

Cross-Sectional Study of Determinants of Upper and Lower Urinary Tract Outcomes in Adults with Spinal Dysraphism—New Recommendations for Urodynamic Followup Guidelines?

Paul W. Veenboer,^{*,†} J. L. H. Ruud Bosch,[‡] Peter F. W. M. Rosier,[§] Pieter Dik,[§] Floris W. A. van Asbeck,[§] Tom P. V. M. de Jong[§] and Laetitia M. O. de Kort[§]

From the Department of Urology (PWV, JLHRB, PFWMR, LMOdK) and Department of Rehabilitation (FWAvA), University Medical Center Utrecht, and Department of Pediatric Urology, Wilhelmina Children's Hospital (PD, TPVMdJ), University Medical Center Utrecht, Utrecht, and Department of Pediatric Urology, Elizabeth Children's Hospital, Academisch Medisch Centrum Amsterdam, Amsterdam (TPVMdJ), The Netherlands

Purpose: Although annual urodynamic study is currently recommended for all adults with spinal dysraphism, this followup might be overly intensive. Therefore, in this cross-sectional study we examine which determinants of upper and lower urinary tract outcomes are associated with relevant urodynamic findings.

Materials and Methods: All patients visiting our specialized outpatient clinic for adults with spinal dysraphism during a 26-month period underwent evaluation of the lower urinary tract by (video)urodynamic study. High end filling pressure (40 cm H₂O or greater), poor compliance (less than 10 ml/cm H₂O) and high detrusor leak point pressure (40 cm H₂O or greater) were classified as relevant findings and together called unsafe bladder. Multivariable analysis was performed to reveal determinants of unsafe bladder (type of spinal dysraphism, being wheelchair bound, hydrocephalus, urological symptoms and renal dilatation) and diagnostic accuracy was calculated for the significant determinants.

Results: Of the 134 patients evaluated (median age 31.5 years) 120 underwent complete urodynamic study and were included in this study. In the multivariable model unsafe bladder was significantly associated with being wheelchair bound (OR 5.36, p=0.008). In patients without symptoms who were not wheelchair bound the negative predictive value of urodynamic study for finding an unsafe bladder was high (1.00).

Conclusions: If an adult patient with spinal dysraphism is not wheelchair bound, unfavorable findings at urodynamic study are unlikely. If these patients are asymptomatic, these findings are even more unlikely. In these patients it is probably not necessary to perform urodynamic study as frequently as is currently recommended. Patients with an unsafe bladder need active surveillance and treatment when upper tract safety is threatened.

Key Words: spinal dysraphism; meningomyelocele; urinary bladder, neurogenic; urodynamics

FEW data are available concerning how adults with spinal dysraphism and neurogenic bladder should be followed. There is some evidence that bladder function may change during

one's lifetime and that regular followup might be necessary.^{1–5} Furthermore, in a prospective study of 117 children with myelomeningocele Hunt and Oakeshott reported

Abbreviations and Acronyms

C(S)C = clean intermittent catheterization

CKD = chronic kidney disease

DLPP = detrusor leak point pressure

EFP = end filling pressure

eGFR = estimated glomerular filtration rate

NDO = neurogenic detrusor overactivity

SD = spinal dysraphism

UDS = urodynamic study

UTI = urinary tract infection

VUDS = videourodynamic study

VUR = vesicoureteral reflux

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* Correspondence: Department of Urology, University Medical Center Utrecht, Room 04.236, PO Box 85500, 3508 GA Utrecht, The Netherlands (telephone: 31-887553348; e-mail: P.W.Veenboer-2@umcutrecht.nl).

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that 54% of patients died (29% due to a urological cause), leading to a survival rate of 50% or less at age 35 years.⁶ The followup of patients with SD is certainly not finished after the age of 18 years. However, it is not known at which interval followup should occur, what it should consist of and whether it will lead to the identification of clinically relevant findings, ie the need for intervention.

Although some recommendations are made in current guidelines,^{7–10} they are often based on data related to noncongenital neurogenic bladder disorders or on pediatric studies. The European Association of Urology Guidelines on Neurogenic Lower Urinary Tract Dysfunction recommend urodynamic study every 1 to 2 years. This recommendation applies to all patients with SD with no distinction among the various types of patients (eg symptomatic vs nonsymptomatic, open vs closed SD).⁹ In fact, the recommendations of these guidelines apply to all patients with neurogenic lower urinary tract dysfunction. However, the detrusor pathophysiology in patients with SD is different from that in patients with spinal cord injury. Some studies also indicate high levels of urologist noncompliance with recommendations in neurogenic lower urinary tract dysfunction guidelines.^{11–13} Many urologists only perform UDS on indication.

Based on the premise that examinations should be performed only when the outcome will influence treatment policy, an important question is in which patients might less frequent urodynamic followup be justified? To answer this question it is useful to identify the determinants associated with relevant urodynamic findings, those that might indicate risks of harm to the upper urinary tract or guide incontinence management. In addition, diagnostic accuracy was calculated using these determinants as a diagnostic test.

PATIENTS AND METHODS

From January 1, 2011 to March 1, 2013 all patients visiting the specialized outpatient clinic for adult patients with SD at our hospital were offered a complete prospective urological evaluation. All patients were unselectively invited regardless of the presence or absence of urological symptoms. The internal review board declared that this study, an evaluation of standard practice, was not subject to the Law on Medical Research with human beings and that it had no objections to the performance of this study.

The patients had a diagnosis of open spinal dysraphism (predominantly myelomeningocele, ICD-10 Q05) or closed spinal dysraphism (ICD-10 Q76) and were age 18 years or older. The Tortori-Donati classification was used for classification of the SD lesions.¹⁴ During the initial evaluation in this cross-sectional study a rehabilitation physician (FWAvA) assessed various aspects of the

urinary tract including the method of voiding (spontaneous, indwelling catheter, CI[S]C, abdominal pressure or [in]continent stoma), UTIs and urinary incontinence. If any urological symptom was present it was scored accordingly and scored whether symptoms were spontaneously expressed or solicited. Symptoms were defined by the standards of the International Continence Society (2002) and were categorized based on history.¹⁵ Thus, incontinence was defined as any involuntary loss of urine and was quantified (per time unit). Patients with an indwelling catheter were evaluated as a separate group. UTIs were assessed by history, ie not always confirmed by urinary culture, and based on symptoms (frequency, urgency, dysuria, loin pain and strong smelling urine).

In addition to history, 3 baseline characteristics were determined for each patient based on history, including the type of SD (closed or open), the presence of hydrocephalus (present or not) and mobility (wheelchair bound or able to walk). This final factor corresponds with the neurological level. A recent systematic review identified these characteristics as prognostic factors of kidney impairment and incontinence.⁵

Subsequently all patients unselectively underwent videourodynamic study. (V)UDS was performed following Good Urodynamic Practice guidelines.¹⁶ If the patient was taking antimuscarinic drugs these were continued during UDS because the intention was to measure the actual situation.

For urodynamic testing a filling speed of 20 to 30 ml per minute was used. Filling was continued until strong desire to void occurred, or in absence of proper sensations until leakage occurred, or until detrusor pressures clearly exceeded 50 cm H₂O. In addition, voiding diaries (with catheterized or voided volumes) were used as a reference to determine whether a representative volume was observed during the urodynamic test. In some patients leakage did not occur until a large capacity was reached (in some cases up to 1,000 ml).

NDO was defined as any activity of the detrusor during filling cystometry. End filling pressure was defined as the detrusor pressure ($p_{det} = p_{ves} - p_{abd}$) at the end of the filling phase. Compliance was defined as the increase of volume up to cystometric bladder capacity divided by the increase of detrusor pressure, in cm H₂O ($\Delta V/\Delta p_{det}$). DLPP was determined as the lowest detrusor pressure at which urine leakage occurs in the absence of a detrusor contraction or increased abdominal pressure. In the majority of patients, because (spontaneous) micturition was not possible, only filling cystometry was reported. Vesicoureteral reflux during VUDS was graded using the International Reflux Classification.¹⁷ In addition to VUDS, bladder and kidney ultrasonography was conducted in all patients. Upper tract dilatation was scored as present or not present.

Cutoff values were used for statistical analysis to define whether urodynamic findings were deemed relevant. Values were determined based on Galloway's Hostility Score¹⁸ and the McGuire Principles.¹⁹ EFP was defined as high when 40 cm H₂O or greater. DLPP was considered safe when less than 40 cm H₂O. If no leakage occurred during UDS, but EFP remained less than 40 cm H₂O, DLPP was also scored as such (with less than 40 cm

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