in consecutive measurements we calculated the differences between the first and the second measurement of the different parameters in each patient. Mean, standard deviation, range and variance of the differences are given in table I: DIFFERENCES IN TWO CONSECUTIVE UCPP MEASUREMENTS.

N = 20	Pves cm H_2O	MUCP cm H_2O	MUP cm H_2O	Functional profile length, mm	Distance from bladder neck to MUCP, mm
Mean	+ 0.3	- 0.1	- 0.9	- 0.9	- 0.4
SD	1.0	5.0	4.6	1.7	2.0
Variance	1.0	25.2	21.4	3.0	4.0
Range	-1/+3	-9/+10	-9/+7	-3/+2	-6/+3

The reproducibility within one month was evaluated from differences between mean values of consecutive measurements obtained with one month interval - table II: DIFFERENCES IN UCPP MEASUREMENTS REPEATED WITHIN ONE MONTH.

N = 10	Pves cm H_2O	MUCP cm H_2O	MUP cm H_2O	Functional profile length, mm	Distance from bladder neck to MUCP, mm
Mean	- 0.5	+ 1.4	+ 0.8	- 0.9	+ 0.1
SD	3.8	8.1	9.2	2.7	3.1
Variance	14.1	65.9	85.2	7.5	9.6
Range	-6.5/+5.5	-10.0/+19.5	-14.5/+17.5	-4.5/+6.0	-5.0/+5.0
F test, p	<0.01	<0.05	<0.01	<0.05	>0.05

An F-test for the proportion of variances within consecutive and repeated measurements was performed. A statistically significant larger variance was found within measurements with one month interval compared to consecutive measurements, except for distance from bladderneck till MUCP - table II.

For each UCPP parameter, mean values obtained with one month interval did not differ statistically significant - Wilcoxon Matched - Pairs Signed Rank test, $p > 0.05$.

DISCUSSION

Variation in results from UCPP measurements may be due to physiological and instrumental factors.

The latter has been discussed by Harrison (6), Asmussen (3) and recently Abrams et al. (4). Important factors among others seem to be delay in response time, damping due to airbubbles and leak of fluid in connections, variation in flow rate and catheter withdrawal rate, variation in bladder volume and of course inaccurracy in transducer position and calibration. Axial rotation of catheter during withdrawal seems unimportant (4).

Physiological factors might be involuntary and voluntary activity of smooths and striated urethral muscles and transmitted abdominal pressure alterations, influences from respiration, hormones e.g. oestrogen, drugs and pulsation.

The pure instrumental contribution to the total variability was estimated for consecutive measurements by Abrams et al. (4) to be $\pm$ 4 cm H_2O for MUP, and they calculated a standard deviation of 7 cm H_2O - slightly above the standard deviation for that value in this series.

In a previous study in this laboratory nine postmenopausal women in a controlled clinical trial had UCPP measurement with four months interval before and after placebo-treatment. UCPP was measured with a method similar to the present one, except a manual catheter extraction, guided by metronome was undertaken (8). Standard deviations of differences in consecutive measurements were in the same order as in this paper, and the variations were statistically significant larger in measurements with four months interval compared to consecutive measurements except for MUP and functional profile length.

Ghoneim (5) mentions a reproducibility in anaesthetised dogs within four hours in the range of $\pm$ 5%.

CONCLUSION

It is important to know the reproducibility of results from a method of investigation in order to assess if changes in results are due to treatment or as well may be due to the unavoidable experimentel variation.

If control MUCP measurements obtained with the described method after one month of treatment in a single patient e.g. show an alteration less than $\pm$ 2 x SD ($\pm$ 16 cm H_2O), the alteration is not for certain to be regarded due to treatment. And for consecutive measure-

ments of MUCP - e.g. before and after injection of Regitin^{R} - a decrease less than 10 cm H_2O might as well be due to the experimental variation.

Otherwise for a group of patients a significant change of mean MUCP after one month treatment is most likely due to treatment, since mean values did not change statistically significant in this study.

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VOIDING REFLEXES AND THEIR RELATIONSHIP TO VESICAL AND URETHRAL PRESSURE DISTRIBUTION THRAL

Duncan E. Govan and Christos E. Constantinou

Stanford University Medical Center, Division of Urology, Stanford, California 94305

ABSTRACT

Simultaneous recordings of vesical and urethral pressures obtained from healthy female volunteers are presented. The dynamic re-distribution of urethral pressures upon the onset of detrusor contraction and voiding are analyzed with respect to continuous and interrupted flow.

INTRODUCTION

In the assessment of the mechanism of urine containment and evacuation by the female urethra, it may be useful to consider the contribution of the proximal, mid, and distal areas of this structure. As bladder contraction and urethral relaxation are synergistic, it would be beneficial to simultaneously record the dynamic detrusor and urethral pressure distribution and associate urine flow simultaneously. In addition, as the voiding reflex is affected by the contribution of pelvic floor activity the EMG of the anal sphincter is incorporated in the measurements presented. This paper presents an exploratory effort to characterize the voiding reflexes in the normal female with no apparent pathology.

METHODS

Investigations were performed on healthy volunteers using a 4-lumen catheter as described in (1). Subject's bladder was filled at a rate of 10 mL/min in the sitting position. Prior to voiding, catheter was held so that bladder and urethral pressures could be recorded. In addition, the flow rate could be measured using a mictiograph. The four pressures, EMG of anal sphincter and flow rate could be recorded simultaneously using a polygraph. An initial continuous flow rate recording was obtained. The bladder was subsequently filled and subject was asked to initiate and stop voiding stream.

RESULTS

The illustration of Fig. 1 shows a typical continuous flow curve obtained using the aforementioned methodology. The flow rate curve is shown as the bottom line and is marked with an arrow. The four urethral pressures are also indicated with P4 slightly displaced from the remainder. Upon the onset of flow the closing urethral pressure is shown to decrease but is maintained at a level higher than that of the bladder in the proximal urethra and lower than the bladder in the distal urethra.

As shown by the EMG, pelvic floor activity is minimal during voiding.

At the termination of voiding, the onset of pelvic floor contraction is readily demonstrated by an increase in the EMG activity. Similarly, the proximal urethral pressures increase differentially to the distal pressures.

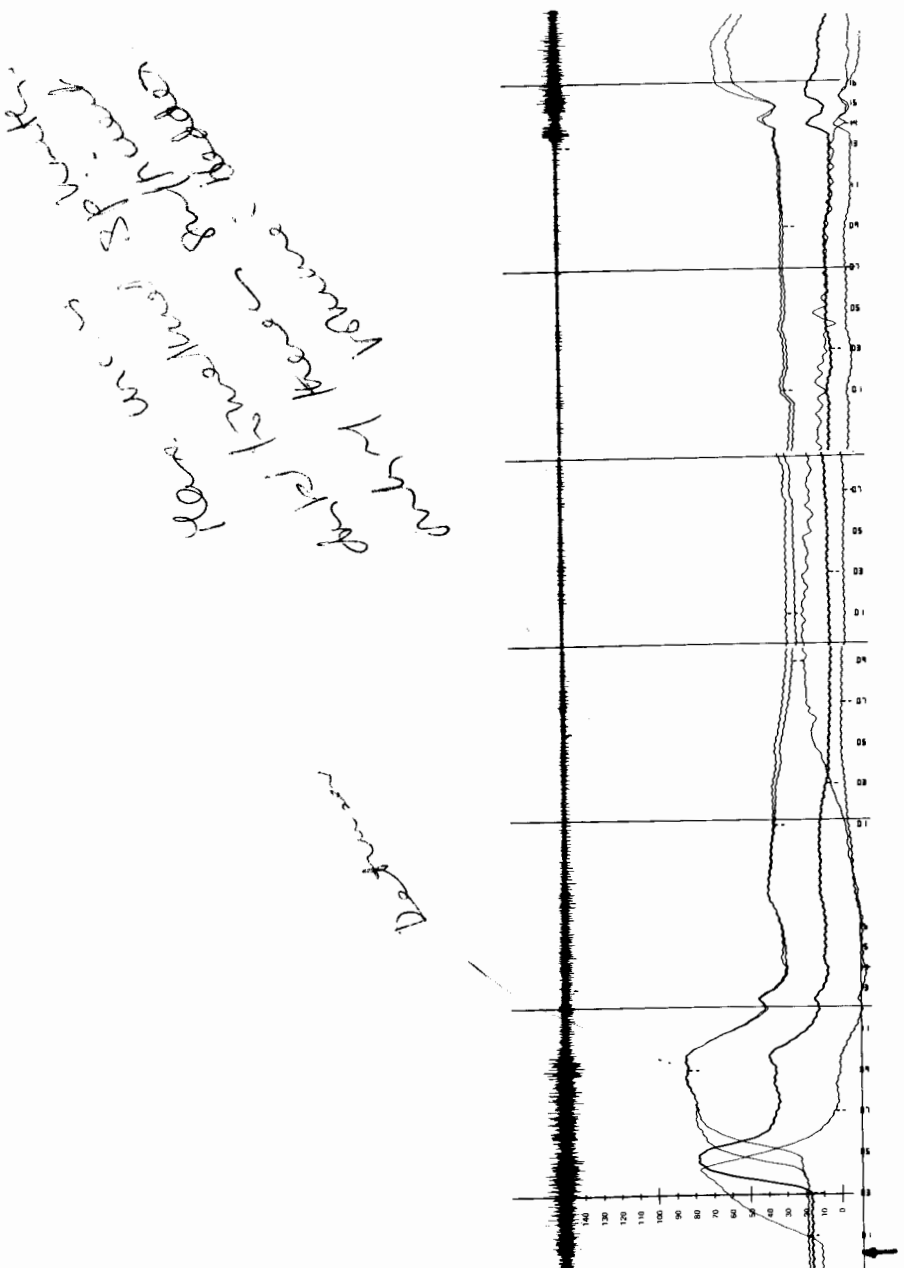

Fig 1.

(1) Christos E. Constantinou and Duncan E.Govan: Urethral Pressure Distribution (In these proceedings)

THE IMPORTANCE OF POSTURAL INFLUENCES ON URETHRAL MUSCULATURE

N. J. R. George and R. C. L. Feneley

Clinical Investigation Unit, Ham Green Hospital, Bristol, England

INTRODUCTION

The correlation between urethral pressure recordings and clinical dysfunction of the lower urinary tract is not consistent.

Sphincterometry, performed in the supine position, may not reflect the changes which occur when the patient assumes an upright posture.

METHODS

Sphincterometry has been performed on 84 patients in both lying (0°) and sitting (70 - 85°) positions. An 8 FG porges profile catheter is mechanically withdrawn through the urethra at 4 mm per second, the catheter being perfused at 2 ml per minute by a Braun Perfusor pump. Elema Schnander EMT 34 transducers and Mingograph M 81 ink jet polygraph are used for recordings. Sensitivity is such that 100 cm H20 urethral pressure corresponds to 240 mm chart displacement.

A sphincteric response to change in posture has been demonstrated. Figure 1 demonstrates that the change in response from lying (Fig. 1a) to sitting (Fig. 1b) is not due to raised intra-abdominal pressure present in the upright posture, since the response is not seen when the patient remains supine but intra-abdominal pressure is raised by artificial means (Fig. 1c).

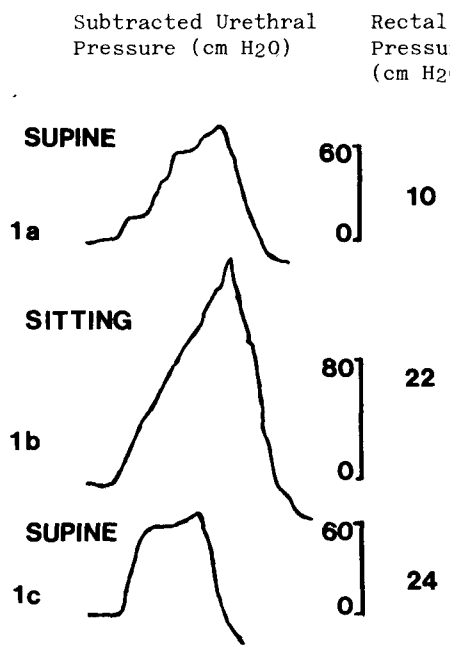

Fig. 1 Female aet 50. Abnormal postural response.

RESULTS

It has proved possible to identify variations in the response in several groups of patients; changes observed in Maximum Urethral Closure Pressure (MUCP) are recorded as percentage of supine values.

GROUP I 10 patients with minimal symptoms and no clinical, radiological or endoscopic evidence of pathology, showed a mean increment on rising of + 23% (range 14 - 43%).

GROUP II 11 young female patients with resistant cyclical sensory frequency and dysuric discomfort showed minimal change in MUCP; mean increment + 5% (range - 8% to + 18%).

GROUP III 8 patients were observed in whom increments in MUCP were considered excessive; (mean 124%, range 100 - 171%). In this group - persistent chronic retention despite adequate surgery (4 patients), lumbar disc disease with urological signs (3 patients) and one patient with persistent urinary infections - response to treatment was poor. This effect has been noted by Gibbon (1) and regarded as possible denervation hypersensitivity. It appears possible however from our findings that this excessive response may merely illustrate one extreme of a range of neurophysiological activity.

In the remaining patients, mainly prostatic males, varied changes were seen the significance of which remains uncertain.

COMMENT

The sympathetic nervous system has been shown to play a significant role in the control of urethral musculature (2). The postural changes observed in the peripheral cardiovascular system are known to be mediated by sympathetic vasomotor nerves. It is thus theoretically possible that changes related to posture might be observed in the α adrenergic smooth muscle of the urethra.

It is suggested that the postural changes detected within the urethra have important therapeutic and aetiological implications. We consider it absolutely essential that such recordings are included routinely in the urodynamic assessment of the lower urinary tract.

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This work is supported by a Grant from the Medical Research Council.

DILATATION OF THE RESTING POSTERIOR URETHRA IN SPINAL CORD INJURY PATIENTS

J. Nordling, K. P. Olesen and T. Hald

Urological Laboratory, Department of Urology and Department of Radiology, Herlev Hospital, University of Copenhagen, Denmark

ABSTRACT

In 26 patients with detrusor-sphincter dyssynergia after a spinal cord injury the resting posterior urethra at cystography was found either closed as in normal subjects or open to a varying degree. Highest intravesical pressure measured at cystometry during uninhibited detrusor contraction was statistically significantly related to the degree of dilatation of the resting posterior urethra. An even higher correlation coefficient was found between the dilatation of the resting posterior urethra and an arbitrary score calculated on the basis of highest cystometric pressure and duration of disease since spinal cord injury. The possible importance of this finding in relation to incontinence after urethral sphincterotomy is discussed.

INTRODUCTION

In a series of patients with spinal cord injuries examined for bladder disorders, voiding cysto-urethrography revealed inexplicable variations in the configuration of the posterior urethra, when the bladder was at rest. Some cases showed an entirely open urethra down to the external sphincter, while others were completely closed and others again displayed a downwards pointed beak of contrast medium from a partly open internal urethral orifice. Since all patients suffered from upper motor neuron lesions with detrusor-sphincter dyssynergia one explanation for the varied configuration of the posterior urethra might be a deterioration of this part of the urethra caused by long lasting strain from the high pressure detrusor working against the contracted sphincter. It has previously been shown that the posterior urethra is widely dilated during voiding with detrusor-sphincter dyssynergia (1), but the configuration of the posterior urethra with the bladder at rest does not seem to have been reported.

MATERIAL AND METHOD

The records of 26 consecutive patients with spinal cord injuries without previous surgery of the lower urinary tract were studied. There were 20 males and 6 females. The neurological level of the spinal cord injury was 9 cervical, 10 thoracic and 7 lumbar. 3 cervical, 8

thoracic and 6 lumbar lesions were complete, the rest incomplete. The mean age was 35 years with a range from 19-68 years.

All patients had been examined by
1) CO_2-cystometry during filling of the bladder at a rate of 200 ml/minute combined with electromyography from the urethral sphincter using an intraurethral ring electrode mounted on an 18 F Foley bag catheter.
2) Urodynamic evaluation with simultaneously bladder and rectal pressure measurement, electromyography from the anal sphincter with a coaxial needle electrode and urinary flow recording.
3) Cysto-urethrography in the lateral projection with simultaneous intravesical pressure measurement through a transurethrally positioned 5 F catheter.

Highest intravesical pressure during uninhibited detrusorcontraction measured at cystometry was used as an expression of detrusor strength. As the CO_2 cystometer only registers pressures lower or equal to 100 cm H_2O, the patients were devided into three groups. Group 1 with intravesical pressures below or equal to 50 cm H_2O, group 2 with pressures exceeding 50 cm H_2O but lower or equal to 100 cm H_2O and group 3 with pressures exceeding 100 cm H_2O. Because it could be suspected that it would take a certain time to develop a dilated posterior urethra the patients were also devided into three groups according to duration of disease. Group 1: patients investigated less than 1 year after injury, group 2: patients investigated between 1 and 2 years after injury and group 3: patients investigated more than 2 years after injury.

Finally the cystographic pictures of the resting bladder and urethra were classified into three types:
1. closed bladder neck, 2. beak of contrast medium from partly open bladder neck into the posterior urethra, 3. open bladder neck and contrastfilled posterior urethra down to the level of the external sphincter. No cystographic pictures were accepted for classification unless simultaneous intravesical pressure recording proved that the bladder was at rest.

The cystometric groups and the duration groups were correlated to the three cystographic types using a non-parametric correlation test (Spearman's test).

To obtain a classification involving both detrusor strength and duration of disease the patients' cystometric group number was multiplied with his duration group number. These pressure-duration scores ranging from 1 to 9 were also correlated to the cystographic types using a Spearman's test.

RESULTS

16 patients had a closed bladder neck and 10 patients an open posterior urethra with the bladder at rest. The correlation to highest intravesical pressure at cystometry is shown in figure 1. The correlation is statistically significant with $p < 0.02$.

The correlation between configuration of posterior urethra and duration of disease is shown in figure 2. This correlation is not statistically significant ($p > 0.05$) although it can be seen that only two of eleven patients investigated within the first two years after

spinal cord injury had an open posterior urethra.

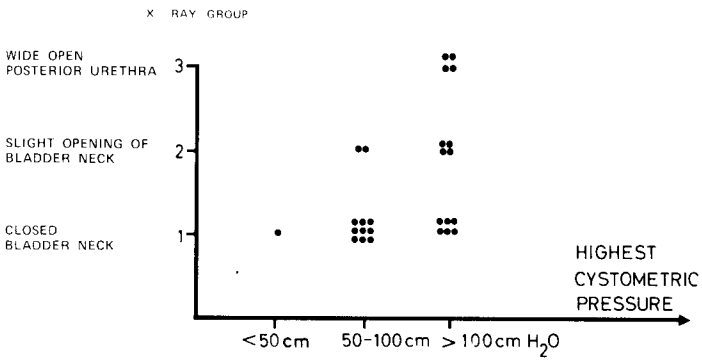

Fig. 1

Correlation between configuration of the resting posterior urethra at cystography and highest intravesical pressure during uninhibited detrusor contraction. (Spearman's rho = 0.5098, $p < 0.02$).

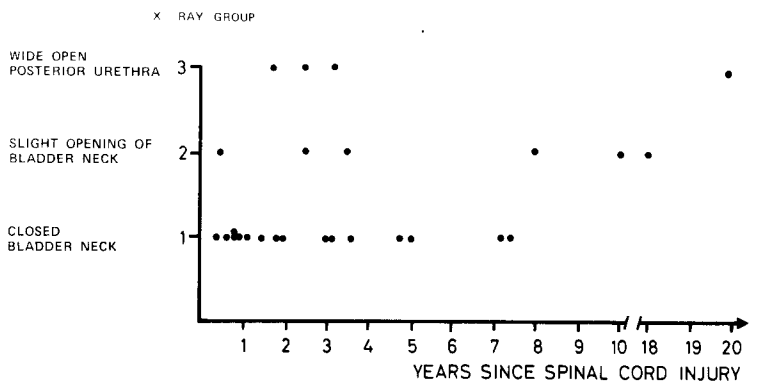

Fig. 2

Correlation between configuration of the resting posterior urethra at cystography and duration of disease since spinal cord injury. (Spearman's rho = 0.3831, $p > 0.05$).

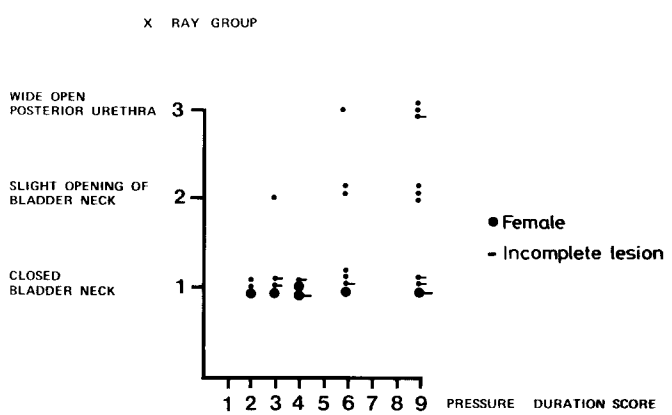

Fig. 3

Correlation between configuration of the resting posterior urethra at cystography and pressure-duration score (for explanation see text). (Spearman's rho = 0.5852, $p < 0.01$).

The correlation between configuration of posterior urethra and pressure-duration score is shown in figure 3. This correlation was also statistically significant ($p < 0.01$) with a higher correlation coefficient than between configuration of posterior urethra and highest cystometric pressure.

None of the 6 females in the material and only 1 with an incomplete spinal cord lesion had dilated posterior urethra with the bladder

at rest.

DISCUSSION

In this series of patients with spinal cord injury and detrusor-sphincter dyssynergia a correlation has been found between increasing dilatation of the posterior urethra at rest and a high intravesical pressure during detrusor contraction, indicating that a strong detrusor muscle might be necessary to produce this widening of the posterior urethra.

The treatment of severe detrusor-sphincter dyssynergia is division of the external urethral sphincter (2,3). The rationale is that relief of obstruction with improved bladder emptying diminishes the risk of infection and/or damage to the upper urinary tract.

Such sphincterotomies may cause erectile impotence (4) and are feared to cause or worsen incontinence. The impotence seems especially to occur after transurethral sphincterotomies at the 3 and 9 o'clock positions (4) whereas sphincterotomies at the 1 and 11 o'clock positions seem to be free from this complication (5). The literature, however, gives no specific reference to incontinence arising after sphincterotomy, perhaps because the patients were already incontinent before the operation or because incontinence was considered a minor problem in the context.

Dilatation of the posterior urethra is supposedly a factor leading to destruction of the upper urethral closure mechanism. Therefore, the importance of maintaining a normal posterior urethra is obvious since the posterior urethra will be the only structure to sustain continence when the distal urethral continence zone is destroyed by sphincterotomy. It is possible that early sphincterotomy within one or two years after spinal cord injury could prevent the development of a dilated bladder neck and posterior urethra, thereby decreasing the risk of making these patients severely incontinent after a sphincterotomy. One patient in this series with a wide open posterior urethra at rest had a transurethral sphincterotomy because of insufficient bladder emptying. Before the operation he was wearing an appliance because of occasional leak of urine, but after the operation he became totally incontinent with constant dripping and loss of large volumes of urine at the slightest straining.

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URODYNAMIC AND ELECTROMYOGRAPHIC ASSESSMENT OF URETHRO-VESICAL ACTIVITY IN SPINAL SHOCK PATIENTS*

Alain B. Rossier*,*, Bushra A. Fam*, +, Margarete Di Benedetto**,*** and Mehdi Sarkarati***

Spinal Cord Injury and Rehabilitation Medicine** Services, West Roxbury Veterans Administration Hospital and the Departments of Orthopaedic Surgery*** and Surgery+, Harvard Medical School, Boston, MA 02132, U.S.A.*

ABSTRACT

Seventeen spinal shock patients with traumatic complete cord lesions were investigated with cystometry, urethral pressure profile, anal and rectal pressure recordings, and EMG of pelvic floor sphincters. Bladder filling was accompanied by an elevation of resistance in the bladder neck area with concomitant increase of pressure in the external sphincter zone without simultaneous increase of the EMG activity. These results point to an increased sympathetic activity in the smooth muscle component of the entire urethra. In the majority of patients the continuous withdrawal pressure profile (dynamic UPP) showed higher values in the membranous urethra than the interrupted withdrawal pressure profile (static UPP) pointing to the importance of sensory afferents from the urethral mucosal receptors in producing artefactual reflex activity in the pelvic floor muscles. In the majority of static UPP's higher pressures were recorded in the juxtabulbar than in the midst part of the membranous urethra. A somewhat decreased EMG activity was found in the anal and urethral sphincters at "rest." It did not often relate with the amount of resistance recorded in either sphincter. High urethral sphincter pressures and somatic activity of the conus medullaris reflexes show that external urethral and anal sphincters escape spinal shock, the primary characteristic of which is areflexia.

INTRODUCTION

Seventeen male spinal shock patients were studied to determine the effect of spinal shock on the detrusor, the internal and external sphincter zones, and the reflex activity of the pelvic floor muscles. The relation between activities of the conus reflexes, urethral pressure profile, bladder activity, and EMG patterns of the pelvic floor sphincters is the subject of the present study.

MATERIAL AND METHODS

All but 2 patients were admitted within 48 hours of injury. With the exception of a 64-year-old paraplegic, their age ranged from 17 to 39, average 24. There were 13 tetraplegic and 4 paraplegic patients. All had traumatic complete cord lesions.

*Methods, definition, and units conform to the standards established by the International Continence Society except where specifically noted.

The urodynamic investigations which were conducted with patients lying supine with about 15 degrees of pelvic obliquity consisted of dynamic and static urethral pressure profiles (UPP) with simultaneous bladder and rectal pressure recordings and EMG of the external urethral and anal sphincters. P23 DB Statham gauge transducers* connected to a polygraph** consisting of 6 carrier preamplifiers and a direct writing recorder were utilised for pressure measurements. Intrarectal pressure changes were measured with a custom-made flaccid balloon condom taped over the end of a plastic tube 10F+. The balloon was filled with 5 ml water and zeroed in in the rectum as to record only relative pressure variations. Urethrovesical and external anal sphincter pressure recordings were obtained from a 10F trilumen plastic catheter and a water filled dumbbell balloon plastic catheter, respectively, devised by one of us (ABR) (Portex Ltd., Hythe, Kent, England CT 21 6JL).

Bladder filling of up to 400 ml or more with diluted radiopaque solution and urethral infusion via two Harvard pumps++ were carried out at the constant rate of 4 ml and 2 ml per minute, respectively. Simultaneous bladder and UPP recordings were done with the radiopaque urethral marker successively positioned under fluoroscopy at the vesicourethral junction (VUJ), the prostatic urethra (U1), the mid membranous urethra (U2), the distal part of the membranous urethra (U3), and the bulbous urethra (U4).

The study was monitored by an image intensifier, soundtracked and videotaped as indicated. In 11 patients a UPP with continuous manual withdrawal of the catheter (1)--about 1 cm per 5-10 s--was first obtained, the so-called dynamic UPP; it was followed by a static UPP, i.e., by placing the radiopaque urethral marker alternatively into each of the locations to be analyzed. Dynamic versus static UPP recordings were done with empty and full bladder. EMG recordings of both urethral and anal external sphincters were carried out with coaxial needles$^{\phi}$ and with a two-channel electromyograph$^{\phi\phi}$ incorporated into the polygraph.

RESULTS

Although in spinal shock all patients had one or more conus reflexes present (anal wink, anal tone or bulbocavernosus reflex). In none of our patients could we find any vesical activity. By the time it reappeared spinal shock was long gone. Bladders were hypotonic but not atonic.

In 10 of 14 patients dynamic UPP displayed about 30 per cent higher values than recorded by static UPP at the external sphincter zone. In 11 of 17 patients static UPP's disclosed higher pressures at U3 than U2, and equal and lower pressures in each of 3 patients. Average pressure was about 70 cm H20 at U3 and 60 cm H20 at U2.

The effects of bladder filling on the static UPP were analysed in 13 patients. While no change of pressure was noted in the internal sphincter zone in 4 patients, the rest have shown increase in pressure which averaged 8 cm H20 in U1. In the external sphincter zone, 7 patients displayed an average increase of pressure by 17 cm H20 in U2 while the rest showed no increase in pressure. Six of the 7 patients also had a concomitant rise in U1 pressure. Three patients showed a rise in U3 pressure with a concomitant increase of pressure in U1 and U2. While in 8 patients

*Statham Laboratories, Inc., Hato Rey, Puerto Rico.
**F. Hellige & Co., Freiburg i. Brisgau, Germany, and Litton Medical Electronics Elk Grove, Illinois, U.S.A.
+Medex, Inc., Hilliard, Ohio.
++Harvard Apparatus Company, Inc., Millis, Massachusetts.
ϕDisa Electronics, Franklin Lakes, New Jersey.
$\phi\phi$W. Tönnies, Freiburg i. Brisgau, Germany

there was no increase in U3 pressure, four of those had an increased pressure in U1 and U2.

In two patients in whom 8 mg of phentolamine were administered intravenously, a drop of 25-50 per cent in UPP pressure was noted in the external sphincter zone (U2-U3) with concomitant drop in U1 pressure in one patient.

Needle insertion in both sphincters caused normal insertional activity which returned to base line activity earlier than would usually be observed in normals or upper motor neuron lesions out of spinal shock. During "rest" there was a frequency of 3-7 action potentials per second; the amplitude and the mean duration of potentials being usually 40-60 microvolts and 4-5.5 milliseconds, respectively. After examination was continued for 10-15 minutes potentials seemed to decrease in amplitude or even disappear until the end of the recording.

DISCUSSION

Spinal shock was first described by Hall (2) as the "suspension of the excito-motor power and of the reflex actions for a time." It should, therefore, be limited to that period during which all tendon reflexes are abolished and other reflex activity below the level of cord damage is markedly depressed (3). Bulbocavernosus and anal reflexes have been noted as early as a few hours post-injury (3-6). Whether in fact they are ever abolished remains to be proven (7). The anal tone and the BCG responses recorded from the external urethral sphincter, though not mentioned by other authors, have been present in all our patients.

The dynamic UPP displayed higher values than the static UPP at the external sphincter zone in most cases because it probably stimulates more afferents from urethral mucosal receptors which have been shown to play an important role in the reflex activity of the pelvic floor muscles (8,9). This is also substantiated by the enhanced EMG pattern observed in our patients at the time of catheter withdrawal. It therefore appears that preference should be given to the static UPP over dynamic UPP in the evaluation of urethrovesical activity in upper motor neuron lesions. Our findings present and past point to a higher pressure at the juxtabulbar urethra U3 (10) which has been shown to have the greatest concentration of striated muscle fibers (11,12).

Experimental data have suggested that the "internal sphincter" contracts as the bladder is filled with urine (13,14). This intraurethral pressure rise in normals is believed to be mediated by the sympathetic alpha-receptors (13,15,16). Our results in spinal shock patients are at variance with those of McGuire *et al.* (17) who did not find any change in urethral pressure with bladder filling; 9 of 13 patients had an increased pressure in the "internal sphincter" zone, a finding also disclosed by Awad *et al.* (18). This pressure increase was however most consistently found in U1 (6 patients) and was accompanied by an increase of pressure in U2.

Intertwining of smooth and striated muscle fibers have been demonstrated anatomically and functionally at bladder neck (19,20). It may therefore be questioned which of the smooth or striated muscle components or a combination of both accounts for that increase of pressure in U1 and U2. The absent BCG in U1 in 5 of the above-mentioned 6 patients but the markedly positive BCG in U2 in all 6 patients, the lack of simultaneous increased EMG activity in the urethral sphincter or even its diminution with bladder filling, and the marked decrease of pressure in U2 and U3 following the administration of an alpha-adrenergic blocking agent in two patients would lend support to the hypothesis of a predominant smooth muscle component in response to bladder filling. In the first of two patients to receive phentolamine, the BCG was positive in the VUJ and U1, but the drug did not bring any change of

pressure within either location. In the second patient the BCG was negative in the VUJ and in U1; the drug however decreased the pressure in U1 by 50 per cent. These results lead us to conclude with Nanninga *et al.* (21) that the pharmacologically induced pressure decrease in U2 and U3 is secondary to a decreased activity in the smooth component of the membranous urethra. In both of our patients the decrease of the maximum urethral closing pressure by 25 and 50 per cent, respectively, is similar to Nordling's findings in neurological patients (22).

Increased UPP values have been found in U2 and/or U3 in 9 of 13 patients after they went out of spinal shock and became spastic. These findings tend to support the fact that in spinal shock the striated component of the external urethral sphincter does not disclose its activity to its full extent. This is further evidenced by the EMG recordings of the external urethral and anal sphincters in shock patients which revealed low amplitude and frequently disappearance of potentials at "rest" in the majority of cases.

ACKNOWLEDGEMENT

These studies were carried out in the Urodynamics Laboratory of the Spinal Cord Injury Service at the West Roxbury Veterans Administration Hospital. We would like to record our appreciation of the technical assistance provided by Mr. Anthony Castello, Mr. Joseph Cronin, and Mr. William Reilly, and by Miss Rosemary Phillips, Medical Photographer.

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URETHRAL MEASUREMENTS— RESULTS OF SURGERY

Chairmen: N. ZINNER
R. J. BARNARD

Too clever by half.

ACCURACY AND INTERPRETATION OF RESULTS FROM THE DISA MOMENTUM FLUX METER

H. H. Meyhoff*, D. J. Griffiths*, J. Nordling and T. Hald****

***Urological Laboratory, Urological Department H, Herlev Hospital, University of Copenhagen, Denmark*
**The Department of Physics, University of Exeter, Devon, England*

ABSTRACT.

The momentum flux apparatus was tested for accuracy in vitro. Errors were within an acceptable range for clinical evaluation and research of meatal properties in male patients - provided the stream exit angle was horizontal within 10 - 15 degrees. Measurements from the apparatus give information about the rigid nozzle or distensible meatus from which the stream is discharged. Great caution has to be exercised in the interpretation of the residual kinetic energy density and of the energy loss during micturition.

INTRODUCTION.

Measurement of flow rate is a well accepted urodynamic investigation. Further information has been extracted from the urinary stream e.g. velocity calculated from the cast distance or from the trajectory on cinefilms (1). The meatal diameter during voiding has been measured on X-ray pictures. The force in the urinary stream has been measured by different "dynamometers" (e.g. 2). A lot of information has been extracted with the Urinary Drop Spectometer. None of these techniques are in routine use outside a few centers, and a simple and reliable apparatus for the combined measurement of flow rate and force in the urinary stream could be of value.

DISA has constructed an apparatus called a "Momentum flux meter". Preliminary clinical results from the testing of this apparatus have been presented earlier (3). The aim of this paper was to evaluate the accuracy of this apparatus and to give an interpretation of the results.

MATERIAL.

The momentum flux meter consists of a vertically mounted smooth measuring plate connected to two semiconductor strain gauges. It is designed in such a way that the point of force impact on the plate is unimportant. Measuring range is 0-0.2 Newton with a sensitivity of 25 volt/Newton. The transducer's natural frequency is 21 Hertz and its time constant 0.23 sec.

The apparatus is mounted on top of a rotating disc flowmeter (type 14 F 41, time constant 0.47 sec.) allowing simultaneous recording of momentum flux and flow rate - fig. 1

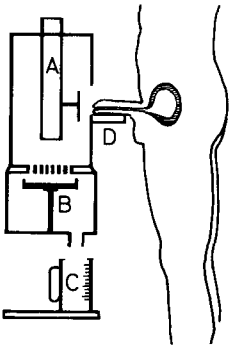

Fig. 1

A. Momentum flux transducer
B. Flow rate transducer
C. Measuring receptacle
D. Penis holder

In the standing position the male patient guides his stream horizontally onto the plate. The penis rests softly on a shelf and the prepuce is gently retracted during voiding.

The momentum flux meter measures the force exerted by the urinary stream on the plate. The force is equal to the momentum delivered to the plate (and there destroyed) per second - called the momentum flux. Assuming that there is no splash back from the disc and that the flow is constant the momentum flux M is given by $M = rho \cdot Q \cdot v$ where rho is the urine density, Q is the flow rate and v is the average velocity of the stream. By measuring M and Q simultaneously the velocity of the stream and its cross sectional area A (= Q/v) can be calculated. So can the residual kinetic energy density Estr in the stream. $Estr = 1/2 \cdot rho \cdot v^2$

METHOD.

The momentum flux apparatus was tested with a dynamometer with a measuring range 0-0.2 Newton, accurately calibrated by precision test weights. The measuring plate was pulled from behind by means of a copper wire (diameter $5 \cdot 10^{-2}$mm) running to the dynamometer over a specially designed glass pulley (friction error $\pm$ 2%).

Further the apparatus was tested in vitro with various steady flows of 0.9% saline. The flow rates were recorded from an electromagnetic flowmeter. A rigid flow probe (inner diameter 5 mm) was used.

Finally the cast distance was compared to measured momentum flux and flow rate values.

RESULTS.

Results from the dynamometer calibration are given in fig. 2. Standard deviation and range of error denote deviation of measured values from the line y = x. Fig. 3,4 and 5 give results from tests with the electromagnetic flowmeter. The nozzle tip was horizontally positioned at a distance of 3 cm from the measuring plate. The impact on the measuring plate was central in all these tests. Testing with different impact locations on the plate (north, south, east, west and center) gave no observable change in measured momentum flux values.

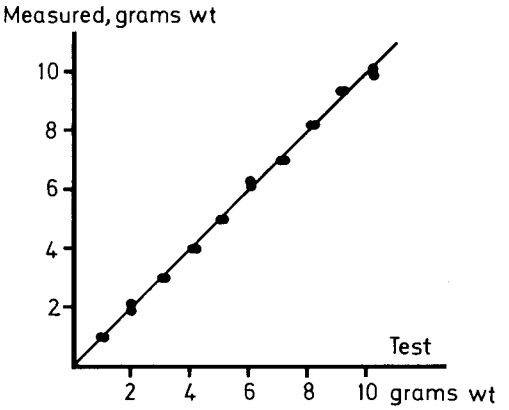

Fig. 2
Force from dynamometer (test) and from momentum flux meter (measured). Error range: -0.3 to +0.1 grams wt, SD: ± 0.11 grams wt.

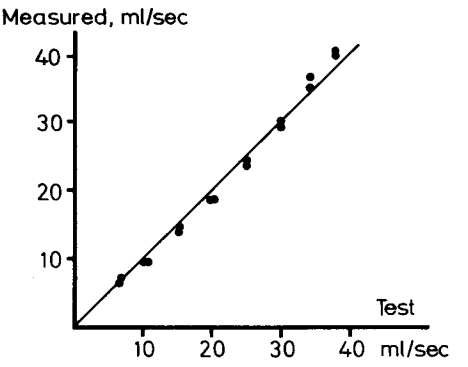

Fig. 3
Flow rate from electromagnetic flow meter (test) and from DISA flow meter (measured). Error range: -1.5 to +2.3 ml/sec, SD: ± 1.25 ml/sec.

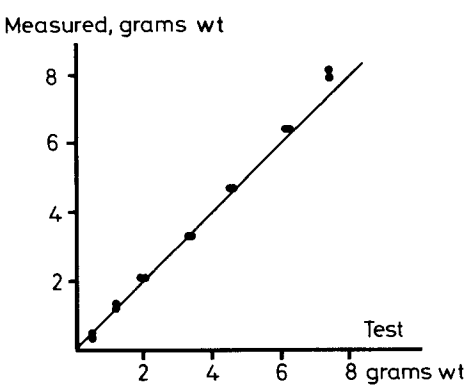

Fig. 4
Force calculated from nozzle diameter and flow rate from electromagnetic flow meter (test) and from momentum flux meter (measured). Error range: -0.2 to +0.7 grams wt, SD: ± 0.26 grams wt.

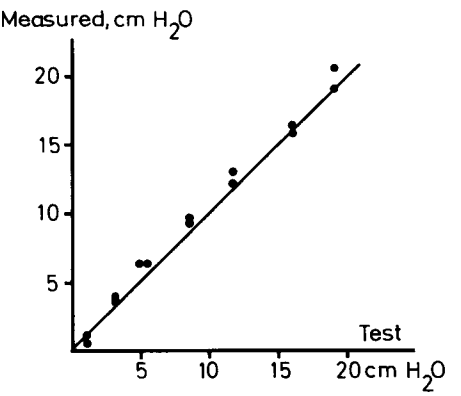

Fig. 5
Estr calculated from flow rate from electromagnetic flow meter and nozzle diameter (test) and from momentum flux meter (measured). Error range: -0.8 to +1.7 cm H_2O, SD: ± 0.94 cm H_2O

The influence of the gravitational field was tested by varying the distance from the flow probe to the measuring plate from 3 to 5 to 7 cm. No detectable differences in momentum flux values were recorded.

The importance of exit angle is seen in table I. Distance from flow probe to measuring plate was about 3 cm. Angles were measured as exactly as possible, the estimated error being ± 5°.

With a horizontal flow probe the apparatus measured momentum flux 4.2 g.wt. and flow rate 2o.5 ml/sec. The height h of the nozzle was 61 cm from the floor and from that position cast distance x was mea-

sured to be 66.5 cm. From the cast distance the calculated velocity is 188 cm/sec. From the momentum flux meter 201 cm/sec. The difference between these calculated results is 6.5%

Exit angle (a)	Momentum flux grams wt.	Measured error %	Expected error (1-cos(a)) · 100 %
0^{o}	3.2	0	0
10^{o} up	3.1	3.1	1.5
10^{o} down	3.1	3.1	
20^{o} up	3.0	6.3	6.0
20^{o} down	2.6	18.8	
30^{o} up	2.7	15.6	13.4
30^{o} down	2.5	21.9	

Table I. Different stream exit angles.

DISCUSSION.

Accuracy: For all static accuracy tests presented it has to be kept in mind that the test procedure itself is not without errors although they have been minimised as much as possible.
The dynamometer set-up is a test of the momentum flux transducers and the recorder. The errors presented are not important.

With the flow probe horizontal the measured results fall within an acceptable range of error (fig. 3 to 5 and for cast distance). The location of the impact on the plate and the influence of the gravitational field are unimportant. Splash back from the plate cannot be important.

Different stream exit angles (above 10^{o}-15^{o}) can cause great errors. The shelf for penis support should minimise this problem. Retraction of the prepuce is extremely important to avoid enormous artefacts in the exit area.

In clinical use measurements are usually made on flows varying in time. The extra sources of error affecting such dynamic measurements are; (i) the fact that the basic equations are strictly true only for constant flow; (ii) the finite and unequal time constants of the momentum flux meter and the flow meter; (iii) the time delay between the measurement of momentum flux and that of flow rate. Preliminary observations suggest that none of these errors should be important at maximum flow, since this in most cases is maintained for at least 2 sec. The apparatus may have to be improved to yield reliable measurements throughout micturition.

Interpretation: From the equations given in the section on material, it follows that during constant flow $M = rho \cdot Q^2/A$
In the case of a stream discharged from a rigid nozzle, the cross sectional area A of the stream is the same at different flow and approximately equal to that of the nozzle. Therefore the momentum flux M is proportional to the square of the flow rate Q, and so a graph showing values of M plotted against corresponding values of Q should be a parabola, from which the area A can be calculated. We have veri-

fied that this is so in practice. In the case of the male urethra the stream cross section A becomes larger at high flow rates, as the meatus is distended (4). Therefore a graph of M against Q should no longer be parabolic. The departures from the parabolic form give information about the distensibility of the meatal part of the urethra. In each case, then, measurements of momentum flux and flow rate give information about the rigid nozzle or distensible meatus from which the stream is discharged.

In addition one may calculate the residual energy density Estr in the stream and hence the energy loss (Pves - Estr) suffered by unit volume of fluid in flowing through the urethra. This in turn may be converted to the energy loss factor (Pves - Estr)/Pves introduced by Bottaccini et al. (2). However, flow through highly distensible tubes such as the urethra has peculiar characteristics (5). For example, it is certainly possible that dilatation of the meatus may reduce the stream speed and residual energy density, and so paradoxically increase the energy loss, for the same bladder pressure and flow rate. Therefore great caution has to be exercised in the interpretation of Estr and the energy loss factor, and in comparing their values in different patients.

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GAS URETHRAL PROFILE WITH SIMULTANEOUS RECORDING OF EMG-ACTIVITY FROM PERI-URETHRAL STRIATED MUSCLES: WHAT IS TRUE AND WHAT IS ARTIFACT?

G. C. Vignoli, A. Martelli, and G. Cecolin

The Department of Urology, Urodynamics Laboratory, University of Bologna and Urodynamic Section, Polman S.p.a., Medicals and Electronics, Bologna, Italy

INTRODUCTION

Gas urethral profile with simultaneous recording of EMG-activity from peri-urethral striated muscles, recently described by Bradley et al. (1), is a new interesting method for studying urethral function. In fact it provides a correlation between intra-urethral pressure and activity of peri-urethral striated muscles, thus allowing differentiation between organic and functional stenosis in a simple and rapid way.

Nevertheless, while the pressure profile is totally reproducible in the various types of pathology, the EMG is highly variable and of difficult interpretation even in the same patient.

These observations led us to verify the possible superimposition of artifacts, either due to the particular structure of recording catheters or the effects of interaction between gas outflow and urethral wall during catheter withdrawal. These artifacts could be misinterpreted as EMG activity by using an integrated system of recording.

MATERIALS AND METHODS

We used DG-40 catheters manufactured by American Medical Systems and recordings were made by means of the Multifunctional Monitor of the same Company. In all our experiments the speed of catheter withdrawal was 12.5 cm/min. Tests were carried out both in vivo and in vitro. In the latter case we used a mechanical model consisting of an elastic tube 8 cm in length, external diameter 1 cm, each end being attached to a plexiglass structure, one of which was mobile, thus allowing to change the tension of the tube and therefore its actual coefficient of elasticity.

It was also possible to connect the fixed end of the tube with a funnel-shaped rubber structure in order to simulate the bladder outlet.

RESULTS

Classic tracings in normal patients

Pressure and electric profiles have different morphologies depending on sex.

In women EMG activity is recorded in a limited area which correspond to the middle portion of the pressure curve. In men two increases in activity are recorded: the first one in the area corresponding to the bladder neck and the second in the point of maximum pressure in the profile. Therefore we analyzed the mid-urethral activity and the activity corresponding to the bladder neck separately.

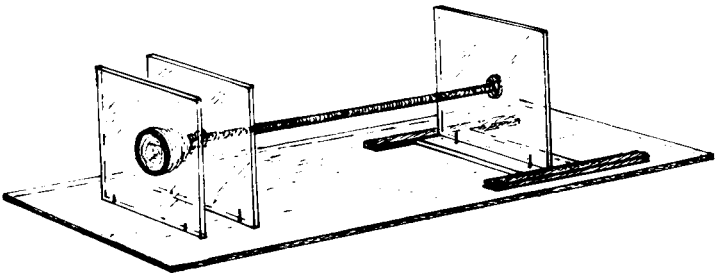

Fig. 1. Mechanical model

MID-URETHRAL ACTIVITY

In vivo experiments These were carried out in normal women, where the anatomy of the urethra is simpler. The patient being in supine position, pressure and electric profiles were recorded at different flows of gas infusion. The results we obtained were as follows:

- Flow 0 cc/min.: no sign of electrical activity

- Flow 100 cc/min.: very slight electrical activity, which corresponded to a limited area in the middle of the urethra.

- Flow 150 cc/min.: electric profile could be described as normal, according to its features. In these conditions electric activity disappeared by blocking the catheter in the mid-urethral portion, that is where EMG activity started, and by reducing flow to 0. Switching-on the flow, electric activity started again, its intensity being proportional to gas flow. The flow rate variations, however, did not correspond to any increase in intra-luminal pressure. Furthermore, the more sudden was the passage between the flow values, the greater was the recorded increase in activity.

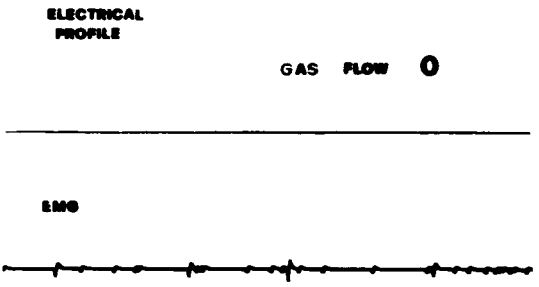

Fig. 2. Without gas infusion, no electrical activity was recorded.

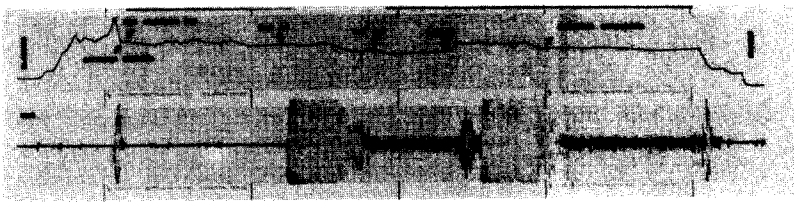

Fig. 3. Electrical activity was related to gas inflow.

In vitro experiments. After lubrication to avoid errors due to friction we introduced a DG-40 catheter into the mechanical model described above and determined urethral profiles at different degrees of tension in the tube with a gas flow of 200 cc/min. Electric activity varied according to tension in the tube as measured on the basis of an arbitrary scale. It was minimal at maximum degree of tension, and maximum at minimal tension. In the latter case the vibrations were apparent throughout the tube.

ACTIVITY CORRESPONDING TO THE BLADDER NECK

As observed in the female, in the male the electric profile was completely silent in absence of gas inflow. To assess the possible mechanical effect of the vesico-urethral angle on EMG activity, we connected the fixed end of the model with a funnel shaped structure and started measuring pressure profiles, the catheter being left free inside the concave part of the funnel. Passing through the connection resulted in a marked increase in EMG activity which was definitely similar to that observed in the male. Its amplitude was strictly related to the gas infusion: minimal at flow 0, it became maximal at flow of 200ml/min.

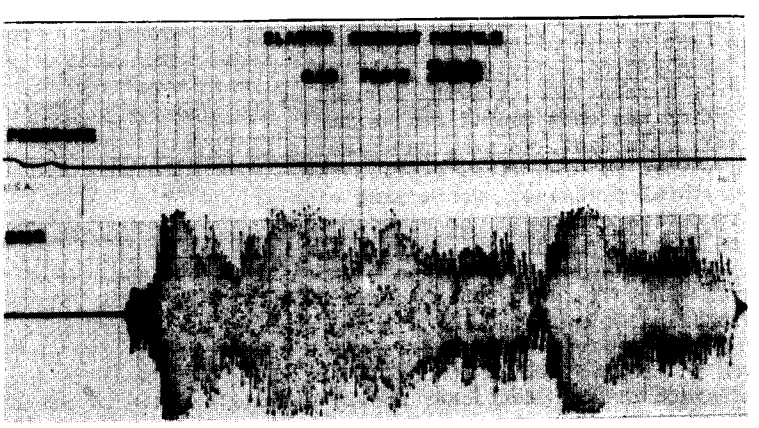

Fig. 4. Elastic conduit profile at minimal degree of tension

COMMENT

The interpretation of the different morphologies of electric profiles is based on the different arrangement of peri-urethral striated muscles in women and in men, as in the latter case they reach the neck of the bladder. Our data seem to show that the electric profile is not a reliable index of a real electric activity and suggests its relationship to mechanical vibrations of the catheter inside the urethra.

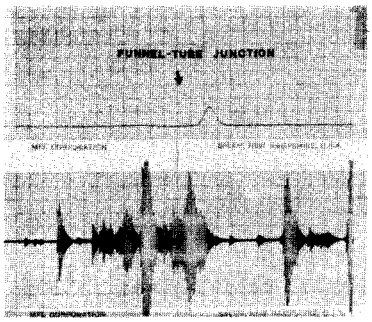

Fig. 5. Electrical activity at the funnel-tube junction.

It is, in fact, totally silent in absence of gas infusion, although it is well known that peri-urethral striated muscles, in physiologic conditions, have a characteristic tone whose activity should be recorded. The localization of maximum electrical activity in the middle of the urethra is due to the fact that the most sensitive part, from the mechanical point of view, of an elastic conduit with fixed ends is the central part. The sequence of events during measurement of gas urethral profile might be as follows:- Gas outflow from the holes of the catheter causes an oscillation of urethral wall which is transmitted back to the catheter with resulting light vibrations inside the lumen. The oscillation is directly proportional to the degree of elasticity of the wall, which is maximum in its middle portion. The vibrations of the catheter in turn give rise to electric tensions in the electrodes of the order of magnitude of muscular potentials, thus simulating the EMG activity. In the absence of gas flow no vibrations are produced and therefore no electric activity is recorded. The hypothesis of a relex EMG activity induced by gas infusion, which was once considered valid, seems less likely. In fact, varying gas flow brings about a change in electrical profile but not in intra-urethral pressure. Concerning electrical activity corresponding to the bladder neck, our experiments with the mechanical model allow us to state that it is reasonable to relate it to a vibratory phenomenon induced by gas at the point where it leaves the concave part of the funnel (bladder) and enters the cylindrical structure of the tube (urethra). Its presence in men but not in women may be related to the different degree of elasticity of the vesico-urethral region in the two sexes. On the whole these data seem to suggest a new possible application of the technique; namely the utilization of mechanical vibrations of the urethral wall induced by a constant gas flow as an index of the elasticity of the urethra at subsequent points and throughout its length.

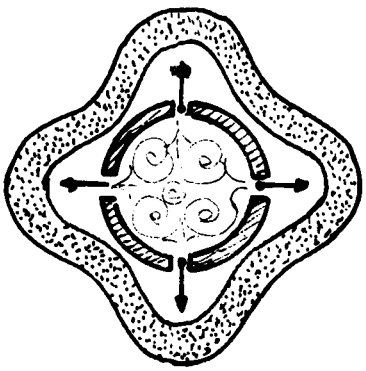

Fig. 6. Mechanical interpretation of EMG activity.

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INTRODUCTION OF AMPULLOMETROGRAM (AMG) AND ANAL PROFILOMETRY IN URODYNAMIC EVALUATION

Ciril J. Godec and Alexander S. Cass

Division of Urology, Hennepin County Medical Center, Minneapolis, Minnesota and Department of Urology, St. Paul Ramsey Hospital, St. Paul, Minnesota, U.S.A.

Early in fetal life, at the age of six weeks, the cloaca is divided by urorectal septum into anterior urogenital sinus and posterior rectal ampulla. The urogenital sinus is further evolved into the bladder and proximal urethra. Therefore, the bladder and rectal ampulla have similar innervation with the spinal sacral center at the level of S2-S4. The urethra and anal canal have similar innervention as well. Bladder and rectal ampulla are responsible for expulsion of urine and feces. The anal canal and urethra are responsible for continence in lower urinary and fecal pathways.

In our earlier publication (Godec et. al. 1977) (1) we found that the stimulation of the rectal ampulla can produce reflex voiding. In this paper we present the new technique of functional evaluation of the rectal ampulla - ampullometrogram. Also the correlation between anal and urethral profilometry is presented.

METHODS

Specifically designed, pear-shaped rectal silastic balloon was constructed * and attached to the tip of a simple red Robinson catheter, #18 French. The capacity of the balloon was 350 cc. The balloon, in deflated position, was inserted into the rectal ampulla, above the canal canal. The balloon was progressively filled with air at the rate of 150 cc./minute. The curve depicting pressure versus volume is recorded on the Merril air cystometer (Model EU-208)**. Thus, the communication above the rectal ampulla with the rectum was closed and only the rectal ampulla was functionally evaluated.

The cystometrogram (CMG) was performed on the same patients with the same equipment and simple Foley catheter, #16 French.

The anal and urethral profiles were measured with the Millar Micro-Tip TM

*Minnesota Mining and Manufacturing Company, St. Paul, Minnesota
**Modern Controls, Minneapolis, Minnesota

catheter***, both in supine position with mechanical steady speed withdrawal.

RESULTS

In 20 patients the CMG and AMG were performed in supine position. CMG demonstrated normal curves in 14, hyper-reflexic bladder in five and fibrotic bladder in one case. AMG displayed very close correlation with CMG. In five hyper CMGs, four AMGs were hyper-reflexic and only one was normal. In 14 normal CMGs, 13 showed normal AMGs and one patient showed fibrotic type of rectal ampulla and one fibrotic CMG demonstrated fibrotic AMG as well.

Profilometric studies in urethra and anal canal displayed no correlation between peak pressure and functional length of anal canal. In the urethra, on the contrary, the close correlation was found between the peak pressure and functional length.

The average length of functional profile in the urethra was 28 mm. and in the anus 41 mm. The average peak pressure in the urethra was 69 cm. H_2O and in the anus 79 cm. H_2O.

DISCUSSION

Due to the common embryologic origin, and to the similar spinal innervation, the lower urinary and fecal pathways can be evaluated with the similar approach. CMG is established as the only functional test for the bladder. Our pilot 20 cases where rectal ampulla was also functionally evaluated with AMG confirmed the similar function and/or dysfunction of bladder and rectal ampulla. Rectal ampulla is composed from smooth muscles with predominantly parasympathetic innervation. The distribution of autonomic nerve receptors is not yet as well documented as in the bladder.

Also, the canal canal may show more functional similarities with urethra. Its anatomical and neurological composition is similar to the one in the urethra. Smooth and striated muscles are interwoven in the same pattern as they are in the urethra. In our pilot study we have not been able to confirm the close functional correlation between the urethra and anal canal. But the data obtained are proving that further study is necessary in order to elucidate their functional relationship.

CONCLUSION

The concept of functional and embryological relationship between lower urinary and fecal pathways is attractive and might produce better understanding of urodynamic parameters. With additional functional evaluation of the rectal ampulla and the anal canal, more precise information can probably be obtained to further clarify still poorly understood voiding dysfunctions. Also chronic constipation and/or fecal incontinence might benefit from this study.

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DEFORMATION OF THE PROXIMAL URETHRA

W. Schäfer, K-U. Laval, H. Lindow and W. Lutzeyer

Department of Urology RWTH Aachen, West Germany

ABSTRACT

A comparative study of UPP and "balloon sphincterography" showed that the definition of an "assumed anatomical length" of the urethra is helpful for describing the differences in sphincter function between normal and stress incontinent female patients.

METHOD

The Brown and Wickham UPP in normal and stress incontinent female patients was compared with the combined radiographic-manometric method for investigation of sphincter function, we presented in Antwerp ICS 76. *
The UPP is a recording of pressure distribution along the urethral length for a certain diameter of distention equal to catheter diameter.
The "balloon sphincterography" shows the stepwise deformation of bladder neck and urethra under a certain uniform pressure along the whole urethra.
Typical parameters to describe the results from the UPP are maximum or mean pressure amplitude and functional length. A similar way to quantify the "balloon sphincterography" is to measure the urethral (-balloon-) closure length (L_{UC}) at bladder pressure level and the urethral opening pressure. By plotting the decreasing L_{UC} against the increasing pressure in the balloon, additional information is obtained, comparable to the shape of the UPP. To make use of further information provided by "balloon sphincterography", the distance between a tangential line to the bladder base at the internal meatus was defined as the "assumed anatomical length" of the urethra (L_{AA}), Fig. 1.

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*Acylindrically shaped, extremely thin walled flexible polyethylen balloon is positioned in the urethra and filled with contrast medium. X-ray pictures are taken at various balloon pressures.

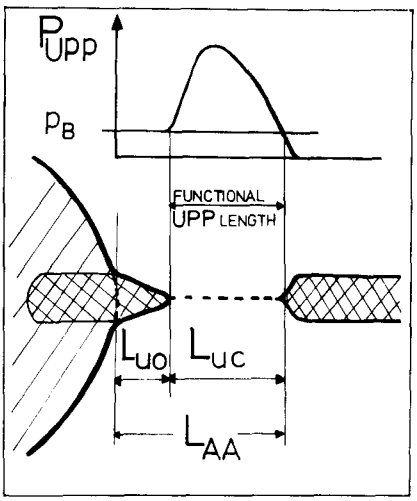


Fig. 1

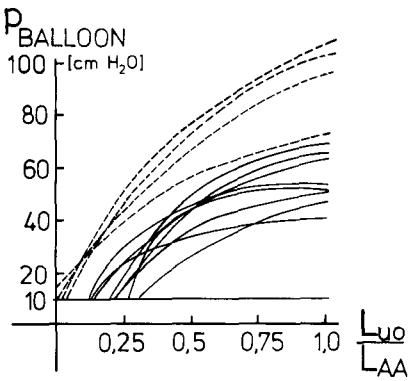


Fig. 2

This was measured at about 100 ml of fluid in the bladder and balloon pressure equal to resting bladder pressure of about 10 cm H_2O. The "urethral opening length" (L_{UO}) was calculated:

$$L_{UO} = L_{AA} - L_{UC}$$

To cope for the normal distribution of anatomical length of the urethra we used the percentage of the urethral opening, L_{UO}/L_{AA}, and plotted this dimensionless parameter against balloon pressure. Because of the x-ray exposure only four patients without any continence or voiding problems were investigated with the balloon procedure.

RESULTS

The evaluation of the "balloon sphincterography" by parameters such as urethral closure length and balloon pressure gave poor seperation between sphincter function in normal and stress incontinent patients, similar to the UPP analysis by pressure amplitude and functional profile length. A plot of balloon pressure against percentage of urethral opening shows a rather distinct seperation between normal and stress incontinent women. Fig. 2 .

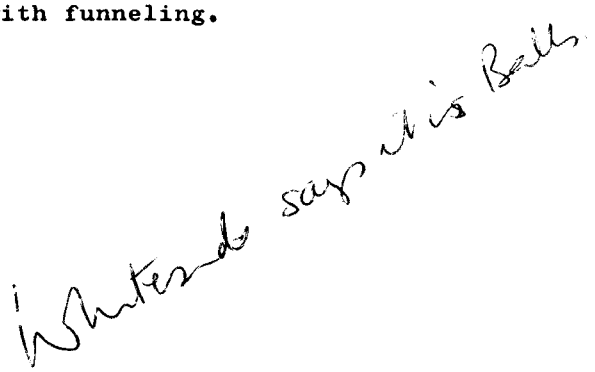
DISCUSSION

The UPP can give only information about this part of the urethra, where the urethra is closed or at least is smaller in diameter than the measuring catheter. Thus funneling of bladder neck and opening of the proximal urethra will be obscured and result in a short UPP-length, interpreted as a short functional urethral length. Our balloon method will also show a short urethral (-balloon-)

closure length at bladder pressure level, but additionally it will prove, whether it is a short anatomical urethra or a reduced closing length, due to funneling of proximal urethra.
Funneling of bladder neck and proximal urethra is a radiologic feature frequently associated with stress incontinence. But similar to the loss of the posterior urethro-vesical angle, this seems to be more a sign than the cause of insufficient bladder closure mechanism.
Funneling of the bladder neck seen at the "balloon sphincterography" is not the same as in normal cystography, because longitudinal tension in the balloon gives an additional load to the bladder neck which aggravates funneling. Thus, even slight weakening of closure function at the bladder neck is detected.

CONCLUSIONS

In a group of 50 patients we did not see stress incontinence without funneling of the proximal urethra under "balloon sphincterography". In continent patients funneling was always small and combined with much higher urethral closure pressure. Our study indicates that at some urethral closure pressure a short urethra without funneling gives more efficient closure than a longer urethra with funneling.



DETECTION OF FLUID ENTRY INTO THE PROXIMAL URETHRA DURING COUGHING

M. Brown and J. R. Sutherst

University of Liverpool

ABSTRACT

A method is presented for detecting fluid entry into the proximal urethra during coughing as an aid to the urodynamic investigation of incontinence. The method employs the same apparatus as used for water infusion urethral pressure profile measurement.

INTRODUCTION

Stress testing as part of urodynamic investigation has been approached in various ways. The object is to identify those cases in which fluid passes, or could pass into the urethra during rises in abdominal pressure.

In some tests the fluid is actually visualised. Examples are when a leak of urine is detected on clinical examination, or when radio-opaque fluid is seen to penetrate the urethra during screening (for e.g., Ref. 1).

Other methods seek to identify these cases by inference from pressure relationships between the bladder and urethra (for e.g., Ref. 2). Of these only the Shelley force gauge can differentiate between the squeeze of the urethral wall and the hydrostatic pressure of the bladder (3).

Urethral pressure measurement by the water infusion method of Brown and Wickham (4) is not usually suitable for "stress profiles" because the response time of the apparatus is too slow. However, this deficiency can be turned to advantage in differentiating between urethral wall pressure and hydrostatic pressure transmitted from the bladder.

A method has been developed using the same apparatus, whereby fluid descending into the urethra during a cough can be detected directly.

METHOD

Urodynamic investigation on our unit includes measurement of the urethral closure pressure profile (U.C.P.P.) using the water infusion method of Brown and Wickham (4). A double lumen bladder/urethral catheter* is used so that bladder pressure can be simultaneously recorded.

After measurement of the U.C.P.P. the infusion rate to the profile catheter is reduced to less than 1 ml per minute to slow the response time well below that required for recording urethral wall pressure during coughing.

The catheter is then returned to the bladder so that both channels are recording bladder pressure. The patient is asked to give a cough, and the pressures are displayed on a storage cathode ray tube screen. This procedure is a check on the measuring system. At this stage the two pressure tracings should be identical.

Using the U.C.P.P. as a guide, the urethral channel is withdrawn into the proximal urethra to the point at which measurement is required. We usually record pressures 1 cm and 2 cm from the urethro-vesical junction. The patient is asked to cough again, and the recording on the C.R.T. screen is photographed.

RESULTS

The results can be interpreted by reference to Figs. 1 and 2.

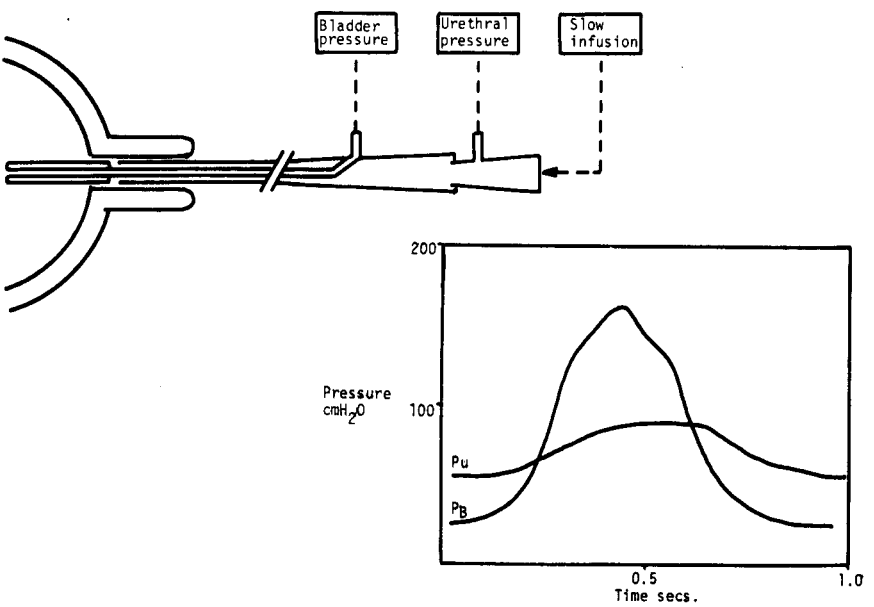


Fig. 1 Bladder neck remains closed during cough. Urethral pressure derived from wall. (Pu = urethral pressure; PB = bladder pressure)

*Portex Ltd., Hythe, Kent.

If the bladder neck remains closed during the cough as in Fig. 1, the urethral pressure recording will fall short of the bladder pressure, because the measuring system (with reduced flow rate) cannot respond to the rapid changes in wall pressure.

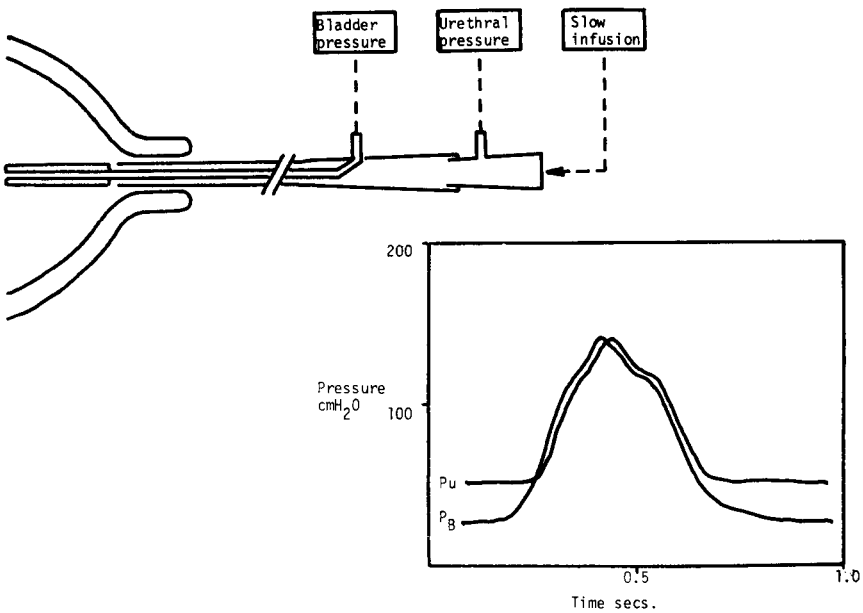


Fig. 2 Bladder neck opens momentarily during cough. Urethral pressure derived from bladder. (Pu = urethral pressure; PB = bladder pressure)

If the bladder neck opens up to the selected measuring point as in Fig. 2, the urethral pressure recording will follow the bladder trace. This is because the response time is greatly improved by the existence of free fluid around the eyes of the catheter.

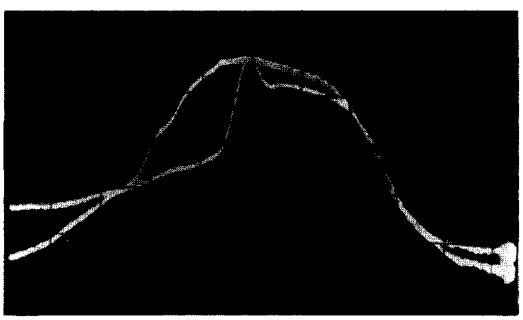


Fig. 3 Bladder neck remains closed until halfway through the cough cycle.

A variation on these two situations occurs when the bladder neck opens late in the cough cycle. Fig. 3 is the recording from a patient in whom the urethra (at the measuring point) remained closed until half way through the cough.

DISCUSSION AND CONCLUSION

Measurement of the urethral closure pressure profile (U.C.P.P.) has not gained recognition in some centres since the method and the interpretation of the results require considerable understanding and expertise (5). The search for a cause for incontinence in each patient is therefore often abandoned after bladder instability has been excluded, even though no urethral abnormality has been detected. In every urodynamic clinic there is probably a proportion of patients whose incontinence is still unexplained after investigation. There is still a need, therefore, for better methods of studying urethral dynamics.

This new method may help to complete the picture by direct detection of incompetence at the bladder neck, even when no leak has been demonstrated on clinical examination. Used in conjunction with measurement of the U.C.P.P. the two tests are complementary, and the position of the test point is known from the profile calibration.

A possible criticism of the method is that the catheter may be moved during the cough. According to Henriksson (6) movement of the catheter during stress-profiles need not be a problem. Also if the catheter does move during the test, the urethral pressures immediately before and after will be different, and this will be noticed.

The method described is simple, cheap, and is performed using apparatus which is commonly available. The detection of descending fluid is "direct" and does not rely on the acceptance of theories about pressure transmission to the urethra.

All the tests so far have been done with the patients supine. We appreciate that the method could be improved by using a smaller catheter and by recording pressures with patients in the erect position.

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URETHRAL CROSS SECTIONAL AREA MEASURED BY URINARY STREAM IMPEDANCE TO HF ELECTRICAL CURRENT

S. Mortensen, J. C. Djurhuus, H. Rask Andersen and C. Frimodt-Møller

Surgical Department D, State University Hospital, Copenhagen Denmark

ABSTRACT

A method for measuring the cross sectional area of the urinary stream by means of an impedance measuring probe is described. Results from measurements at the external meatus in eight male patients are presented and some hydrodynamic parameters are calculated from the cross sectional area, the flow and the corresponding bladder pressure.

INTRODUCTION

Harris, Therkelsen and Zinner (1971) described a method for measuring ureteral cross sectional area by measuring impedance to electrical current in the urine. They found that the impedance of the urine was much smaller than that of the urothelium and inversely proportional to the cross sectional area of the stream. The principle has been adapted for use in the urethra where the cross sectional area, together with knowledge of pressures and flow will provide basic hydrodynamic parameters. In this study, results from measurements at the external meatus of the male urethra is presented.

METHOD

The cross sectional area measuring probe was a modified 3-F ureteral catheter, equipped with four circular gold electrodes 2 cm

from the tip. Two electrodes were used for generating a field of electrical current, two electrodes in between sensed the voltage drop in the center of the field.

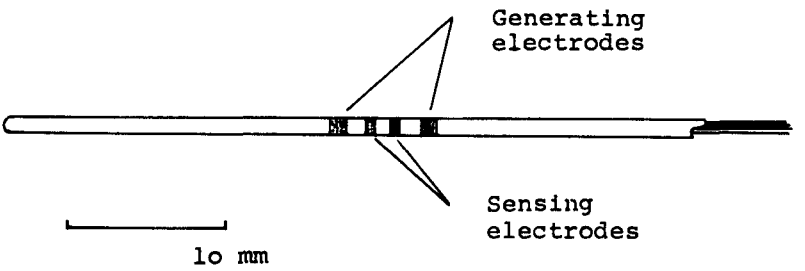

Fig. 1. The probe. Scale: 1:2,5

The generating current was a sine-Wave alternating current at lo kHz. Maximal current used was 5o μA at 25 V and was not sensed by the patients. The probe was placed in the distal part of the urethra and held in place during voiding with cotton thread, fixed to the glans with adhesive tape.

Bladder pressure was measured through a suprapubic catheter, zero pressure was defined as atmospheric pressure at the level of the external meatus in the voiding postion. Abdominal pressure was measured through a saline filled catheter in the rectum. Urinary flow was measured with a DISA Mictiometer. All parameters were recorded with an 8-channel Siemens Elema Mingograph.

The mean linear velocity of the stream, averaged over the cross section at the meatus was calculated from

$$\bar{v} = \dot{Q}/A$$

where $\dot{Q}$ was the flow in cm^3/sec, A the corresponding cross sectional area in cm^2 and $\bar{v}$ the velocity in cm/sec.

Assuming the flow to be two-dimensional, the kinetic energy would be

$$Ex = \tfrac{1}{2}\, \rho\, \bar{v}$$

where ρ is the absolute density of the fluid (for practical purposes in urodynamics equal to 1 g/cm^3), and Ex expressed in $dynes/cm^2$. For conversion to cmH_2O, a factor of 1/98o,6 cmH_2O per $dyne/cm^2$ was used.

MATERIAL

8 males, referred for routine urodynamic investigation because of varying lower urinary tract disorders were studied. All of the patients had been instrumentated previously, none of them were judged as having meatal stenosis of any significance, allthough previous instrumentations may have influenced the compliance of the meatus.

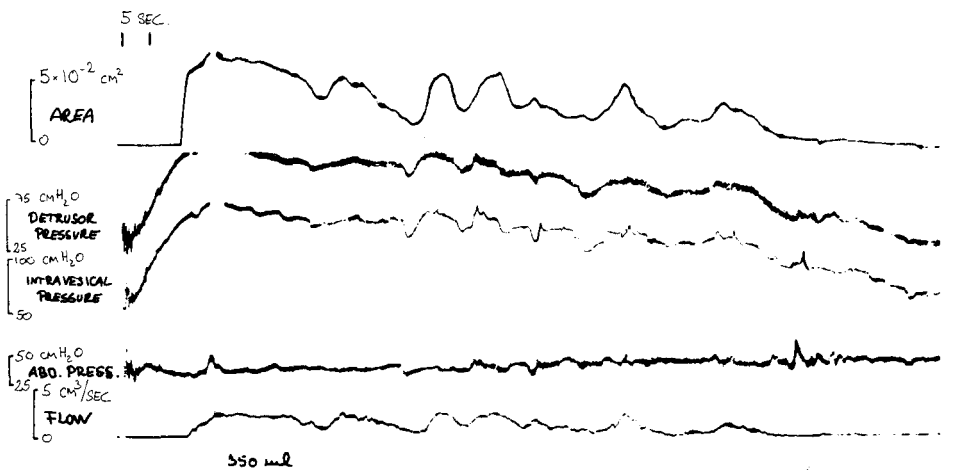

Fig. 2. Recording from a 64-year old male with persisting infravesical obstruction after suprapubic prostatectomy.

RESULTS

The maximal cross sectional area of the stream at the meatus varied between $7{,}5 \times 10^{-2}$ and $17{,}0 \times 10^{-2}$ cm^2, which in a circular lumen would correspond to 10 vz. 15 French. The calculated mean linear velocity, $\bar{v}$, varied between 27,7 and 155,0 cm/sec at peak velocity. Exit energies at peak flow, Ex, are presented in table 1 together with some commonly used expressions of resistance.

Table 1. Peak flow values of bladder pressure, exit velocity and various resistance parameters.

Patient	Q	Pb	Pb/Q^2	$\bar{v}$	Ex	Pb/Ex	$\frac{Pb - Ex}{Pb}$
A	5,3	174	6,19	76,8	3,oo	58,o	.98
B	7,5	6o	8,oo	93,8	4,49	13,4	.93
C	14,o	11o	7,85	81,8	3,41	32,3	.97
D	7,4	144	2,36	154,2	12,1	11,9	.92
E	2,3	147	27,6o	27,7	o,48	367,5	.99
F	11,5	1o8	1,o8	155,4	12,3	8,8	.89
G	12,5	163	1,o4	133,o	9,oo	18,1	.94
H	7,5	133	2,63	75,8	2,94	45,9	.98

Q: peak flow in cm^3/sec. Pb: Total bladder pressure in cmH_2O.
$\bar{v}$: stream velocity in cm/sec. Ex: Exit energy in cmH_2O.

DISCUSSION

The critical points in the described method for measuring cross sectional areas in the urethra are principally: 1) Leak current through the urethral wall. Allthough the impedance of the wall is much higher than that of urine, the urothelium is still not a perfect insulator. 2) The position of the probe with regards to the wall and the axis of the stream which together with the shape of the lumen is not entirely without influence on the measurement. 3) The method is invasive. We feel however, that the method is useful and that it- with a few modifications - will provide information of interest from other parts of the urethra as well.

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SURGICAL TREATMENT OF INCONTINENCE IN ELDERLY WOMEN

Stuart L. Stanton and Linda D. Cardozo

Urodynamic Unit, Department of Obstetrics and Gynaecology, St. George's Hospital, London

ABSTRACT

Nineteen elderly women with genuine stress incontinence were treated by a colposuspension procedure with special pre. and postoperative precautions. Fourteen patients (74%) were cured. Four of the remaining five patients were improved. No fatalities were recorded and complications were few.

INTRODUCTION

The proportion of women with urinary incontinence who are treated by surgery is less amongst the elderly than amongst the younger population. This may be due to a reluctance to operate because of poor physical health or the greater likelihood of detrusor instability (which responds poorly to surgery) amongst the elderly. Of the 245 patients attending our Unit and diagnosed as having genuine stress incontinence on videocystourethrography (V.C.U.) (Bates and Corney 1971), 32 (13%) were over the age of 65 years of age: of these 19 (59%) were considered suitable for surgery. We report on our experience of their surgical management.

PATIENTS AND METHODOLOGY

All 19 women underwent a clinical assessment with a urodynamic questionnaire and physical examination. They were investigated by V.C.U. and selected for surgery on assessment of their physical and mental wellbeing. The latter was judged by their alertness and mental state, cardiovascular and neurological condition - an upper motor neurone lesion being a contraindication. A medical opinion was sought for all doubtful cases and patients were seen by an anaesthetist prior to surgery. The operation and postoperative regime were fully explained to them and to their relatives. Scopolamine was avoided in their pre-medication and early mobilisation together with small and frequent analgesia following surgery were encouraged. Any intravenous therapy was carefully monitored and accurate fluid-balance charts were maintained. Attempts were made to ensure easy access to toilet facilities and low beds were used when available.

Their average age was 69 years (range 65-82 years), parity 2.3 (range 0-6) and 13 patients had undergone previous unsuccessful surgery for urinary incontinence. Their average weight was 61.7 kg (range 44.5 - 83.2 kg). Table 1 shows their preoperative medical and surgical conditions.

TABLE 1 Preoperative Medical and Surgical Conditions

Chronic paranoid schizophrenia	1
Umbilical hernia	1
Carcinoma of the breast and oestrogen therapy	1
Cauda equina lesion	1
Hypertension	2
Left bundle branch block	1
Coronary angina	1

The drugs taken prior to surgery are shown in Table 2.

TABLE 2 Drug Therapy

Cortico-steroids	2
Diethyl stilboestrol	1
Hypotensives	2
Thyroid extract	1
Tranquillisers	1

Their urinary symptoms and signs prior to and after surgery are shown in Table 3 and Table 4 respectively.

TABLE 3 Symptoms Before and After Surgery

	Before	After
Stress incontinence	19	4
Prolapse	3	0
Diurnal frequency	12	8
Nocturia	9	7
Urgency	11	9
Urge incontinence	9	7

TABLE 4 Signs Before and After Surgery

	Before	After
Cystocoele/cystourethrocoele	7	0
Rectocoele	3	1
Enterocoele	0	(2)
Uterine or vault descent	1	0

The colposuspension procedure as previously described but without bladder neck plication (Stanton et al 1976), was accompanied by an abdominal hysterectomy in 4 patients, repair of an umbilical hernia in 1 patient and bilateral oophorectomy in 1 patient. Only one complication occurred during surgery and this was a two litre haemorrhage from the perivesical venous plexus.

Table 5 indicates the postoperative complications.

TABLE 5 Postoperative Complications

Acute cholecystitis	1
Congestive cardiac failure	1
Reactionary vaginal haemorrhage	1
Bradycardia	1

All cases were drained by a suprapubic Bonnano catheter: the mean time when spontaneous voiding was resumed was the fifteenth postoperative day (range 6-37 days). Continence was achieved in 14 patients (74%) as shown by clinical, V.C.U. and Urilos assessments. There were 5 patients who had persistent urinary incontinence.

Table 6 illustrates their postoperative condition.

TABLE 6

Name	Causative factors	Method of diagnosis of incontinence			
		Symptoms	Signs	Urilos	V.C.U.
E.M.	Two previous operations	+	-	-	+
E.A.	Inadequate bladder neck elevation	+	-	-	+
R.W.	Cauda equina lesion	+	-	+	-
E.J.	Unknown	+	-	+	-
L.T.	Unstable	-	-	+	-

One patient remained wet and later proceeded to an ileal conduit diversion and then a lumbo-sacral decompression for a progressive cauda equina lesion. The remaining 4 patients had their incontinence improved.

DISCUSSION

The patients with genuine stress incontinence who were not considered for surgery had either refused it or were rejected because of poor physical health or mental frailty. They were treated conservatively by catheter drainage or drug therapy. The patients selected for surgery had a "manageable" medical problem and in some cases were jointly cared for by the physicians after surgery. This procedure worked well and in addition we would recommend that any patient already on a medical ward, should be returned to that ward immediately after surgery, to minimise the risk of disorientation following anaesthesia, which is common in the elderly.

Only one complication (venous haemorrhage) was encountered during surgery. The postoperative complications (Table 5) were both surgical and medical, illustrating the need for a combined and careful postoperative management.

The onset of spontaneous micturition appears to be adversely affected by age: the mean of 15 days may be compared to the mean of 10.5 days (range 6-25 days) for women under the age of 65 years treated by colposuspension. The importance of this is:

1. to forewarn the patient and relatives that there may be prolonged catheter drainage following surgery.

2. to ensure adequate catheter drainage of the bladder preferably by a suprapubic catheter.

On symptomatic assessment, 15 patients (79%) were cured. However objective assessment corrected this to 14 patients. The remainder were improved except 1 patient who requested a diversion. Subsequent investigation revealed that her cauda equina syndrome was progressive and a lumbo sacral decompression was performed. It would seem that a lower motor neurone syndrome is a contraindication to incontinence surgery. Of the remaining failures, only 1 case seemed related to old age, where there was failure of adequate elevation of the bladder neck, caused by difficulty in mobilisation and lack of elasticity of the paravaginal fascia. One patient developed detrusor instability following surgery. This has already been documented and may be related to a combination of previous surgery and to the extensive surgery employed in the colposuspension dissection.

CONCLUSION

Careful selection of patients can lead to a modest cure rate for genuine stress incontinence in elderly women. This is worthwhile when considering the few complications encountered during and after surgery and the independence they have now achieved and the alternative incomplete cure which would have been afforded by conservative therapy.

ACKNOWLEDGEMENT

I should like to acknowledge the help and advice of Dr. Peter Millard and Dr. Das, Consultant Geriatricians at St. George's Hospital and St. Helier Hospital respectively.

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France

suprapubic drainage

infection less for 5 days

after same as transurethral

No clamping

A PRE AND POSTOPERATIVE EVALUATION OF THE USE OF THE COLPOSUSPENSION WITH TWO VAGINAL FLAPS FOR THE CORRECTION OF URINARY STRESS INCONTINENCE

U. Bologna

Professor of Obstetrics Gynecology and Gynecological Urology, University of Rome, Italy

ABSTRACT

Radiological and urodynamic investigations were performed pre and postoperatively in the patients submitted to colposuspension using two flaps of anterior vaginal wall, passed to prevesical space and fixed to Cooper's ligaments, for the treatment of urinary stress incontinence.
In all cases clinically cured the radiological findings (urethro - cystography, colpocystography) were normal. In the cases with improved or persistent incontinence there was no radiological change. In the cases investigated urodinamically normal data was observed in 77% of the patients clinically cured.

At the 6th annual Meeting of the International Continence Society (Antwerp,1976) I proposed a new surgical technique for the correction of urinary stress incontinence in women, already performed with good results in the Urology Clinic of the University of Rome. The technique, employed more often for the relapsing cases, consisted in the preparation of two flaps from the anterior vaginal wall complete with the corresponding Halban's fascia. These flaps, drawn to the prevesical space through two paracervical apertures, realized in the deep perineal fascia, are fixed to Cooper's ligaments.
At the 7th annual Meeting of I.C.S., held at Portoroz (Yugoslavia) 1977, I reported employing in a few cases the technique described without the vaginal phases, when the correction of U.S.I. was combined with a total abdominal Hysterectomy. Specifically the preparation of the two vaginal flaps, instead of from below, as seen in the original technique, was performed via abdominal approach after asportation of the uterus. This semplified the method in such a way as to reduce the steps and the surgical manouevres.
Five years after the initial use of this method I am able to furnish evidence of its effectiveness. From 1973 to the present 79 patients with relapsing U.S.I., selected from all of the cases with U.I., recovering in the Urological and Gynecological Clinics of the University of Rome, were submitted to surgical correction of the defect using

this abdomino-vaginal operation. Before the operation they were systematically investigated with functional urethrocystography, sometimes associated with colpography and integrated by the urodynamic examination (cystometry, urethral profile, E.M.G.). After the operation all patients were studied radiologically and a number were controlled urodynamically. The uroradiologic examinations were performed in the Radiology Division of the Urology Clinic of the University of Rome. Urografin was used for the visualization of the bladder and Barium sulphate cream was employed in the cases in which colpography and cystography were performed together (colpocystography). Antero-posterior and lateral projections were used in the standing patients at rest and under stress. The percentage of cures even with the passage of time was very satisfactory.In fact, of 79 cases operated, we noted 73 cures (92%), 4 improvements and 2 failures.

Steen et al. in a recent postoperative evaluation of the surgical treatement of U.S.I. in women (vaginal repair or colposuspension), were able to report no difference in the urodynamic findings between the cured patients and the failures.

More recently other authors (Gaudenz and Weil,1977) confirmed these findings. They found a urethral closure pressure stress profile equal to that of an incontinent patient in 84% of the clinically cured cases after M.M.K. operation and 75% of the clinically cured cases after Pereyra operation. Regarding radiographic control, they noted normalization of the angles in 76% of the clinically cured cases after M.M.K. operation and in only 28% after Pereyra operation.

In our subjectively cured patients, the radiographic examinations after the new operation were all modified to a degree that could be considered normal.

In the cases of the improved group, or in the failures, the examinations showed insignificant modifications. In the 18 cases observed the urodynamic investigations of 14 showed normal findings, corresponding to a clinical cure.

Even if the cases investigated urodynamically are too few to have a definate statistical value, they represent important findings, which, together with radiologic data, would positively support the proposed technique.

A hypothesis to explain the difference between these results and those of the other techniques is based on the profound modifications of the pelvic architecture of the urinary tract, obtained by the new method. It is obvious that the cure is of prime importance. But we know that the factors responsible for the correction of U.S.I. are numerous and related to the anatomical and functional characteristics of the subject. Founded on a vast base of anatomical and functional, the various types of investigation of the clinically cured patients, represents a more sure guarantee of success. These characteristics in fact are not only proven by the subjectively evaluated results, but also by those demonstrable objectively.An analysis of the particular modifications of the pelvic structures that are obtained by the new technique, shows that the urethra is elongated by traction and stret-

ching, resulting in the reduction of the lumen and an increase of the tone. Besides this its relationship with the pelvis and the pelvic floor are profoundly changed. In fact the urethro-vertical angle is reduced and the primary tract of the urethra, having first been below, is now drawn above the pelvic diaphram. Furthermore this is elevated together with the vagina, forming a firm rest for the urethra. Most significantly the urethra is subject to the augmented endoabdominal pressure, which brings about an increase in urethral closure pressure. The relationship between the various segments of the inferior urinary tract is tangibly modified by the elevation of the bladder neck and the cranial portion of the urethra, which brings about a reduction of the degree of the urethro-vesical posterior angle. Even the bladder, together with the urethra and the bladder neck is drawn up by the traction from the vaginal flaps, fixed to Cooper's ligaments and sustained by the elevation of the vagina and pelvic diaphram. The effect of this elevation in the normalization of its relationship with the pelvis, pelvic floor, bladder neck and urethra. The difference in the results obtained by the new technique regarding its relationship between urodynamic and radiographic findings is explained also by the support given by the posterior colporraphy, systematically realized, and by the anterior colporraphy. The last mentioned repair closes the gap, left on the anterior vaginal wall by the removal of the flaps.

In conclusion we are able to state that the results obtained are encouraging and warrant the use of the method.

URINARY INCONTINENCE BEFORE AND AFTER PELVIC FLOOR SURGERY

Thelma M. Thomas, A. M. Fisher, Jacqueline M. Walsh J. Imeson and T. W. Meade

Northwick Park Hospital, Watford Road, Harrow, Middlesex, England

ABSTRACT

A postal survey was carried out of 210 women who had had operations for prolapse or urinary incontinence. 121 (57.6%) were incontinent before operation and 89 (42.4%) were not. Of the incontinent group 56 (46.3%) were still incontinent at the time of the postal survey; 65 were not. Of the 89 not incontinent before surgery 17 (19.1%) reported incontinence at the time of the postal survey. 49 of the women reporting incontinence at the time of the survey were interviewed. 25 considered their incontinence was not a major problem but 24 felt that it was. Some of the latter might benefit from health or social services which they otherwise do not seek or receive.

INTRODUCTION

Various estimates have been made of the prevalence of urinary incontinence in women (Refs. 1 - 6). Urge and stress incontinence are frequently, though not invariably, associated with anterior vaginal wall prolapse. However, it is not clear how often these urinary symptoms are found in association with prolapse and there are conflicting reports of the effect of pelvic floor surgery on these symptoms (Refs. 7,8). As part of a larger study of incontinence in the London Boroughs of Harrow and Brent we have investigated the prevalence of urinary incontinence in women who have had pelvic floor surgery.

PATIENTS AND METHODS

The patients were identified from the theatre record books of Northwick Park Hospital between 1970 and 1976 (inclusive). All patients who had vaginal operations for prolapse or urinary symptoms were included. Clinical details were extracted from the patients' hospital records.

290 patients were identified but 40 were excluded from further study; of these, 16 had died, 12 sets of notes were not traced,

four patients were on the waiting list for further surgery for incontinence and eight had other medical conditions making further study inappropriate.

A postal questionnaire was sent to the remaining 250 patients; 216 (86.4%) replied. Six questionnaires were incomplete and were omitted from further study, leaving 210 patient questionnaires for analysis. Questions were asked about pre and post-operative incontinence and the women were also asked whether they considered their "bladder control" was unchanged, better or worse since operation.

Women were defined as "Incontinent" preoperatively if this symptom was recorded in the clinical notes, whether or not it was the main complaint. At postal follow-up only those women who stated they were incontinent twice or more a month were included in the 'Incontinent' group.

The mean duration between surgery and postal follow-up was 3½ years (range 6 months - 7 years).

A total of 73 women answered in the postal questionnaire that they were incontinent twice or more a month and 68 still lived in the locality; of these 49 were interviewed at home by a survey team nurse using a structured questionnaire. The remaining 19 refused interview.

RESULTS

Results are summarized in Table 1 for the 210 women who gave complete information.

TABLE I

Patients Assessments of Bladder Control In Relation to Incontinence

		Bladder Control		
	Number	No Change	Better	Worse
A. Patients incontinent preoperatively and at postal follow-up	56	22	24	10
B. Patients incontinent preoperatively and not at postal follow-up	65	12	52	1
C. Patients not incontinent preoperatively nor at postal follow-up	72	44	25	3
D. Patients not incontinent preoperatively but incontinent at postal follow-up	17	4	1	12
TOTAL	210	82 (39.0%)	102 (48.6%)	26 (12.4%)

The higher prevalence of incontinence in the postal survey (34.8%) than at the six weeks hospital follow-up (17.1%) may reflect the development of incontinence later than six weeks postoperatively or underreporting of incontinence at the postoperative visit. The lack of an association between the prevalence of incontinence in the postal survey and the time since operation suggests the latter.

The definition of incontinence used in the postal survey was intended to identify only those women who felt they had a significant problem. Nevertheless the interviews suggested that 22 (32.4%) of 68 incontinent women were satisfied with the results of surgery and accepted their residual symptoms. The 19 (27.9%) who refused interview may have done so because they did not consider they had a significant problem and there is some evidence of this from their replies.

There remains, however, a small group of women - 24 (11%)-in our series with an embarrassing, socially disabling and costly condition. Some of these women might benefit from services which they are not at present seeking.

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ACKNOWLEDGEMENTS

We thank Mr. I. McFadyen and Mr. H. Gordon for their help with the study and Mrs. T. Jones for preparing the manuscript.

A total of 121 patients - Groups A and B - were incontinent before pelvic floor surgery; 65 (53.7%) of these patients were not incontinent at postal follow-up but 56 (46.3%) were. In line with these findings "bladder control" was said to have improved or to be unchanged in 64 of the 65 patients no longer incontinent. In the 56 patients who were still incontinent, 46 reported "bladder control" to be unchanged or better while 10 patients said it was worse.

Of the 89 - Groups C and D - not incontinent preoperatively, 17 (19.1%) reported incontinence at postal survey of whom 12 stated that their "bladder control" was worse. Only 3 out of the 72 patients not incontinent pre-operatively nor at postal follow-up said their "bladder control" was worse.

Information from the hospital notes showed that 36 (17.1%) reported incontinence at the postoperative visit six weeks after surgery. At postal survey, 73 (34.8%) - Groups A and D - of the 210 women were incontinent. However, the prevalence of incontinence at postal survey follow-up was not related to the length of time since operation.

Of the 49 women with post-operative incontinence who were interviewed, two were in fact not incontinent and one was too confused for her answers to be recorded. Twenty-two of the remaining 46 felt that their operation had been successful, though four wore protective pads continually. Twenty-four were dissatisfied with the results of their operation and 13 wore pads continually. Questions about other symptoms were not included in the structured interview, but five women complained of dyspareunia and five of severe pruritus, symptoms which they had not reported to their doctors. Twelve of the dissatisfied women did not want further medical advice for their incontinence because they were not prepared to undergo further surgery; four wanted further advice but had not sought it.

Fifteen of the 46 women had not told their doctors that they were still incontinent. Twenty-two said they were embarrassed or socially restricted by their incontinence. Seventeen had extra washing and all the women using protective pads - sanitary towels, Paddipads or cotton wool - were buying them themselves.

DISCUSSION

Most of the women in this study were operated on for symptoms of prolapse and they expressed a high level of satisfaction with the results of surgery from this point of view.

As far as urinary symptoms are concerned 184 (88%) women (Table 1) felt their bladder control was better or no different than before surgery but most of the remaining 26 (12%) had troublesome incontinence.

A few inconsistent replies were noted. Two women who recorded incontinence in the postal survey denied this at interview. Another woman who said her incontinence was cured claimed her bladder control was worse; she attributed this to recurrent cystitis. In the postal survey 139 women stated they were incontinent before operation but this was recorded in only 121 preoperative case histories.

A NEW METHOD IN THE TREATMENT OF FEMALE URINARY INCONTINENCE. PRELIMINARY RESULTS

C. Frimodt-Møller, J. Kielmann, E. Lykkegaard Nielsen, T. Bonnesen and S. Mortensen

State University Hospital, Copenhagen and Esbjerg Municipal Hospital, Denmark

ABSTRACT

A new surgical procedure is presented where a levator-ani-muscle repair is performed by abdominal approach. The method is discussed in the light of the traditional techniques. A preliminary report of 47 patients treated by this method is presented. Clinical cure was found to a high extent, and the results were particularily excellent in patients with bladder-base insufficiency.

A procedure for the correction of stress-incontinence has been devised which differs from the above-mentioned procedures by correcting the position of the bladder neck and lengthening the urethra without any direct interference of the bladder neck or urethra at all. A plastic repair of the levator ani muscles anteriorly and posteriorly to the vagina is the essential part of the procedure. The method will be discussed in detail and the preliminary results of the operative method performed in 47 patients will be presented.

METHOD

The operative stages are as follows:

1. The patient is placed in the supine position.
2. A 16-French Foley catheter is inserted into the bladder and the balloon inflated with 5-10 ml of saline.
3. A lower midline or long left paramedian incision is used.
4. The anterior muscular repair is performed through a transverse incision of the pelvic peritoneum in the vesico-vaginal pouch. A few scissor-cuts start the dissection which is then continued with gauze pushers to expose the anterior vaginal wall and the urethra down to the lower edge of the pubis.
5. The transversally orientated muscular fibres of the levator ani muscles are displayed laterally and can be distinguished by a thin glincening fascia covering the medial edges of the muscles. There is usually no difficulty in mobilizing the muscles, but if scarring is present because of previous vaginal procedures, dissection laterally is necessary. Notice must be given to the ureters that may be medially displaced due to previous surgery. The anterior repair of the

levator muscles can now be performed.
6. Four sutures (dexon or chromic catgut no. 0) are inserted in the left and right levator ani muscle, the anterior suture being placed close behind the bladder wall, and the posterior suture just in front of the vagina.
7. The posterior repair is performed through a transverse incision of the pelvic peritoneum in the fossa Douglasi. As with the anterior plastic procedure dissection between the rectum behind and vagina in front is easily performed by blunt dissection down to the anorectal ring unless a posterior vaginal repair previously has been attempted.
8. Closely related to the peritoneum and immediately lateral to the incision the almost vertically positioned muscle fibres of the levator ani are found. The fibres are caught with a forceps and freed from connective tissue. Three sutures (dexon, no. 0) are then placed in each muscle from just behind the vagina and down in front of the rectum taking care of not making a stenosis of the rectum.

Post-operative management: the bladder is drained for 5 days and the patient kept in bed for 2 days.

MATERIAL

Forty-seven female patients were operated upon as described, their age ranging from 30 to 81 years (mean 56,4 years, median 52 years). They had suffered from urinary incontinence between ½ and 22 years . Pure stress-incontinence occured in 21 cases, pure urge in 17 cases, mixed types in 6 cases, and in 26 cases there were complaints of more or less constant dribbling. The majority of patients had had several unsuccessfull operations performed, averaging 1,5 operations pr. patient. Anterior and/or posterior vaginal repair had been performed in 45 cases, hysterectomy in 15 cases, colposuspension i 6 cases and ventrosuspension of the bladder and uterus in one case. Eleven patients had had three or more operations performed. An extensive urological, urodynamic and radiological investigation was performed prior to and following the levator-muscle repair.

A follow-up was performed three, six and twelve months following operation. An evaluation similar to the preoperative investigations was performed.

RESULTS

The table shows the classification of bladder dysfunction at the time of operation and the clinical results following surgery. In this preliminary study only 24 of 47 patients have until now been investigated at 6 months' follow-up and only 10 patients have been followed for more than 12 months.

Urodynamic investigations at follow-up disclosed lengthening of the urethra and increase in maximum urethral closure pressure, especially seen in patients with bladder base insufficiency. The other urodynamic parameters (cystometry and pressure-flow studies) did not show any consistent findings apart from slightly increased voiding pressure and continuous flow. Micturition-cysto-urethrography confirmed the findings from the urethral pressure profile since the bladder neck in all the successful cases was in its right position

and the configuration of the urethra and bladderneck practically normal.

In a few cases come patients complained of transient pain in their loins, and some patients had minor difficulty in defæcation.

DISCUSSION

It has been stated by Enhörning (1961) that urinary continence is achieved when the bladder neck and proximal urethra are elevated into the abdominal pressure zone. Practically all the operations up till now tend to accomplish this statement by manipulating with the bladder neck (sling operations) or lengthening the posterior urethra (urethropexy). These procedures may lead to mechanical obstruction with concurrent problem: residual urine, infection, injury to the urethra and/or the bladder, annoying narrowing of the vagina resulting in dyspareunia, osteitis of the pubis and rather frequent recurrence of incontinence.

With the abdominal levator-muscle repair the bladder neck and urethra are not at all involved since the suturing of the levatur muscles is performed proximal to the bladder neck. Nevertheless, urethral pressure profile studies as well as micturition-cysto-urethrography demonstrate lengthening of the urethra, an increase in the maximal closure pressure profile, and - depending on the type of vesical dysfunction - very often normalization of the bladder neck as seen on X-ray. The vaginal length is usually increased, and there have been no complaints of dyspareunia. In a few cases uninhibited bladder contractions have been found at follow-up, but they have all been eliminated by parasympatolytic agents. Residual urine has been eliminated, even in a 41-year old female with an infranuclear bladder paresis ("pelvic bladder") since she was able to exert much higher pressure on her bladder by straining without kincking the urethra due to bladder descent.

CONCLUSION

Although the long-term results of the abdominal levator-muscle repair are rather limited it is apparent that this new contribution to treat urinary incontinence in females is a welcome aid. From the present study material of selected patients with recurrent incontinence following unsuccessful surgery it may be concluded that especially patients with bladder base insufficiency may benefit from this type of surgery.

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	PREOPERATIVE FINDINGS.	POSTOPERATIVE CLINICAL FOLLOW-UP. (CURED +, IMPROVED (+), UNCHANGED -)		
	No. OF PTS. (N)	3 MONTHS N	6 MONTHS N	12 MONTHS N
BLADDER BASE INSUFFICIENCY (DEFECT OF ANTERIOR BLADDER SUSPENSION)	20	20 { 19 +, 1 - }	12 { 8 +, 1 (+), 3 - }	3 3 +
VESICAL DESCENSUS (CYSTOURETHROCELE)	15	15 { 12 +, 1 (+), 2 - }	6 { 3 +, 3 - }	3 3 +
TRIGONOCELE (CYSTOCELE)	1	1 1 +		
DETRUSOR HYPERREFLEXIA (UNSTABLE BLADDER)	2	2 2 +	2 2 +	2 2 +
INFRANUCLEAR BLADDER PARESIS ("PELVIC BLADDER")	1	1 1 -		
NON-CLASSIFIED	8	8 { 7 +, 1 - }	4 4 +	2 2 +
TOTAL	47	47 { 41 +, 1 (+), 5 - }	24 { 17 +, 1 (+), 6 - }	1o 1o +

Pre- and postoperative findings in 47 urine incontinent females treated with the levator-ani muscle repair.

POSTER PRESENTATIONS

VIDEOTAPE EVALUATION OF VESICAL NECK FUNCTION IN THE FEMALE

Jack R. Robertson

Associate Clinical Professor of Obstetrics and Gynecology, University of Southern California Medical School, Los Angeles, California, U.S.A.

INTRODUCTION

During the past three years the author has evaluated vesical neck function in female patients using a female urethroscope and carbon dioxide gas for insufflation. Every patient examined by urethroscopy is examined in this manner. A total of 1641 patients have been examined, and 35 hours of videotape have been recorded.

A television recording with a videotape record has the following advantages:

1. Binocular vision.
2. Significant magnification. The new monitors have good resolution with marked magnification.
3. Instant replay.
4. The image may be seen by many observers, including the patient.
5. Storage. It is a permanent record.

INSTRUMENTATION

The Robertson™ gas urethroscope has an 180 degree view (straight ahead). It is 8 inches long, and the 24 French sheath is tapered at the end for easy insertion. The light cord and gas tubing attach to the handle, which is swedged to the telescope.

The Robertson™ Endoscopy Monitor records opening urethral pressures, cystometrograms under endoscopic control, and urethral pressure profiles.

A continuous permanent record of the pressure and volume of gas delivered to the patient is recorded on a precision X-Y recorder. The gas flow rate is optional.

TECHNIQUE

The patient is placed in the lithotomy position. A Sims speculum is placed in the vagina to spread the labia and make the urethral meatus easily available.

The tapered end of the 24 French scope is placed at the meatus, and the force of the gas flow overcomes the urethral resistance as the urethroscope is threaded through the urethra. The examiner views the urethra through the endoscope as the opening pressure is recorded. After entering the bladder, the gas is turned off, and a urinary residual is collected.

The tip of the scope is withdrawn from the bladder until the tip is approximately half a centimeter distal to the vesical neck. The vesical neck is observed as the bladder is insufflated with carbon dioxide.

Vesical neck closure patterns, as viewed by gas urethroscopy, are:

Normal

1. Average opening urethral pressure of 80 cm water.
2. No urinary residual (less than 50 ml).
3. Bladder trabeculations are not present.
4. Normal bladder capacity with stable bladder (inhibition of micturition).
5. Normal cystometrogram.
6. Vesical neck is up behind symphysis and does not drop with "bear-down" maneuver.
7. Patient notes urge to void at about 100 ml insufflation.

Genuine Stress Incontinence

1. Low opening urethral pressure.
2. No urinary residual (less than 50 ml).
3. First urge to void at 100 ml insufflation.
4. No bladder trabeculations.
5. Bladder capacity is normal.
6. Stable bladder (inhibition of micturition).

7. Vesical neck not supported. Funnels and opens with "bear-down" maneuver.

8. Normal cystometrogram.

Unstable Bladder

1. Opening urethral pressure usually high.

2. First urge to void occurs early.

3. No urinary residual (less than 50 ml).

4. Fine bladder trabeculations may be present.

5. Unstable bladder. Inhibition of micturition is absent.

6. Bladder capacity is usually decreased.

7. Vesical neck is well supported.

8. Abnormal cystometrogram. Increased pressure and shift to the left.

Neurogenic Bladder

1. Opening urethral pressure very high or low.

2. Urinary residual present.

3. Bladder trabeculations present.

4. Abnormal cystometrogram. Hypertonic or Hypotonic.

5. Vesical neck supported.

6. Urge to void is early. Hypertonic.

7. Vesical sensation is absent. Hypotonic.

8. Bladder capacity low. Hypertonic.

9. Bladder capacity large. Hypotonic.

SUMMARY

Urethroscopy, using gas for insufflation, allows urethral and bladder pressures to be recorded during endoscopic evaluation. A television camera with a videotape recording makes a permanent record of vesical neck function. The entire procedure requires 10 to 12 minutes.

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THE START/STOP TRIAL

Angela Shepherd and R. C. L. Feneley

Clinical Investigation Unit, Ham Green Hospital, Bristol, England

ABSTRACT

Stress incontinence is common in women of reproductive age. It has been suggested that this may be due to an inability to use the voluntary muscles of the pelvic floor. Results of a preliminary trial relating the ability to stop voiding in mid-stream are reported. It is concluded that those women with symptoms of stress incontinence are not able to contract the muscles of the pelvic floor as well as asymptomatic women.

Stress incontinence alone or combined with urge incontinence is common in women of reproductive age and accounts for the symptoms of 25% of those seen in our unit. It is particularly common in parous women and the clinical impression is that it is associated with multiparity and difficult vaginal deliveries. It has been suggested that this problem may be due to the failure of these women to use the muscles of the pelvic floor effectively.

This trial was set up to see if a relationship could be established between the presence of urinary symptoms during and after pregnancy and the ability to contract the muscles of the pelvic floor. The strength of these muscles was recorded as was the woman's ability to stop voiding while in mid-stream. These measurements were performed at different stages of gestation and after delivery.

METHOD

A small preliminary trial was conducted during routine ante and postnatal clinics. Only those women wishing to void were asked to participate. 42 have been investigated but 9 had to be excluded as they passed less than 100 mls of urine. Of the remaining 33 women there were 24 antenatal and 9 postnatal cases. Details of age, height, weight, parity and obstetric history were noted. Special attention was paid to bowel habit and to urinary symptoms of frequency, urgency and incontinence both in the pregnant and post-partum state.

The procedure was explained to the woman first. Using a Mictiograph situated in privacy and with running water to hand, she was asked to void and as the peak flow was reached the command to "Stop" was given. The time from command to its execution was recorded, the act of micturition was completed and the total volume passed was measured. The ability of the woman to contract her pelvic floor muscles was then tested by using a periniometer based on the one described by Kegal in 1948.

RESULTS

Of the 24 antenatal cases the ages ranged from 18 to 36 years with an average age of 28 years; the average height was 1.6 metres. Parity was between 0.3 and the duration of pregnancy varied between 8 to 41 weeks.

16 women had no abnormal urinary symptoms, 4 complained of urgency of micturition, three of them had stress incontinence and one had mixed symptoms.

There were 9 postnatal cases with an age range of 18 to 41 years; average height was 1.57 metres and parity varied from 1 to 4. They were seen between six and ten weeks after delivery. Six of them were symptom-free, one complained of urgency and two of stress incontinence.

With these small numbers there was found to be no significance in the parity or method of delivery but there is a suggestion that symptoms arise in the second half of pregnancy.

When considering the time taken to stop voiding on command, all those with no symptoms were able to achieve this in less than 2.5 seconds. This appears to be the same time as nulliparous non-pregnant asymptomatic women of the same age. The three antenatal and two postnatal women who had stress incontinence all had a stopping time in excess of 3.0 seconds and the one person with mixed symptoms had a time of 2.6 seconds. All the others with urgency were able to stop within the normal limit of time.

When testing the active contraction of muscles surrounding the vagina using the periniometer the results tallied well with the stopping time. Of the asymptomatic women, only one had no idea of pelvic floor action. All the others registered a substantial pressure on the gauge between 3 - 6 cms H_2O. Those with stress incontinence had poor ability to produce a perineal squeeze and none created a pressure of more than 3 cms H_2O. Those with urgency of micturition presented a mixed picture, although our urodynamic results suggest that the majority of patients with this symptom have good control of their pelvic muscles.

CONCLUSION

There would appear to be a relationship between stress incontinence and voluntary control of the pelvic muscles. Men do not have this symptom except after trauma, and they have a far greater ability to contract the muscles of the pelvic floor when controlling the urinary flow. Recent advances in the understanding of the control of micturition indicate that in women the striated (or voluntary) component is better developed than the smooth muscle fibres. Rather than concentrate only on restoring the normal anatomy perhaps we should be designing our treatment to allow over-stretched and poorly functioning muscles to contract to their best advantage and to hypertrophy those muscle fibres which remain. This is a preliminary report on a trial which is still in its infancy.

We would like to acknowledge the support of the Medical Research Council.

REPEAT CYSTOMETRY

A. Murray, J. R. Sutherst and M. Brown

University of Liverpool

ABSTRACT

Repeat cystometry is a means of evaluating treatment of bladder disorders. A study was conducted in which this method of assessing response to treatment was appraised.

In 25 female patients cystometry was repeated after an interval of several days, and also serially on the same day. No interim treatment was employed.

The changes observed on repeat testing are discussed in relation to assessing treatment of the unstable bladder.

INTRODUCTION

In the management of patients with unstable bladder it is important to evaluate response to therapy by objective means. Parameters such as bladder volume at the first desire to micturate, bladder capacity, and the rise in detrusor pressure during filling are recorded before and after treatment. A bladder is considered to be less "unstable" if there is a higher first sensation volume, a rise in maximum capacity, less intrinsic pressure rise during cystometry, and less evidence of detrusor contractions.

Bladder function can be modified by the influence of higher centres in the central nervous system. Therefore the ability to accommodate more fluid in the bladder and perhaps to inhibit detrusor action may vary according to the emotional state of the patient. For example, observed changes in these parameters may be due entirely to familiarity with the investigative programme rather than to the treatment.

This study was designed to evaluate any variations in these measurements which may occur spontaneously on repeat cystometry.

Usually cystometry is performed after the patient has voided, but in some instances the test is repeated after catheter drainage. It was considered important to determine also whether the behaviour of the bladder depended on the prior method of evacuation.

PATIENTS AND METHOD

On our unit urodynamic investigation includes medium-fill cystometry using saline at 37°C instilled at a rate of approximately 50 ml per minute with the patient supine. In each patient an attempt is made to provoke detrusor contractions by asking her to cough while standing up with a full bladder. Urethral closure pressure profiles are measured by the method described by Brown and Wickham (1).

Twenty-five female patients with incontinence were tested in this manner, and then underwent repeat cystometry.

Each patient was allocated either to a stable group or to an unstable group on the results of the first assessment. Thirteen patients had some degree of bladder instability. Twelve were considered to have stable detrusors.

Repeat cystometry was performed on average nine days later. On this occasion three consecutive cystometries were performed with the patient in the supine position. In half the patients the bladder was emptied by catheter drainage after the first cystometry and by voiding after the second. In the remaining patients the order was reversed.

RESULTS

Repeat on separate occasion

In most patients in the stable group bladder capacity remained unchanged. Variations were expressed as a percentage of the higher bladder volume involved. Less than 20% was considered to be insignificant. In the unstable group bladder capacity tended to decrease (Table 1).

TABLE 1 Repeat cystometry on separate occasion

	Parameter	Decrease	No change	Increase
Stable	sdv	3	6	3
	bc	2	8	2
Unstable	sdv	8	4	1
	bc	7	5	1

sdv = strong desire to void (maximum cystometric capacity)
bc = bladder capacity after encouragement to hold

Repeat on same occasion

In both groups there were some individuals who showed definite improvement on successive cystometries (Table 2).

TABLE 2 Repeat cystometry on same occasion

	Parameter	Decrease	No change	Increase
Stable	sdv	2	7	3
	bc	2	5	5
Unstable	sdv	3	3	7
	bc	3	6	4

sdv = strong desire to void (maximum cystometric capacity)
bc = bladder capacity after encouragement to hold

Influence of passive or active emptying

Five patients who were unable to inhibit detrusor activity were excluded because bladder contraction occurred at the same time as catheter drainage. A sixth patient who was unable to void between cystometries was also excluded.

In the remaining 19 patients little difference was observed in subsequent bladder capacity when catheter drainage was compared with voluntary voiding (Table 3).

TABLE 3 Changes in bladder capacity following passive drainage

	Parameter	Decrease	No change	Increase
Stable	sdv	1	9	1
	bc	2	9	0
Unstable	sdv	2	5	1
	bc	2	6	0

sdv = strong desire to void (maximum cystometric capacity)
bc = bladder capacity after encouragement to hold

DISCUSSION AND CONCLUSIONS

In the practical management of patients with disorders of micturition it is important to know that the objectively measured parameters of bladder function do not change without treatment. This is especially important in assessing any method of treatment of the unstable bladder. Repeat cystometry after an interval of time is used in measuring the efficacy of oral drug therapy and serial cystometry has been used to evaluate parenteral drug therapy (2).

The results of our study suggest that the unstable bladder does not show spontaneous improvement after an interval of time. Therefore any improvement observed after treatment is likely to be real.

The fact that some patients show progressive improvement when serial cystometry is performed on the same day is in keeping with the fact that a favourable response to psychological support, bladder retraining, and bio-feedback techniques is sometimes observed (3, 4, 5).

The method of emptying the bladder between cystometries does not appear to modify its behaviour.

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FLUID IN THE PROXIMAL URETHRA AND THE UNSTABLE BLADDER

J. R. Sutherst and M. Brown

University of Liverpool

ABSTRACT

The underlying cause of the unstable bladder and the mechanism whereby the detrusor contracts in response to stress is unknown. One possible aetiological factor which has been suggested is the entry of fluid into the proximal urethra.

In 50 female patients attending a urodynamic clinic the proximal urethra was stimulated by the rapid injection of saline against the urethral wall. In none of the patients studied was a detrusor contraction initiated.

The relevance of the results in relation to the unstable bladder and its treatment is discussed.

INTRODUCTION

The recognition of the unstable bladder as a clinical entity (1) has meant that gynaecologists have become more selective when treating stress incontinence by surgical means. Only patients with genuine stress incontinence in whom there is no demonstrable element of detrusor instability are treated. However, it may be wrong to exclude all patients with unstable bladder from surgical treatment. A recent report from Beck and colleagues (2) has suggested that there is a group of patients with detrusor overactivity who can be cured by bladder neck repair. Satisfactory surgical results were obtained in over 60% of patients with both detrusor instability and bladder neck funnelling.

This report raises again the controversial issue that urine in the proximal urethra can cause detrusor action. Whether or not it can do so has been the subject of debate for over a century.

In 1874 Goltz (3) first suggested that the expression of drops of urine into the urethra could cause the micturition reflex, but neither Guyon in 1887 (4) nor Denny-Brown and Robertson in 1933 (5) were able to demonstrate any such facilitative response. However, Barrington in 1931 (6), and more recently Mahony et al in 1977 (7) were able to do so. Their studies demonstrated that the flow of urine across the urethral mucosa did cause contraction of the detrusor, but only continued contraction after it had already started. There was no definite evidence that the

entry of urine into the urethra could initiate a detrusor contraction.

On the other hand Karlson in 1953 (8) described definite bladder contractions when fluid was introduced into the proximal part of the urethra. Angell (9) also believed that fluid entering the urethra could trigger off contractions. At the I.C.S. meeting in 1976, Warrell (10) commented that at least on some occasions, the presence of urine in a mechanically weak sphincter seemed to irritate the bladder.

In an attempt to demonstrate whether or not fluid in the proximal urethra could cause a micturition reflex we conducted a small study in which we injected saline into the proximal urethra.

PATIENTS AND METHOD

The details of this study have been reported elsewhere (11).

Observations were made on 50 consecutive female patients attending a urodynamic clinic. The diagnosis* in the 50 patients was as follows: genuine stress incontinence (G.S.I.) was present in 16; incontinence due to unstable bladder (U.B.) was present in 14; mixed incontinence (G.S.I. and U.B.) was present in 7. Thirteen other patients had a variety of symptoms but their urodynamic tests were essentially normal.

A fluid-filled double lumen bladder/urethral catheter** was used to perform cystometry and to measure the urethral closure pressure profile (U.C.P.P.) by the method described by Brown and Wickham (12). Then with the urethral pressure channel positioned 1 cm from the bladder neck (as defined on the U.C.P.P.) 1 ml of saline was injected rapidly against the urethral wall (Fig. 1). During the injection, and for approximately 10 seconds afterwards, intravesical, urethral and rectal pressures were observed.

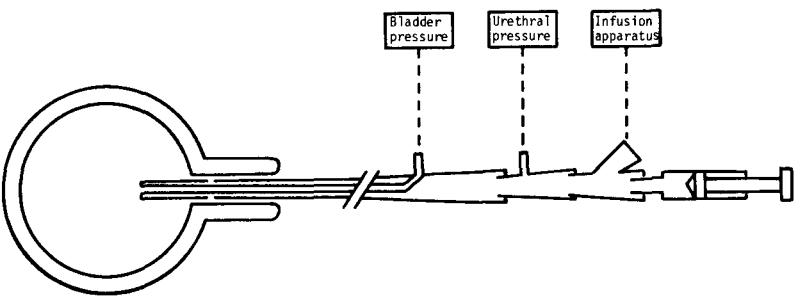

Fig. 1 Diagram showing the arrangement of the catheter, syringe and pressure lines.
(Reproduced by permission of Brit.J.Urol.)

*In this paper all methods, definitions and units conform to the standards proposed by the I.C.S. except where specifically noted.

**Portex Ltd., Hythe, Kent.

RESULTS

In none of the patients investigated was there any change in intrinsic bladder pressure following the injection. This was true even in patients with grossly unstable bladders in whom detrusor contractions had been provoked by medium-fill cystometry alone.

The results of this study indicated that whatever the type of incontinence in the female, sudden entry of fluid into the proximal urethra did not cause detrusor activity. The bladder remained stable, even though a considerable volume was instilled into the urethra very quickly.

DISCUSSION AND CONCLUSION

The underlying cause for most cases of bladder instability in women is still unknown, and this is reflected in the unsatisfactory methods of treatment available at present (13, 14). It is known that surgical treatment gives poor results, and in general women with unstable bladders are excluded from this. However, there are reports of surgery having been successful in some instances (2, 15). Unfortunately, there is no way of identifying these patients at the outset.

The fact that some women do improve following bladder neck surgery suggests that at least in these women there is some stimulus at the bladder neck which initiates the detrusor reflex. We had hoped that our study would have allowed us to divide patients with unstable bladder into two groups, one of which would be suitable for surgical repair of the bladder neck. In practice it did not do so.

The stimulus does not appear to be fluid in the posterior urethra. Perhaps there is some other change at this site which triggers off the stress-induced contraction, and which is as yet undetectable.

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THE SITTING AND STANDING URETHRAL PRESSURE PROFILE — A SIMPLE TEST FOR STRESS INCONTINENCE

R. O. Witherow and R. C. Tiptaft

Department of Urology, The London Hospital

INTRODUCTION

To distinguish detrusor instability from a defect of urethral closure is a fundamental aim of the investigation of incontinence in women. Several studies 1,2 have shown the urethral pressure to be lower in 'true stress' 2 or stable incontinence than in normal or detrusor incontinence, but the diagnostic value of the standard urethral closure pressure profile is lessened because of its wide normal range 3 and its variation with age 4. Edwards and Malvern 4 and Griffiths 5 found a rise in the urethral pressure profile associated with the erect position and Harrison 6 demonstrated a significant reduction in the profile amplitude in children with stress incontinence compared with normals.

We found in a few patients that if we compared the urethral closure pressure profile in the sitting and standing positions there seemed to be a marked difference between the alteration in the length and amplitude of the zone of high pressure in women who had stress incontinence compared with those who were normally continent.

The following study was prepared to determine whether in stress incontinence this observation could be of diagnostic significance compared with women who were normally continent.

METHOD

We studied five normal and eleven stress incontinent women. The continent group were being investigated for other urinary symptoms and gave their informed consent for a urethral pressure profile study. The women with stress incontinence gave a history suggestive of 'stress' and showed abnormal descent of the bladder base on the stress cystogram. All patients and normals first had a cystometrogram performed filling at 50 ml/min and all were observed to be stable; none had had previous surgery.

Urethral pressure profiles were performed with the bladder filled to 250 ml using a Porges 8 Ch twin hole catheter. The perfusion rate

was 2 ml /min with a transducer in line and withdrawal speed of 3 cm/min. The usual precautions 7 were taken to ensure accuracy.

First a profile was measured with the subject sitting comfortably on the side of a couch and this was followed by a second one in the standing position with the feet approximately one foot apart.

RESULTS

The typical profiles in the sitting and standing position in a normal continent subject (Fig. 1) show an increase in functional urethral length from 2.0 cm to 2.3 cm as well as an increase in the sitting urethral closure pressure of 70 cm H_2O to about 100 cm H_2O on standing.

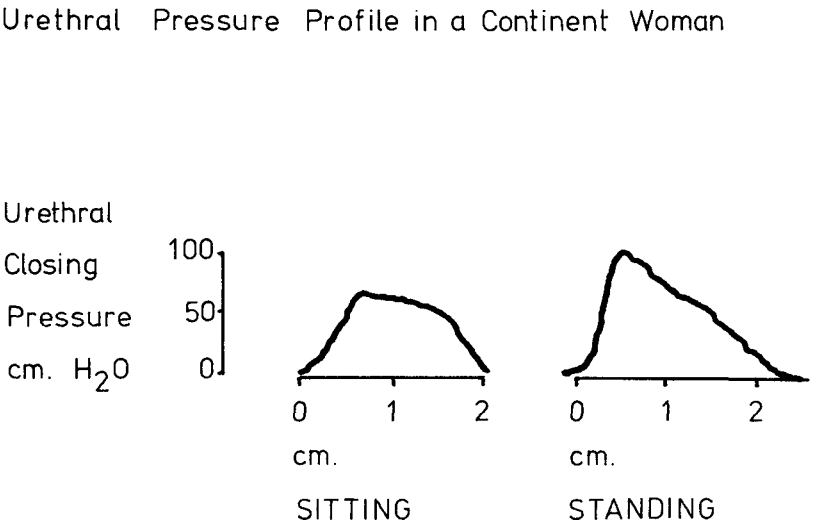

Fig. 1 Urethral Pressure in a Continent Woman

In stress incontinence (Fig. 2) the sitting and standing profiles show a reverse; i.e. a decrease in maximal urethral closure pressure and a shortening of the functional urethral length from 2 cm to 1 cm.

In stress incontinence there is a decrease in the area under the curve of the urethral pressure profile. To express this simply the following approximate method of integration was used by adding the values of the urethral closure pressure at half centimeter intervals and multiplying the sum by the functional urethral length: the quotent is termed the "urethral resistance factor". These urethral resistance factors in both groups of patients are shown compared in Fig. 3. The normal subjects show an increase in the urethral resistance factor from sitting to the standing position while there is a consistent fall in this factor in those patients with stress incontinence.

The mean maximal urethral closure pressure in continent women was 51 cm H_2O sitting and 92 cm H_2O standing.

Urethral Pressure Profile in a Woman with Stress Incontinence

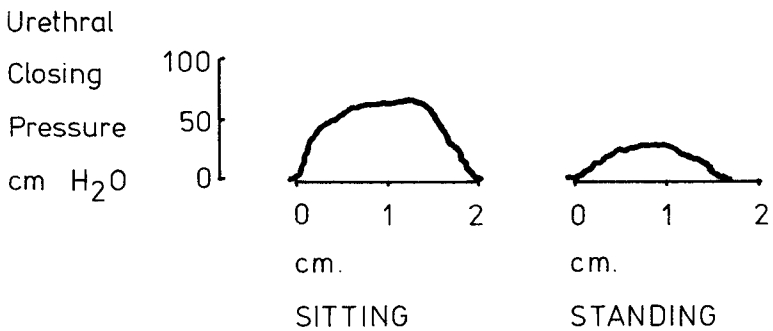

Fig. 2 Urethral Pressure Profile in a Woman with Stress Incontinence

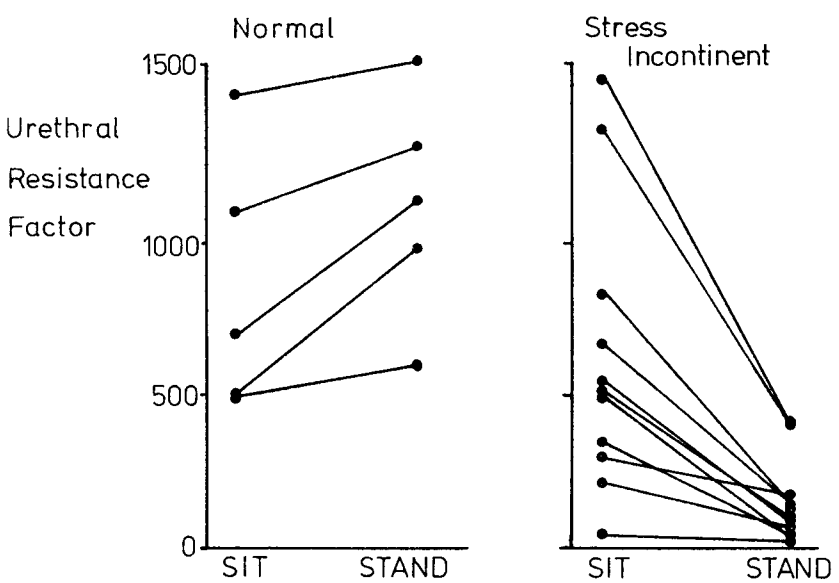

Fig. 3

DISCUSSION

It is fairly well accepted that isolated values of the urethral pressure are of little significance 4,6 but it does remain a reproducable measurement. In a large group of 'normal' subjects Harrison found the mean maximal urethral pressure to be 60 cm H_2O (8), in our small group the mean maximal value in the supine position was 78 cm H_2O.

Many mechanisms have been suggested for deficiency in stress incontinence but none of the conventional diagnostic aids including the history are completely reliable. We believe that this pilot study may provide a simple method for quantitating the change in the vesico-urethral mechanism associated with stress incontinence.

The addition of yet another term, urethral resistance factor, to the vocabulary of urodynamics is probably undesirable but we believe this simple addition of the profile values at half centimeter intervals related to the functional urethral length will lead to the determination by computer of the area under the curve thus enhancing the value of comparative urethral profiles.

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I would like to thank Professor Blandy for his assistance in this study and to Miss Jane Price for kindly typing the manuscript.

THE AETIOLOGY AND OBJECTIVE INVESTIGATION OF PSYCHOSOMATIC URGENCY INCONTINENCE

William K. Frewen

Consultant Gynaecologist, Royal Berkshire Hospital, Reading

ABSTRACT

The aetiology of the unstable bladder is discussed and the symptomatology of its psychosomatic aspect is reviewed. The treatment is outlined and the objective cystometric results of such treatment are determined. In a series of fifty consecutive patients in whom an organic bladder lesion had been excluded the objective cure rate was 82 per cent. The post-therapeutic follow-up was from three to nine months.

INTRODUCTION

An attempt has been made to analyse objectively the unstable bladder in which as far as is possible an organic or structural cause had been excluded. It is generally accepted that an emotional conflict may well be converted into a physical symptom and this kind of conversion syndrome is recognised by psychologist and psychiatrist alike. Quoted examples of this syndrome are peptic ulcer, pseudo-cyesis, spastic colon and emotional menorrhagia. Bladder behaviour under certain circumstances also exemplifies this process of conversion and it has the advantage that the resulting uninhibited autonomic activities can be monitored by cystometry. An objective assessment is therefore possible of the physical symptomatology which was initiated by an emotional or psychological conflict.

AETIOLOGY

The acceptance of the philosophy that the unstable bladder in which no discernible organic cause can be found is idiopathic in nature can no longer be sustained. It is inconceivable that such a prevalent disorder has no aetiological basis to account for its symptomatology. The medical profession as a whole has acknowledged that an emotional or psychological disturbance may well express itself in a physical disorder and this is particularly relevant to the female reproductive organs, because of their autonomic innervation. Likewise in the unstable bladder there is a loss or diminution of cortical inhibition of autonomic activities as a result of psychogenic disturbances. In such circumstances the bladder enjoying its freedom from central control will present symptoms of a bizarre and unpredictable physical nature. In time the physical aspects of the disorder will obscure the emotional background and as is usual in psychosomatic disturb-

ances the patients become quite unaware of the connection between the emotive and somatic aspect of their illness. This is particularly exemplified in the unstable bladder in which there is a clear disassociation between the physical and psychological components and in which as a result of this disassociation the diagnosis of the psychosomatic bladder has been delayed for more than a generation. Such a diagnosis will depend on the establishment of an emotive aetiology for the patient's symptoms and also of the exploration and evaluation of the relevant data peculiar to them. The emotive impulses responsible are of infinite variety and may be the result of an unessential triviality or, on the other hand, a major catastrophe. Direct questioning of the patient with regard to the onset of her symptoms will elucidate in almost all cases an emotional causation which is frequently of environmental or psycho-social origin. Characteristically the patient will never volunteer such an association but will accept it with enthusiasm as an explanation of her urinary symptoms which had previously bewildered not only the patient but also her medical advisors. If a psychosomatic aetiology is to be acceptable in urgency incontinence it follows that the symptomatology should support such a diagnosis and that the treatment applied should be objectively convincing. Apart from the classical symptoms of the unstable bladder, urgency and urge incontinence, nocturia and postural leakage, there are indeed other symptoms and factors characteristic of the psychosomatic nature of the disorder. Perhaps the copy-cat syndrome exemplifies this most clearly in that two or more members of the same family present the same symptoms of an unstable bladder and this presentation may extend into three generations. It is a recurring theme in some families and applies to both diurnal and nocturnal loss of urinary control. It is indeed a communicable disorder, as the child develops the urgency habit from her mother or from her brothers or sisters. A further aspect of the disorder is the predetermination of their symptoms. The patients know with certainty that a particular event, whether physical or mental, will produce incontinence of urine and they thereby establish a self-imposed conditioned reflex of a Pavlovian nature. The relationship between urgency incontinence and water in all its forms is well known but perhaps its iatrogenic aetiology has not been fully appreciated. The author has encountered numerous patients with an unstable bladder in whom the initiation of their symptoms directly evolved as a result of the running of water taps for the collection of urine specimens or for post-operative urinary retention. The transposition of symptoms from a nocturnal phase is not uncommon and can sometimes be seen in the enuretic, who, undergoing a spontaneous cure at or around the time of puberty develops an alternative diurnal pattern of urgency incontinence. Sometimes as a direct result of treatment the patient's symptoms may also be transposed from day to night. Another important factor in psychosomatic incontinence is the age group. It can occur at any age, but by far the most frequent occurrence is between the ages of 45 and 55 years. This is not unexpected in that it is the decade of emotional instability and psychological disharmony.

METHODS

An objective study of 50 consecutive patients with urgency incontinence of psychosomatic origin was made. Patients who had an organic, infective or structural abnormality, either in the urethra or the bladder were eliminated from the survey. The age group range was from 15 years to 77 years. Forty patients required hospitalisation for bladder drill treatment and the remaining 10 patients were treated in the Out-patient Department. Prior to the adoption of treatment all patients were investigated objectively by cystometry, with simultaneous rectal and bladder pressure recordings and a filling volume rate of 100 mls. per minute. After three months treatment cystometry was repeated. Those patients in whom the initial cystometric appearances were considered to be normal were omitted and not included in the series. The average length of stay

in hospital was 10 days and the patients were followed up at monthly intervals for three months. The investigation and surveillance of all the patients was done personally by the author.

TREATMENT

The essential aim of bladder drill therapy is to increase the bladder capacity day by day and to prolong the interval between the acts of micturition. Prior to the institution of bladder drill it is of paramount importance that the patient has a complete understanding of the nature and aetiology of her disorder and the methods proposed to overcome it. Without the patient's acquiesence and cognisance of the aetiological processes involved the results of treatment are likely to be disappointing. Providing the patient has a clear insight into the nature of her symptoms she will be ready to participate energetically in the measures necessary to overcome them and to accept the challenge to surmount her difficulties. On admission to hospital the patient is issued with a typescript on which is explained the nature of her disorder, how she can help to overcome it, the treatment she will receive and the certainty of an excellent prognosis providing she is willing to co-operate. Bladder discipline is maintained by the patient personally recording on a micturition chart the volume of urine passed, the intervals between micturition and the degree of incontinence present. Fluids are not restricted, although the patient is requested not to drink excessively in the evening. Communication with other gynaecological patients is encouraged and a sympathetic and constructive approach by both medical and nursing staff should always be available. Further supportive treatment is given by the use of drugs. Medical therapy in this respect is absolutely essential as the patients, for one reason or another, are certainly unable to overcome their urinary difficulties without the additional aid of the anticholinergic group of drugs and sedatives. Placebo trials have produced negative results even with the addition of a variety of sedative and anti-depressant drugs. Psychosomatic patients have an inbuilt selectivity with regard to drugs and as a result it may be necessary to alter medication until the most suitable combination can be ascertained. Cetiprin (Emepronium bromide) or Probantheline bromide have been employed extensively by the author and should be given in adequate doses. Cetiprin is given routinely in a dosage of 200 mgms. three times daily, but if the patient has severe nocturia or enuresis the last dose at night should be raised to 400 mgms. Probanthine, which is mostly employed in the younger age group, is given in a dose of 30 mgms. three or four times daily. Apart from dryness in the mouth adverse reactions are very unusual. Motival, a mild anti-depressant, is given to all patients and usually one tablet three or four times daily is sufficient. A ten day stay in hospital is usually required, but the patient must be kept on treatment for a period of three months and seen regularly at three or four weekly intervals.

RESULTS

The criterion of cure adopted was that the patient should be free from all urinary symptoms within three months from the start of treatment and that the cystometric appearances were within normal limits at the completion of treatment. It is important to realise that the disappearance of symptoms may well antedate the return to normal cystometry by a period of two to three months. Patients not fulfilling the criterion of cure stated above, were regarded as failures. In a series of 50 consecutive patients with urgency incontinence the abnormal cystometry nine failed to respond to treatment either from the symptomatic or cystometric point of view. The objective cure rate in the series was therefore 82 per cent. The nine patients who failed to respond to treatment were to some extent symptomatically improved, but on cystometry their unstable bladder showed only minor degrees of variation from the initial investigation. Seven of the nine

failures had environmental difficulties at home which were irremediable and certainly in the short-term it is doubtful whether such patients are amenable to any form of treatment. One patient had had incontinence for 70 years and the ninth patient was awaiting divorce proceedings.

DISCUSSION

The unstable bladder accounts for about 30 per cent of all cases of incontinence of urine in the female and of these 80 per cent are the result of an emotive or psychological event. The medical profession has failed to appreciate the significance or indeed the implications of psychosomatic incontinence and consequently a great deal of unnecessary suffering is endured by thousands of women of all age groups who, in the end, reluctantly resign themselves to their distressing symptoms and the inevitable sequelae. It is now, however, becoming clear to all those interested in the subject that the gloomy prognostications for such patients may well be erroneous and that bladder drill therapy can produce a beneficial and objective cure in most cases. The identification of the factors concerned in the aetiology of the unstable bladder is essential before the appropriate treatment is adopted. It follows, therefore, that if an organic cause cannot be found the adoption of an instrumental or surgical approach is unlikely to be curative. Certainly, in such circumstances bladder drill therapy should be instituted prior to surgical intervention because at the least it has the merit of being harmless to the patient. Furthermore, bladder drill is in itself a therapeutic test of bladder function in that patients with an organic disorder of the bladder, whether structural or infective, will not show clinical improvement with such a regime. Indeed in those patients who fail to respond to bladder drill the aetiological diagnosis is almost certainly incorrect. Bladder drill therefore has not only a curative value but also it is an additional aid in the differential diagnosis of the unstable bladder syndrome.

THE CO-ORDINATED MANAGEMENT OF INCONTINENCE

Dorothy A. Mandelstam

Edgware General Hospital and Disabled Living Foundation, London

INTRODUCTION

The writer is attached to a Department of Geriatric Medicine and is also Incontinence Adviser to the Disabled Living Foundation. The latter appointment entails active involvement with the problems of incontinent people throughout the United Kingdom, as well as participation in the education and training of those professionals concerned with their care.

In the past lack of interest coupled with incomplete knowledge and understanding has tended to produce a decidedly casual attitude to this complaint. The dearth of literature especially in relation to the practical management of incontinence makes this evident. This paper sets out to show that even with our present resources a greater awareness of the many aspects of the subject, and a more co-ordinated approach by all professional people involved in the care and management of elderly incontinent patients would lead to improved results. Two areas require consideration:

Firstly the need for a full and accurate assessment of each individual's particular problems.

Secondly the need for knowledge of the practical methods of management in addition to medical and surgical measures.

FULL ASSESSMENT

Medical

Naturally this involves a medical diagnosis including an accurate history of the past and present pattern of micturition. It also includes an appraisal of the general condition and mobility of the patient as well as the personality and emotional state. Life style and environmental circumstances have to be taken into account. The history supplied by the patient can be supplemented by information from relatives, nurses and other professionals involved.

Although at first glance some depth of assessment might appear easy to come by for the individual case this is not often so. The reason is that many general practitioners have a negative and pessimistic attitude which may be prompted by the scanty facilities available to the elderly in this situation. Development of clinics is needed where multi-disciplinary consultations are possible.

Nursing

As part of any assessment detailed and objective observations from a nurse are invaluable. Regrettably not all nurses have had much training in this subject and some special education is essential. This would make it possible to differentiate between the various types of incontinence, so that the appropriate form of management can be planned and instituted. In any urodynamic unit or incontinence clinic the staff must include a nurse as part of the multi-disciplinary team. In addition to patient care this is also in the interest of training and instruction so that nursing knowledge and expertise may be generally disseminated. In the United Kingdom the inadequacy of the care of the incontinent patient is recognised by the Department of Health and acknowledged by the Chief Nursing Officer in a circular letter to nurses the first in a series on Standards of Nursing Care. Two specific proposals are made:

That there should be seminars to discuss and disseminate information and research findings on matters related in particular to the promotion of continence.

That there should be identification of the subject in the work-load of an appropriate nursing officer, to act as a point of reference to nurses in all fields of the service.

The development of this service should not be confined to Urodynamic Units or Incontinence Clinics but these would be its main source of current knowledge and practice for nurses as well as doctors, and be centres for evaluation and supply of material resources.

PRACTICAL MANAGEMENT

This includes knowledge of methods of:

Maintaining continence where possible.
Strengthening and restoring bladder control.
Dealing with persistent incontinence.

Maintenance of Continence

In hospital certain important factors need to be considered.

1. The attitude of staff should be positive and reassuring in order to allay anxiety.
2. Someone must undertake to outline and explain ward treatment to patient.
3. Recorded observation indicating the pattern of micturition is essential.
4. Planned toiletting routine to meet bladder needs is required.
5. Some system of communication is needed for aphasic patients.
6. The provision of adequate toilet facilities is absolutely essential.

If lavatory accommodation is insufficient or inaccessible a supply of commodes or special type urinals is demanded, particularly for those patients aware of the urge to micturate. (Mandelstam (1))

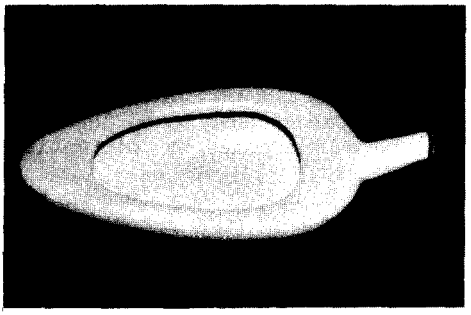


Fig. 1.

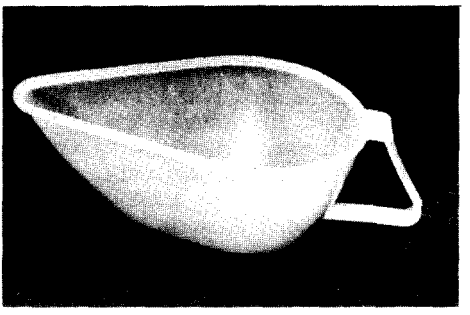
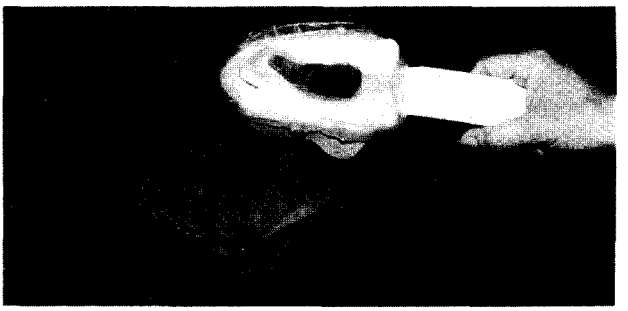


Fig. 2.

These illustrated small female urinals can be handled easily by the patient. One type 'Fig.1', kept near at hand could be the means of remaining continent especially at night. Another, 'Fig.2', is suitable for either sex used in standing or sitting on the edge of the bed or chair.



A new type of urinal, specially designed for the female anatomy, when held firmly to the perineum, can be used both in standing and the lying position.
Elderly patients often spend long periods in hospital, both in orthopaedic and medical wards as well as those in geriatric medicine. If adequate facilities are not provided to suit the individual's bladder rhythm the label of incontinence is inevitable.
Although this appears obvious, it requires from the doctor constant awareness and frequent discussion of ward routine and facilities and ongoing support of all staff concerned.

Methods of Bladder Control.

While the mechanism of continence in the main is involuntary it does include a voluntary element, and control can be developed successfully in treatment. The action of the pelvic muscles, particularly pubo-coccygeus, can be taught and used in varying degrees depending on the understanding and application of the patient. In its simplest form control can be initiated by stopping and starting the flow of urine during micturition. An awareness of this means of control often lessens anxiety and thereby contributes to physical improvement.
A course of muscular re-education (which in the female can be facilitated by the use of a visual aid, Kegel's Perineometer (2)) has proved successful in the treatment of genuine stress incontinence in women, and post prostatectomy incontinence. It also makes bladder drill easier, and some cases of urgency can be controlled just long enough for toilet facilities to be used.
Obviously, where possible, methods of voluntary control have advantage over others (Mandelstam (3)). The use of physiotherapeutic measures merit further evaluation (Brown (4)) not only in relation to actual treatment but also in helping to define the role of the pelvic floor muscles in continence.

Persistent Incontinence.

Where incontinence is proven to be intractable, despite all adequately applied regimes, some form of personal protection becomes necessary.

Pads and pants At present many patients, incompletely clothed, are 'anchored' to a chair. There is a variety of pads and pants available. When these are chosen to suit individual needs they permit a more active and independent existence. Age, general physical and mental condition, degree of mobility and dexterity, amount and occasion of leakage determine the choice.

Fig. 3.

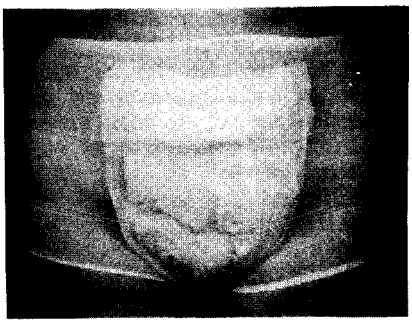


Fig. 4.

These are only two examples, each made on a different principle. The marsupial pant, Fig.3. made of hydrophobic material, enables the skin to remain dry, as the wet pad is enclosed in a plastic pocket on the outside of the garment and can be changed without removing the pants. These are not designed for night wear. A feather weight stretch pant, Fig.4. fits any wearer, is worn over a plastic backed pad, is easy to manipulate and can be worn at night.
Not only nurses need to know in some detail what each form of protection offers, but also medical interest is necessary for there is a need for trials and continuing assessment of such products. Manufacturers would welcome discussion.

Urinary appliances These may be suitable and prove acceptable to some male patients. Success, however, depends on skilled fitting which unfortunately is not generally available except through certain surgical supply firms.

Catheterisation In-dwelling catheterisation may well be the answer in certain elderly patients with intractable incontinence, and may allow some to return home. In others, however, catheters are used for medical and nursing convenience only and are allowed to remain in situ indefinitely. Before recourse to catheterisation, in each case there should be adequate evaluation of the patient's circumstances and bladder function. Furthermore there should be repeated assessment of the continuing need for the catheter, and adequate instruction regarding catheter care and maintenance. An increase in technical training is necessary and this would appropriately stem from an Incontinence Clinic.

CONCLUSION

Shortcomings in the care of the elderly incontinent patient have been outlined resulting mainly from deficiencies in education and training, and greater co-operation between the professional disciplines is advocated. As a pragmatic approach, the Urodynamic Unit or Incontinence Clinic could engender and diffuse knowledge, and lead to improved professional understanding.
In addition to diagnosis, a comprehensive assessment of the incontinent person establishes that practical management is just as relevant as medical and surgical treatment.

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ABSTRACT

The control and management of urinary incontinence is described with emphasis on co-ordinated care.

D. A. MANDELSTAM

A CLINICAL TRIAL OF PANTS AND PADS USED IN CASES OF URINARY INCONTINENCE

Angela Shepherd, J. P. Blannin and R. C. L. Feneley

Clinical Investigation Unit, Ham Green Hospital, Bristol, England

ABSTRACT

Active management of urinary incontinence is not always practical in the elderly and other methods have to be considered. A trial has been performed to assess the relative efficiency, acceptability and cost of different types of pants and pads which are marketed commercially but not always available within the Health Service. Twenty people living in the community and having different causes for their incontinence each tried all three different combinations. Information was collected on a proforma and the results together with impressions and conclusions are presented.

From a recent survey performed in the community we know that 25% of women and 10% of men have some problem of urinary incontinence. In those over 65 years 30% of women and 17% of men suffer from this distressing and socially embarrassing condition. It is an embarrassment not only to the individual, but also to those involved in her care. Surgical or pharmacological treatment is not always available or, indeed, always effective. In these people other methods of management have to be considered.

A trial has been performed to assess the relative efficiency, acceptability and cost of pants and pads specially designed for the incontinent. Three different combinations were used and each was tried for a period of one month.

MODEL NO. I

Pants were made of 100% polyester with waterproof outer pouch for holding the pad, made in six sizes and available with a side opening if required.

Pad 15 ply wadding with a permeable cover to allow rapid passage of urine and backed by a non-slip film of material.

MODEL NO. II

Pants made of elastic Helanca thread, knitted loosely, of universal size and with two Lycra ribbons to hold the pad in place.

Pad - cellulose pulp with a non-woven cover and backed by polyethylene.

MODEL NO. III

Pants made of strong nylon material lined with waterproof P.V.C. and with a holder for an incontinence pad, available with a side opening if required.

Pad - heavy wadding with an absorbent covering.

METHOD

Twenty people living in one area of the City of Bristol and who were already using protective garments took part in the trial which was carried out in the spring. They were all being attended by the community nurse on at least one occasion each week and the majority were living in their own homes. Four were being cared for in Social Service Homes. Information was collected on individual proformas, one for each type of commodity used.

There were eighteen women and two men. The ages ranged from 4 years to 84 years. There were four main causes for their urinary incontinence :- spina bifida, sub-normality, cerebro-vascular accidents and senility.

RESULTS

MODEL NO. I was found to be the most satisfactory. Only one man was not satisfied, having difficulty in manipulation before voiding. Several people thought that the pants would be too hot during the summer weather and four women complained that they were too bulky. Otherwise the garments were found to be well-fitting, comfortable and stood up well to wearing and washing during the trial month.

MODEL NO. II proved to be difficult to handle for those who had had strokes and for parents of the children who were disabled. For those with adequate dexterity and mobility this type was found to be economical, comfortable and washed well. The pants lasted throughout the month despite their frail appearance.

MODEL NO. III was the most unsatisfactory garment tried. There was too high an incidence of skin irritation, sweating and general discomfort for them to be acceptable. They were not very robust and tore easily. When washed they became hard and the general impression was that they were not suitable for summer wear.

None of the pads were totally satisfactory. All tended to disintegrate when wet, but Model II with the cellulose padding was the worst. Models I and III were reported as not being sufficiently absorbent in a number of cases. Overall, the pads used in Model I were the best but as these pants have a unique pouch for maintaining the pad, a real comparison cannot be made.

Disposal of the equipment was not a problem in the urban area in which this trial was conducted. Black plastic bags were provided by the Corporation on request and were collected at weekly intervals with the refuse. Those who burnt their disposables did so by choice.

The cost of these products varies considerably as does their life-expectancy. Although the price of Model I exceeds that of the others, four pairs properly cared for should last for 12 months, compared to twelve pairs of Model II and Model III, with a relative annual expenditure of £6.80, £3.60 and £6.00. Pads also varied in price and when the average number of each type of pad used daily is assessed on an annual basis Model I costs £92, Model II costs £248 and Model III £88.

CONCLUSION

Although the combination used in Model I appears superior in this small trial it is also apparent that there is a need for each person to be treated as an individual. Full facilities for trying all the different combinations of pants and pads should be available before a decision on the long term management is made. If each Area Health Authority had a central supply from which both hospital and community could obtain their requirements the demand would be sufficiently large for a variety of stock to be purchased at an economical price. Then medical personnel could provide garments in hospital in the knowledge that these are also available in the community.

We would like to acknowledge the support of the Medical Research Council.

AN ANTEPUBIC SLING OPERATION FOR CASES OF URINARY INCONTINENCE BECAUSE OF SCARIFICATION OF THE URETHRA OR DESTRUCTION OF THE SPHINCTER

Axel Ingelman-Sundberg, Jan Rosén and Anders Öbrink

Department of Obstetrics and Gynecology, Karolinska Institutet, Sabbatsberg Hospital, S-113 82 Stockholm, Sweden

The urethra kinking operation was published by Ingelman-Sundberg in 1951 (1) and recommended for cases with destruction or paralysis of the urethral sphincter. At this operation the urethra is lengthened up to the clitoris and covered by the bulbocavernous muscle, which is sutured over it together with the fat tissue in the labia. A kink of the urethra is thus created under the symphysis. When the patient starts to micturate the bladder base is lowered and the kink disappears. When the micturition is finished the bladder is elevated again and the kink re-established.

The primary results with this operation have been good. With increasing age of the patients, however, the tissue has relaxed and the kink formation disappeared. A patient operated upon in 1951 had a recurrence in 1977 at the age of 72 years. The tissue covering the new part of the urethra was very loose. Ingelman-Sundberg then got the idea to strengthen it applying a sling from the abdominal aponeurosis drawn subcutaneously over the symphysis and around the new urethra as described here. The operation was a success and the pressure profile in the new urethra showed good sphincter action when the musculature of the abdominal wall contracted.

This operation has so far been performed successfully in 5 cases, two of which had previously had kinking operations. The other three were cases of scar incontinence, where previous conventional operations had failed.

The technique will be presented as a Poster Demonstration.

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THE CATHETER AS A SOURCE OF ERROR IN URODYNAMIC STUDY

Mamdouh Koraitim

Department of Urology, Alexandria University, Egypt

ABSTRACT

The effect of introducing a fine catheter on the urethral wall was studied by electromyography in rabbits. On introducing the catheter, increased electrical activity in the form of biphasic potentials was recorded from the external sphincter and bladder neck. This indicates active muscular contraction of these regions. The biphasic potentials persisted for about four minutes and then became less frequent and lower in voltage until they disappeared completely after 14 minutes. We conclude that in urodynamic study one must wait for at least 15 minutes after catheter introduction before recording the results.

INTRODUCTION

Most urodynamic studies entail introduction of a catheter per urethram to measure intravesical and urethral pressures. This, presumably, irritates and stimulates the muscular elements of the urethral wall to contract with consequent augmentation of urethral pressure that leads to false results. To overcome this the use of a fine catheter has been adviced and special catheters have been manufactured for urodynamic study. The aim of the present work is to learn the effect of introducing a fine catheter on the urethral wall and whether this effect is temporary or persistent.

MATERIAL AND METHOD

Five male rabbits (averaging 2.5 kg of body weight) were lightly

anesthetized with phenobarbital sodium. The bladder and proximal urethra were exposed through a suprapubic midline incision with excision of the symphysis pubis. Two bipolar concentric electrodes of 0.45 mm diameter and 0.07 mm contact platinum surface (DISA 13L50) were fixed into the regions of the bladder neck and external sphincter. Electrical changes wre recorded on a DISA 14A21 two-channel electromyograph before, during and after introducing an 8F plastic catheter per urethram into the bladder. Records were obtained every two minutes for a period of 30 minutes after introduction of the catheter. During registration of the results every attempt was made to minimize extraneous sources of electropotentials (1).

RESULTS

Before introduction of the catheter a continuous low voltage activity of about 20 microvolts was recorded from both the bladder neck and external sphincter (Fig. 1). This can be considered as the base line activity representing their resting tonic discharge. On introduction of the catheter, biphasic potentials ranging from 40 to 100 microvolts were recorded from both regions; changes in the external sphincter tracing appeared 0.1 second earlier than those of the bladder neck. These electrical changes persisted with nearly the same amplitude and frequency during the succeeding four minutes (Fig. 2). Six minutes after catheter introduction the biphasic potentials, especially those of the B.N., became less frequent and lower in amplitude (30 to 50 microvolts) as shown in Fig. 3. These infrequent potentials could still be observed in the external sphincter tracing 8 and 10 minutes after catheter introduction (Fig. 4). During this time, however, only insignificant biphasic spikes were occasionally recorded from the B.N. Then the increased electrical potentials became less and less apparent until they disappeared completely from both tracings in the 14 minute electromyogram (Fig. 5).

DISCUSSION

Many factors must be considered carefully when interpreting data derived from urodynamic studies (2). One of these factors is the role of the catheter as a stimulus of muscular activity that would alter the actual urethral pressure. This assumption has been held by many investigators but the literature is lacking any documental proof for it.

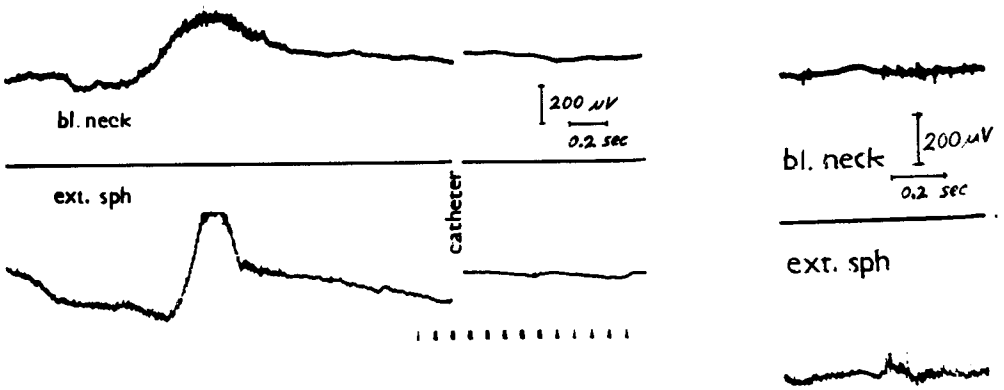

Fig. 1. EMG of BN and external sphincter before (right) and during (left) catheterisation.

Fig. 2. EMG shows increased activity 4 minutes after catheterisation.

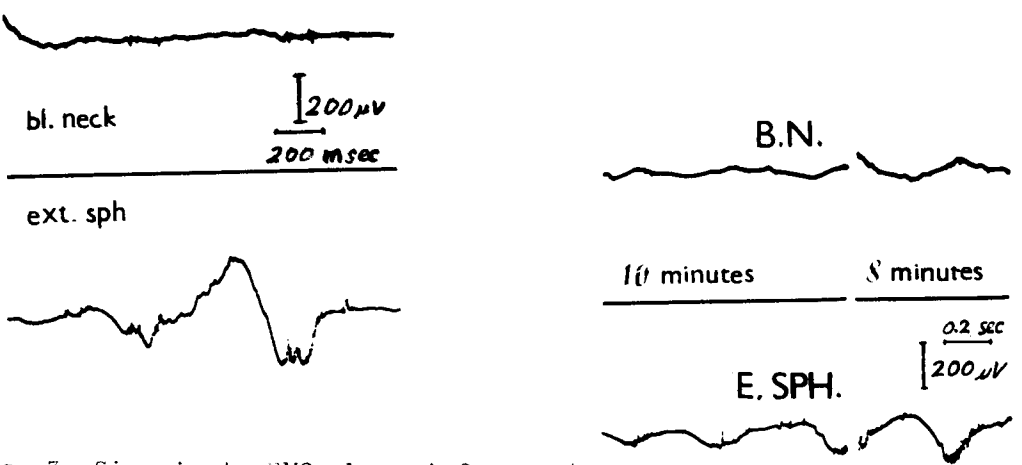

Fig. 3. Six minute EMG shows infrequent potentials of BN and external sphincter.

Fig. 4. Active potentials still recorded from external sphincter after 8 and 10 minutes.

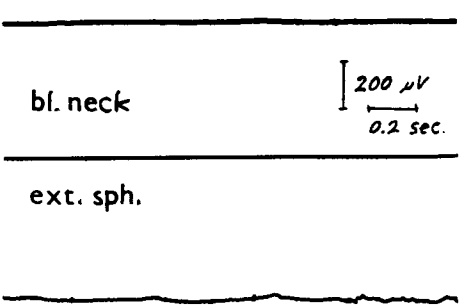

Fig. 5. EMG 14 minutes after catheter introduction showing no active potentials of BN and external sphincter.

The correlation between muscular activity and electrical potentials has been well established in the bladder and urethra where muscular contraction is accompanied by typical electromyographic changes (3). In the present study, as soon as the catheter is introduced increased electrical potentials are recorded almost simultaneously from the external sphincter and bladder neck which indicate active muscular contraction of these regions. The delay of 0.1 second of B.N. activity after that of the external sphincter is the time needed for the catheter to cross the interval between the two. The increased electrical activity, and as a corollary the muscular contraction, persists for about four minutes with more or less the same amplitude and frequency. Then it diminishes, particularly that of the B.N. which shows only insignificant activity after this time, The external sphincter, however, demonstrates some muscular activity 12 minutes after catheter introduction. After 14 minutes the external sphincter and B.N. become practically quiescent as before passage of the catheter. From this time onwards the presence of a catheter has no effect on the urethral wall and any data recorded through it represent the real ones. We conclude that in urodynamic studies of lower urinary tract one must wait for at least 15 minutes after the passage of catheter before recording the results.

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AN OBJECTIVE COMPARISON OF THE EFFECTS OF PARENTERALLY ADMINISTERED DRUGS IN PATIENTS SUFFERING FROM DETRUSOR INSTABILITY

Linda D. Cardozo and Stuart L. Stanton

Urodynamic Unit, Department of Obstetrics and Gynaecology, St. George's Hospital, London

ABSTRACT

The cystometric changes produced by three parenterally administered drugs - flavoxate hydrochloride, emepronium bromide and imipramine hydrochloride have been evaluated in fifteen female patients suffering from detrusor instability. Each patient was given two of the three drugs and cystometric recordings were carried out at 10 minutes and 30 minutes after the administration of each drug. This study shows that emepronium bromide was the only drug to cause a significant improvement in bladder capacity and reduction in detrusor pressure.

INTRODUCTION

Detrusor instability is resistant to treatment. Although surgery, in the form of sacral neurectomy (Torrens et al 1974), cystodistension (Ramsden et al 1976) and bladder drill (Frewen 1978) are all used in the management of detrusor instability, they have limited success in alleviating symptoms and producing cystometric improvement. Oral drug therapy is still the mainstay of treatment and even though certain drugs are frequently prescribed, their comparative efficacy in terms of objetive changes in bladder function has not been adequately investigated. Part of the problem lies in the failure of some drugs to be consistently absorbed when administered orally, as well as the differences in time taken for drugs to reach their maximum effectiveness. Flavoxate hydrochloride (urispas) is a musculotrophic agent which produces a papaverine-like relaxant effect on smooth muscle, especially the detrusor (Setnikar et al 1960). Emepronium bromide (cetiprin) is a quaternary ammonium compound with anticholinergic properties and a ganglion blocking effect. It has been shown to produce an increase in bladder capacity (Jonsson and Zederfelt 1957) and a decrease in intravesical pressure (Boman and von Garrelts 1973). The mechanism of action of imipramine hydrochloride (tofranil) is conjectural but it does produce parasympatholytic activity (Gregory et al 1974) and acts centrally as an antidepressant. It also has a musculotrophic relaxant action on detrusor muscle in organ bath preparation (Benson et al 1977). All three drugs are commonly used (in their oral forms) in the treatment of symptoms due to detrusor instability.

METHOD AND PATIENTS

Fifteen female patients who complained of the symptoms of frequency, urgency and urge incontinence were diagnosed as having detrusor instability by means of videocystourethrography with pressure and flow studies (Bates and Corney 1971). A det-

rusor pressure rise greater than 15 cm of water during fast bladder filling or provocative testing (such as coughing, passive posture change, catheter withdrawal and coughing while standing erect) was diagnostic of detrusor instability. Of the patients selected eleven had primary detrusor instability and four had detrusor instability secondary to an upper motor neurone lesion (two had multiple sclerosis and the other two had suffered cerebrovascular accidents.

When each patient attended the Urodynamic Unit a baseline cystometrogram was performed. The bladder was filled with 0.9% saline, pre-warmed to body temperature at a rate of 100 ml/min. A record was made of the first sensation of desire to void, bladder capacity, height of detrusor pressure rise during bladder filling, detrusor contractions and accidental leakage of urine. One of the three drugs was then administered, either flavoxate hydrochloride 200 mgms (intravenously), emepronium bromide 50 mgms (intramuscularly) or imipramine 50 mgms (intramuscularly). Cystometrograms were carried out 10 minutes and 30 minutes after administration of the drug. If there was no change in the cystometrogram a second drug was given. If, however, the cystometrogram did alter the patient was asked to return on another occassion for a second drug. In this way ten patients received each of the three drugs. The order of the drugs was randomized, and any side-effects were noted.

RESULTS

The mean age of the patient group was 52 years with a range from 21 years to 88 years. The mean cystometric changes produced by flavoxate, emepronium and imipramine are shown in Tables 1, 2 and 3 respectively.

TABLE 1 Cystometric Changes Produced by Flavoxate Hydrochloride

CMG Findings	Prior to treatment	10 min. CMG	30 min. CMG
First sensation (ml)	181	197	207
Capacity (ml)	358	340	374
Pressure rise on filling (cm H_2O)	45	43	48
Detrusor contractions (No. of patients)	8	8	8
Leaks (No. of patients)	9	8	9

TABLE 2 Cystometric Changes Produced by Emepronium Bromide

CMG Findings	Prior to treatment	10 min. CMG	30 min. CMG
First sensation (ml)	176	227	215
Capacity (ml)	320	506	540
Pressure rise on filling (cm H_2O)	51	17	18
Detrusor contractions (No. of patients)	10	3	2
Leaks (No. of patients	8	1	0

TABLE 3 Cystometric Changes Produced by Imipramine Hydrochloride

CMG Findings	Prior to treatment	10 min. CMG	30 min. CMG
First sensation (ml)	163	161	161
Capacity (ml)	361	343	349
Pressure rise on filling (cm H_2O)	48	47	47
Detrusor contractions (No. of patients)	9	9	8
Leaks (No. of patients)	7	6	6

The increase in first sensation and bladder capacity and the decrease in detrusor pressure rise during filling, due to emepronium are all statistically highly significant (Chi^2 test) both at 10 minutes and 30 minutes. Flavoxate and imipramine produced no significant changes at 10 minutes or 30 minutes.

One patient developed an acute erythematous rash following the administration of flavoxate, but this disappeared within an hour. No other side-effects were encountered with flavoxate or imipramine. After the administration of emepronium four patients complained of blurred vision, three of a dry mouth, one patient was unable to void at all and one was left with a marked residual.

DISCUSSION

Flavoxate hydrochloride is commonly used in the management of detrusor instability. Delaere et al (1977) found that oral flavoxate hydrochloride completely relieved 11 out of 42 patients of their symptoms, even though their detrusor instability had previously proved resistant to other forms of drug therapy. Oral flavoxate has also been shown to produce a significant increase in bladder capacity (Stanton 1973). Pedersen (1977), using intravenous flavoxate found a reduction of the intravesical pressure in 7 out of 11 patients with hyperactive neurogenic bladders, which occurred 10 - 20 minutes following an injection of 100 - 200 mgms of the drug. We were unable to shown any decrease in detrusor pressure following the administration of flavoxate.

Imipramine has long been used in the management of enuresis, which may be a manifestation of detrusor instability. Several in vitro studies have been performed using imipramine, (Labay and Boyarsky 1973), Lipshultz et al 1973), which show that it is capable of relaxing bladder musculature. Few studies have been carried out using imipramine in patients with detrusor instability; however Diokno et al (1972) found that uninhibited detrusor contractions were not abolished by a single injection of imipramine. Despite this it has been suggested that clinically imipramine is an effective remedy for uninhibited detrusor contractions (Gregory et al 1974). As our results show, a single intramuscular dose of imipramine did not alter the cystometric findings.

The use of anticholinergic agents in the management of detrusor instability was first suggested by Langworthy (1936) who found that atropine decreased urgency and frequency of micturition and increased bladder capacity in patients with spastic paraplegia. The side-effects of atropine outweigh the benefits. Emepronium bromide has been in use for over 20 years. Quaternary ammonium compounds are known to be poorly absorbed from the gastrointestinal tract (Vessman et al 1970), but

only recently has it been realized that emepronium bromide has little effect on the bladder when given orally (Ritch et al 1977). However, studies have shown emepronium bromide to be very effective when given intramuscularly (Ekeland and Sander 1976), Ritch et al 1977). The cystometric changes due to emepronium in this study were quite dramatic, converting unstable bladders into apparently stable ones.

In view of our findings and those of others it is likely that intramuscular emepronium bromide has a place in the management of detrusor instability. Twice daily injections are frequently prescribed in the management of diabetes, and although symptoms of incontinence, urgency and frequency of micturition are not life threatening they may be severely incapacitating. Elderly and disabled patients, and those in hospital for various reasons often become incontinent because of an inability to reach a lavatory or commode in time. In these patients an injection of emepronium bromide once or twice daily could help in the prevention of bed sores, ease discomfort and eliminate degradation until such time as suitable facilities are available or the patient regains mobility.

CONCLUSIONS

In female patients with objective evidence of detrusor instability intravenous flavoxate hydrochloride and intramuscular imipramine hydrochloride fail to produce cystometric change, whereas emepronium bromide causes an increase in bladder capacity, and a decrease in detrusor pressure together with the abolition of detrusor contractions and leakage of urine in the majority of cases.

ACKNOWLEDGEMENTS

We would like to thank the Multiple Sclerosis Society for their generous funding in respect of Dr. Linda Cardozo.

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These are available on request from Dr. Linda Cardozo.

CLINICAL EXPERIENCE OF PHENOXYBENZAMINE FOR BENIGN PROSTATIC HYPERTROPHY

Atsuo Kondo, Toshikazu Otani, Harunori Narita, Mineo Kobayashi, Tohru Takita and Hideo Mitsuya

Department of Urology, Nagoya University School of Medicine, Nagoya 466, Japan

ABSTRACT

Phenoxybenzamine has been successfully utilized in 43 (86%) out of 50 patients with benign prostatic hypertrophy. This drug does not reduce the size of adenoma itself but functionally alleviates the obstructive symptoms and facillitates the bladder emptying.

INTRODUCTION

The clinical effect of phenoxybenzamine, alpha adrenergic blocker, has been first demonstrated by Krane and Olsson (1) in neurogenic bladder dysfunction. Caine and his associates (2) used this drug for the patients with benign prostatic hypertrophy. The aim of this article is to report the clinical effect of phenoxybenzamine and several parameters observed in 50 cases of benign prostatic hypertrophy.

PATIENTS AND METHODS

A series of 50 patients with prostatic hypertrophy representing the varying degrees of obstructive symptoms have been treated with oral administration of phenoxybenzamine. Their ages varied from 49 to 82 years old (mean $\pm$ standard deviation; 69 $\pm$ 8). The conventional and urodynamic examinations were required to establish the diagnosis and thereafter to assess its effectiveness. All the patients were treated solely by phenoxybenzamine except 2 who necessitated the intermittent self-catheterization.

RESULTS

Overall Results

43 cases (86%) out of 50 were found effective, who achieved the successful or satisfactory voiding and required no surgical interventions.

Non-effective 3 (6%), who later underwent the prostatectomy. Phenoxybenzamine had to be changed to other medication in 4 (8%) due to the adverse effects.

Amount of Residue

Decrease in residue was observed in 16 (43%) out of 37 patients, increase in 4 (11%), and 17 (46%) remained unchanged. 8 patients with indwelling catheter were liberated from it.

Urethral Pressure Profile

Elongation of continence zone (3), i.e. length of posterior urethra, was characteristic of these patients. The mean value reduced from 51 to 47mm. The maximum urethral pressure fell from 52 to 45mmHg. These changes, however, were not statistically significant after the treatment.

Urinary Flow Curve

20 (71%) out of 28 cases demonstrated the improved flow pattern. The rest either showed no improvement or remained in a fairly good flow rate by the compensated detrusor contraction.

Subjective Symptoms

The improvement was noted in 42 (84%) out of 50 cases. Decrease in frequency, prompt start of micturition and less abdominal strain to accomplish the voiding were the common findings.

Maintenance Dose

The effective maintenance dose was found in most patients 7.5 to 15mg per day. The dose required is dependent in general upon the size of adenoma.

Adverse Effect

This occurred in 12 patients (24%). Dizziness 6, nasal obstruction 3, are the common complaints followed by dull headache 2 and syncope 1.

DISCUSSION

Phenoxybenzamine was effective to relieve the subjective symptoms promptly in the majority of cases and also to liberate 8 patients from the indwelling catheter. Moreover 3 patients, originally hospitalized for the prostatectomy, became free from the obstructive symptoms enough to be discharged without the surgery. The phenoxybenzamine administration will be indicated to the following cases.

1. Patients who exhibite the varying degrees of obstructive symptoms with a mild or moderate enlargement of adenoma.
2. Patients who refuse the surgical intervention.
3. Patients who have limited life expectancy and/or are unable to bear the surgical burdons.
4. Patients who have an indwelling catheter due to acute or chronic urinary retention.

The effective maintenance dose was 7.5 to 15mg a day. Though

occasional dizziness and nasal obstruction were the most common complaints, they were usually minor problems. Provided the daily dose does not exceed 15mg a day, this drug can be prescribed safely without any severe side effects such as syncope. Renal and liver dysfunction have not been experienced.

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THEORETICAL CONSIDERATION ON URETHRAL RESISTANCE AND BLADDER WORK IN VIEW OF MICTURITION ENERGY

Tohru Takita, Atsuo Kondo and Hideo Mitsuya

Department of Urology, Nagoya University School of Medicine, Nagoya 466, Japan

ABSTRACT

We showed that the urethral resistance could be theoretically induced in relation to the bladder work done during the voiding. The hypothetical diagram has been proposed with the correlation between intravesical pressure and exit dynamic pressure, which might be of value to differentiate the type of micturition disorders.

INTRODUCTION

We established a formula for quantitative evaluation of the urethral resistance by means of introducing the concept of the bladder work, and attempted the clinical interpretation of the hypothetical diagram based upon the bladder work analysis from the theoretical point of view.

URETHRAL RESISTANCE

Byrne et al. (1) expressed the urethral resistance by the following formula,

$$P_B = R + \frac{1}{2}\rho v_E^2 \qquad [1]$$

where P_B stands for intravesical pressure, R urethral resistance, ρ density of urine, and V_E velocity of urine at the external urethral orifice. They reported that this value of urethral resistance was constant in the normal subjects and was considerably related to the severity of the difficulty in urination. It seems logical to define the urethral resistance R as energy loss (or loss ratio) at the moment when one unit of urine, e.g. 1 ml. passes the urethra. With this definition we studied the theoretical model to permit calculating quantitatively the value R based Bernouilli's principle and bladder work curve. (2)

Figure 1 illustrates the bladder work curve, where AC stands for the conventional slow-filling cystometrogram and DHFE the cystometrogram during the voiding. Bladder work from point H to E is given by the space AGIHFE and expressed by $\int_0^{V_i} P_B dV$, where P_B represents the intravesical pressure. Similary the bladder work from F to E is space AGFE and $\int_0^{V_{i-1}} P_B dV$

Consequently the bladder work from H to F is naturally

$$\int_0^{V_i} P_B dV - \int_0^{V_{i-1}} P_B dV = \int_{V_{i-1}}^{V_i} P_B dV \qquad [2]$$

which is the energy required to expel 1 ml of urine from bladder to external urethral orifice, i.e. "the unit micturition energy." Since the each parameter in equation [1] is the function of bladder capacity V, this can be transformed by equation [2] and integrated as

$$\int_{V_{i-1}}^{V_i} P_B dV = \int_{V_{i-1}}^{V_i} R dV + \frac{1}{2}\rho \int_{V_{i-1}}^{V_i} v_E^2 dV \qquad [3]$$

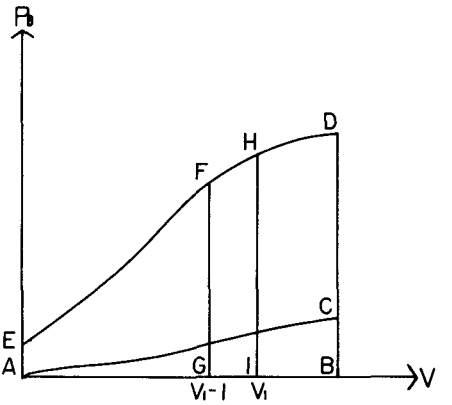

Fig. 1 Bladder work curve.

This is the theoretical concept of urethral resistance we have arrived from the analysis of bladder work curve. Though the equation [3] is only the modification of equation [1], the former expresses more precisely the change of P_B, resultant V_E and R and seems to be better than the latter. As for the practical purpose, however, the formula reported by Byrne et al. is useful enough to predict the presence of voiding pathology.

DIAGRAM FOR MICURITION DISORDER

The generalization of bladder work proposed by Abrams et al. (2) has been attempted in the diagram (Fig. 2). The ordinate

represents PB, the unit micturion energy, and the abscissa PE, dynamic pressure at external urethral orifice or residual energy. The point 100% is in between upper and lower normal range. Zone A represents the normal micturition performance. Zone B stands for a person who voids weak stream with decreased abdominal pressure and/or poor contractitility of detrusor muscle. This is observed in such a case of infranuclear lesion, atonic bladder or decompensated detrusor. Zone C requires the exaggerated energy to pass a normal stream of urine. This is the compensated outflow obstruction. Zone D performs a poor stream with noraml or exaggerated energy, seen in a person with a advanced outflow obstruction. Zone E represents a person with the reduced urethral resistance, which is seen in cases of stress incontinence and post-sphincterotomy. It might be difficult to categorize clearly every voiding pattern according to the present diagram. We believe, however, this will be of value as one of the diagnostic tools to evaluate the function of lower urinary tract as a whole.

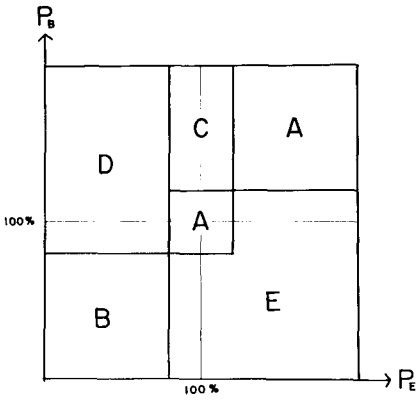

Fig. 2 Diagram for the difficulty of urination.

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REFLEX RESPONSES IN THE ANAL SPHINCTER RECORDED BY ELECTROMYOGRAPHY

Ejner Pedersen, Benny Klemar and Jesper Tørring

Neurological Laboratory, Department of Neurology, Aarhus Kommunehospital, 8000 Aarhus C, Denmark

ABSTRACT

By EMG recording from the external anal sphincter the reflex reactions on electrical stimulation of the perianal skin (anal reflex), over the posterior tibial nerve (part of the flexor reflex) and glans penis or clitoris (bulbo-cavernosus reflex) were constantly present in normal subjects and in patients with suprasegmental central lesions. The latency decreased with increasing stimulation within certain limits and there was no significant difference in minimum latency between normal subjects and patients with suprasegmental central lesions. Absence of reflexes or prolonged minimum latency is an indication of lesion of the reflex arc. By combination of reflex studies the lesion of the reflex arc may be localized to the efferent or afferent part.

INTRODUCTION

The anal sphincter is attractive for recording of reflex reactions by electromyography (EMG) since it is easily accessible for EMG study, and the muscle may, with some limitations, be taken as representative for other parts of the striated pelvic floor, especially the external urethral sphincter.

In the standardization of reflexes, electrical stimulation is necessary, particularly for the acurate measurement of latency. Such investigations are of interest in studies of mechanisms of voiding and defaecation and of the interaction of reflexes involving the sphincters, the bladder, the rectum and the legs.

This paper reports on our experience with EMG recording from the anal sphincter of reflexes elicited by electrical stimulation of the perianal skin (classical anal reflex), over the posterior tibial nerve behind the malleolus (part of the flexor reflex) and the glans penis or clitoris (bulbo-cavernosus reflex).

TECHNIQUE

Stimulation

The electrical stimulation was led to the patient by a digital programming unit of our own design and a modified constant current output unit (Disa 15EO7). It was applied to the skin by a pencil electrode of our own construction and to the posterior tibial nerve by surface electrode placed on the skin over the nerve.

A train of square-wave pulses of a duration of 1 millisecond (ms) separated by 1 ms was used and generally 5 pulses were included. The stimuli were separated by at least 1 minute.

Recording

Recording was generally performed by bipolar needle electrodes (Disa 13K13) introduced into the external anal sphincter. In some cases an anal plug electrode was used. We prefer and utilized a plug of our own design with separated plate electrodes on the two sides. The signal from the electrodes were fed through amplifiers (Disa type 15CO1) to a data-recording equipment employing video technique (Ref. 1).

By perianal electrical stimulation the distance between stimulation and recording electrodes were so short that the amplifier often was saturated for several hundred ms. A relay was therefore incorporated in the input stages of the pre-amplifier. This relay was activated just before stimulating and a cutting-off period of 1o-2o ms was normally used.

RESULTS

(1) Perianal Stimulation

By perianal electrical stimulation reflex reaction was constantly present in the anal sphincter in persons with intact neuraxis. This has been demonstrated in a large series including some hundred persons (Ref. 2, 3).

The latency decreased within certain limits with increasing stimulation and in 3o adult normal subjects an average minimum latency of 5o ms (SD 1o.5) was found. There was no significant difference between the minimum latency in normal subjects and in the patients with suprasegmental central lesions (Ref. 3).

(2) Stimulation over the Posterior Tibial Nerve

It has been demonstrated that reflex reaction can also be picked up from the external anal sphincter by methods of stimulation which are able to produce the flexor reflex (Ref. 4) i.e. mechanical or electrical stimulation of the sole of the foot or stimulation over the posterior tibial nerve behind the medial malleolus (Ref. 5).

This reflex was also constantly present in the anal sphincter in normal persons and the latency decreased within certain limits with increasing stimulation reaching an average minimum latency in the 3o adults studied of 93 ms (SD 21). There was no significant difference between minimum latency of normal subjects and patients with suprasegmental central lesions (Ref. 3).

(3) Stimulation of Glans Penis or Clitoris

Our experience with this reflex is limited but so far reaction in the anal sphincter has constantly been found in normal persons. This is in accordance with studies by Allert and Jelasic (6, 7) of greater series. The latency of this reflex is also dependent on the intensity of stimulation and is reduced by increased stimulation within certain limits to a minimum latency of 4o-9o ms (Ref. 6).

DISCUSSION

The reflex reaction recorded by EMG from the external anal sphincter was constantly present on electrical stimulation of perianal skin in normal subjects and patients with suprasegmental lesions. Absence of the reflex or prolonged latency is a strong indication of a lesion of the reflex arc. By mechanical perianal stimulation the reflex is weak or absent in some normal subjects, especially elderly persons, but also in these cases the reflexes are elicitable by electrical stimulation although high intensity is usually required. The reflex elicited by electrical stimulation of glans penis or clitoris is also constantly present in the anal sphincter according to Allert and Jelasic (6, 7), which is in agreement with our experience, whereas others (Ref. 8) surprisingly found the reflex reaction only present in 21% of the cases from the anal sphincter. This reflex is reported to be present in 7o% of normal subjects by mechanical stimulation (Ref. 9) and especially in elderly persons weak or absent.

The reflex reaction in the anal sphincter provoked by 'flexor reflex elicitation' was constantly present in normal subjects and in patients with suprasegmental lesions. This reflex has another afferent pathway than the perianally provoked reflex, namely lumbar and sacral, respectively, but the efferent pathway in common. By absence of one of the reflexes this difference may sometimes be utilized in the localization of the lesion of the reflex arc to the afferent or efferent part after investigation of both reflexes.

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CONTINENT URINARY DIVERSION VIA AN ILEUM RESERVOIR

An Experimental Study in Dogs

Lars Norlén, Nils G. Kock, Arne E. V. Nilson, Torsten Sundin and Harald Trasti

Departments of Urology, Surgery II and Roentgenology, Sahlgren Hospital, University of Göteborg, Göteborg, Sweden

ABSTRACT

Urinary diversion of the right ureter via a continent ileum reservoir was studied in twelve dogs with special regard to the upper urinary tract and renal parenchyma. Continence was provided by an intussuscepted ileal nipple-valve in an efferent loop leading from the reservoir to a cutaneous stoma. The reservoir was easily emptied by catheterizations twice daily. Diversion without protection against reflux of the contents of the reservoir was complicated by decompensation of the upper urinary tract and renal deterioration. To prevent reflux a nipple-valve was interposed between the reservoir and the afferent loop. Provided the valve was intact decompensation of the diverted upper urinary tract did not occur and only slight pyelonephritic changes were noted after twelve weeks. The valve also seemed to prevent ascending urinary infections. The tendency of the nipple-valve to slide with consequent reflux was a problem. However, a slided nipple-valve could be repaired.

INTRODUCTION

Permanent supravesical urinary diversion is still a major problem in surgery. Innumerable methods for urinary diversion have been devised. Despite extensive research and methodological advancements current techniques for urinary diversion still suffer from serious imperfections.
In proctocolectomized patients conversion of a conventional ileostomy into a continent ileum reservoir has been performed with encouraging results (1). Encouraging results from limited experimental studies concerning urinary diversion via a continent ileum reservoir have been reported (2, 3). Prior to its possible clinical application the method needs thorough experimental evaluation. The aim of the present investigation was to study the upper urinary tract and renal parenchyma following short-term unilateral urinary diversion via a continent ileum reservoir in dogs.

MATERIAL AND METHODS

The material comprised 12 adult mongrel female dogs. The dogs were operated in a surgical theatre under general anaesthesia and under aseptic conditions. The abdomen was opened through a midline incision. The right ureter

was isolated and divided near the urinary bladder. Approximately 40 cm of the ileal intestine was isolated proximal to the ileocaecal valve and a continent ileum reservoir was constructed according to Kock (1). The right ureter was implanted by a non-reflux protecting method (4) into the afferent loop which was closed at its proximal end. The efferent loop in which the continence providing intussuscepted ileal nipple-valve was constructed was pulled out through a separate incision at the right side of the abdominal wall where a stoma was constructed. Two dogs (group I) were operated according to this procedure. In 10 dogs (group II) the same operative procedure was performed but in addition a reflux protecting nipple-valve was constructed between the reservoir and the afferent loop. The capacity of the reservoir at operation was approximately 70 ml. Postoperative catheters were removed after one week and the reservoirs were then catheterized twice daily.
The reservoir and the upper urinary tracts were studied roentgenologically 3-12 weeks after operation. The animals were sacrificed at the twelfth week or earlier if necessary. Sections from the kidneys were prepared for histopathologic examinations. Using sterile techniques samples of urine for quantitative culture were obtained from the urinary bladder at the primary operation and at catheterizations from the contents of the reservoir and at sacrifice from the renal pelvises bilaterally.

RESULTS

Continence was achieved in all dogs and the volume-capacity of the reservoirs increased rapidly. Intubation of the reservoirs was performed easily twice daily.
In group I (without reflux protecting nipple-valve) urography revealed massive reflux from the reservoir to the afferent loop and upper urinary tract which was considerably dilated. This was confirmed at autopsy. On histopathologic examination severe pyelonephritic changes were found in the diverted kidneys. At sacrifice urine obtained from the diverted renal pelvises as well as from the contents of the reservoirs were heavily contaminated and similar bacterial floras were found.
At roentgenological examination of the reservoirs in group II the nipple-valves were clearly visualized. In four dogs no reflux occurred to the afferent loop or the upper urinary tract. In three dogs reflux occurred to the afferent loop or the upper urinary tract. In one dog this was due to a fistula between the reservoir and the afferent loop. In two dogs the reflux was due to sliding of the nipple-valve. After reintussusception in one of these dogs the nipple-valve proved competent on reexamination.
In all dogs examined the reservoir was completely emptied from contrast medium with a catheter. On urography in the four dogs with a competent reflux protecting nipple-valve the upper urinary tracts were of ordinary width. In the dogs with reflux urography revealed dilation of the upper urinary tract of the diverted side.
At autopsy renal pelvises and ureters were not dilated in the absence of reflux. When reflux occurred slight to considerable dilation was found on the diverted side. Histopathologic examinations of the kidneys on the not diverted (control) side appeared essentially normal except in two dogs where slight inflammatory changes were found. While the renal parenchyma appeared normal in one out of four diverted kidneys not exposed to reflux, exceedingly small fibrotic changes were seen throughout otherwise normal parenchyma in three other dogs. In the kidneys exposed to reflux the presence of fibrosis in the renal parenchyma was verified on microscopic examination.

Quantitative urinary cultures from the contents of the reservoirs revealed the constant presence of mixed bacterial floras. In the absence of reflux the urine obtained from the diverted renal pelvises at sacrifice was always sterile. When reflux occurred identical mixed bacterial floras were found in the reservoir and in the renal pelvis on the diverted side.

CONCLUSION

Continence was achieved in all dogs. The reservoirs had good volume-capacity and were easy to catheterize.
Diverted kidneys not protected against reflux of the infected contents of the reservoir were literally destroyed in a couple of weeks (group I). Thus, it seemed necessary with a nipple-valve in the afferent loop preventing urinary reflux with consequent renal deterioration. The present study also indicates that the nipple-valve interposed between the reservoir and the ureter when competent affords protection against ascending urinary infection. The weakness in the nipple-valve procedure is the tendency of the intussusception to slide after some time and thereby become incompetent. However, a slided nipple-valve can be reconstructed as was performed in the present study.

ACKNOWLEDGEMENT

This work was supported by grants from the Swedish Medical Research Council (Project no B 78-17X-00577-14A).

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URETHRAL CLOSURE MECHANISM UNDER STRESS CONDITIONS

Helmut Heidler, Udo Jonas, Eckhard Petri

Department of Urology, University of Mainz Medical School, Mainz, West Germany

INTRODUCTION

With a rise in intraabdominal pressure, intravesical pressure usually exceeds the maximal urethral closure pressure considerably. Nevertheless, if the pelvic floor remains intact and the urethral wall unchanged, continence is retained even under stress conditions. Under these circumstances, the intraabdominal pressure increase is not only transmitted to the urinary bladder, but also causes a simultaneous, corresponding transmittance to the urethra.

This pressure transmission can be explained by the Graber Model[+)], in which the bladder is compared with a planimetric load lying on an elastic buttress representing the pelvic floor. According to this physical principle, an intraabdominal pressure increase causes a distribution of pressure with a distally decreasing intensity. Depending on the elasticity of the pelvic floor, either the vertical or horizontal vector exceeds; for the compression of the urethra, the horizontal vector is determinant (Fig. 1).

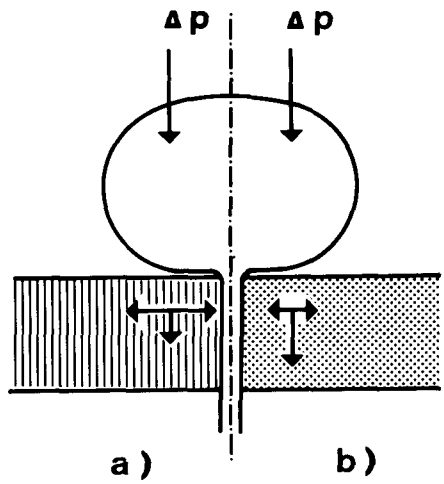

Fig. 1. Pressure distribution and transmission to urethra: a) in intact pelvic floor; b) in weakness of the pelvic floor.

PROBLEMS

1. To what degree does the pressure transmission along the length of the urethra decrease?
2. Is this a continuous decrease merely according to physical principles, or does the pelvic floor reflex - with a simultaneous contraction of the external sphincter - also play a role?
3. Evaluation of the urethral pressure profile was not successful. Therefore, the intensity of the pressure transmission certainly plays a greater role in stress incontinence. What differences can be found here in the comparison of stress incontinent patients with non-stress incontinent patients?

PATIENTS

408 urethral pressure profiles selected from the urodynamic examinations performed over the last 2 years were evaluated. 231 non-stress incontinent patients (= 56.6 %) were compared with 177 stress incontinent patients (= 43.4 %), ranging in age from 22 to 78 years. Classified according to the clinical degree of severity, 54 % showed Grade I stress incontinence, 29 % Grade II and 17 % Grade III.

PROCEDURE

Within the framework of a urodynamic examination, intravesical and intraurethral pressure were measured simultaneously in a sitting position with a bladder volume of 100 ml. For direct urethrometry with measurement of wall tension and pressure waves of deformation during coughing impulse, a 4-channel, 7 F gauge with a balloon located 7 cm from the tip of the catheter (Firma Viggon) was employed. The gauge was withdrawn mechanically from the bladder at a rate of 3 mm/s, leaving the tip of the gauge in the bladder.

After measurement of the urethral resting pressure profile, a urethral stress profile with intermittent coughing was performed. Cough intensity was between 50 and 70 cm water column. As coughing impulses were measured approx. every 5 mm during withdrawal, the number of coughs was determined by the length of the urethra.

After substraction of the urethral resting pressure profile from the stress profile, the height of the responding pressure spikes (a') was determined and expressed in percentage of the simultaneous intravesical pressure increase (a_1 = 100 %). Evaluation was based on the functional length of the urethra. The distance between the bladder outlet and each of the responding pressure spikes (b') was again expressed in percentage of the total functional urethral length (b_1 = 100 %). Both percentages were then charted on a coordinate (Fig. 2).

RESULTS

The percentage calculation of pressure transmission to the urethra in the non-stress incontinent group showed a continuous decrease to 57 % of the intravesical (= intraabdominal) pressure rise along a distance of 40 % of the functional urethral length.

Surprisingly, this decrease does not continue: along the distance of 40 - 75 % of the functional urethral length there is an increase in pressure transmission up to 87 % of the intraabdominal pressure rise. This increase-zone corresponds to the zone of maximal urethral closure pressure. At the end of the functional urethral length, a 35 % pressure transmission could still be measured (Fig. 3).

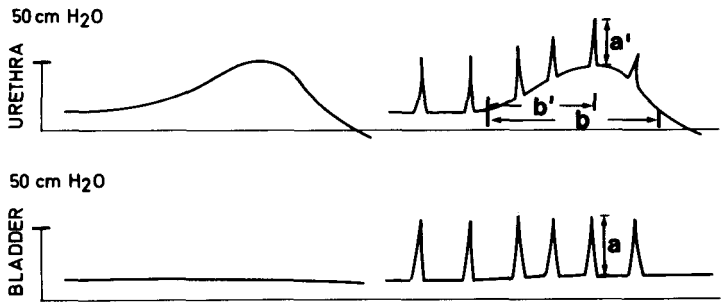

Fig. 2. Urethral resting pressure profile and stress profile: a) intravesical pressure rise; a') intraurethral pressure rise; b) functional urethral length; b') location of the pressure responding spike along the functional urethral length.

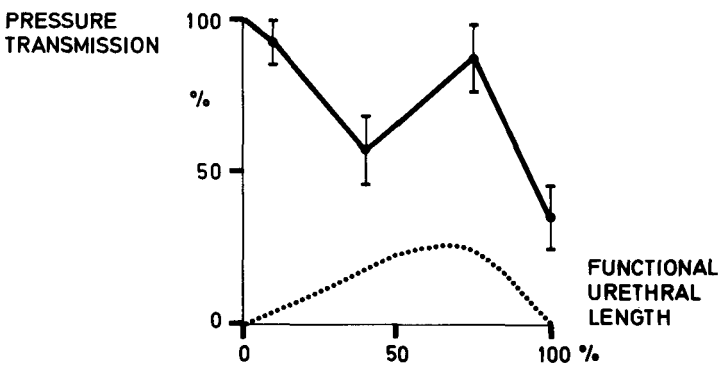

Fig. 3. Urethral resting pressure profile and percentage of pressure transmission to urethra (mean ± SD) in the non-stress incontinent group (n=231).

In the group with stress incontinence, there was an almost linear decrease of pressure transmission from 100 % at the bladder outlet to 43 % at the end of the functional urethra, with an accentuated decrease of 22 % during the first 10 %, and a clear slackening in the rate of decrease along the distance of 40 - 75 % of the functional urethral length. However, there was no increase in the pressure transmission percentage (Fig. 4).

A comparison of both curves therefore shows a similar reduction gradient, although along the further course of the urethra, a clear increase gradient could only be seen in the non-stress incontinent group.

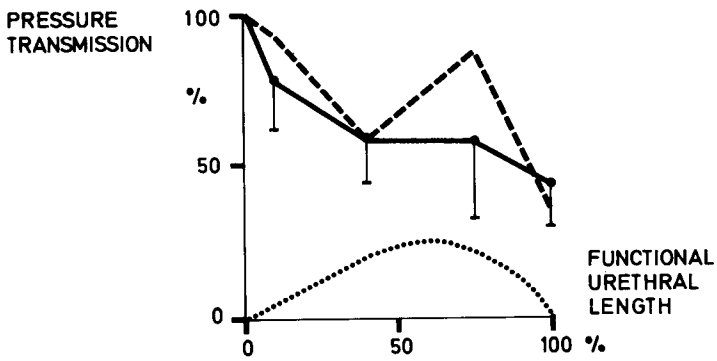

Fig. 4. Urethral pressure profile and percentage of pressure transmission to urethra (mean ± SD) in the stress incontinent group (n=177) (striated line) in comparison to the non-stress incontinent group (dotted line).

THEORETICAL CONSIDERATIONS AND CONCLUSIONS

The transmission of intraabdominal pressure rise to the urethra occurs according to physical principles in the form of a dynamic pressure parameter with an approximately linear decrease in the normal case of up to only 40 % of the functional urethral length. The subsequent increase in pressure transmission in the maximal urethral closure pressure zone must be attributed to the striated muscle located there in association with the pelvic floor cough reflex. It has been shown that the maximal urethral closure pressure zone corresponds with the external sphincter area.

This increase is over 100 % in some patients, so that an active reflex muscle contraction must be assumed. Altered properties of the elastic medium alone with varied pressure distribution would be unable to explain this fact. It therefore seems justified to speak of an additional reflex pressure parameter.

The curve of the mean values shows a clearly different picture; the standard deviation at 75 % of the functional urethral length indicates, however, a considerable spread in patients with stress incontinence. A possible explanation for this can be the fact that some patients with low grade stress incontinence show a rather normal reflex pressure parameter but are incontinent as a result of a low urethral wall tension or an extensive decrease of pressure transmission over the first 40 %.

As the urethral resting pressure profile alone gives unsuitable results and the Heidenreich-Beck Method of responding pressure curves provides only limited data, important information may be obtained for the evaluation of sufficient urethral closure under stress conditions from the reflex pressure parameter.

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TREATMENT OF FEMALE URGE INCONTINENCE WITH METHAUTHELINE BROMIDE

H. J. Deck, P. Faber, J. Herberger and J. Heidenreich

Department of Gynaecology and Obstetrics of the University of Düsseldorf

60% of incontinence in women are related to dysfunctions of the bladder. While the therapy of stress incontinence should be surgical, the incontinences due to dysfunction of the bladder can only be treated by drugs. Most frequently we deal with motor urge incontinence, sensory urge incontinence and combined forms with the stress incontinence; not very often is found the reflex incontinence. The musc. detrusor vesicae is mainly innervated parasympatically by the n. pelvicus from S_{II}-S_{IV}, partially postganglionic, partially direct ganglionic.

The exact causes of urge incontinence is not yet understood. There may be different neuromyogenic mechanisms which are responsible for detrusor overactivity, perhaps nerve end plate disturbances or smooth muscle myogenic disturbances. Therefore, it seems understandable to treat detrusors overactivity by parasympaticolytic drugs. In 1976/77 at the Department of Gynaecology and Obstetrics we treated motor, sensory and combined urge incontinences with the parasympaticolyticum methautheline bromide "Vagantin" in a dose of 3 x 100 mg/day. We used simultaneous continuous urethrocystotonometry with abdominotonometry as described by Beck and Heidenreich.

Before and after therapy we compared following parameters: "first desire to void", maximum cystometric capacity, compliance and the subjective feeling of the patients.

In 25 patients in premenopause we found 14 cases of motor urge incontinences, 9 sensory and 2 with stress combined urge incontinences. After therapy in 4 patients there was no motor urge incontinence

detectible any more. In one patient we found improvement. In 8 patients there was no change of the complaints and in one patient we found the results even worse. In 9 patients with sensory urge incontinence one patient showed after treatment no further symptoms; in 2 patients we got better results; 5 patients were unchanged and in one patient the results were even worse. In the two patients with combined forms of incontinence there was no change at all.

In the same way we treated 12 patients in postmenopause, 5 patients were suffering from motor urge incontinence, 2 showed after treatment no signs of incontinence any more, in one patient we found improvement, and two were unchanged. 7 women of the postmenopausal patients had a sensory urge incontinence from which in 3 cases an improvement could be measured; in two patients the results were even worse.

Taking improvement and recovery together, we found in prae - resp. postmenopausal motor urge incontinence we treated, 35% resp. 60% of the patients successful; in sensory urge incontinence in 33% resp. 43%. According to Beck, Arnusch u. King (Am. J. Obst. Gyn. Vol. 125, No. 5) there could be 20% of patients treated with placebo successfully. With the methautheline bromide is the rate of success, therefore, only a little bit higher, so that it is not a drug of first choice. Only when other drugs fail, the treatment with methautheline bromide seems to be indicated.

URETHRAL PRESSURE PROFILE AND URETHRAL PRESSURE – TIME VARIATIONS

Stanislav Plevnik* and Janez Janež**

**University of Ljubljana, Faculty for electrical engineering, 61000 Ljubljana, Tržaška 25, Yugoslavia*
***Urological clinic, Clinical center, 61000 Ljubljana, Zaloska 7, Yugoslavia*

ABSTRACT

The urethral pressure profile variations (UPP-V) and urethral pressure-time variations (UPT-V) were measured on 13 patients with different urethral-bladder dysfunctions. Data obtained from UPT-V measurements revealed significant physiological pressure variations which were not seen from UPP-V estimated from a small series of urethral pressure profile curves.

INTRODUCTION

Assuming that all possible technical sources of urethral pressure profile (UPP) variability are eliminated, there is only one possible source left, that is physiological variability. Many authors are totally ignoring this possibility, accepting the urethra as "silent", except for the cases with neurogenic lesions which may cause significant spasmodic pressure changes in the urethra.

The values of physiological pressure variations were determined by a few authors by repeated measurements of UPP curves in the same patient. Estimated changes in maximal UPP pressures were either very small (Ref. 1, Ref. 2), or of considerable values (Ref. 3). There is only one article (Ref. 1) known to us, in which the reliable verification of the changes of maximal UPP pressures, done by monitoring the maximal urethral pressure for times up to 1 min., is described. According to these data the measured pressure changed by less than ± 5 cmH_2O. With the aim to verify the possibility of physiological pressure variations the urethral pressure profile variations and urethral pressure-time variations were measured and results compared.

METHODS AND MATERIALS

In order to determine the limits of possible physiological UPP variations (UPP-V) several UPP were successively measured three to four times using either Brown and Wickham (Ref. 4) method (one-side opening with 1 mm diameter, infusion rate 2 ml/min.), or Millar 5F catheter-tip pressure transducer. Infusion measuring system was dynamically calibrated to maximum recordable rate of increase of pressure with time (Ref. 2). The withdrawal speed used (1 mm/sec.) was in accordance with maximum rate of increase of pressure with distance, thus enabling the elimination of possible error due to limited speed of response. Values of UPP-V (maximal UPP pressure variation) were further verified by monitoring the maximal urethral pressures for time up to 10 min. Thus the real maximal urethral pressure-time variations (UPT-V) were obtained. Measurements were done on 13 patients of them in 10 patients with stress (2 pat.), urge (3 pat.), stress and urge (2 pat.) incontinence and frequency of micturition (3 pat.) cystometry (CMG) revealed no uninhibited bladder contractions, while in 3 patients with urge and stress incontinence (1 pat.), reflex bladder (1 pat.- upper motor neuron lesion, level Th 8-10) and nocturnal enuresis (1 pat.) uninhibited bladder contractions were seen from CMG curves. All urethral pressure measurements were done with bladder empty.

RESULTS

Urethral Pressure-Time Variations - UPT-V

In the first group of patients with no urodynamic sign of uninhibited bladders, the pressure-time patterns (UPT-V) measured at approximative sphincteric maximal pressure region revealed very approximative sinusoidal form of variations with maximal "peak to peak" amplitudes (UPT-V) from 8 to 35 cmH_2O. In the second group, i.e. the three cases with uninhibited bladders, similar pattern was observed, the UPT-V being from 8 to 48 cmH_2O. In most of the subjects the periods of sinusoidal wave forms were in ranges from 10 to 20 sec., while in some of them the ranges were from 10 to 30 sec. approximately. Only in two subjects, the urethras exhibited "silent" patterns (one patient with severe stress and urge incontinence from the first group and one patient with reflex bladder from the second group) with values of UPT-V, 8 cmH_2O in both cases. In all other cases UPT-V, i.e. the real physiological pressure variations, were of considerable values.

Urethral Pressure Profile Variations - UPP-V - Comparison with UPT-V

Among 10 patients from the first group, the UPP measurements revealed 8 cases with relatively "silent" urethra, i.e. UPP-V(changes in maximal urethral pressures estimated from 3 to 4 times repeated UPP measurements) ranged from 0 to 10 cmH_2O. In 7 of these cases UPP-V were highly underestimated in comparison with the real possible physiological urethral pressure-time variations (UPT-V), and were in the range of 0 to 35 percents of coresponding UPT-V values, while in 1 case the UPP-V was 62 percents of coresponding UPT-V. In the remaining 2 patients from the first group the UPP-V

were in one case 35 cmH_2O and in the other 17 cmH_2O, thus showing the significant UPP variations. In the first case the UPT-V was also 35 cmH2O, the UPP-V being 100 percents of UPT-V (we must have been very lucky in covering the whole range of UPT-V with only 3 repeated UPP measurements). In the second case the UPP-V was 17 cmH_2O while the UPT-V was 27 cmH_2O, the UPP-V being 62 percents of UPT-V. In the second group of patients the results obtained from UPP measurements were similar to those obtained in the first group, i.e. showing two "silent" urethras with small UPP-V (6 cmH_2O and 10 cmH_2O) while the coresponding UPT-V were low in the first case (8 cmH_2O) and high in the second case (30 cmH_2O). In the third case of this group the UPP-V

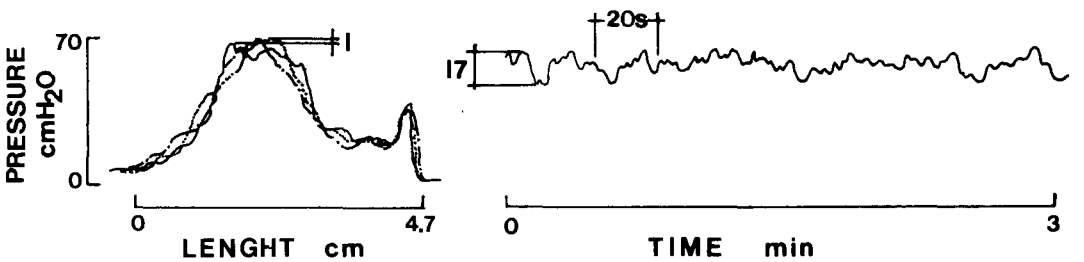

Fig. 1. Small UPP-V (left) and high UPT-V (right) measured in the patient with micturition frequency; bladder exhibited no uninhibited contractions

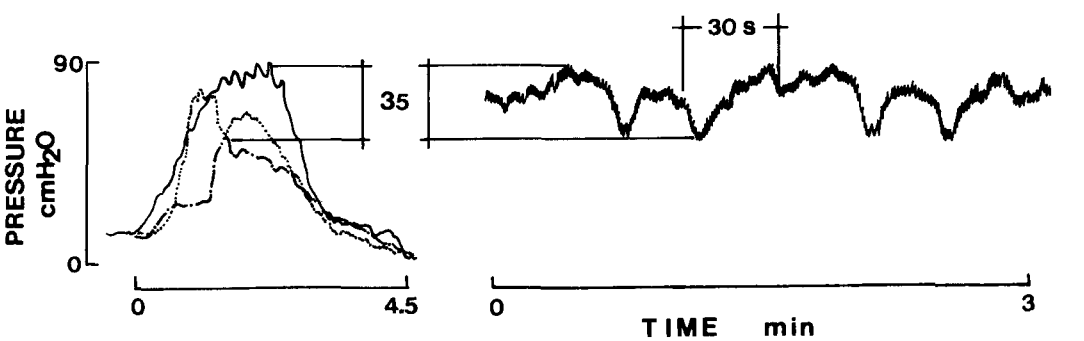

Fig. 2. High UPP-V (left) and high UPT-V (right) measured in the patient with micturition frequency; bladder exhibited no uninhibited contractions

was high (32 cmH_2O) as well as the coresponding UPT-V (48 cmH_2O). In all examined cases the UPP-V were always in the range of UPT-V. The recordings of small UPP variability with coresponding large UPT variability in one patient and of large UPP-V with coresponding large UPT-V in the other patient are shown on Fig. 1 and Fig. 2.

CONCLUSIONS

The results obtained from measurements of the urethral pressure profile variations (UPP-V) and urethral pressure-time variations (UPT-V) on 13 patients are offering several preliminary conclusions:

i) The real physiological UPT-V measurements revealed only 2 relatively "silent" urethras, while in all other cases the UPT-V were of considerable values (up to 48 cmH_2O). Small UPT-V was found in one case of uninhibited bladder as well as in one case of bladder with no sign of uninhibited contractions.

ii) Evaluation of physiological variations by estimation of UPP-V from a small series of UPP curves (3 to 4), gave highly unreliable results. UPT-V patterns proved only 2 "silent" urethras, out of 10 diagnosed by UPP-V patterns. It seems that one has to be very lucky to cover the whole range of possible physiological variations by only several UPP measurements.

iii) The pressures obtained by UPP measurements seems to depend on the pressure-time function at a particular point in the urethra, i.e. on frequencies and amplitudes of approximative sinusoidal pressure waves, as well as on withdrawal speed and the phase which is determined by the time when the measuring of UPP is started.

iv) It is our strong feeling that in any use of UPP curves and especially when using them for comparing the states of the urethra under different conditions (electrical stimulation, drugs, various bladder volumes etc.), the determination of physiological variability by means of UPT-V measurements for times at least up to 5 min. should be included in the examination. The determination of pressure variations from small series of UPP curves seems to be very misleading.

v) Many authors measure "several UPP curves until the reproducible pattern occurs" and thus use the "reproducible" UPP curve as a "reliable" or "proper" one for diagnosis. This way of thinking also seems to be misleading. One can measure highly repeatable UPP curves as well as poorly repeatable UPP curves in the same patient by using adequate withdrawal speeds and starting the measurements at adequate times.

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ACUTE AND POST-ACUTE EFFECTS OF ELECTRICAL STIMULATION IN PATIENTS WITH REFLEX NEUROGENIC BLADDER

Janez Janež*, Stanislav Plevnik and Gregor Homan***

**Urological Clinic, Clinical Centre, 61000 Ljubljana, Zaloška, Yugoslavia*
***University of Ljubljana, Faculty for Electrical Engineering, 61000 Ljubljana, Tržaška 25, Yugoslavia*

ABSTRACT

Acute and post-acute effects of anal or vaginal electrical stimulation were studied in 24 patients with reflex neurogenic bladder. Inhibition of the bladder with contraction or relaxation of the urethral muscles was observed in most cases, and was correlated with clinical success. In the remaining cases, many other combinations of urethral bladder responses occured.

INTRODUCTION

Electrical stimulation has for more than a decade been in use for treatment of micturition disturbancies - mostly urinary incontinence. It is evident from the literature that different types of stimulation (mechanical, electrical) have had different effects on normal or pathologically changed detrusor and on urethral muscles. Therapeutical effects of electrical stimulation also differed. Acute effect of maximal perineal electrical stimulation in patients with stress incontinence was either partially successful (Ref. 1) or very successful (Ref. 2) or completely unsuccessful (Ref. 3). Post-acute effect of electrical stimulation on anal sphincter in patients with hyperreflex bladder (normally inervated urethral closing muscles) revealed immediate improvement in 42 % of patients and partial improvement in the remaining cases (Ref. 4). The best results were obtained by simultaneous anal, vaginal and subcutaneous perineal electrical stimulation in patients with urge incontinence (Ref. 5). In both groups (Ref. 4 and 5), the positive post-acute effect of electrical stimulation was correlated with the objectively urodynamically determined bladder inhibition and the contraction of urethral closing muscles as a consequence of electrical stimulation.

We have studied the effects of acute maximal electrical stimulation of pelvic floor muscles on the detrusor and the urethral muscles, as well as clinical effects of one

or more sessions of acute electrical stimulation.

METHODS AND MATERIALS

Examinations have been done on 24 patients with reflex neurogenic bladders (22 traumatic upper motor spinal lesions, 1 spinal arachnoiditis, 1 thoracal mielomeningocele). In 14 patients complete while in 10 patients incomplete lesions were stated. Clinical and routine urological examinations excluded larger morphological changes. The type and degree of neurogenic lesions were determined by neuro-urological, neurophysiological (EMG of pelvic floor) and urodynamical examinations. The patients were from 16 to 60 years old, among them 8 females and 16 males. Urodynamic measurements were done according to ICS recommendations (Ref. 6). All patients were catheterized and residual urine was determined. With the same catheter (modified two-channel Ch 14 Folley catheter with one side opening of 1 mm diameter for urethral pressure profile measurement, UPP, infusion rate 2 ml/min) the UPP were measured with Brown and Wickham method (Ref. 7) before and during the electrical stimulation.The measuring system was dynamically calibrated (Ref. 8), while the withdrawal speed (1 mm/s) was adjusted not to cause errors due to the limited speed of response.
Cystometry (CMG) was measured by the same catheter at medium infusion rate, before and during the electrical stimulation.
The laboratory version of electrical stimulator was used, generating monophasic square pulses of 1 ms duration, frequency 20 Hz and voltage varying from 10-30 V (average 17 V), corresponding current being from 30-100 mA (average 53 mA). Anal and vaginal plug bipolar electrodes were used. Duration of stimulation sessions varied from 15 to 20 min.
Inhibition or facilitation of detrusor as a consequence of electrical stimulation was evaluated by CMG curves which determined the corresponding increase or decrease of bladder capacity. Contraction or relaxation of the urethra due to electrical stimulation was evaluated by the corresponding increase or decrease of UPP curves.

RESULTS

The inhibition of detrusor with contraction of the urethral muscles revealed in 8 patients (2 complete and 6 incomplete lesions).
From this group, one patient (incomplete lesion, urgency, frequency, nocturnal and diurnal incontinence) was completely cured after 3 repeated stimulation sessions, done within the period of 3 months. In 4 patients (2 complete lesions) the disturbancies in urinating lessened (interval between micturitions increased to 2-4 hours, dribbling was reduced). The effect of stimulation lasted from several days to 4 months. In one patient the vesico-ureteral reflux (VUR) ceased, while in the other it was considerably improved. In 3 patients (complete lesions) spasms and pains in the lower extremities were reduced.
Inhibition of the detrusor with relaxation of the urethral muscles revealed in 8 patients (3 incomplete nad 5 complete lesions). Clinical improvement, observed in 5 patients (3 complete lesions), lasted from several days to 3 weeks. In 2 patients spasms in the lower extremities were reduced. In 1 patient the clinical state aggravated for several days after the stimulating session (difficulties in emptying the bladder due to significant detrusor-sphincter dyssenergia).

Contraction of the urethral muscles with an unchanged state of the bladder revealed in 2 patients (1 complete lesion). There were also no observable therapeutical effects.
In 2 patients (complete lesion) electrical stimulation caused relaxation of the urethral muscles with no effect on the bladder and no observable therapeutical effects.
Inhibition of the detrusor with an unchanged state of the urethra revealed in 2 patients (complete lesions). In one patient (22 months after lesion C 6) a more pronounced autonomic hyperreflexy occured due to electrical stimulation and cystometry. Therapeutical effects were not observed.
In 2 patients (complete lesions) electrical stimulation caused decrease of the bladder capacity with relaxation of the urethral musculature. In one patient (8 months after spinal injury C 6) electrical stimulation and cystometry caused autonomic hyperreflexy. In the other, clinical state was temporarily improved (between the reflex micturitions dribbling was reduced).

DISCUSSION

The data to be found in literature concerning the effects of different types of stimulation on urinary bladder, differ very much. Digital rectal distension caused bladder inhibition in normal cases (Ref. 9), while in the patients with spinal lesions the bladder inhibition as well as the facilitation (Ref. 10, 11, 12) or prevalently facilitation in patients with upper motor neuron lesion was observed (Ref. 13). Anal electrical stimulation in patients with hyperreflex bladder caused mostly bladder inhibition or had no effect (Ref. 4). The same was observed when using vaginal electrical stimulation (Ref. 14).Bladder inhibition with contraction of the urethral muscles or urethral contractions only were observed when using simultaneous anal, vaginal and subcutaneous perineal electrical stimulation (Ref. 5).
It is evident from the results we obtained, that electrical stimulation of the pelvic floor muscles caused different responses of the detrusor and the urethral muscles. Besides bladder inhibition, which most frequently occured, and contraction of the urethral muscles, electrical stimulation caused also relaxation of the urethral muscles with facilitation of the bladder, as well as other possible combinations of bladder and urethral responses, among which also no response to stimulation.
It is difficult to evaluate the facilitation of the detrusor by only measuring intravesical pressure without substruction of the abdominal pressure. It is equally difficult to evaluate the effects of electrical stimulation on the urethral muscles, because the UPP curve may vary due to physiological variations of the urethral pressure (especially during electrical stimulation).
In some patients, who improved clinically after the first stimulating session, the urodynamic follow up revealed an increased bladder capacity, while residual urine was decreased or remained unchanged.
Among the undesirable effects there was one case of aggravated mictuition after the stimulation (due to the increase of bladder capacity at a significant detrusor sphincter dyssenergia), two cases of increased autonomic hyperreflexy during the stimulation (lesion C 6, 8 and 22 months after the injury ; in one of the cases there was a facilitatory effect of stimulation on the bladder). Therapeutic effects proved to be most successful when the patients had an inhibition of the detrusor and a contraction or relaxation of the urethral muscles (Among 16 patients 10 were subjectively improved.). In one patient, VUR ceased completely. This may be the

consequence of contraction of the bladder base (Ref. 15). Therapeutic success was relatively good, though in most cases of short duration.
Some patients were willing to continue the treatment, their difficulties in urination and the spasms of the lower extremities having decreased a great deal. This fact stimulates our further efforts in the field.

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U.K.	Pergamon Press Ltd., Headington Hill Hall, Oxford OX3 0BW, England
U.S.A.	Pergamon Press Inc., Maxwell House, Fairview Park, Elmsford, New York 10523, U.S.A.
CANADA	Pergamon of Canada Ltd., 75 The East Mall, Toronto, Ontario, Canada
AUSTRALIA	Pergamon Press (Aust.) Pty. Ltd., 19a Boundary Street, Rushcutters Bay, N.S.W. 2011, Australia
FRANCE	Pergamon Press SARL, 24 rue des Ecoles, 75240 Paris, Cedex 05, France
FEDERAL REPUBLIC OF GERMANY	Pergamon Press GmbH, 6242 Kronberg-Taunus, Pferdstrasse 1, Federal Republic of Germany

Dec 13th

Printed in Great Britain by Cotswold Press Ltd., Oxford.