Original Article

Long Term Assessment of Neurogenic Bladder Following Myelopathies by Repeat Urodynamic Study and Correlation with Neurological and Functional Recovery

Anupam Gupta[1], Arun B Taly[2]

Abstract

Study Design: Prospective follow-up study

Objective: To assess neurogenic bladder following traumatic and non-traumatic myelopathies during inpatient rehabilitation by performing urodynamic study (UDS). Procedure repeated at least after 12 months follow-up to observe any change in the bladder behaviour and correlation between neurogenic bladder and neurological and functional recovery of the patients during the same period.

Setting: Rehabilitation unit in university tertiary hospital.

Methods: Thirty-one patients (24 males) with myelopathies (23 non-traumatic and 8 traumatic), mean age of 31.2±11.9 yrs (8-65 yrs) admitted for inpatient rehabilitation. All had neurogenic bladder with initial UDS suggestive of 17 patients with overactive detrusor and 14 with underactive/normal detrusor. Management advised accordingly. After minimum 12 months follow-up (12-23 months, 15.5±3.5), UDS was repeated.

Results: Significant change ($p<0.001$) in detrusor behaviour observed comparing initial and follow-up UDS findings. During both occasions there was no significant correlation ($p>0.05$) between bladder behaviour and neurological recovery (using American Spinal Injury Scale-ASIA) and functional recovery (using Barthel Index scale-BI). Significant functional recovery ($p<0.001$) observed between admission and discharge and discharge and follow-up in patients according to BI scores. Neurological recovery was significant between admission and discharge ($p<0.001$) but insignificant ($p>0.05$) between discharge and follow-up according to ASIA scale.

Conclusions: Detrusor behaviour following myelopathies is dynamic and not dependent on neurological and functional recovery. Repeat UDS is essential at regular intervals for effective management of neurogenic bladder and to avoid urinary complications.

Key words : **Myelopathies, urodynamic study, neurological and functional recovery.**

Author's affiliations:

[1] MBBS, MD (Physical Medicine & Rehabilitation), Associate Professor, Neurological Rehabilitation Division, Department of Psychiatric & Neurological Rehabilitation, National Institute of Mental Health & Neuro Sciences (NIMHANS), Bangalore, INDIA

[2] MBBS, MD, DM (Neurology), Professor of Neurology & I/C Head, Neurological Rehabilitation Division, Department of Psychiatric & Neurological Rehabilitation, National Institute of Mental Health & Neuro Sciences (NIMHANS), Bangalore, INDIA

Cite as :

Gupta A, Taly A B. Long term assessment of neurogenic bladder following myelopathies by repeat urodynamic study and correlation with neurological and functional recovery. IJPMR 2012 Mar; 23(1): 5-9.

Correspondence :

Dr. Anupam Gupta, MD

Email ID: drgupta159@yahoo.co.in

Phone No.: +91 80 26995282, Fax No.: +91 80 26564830

Mobile No.: +91 8762689540

Received on 14/12/2011, Accepted on 09/03/2012

Background:

The National Spinal Cord Injury Statistical Centre (NSCISC) estimated the prevalence of spinal cord injury about 755 per million population, with a range of 679–870 per million population and the annual incidence of spinal cord injury to be approximately 40 cases per million population or approximately 11,000 new cases each year.[1-3] In one of study conducted in this centre, 60% of the spinal cord injury (SCI) admitted patients had non-traumatic spinal cord lesions.[4]

Spinal cord injuries are well known to cause neurogenic bladder dysfunction with patients having urinary complaints. Urinary continence and the volitional control of voiding influence a SCI patient's potential for independence both at home and at workplace and the ability to function effectively. After SCI dynamic status

of the bladder/urethra depends on the level, extent and completeness of the lesion.[5]

Causes of mortality after SCI have changed in the last 5-6 decades from being primarily due to urinary tract diseases to increasing numbers of deaths from cardiovascular diseases and respiratory complications.[6-9] Urodynamic testing of bladder and management based on the findings has been one of the methods suggested to have contributed to reduce mortality and morbidity following myelopathies.[10]

There is consensus among the medical professional dealing with SCI cases that all such patients should undergo urodynamic evaluation with the initial study done after the patient has recovered from the initial spinal-shock phase. Management of the urinary tract in SCI individuals should be based on urodynamic principles and findings rather than on the neurologic history.[11,12]

Urodynamic study (UDS) has been considered the ''gold standard'' for evaluating bladder and sphincter function and for documenting the effectiveness of new drugs or other treatment modalities. UDS is recommended to be conducted at regular intervals after SCI to evaluate lower urinary tract function and to prevent upper and lower tract complications in SCI patients. Ideally it should be done once a year following SCI in the initial 5 years post lesion and after that it can done once in 2 years provided the patient continues to have neurogenic but stable bladder.[13] Limited studies have been done in the past to assess long term behaviour of neurogenic bladder following both traumatic and non-traumatic myelopathies.[10,12,14] Present study was conducted to assess neurogenic bladder following traumatic and non-traumatic myelopathies during inpatient rehabilitation by performing UDS. Procedure was repeated at least after 12 months follow-up to observe any change in the bladder behaviour by repeat UDS during this period and to see if there is any correlation between neurogenic bladder according to UDS and neurological and functional recovery of the patients during the same period.

Materials and Methods:

This prospective, follow-up study was conducted in the rehabilitation unit of the university tertiary research hospital. Approval from the institute's internal ethics committee was taken. The study was conducted over a period of 2 years (between April 2009 and March 2011) and included both traumatic and non-traumatic SCI patients admitted for inpatient rehabilitation. Patients consented to participate in the study, had monophasic spinal insult with injury in the cervical, dorsal and lumbar region and neurogenic bladder were included. Patients undergoing UDS for the first time and reported minimum 1 year after initial admission were only included. Patients with recurrent myelopathies, no urinary complication and doing voluntary micturition were excluded from the study.

MRI scan was done to ascertain level and type of lesion in the spinal cord in all the patients. Detailed neurological examination including sacral examination done to ascertain type and severity of injury. American Spine Injury Association (ASIA) classification was used to determine neurological level and functional abilities and were assessed using Barthel Index (BI) score.

All patients underwent UDS using multichannel urodynamic equipment-Primus (Lifetech Biomedica), which included recording of events during both filling and voiding phases. Normal saline used as medium of filling. Sphincter-electromyography was done in all patients. The bladder management of the patients was based on UDS findings.

Patients were called for regular follow-up. Thirty-one such patients reporting till minimum of 12 months and undergoing repeat UDS after minimum of one year were included in this study. Their neurological and functional status in the follow-up was recorded. Antimuscarinic medications were discontinued 1 week before performing repeat procedure and bladder management was based on UDS findings. Difference in bladder (detrusor) behaviour according to initial and follow-up UDS was analysed. Repeat UDS findings were correlated with neurological and functional recovery at 1 year follow-up to observe any definitive pattern.

Data Analysis:

Analysis was done using SPSS 15.0 version. Descriptive statistics included frequency, mean and standard deviation for quantitative variables such as age, duration of illness, duration of stay and BI scores.

Paired Student's t-test was used for the assessment of functional recovery using mean BI scores at admission, discharge and follow-up. The Wilcoxon non-parametric test was used for the assessment of neurological recovery by comparing admission, discharge and follow-up ASIA scale scores. Same test was used to assess change in detrusor behaviour between initial and follow-up UDS. Spearman correlation co-efficient test was used to observe correlation between detrusor behaviour and neurological and functional recovery.

Results:

Study included 31 patients (24 males, 7 females). During the study period 92 patients with traumatic or non-traumatic myelopathies were admitted for inpatient rehabilitation. The age of the patients varied from 8 to 65 years (31.2±11.9 years). Duration of illness at the time of initial admission ranged from 1 to 9 months (2.8±2.4 months). Mean duration of stay in the rehabilitation unit was 65.9 days (range 14-281 days, SD 60.7). Aetiology of myelopathy is reported in Table 1.

Ten patients (32.3%) had cervical myelopathy, 14 patients had dorsal myelopathy with lesion between D1-D6 in 4 patients (12.9%) and lesion between D6-D12 in 10 patients (32.3%). Seven patients (22.6%) had lumbar myelopathy.

Majority of the patients (27/31-87.1%) had urinary complaints in the form of increased frequency, urgency and urge urinary incontinence during initial admission/ after removal of indwelling catheter with 4 patients also had associated stress incontinence. Only 4 patients had complaints of hesitancy and straining to void with poor stream.

Bladder management after initial UDS was based on the detrusor behaviour according to findings. Sixteen patients were advised one or the other antimuscarinic (tolterodine, solifenacin, oxybutynin or propantheline), 4 patients advised adrenergic agonists along with behavioural and supportive measures to maintain balanced bladder and avoid any urinary complications.

Significant neurological and functional recovery was observed according to ASIA impairment scale and BI scale respectively during discharge as compared to admission scores ($p<0.001$). Similar trend was observed after minimum 1 year follow-up in the functional recovery with patients showing significant recovery as compared to discharge scores according to BI scale ($p<0.001$) (Table 2). Although there was trend for further neurological recovery during follow-up as compared to discharge but it didn't reach significant level ($p=0.06$) using ASIA scale.

At mean 15 months follow-up (12-23 months) UDS was repeated. Twenty-four patients were started on anti-muscarinic medications along with behavioural and supportive management according to repeat UDS findings. Significant change in detrusor behaviour

Table 1: ***Aetiology of Myelopathies***

Sl. No.	Aetiology	No. of cases	%
1	Traumatic spinal cord injury	8	25.8
2	Tuberculosis	4	13.0
3	Acute transverse myelitis	7	22.6
4	Arteriovenous malformation	4	13.0
5	Primary tumours	2	6.5
6	Prolapsed intervertebral disc	3	9.7
7	Ossified posterior longitudinal ligament	3	9.7
		31	**100**

Table 2: ***Neurological and Functional Recovery in Patients during Study Period***

Neurological recovery – ASIA scale					
	Admission	**Discharge**	**p value (Admission vs discharge)**	**Follow-up**	**p value (Discharge vs follow-up)**
A	19	6	<0.001	6	0.06
B	2	0		0	
C	6	8		4	
D	0	13		15	
E	0	0		2	
Cauda equina	4	4		4	
Functional Recovery – Barthel Index score					
	(29.7±20.5) 0 - 85	(68.7±19.3) 20 - 100	<0.001	(80.5±18.5) 40 - 100	<0.001

Table 3: *Urodynamic Study (UDS) Findings:*

S. No.	Detrusor Type according to UDS	Initial UDS	Follow-up UDS	p value
1	Overactive Detrusor without sphincter Dyssynergy	14	21	<0.001
2	Overactive Detrusor out sphincter Dyssynergy	3	3	
3	Underactive Detrusor	13	5	
4	Normal Detrusor	1	2	

($p<0.001$) was observed when comparing follow-up UDS finding with initial UDS findings (Table 3). The management of bladder also changed accordingly. Although there was significant change in detrusor behaviour with time as also was the case with functional and neurological recovery but during both initial and follow-up UDS, no significant correlation was found ($p>0.05$) between detrusor behaviour and neurological and functional recovery in patients.

Discussion:

UDS help the clinician in advising the patient on the available choices of bladder management.[15] Majority of the patients in the present study had recovered from the spinal shock by the time they were admitted in rehabilitation unit. Performing UDS is very important as according to our experience, most of such patients are either encouraged by treating team to go for Crede's method or straining to pass urine once they are decatheterised in general practice. On the other hand there are patients who are still advised to do clamping of indwelling catheter and release it after a certain time period. Both practices are dangerous and jeopardise the safety of bladder in the short term and may cause complications in the upper urinary tract in the long term run as well.

Although majority of the patients in the present study had irritative urinary complaints, initial UDS was suggestive of overactive detrusor (with or without sphincter dyssynergy) in only 55% (17/31) of patients who were started on one of the antimuscarinic medications. Remaining patients were advised timed voiding and fluid restriction only. These findings again highlight the importance of performing UDS in all patients so that the detrusor behaviour can be documented and bladder managed accordingly.

Several studies have been conducted in the past to observe correlation between neurogenic bladder and neurological recovery in the patients. Shenot *et al*[16] (1998) in their study with myelopathy patients observed that patients with sacral sparing during initial 72 hours examination had much bright chance of doing voluntary micturition after 1 year whereas patients with complete injury were found to have different types of detursor at 1 year UDS follow-up and required assisted micturition. Another longitudinal study by Generao *et al*[17] (2004) on paediatric SCI patients for up to mean of 5.5 years (range 1 to 15.5) found that bladder characteristics change with time in majority of patients with growth and serial urodynamics confirm dynamic nature of detrusor behaviour. Our study's findings are similar to both these studies as significant change in detrusor behaviour was observed in follow-up with majority of patients with underactive detrusor initially were later observed to have overactive detrusor and their bladder management protocol also changed accordingly.

Significant neurological and functional recovery was observed in follow-up with nearly 80% of the patients (24/31) were ambulatory with or without orthoses and assistive devices. Whereas only 5 patients (16.1%) were doing voluntary micturition with 4 of them were on anti-muscarinic medication to control overactive detrusor. Patki *et al*[18] (2006) in their longitudinal study with myelopathy patients observed that despite relatively near total neurological recovery, patients with incomplete SCI have neuropathic bladder unless proved otherwise.[18] Similarly Nosseir *et al*[19] (2007) in their longitudinal study with myelopathy patients found that the treatment strategy of neurogenic bladder dysfunction in patients with SCI has to be modified in almost all patients for protection of the upper urinary tract and maintenance of continence, based on regular urodynamic follow-up. The findings of our study are similar to these studies although we did follow-up of patients for only up to 23 months with UDS repeated only once. In the repeat UDS, there was significant change in detrusor behaviour (as evident from Table 3) but no significant correlation was found between detrusor behaviour and functional and neurological recovery ($p>0.05$) in the SCI patients conforming to the findings of earlier studies.

Wyndaele[20] (1997) in a study with SCI patients tried to correlate level of spinal cord lesion with bladder behaviour according to UDS and observed significant correlation between neurological examination and UDS findings, with higher lesions (above D10) correspond more with an overactive detrusor and somatic motor activity, lower lesions more with areflexic detrusor. With a lesion between thoracic 10 and lumbar 2 as many reflexic as

areflexic detrusor were found. The objective of our study was different but the mentioned study again highlights the point that there is no consistent correlation between bladder behaviour and level and severity of spinal cord lesions.

Conclusions:

Detrusor behaviour following myelopathies is dynamic and not dependent on neurological and functional recovery. Repeat UDS is essential at regular intervals for effective management of neurogenic bladder and to avoid both upper and lower urinary tract complications.

Conflict of Interest:

The authors declare no conflict of interest.

Carry home message:

Repeated urodynamics is essential for management of neurogenic bladder following myelopathies.

References:

1. DeVivo MJ, Go BK, Jackson AB. Overview of the national spinal cord injury statistical center database. *J Spinal Cord Med* 2002; **25:** 335–8.
2. National Spinal Cord Injury Statistical Center. Spinal Cord Injury Facts and Figures at a Glance. Information Sheet June 2005.
3. Wyndaele1M, Wyndaele JJ. Incidence, prevalence and epidemiology of spinal cord injury: what learns a worldwide literature survey? *Spinal Cord* 2006; **44:** 523–9.
4. Gupta A, Taly AB, Srivastava A, Murali T. Non-traumatic spinal cord lesions: epidemiology, complications, neurological and functional outcome of rehabilitation. *Spinal Cord* 2009; **47:** 307-11.
5. Hackler RH. A 25 year prospective mortality study in the spinal cord injury patient. Comparison with the longterm living paraplegic. *J Urol* 1977; **117:** 486–8.
6. DeVivo MJ, Krause JS, Lammertse DP. Recent trends in mortality and causes of death among persons with spinal cord injury. *Arch Phys Med Rehabil* 1999; **80:** 1411–9.
7. Frankel HL, Coll JR, Charlifue SW, Whiteneck GG, Gardner BP, Jamous MA, *et al*. Long term survival in spinal cord injury: a fifty year investigation. *Spinal Cord* 1998; **36:** 266–74.
8. Hartkopp A, Br_nnum-Hansen H, Seidenschnur AM, Biering-S_rensen F. Survival and cause of death after traumatic spinal cord injury. A long-term epidemiological survey from Denmark. *Spinal Cord* 1997; **35:** 78–85.
9. Soden R,Walsh J, Middleton JW, Craven ML, Rutkowski SB, Yeo JD. Causes of death after spinal cord injury. *Spinal Cord* 2000; **38:** 604–10.
10. Lloyd LK. Long-term follow-up of neurogenic bladder. *Phys Med Rehab Clin North Am* 1993; **4:** 391-409.
11. Watanabe T, Rivas DA, Chancellor MB. Urodynamics of spinal cord injury. *Urol Clin North Am* 1996; **23:** 459-73.
12. Hadiji N, Miri I, Ben Salah FZ, Rahali H, Koubaa S, Lebib S, Dziri C. Neurogenic urinary bladder in patients with spinal cord injury. Protocol of surveillance and management. *Tunis Med* 2009; **87:** 137-43.
13. Linsenmeyer TA, Culkin D. APS recommendations for the urological evaluation of patients with spinal cord injury. *J Spinal Cord Med* 1999; **22:** 139–42.
14. Rapidi CA, Petropoulou K, Galata A, Fragkaki M, Kandylakis E, Venieri M, et al. Neuropathic bladder dysfunction in patients with motor complete and sensory incomplete spinal cord lesion. *Spinal Cord* 2008; **46:** 673-8.
15. Jamil F. Towards a catheter free status in neurogenic bladder dysfunction: a review of bladder management options in spinal cord injury. *Spinal Cord* 2001; **39:** 355–61.
16. Shenot PJ, Rivas DA, Watanabe T, Chancellor MB. Early redictors of bladder recovery and urodynamics after spinal cord injury. *Neurourol Urodynam.* 1998; **17:** 25–9.
17. Generao SE, Dall'era JP, Stone AR, Kurzrock EA. Spinal cord injury in children: long-term urodynamic and urological outcomes. *J Urol* 2004; **172:** 1092-4.
18. Patki P, Woodhouse J, Hamid R, Shah J, Craggs M. Lower urinary tract dysfunction in ambulatory patients with incomplete spinal cord injury. *J Urol* 2006; **175:** 1784-7.
19. Nosseir M, Hinkel A, Pannek J. Clinical usefulness of urodynamic assessment for maintenance of bladder function in patients with spinal cord injury. *Neurourol Urodynam* 2007; **26:** 228-33
20. Wyndaele JJ. Correlation between clinical neurological data and urodynamic function in spinal cord injured patients. *Spinal Cord* 1997; **35:** 213–6.