



## ASSESSMENT OF URINARY BLADDER DYSFUNCTION USING CYSTOMETROGRAM AMONG SPINAL CORD INJURED PATIENTS ADMITTED IN A TERTIARY CARE CENTRE

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### ABSTRACT

Neurogenic lower urinary tract dysfunction such as urinary bladder detrusor over activity, detrusor sphincter dyssynergia and areflexia are the most frequent and devastating sequelae of spinal cord injury. Usually the characterization of bladder in spinal cord injury is done based on findings of clinical examination only but in this study the clinical relevance regarding assessment of neurogenic bladder using cystometrogram is being examined. **Objectives:** To determine the type of bladder dysfunction and to estimate the leak point pressure and also to find its correlation with neurological level of injury. **Methodology:** Observational descriptive study design. After getting approval from Institutional Research committee and Institutional ethics committee; 75 spinal cord injured patients admitted in PMR ward, Government medical college, Thiruvananthapuram from January 2021 to June 2022 was selected for the study. Basic evaluation with cystometrogram done and all the data collected were analysed using SPSS statistical software version 22. **Results:** Out of 75 patients studied 67 with suprasacral and 8 with sacral injuries, out of the first group 43 (64.2 %) demonstrated hyperreflexia, 20(29.4%) detrusor areflexia, and 4(5.9 %) had normal bladders, 28(32.3%) with detrusor sphincter dyssynergia, 27 (40.2%) low compliance and 28 had high detrusor leak point pressure. Of the 8 patients with sacral injuries, 5(62.5%) showed detrusor hyperreflexia, 3(37.5%) detrusor areflexia, and 2 (25%) had low bladder compliance; 1 (12.5%) had high detrusor leak point pressures. Statistical significance present between neurological level of injury and bladder types and compliance but no significance between level of injury and leak point pressure. **Conclusion:** Clinical evaluation and urodynamic findings are different, so it is mandatory to do urodynamic evaluation for better management of bladder dysfunction in SCI.

**KEYWORDS :** Spinal cord injury, Neurogenic bladder dysfunction, Cystometrogram.  
Abbreviations used-SCI-Spinal Cord Injury.

### INTRODUCTION

Neurogenic lower urinary tract dysfunctions (NLUTD) - refers to dysfunctions of either bladder, bladder neck and or its sphincters as a result of a neurological disorder. NLUTD include urinary bladder detrusor over activity, detrusor sphincter dyssynergia and areflexia (1). Spinal cord injury causes neurogenic lower urinary tract dysfunctions like detrusor overactivity, hyporeflexia and detrusor sphincter dyssynergia (2). Management of urinary bladder dysfunction is most important in spinal rehabilitation programme to prevent complications such as infections, hydronephrosis, renal failure, urinary tract stones etc. these complications are the major cause for high morbidity in long term spinal cord injury survivors. Urodynamic investigation, cystometrogram is gold standard investigation to assess the nature and extent of lower urinary bladder dysfunction in spinal cord injured patients(3). In most of the cases the clinical diagnosis of bladder dysfunction as per the neurological level of injury is not the actual dysfunction diagnosed by cystometrogram. Hence a cystometrogram is an essential investigation in the evaluation of neurogenic bladder dysfunctions. This study is being utilized to assess this entity in detail.

### METHODOLOGY

#### OBJECTIVES:

To determine the type of bladder dysfunction and to estimate the leak point pressure and also to find its correlation with neurological level of injury

**Study design:** Observational descriptive study design.

**Study setting:** Hospital based. Department of Physical Medicine and Rehabilitation, Govt Medical college, Thiruvananthapuram

**Study period:** 11/2 years after getting approval from

Institutional Research Committee and Institutional ethics committee.

**Study population:** Spinal cord injured patients admitted in PMR ward, Government medical college, Thiruvananthapuram from January 2021 to June 2022.

**Inclusion criteria:** Spinal cord injured patients admitted in PMR ward

#### Exclusion criteria:

1. Bladder dysfunction due to any cause other than spinal cord injury
2. Urethral injury.
3. Those with cognitive impairment (based on mini mental scale examination).

#### Sampling:

Consecutive sampling of spinal cord injured patients admitted in PMR ward, satisfying the eligibility criteria will be recruited for the study till the sample size is achieved. Sample size = 75

#### Sampling technique:

All spinal cord injured patients who meet the inclusion criteria will be selected consecutively till the required sample size is met.

#### Study variables:

1. Sociodemographic variables like age, gender, occupation, income and socioeconomic status
2. Clinical variables like History- time of injury, mode of injury, Spinal cord injury type—complete or incomplete, Traumatic or non-traumatic.
3. Neurological level of injury
4. Clinical assessment of urinary dysfunction
5. USG finding of bladder
6. Cystometrogram finding in urinary dysfunction.

**Data collection tool:** Semi structured proforma

**Data collection technique:** Patients with spinal cord injury admitted in tertiary care centre during study time are selected for study. A semi structured proforma used to record relevant informations like patient data, history, clinical findings and investigation reports. Physical examination including general and systemic examination with special emphasis on neurological examination done. Neurological level of injury localisation done from history and examination. From those findings assess type of bladder dysfunction, hyper reflexic or areflexic bladder . Routine investigations done, Urine routine examination, ultrasound abdomen to assess post void volume, bladder wall thickness done. Urine culture and sensitivity 1 to 2 weeks prior to the test. Give antibiotic prior to test, urodynamic study cystometrogram done. Evaluate two distinct phases of bladder function. First is filling phase (storage phase), during which fluid is infuse in to the bladder. In this phase evaluate bladder sensation, bladder capacity, bladder stability and leakpoint pressure. Second is voiding phase,in this evaluation of maximum voiding pressure, urethral sphincter activity, flow rate, voided volume and post void residual volume are calculated. In those with potential for autonomic dysreflexia, changes in blood pressure before, during, after the procedure (cystometrogram) also monitored using BP apparatus connected to a monitor in our CMG room. With an empty bladder, there should be no sensation of fluid within the bladder, during the filling phase the first sensation that a person has of having a full bladder usually occur with 100 to 200ml within the bladder. Sensation of fullness occurs at 300 to 400ml, urgency between 400 to 500 ml. bladder capacity ranges between 400 to 750 ml. There should be little to no rise in intravesical pressure and there should not be no involuntary bladder contraction during this part of the study. Based on the values obtained from the cystometrogram categorise the bladder dysfunction. After evaluation of all patients, find out the proportion of each type of bladder dysfunction (hyperreflexic bladder, areflexic bladder, and bladder sphincter dyssynergia). Relation of bladder dysfunction with level of injury is determined.

**Ethical Considerations**

Study was approved by both the institutional research committee and human ethical committee of our institution. All subjects had signed an informed consent form (available in the local language also) to participate in the study.

**Data Management And Statistical Analysis**

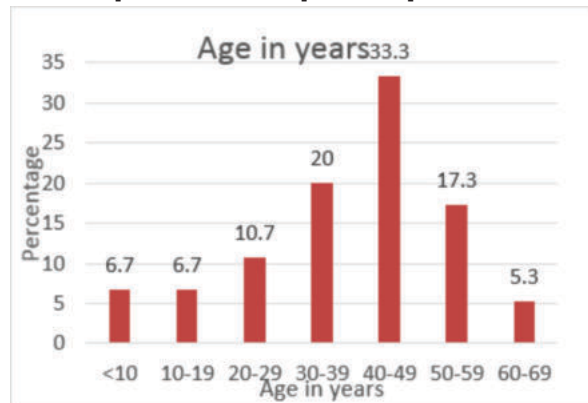
All the data collected were coded and entered in Microsoft excel sheet which was rechecked and analysed using SPSS statistical software version 22. Quantitative variables were summarised using mean and standard deviation. Categorical variables were represented using frequency and percentage. Independent sample t test was used to test statistical significance of difference between means of variables among different independent groups. Pearson chi – square test and fisher's exact test were used for comparing categorical variables between groups. A p value of <0.05 was considered significant.

**RESULTS AND OBSERVATIONS**

Spinal cord injury patients admitted in a tertiary care centre are recruited for the study. 75 such patients were evaluated for urinary bladder dysfunction using cystometrogram. Patient's demographic data, premorbid occupation, type of spinal cord injury, systemic illness, AIS grade, neurological level of injury, time since injury, type of bladder dysfunction, leaks during the study, leak point pressure, detrusor sphincter dysnergia, bladder sensation, self voided status and PVR are presented through tables and graphs.

Mean age of study population was 38 years (SD 14.6), among them 33.3% of patients belonged to age between 40 to 49

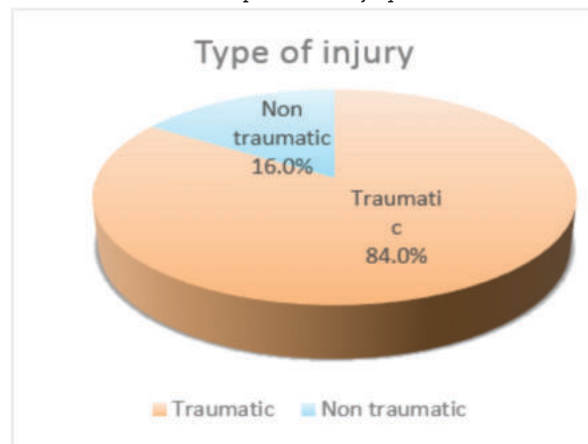
years, followed by 20% in 30 to 40 years, 17.3% in 50 to 59 years, 10.7% in 20 to 30 years, 6.7% in less than 10 years and between 10 to 20 years and 5.3% were in more than 60 years. Most of the patients are in their productive years.



**Figure-1 Age Distribution Of Study Group**

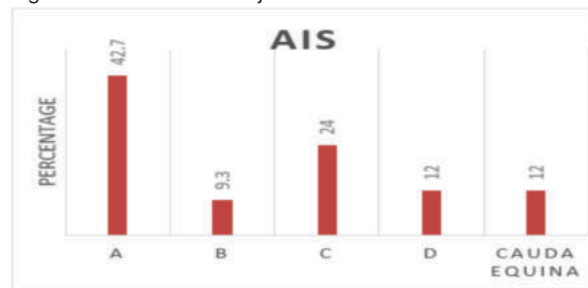
81% were males and 19% were females. SCI was common among males. Considering premorbid occupation of patients 34.7% were manual labourers, 26.7% were drivers, 16% were students, 9.3% were house wives, 6.7% were carpenters, 2.7 % were hotel managers and 1.3 % were other workers. Only 8% patients had comorbidities among them.

Traumatic spinal cord injury was common in this group of study population. 84% had traumatic spinal cord injury and 16% had non traumatic spinal cord injury.



**Figure 2- Distribution Of Types Of Injury**

Among them 42.7% patients were AIS Grade A injury, 24 % had Grade C injury, 12% had Grade D and 9.3 % were Grade B. Most of them were complete injury and sensory incomplete was least. 50.7% patients had thoracic level of injury, 26.7% had cervical level of injury, 12% had Lumbar level of injury and 10.7% had sacral level of injuries. Thoracic level injury was highest and sacral level injuries are less.



**Figure 3- Distribution Of Asia Impairment Scale Among Study Group**

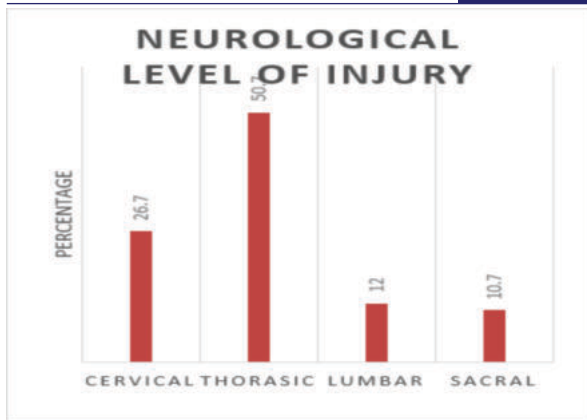


Figure 4- Distribution Of Neurological Level Of Injury Among Study Group

64% patients were within 6 months of duration since injury, 18.7% were more than 1 year and 17.3 % were between 6 months to 1 year. Out of 75 patients, 67 (90.7 %) were suprasacral injuries, 8 (9.3%) were sacral.



Figure 5- Distribution Of Site Of Injury In Study Group

38.7% had leaks among study group. 61.3% had good compliance. 8% were able to self void after the procedure in study.

No significant relation between DSD and neurological level of injury. Among cervical level injury 35% had DSD, in thoracic level injury 21.1% had DSD, in lumbar level injury 55.6% had DSD and among sacral level of injury 25% had DSD.

Statistical significance is present between NLI and leaks during study. Leaks was present in 55% of cervical level injury, 28.9% of thoracic, 66.7% of lumbar and 12.5% of sacral level of injury.

Table 1- Distribution Of Leaks During Cmg In Relation With Neurological Level Of Injury

Leaks	Neurological level of injury								Total	
	Cervical		Thoracic		Lumbar		Sacral		N	%
	N	%	N	%	N	%	N	%		
Yes	11	55	11	28.9	6	66.7	1	12.5	29	38.7
No	9	45	27	71.1	3	33.3	7	87.5	46	61.3
Total	20	100	38	100	9	100	8	100	75	100

P=0.029

12.5% of sacral level injury, 11.1 % of lumbar level injury and 10.5% of sacral level injury were self voided after CMG. 55% of cervical level injury had adequate capacity, 71.1% of thoracic, 22.2% of lumbar and 75% of sacral had adequate capacity. Sacral level injury had higher percentage of adequate capacity and it was least among lumbar level of injury.

Distribution of bladder sensation was 0% among cervical, 26.3% among thoracic, 33.3% among lumbar and 12.5% among sacral level of injury. No statistical significance was there between neurological level of injury and leakpoint pressure. No relationship between nature of bladder and duration of injury.

Table 2- Distribution Of Bladder Types In Relation With Neurological Level Injury

Bladder type	Neurological level of injury								Total	
	Cervical		Thoracic		Lumbar		Sacral		N	%
	N	%	N	%	N	%	N	%		
Atonic	2	10	12	31.6	6	66.7	3	37.5	23	30.7
Spastic	18	90	22	57.9	3	33.3	5	62.5	48	64
Normal	0	0	4	10.5	0	0	0	0	4	5.3
Total	20	100	38	100	9	100	8	100	75	100

P=0.027

90 % Of Cervical level injury patients were having spastic bladders, none of them have normal bladder. Among thoracic level of injury 57.9% had spastic bladders, 31.6% had atonic bladders and 10.5% had normal bladder. Among lumbar level of injury 66.7% had atonic bladder and 33.3% had spastic bladder. Among sacral level injury 37.5% were having atonic bladder and 62.5% spastic bladder. Out of 67 patients with supra sacral injuries, 43 (64.2 %) demonstrated hyperreflexia, 20(29.4%) detrusor areflexia, and 4(5.9 %) had normal bladders. Of the 8 patients with sacral injuries, 5(62.5%) showed detrusor hyperreflexia, 3(37.5%) detrusor areflexia.

Table 3- Relation Between Leakpoint Pressure And Neurological Level Of Injury

Neurological level of injury	N	Leak Point pressure	
		Mean	Sd
Cervical	11	36.9	12.1
Thoracic	13	40.9	17.9
Lumbar	2	30.0	0.0
Sacral	3	30.0	4.6
Total	29	37.5	14.4

P=0.578, No relation between leakpoint pressure and neurological level of injury

**DISCUSSION -**

Aim of this study is to assess the nature of bladder dysfunction using cystometrogram among spinal cord injury patients, its relation with different neurological levels of injury made out by clinical examination & duration of injury and to study the leak point pressure in relation with neurological level of injury.

Out of 67 patients with suprasacral injuries, 43 (64.2 %) demonstrated hyperreflexia, 22(32.3%) with detrusor sphincter dyssynergia, 20(29.4%) detrusor areflexia, and 4(5.9 %) had normal bladders. Of the 8 patients with sacral injuries, 5(62.5%) showed detrusor hyperreflexia, 3(37.5%) detrusor areflexia, 2(25%) had low bladder compliance, 1(12.5%) had high detrusor leak point pressures. 90 % of Cervical level injury patients were having spastic bladders, none of them have normal bladder. Among thoracic level of injury 57.9% had spastic bladders, 31.6% had atonic bladders and 10.5% had normal bladder. Among lumbar level of injury 66.7% had atonic bladder and 33.3% had spastic bladder. Among sacral level injury 37.5% were having atonic bladder and 62.5% spastic bladder.

After recovery from spinal shock, patients with suprasacral injuries should theoretically retain reflex detrusor activity. In contrast, injury to or below the sacral cord should lead to detrusor areflexia. Neurological and urodynamic evaluation necessary to objectively define the neurologic deficit of the bladder. Understanding of the basic neurologic lesion and bladder dysfunction is vital to bladder retraining or transurethral surgery to provide adequate voiding.

In a study conducted by Maryam Kooshesh1, Mahdi Safdarian et al among the suprasacral lesion group 75% had overactive bladder function and among sacral lesion 31.7% of patients had underactive bladder function(4). Study of Maryam Kooshesh1, Mahdi Safdarian et al rate of cervical injury was 20.7%, while other studies demonstrated higher rates of cervical injury level, as 47% by Weld et al.or 50% by Agarwal et al. Most of the patients with complete lesions (AIS-A) in Study of Maryam Kooshesh1, Mahdi Safdarian et al had the suprasacral Discussion 65 lesion(4). The Weld and Dmochowski finding was demonstrating a high frequency of impaired compliance in the sacral injury group(5). In a similar study by Agarwal et al. in 2015 to evaluate the correlation between the neurological level of the spinal injury and bladder functions, seventy individuals with TSCI were studied through detailed clinical, neurological evaluation along with clinical examination of bladder and urodynamic study. The correlation between somatic neurologic findings, spinal imaging studies, and urodynamic findings in patients with SCI was reported not to be significant. Therefore, bladder management recommended not to completely rely on the clinical bladder evaluation or neurological examination alone, but to always include urodynamic studies. Perakash proposed arterial ischemia and incompleteness of injury as explanations for this inexact correlation between anatomic lesion and neurourologic clinical findings(6). Multiple injuries coexisting at different levels can result in an unpredictable mixed urodynamic patterns. In a retrospective review of 316 patient records, Weld and Dmochowski tried to investigate the associations between the radiographically determined level of injury and urodynamic findings. In patients with a single level of spinal cord injury, this study revealed a significant association between the level of injury and the type of voiding dysfunction. Patients with combined suprasacral and sacral injuries, as identified with precise spinal imaging techniques, had relatively unpredictable urodynamic findings (5). This study indicated that management of the urinary tract in patients with spinal cord injury must be based on urodynamic findings rather than inferences from the neurologic evaluation. The aim of classifying the neurogenic bladder is to facilitate better understanding of the pathophysiology behind the clinical findings, and to help in better management and changes in bladder or outlet activity. The history and physical examination alone cannot determine the type of bladder and sphincter function in a person with spinal cord injury.

## CONCLUSION

In this study a statistically significant correlation is present between the site of lesion and neurological bladder dysfunction but the relationship was not absolute. In cervical level injury the bladder nature is mostly predictable, but lower the lesion became more unpredictable. Sacral level patients had adequate safe capacity bladder and it was least among lumbar level spinal cord injury. Leaks during the study was more in lumbar level injuries and it was less in sacral level injury.

Urodynamic study is recommended for better management of neurogenic lower urinary tract dysfunction in spinal cord injury patients as it seems the bladder behavior is not predictable according to the level and completeness of the injury as made out by clinical examination.

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