
Urodynamic Assessment of Neurogenic Bladder in Spinal Cord Injury

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Abstract

Objective: The aim of this study is to describe the urodynamic findings that distinguish upper from lower motor neuron bladder dysfunction in spinal cord injured patients & to evaluate the benefit of medications used to treat their voiding disorders.

Patients & methods: Ninety-one patients (57 males, 34 females, age range 5 to 80 years) with neurogenic bladder caused by spinal cord injury were studied from January 2005 to July 2006. They were classified into two groups; first group (58) patients with incontinence of urine & second group (33) patients with retention of urine. All patients underwent urodynamic studies using (Duet-Logic G2) system.

Results: In the first group of patients urodynamic testing had shown that the cause of incontinence of urine was detrusor overactivity which is a typical finding of upper motor neuron (UMN) bladder dysfunction while in the second group urine retention was attributed to underactive detrusor which is usually seen in lower motor neuron (LMN) bladders.

Conclusion: Management of the urinary tract in spinal cord injured individuals should be based on urodynamic principles & findings in addition to the neurologic history & physical examination.

Key words: Spinal cord injuries, Urodynamic, Neurogenic bladder.

Introduction

Neurogenic bladder dysfunction occurs with spinal cord injury (SCI) & other neurologic diseases, affecting the ability of the urologic system to appropriately store & empty urine^[1]. Historically, urologic diseases complicating lower urinary tract dysfunction have been a major source of morbidity & mortality among SCI patients.

The urodynamic investigation of those with neurological impairment can provide objective information regarding the nature and extent of the effect on the lower urinary tract. For this reason, urodynamic studies should be an integral part in the evaluation of all patients with complete and incomplete SCI^[2,3,4,5,6]. They are the gold standard for evaluating bladder & sphincter function & for documenting the effectiveness of new drug or other treatment modalities^[2,7]; therefore all SCI patients should undergo urodynamic evaluation, with the initial urodynamic study done after the patient is beyond the spinal-shock phase^[1,3].

Patients & methods:

From January 2005 to July 2006, 91 (57 males, 34 females; age range 5 to 80 years) with neurogenic bladder dysfunction were studied at Ibn Al-kuf spinal cord injuries hospital.

A detailed history, physical examination including full neurological examination & investigations including general urine examination, urine culture & sensitivity, blood urea, serum creatinine, complete blood count & abdominal U/S were performed on all patients, intra venous urography (IVU) & micturating cystourethrography

(MCU) were done as indicated. None of the patients were in spinal shock. Patients had been treated for urinary tract infection (UTI) with antibiotics just before urodynamic testing and continued to receive a prophylactic dose of antibiotic during and after the testing.

The patients were classified into two groups; the first group 58 patients (64%) had incontinence of urine and the second group 33 patients (36%) complained of retention of urine. In all patients the urodynamic studies were conducted in the same manner, with the same equipment and by a single physician and his urology staff. The equipment used was Duet-Logic G2 system. The patients were placed in lying and sitting positions. Before testing, their bladders were emptied by catheterization using a 10F catheter for men and an 8F catheter for women. The bladder was filled with normal saline at a constant infusion rate of 60 ml / seconds. The intra abdominal pressure, intra vesical pressure and detrusor pressure were recorded throughout the voiding cycle. During test the patient was asked to cough or strain to evaluate detrusor instability. The first desire to void was recorded as soon as it was perceived by the patient. The test then continued until the patient reached full bladder capacity at which time the infusion stopped and the patient was asked to void and the voiding pressure recorded. Then the bladder was emptied to determine the post voiding residual volume (PVR). The patients underwent this urodynamic testing regardless of bladder management methods and were analyzed for first sensation volume, maximum detrusor pressure, maximum cystometric capacity, bladder compliance, voided

volume, voided pressure and PVR. In subjects with a history of autonomic dysreflexia or whose neurologic level of injury was T6 or above, continuous blood pressure (B/P) monitoring was initiated and maintained throughout the study

Results:

The total number of individuals assessed was 91, consisting of 57 males & 34 females. The age range was 5 to 80 years (mean 33.8 years). The baseline individual characteristics are shown in (table 1).

Subjects included patients with either traumatic or non traumatic SCIs who underwent urodynamic

evaluation. Neurologic diagnoses included 77 spinal cord injuries, 7 multiple sclerosis, 4 cauda equina and 3 Parkinsonism. There were 53 patients with complete SCI and 37 with incomplete injuries. Neurologic level of injury ranged from C2 to L2.

The patients used various urinary drainage methods including clean intermittent catheterization (CIC), indwelling urethral and suprapubic catheters, reflex voiding and voluntary voiding (Table 2).

Pre-urodynamic urine culture results were available for 82 (90%) patients (53 positive & 29 negative), other urologic complications found in those patients included calculi, urethral stricture, vesico-ureteral reflux and hydronephrosis (Table 3).

Table 1: Baseline individual characteristics

Total no.	91 patients
Mean age	33.8 years
Gender distribution	57 ♂ & 34 ♀
Duration of spinal cord injury(range)	6 months-4 years

Table 2: Bladder management methods

Method		No.	%
Intermittent catheterization		26	28.5
Indwelling Catheters	Urethral	20	22
	Suprapubic	14	14.2
Reflex voiding		27	29.6
Voluntary voiding		5	5.5
Total		91	100

Table 3: Urinary tract complications after SCI

Complication	No.	%
UTI	53	58.2
Calculi	21	23
Urethral stricture	20	21.9
Vesicoureteral reflux	19	20.8
Hydronephrosis	25	27.4

In the first group (patients with urinary incontinence); 17 patients (29.3%) had early first sensation (less than 100 ml), 32 (55.1%) had low maximum bladder capacity below (400 ml) and 52 (89.6%) had an uninhabitable elevation in intravesical pressure during bladder filling together with high voiding pressure more than (50 cm H₂O) and detrusor sphincter dyssynergia (DSD). (Figure 1).

In the second group (patients with retention of urine); 8 (24.2%) had delayed first sensation (more than 200 ml), 17 (51.5%) had maximum bladder capacity more than (500 ml) with very low detrusor contractions (low wave amplitude) throughout the phase of bladder filling and 23 (69.6%) had low voiding pressure below (20 cm H₂O). (Figure 2) (Table 4).

FIGURE 1

Facility: Life-Tech, Inc.
Physician: AL-DABBAGH
Referring Physician: SULAIMAN

Study date: 1/16/2006 9:43:56 AM
Clinician: Dr.ALA'A AL-DABBAGH
Phone: 7179004

Urodynamic Evaluation

Patient: (1/16/2006 9:43:56 AM)
Birth Date: 7/1/1974
Patient #:

Sex: M
Age: 31

Complaint: Incontinence of urine
Diagnosis:
Record #:

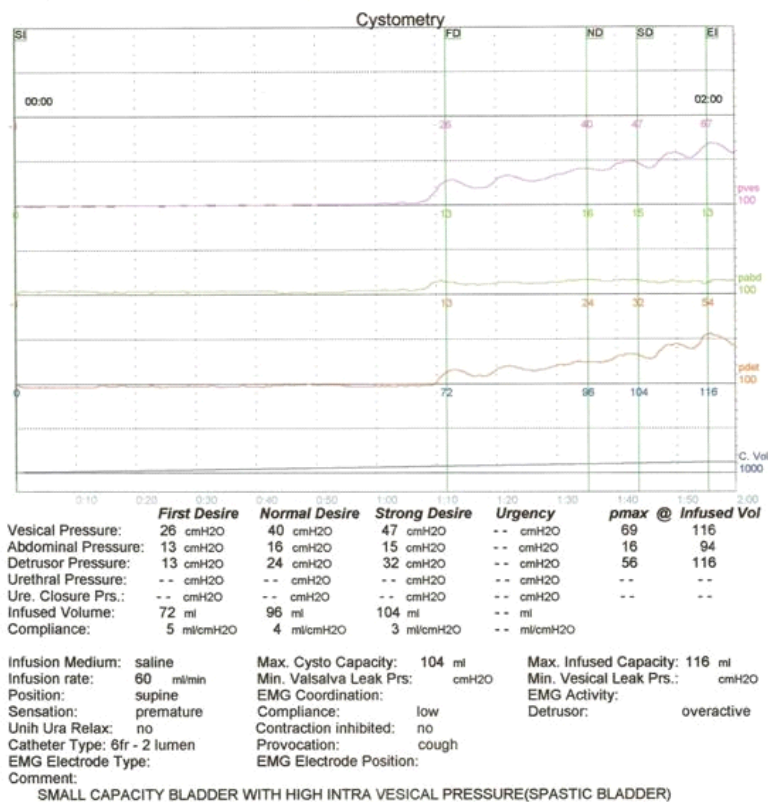


Table 4: Abnormalities of the main urodynamic parameters; First sensation volume, Maximum bladder capacity, Bladder compliance & Voiding pressure

Urodynamic parameters	Patients No (%) First group (incontinence of urine)	Patients No (%) Second group (retention of urine)
First sensation volume (100-200) ml	17 (29.3 %) < 100 ml	8 (24.2 %) > 200 ml
Maximum bladder capacity 400-500ml	32 (55.1 %) < 400 ml	17 (51.5 %) > 500 ml
Bladder compliance	Low	High
Voiding pressure (20-40) cm H ₂ O	52 (89.6 %) > 50 cm H ₂ O	23 (69.6 %) < 20 cm H ₂ O
Post-void residual volume (ml)	Very low, unless DSD is present	Very high

Discussion:

Urodynamic studies are used routinely to evaluate bladder function after SCI. They are an important component of a comprehensive assessment of the lower & upper urinary tract in conjunction with

other modalities such as cystoscopy, renal U/S and renal nuclear medicine scan.

Our groups included 91 patients with different bladder management methods, different causes for SCI and different levels and completeness of injury, coming in for bladder testing. Prior to urodynamics, the patients were treated for (UTI) with antibiotics and kept on long term prophylactic dose throughout the procedure and thereafter to reduce the incidence of (UTI) after urodynamic investigation. This is supported by Esclarin & Colleagues^[8] who found an

increased risk of (UTI_s) after instrumentation in patients with high level injuries and recommended antibiotic treatment. However Baker & colleagues^[9], and Almallah et al^[10] found that use of antibiotics prior to urodynamic did not make a difference in the incidence of (UTI).

In our study 58 patients (first group) had incontinence of urine with abnormal urodynamic results, shown as early first sensation less than 100 ml, low maximum bladder capacity less than 400 ml and high voiding pressure more than 50 cm H₂O. The main problem in these patients was detrusor over activity which is typically seen in (UMN) bladder & this explained the cause of their incontinence. These findings are in agreements with those reported by Papa-Petrous^[11], Sakakibara^[12], Goldstein et al^[13], Weinstein et al^[14] and Sirls et al^[15] who stated that in these patients urodynamically, the most common pattern seen is detrusor hyperreflexia (in about 70%); 50% accompanied by detrusor external sphincter dyssynergia

In the second group (33 patients) with retention of urine, the abnormal cystometric findings were shown as delayed first sensation more than 200 ml, high maximum bladder capacity more than 500 ml and low voiding pressure below 20 cm H₂O. This could be attributed to hypotonic detrusor function which is seen in (LMN) bladders. These findings tend to support the results obtained by a study reported by Wein AJ et al^[16] and Gonor et al^[17].

Surveillance with urodynamic studies to ensure safe emptying pressure is necessary after SCI and periodically for proper management of the urinary tract due to long term complications.

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