Bladder management of patients with spinal cord injuries sustained in the 2008 Wenchuan earthquake

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Abstract This study's aim is provide an overview of the patients who suffered spinal cord injury (SCI) after the magnitude 8.0 Wenchuan earthquake, including each patient's demographic and epidemiological characteristics, bladder management status, and quality of life (QOL). We also assessed the relationships between bladder management methods, symptomatic urinary tract infection (SUTI), and QOL. Two years after the 2008 Wenchuan earthquake, a cross-sectional face-to-face survey was conducted on 180 patients with SCI. A self-administered questionnaire and the WHOQOL-BREF assessment were used to assess injury-related information, bladder management methods, and SUTI. Statistical analysis was performed using the Chi-square test and analysis of variance. A p value < 0.05 was considered statistically significant. This study found that a male-to-female ratio of approximately 1.2:1, including 98 (54.4%) male patients and 82 (45.6%) female patients. Thoracic-level injuries were seen in 82 patients (45.56%), 60 (33.33%) patients had lumbar-level injuries, 18 (8.33%) patients had thoracolumbar-level injuries, and a small number of patients had cervical- or sacral-level injuries. Sixty-two patients (34.44%) demonstrated normal voiding, 65 (36.11%) required manually assisted voiding, 29 (16.11%) required catheterization, and 24 (13.33%) used aurine-collecting apparatus. The prevalence of SUTI was 43.89%. Patients who emptied their bladder via manually assisted voiding, catheterization, or with the use of a urine-collecting apparatus demonstrated higher rates of SUTI compared with patients who voided normally (p < 0.05); the patients who required catheterization had higher rates of SUTI compared with patients who required manually assisted voiding (p < 0.05). When manually assisted voiding and catheterization were compared with the use a urine-collecting apparatus, no statistically significant differences were observed in terms of the risk of developing SUTI. The patients in this study demonstrated low scores on the WHOQOL-BREF physical domain (11.61 ± 3.80), psychological domain (10.11 ± 3.63), social domain (11.46 ± 2.84), and environmental domain (11.86 ± 2.51). The patients who reported normal voiding also demonstrated the best QOL in...
terms of physical, psychological, and social component scores ($p < 0.05$). In conclusion, the percentage of women in this study is higher than that reported in other studies on traumatic causes of SCI. Patients who suffered SCI following the Wenchuan earthquake demonstrate poor bladder management status and are unable to take advantage of urodynamic testing that is used to monitor the functional state of the bladder. This study’s findings indicate that bladder management methods influence the rate of SUTI and the QOL of patients with SCI. Caring for SCI patients following a disaster requires comprehensive long-term planning. Bladder management of patients with SCI is essential for improving the QOL of these patients.

Materials and methods

Patient recruitment and data collection procedures

A cross-sectional, face-to-face survey was conducted 2 years after the 2008 Wenchuan earthquake. A total of 180 patients who suffered from SCI in Sichuan province were included in the study. All of the investigators were trained in the relevant skills and technology for the rehabilitation and bladder management of patients with SCI. Patient addresses and telephone numbers were obtained from the ministry of health of Sichuan province, the administrative departments of Sichuan province, and local hospitals.

Statistical analysis

Data entry, management, and analyses were conducted using Windows Microsoft Excel (Windows Microsoft Excel, Microsoft Corporation, Redmond, Washington, USA) and SPSS 11.5 (SPSS Inc., Chicago, IL, USA). Descriptive statistics and Chi-square significance comparisons were used to evaluate...
the relationship between different bladder management techniques and the risk of developing SUTI.

For the statistical analysis, the WHOQOL-BREF assessment was first summarized as a 4-domain construct (physical health, psychological health, social relationships, and environmental health) according to the guidelines of WHOQOL-BREF [7]. All domain scores were calculated by taking the mean score of all of the items included in each domain and multiplying the scores by a factor of 4 [7]. Analysis of variance was subsequently used to determine the significant interactions between each bladder management method and the scores on all of domains that were investigated using WHOQOL-BREF. A p value < 0.05 was defined as statistically significant.

Results

The male-to-female ratio in this study was approximately 1.2:1, consisting of 98 (54.4%) male patients and 82 (45.6%) female patients. Eighty-one patients (45%) were 41–60 years of age (Fig. 1). Eighty-two patients (45.56%) had thoracic-level injuries, 60 (33.33%) had lumbar-level injuries, 18 (10.00%) had thoracolumbar-level injuries, and a few had cervical- or sacral-level injuries (Table 1). Forty-one patients (22.78%) had ASIA grade A injuries, 18 (10.00%) had grade B injuries, 16 (8.89%) had grade C injuries, 74 (43.89%) used aurine-collecting apparatus. The prevalence of SUTI was defined as 43.89% (Table 2).

As shown in Table 3, patients who required manually assisted voiding, catheterization, or a urine-collecting apparatus reported higher rates of SUTI than patients who voided normally (p < 0.05). Patients who required catheterization had higher rates of SUTI than patients who required manually assisted voiding (p < 0.05). However, patients who used a urine-collection apparatus did not report significantly different rates of SUTI than patients who required manually assisted voiding or catheterization.

The patients in this study demonstrated low scores on the WHOQOL-BREF, including physical domain scores of 11.61 ± 3.80, psychological domain scores of 10.11 ± 3.63, social domain scores of 11.46 ± 2.84, and environmental domain scores of 11.86 ± 2.51. The WHOQOL-BREF scores of the SCI patients who required different bladder management methods are shown in Table 4. Significant differences in terms of physical health, psychological

<table>
<thead>
<tr>
<th>Level of Injury</th>
<th>Patients</th>
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<tbody>
<tr>
<td>Cervical</td>
<td>6.67% (n = 12)</td>
</tr>
<tr>
<td>Thoracic</td>
<td>45.56% (n = 82)</td>
</tr>
<tr>
<td>Lumbar</td>
<td>33.33% (n = 60)</td>
</tr>
<tr>
<td>Thoracic and lumbar</td>
<td>8.33% (n = 15)</td>
</tr>
<tr>
<td>Cervical and thoracic</td>
<td>1.67% (n = 3)</td>
</tr>
<tr>
<td>Lumbar and sacral</td>
<td>1.11% (n = 2)</td>
</tr>
<tr>
<td>Cord contusion</td>
<td>3.33% (n = 6)</td>
</tr>
</tbody>
</table>

Discussion

During the past 20 years, natural disasters have claimed more than 3 million lives worldwide, affected at least 800 million people, and resulted in property damage exceeding US $500 billion [8]. In terms of loss of life and assets, earthquakes are the most harmful natural disasters [9]. SCI is frequently reported following earthquakes [10]. SCI is one of the most devastating of all traumatic events and often causes the loss of some or all of an individual’s sensation and movement [11].

Epidemiological studies on SCI in both developed and developing countries have consistently reported male-to-female ratios ranging between 3:1 and 8.3:1 [12,13]. Following earthquakes, the percentage of women with SCI is higher than that reported following other traumatic causes of SCI. Maruo and Matumoto [14] reported that 70% of patients with spine fractures in their study were female. In this study, the male-to-female ratio was approximately 1.2:1. This difference may be due to behavioral and occupational risk factors that generally increase the risk of SCI in men. However, this natural disaster, which occurred during the middle of the day when most Chinese women were at home, resulted in a higher percentage of women being injured. The majority of the patients in this study were 41–60 years of age.

SCI following an earthquake is primarily due to being hit by falling debris while sitting or standing [14]. Rathore

Figure 1. Age distribution of patients.
et al. [15] reported that 89.3% of persons injured in October 2005 earthquake in Northern Pakistan earthquake developed paraplegia, suggesting that either the number of persons with cervical injuries was low or that persons with tetraplegia did not survive long enough to make it to an SCI healthcare facility. Maruo and Matumoto [14] reported that the most common levels of injury among earthquake survivors in their series were T12 (29%) and L1 (29%). Our data are consistent with previous studies: namely, 45.56% of patients (n = 82) had thoracic-level injuries and 33.33% (n = 60) had lumbar-level injuries. Our data also show that compared with other patients who require bladder management, patients who are able to void normally suffered lower level and lower grade injuries. According to the ASIA scoring classification, grade D was the most common grade of SCI among the survivors of this earthquake (41.11% of patients; n = 74). However, there is a paucity of data regarding the expected level and severity of injuries after this event, preventing the determination of whether the mechanism of injury or other factors regarding extrication and in-field care led to the particular characteristics of the SCI survivors reported in these studies.

Urological dysfunction is an important issue for patients with SCI. An earlier study recommended that the choice of the bladder management technique should consider many factors, such as age, patient preference, financial concerns, functional status, and patient motivation [16]. In our study, only 34.44% of patients with SCI reported normal voiding, and 65.56% patients required specific bladder management techniques to facilitate emptying.

UTI is a common problem among patients with SCI, accounting for 67.1% of complications following nontraumatic and traumatic SCI [17]. In this study, the prevalence of SUTI was 43.89%. Certain structural and physiological factors, such as bladder overdistention, vesicoureteral reflux, high-pressure voiding, large postvoid residuals, stones in the urinary tract, and outlet obstruction, increase the risk of infection. The method of bladder drainage also influences the risk of UTI, and most persons with SCI and an indwelling urinary catheter developed a UTI. About one-third of SCI patients in this study used urethral or suprapubic indwelling catheterization. From the moment the urethral catheter is introduced, the incidence of bacteriuria is 5—10% per day [18]. Almost all of the complications of urinary catheterization are the result of subsequent bacteriuria [18].

CIC has been shown to be the safest bladder management method for patients with SCI in terms of urological complications [19]. Published studies suggest that the main advantage of CIC is that it is the most effective method of providing bladder management in terms of renal protection. However, it is not widely accepted in China. Inconvenience and the difficulty of performing the technique are the main reasons. Furthermore, basic healthcare providers have limited knowledge regarding bladder management after SCI and lack sufficient materials and staff resources to use CIC as a method of bladder management. In our study, the overwhelming number of patients with SCI lived in remote villages with bad transportation systems and scarce health resources. Most of these patients lacked adequate education regarding bladder management, and the number of patients who were fit to receive CIC were reluctant to use this method of bladder management.

Our data show that patients who empty their bladder by CIC demonstrate a high incidence of UTI. Barnes et al. [20]
found that urinary complications, mostly UTI, occurred in 75% of patients. Deficiency in manipulation skills and bad personal hygiene may have contributed to the higher rate of UTI. Our results may also have been influenced by statistical bias due to the small sample size. Moreover, a portion of our patients used a single-use catheter for 3–7 days. Convincing patients who are suitable for CIC to accept this bladder management method, and appropriately training these patients in order to prevent side effects, is a major challenge for Chinese urologists.

In this study, 21.67% of SCI patients preferred the Credé maneuver to expel urine, but only a number of SCI patients (13.33%) with small-volume bladders preferred condom collector bags (for men) or a diaper (for women). The Credé maneuver is a simple and effective voiding technique for managing patients with a flaccid bladder, large bladder capacity, low bladder storing pressure, or an incompetent or relaxed external and/or internal urethral sphincter [21]. However, the Credé maneuver, even when used to treat large-volume flaccid bladders, can cause renal damage, and is not safe for long-term use, especially in men [22]. Patients with suprasacral injuries often demonstrate detrusor hyperreflexia and detrusor sphincter dyssynergia (DESD), thereby resulting in an elevated voiding pressure [23].

SCI can result in severe physical and psychosocial limitations and can affect the QOL of individuals and their families. The patients assessed in this study had low WHOQOL-BREF scores. Mental health status was also found to be associated with the deprivation of basic goods and services, traumatic events, and fear and uncertainty among displaced and crisis-affected populations [24]. These patients experienced a significant amount of emotional distress and many social, physical, and functional problems. However, there was no difference between SCI patients and normal persons on the environmental domain of the test. SCI can have a significant impact on the QOL of both patients and their families. QOL may be influenced by a variety of factors, such as family support, ability to adjust and cope, productivity, self-esteem, financial stability, education, and their physical and social environment [25].

Table 4 The results of WHOQOL-BREF: comparisons in quality of life in SCI patients (n=180) using various bladder management methods.

<table>
<thead>
<tr>
<th>Bladder management methods</th>
<th>N</th>
<th>Physical health M ± SD</th>
<th>Psychological health M ± SD</th>
<th>Social Relationship M ± SD</th>
<th>Environment M ± SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>Normal voiding</td>
<td>62</td>
<td>13.64 ± 1.77</td>
<td>12.56 ± 1.18</td>
<td>13.08 ± 1.22</td>
<td>12.57 ± 1.43</td>
</tr>
<tr>
<td>Credé maneuver</td>
<td>39</td>
<td>10.53 ± 2.65</td>
<td>9.23 ± 2.11</td>
<td>10.99 ± 1.93</td>
<td>11.46 ± 2.11</td>
</tr>
<tr>
<td>Valsalva</td>
<td>20</td>
<td>12.34 ± 3.07</td>
<td>9.55 ± 2.89</td>
<td>10.73 ± 2.01</td>
<td>11.49 ± 0.89</td>
</tr>
<tr>
<td>Reflex trigger</td>
<td>6</td>
<td>11.37 ± 2.54</td>
<td>9.12 ± 1.56</td>
<td>10.45 ± 1.02</td>
<td>11.87 ± 1.32</td>
</tr>
<tr>
<td>CIC</td>
<td>11</td>
<td>9.89 ± 1.78</td>
<td>8.55 ± 2.03</td>
<td>9.34 ± 0.72</td>
<td>12.27 ± 2.10</td>
</tr>
<tr>
<td>ITC</td>
<td>11</td>
<td>9.76 ± 1.53</td>
<td>8.79 ± 2.14</td>
<td>9.87 ± 1.12</td>
<td>11.48 ± 1.78</td>
</tr>
<tr>
<td>ISC</td>
<td>7</td>
<td>10.01 ± 2.20</td>
<td>7.94 ± 1.46</td>
<td>9.99 ± 1.31</td>
<td>11.82 ± 2.01</td>
</tr>
<tr>
<td>Urinal collecting apparatus</td>
<td>24</td>
<td>9.67 ± 1.12</td>
<td>7.89 ± 1.41</td>
<td>11.02 ± 2.01</td>
<td>10.98 ± 1.12</td>
</tr>
<tr>
<td>P value*</td>
<td></td>
<td>0.012</td>
<td>0.001</td>
<td>0.023</td>
<td>0.07</td>
</tr>
</tbody>
</table>

Abbreviations: CIC, clean intermittent catheterization; ITC, indwelling transurethral catheterization; ISC, indwelling suprapubic catheterization. M ± SD, mean ± standard deviation.*P-values were computed by general linear model (GLM) with sex, age and severity of spinal cord injury as adjusted variables.

In this study, patients who reported normal voiding demonstrated the best QOL in terms of the physical, psychological, and social component scores, but not in terms of the environmental component score. We also observed that the indwelling catheterization methods were associated with poorer reported emotional conditions and personal interactions, possibly resulting from obstacles to the patients’ physical contact with their partners. Oh SJ et al. [26] also found that patients who are unable to independently perform catheterization are at a higher risk of depression compared with those who are unable to perform self-catheterization. Bladder dependence does, indeed, have a negative impact on several QOL domains among individuals with SCI.

An earthquake that results in a large number of people with new SCIs will add stress to any healthcare system. It is important for Chinese healthcare providers to consider how our medical and rehabilitation systems of care would fare under these circumstances. The importance of educating local healthcare providers on issues regarding the care (both in the field and throughout the course of hospitalization and rehabilitation) of patients with SCI is clear. One feasible solution is to have patients participate in an educational program run by nurses who have been trained by experts in SCI care. The long-term and systematic care of patients living in remote village remains problematic. However, this approach is an essential part of SCI care and is necessary for ensuring that the initial medical and rehabilitation efforts will have long-term benefits in China.

Study limitations

Although we made a thorough effort to evaluate all of the patients who sustained an SCI during the 2008 Wenchuan earthquake, some patients could not be located, meaning that this sample may not completely reflect the demographics, epidemiological characteristics, or the QOL among all patients with SCI following the Wenchuan earthquake.
Conclusion

The percentage of women in this report is higher than percentages previously reported in other studies on traumatic causes of SCI. Patients who suffered SCIs in the Wenchuan earthquake demonstrated poor bladder management status and lacked access to the urodynamic testing needed to monitor the functional status of the bladder. Bladder management methods can have a major influence on the risk of SUTI, as well as the QOL of patients with SCI, and bladder management is essential for health-care planning after a catastrophe. Also, providing education to the healthcare providers is essential for the construction of comprehensive long-term care plans that could improve the QOL of patients with SCI.

References