

### Long-term follow-up study of patients with spinal cord injury

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Traumatic spinal cord injury (TSCI) is a serious medical disorder that affects all regions of the world. Although survival after TSCI has greatly improved over recent decades, patients with TSCI still have an increased risk of death compared with the general population.<sup>1</sup> The lack of effective pharmacological and surgical treatments for spinal cord injury (SCI) makes it reasonable to focus on the global strategy of prevention programs. To assess the financial and physical burden of TSCI in different countries, it is necessary to evaluate the epidemiological data of the TSCI population. In Iran, a developing country, a high prevalence of TSCI is reported;<sup>2</sup> however, there is a lack of data on the long-term follow-up of SCI. In the present study, we aimed to identify the long-term secondary medical complications and mortality of TSCI patients. This study was conducted as a historical cohort.

Fifteen patients with TSCI who had survived the injury and primary treatment were identified between 1983 and 2006 at the main center of trauma (Khatamol-Anbia Hospital, Zahedan) in southeastern Iran (Table

1). The inclusion criteria comprised: a neurological deficit attributable to TSCI, minimum follow-up of 4 years after discharge from hospital, availability of complete medical records including age, gender, year, and cause of injury, level of lesion, imaging studies, and reports of the clinical examination as well as any treatments. Patients were excluded if: available follow-up data were inadequate, or they refused to complete the questionnaire. According to studies focused on complications of TSCI, we designed a questionnaire containing common secondary complications of TSCI. A patient was considered to have complete recovery if he had normal ambulatory status and satisfactory voiding. A partial recovery was recorded if there were some degree of improvement in ambulatory status and/or if they were incontinent. Out of 15 patients contacted in March 2011, 3 had died, and one did not give his consent for the follow-up study. The questionnaire was administered to the 11 surviving individuals.

The subjects were followed for a mean of  $10.36 \pm 5.8$  years (range 4-27 years). Age and time of death were missing in the data for one dead subject with a cervical lesion. The mechanism of injury was motor vehicle accident for 10 (71%), fall from height for 3 (21%), and gunshot for one (7%). The male to female ratio was 4:1 with males comprising 79% ( $n=11$ ), and females 21% ( $n=3$ ) of the data. Overall, age at injury ranged from 6-38 years (mean= $24.30 \pm 8.5$ ). Ten out of 14 (71%) patients underwent surgery. Complete recovery was

**Table 1** - Characteristics of Iranian long-term traumatic spinal cord injury patients.

Case	Gender	Age	Cause of injury	Year of injury	Neurological level	Completeness	Fecal & urine incontinency	Spinal surgery	Recovery
1	Male	56	MVA*	1983	T12-L1	Complete	Yes	Yes	Partial
2	Male	32	Gun shot	2003	Below L2	Complete	Yes	No	None
3	Male	23	MVA	2004	C4-5	Incomplete	Yes	Yes	Partial
4	Male	46	MVA	1999	C5-6	Incomplete	Yes	Yes	Partial
5	Male	52	Fall	1996	L1	Incomplete	Yes	Yes	Partial
6	Male	24	MVA	2001	Cervical	Complete	Yes	No	Partial
7	Male	29	Fall	2006	C4	Incomplete	No	No	Complete
8	Male	30	MVA	2003	C5	Incomplete	No	Yes	Complete
9	Male	32	MVA	2002	T12	Complete	Yes	Yes	Partial
10	Female	28	MVA	2003	C4-5	Complete	Yes	Yes	None
11	Female	22	MVA	1994	C1	Incomplete	Yes	Yes	Partial
12	Male	41	MVA	1997 (2010)*	C6-7	Complete	Yes	Yes	None
13	Male	NA	MVA	2002 (NA)*	C6-7	Complete	Yes	Yes	None
14	Female	32	Fall	2002 (2004)*	T11-12	Complete	Yes	No	None

MVA - motor vehicle accident, NA - not available, \*time of death, T - thoracic, L - lumbar, C - cervical

observed in 1/10 (10%) of the patients who underwent surgery and in 1/4 (25%) of the patients who underwent non-operative management. Both of the patients with complete recovery had an incomplete cervical TSCI. Partial recovery was observed in 6/10 (60%) of the surgically, and 1/4 (25%) of non-operatively managed patients. No recovery was seen in 3/10 (30%) of the patients who underwent surgery, and 2/4 (50%) of the patients who underwent non-operative management. Nine (64%) patients had a cervical injury and 5 (36%) had thoracolumbar (TL) injury. The mean age at injury was  $21.25 \pm 8.8$  years for patients with cervical injuries, and  $29.2 \pm 5.5$  years for patient with TL injuries. Eight (57%) patients had a complete neurological deficit, and 6 (43%) had a partial lesion. The following outcomes were evaluated in patients.

**Ambulation.** Three out of 5 patients with complete lesions were wheelchair bound, while 2 were ambulatory with braces. In 6 cases with incomplete lesions, one was able to ambulate with a cane but 5 were ambulatory by themselves.

**Bladder management.** Among patients with cervical incomplete lesions 2/5 (40%) voided satisfactorily without using reflex stimulation, catheters or compression bladder with hand, and 3/5 (60%) had urge incontinence. Of those with incomplete TL lesions, 1/1 had urge incontinence. Of those with complete cervical injuries 1/2 (50%) were using indwelling catheterization and 1/2 (50%) had urge incontinence. In patients with complete TL injuries 1/3 (33%) used bladder compression by hand, 1/3 (33%) used an intermittent catheterization program, and 1/3 (33%) were still in need of a condom catheter.

**Secondary urologic complications (55%).** These included urinary tract infection (UTI) and urolithiasis. Five (45%) had recurrent episodes of UTI from the time of injury. Out of these 5 patients, 3 were using external incontinence devices. Also, 3 (27%) cases had a calculus in the urinary tract during the follow-up period.

**Sexual dysfunction in males (67%).** This included erectile dysfunction, decreased sexual satisfaction, and sensation. With this definition, 6/9 (67%) patients had a form of sexual dysfunction. All patients with normal sexual function presented with incomplete lesions.

**Pressure ulcer (64%).** Seven out of 11 (64%) patients developed pressure ulcers in the early years after injury.

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**Musculoskeletal complications (73%).** Of 11 patients, 6 (55%) had muscle atrophy in different locations of body. Three (27%) also experienced spasticity.

**Respiratory complications (55%).** Six (55%) patients had a history of dyspnea or/and pneumonia after injury. Four of them had cervical lesions.

**Cardiovascular complications (27%).** The cardiovascular problems of hypertension, ischemic heart disease, valvular heart disease, and deep vein thrombosis (DVT) were observed in 3 (27%) patients.

**Gastrointestinal complications (64%).** Defined as diarrhea, constipation, and peptic ulcer disease (PUD). One (9%) had episodes of diarrhea, 5 (45%) suffered from constipation, and 2 (18%) reported a history of PUD.

**Central nervous system complications (18%).** Cerebrovascular accident and seizure were seen in 2 (18%) individuals.

Three patients (2 men and one woman) had died by March 2011. The mean age at injury was  $29 \pm 1.4$  years in the deceased patients, compared with  $23.5 \pm 9$  years in the patients still alive. Among the deceased, 2 had complete cervical lesion, one had complete thoracic lesion, and none of them made any improvement from the injury.

Traumatic SCI often affects young male adults, but the average age of TSCI increased from 28.7 years in 1979 to 37.6 years in 2000,<sup>3</sup> because of the rising median age. In our study, age at injury ranged from 6 to 38 years (mean= $24.30 \pm 8.5$ ). In the past, urosepsis was reported to be the most common cause of death in SCI. However, in recent decades, improvements in medical practice have altered the frequent causes of death. Now, the frequent causes of death in SCI patients are almost the same as in the general population.<sup>4</sup> Individuals with SCI are prone to several medical complications that increase the duration and cost of hospitalization, and compound disability. Urinary tract infections, pressure ulcers, cardiac and vascular/hemorrhagic complications, psychiatric complications, and autonomic dysreflexia are the most common complications found in individuals with SCI.<sup>5</sup> We found a frequency of 91% of medical complications in our series. The most common complications being pressure ulcers, sexual dysfunction, muscle atrophy, constipation, urinary tract infections, dyspnea, and pneumonia. The current study showed a higher prevalence of TSCI in young male adults, which is similar to earlier reports.<sup>3</sup>

In conclusion, as TSCI mostly affects young male adults, mortality and secondary complications of TSCI impose a high burden on countries. It is cost-effective

to allocate resources for trauma prevention efforts, and perform research aimed at improving the care of injured patients. Our major limitations in this study were the subjective method of evaluating patients, and small sample size. We did not carryout a statistical analysis because of this small sample size.

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## STATISTICS

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Describe statistical methods with enough detail to enable a knowledgeable reader with access to the original data to verify the reported results. When possible, quantify findings and present them with appropriate indicators of measurement error or uncertainty (such as confidence intervals). Avoid relying solely on statistical hypothesis testing, such as the use of *P* values, which fails to convey important information about effect size. References for the design of the study and statistical methods should be to standard works when possible (with pages stated). Define statistical terms, abbreviations, and most symbols. Specify the computer software used.