Original Article ISSN (O):2395-2822; ISSN (P):2395-2814

Urodynamic Assessment of Bladder Behaviour in Traumatic Spinal Cord Injury (SCI) Patients in Response to Rehabilitation: Findings from a Government Tertiary Care Hospital in Bihar, India.

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Received: October 2018
Accepted: November 2018

ABSTRACT

Background: The objective of the study was to document the bladder behaviour in response to rehabilitation intervention in patients with traumatic spinal cord injury (SCI) using urodynamic study (UDS). Additionally, it also aimed to compare the nature of the bladder in a rehabilitated and non- rehabilitated neurogenic bladder of traumatic SCI. **Study design:** The study adopted a prospective follow-up design. **Setting:** Department of Physical and Rehabilitation Medicine, Jawahar Lal Nehru Medical College and Hospital (JLNMCH), Bhagalpur, Bihar, India. **Methods:** One hundred and thirty traumatic SCI patients mean age 31.3±7.8 years, 113 males and 17 females, admitted for rehabilitation were done UDS to see the bladder behaviour in response to rehabilitation intervention and compare the nature of bladder of the rehabilitated and that of the non-rehabilitated neurogenic bladder. **Result:** There were significant changes in the max. cystometric capacity (p=0.019) after rehab intervention in upper motor neuron (UMN) neurogenic bladders. The compliance, Pdet. at first desire to void and Pdet. at max. cystometric capacity were also found to have significant correlations (p=0.010, 0.010 and 0.013 respectively) in those with UMN neurogenic bladders. However, the volume at the first desire to void did not show significant changes after rehabilitation intervention (p=0.54). Significant decrease in amplitude and frequency was found in involuntary contractions (detrusor hyper-reflexia). In lower motor neuron (LMN) neurogenic bladder significant changes after rehabilitation intervention was found only in the max. cystometric capacity (p=0.015). **Conclusion:** Based on these findings we conclude that the change in the nature of the rehabilitated neurogenic bladder is different with the type of bladder.

Keywords: Trauma, Spinal Cord Injury, Rehabilitation.

INTRODUCTION

Although spinal cord injury (SCI) has been known since long but its management has improved substantially only few decades back, by focusing mainly on adequate bladder management. It is difficult to obtain reliable data from India on SCI due to difference in data collection methodologies. In one of the studies, it is estimated to be about 20,000 new cases every year.[1] According to the National Spinal Cord Injury Statistical Centre (NSCISC), nearly 12,000 new cases are added each year in the United States.[2] In developing countries, the road traffic accidents and fall from height is probably the most common cause of spinal fractures and spinal cord injuries.[1] The nature of spinal cord injury varies with age, where motor vehicle crash is the leading cause until age 45 and falls represent the prominent cause in age group of 46 years and above.[2] It is important to note that recreational sports and violent acts decrease with advancing age as leading causes of injury.[2] Men suffer from traumatic SCI much more commonly than women.

Renal failure most commonly arises due to bladder and sphincter dysfunction leading to infection as a result of stasis.[3] Most of the SCI patients develop a neurogenic bladder. Inadequate bladder management in spinal cord injury (SCI) patients results in

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significant morbidity and even mortality. It may also result in significant morbidity including medical complications and social problems. The frequent leakage of urine causes soiling of clothes and smell and can lead to psychosocial stress, skin breakdown and pressure ulcers.[4] Due to development of specialized units, complications of pressure sores, respiratory and urological problems have largely been prevented in recent years and have consequently led to improved long term survival of the spinal cord injured patient. Unfortunately, despite these advances, permanent disability and bladder problems still exist. Since urinary tract complications are closely related to altered bladder and sphincter function it implies that complications are preventable many a times. Bladder evaluation and an adequate voiding program is required to ensure a safe and complication free rehabilitation plan. Patient education, their preferences and compliance are equally important when building a bladder management plan. The urodynamic investigation has crucial role to understand detrusor and sphincter status of the patient and accordingly plan the management.[5,6] In the present study, urodynamic assessment was used to assess the manifestations of the bladder following spinal cord injury. Urodynamic assessment was done in two groups of SCI patients i.e. one who did not undergo any form of bladder rehabilitation and the other underwent a standard bladder rehabilitation programme.

MATERIALS AND METHODS

The study was conducted on one hundred thirty inpatients, admitted for in the Department of Physical and Rehabilitation Medicine/ Department of Orthopaedics/ Department of Medicine, of a tertiary care hospital of Delhi. Ethical approval was taken from the Institutional Ethics Committee. The study was conducted from August 2016 to September 2017, and a minimum follow-up period of one year. The study included patients with spinal cord injury due to only the traumatic causes. A detailed clinical history was taken for all patients along with examination and baseline investigations. Written informed consents were taken after proper instruction given about the procedure of urodynamic assessment (UDA). The cases were divided into two groups, (i) those who had never received any specific rehabilitation programme for bladder and were managed with an indwelling catheter and (ii) those who underwent rehabilitation programme of the bladder for at least 3 months, according to its type of manifestation in UDA with the available treatment protocols.[3,7] Patients who came without any bladder rehabilitation for 3 months or more since the time of injury were included in the first group. UDA was performed and treated according to the findings. Treatment included catheterisation, intermittent clamping, intermittent catheterisation, behavioural therapy and oral medications depending on the nature of the bladder. Interventions like botulinum toxin injection of detrusor were excluded. As part of patient preparation, two tablets of dulcolax (bisacodyl 5mg) or in suppository form (10mg) was given on the night before the test. Next morning on the day of examination the study subjects were asked to void their bowels and not to take any solid food till the test is done. UDA was done and recorded for both filling and voiding cystometry using multichannel auto pumping urodynamic machine (Medtronic DUET® LOGIC G|2, Software: IEC Publication 60601-1-1). Infusion with normal saline at a rate of 50 ml per minute and at room temperature was done. All the patients were asked to take ciprofloxacin 500 mg after the test and this was continued for 3 days two times daily. For the sake of comparison, we divided the cases into four main groups i.e. rehabilitated upper motor neuron, rehabilitated lower motor neuron, non-rehabilitated upper motor neuron and non-rehabilitated lower motor neuron cases. Unpaired student's t-test was used to compare the changes of the quantitative variables after rehabilitation compared to the non-rehabilitated. A p-value of <0.05 was considered statistically significant. The analysis was carried out using statistical package "STATA Version 13".

RESULTS

Out of the 130 patients, 86.9% (n=113) were males and 13.1% (n=17) were females. The mean age group was 31.3±7.8 (range 15- 60 years). Maximum number of patients belong to the age group 26–40 years (60%, n=78) followed by 15-25 years (n=30; 23.1%) and 41-60 years (n=22; 16.9%) (Table 1). Road traffic accident (RTA) was the most common cause (50%, n=65) followed by fall from height (23.3%, n=30), slipping (n=18; 13.8%) and violence (n=17; 13.1%). Majority of the patients were daily labour (23.3%, n=7), students (n=26; 20.0%), business personnel (n=22; 16.6%) and farmers (n=13; 10.0%).

The mean duration of stay in the rehabilitation ward was 75.26±29.3 days (range between 16 and 146 days). Out of all the study participants, a total of 95 (73.1%) had suprasacral injury whereas the remaining 35 (26.9%) had sacral injury. Among those who had supra-sacral level injury; 17 (17.9%) had cervical injury, 52 (54.7%) had thoracic injury and remaining 26 (27.4%) had lumbar injury. A total of 82 patients (63.1%) had UMN type of neurogenic bladder of which 74 (90.2%; 74/82) had detrusor hyper-reflexia with detrusor sphincter dyssynergia (DSD) and 8 (8/82; 9.8%) without DSD. Of the 82 UMN type bladders, 42 (51.2%) were of rehabilitated and 40 (48.8%) were non-rehabilitated bladder. Among the 48 LMN types, 22 (45.8%) were rehabilitated and 26 (54.2%) were non-rehabilitated [Table 3]. Comparison of the different variables of

cystometry among the rehabilitated and non-rehabilitated was done using unpaired t-test. The values are summarised in [Table 4]. Among those with UMN type of bladder, maximum cystometric capacity was higher in those who were rehabilitated compared to those that were not and this was statistically significant (P=0.019). Similarly, there were statistically significant differences between those who were rehabilitated, compared to those who were not, in terms of compliance and Pdet at first desire to void, Pdet at maximum cystometric capacity. However, we did not find any statistically significant differences for volume at first desire to void. For the LMN type of bladder- those who were rehabilitated had higher maximum cystometric capacity compared to those who were not rehabilitated (P=0.015).

No statistical differences were observed for compliance, Pdet at first desire to void, Pdet at maximum cystometric capacity and volume at first desire to void [Table 4].

Table 1: Key characteristics of the study participants (N=130)

Variables		Rehabilitated (n=65)	Non-rehabilitated (n=65)	Total
Age (yr)	15 - 25	13 (10%)	17 (13.33%)	30(23.1%)
	26 – 40	43 (33.3%)	35 (26.7%)	78 (60%)
	41 - 60	9 (6.7%)	13 (10%)	22 (16.9%)
Sex	Male	74 (56.9%)	39 (30%)	113(86.9%)
	Female	4 (3.1%)	13 (10%)	17 (13.1%)
Cause	RTA	39 (30%)	26 (20%)	65(50%)
	Fall from height	17 (13.33%)	13 (10%)	30(23.1%)
	Slipped	9 (6.66%)	9 (6.66%)	18 (13.8%)
	Violence	0	17 (13.33%)	17 (13.1%)
Occupation	Daily labour	17 (13.33%)	13 (10%)	30 (23.3%)
	Student	9 (6.66%)	17 (13.33%)	26(20.0%)
	Business	9 (6.66%)	13 (10%)	22(16.6%)
	Farmer	9 (6.66%)	4 (3.33%)	13(10.0%)
	Unemployed	9 (6.66%)	0	09(6.6%)
	Housewife	0	9(6.66%)	09(6.6%)
	Others	13 (10%)	9 (6.66%)	22(16.6%)

Table 2: Details of level of injury and associated urodynamic findings (N=130)

Level of Injury (No. of patients)		UMN type bladder		LMN type bladder areflexia (%)	Normal
		Detrusor hyper-reflexia with DSD (%)	Detrusor hyper-reflexia without DSD (%)		
Suprasacral spinal	Cervical (17)	17 (13.1)	--	--	--
	Thoracic (52)	48 (36.9)	4 (3.1)	--	--
	Lumbar (26)	9 (6.9)	--	17 (13.1)	--
Sacral (35)		--	4 (3.1)	31 (23.8)	--

Table 3: Distribution of Neurogenic Bladder to Rehabilitated or Non-rehabilitated (N=130)

Patients	Types of Bladder	
	Upper motor neurone	Lower motor neurone
Rehabilitated	42 (51.2%)	22 (45.8%)
Non-rehabilitated	40 (48.8%)	26 (54.2%)
Total	82	48

Table 4: Findings on urodynamic assessment along with unpaired t-test values

Urodynamic Study variables	UMN type bladder			LMN type bladder		
	Rehabilitated (mean)	Non-rehabilitated (mean)	p-value	Rehabilitated (mean)	Non-rehabilitated (mean)	p
Max. cystometric capacity	523.54 ± 185.01	330.80 ±117.9	0.019	510.00±69.78	316.00±73.71	0.015
Compliance	15.27±11.05	5.39±2.6	0.011	15.12±8.90	4.1±2.6	0.148
Pdet. at first desire to void	23.89±23.56	49.89±24.86	0.010	24.4±26.91	52.00±17.38	0.424
Pdet. at max. cyst. capacity	41.78±24.95	69.40±14.59	0.013	39.83±32.33	64.00±14.56	0.312
Volume at the first desire to void	284.78±139.45	252.56±79.45	0.54	324.2±55.22	249.50±23.13	0.124

DISCUSSION

It is difficult to avoid neurogenic bladder (NB) following traumatic SCI and the management of NB dysfunction is an essential component of a rehabilitation programme. It is somehow difficult to predict bladder and sphincter behaviour on the basis of clinical somatic neurological deficits.[5,6] Urodynamic evaluation of SCI patients is done with the intent to identify those at risk of developing urological sequelae and also to determine the requirement of early intervention. The key governing goals of managing NB are to preserve renal function and to promote patient's quality of life by attenuating urological complications. With an adequate bladder management plan that optimises both renal function and social functioning, the patient with SCI can have a healthier life. There are various approaches to managing urinary disorders, ranging from surgery to the drug therapy and intermittent catheterisation (CIC) or the insertion of endourethral prosthetic devices.[7,8] Though the study did not intend to document the incidence or prevalence of SCI, we have presented here simply to highlight its correlation with the available international data.

According to the NSCISC, the incidence rates are lowest for the paediatric age group and thereafter increase with age.[2] In our study majority of the cases belonged to age group 26 to 40 years followed by the age group 15 to 25 years. The proportion of men in the NSCISC database is 80.8% which makes a gender ratio of 4.2:1. In our study male patients comprised 86.9% making a gender ratio of 6.5:1. According to the NSCISC database there are many causes of SCI of which the motor vehicle crashes rank first (41.3%), followed by falls (27.3%), violence (15.0%), sports injury (7.9%), and others (8.5%) including hit by a falling objects, medical or surgical complications, stab wounds and bicycle mishaps. In the present study, majority of the cases were due to road traffic accident (50.0%), followed by fall from height (23.1%), slipped (13.8%) and violence (13.1%). Most of the patients in our study belonged to daily labour comprising 23.3% followed by students (20%) and business professionals (16.6%). The issue of using antibiotics as prophylaxis during urodynamic study has often been an issue of debate. While some studies do not favour giving antibiotic, a majority of the studies recommend antibiotic prophylaxis. Quek and Tay (2004) in their study of 93 patients found that significant bacteriuria after urodynamic pressure flow study is largely asymptomatic and self resolving.[9] Due to extremely low rate of symptomatic infection, they were not in favour of advocating antibiotic prophylaxis.[9] On the other hand, Pannek and Nehiba (2007), Latthe et al (2008), Bergman and McCarthy (1983), Kartal et al (2006) were in favour of antibiotic use before or after UDA.[10-13] In our study we used ciprofloxacin 500mg two times daily for 3 days.

We found that some of the bladders behave in contrary to prediction from the level of spinal injury. A total of 17 (17.9%) of the 95 suprasacral spinal injury show hyporeflexic/areflexic bladder and 4 (11.4%) of the 35 sacral spinal injury show detrusor hyper-reflexia without DSD. These findings are similar to those seen by Kaplan et al (1999),[14] where 20 of 117 cervical cord lesions had areflexia, 26 of 84 sacral cord had either detrusor hyperreflexia or detrusor-external sphincter dyssynergia. Light and Beric (1992),[15] suggested the unexpected bladder behaviour in high spinal cord injury to be linked to associated lesion or dysfunction of sacral cord. Similar poor correlation between physical observations and level of injury has also been shown in other previous studies. There is substantial lack of studies that compare the different variables of UDA in a rehabilitated and non-rehabilitated NB. In a follow up study by Khanna et al (2009),[16] nearly 82% patients underwent three to four urodynamic studies that revealed an increase in cystometric capacity and a decrease in the maximum detrusor pressures. In our study, significant changes occurred in the maximum cystometric capacity. We also found that there were significant reductions in the involuntary contractions (detrusor hyper-reflexia), not amounting to leakage, which occurred during the filling cystometry. In similar comparison of the LMN type bladders, significant correlation could be found only in the maximum cystometric capacity. Other variables like compliance and volume at first desire to void and at maximum cystometric capacity were found insignificant.

CONCLUSION

We found that the change in the nature of the NB after rehabilitation is different with the different types of bladder and not all variables of the cystometry change significantly post- rehabilitation. The number of study participants in the present study is small and future studies will be required with a larger population.

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How to cite this article: Sinha MB, Anutosh Singh A, Ranjan R, Ranjan R, Arya DP, Sharma R. Urodynamic Assessment of Bladder Behaviour in Traumatic Spinal Cord Injury (SCI) Patients in Response to Rehabilitation: Findings from a Government Tertiary Care Hospital in Bihar, India. Ann. Int. Med. Den. Res. 2019; 5(1):MC09-MC13.

Source of Support: Nil, **Conflict of Interest:** None declared