e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2023; 15(10); 677-681

Original Research Article

An Observational Study to Investigate the Association between the Detrusor Muscle Function and the Level of the Spinal Cord Injury

Kumar Gaurav Mishra[1], Ahsan Ahmad[2], Sanjay Kumar Gupta[3]

[1]Senior Consultant and HOD, Department of Urology, ESICMCH, Bihta, Patna, Bihar, India

[2]Professor, Department of Urology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

[3]Assistant Professor, Department of Urology, Indira Gandhi Institute of Medical Sciences, Patna, Bihar, India

Received: 13-06-2023 Revised: 19-07-2023 / Accepted: 27-08-2023
Corresponding author: Dr. Sanjay Kumar Gupta
Conflict of interest: Nil

Abstract

Aim: The purpose of this study was to investigate the association between the detrusor muscle function and the level of the spinal cord injury.

Material & Methods: An observational study including 50 patients was conducted in the Department of Urology, ESICMCH, Bihta, Patna, Bihar, India . Written informed consent was obtained from all participants.

Results: There was a total of 50 individuals with traumatic SCI, of whom 25 (50%) had cervical injury, 12 (24%) had thoracic injury, 8 (16%) had lumbar injury, and 5 (10%) had sacral vertebral injury. Among these individuals, 29 had neurologically complete injuries and 21 incompletes (according to ASIA) at the time of examination. All but one cervical patient with DO and detrusor sphincter dyssynergia were negative for sacral cord lesion. Only one of the 12 patients with thoracic-level injuries had normal urodynamic findings and sacral cord lesion, whereas none of the patients had detrusor areflexia. None of the 8 patients with lumbar cord injuries with DO and detrusor sphincter dyssynergia had positive sacral cord lesion, whereas all four patients with detrusor areflexia were positive for sacral cord lesion. Low bladder compliance was seen in 15 cases with DO, 14 cases with detrusor sphincter dyssynergia, while in only four cases with detrusor areflexia and one with normal bladder. Most of the patients with suprasacral cord lesions had high detrusor leak point pressures.

Conclusion: Bladder function differs according to the level of injury. It is, therefore, important to define the neurological lesion to appreciate the voiding dysfunction and thereby to develop an appropriate management plan for long-term urologic care. Bladder management should be directed towards protection of upper tracts, prevention of infection, autonomic dysreflexia, and encouraging bladder emptying at low pressures, as the first and foremost goal. Despite consistent data regarding classic voiding dysfunction with complete injuries, multiplicity of injury may contribute to complicated urodynamic findings. Therefore, urodynamic evaluation is crucial to correctly identify the type of voiding dysfunction and to optimize long-term management.

Keywords: Detrusor, Bladder, Neurogenic, Spinal cord injuries, Bladder management, Urodynamic study

Introduction

Spinal cord injury (SCI), a devastating event, [1] is acquired by almost half a million people each year worldwide. [2] Besides motor recovery, i.e., the ability to walk or utilize the upper extremities, lower urinary tract (LUT) [3,4] and cardiovascular system (CVS) [5] function are among the primary priorities for patients with SCI. [6] The damage of spinal cord injury (SCI) is not just limited to the mobility of the patients, but it might impose disabling complications such as spasticity, bowel and bladder dysfunction and chronic neuropathic pain that reduce the quality of life. [7] Neurogenic bladder is one of those complications of SCI that can be life-threatening. [8,9] More than 80% of these individuals exhibit at least some degree of bladder dysfunction and one of the most fundamental steps following the initial injury is bladder management. [10] Urologic complications continue to be an important reason for high morbidity in long-term SCI survivors. [11] NLUTD is associated with urological morbidity, such as urosepsis, urinary incontinence, and the risk of deteriorating renal function and has a significant negative impact on health-related quality of life. [12,13] Consequently, recovery of bladder function is often identified as one of the top priorities in patients with SCI. [14] Due to the potential for changes in neurological and lower urinary tract (LUT) function during the first

year after SCI, neuro-urological management aims to maintain or improve upper urinary tract (UUT) and LUT function and to identify and treat patients with risk factors for urological morbidity. [15] Also changes in bladder or outlet activity may make it impossible to always predict accurately lower urinary tract activity solely on the basis of neurologic lesion.

Several factors merit consideration as contribution to this inexact correlation. First, degeneration and reorganization of crucial neural pathways distal to the lesion with or without neural sprouting at the level of injury may affect the neurologic and urodynamic findings. Second, SCI may be incomplete, thereby partially allowing the integration and modulation of complex micturition signals at multiple levels of the nervous system. Multiple injuries coexisting at different levels can result in unpredictable mixed voiding dysfunction. [16]

Management of the urinary tract has an important role in improving quality of life and reducing the mortality in patients with SCI. The most instructive and essential procedure for this management is the urodynamic evaluation. [17] The urodynamic investigation is the only method that can objectively assess the function of the lower urinary tract. [18] The most common urologic complications following SCI are UTI, upper and lower urinary tract deterioration, and bladder or renal stone. [9]

The purpose of this study was to investigate the association between the detrusor muscle function and the level of the spinal cord injury.

Material & Methods

An observational study including 50 patients was conducted in the Department of Urology, ESICMCH, Bihta, Patna, Bihar, India for one year Written informed consent was obtained from all participants.

Inclusion Criteria

Patients with SCI of more than 3 months duration who were willing to undergo urodynamic evaluation.

Exclusion Criteria

All those who were diagnosed with urinary tract stones, foreign body, symptomatic UTI, or any other bladder abnormality were excluded from the study.

Methodology

All patients underwent routine history and physical examination, including evaluation of perianal sensation, anal sphincter tone, and sacral reflexes along with bladder diary and urodynamic study. The patients were divided into neuroanatomical groups based on the clinical neurological level. Patients were also categorized as complete or incomplete, based on American Spinal Injury Association Classification (ASIA), in which subgroups based on the integrity of the sacral dermatomes were made. Those with abnormalities of the sacral reflex arc (absent bulbocavernosus reflex, and lax anal sphincter tone) were deemed positive for the presence of sacral cord lesion and those with intact sacral reflexes were deemed negative for sacral cord lesion. All the patients considered for the study underwent routine testing including blood counts, renal function tests, urine microscopy, urine culture and sensitivity, radiographs, and diagnostic ultrasound of the urinary tract.

Urodynamic evaluation

Urodynamic evaluation on each patient was performed using Ellipse, which is a Danish-designed German urodynamic device from Andromeda (Buckinghamshire, UK, established as Mediplus in 1986) placed in our department. It consisted of a filling phase and a voiding phase cystometrogram along with perineal muscle electromyography (EMG). A 9F double-lumen catheter was introduced transurethrally into the bladder. One lumen was used for bladder filling at an average flow rate of 21 ml/min (according to ICS guidelines) and another was used to record intravesical pressure. Intra-abdominal pressure was recorded by a 12F rectal catheter. Through multichannel pressure transduction, intravesical and intra-abdominal pressures were simultaneously transduced on a strip chart recorder. Sphincter EMG was performed using patch electrodes (Ambu blue sensor NF) by an experienced electromyographer.

Results

Table 1: Neurological level of injury

Neurological level of injury	Complete	Incomplete
Cervical	15	10
Thoracic	10	2
Lumbar	2	6
Sacral	2	3

There was a total of 50 individuals with traumatic SCI, of whom 25 (50%) had cervical injury, 12 (24%) had thoracic injury, 8 (16%) had lumbar injury, and 5 (10%) had sacral vertebral injury. Among these individuals, 29 had neurologically complete injuries and 21 incomplete (according to ASIA) at the time of examination.

Table 2: Urodynamic findings in spinal cord injury at each level in accordance with sacral cord lesion (SCL)

Neurological level	Detrusor overactivity		Detrusor sphincter dyssynergia		Detrusor areflexia		Normal	
	SCL +	SCL −	SCL +	SCL −	SCL +	SCL −	SCL +	SCL −
Cervical	1	10	0	15	2	0	0	0
Thoracic	0	6	0	7	0	0	1	0
Lumbar	0	3	0	2	4	0	0	5
Sacral	1	1	0	0	3	0	0	0

All but one cervical patient with DO and detrusor sphincter dyssynergia were negative for sacral cord lesion. Only one of the 12 patients with thoracic-level injuries had normal urodynamic findings and sacral cord lesion, whereas none of the patients had detrusor areflexia. None of the 8 patients with lumbar cord injuries with DO and detrusor sphincter dyssynergia had positive sacral cord lesion, whereas all four patients with detrusor areflexia were positive for sacral cord lesion.

Table 3: Bladder compliance at various levels of spinal cord injury

	Low bladder compliance			
	Detrusor overactivity	Detrusor sphincter dyssynergia	Detrusor areflexia	Normal
Cervical	10	10	1	0
Thoracic	2	4	0	1
Lumbar	2	0	3	0
Sacral	1	0	0	0

Low bladder compliance was seen in 15 cases with DO, 14 cases with detrusor sphincter dyssynergia, while in only four cases with detrusor areflexia and one with normal bladder.

Table 4: Leak point pressure at various levels of spinal cord injury (mmHg)

		Leak point pressures		
	Detrusor hyperreflexia	Detrusor sphincter dyssynergia	Detrusor areflexia	Normal
>40	19	24	7	2
<40	6	6	3	4

Most of the patients with suprasacral cord lesions had high detrusor leak point pressures.

Discussion

Urologic complications continue to be an important reason for high morbidity in long-term spinal cord injury (SCI) survivors. Longitudinal studies compiled from rehabilitation centers reveal a high incidence of urinary tract infection (UTI; incidence of bacteremia at least one episode in 1 year being 66.7–100% depending on various bladder management methods), [19] renal stones (8%), bladder stones (36%), vesicoureteral reflux, hydronephrosis, and renal deterioration. [20-22] These complications can lead to renal failure, death rate from which reported in the 1960s was between 37 and 76%. [23]

There was a total of 50 individuals with traumatic SCI, of whom 25 (50%) had cervical injury, 12 (24%) had thoracic injury, 8 (16%) had lumbar injury, and 5 (10%) had sacral vertebral injury. Among these individuals, 29 had neurologically complete injuries and 21 incomplete (according to ASIA) at the time of examination. All but one cervical patient with DO and detrusor sphincter dyssynergia were negative for sacral cord lesion. Only one of the 12 patients with thoracic-level injuries had normal urodynamic findings and sacral cord lesion, whereas none of the patients had detrusor areflexia. None of the 8 patients with lumbar cord injuries with DO and detrusor sphincter dyssynergia had positive sacral cord lesion, whereas all four patients with detrusor areflexia were positive for sacral cord lesion. Low bladder compliance was seen in 15 cases with DO, 14 cases with detrusor sphincter dyssynergia, while in only four cases with detrusor areflexia and one with normal bladder. Most of the patients with suprasacral cord lesions had high detrusor leak point pressures. A poorly compliant bladder distends with high intra- vesical pressure at relatively low volumes, and may lead to vesicoureteral reflux and places the upper urinary tract at even greater risk for deterioration, as has been explained by Weld et al [24] Hackler et al [25] and McGurie et al [26] Samson et al [27] said that a highly com- pliant bladder is associated with

hyporeflexive or are- flexive bladder as seen in lower motor neuron injuries, which is in close agreement to the findings in our study in which the patients with low bladder compliance had either DO or detrusor sphincter dyssynergia. But our findings do not match with the findings of Weld and Dmochowski, who demonstrated a higher frequency of impaired compliance in the sacral injury group, which can be explained on the basis of a relatively smaller sample size in our study. [28]

Arnold et al [29] reported two cases of upper motor neuron lesions with detrusor areflexia. Light et al [30] reported on 13 patients with suprasacral SCI and detrusor areflexia who were evaluated with somatosensory testing and sacral evoked potentials. In our series, since somatosensory testing and evoked potentials were not performed, one can only speculate on the incidence of subclinical sacral cord injury. Most of the patients with traumatic thoracic cord lesions in our study had complete lesions. In fact, in our series, all patients with traumatic thoracic cord lesions had either DO or detrusor sphincter dyssynergia and negative sacral cord signs except one who had normal bladder function. Patients with mixed cord lesions or simultaneous thoraco-lumbar injury have less predictable voiding dysfunction, as noted by Yalla and Andriole. [31]

Conclusion

Bladder function differs according to the level of injury. It is, therefore, important to define the neurological lesion to appreciate the voiding dysfunction and thereby to develop an appropriate management plan for long-term urologic care. Bladder management should be directed towards protection of upper tracts, prevention of infection, autonomic dysreflexia, and encouraging bladder emptying at low pressures, as the first and foremost goal. Despite consistent data regarding classic voiding dysfunction with complete injuries, multiplicity of injury may contribute to complicated urodynamic findings. Therefore, urodynamic evaluation is crucial to correctly identify the type of voiding dysfunction and to optimize long-term management.

References

1. Pavese C, Schneider MP, Schubert M, Curt A, Scivoletto G, Finazzi-Agrò E, Mehnert U, Maier D, Abel R, Röhrich F, Weidner N. Prediction of bladder outcomes after traumatic spinal cord injury: a longitudinal cohort study. PLoS medicine. 2016 Jun 21;13(6):e1002041.
2. Bickenbach J, Officer A, Shakespeare T, von Groote P, World Health Organization. International perspectives on spinal cord injury. World Health Organization; 2013.
3. Groen J, Pannek J, Castro Diaz D, Del Popolo G, Gross T, Hamid R, Karsenty G, Kessler TM, Schneider M, t Hoen L, et al. Summary of European Association of Urology (EAU) Guidelines on Neuro-Urology. Eur Urol. 2016; 69(2):324–33.
4. Panicker JN, Fowler CJ, Kessler TM. Lower urinary tract dysfunction in the neurological patient: clinical assessment and management. Lancet Neurol. 2015;14(7):720–32.
5. Furlan JC, Fehlings MG. Cardiovascular complications after acute spinal cord injury: pathophysiology, diagnosis, and management. Neurosurg Focus. 2008;25(5):E13.
6. Karlsson AK. Autonomic dysreflexia. Spinal Cord. 1999;37(6):383–91.
7. Kim JH, Shim SR, Doo SW, Yang WJ, Yoo BW, Kim JM, Ko YM, Song ES, Lim IS, Lee HJ, Song YS. Bladder recovery by stem cell based cell therapy in the bladder dysfunction induced by spinal cord injury: systematic review and meta-analysis. PLoS One. 2015 Mar 17;10(3):e0113491.
8. Carter RE, Jr. Etiology of traumatic spinal cord injury: Statistics of more than 1,100 cases. Tex Med. 1977; 73: 61-65.
9. Taweel WA, Seyam R. Neurogenic bladder in spinal cord injury patients. Res Rep Urol. 201 5;7:85-99.
10. Agrawal M, Joshi M. Urodynamic patterns after traumatic spinal cord injury. J Spinal Cord Med. 2015; 38: 128-133.
11. Bénard A1, Verpillot E, Grandoulier AS, et al. Comparative cost-effectiveness analysis of sacral anterior root stimulation for rehabilitation of bladder dysfunction in spinal cord injured patients. Neurosurgery. 2013; 73: 600-608.
12. Panicker, J.N.; Fowler, C.J.; Kessler, T.M. Lower urinary tract dysfunction in the neurological patient: Clinical assessment and management. Lancet Neurol. 2015,14,720–732
13. Groen, J.; Pannek, J.; Diaz, D.C.; Del Popolo, G.; Gross, T.; Hamid, R.; Karsenty, G.; Kessler, T.M.; Schneider, M.; Blok, B. Summary of European Association of Urology (EAU) guidelines on neuro-urology. Eur. Urol. 2016, 69, 324–333.
14. Simpson, L.A.; Eng, J.J.; Hsieh, J.T.; Wolfe, D.L.; Spinal Cord Injury Rehabilitation Evidence Scire Research Team. The health and life priorities of individuals with spinal cord injury: A systematic review. J. Neurotrauma 2012, 29, 1548–1555.
15. Welk, B.; Schneider, M.P.; Thavaseelan, J.; Traini, L.R.; Curt, A.; Kessler, T.M. Early urological care of patients with spinal cord injury. World J. Urol. 2018, 36, 1537–1544.
16. Ghoniem GM, Roach MB, Lewis VH, Harmon EP. The value of leak pressure and bladder compliance in the urodynamic evaluation of meningomyelocele patients. J Urol 1990;144 (6):1440–2.

17. Yalçın S, Ersöz M. Urodynamic findings, bladder emptying methods and therapeutic approaches in patients with upper lumbar and lower lumbarsacral spinal cord injury. Neurol Sci. 2015; 36: 2061-2065.
18. Rosier PF. The evidence for urodynamic investigation of patients with symptoms of urinary incontinence. Prime Rep. 2013; 5: 8.
19. Lloyd LK, Kuhlemeier KV, Fine PR, Stover SL. Initial bladder management in spinal cord injury: does it make a difference? J Urol 1986; 135(3):523–7.
20. De Vivo MJ, Fine PR. Predicting renal calculus occurrence in spinal cord injury patients. Arch Phys Med Rehabil 1986;67(10): 722–5.
21. De Vivo MJ, Fine PR, Cutter GR, Maetz HM. The risk of bladder calculi in patients with spinal cord injuries. Arch Intern Med 1985; 14 5(3):428–30.
22. Subramonian K, Cartwright RA, Harnden P, Harrison SC. Bladder cancer in patients with spinal cord injuries. BJU Int 2004;93(6):739–43.
23. Price M, Kottke FJ, Olson ME. Renal function in patients with spinal cord injury: the eighth year of a ten-year continuing study. Arch Phys Med Rehabil 1975;56(2):76–9.
24. Weld KJ, Graney MJ, Dmochowski RR. Differences in bladder compliance with time and associations of bladder management with compliance in spinal cord injured patients. J Urol 2000; 163(4):1228–33.
25. Hackler RH, Hall MK, Zampieri TA. Bladder hypocompliance in the spinal cord injury population. J Urol 1989;141(6):1390–3.
26. McGurie EJ, Woodside JR, Borden TA, Weiss RM. Prognostic value of urodynamic testing in myelodysplastic patients. J Urol 1981;126(2): 205–9.
27. Samson G, Cardenas DD. Neurogenic bladder in spinal cord injury. Phys Med Rehabil Clin N Am 2007;18(2):255–74.
28. Weld KJ, Dmochowski RR. Association of level of injury and bladder behavior in patients with post traumatic spinal cord injury. Urology 2000;55(4):490–4.
29. Arnold EP, Fukui J, Anthony A, Utley WL. Bladder function following spinal cord injury: a urodynamic analysis of the outcome. Br J Urol 1984;56(2):172–7.
30. Light JK, Faganel J, Beric A. Detrusor areflexia in suprasacral spinal cord injuries. J Urol 1985;134(2):295–7.
31. Yalla SV, Andriole GL. Vesicourethral dysfunction following pelvic visceral ablative surgery. J Urol 1984;132(3): 503–9.