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Risk factors for bladder calculi in patient with spinal cord injury

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Abstract
Objectives: We aimed to investigate the risk factors for bladder calculi in patient with spinal cord injury.
Study Design: Prospective study.
Methods: From January 2019 to June 2020 in our hospital spinal cord injury rehabilitation center, 41 patients with bladder stones and surgical treatment of spinal cord injury were found. Multivariate analysis was performed to determine the risk factors of initial bladder stones.
Results: Among the 41 patients, 38（82.9%） were male, 22 (53.7%) were with high spinal cord injury (T6 or above), including 14 cases of cervical injury, 4 cases (9.8%) of Cauda Equina injury, and 15 cases (34.1%) of other thoracolumbar injuries. The main cause of stone formation was indwelling catheterization. There were 22 cases, accounting for 53.7%. Involuntary leakage and intermittent catheterization within 3 times a day were also easy to cause stones, accounting for 10 cases (24.4%) and 6 cases (14.6%) respectively. Only 3 cases (7.3%) had intermittent catheterization 3 to 6 times a day.
Conclusions: Bladder calculi were most likely to develop within one year of spinal cord injury, indewelling catheterization is the most common cause. In order to prevent the formation of bladder stone, early removal of urethral catheter is recommended and indwelling catheters should be avoided if possible in patient with spinal cord injury.

Keywords: bladder calculi, spinal cord injury, Cauda Equina injury

Introduction

It was reported in 2001 that the Incidence of Spinal Cord Injury (SCI) in China is 0.67–1.37 Per 100,000 Population [1]. Since China has a Population of 1.3 Billion, this translates into more than 13,000 new SCI patients each year. However, in 2014, a new epidemiological investigation revealed that the incidence was approximately 50,000 new cases each year, mainly due to the increase in vehicle accidents with increasing numbers of cars and motor bicycles [2]. Of these patients 60–95% will develop neurogenic lower urinary tract dysfunction (NLUTD), which can cause a range of long-term neuro-urological symptoms and develop a variety of urologic complications [9], such as Bladder stone disease [10]. Bladder stone can cause considerable morbidity, associated with hematuria, recurrent urinary tract infections IUT), urinary retention leading to urosepsis, and bladder carcinoma [5-8]. They often require surgical remove, which carries with it associated anesthetic and infectious risks. Preventive measures are essential in these cases to avoid urological complications. So we expected to identify factors in SCI patients that increase the risk of bladd stone formation so that these patients can be Recongnized, evaluated, and treated appropriately to reduce their incidence and morbidity.

Materials and methods

From January 2019 to May 2020 in our hospital spinal cord injury rehabilitation center, 41 patients with bladder stones and surgical treatment of spinal cord injury were enrolled in this study. In general, we found bladder stones in regular yearly follow-up, by ultrasound or videourodynamics. In symptomatic patient, we performed ultrasound immediately. If there were some unclear findings we performed cystoscopy. All bladder stones were treated by endoscopic lithotrypsy, without open surgery under general anesthesia.

We excluded sludge from the study, which could be 'washed out' during cystoscopy. Risk factors assessed in this study included age, sex, neurologic level and extent (completeness) of injury, method of bladder drainage management and so on. Multivariate analysis was performed to determine the risk factors of initial bladder stones.

Results

From January 2019 to June 2020 in our hospital spinal cord injury rehabilitation center, 41 patients with bladder stones and surgical treatment of spinal cord injury were found. Table1 gives an overview about demographic and clinical features. among the 41 patients, 34（82.9%） were male, 22 (53.7%) were with high spinal cord injury (T6 or above), including 14 cases of cervical injury, 4 cases (9.8%) of cauda equina injury, and 15 cases (34.1%) of other thoracolumbar injuries.The main cause of stone formation was indwelling catheterization. There were 22 cases, accounting for 53.7%.

Involuntary leakage and intermittent catheterization within 3 times a day (IC<3) were also easy to cause stones, accounting for 10 cases (24.4%) and 6 cases (14.6%) respectively. Only 3 cases (7.3%) had intermittent catheterization 3 to 6 times a day(IC>3).

Table 1: Demographic and clinical features: n=41 SCI patients with bladder stones

Age (year)	**Mean 50**	**Range 21–78**
SCI-time (month)	Mean 35.6	Range 2–600
Gender, n (%) Male/female	34(82.9)/7 (17.1)	
AIS classification, n (%) AIS—A/B/C/D	20 (48.8)/11 (26.8)/6 (14.6)/4 (9.8)	
Completeness of injury, n (%) Complete/incomplete	31 (75.6)/10 (24.4)	
Level of injury, n (%) C/T/L/S	14 (34.1)/23 (56.1)/3 (7.3)/1(2.4)	
Prophylactic measures, n (%) TC/RM/IC<3/IC>3	22 (53.7%)/10(24.4%)/6(14.6%)/3(7.3%)	

Overall, Bladder stones occurred in 4.2% of the patients, emptied the bladder by indwelling catheterization was 10.2%, Reflex micturition 4.48%, Intermittent catheterization <3 3.5%, Intermittent catheterization>3 0.8% respectively (Table 2). We detected more bladder stones in SCI patients using indwelling catheterization than without, involuntary leakage and intermittent catheterization within 3 times a day were also easy to cause stones.

Table 2: Methods of bladder management in patients developing Stones

Bladder management	**Patient**	**Bladder stone**	
	n	**n**	**%**
indwelling catheterization	216	22	10.2
Reflex micturition	223	10	4.48
Intermittent catheterization<3	171	6	3.5
Intermittent catheterization>3	262	3	08
All	972	41	4.2

Discussion

In this study, the incidence of bladder stones varies depending on the bladder management. Particularly indwelling catheters are associated with a higher risk of stone formation. This is similar to a previous report,in that study Ord *et al*. reported an absolute annual risk of bladder stone formation in SCI patients with indwelling catheters of 4% compared with a rate of 0.2% for those on intermittent self-catheterization [9]. Ku *et al*. also determined that bladder stones were more common in patients with urethral catheters than in those without [10]. In our study, we found that indwelling catheter more than 2 months prone to form bladder stone, slightly longer than the previous study of a month. Nagashima *et al*. found that indwelling catheters for longer than a month were a risk factor for bladder stone formation in SCI patients.We also found reflex urination and intermittent catheterization less than three times were also risk factors for bladder stones in patients with spinal cord injury. Bartel *et al*. demonstrated bladder stone by suprapubic catheter (SPC) in 11%, by transurethral catheter (TC) in 6.6%, by intermittent catheterization (IC) in 2% and by reflex micturition (RM) in 1.65%. We can conclude that bladder stones in SCI patients used indwelling catheters more common than without.

The retrospective nature is one of the major drawbacks of our study, as it did not allow evaluating the incidence and the causative organisms of urinary tract infections in the patients with bladder stone formation.

Conclusion

Bladder calculi were most likely to develop within one year of spinal cord injury, indewelling catheterization is the most common cause. In order to prevent the formation of bladder stone, early removal of urethral catheter is recommended and indwelling catheters should be avoided if possible in patient with spinal cord injury.

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