Bladder outlet obstruction in females

W1, 15 October 2012 09:00 - 10:30

Start	End	Topic	Speakers
09:00	09:10	the growing problem of female obstruction	• Luis Monteiro
09:10	09:30	clinical presentations	• Miguel Silva-Ramos
09:30	09:40	existing nomograms	• Ruth Kirschner-Hermanns
09:40	09:50	data presentation	All
09:50	10:15	nomogram adjustments for use in women	• Luis Monteiro
10:15	10:30	Discussion	All

Aims of course/workshop

Female outlet resistance and detrusor contractility are the mainstays of dysfunctional voiding. This problem is increasing in women after the new anti-incontinence surgeries.

Evaluation of these parameters has been extensively studied and used in men. Female anatomy poses different problems of evaluation. Using the same methodology, however, most of women can be classified by their urethral resistance and/or detrusor function.

We present the clinical grounds of female voiding dysfunction and the basics of pressure/flow curves physics. The pros and cons of existing female nomograms are discussed and some data-supported methods are proposed.

Educational Objectives

Bladder outlet resistance and detrusor contractility measurements are not of routine use evaluating female voiding dysfunction. The clinical presentations are usually misleading and the overall importance of the problem has been disregarded. Female obstruction and detrusor dysfunction is more common than previously thought. Moreover, after the new anti-incontinence surgeries, iatrogenic outlet obstruction is increasing and post op urinary retention risk must be assessed.

With some limitations and small adjustments, these parameters can be calculated in the same way as in men. Pressure/flow curve analysis is an efficient tool to diagnose and prevent voiding problems in women.

Female bladder outlet obstruction

- The growing problem of female obstruction
- Old and new causes
- Female clinical features
- Diagnosis and existing nomograms
- Data and nomogram adjustments for use in women
- Discussion and conclusions

The problem

Bladder outlet obstruction is not so common than in man

Seldom explored when evaluating female LUTS

Not diagnosed when not suspected

- But…
- Recently recognized as more frequent than previously thought and is responsible for a array of symptoms
- Iatrogenic obstruction is increasing with new treatments for incontinence
- There is still some debate about diagnostic methods

The problem

The boundaries of normal voiding are more blurred in women than in men

There are no universally accepted urodynamic criteria

Some use plain uroflowmetry with PVR measurement
Most are based on Pressure/flow plots
Some find video-urodynamics mandatory

It is difficult to separate functional from anatomical obstruction

New and old causes

- Etiologic factors:
  - Anatomical
  - Functional
- Association to hyperactive detrusor
  - Cause?
  - Effect?

Female voiding dysfunction

New and old causes

- Anatomical
  - Extraurethral
    - Gynecologic masses
    - Incontinence surgeries
  - Urethral
    - Stenosis
    - Neoplasia
    - Infection
      - Glandular
      - Diverticula
    - Cervical obstruction

Carr e Webster, Urol Clin N Amer, 1996

New and old causes

Female voiding dysfunction

- Functional
  - Dissynergias (neurogenic)
    - Active contraction during voiding
    - infrapontical, suprasacral lesions
  - Dysfunctional voiding (non neurogenic)
    - Sphincteric spasms [1,2,3]
    - Cervical obstruction [4]
    - Pseudodyssinergia
    - Neurogenic/non-neurogenic
    - Fowler's syndrome
    - Pelvic spasticity (vesico-pelvic dyssinergia)
    - Hinman syndrome[5]
    - Idiopatic dyssinergia[6]
    - Learned voiding dysfunction[7]
    - Acquired voiding dysfunction[8]

1-Raz e Smith J Urol, 1976
2-Kaplan et al. JUrol, 1980
3-Axelrod e Blaivas J Urol, 1987
4-Diokno et al. J Urol, 1984
5 Hinman, J Urol, 1986
6 Jorgensen et al Eur Urol, 1982
7 Groutz et al Neurourol Urodyn, 2001
8 Groutz e Blaivas Curr Opin Urol, 2002

Female voiding dysfunction

New and old causes

• anti-incontinence surgery	26%
• Severe urogenital prolapse	24%
• Urethral stenosis	13%
• Cervical obstruction	8%
• Acquired voiding dysfunction	5%
• Vesico-sphincteric dyssinergia	5%
• Urethral diverticula	3%
• Idiopathic	16%

Groutz, Blaivas e Chaitkin, Neurourol Urodyn, 2000

Female voiding dysfunction

Clinical presentations

Clinical presentations

often misleading

storage symptoms are predominant and less associated to obstruction

by the patient… and their doctors

Female voiding dysfunction

Female symptoms

Voiding symptoms (weak stream, hesitancy, strain to void) are even less reliable among women

female

“The bladder is an ~~un~~reliable witness…”

even less

Female voiding dysfunction

- Storage symptoms are predominant and usually less associated to obstruction
- Obstructive female syndromes like:
  - Dysfunctional voiding
  - Pelvic organ prolapses
  - Dyssinergias

  are similar to overactive bladder syndrome

Female voiding dysfunction

Female symptoms

Obstructed women have higher symptom scores but with similar storage complaints [2]

Only half of urodynamically obstructed women have voiding symptoms [3]

1- Lemack. Nature, 2006
2- Groutz et al. Neurourol Urodyn, 2000
3- Lemack e Zimmern J Urol, 2000

Female voiding dysfunction

Female symptoms

- But…
  - With symptoms:
    - Weak stream
    - Hesitancy
    - Straining
    - Incomplete emptying sensation

55% of women have obstruction compared to just 25% with other symptoms

Special presentations

- Female dysfunctional voiding
  - Lack of adequate urethral relaxation at any level (cervical, distal) without any known neurogenic cause
  - Implies suggestive EMG but it can only assess distal urethral and pelvic muscular activity
  - Cervical dysfunctional voiding is difficult to differentiate from anatomical cervical stenosis

Female voiding dysfunction

Special presentations

- Dysfunctional voiding
  - Urgency and frequency 82%
  - Urgency incontinence 23%
  - Urinary infections 42%
  - Hyperactive detrusor 42%
  - Occult neurologic disease 5%
    (reclassifying diagnosis to dyssinergia)...

Female voiding dysfunction

- Other presentations
  - Learned or acquired voiding dysfunction
  - Fowler's syndrome

Female bladder outlet obstruction

diagnostic nomograms

Beijing, october 2012

---

diagnosis

- Assessment of obstruction can be done clinically, by image methods or by urethroscopy
- But…
- the physical concept of obstruction (high pressure – low flow, requires pressure measurements
- The intimate relationship between pressure and resulting flow require both estimates
- Obstruction (increased urethral resistance) should be dealt with detrusor performance to define a broader concept of voiding dysfunction

---

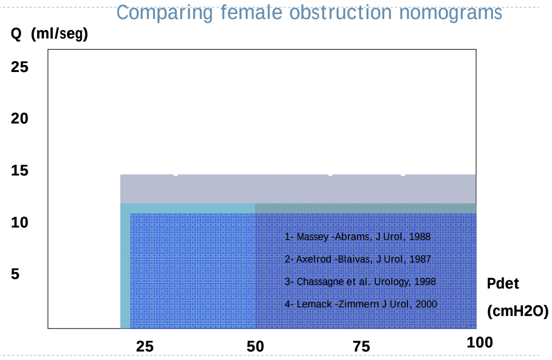
- 1 st message:
  - Voiding efficiency is a function of contractility and resistance and nomograms have to consider Flow and Pressure
- 2 nd message:
  - During the voiding phase, detrusor pressure (pdet) is not a measure of detrusor contractility, (unless there is no flow)

- Existing obstruction nomograms applied to women:
  - Axelrod -Blaivas, 1987
    - Pdet>20 cmH_2O and Q< 12 ml/sec
  - Massey - Abrams, 1988
    - Pdet>50 cmH_2O and Q< 12 ml/sec
  - Chassagne et al. 1998
    - Pdet>20 cmH_2O and Q< 15 ml/sec
  - Lemack - Zimmern 2000
    - Pdet>21 cmH_2O and Q< 12 ml/sec

---

diagnosis

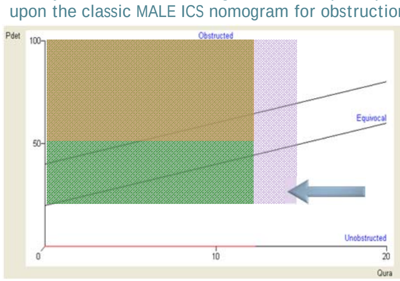
Comparing female obstruction nomograms



---

diagnosis

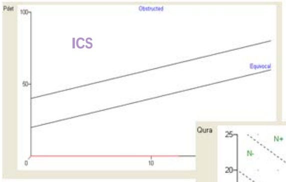
Massey, Axelrod and Chassaigne criteria superimposed graphically upon the classic MALE ICS nomogram for obstruction



Not so different from man, but some women "invade" a unobstructed area indicating a globally lower urethral resistance.

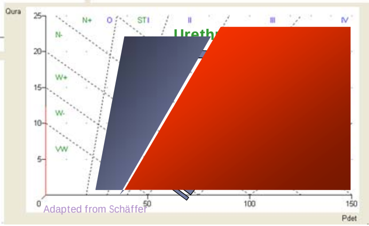
diagnosis

The classic Male nomograms:



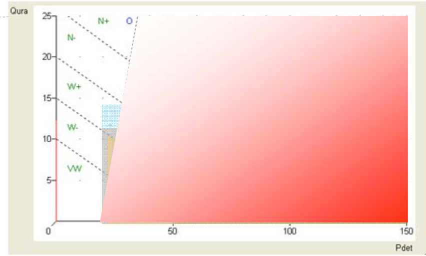
ICS for obstruction

Schäffer for obstruction and detrusor contractility



Approximate correspondence of equivocal and obstructed areas of ICS's onto Schäffer's

diagnosis



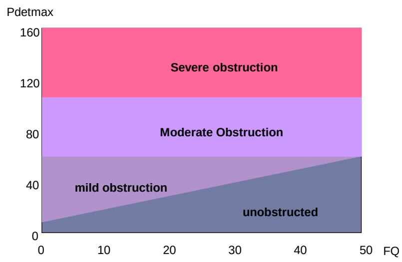
Massey, Axelrod, Chassagne and Lemack's female criteria superimposed graphically upon the male Schäffer's nomogram of obstruction and detrusor contractility.

Showing that female obstructive areas match to Schäffer's grade I to VI

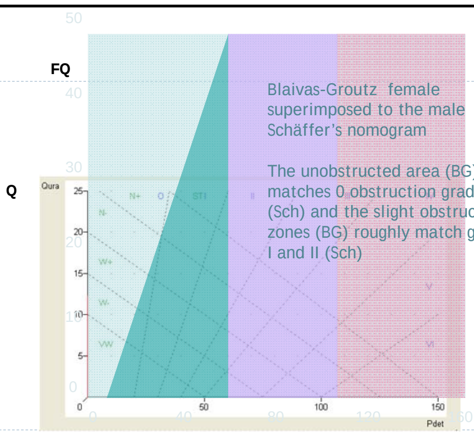
diagnosis

- Blaivas and Groutz describe as important the obstructive effect of 7 Fr urethral catheters accounting for a misleading results of PQ curves in women
- They proposed using the value of maximum flow from the non-intubated free flowmetry just previous to cystometry, plotted against mamimum detrusor pressure (Pdetmax) instead of detrusor pressure at the maximum flow (PdetQmax) because:
  - They found no statistical difference between Pdetmax and PdetQmax
  - Pdetmax is "easier to understand" (?)
  - Pdetmax can be used even in the absence of flow

Blaivas-Groutz female nomogram for obstruction



Adapted from Groutz e Blaivas Neurourol & Urodyn, 2000



Blaivas-Groutz female superimposed to the male Schäffer's nomogram

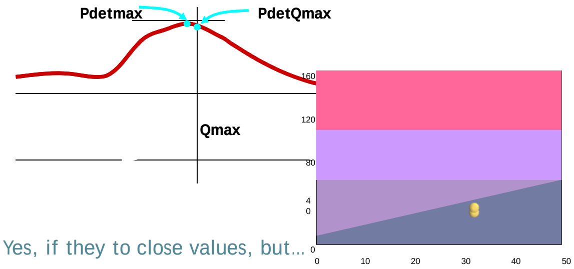
The unobstructed area (BG) matches 0 obstruction grade (Sch) and the slight obstruction zones (BG) roughly match grades I and II (Sch)

- Yet,
  - BG nomogram use free flow (FQ) and Detrusor pressure from different voidings
  - Detrusor pressure used is Maximum detrusor pressure (Pdetmax) instead of Detrusor Pressure at maximum flow (Pdetqmax)
    - The two detrusor pressure parameters may prove statistically similar, but in the individual patient…

- Q or FQ – entubated or free flow
  - Does it matter?

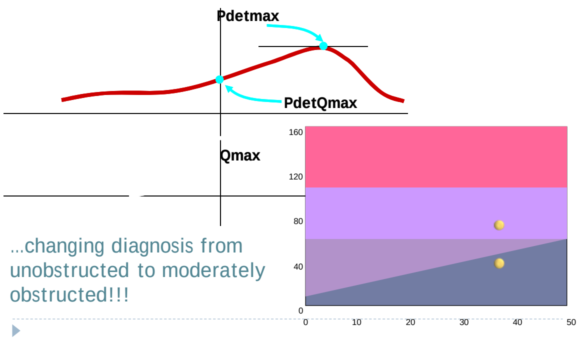
Mostly depends on catheter size.
It certainly does matter with > 7 Fr

- Pdetmax or PdetQmax?
  - Are they the same?



Yes, if they to close values, but…

…quite different if they are distant enough!



…changing diagnosis from unobstructed to moderately obstructed!!!

Blaivas-Groutz female nomogram for obstruction

- If not corrected by the computer application or the observer, a disproportionate amount of "obstructions" are diagnosed!
- Free flow of uroflowmetry is plotted against Pdet of another and intubated voiding with (potentially) different bladder volumes.
- For very high flows (40 to 50 ml/sec) there is no place for mild obstruction.
- Detrusor function is not considered

Ideal features for a female PQ nomogram:

• Built after a female series including normal controls

• Assess Pressure and flow in the same voiding using small enough catheters with negligible urethral effect

• Have a scale for detrusor contractility evaluation

• Be independent of abdominal influence (Pves instead of Pdet?

- But, such nomogram is still not available or validated for women
- In the meanwhile…

  diagnosis of obstruction must be supported by other methods
  video-urodynamics
  ultrasound
  EMG

- The usage of approved male nomograms with adequate adjustments may prove clinically useful

Female nomograms for voiding functions

- A little of physics…

  System with:
  a reservoir with volume
  a pumping engine with power
  an outlet with resistance

  No matter if its is a man, a woman, a syringe, a fireman's hose, etc

- Special features of lower urinary tract:
  - The engine has variable power depending on
    - The length of muscular fibers or bladder volume
      - Starling's law
    - The shortening velocity
      - Hill's equation
    - Fueled by micturition reflexes
      - CNS-bladder
      - Urethro-vesical

- Special features of lower urinary tract:
  - The outlet is a distensible/collapsible/contractile tube
    - When rigid, is governed by
      - Poiseuille's or Bernoulli's law depending on flow controling zone level, where
        - » $Q=P.R^4/8$
    - When collapsible/distensible
      - Radius is dependent on reservoir's pressure and there is an equation for each moment of the emptying phase

- Outlet resistance equation varies with pathology.
  - Ranging…
    - from urethral rigid stenosis…
    - To a elastic compression of proximal urethra of BPH…
    - Ending in normal distensible, low resistance female urethra

- In each case…
  - Flow will increase
    - with bladder pressure in a linear way, but…
    - In a quadratic or even at the 4^{th} power with urethral section (radius)
  - And…
    - If distensible, radius can increase with bladder pressure

- Flow is more influenced by radius than pressure especially in less distensible outlets
- In elastic urethras, pressure acts in two ways increasing flow:
  - By the poiseuille/bernoulli equation
  - By increasing the urethral radius

- In summary, our variables are:
  - Detrusor fibers shortening strenght
  - Urethral radius and elasticity

- A little of maths…
  - If
    - Q=k.P.r,
    - Then shortening os detrusor fibers results in
      - Pressure in bladder

      And/or

      - Flow

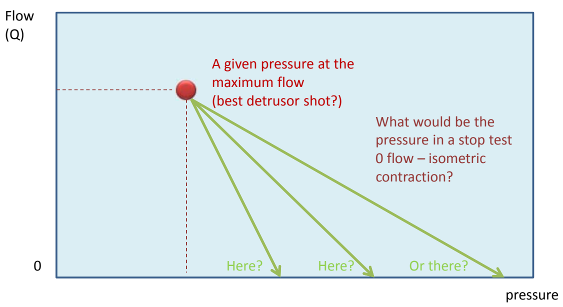
- In other words,
  - Detrusor contraction results in bladder pressure depending on urethral resistance.
  - When flow exists, it results in less pressure
  - Our system state varies then, from
    - Total outlet resistance (closed urethra) and maximal pressure
    - And low outlet resistance, flow and less pressure

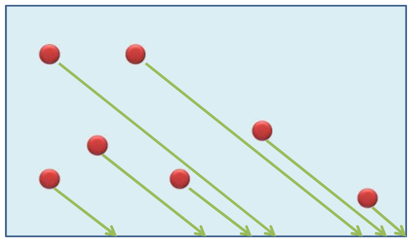
- Then, bladder pressure (pdet) is a function of:
  - Detrusor contraction
  - Resulting flow
- It only reflects detrusor performance when flow is 0! (isometric contraction)

- Since bladder pressure varies widely with flow, detrusor contractility can only be measured in a closed urethra (maximal resistance)
- But…
  - Since detrusor power varies within the emptying phase,
  - We need to measure the bladder pressure at the maximum flow, but with no flow!!!

- The stop test
  - Urethra is closed suddenly when maximum flow is reached
    - Voluntary contraction of urethra
    - Balloon occlusion of bladder neck
      - in the precise moment of maximum flow
  - It is unreliable, unconfortable
  - Depends on several and uncontrollable local and personal variables

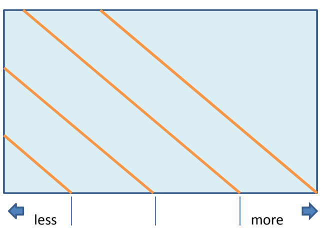
- Theoretical extrapolation of Stop test:
  - The projected isometric pressure
- In a given system described by a two variable plot of pressure and flow, maximum flow pressure can be projected onto the 0 flow if we know the probable direction of the projection.



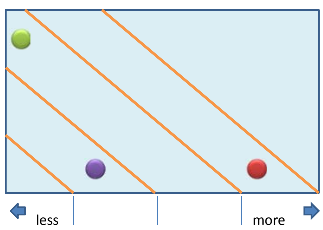


In a number of stop tests in men the pressures at 0 flow run in a fairly linear and parallel fashion, although a more parabolic (Hill's equation) theoretical curve would be expected. Some simplicity is added for the sake of practical use.

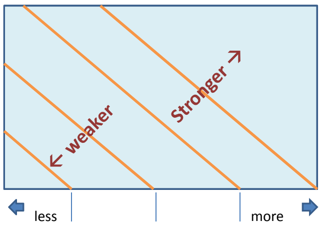
In men, lines of y=-5x slope were most often found (Q in ml/sec to 5Q in cm H2O of pdet) – PIP5 (projected isometric pressure), recently named as Bladder Contractility Index (BCI)



A scale of probable contractility at 0 flow can be drawn with no more need of stop test



- High flow, very low pressure = good contraction
- Low flow, higher pressure = worse contraction
- Low flow, higher pressure = very good contraction (but obstructed)

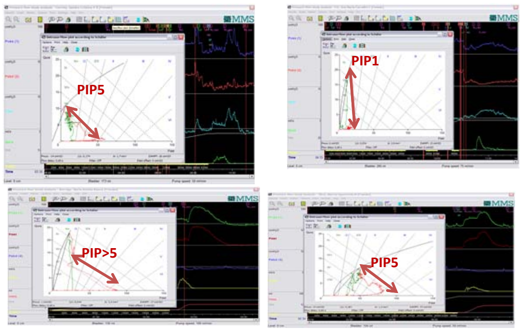


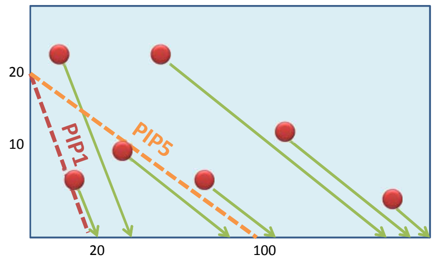
Schäfer considered 7 degrees of contractility :
Very Weak, weak minus, Weak, plus, Normal minus, Normal plus and Strong
after plotting hundreds of men, from non-obstructed (operated) to obstructed

- What about women?
  - Problems:
    - Some have abdominal contractions making impossible to determine what is the main driving force to generate the flow (detrusor or abdomen?)
    - Stop test are even less reliable because less ability to suddenly close the urethra
    - Urethra is often a distensible tube with more radius variability
  - But… the same principles should apply

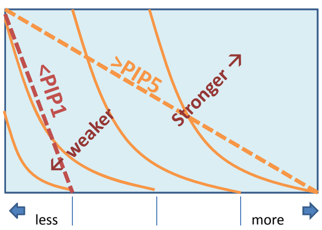
Some women show a clear PIP5 but some have more vertical patterns, say PIP1 (the same value of Q in ml/sec as pdet in cm H2O) and some in between.

STOPTESTS in Women





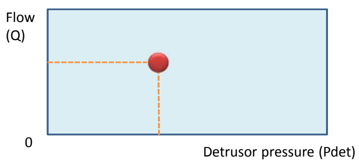
But, can we draw some pattern out of this variability?
1) Older women and those with higher flowrates and less urethral resistance tend to have lower PIP
2) Higher flows and less obstruction have PIP closer to 1 probably reflecting a more parabolic distribution of Hill's equation



A more parabolic design could be more closely adapted to female variations from PIP1 or less to PIP5 or more.

A closer attention to the pattern of Female stop-tests should be warranted

The abdominal contamination



When a flow is generated by intravesical pressure, it can be influenced by the abdominal contraction and detrusor contraction.
But, only detrusor pressure is considered in existing pressure-flow plots.
No pressure-flow plot using vesical pressure (Pdet) has been tested

Detrusor pressure plots are only valid with no abdominal activity!

Or,

- keep PIP5 option (Schäfer's)
  - But not considering the exceptionally low pressure-high flows.
  - Eventually exclude women older than 65?
  - Definitely exclude the "abdominal" micturitions

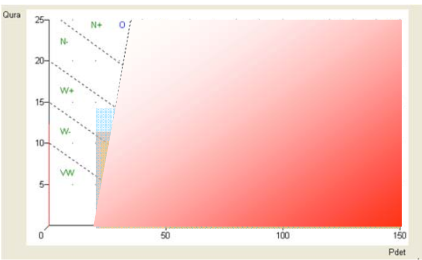
- And profit from it's simplicity, ease of use and clinical value long used in men.

- And, what about the measure of urethral resistance in women?

- A few more agreement in the literature…

- Several nomograms already described:
  - Massey-Abrams
  - Lemack-Zimmern
  - Chassagne
  - Blaivas-Groutz

- Superimposition of several female nomograms for obstruction



- Putting alltogether:

1) Detrusor pressure/Flow plots are not valid under abdominal "contamination"!

2) Women have more variabilty of urethral resistance and detrusor performance

3) Older women and those with very high flows have different "isovolumetric pressure projections" than the rest and than men

4) Validated female obstruction nomograms are not so different from those of men.

- Putting alltogether:

5) Detrusor performance and urethral resistance have to be measured to assess the increasingly frequent female voiding dysfunction

6) The boundaries of normality are less well defined than in men

7) Continuous scales should be used not to stick to "normal/abnormal" terms

---

- Putting alltogether:

8) the use of progressively thinner catheters warrants the intubated flow plots

9) Vesical pressure (instead of Pdet) plots can prevent the misleading effect of abdominal strain?

10) Mathematical simplification of nomograms may not hamper their (urgent) clinical use

Notes

Record your notes from the workshop here