182

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RENAL DETERIORATION AFTER SPINAL CORD INJURY IS ASSOCIATED WITH LENGTH OF DETRUSOR CONTRACTIONS DURING CYSTOMETRY – A 45-YEAR FOLLOW-UP STUDY

Hypothesis / aims of study

Renal deterioration was the main cause of death in patients with spinal cord injury (SCI) until the 1970s. Hence, patients with SCI are recommended to attend renal and upper urinary tract examinations lifelong, and invasive urodynamic examinations have been the preferred method to describe the neurogenic bladder dysfunction. Based on a study with 42 myelodysplastic children by McGuire et al. in 1981, a leak point bladder pressure above 40 cmH_2O has been considered a risk indicator of renal deterioration [1].

The aim of this retrospective study was to investigate which invasive urodynamic parameters are associated with renal deterioration over a 45-year follow-up period in patients with a traumatic SCI.

Study design, materials and methods

Medical records of 154 patients admitted with a traumatic SCI between 1944 and 1975 were reviewed from time of injury until 2012. To be included in the study, the patients should have attended follow-up examinations in our department with a minimum of one invasive urodynamic examination. The follow-up program in our department consisted of serum creatinine and X-ray or intravenous pyelography. From the 1980s renography was conducted every second year and renal radiolabeled tracer clearance (Glomerular Filtration Rate, GFR) and CT scans were conducted when indicated. Urodynamic investigations were performed when considered necessary. For the patients with more than one urodynamic examination, the first examination of sufficient quality was selected. Detrusor function, urethral function, maximum detrusor pressure, post-void residual volume and cystometric bladder capacity were obtained. For patients with detrusor overactivity (DO) and accessible urodynamic curves, a DO/cystometry-ratio was calculated by the total duration of detrusor contraction(s) during filling cystometry divided by the total duration of filling cystometry. The ratio was categorized into three groups: < 0.33, 0.33–0.66 and > 0.66.

Renal deterioration was diagnosed if there was a split renal function ≤ 30% in one kidney on renography or a relative GFR ≤ 51 % of expected according to age and gender.

Nonparametric continuous variables were analyzed using Wilcoxon test and categorical variables were analyzed using Fisher's exact test. All statistical analyzes were conducted using SAS (version 9.3; SAS Institute, Cary, NC, USA) and Microsoft Excel 2011 (Microsoft, Redmond, WA, USA). Only P-values < 0.05 were considered significant.

Results

A total of 73 patients were included in the study. Eight of the patients were women (11%), and the median age at time of injury was 21 years (range 1–52). There were 32 patients (44%) with cervical, 32 (44%) with thoracic and nine (12%) with lumbar SCI. Twenty-nine patients (40%) had a complete and 44 (60%) had an incomplete injury (Frankel grade A: 29, B: 20, C: 8, D: 14 and E: 2). The patients were followed until a median of 41 years after injury (range 24-56). The bladder emptying methods used for the longest period after injury were reflex triggering (63%), bladder expression (25%), clean intermittent catheterization (4%), chronic urethral catheter (4%) and normal voiding (4%). During the follow-up period, 44 patients (60%) change method to clean intermittent catheterization. Nineteen patients (26%) experienced renal deterioration, which was diagnosed after a median of 30 years after injury (range 8–54).

The urodynamic examinations revealed that four patients (5%) had normal detrusor function during filling cystometry and voiding. Of the four patients, none experienced renal deterioration. Fifty patients (68%) had neurogenic DO, of whom 13 experienced renal deterioration (26%). Ten patients (14%) had neurogenic acontractile detrusor, of whom three experienced renal deterioration (30%). The remaining nine patients (12%) were classified with underactive detrusor, due to a reduced detrusor strength and/or duration during voiding, of whom three experienced renal deterioration (33%).
A total of 42 patients (58%) had detrusor sphincter dyssynergia, of whom 12 experienced renal deterioration (29%).

In the group of patients with neurogenic DO and an available DO/cystometry-ratio, 4 out of 25 patients (16%) with a DO/cystometry-ratio < 0.33 experienced renal deterioration, 4 out of 8 (50%) with a DO/cystometry-ratio between 0.33–0.66 experienced renal deterioration and 2 out of 2 (100%) with a DO/cystometry-ratio > 0.66 experienced renal deterioration. Using a cut-of limit on 0.33, there was a significant association between an increased DO/cystometry-ratio and renal deterioration ($p < 0.02$). Median max detrusor pressure during filling in the group of patients with a DO/cystometry-ratio > 0.33 was 60 cmH_2O (range 37-100) for patients with renal deterioration and 60 cmH_2O (range 38-120) for patients without renal deterioration. The association between other urodynamic parameters and renal deterioration for patients with DO is shown in table 1.

Interpretation of results

This study shows that a prolonged duration of detrusor contractions during the filling phase in patients with neurogenic DO is a highly significant risk indicator of renal deterioration. No significant association was found between other urodynamic parameters and renal deterioration. We hypothesize that a sustained DO during the filling phase results in prolonged compression of the orifices of the ureters, which leads to obstructed urine outlet and, consequently, renal damage. The risk of vesicoureteral reflux has been the main concern in patients with a high-pressure bladder, but this study shows that patients with a sustained DO during the filling phase are also at risk of developing renal deterioration. Based on this study, it could be questioned if future interventions should aim at reducing the duration of DO during the filling phase, in order to prevent renal damage.

Concluding message

Duration of DO longer than one third of the cystometry-time (DO/cystometry-ratio > 0.33) increases the risk of renal deterioration after spinal cord injury.

Table 1. Urodynamic parameters and renal deterioration in patients with neurogenic detrusor overactivity.

Urodynamic parameter	n	Renal deterioration	No renal deterioration	P-value*
Max detrusor, filling (cmH_2O)	39	50 (20-100)	46 (20-120)	0.80
Max detrusor, voiding (cmH_2O)	33	69 (60-127)	70 (29-150)	0.74
Post-void residual volume (ml)	45	118 (0-319)	93 (0-500)	0.66
Max bladder capacity (ml)	46	350 (220-893)	371 (68-773)	0.63
Compliance (ml/cmH_2O)	36	26 (12-85)	35 (10-150)	0.18

*Wilcoxon nonparametric test. Numbers are expressed as median (range).

References

1. McGuire EJ, Woodside JR, Borden TA, et al. Prognostic value of urodynamic testing in myelodysplastic patients. The Journal of urology. 1981;126(2):205-9.

Disclosures

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