URODYNAMIC BLADDER PATTERNS IN SPINAL CORD INJURY PATIENTS

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ABSTRACT

Objective: To determine the frequency of various neurogenic bladder patterns in patients with traumatic spinal cord injury presenting at Armed Forces Institute of Rehabilitation Medicine Rawalpindi based on urodynamic studies.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi, from Jul 2014 to Jun 2016.

Material and Methods: One hundred and forty traumatic spinal cord injury patients fulfilling the inclusion criteria were included both from indoor and outdoor departments through non-probability purposive sampling. Urodynamic studies were performed using the urodynamic equipment at urodynamic laboratory. Data were collected and recorded on specialized proforma by the principal investigator.

Results: Among 140 study participants detrusor overactivity was found in 100 patients out of which 76 (76%) had thoracic level of injury, 20 (20%) had cervical level and 4 (4%) had lumbar level of injury. Detrusor areflexia was the bladder pattern in 40 patients out of which 26 (65%) had thoracic level of injury, 10 (25%) had cervical level, and 4 (10%) had lumbar level of injury.

Conclusion: Detrusor overactivity was the commonest neurogenic bladder pattern among the traumatic spinal cord injury patients.

Keywords: Detrusor overactivity, Detrusor areflexia, Neurogenic bladder, Spinal cord injury, Urodynamic study/Urodynamics.

INTRODUCTION

Spinal cord injury (SCI) is one of the most disabling medical conditions that results in a multitude of physical and medical comorbidities lasting lifelong[1]. According to National Spinal Cord Injury Statistical Center (NSCISC) of United States (U.S.) the annual incidence of SCI is approximately 54 cases per million population or approximately 17,000 new cases each year and prevalence is approximately 282,000 persons[2]. Road traffic accidents (RTA) and falls are the two major etiologies accounting for 38% and 30.5%[2]. Statistics from Pakistan show that mechanisms of injury included fall in 62% and road traffic accidents in 32%[3].

SCI patients are assessed by an international standard of classification system i.e. the American Spinal Injury Association (ASIA) classification system that determines the sensory, motor, and neurological level of injury (NLI); the completeness/incompleteness of the injury; and classifies the patient in one of the impairment scales (A-E)[4]. Sensory level is the most caudal dermatome to have normal sensation for both pinprick/dull and light touch on both sides. Motor level is the most caudal key muscle group that is graded 3/5 or greater with the segments cephalad graded normal (5/5) strength according to manual muscle testing. NLI is the most caudal level at which both motor and sensory modalities are intact[4]. The extent of SCI is categorized by the ASIA impairment scales in which A refers to a

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Received: 18 Jan 2017; revised received: 08 Feb 2017; accepted: 24 Feb 2017

complete injury in which no sensory or motor function is preserved in sacral segments S4-S5, B denotes an incomplete injury in which sensory, but not motor, function is preserved below the neurologic level and extends through sacral segments S4-S5, C signifies an incomplete injury in which motor function is preserved below the neurologic level, and most key muscles below the neurologic level have muscle grade less than 3/5, D depicts an incomplete injury in which motor function is preserved below the neurologic level, and most key muscles below the neurologic level have muscle grade greater than or equal to 3/5, and E means that sensory and motor functions are normal[4].

SCI gives rise to a number of devastating medical complications among which neurogenic bladder (NB) is an important one that results in various secondary urologic complications which continue to be a major cause of high morbidity in long-term SCI survivors in the form of a higher incidence of urinary tract infection (UTI), renal stones (8%), stones (36%), vesicoureteral reflux, hydronephrosis and renal deterioration[5,6]. Urodynamic studies or urodynamics (UDX) are an established and recommended diagnostic tool to assess and evaluate patients with voiding dysfunctions and to predict, based on results, the appropriate management method for the individual patient[7,8]. Different patterns of NB can that can be obtained on UDX testing including detrusor hyperreflexia/ overactivity (DO) which is defined as the urodynamic finding characterized by involuntary detrusor contraction, detrusor hyporeflexia/ areflexia/ acontractility (DA) which is defined as the urodynamic finding characterized by no or weak detrusor contraction, and detrusor sphincter dyssynergia (DSD) defined as the urodynamic finding characterized by simultaneous contractions of both detrusor and urethral sphincter[9-12].

All SCI patients should undergo urodynamic evaluation because it provides a more precise diagnosis for each SCI patient, with the initial urodynamic study done after the patient is beyond the spinal-shock phase[12,13]. Traumatic supra-sacral SCI usually results in an initial period of spinal shock which is characterized by flaccid paralysis and extinction of muscle stretch reflexes below the level of injury and detrusor areflexia[14,15].

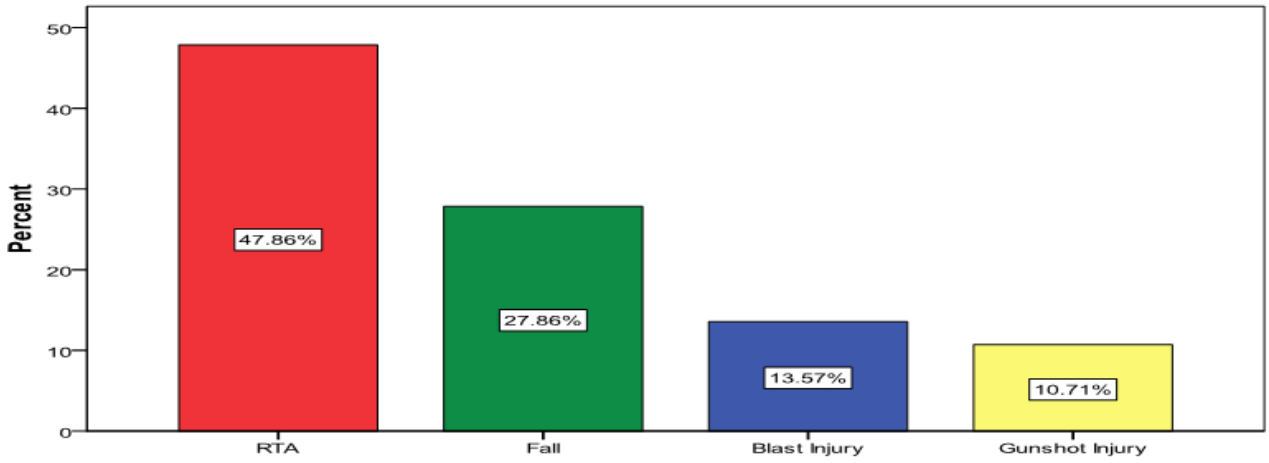

Figure-1: Mechanisms of pattern of injury among participants.

To our knowledge in Pakistan the data regarding neurogenic bladder patterns in SCI patients is limited. Early establishment of NB pattern can help prevent urologic complications which are the cause of prolonged hospital stay, repeated hospital visits and delay in rehabilitation program.

This study aims to emphasize the need and importance of urodynamic testing in SCI patients,

so as to evaluate specific type of voiding dysfunction associated with NB with an intent to guide the primary care physicians to choose wisely among various available bladder management options, thus avoiding various potential urologic complications, minimizing associated morbidity and mortality, and improving quality of life (QOL).

MATERIAL AND METHODS

This descriptive cross-sectional study was conducted at Armed Forces Institute of Rehabilitation Medicine (AFIRM) Rawalpindi from July 2015 to June 2016. After obtaining permission from the institutional ethical committee, 140 traumatic SCI patients, aged 12 and above of both genders who were out of spinal shock, both from indoor and outdoor departments of AFIRM during the study period were included, through non-probability purposive sampling, who had willingly accepted to participate in the study. The sample size was calculated using WHO sample size calculator[16]. The patients with non-traumatic SCI, traumatic brain injury and cognitive problems, urethral strictures, prostate related conditions, urinary calculus disease, and active UTI, hepatitis B&C/HIV infections, previous or current surgeries on lower urinary tract and drugs affecting lower urinary tracts were excluded from the study. After explaining the objectives and benefits of the study informed consent was taken from all participants and they then underwent interview for detailed clinical history and relevant physical examination, ruling out spinal shock.

Urodynamic studies were then performed by the same examiner using "Dantec Menuet Compact® Plus" urodynamic equipment. Filling phase and voiding phase cystometrogram were performed using 6Fr double-lumen cystometry catheter which was inserted in to bladder transurethrally. One lumen was used for bladder filling at an average flow rate of 30 ml/min and the other was used to record intravesical pressure. Intra-abdominal pressure was recorded by a 12Fr rectal catheter. All studies were performed at 0800 hours by the same examiner. Data thus collected were recorded on specialized proforma by the principal investigator. The outcome variable was the frequency of neurogenic bladder patterns. Patients' confidentiality and anonymity were kept preserved.

Data Analysis

Data were analyzed with the help of statistical analysis program SPSS Ver 17.0. For qualitative variables like gender, and neurogenic bladder patterns (DO, DA, and DSD) frequency and percentages were used. For quantitative variables like age mean and standard deviation (SD) were used.

RESULTS

Out of 140 enrolled participants 123 (87.9%) were males and 17 (12.1%) were females. Mean age was 40.7 ± 11 years. RTA was the most common mechanism of injury accounting for 67 patients followed by fall in 39, blast injuries in 19, and gunshot injuries in 15 (fig-1).

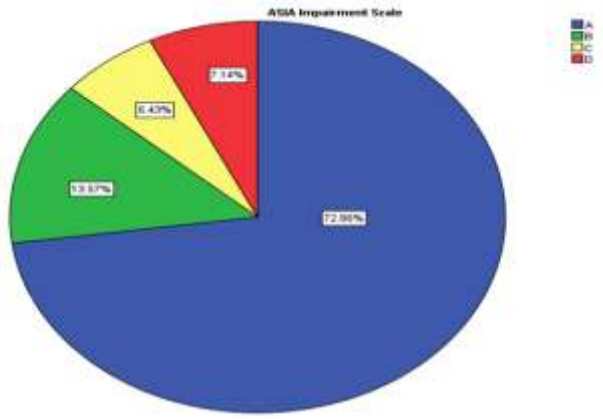

Figure-2: Classification of patients based on American Spinal Injury Association impairment scale.

According to ASIA impairment scale classification most of the patients i.e. 102 (72.9%) were in ASIA A (fig-2).

NLI was thoracic in 102 (72.9%), followed by cervical level in 30 (21.4%), and lumbar level in 8 (5.7%).

Overall 100 (71.4%) of SCI patients demonstrated DO, while 40 (28.6%) had DA. None of the patients demonstrated DSD or normal bladder pattern. Thoracic level of injury was the commonest in patients with both DO and DA (fig-3).

DISCUSSION

The management of NB and voiding dysfunction is an important part of rehabilitation programs for SCI patients[12]. Better urologic care has been an important factor in the improved survival rate and QOL in SCI population by avoiding potential urologic complications[7]. On pure anatomical basis, injury caudal to sacral segments of spinal cord will result in an upper motor neuron type bladder i.e. DO with or without DSD, while an injury to the sacral segments of spinal cord or cauda equina segment should result in a lower motor neuron type bladder i.e. DA but this relation between physical neurological findings and the resulting NB type is often not that straightforward. Work of Erol B, et al and others showed that normal compliance and DA can be found in patients with supra-sacral injuries as DO and normal bladder compliance can be seen with sacral injuries[14,15]. Wyndaele JJ and others concluded that clinical neurological examination alone is inadequate to predict type of NB dysfunction especially in the setting of combined supra-sacral and sacral injuries[16-18]. Therefore the old fashioned way of predicting type of NB pattern, voiding dysfunction and sphincter function in patients with SCI only on the basis of history and physical examination is not reliable[6,9].

According to the latest statistics from NSCISC of U.S.[2], the average age at injury is 42 years and our study shows that the mean age was 40.7 ± 11 years. With regard to gender distribution, in our study 87.9% of the SCI patients were males, and according to the NSCISC statistics of U.S.[2], approximately 79% of SCIs occur among males. This higher percentage of male patients, as compared to U.S., is explained by the fact that the study was conducted at a military rehabilitation center and hence most of our patients were male military personnel.

The most common mechanism of injury, according to the NSCISC statistics of U.S.[2], is RTA in 38%, and so was in our study where RTA was the etiology of SCI in 47.9% but according to our results acts of violence (blast injuries and gunshot injuries) account for a greater percentage of patients (13.6% and 10.7% respectively) as compared to NSCISC statistics of U.S.[2] according to which acts of violence (gunshot wounds) in account for the etiology in 14%. This is explained by the fact that the study was conducted at a military rehabilitation center and hence most of our patients were military personnel who

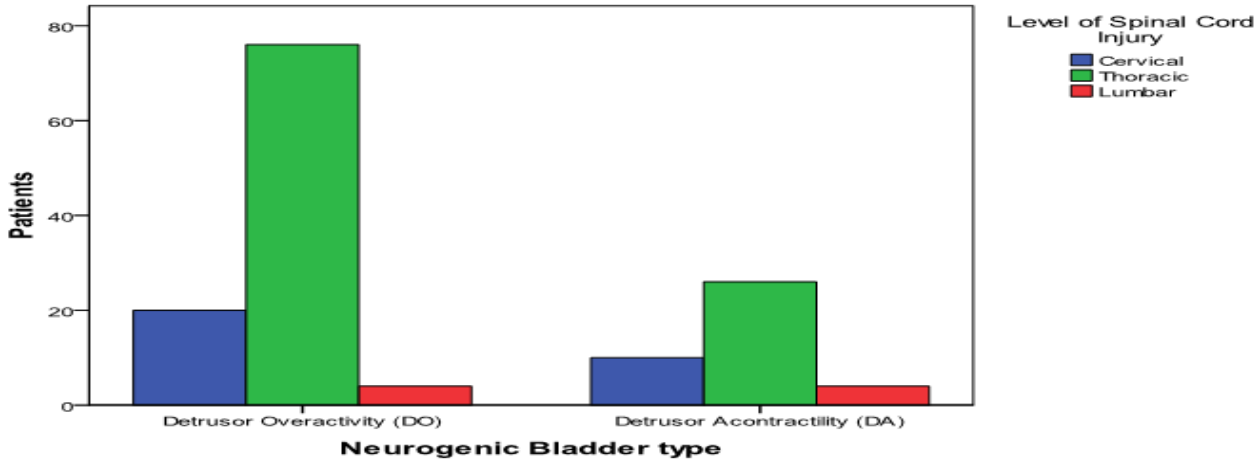

Figure-3: Urodynamic bladder patterns with neurological level of injury.

suffered blast injuries and gunshot injuries while fighting war against terrorism.

Referring to an Indian study, which was also conducted at a military rehabilitation center, majority of the SCI patients (76%) were classified in ASIA impairment scale A[5], and results of our study also similarly show that majority (72.9%) of patients were in AISA impairment scale A.

According to several international studies, 78% of thoracic, 65% of cervical, and 49% of lumbar level of SCI demonstrated DO, while 39% of lumbar, 9% of cervical, and 9% of thoracic level of SCI demonstrated DA[16-19]. Similar results are also shown by an Indian study[5]. Agrawal M and Joshi M showed that 81.5% demonstrated hyperreflexia while 9.2% had detrusor areflexia[6]. According to Janjua et al, 67% of SCI patients demonstrated DO, and 33% were having DA[20]. Our results are also in overall accordance with these studies showing that overall 71.4% of our patients demonstrated DO, and 28.6% were having DA. Based on NLI, 76% of thoracic, 20% of cervical, and 4% of lumbar level of SCI demonstrated DO, while 26% of thoracic, 10% of cervical, and 4% of lumbar level of SCI demonstrated DA.

CONCLUSION

Detrusor overactivity was the commonest NB pattern among the traumatic spinal cord injury patients.

Voiding dysfunctions resulting from NB are one of the major and disturbing complications of SCI having pathophysiological and psychosocial effects on the patients' QOL. As the correlation between NLI and the type of neurogenic bladder is not precise and straightforward, urodynamic studies are mandatory to be performed in every SCI patient to establish the exact type of NB for deciding and prescribing the adequate modalities of individualized bladder rehabilitation program.

RECOMMENDATION

Based on the discussion generated from literature review and our present study, it is emphasized and recommended that every patient of traumatic spinal cord injury should be subjected to urodynamic testing after the spinal shock phase is over and the neurogenic bladder pattern be determined and individualized bladder management options may then be offered to the patient based on urodynamic findings.

Limitations

As our study was conducted in one center and our study participants were mainly male soldiers, the results of our study should not be generalized and further multicenter studies are required to have better understanding of bladder pattern at different level of spinal cord injury.

Disclosure

This is an FCPS dissertation based article.

CONFLICT OF INTEREST

This study has no conflict of interest to declare by any author.

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