

## Epidemiology of spinal cord injuries in Novosibirsk, Russia

B Silberstein<sup>1</sup> and S Rabinovich<sup>2</sup>

<sup>1</sup>Department of Spinal Cord Injuries and <sup>2</sup>Department of Neurosurgery, Research Institute of Traumatology and Orthopaedics, 17 Frunze Street, 630091 Novosibirsk, Russia

The incidence of spinal cord injuries (SCI) in Novosibirsk is 29.7 per million per year. Almost all of these SCI patients (94.3%) are hospitalized to our clinic. Over the past 5 years (since 1989), a total of 196 patients with SCI were admitted. SCI were distributed as follows: cervical, 96 patients (49.0%); thoracic, 54 (27.5%); and lumbar, 46 (23.5%). SCI was diagnosed using computed tomography (CT), magnetic resonance imaging (MRI), pneumomyelography, epidurography, radiography and electrophysiological methods (neuromyography, evoked potentials). All patients had a neurological deficit of varying degree; Frankel grade A, 64 patients (32.7%); B, 22 (11.2%); C, 67 (34.2%); and D, 43 (21.9%). Almost 40% (39.7%) of the patients had unstable fractures, most of them being in the cervical spine. One hundred and ninety patients were operated on, 52 within 3–4 h after trauma. Several types of operation were used: anterior decompression (106 patients); posterior decompression (64 patients); omentomyelopenia (seven patients); meningomyelodectomy (13 patients). Conservative treatment ('halo' traction) was applied in six patients. No patient was made worse because of the surgery. Twenty four patients had a complete neurological recovery, 113 patients could be reclassified into a higher group (Frankel classification), and 59 patients had no neurological improvement. The overall mortality was 16.8% (13.7 postoperatively).

**Keywords:** spinal cord injury; epidemiology; incidence; Novosibirsk; Russia

### Introduction

As has been shown by Western doctors, establishment of a regional spinal cord injury care system is the most effective way of managing patients with SCI.<sup>1</sup> We attempted to organize such a system in Novosibirsk, and since 1989 all patients who had a SCI within the territory of Novosibirsk have been treated in the Department of Spinal Cord Injuries, Research Institute of Traumatology. Our 5 year experience in the diagnosis and treatment of these patients as well as epidemiological data obtained during this period provide the basis for this study.

### Materials and methods

We analysed all inpatients with SCI during 5 consecutive years from 1989 to 1993. Those with an extradural nerve root or a plexus injury were not included. SCI was diagnosed using CT, MRI, pneumomyelography, epidurography, radiography and electrophysiological methods (neuromyography, evoked potentials). The neurological deficit was classified according to the Frankel classification.<sup>2</sup> One hundred and ninety patients had an operation, and the types of operation used were as follows: anterior decompression, posterior decompression, omentomyelopenia, and meningomyelodectomy. Six patients had conservative treat-

ment ('halo' traction). As a well equipped rehabilitation centre is not available in Novosibirsk, we also provided rehabilitation for these patients using physical therapy and medication.

### Results

#### Incidence

Over the past 5 years, 196 SCI patients were hospitalized to our clinic, and 12 to other clinics in Novosibirsk (they are not included in this study). As the population of Novosibirsk is 1.4 million (according to the data of 1 January 1994), the incidence of SCI is 29.7 per million per year (Table 1). All patients had a neurological deficit of varying degree (Table 2).

#### Gender and age

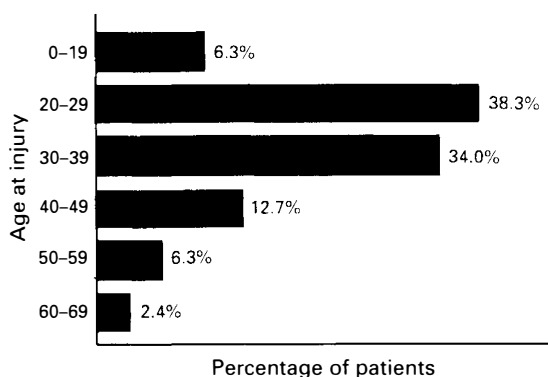
There were 153 (78.1%) males and 43 (21.9%) females. The number of males was 3.5 times greater than the females. The mean age was 34.7 years in the males and 32.3 in the females. The age distribution showed a peak in the age group of 20–29 years. The incidence of SCI also slightly increased at the age of 50–59 years, whereas in patients from the other age groups it was minimal (Figure 1).

**Table 1** Incidence of SCI in Novosibirsk

Population (million)	1.4
Number of patients hospitalised to our clinic	196
Number of patients hospitalised to other clinics	12
Total	208
Incidence (per million)	29.7

**Table 2** Neurological status of hospitalised patients (on admission)

Frankel grade A	64	(32.7%)
Frankel grade B	22	(11.2%)
Frankel grade C	67	(34.2%)
Frankel grade D	43	(21.9%)
Total	196	(100%)



**Figure 1** Age distribution at the time of injury

### Causes of injuries

Traffic accidents and falls from a height were the most common causes of SCI. Diving was also a common cause, especially in younger patients. Two patients were stabbed, and one had a shotgun injury. Gymnastics and wrestling were the causes of sport injuries in 9.7% patients (Table 3). It is of interest that 20.3% of males and 9.3% of females were found to be under the influence of alcohol at the time of their injury.

### Characteristic of spine injuries

There were several types of vertebral column lesions (Table 4): wedge-shaped fractures and fracture-dislocations were noted to be commonest, burst fractures and isolated fractures of pedicles or articular processes were less often seen.

As is shown in Table 5, the most frequent localisation of a spinal injury was of the cervical spine (49%), with C3-7 being 5.4 times more frequent than C1-2. The relationship between the level of injury and the cause of the trauma is indicated in Table 6.

According to the Holdsworth classification,<sup>3</sup> all spinal injuries were divided into two groups—stable fractures and unstable fractures. Unstable fractures occurred more frequently in cervical spine (64% of all

**Table 3** Causes of SCI in Novosibirsk

Fall from a height		
Life trauma (fall from a tree, balcony, roof, etc)	38	19.4%
Industrial accident	21	10.7%
Escape from chasers	14	7.2%
Suicide	6	3.1%
Total	79	40.4%
Traffic accident		
Car, truck	19	9.7%
Pedestrian	15	7.7%
Motorbike	9	4.6%
Bicycle	6	3.1%
Total	49	25.1%
Diving	46	23.2%
Sport	19	9.7%
Gunshot, stab	3	1.6%
Total	196	100%

**Table 4** Type of spinal lesion followed by SCI

Fracture-dislocations	78	39.7%
Wedge-shaped fractures	75	38.3%
Burst fractures	35	17.9%
Isolated fractures of pedicles and articular processes	8	4.1%
Total	196	100%

**Table 5** Level of spinal lesion resulting from SCI

Cervical spine	C1-2	15	7.7%
	C3-7	81	41.3%
Thoracic spine	T1-12	54	27.5%
Lumbar spine	L1-5	46	23.5%
Total		196	100.0%

**Table 6** Causes of trauma and the level of the spinal injury

Cervical spine		
Diving	46	23.5%
Fall from a height	21	10.7%
Traffic accident	19	9.7%
Sport	8	4.1%
Stab	2	1.0%
Total	96	49%
Thoracic spine		
Fall from a height	23	11.7%
Traffic accident	19	9.7%
Sport	11	5.6%
Gunshot	1	0.5%
Total	54	27.5%
Lumbar spine		
Fall from a height	35	17.9%
Traffic accident	11	5.6%
Total	46	23.5%
Total	196	100%

unstable fractures) and predominated among the cervical spine injuries (Figure 2).

### Treatment

As our clinic is available for operations 24 h a day, the interval between the occurrence of trauma and the admittance to the hospital was usually quite short, and most patients (52%) were operated on within 2–8 h of trauma (Figure 3). Patients with an acute SCI who had surgery later had been transferred from other emergency hospitals. We also hospitalised some patients with a spinal fracture intreated for more than a year after the SCI in order to perform reconstructive surgery.

One hundred and ninety patients were operated on, 52 of them within 3–4 h after trauma. Several types of operation were used: anterior decompression (106 patients), posterior decompression (64 patients), omentomyelopenia (seven patients), meningomyelorrhachyolysis (13 patients). Six patients were managed conservatively with 'halo' traction.

No patient was made worse as a result of surgery. Twenty four patients made a complete recovery, 113 patients could be reclassified into a higher group (Frankel classification), and 59 patients had no neurological improvement. The overall mortality was 16.8% (13.7 postoperatively). Most patients who died (84.8%) had injuries of the cervical spinal cord at the level of C4 and above.

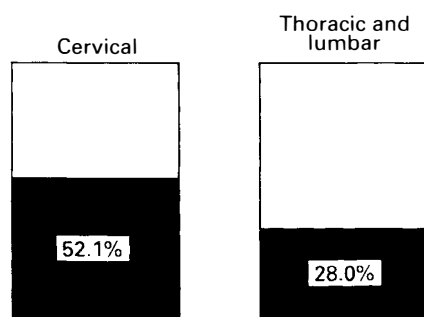


Figure 2 Frequency of unstable lesions of spine

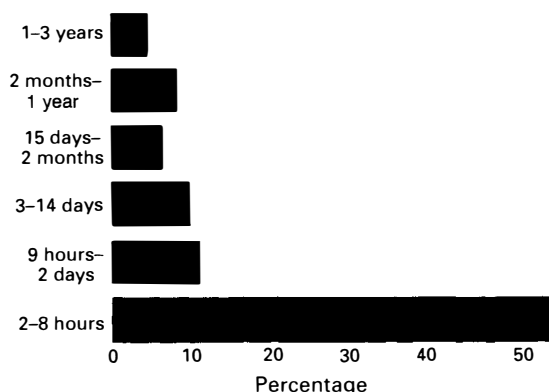


Figure 3 Time between the occurrence of trauma and surgical treatment

### Discussion

It is unquestionable that truly comprehensive medical care for SCI patients can only be provided by specialist centres. The Department of Spine and Spinal Cord Injuries was founded in 1989, and since that time all patients who had suffered such trauma in Novosibirsk have been hospitalized in our clinic. We undertook a study of the epidemiology of SCI in order to estimate the results of our work, plan measures for the improvement of medical care in the future (the number of beds required, expenses, etc) as well as to establish ways of preventing SCI.

The incidence of SCI in Novosibirsk is comparable to that in other countries.<sup>4</sup> Although it is slightly lower than in Florida, FRG or Japan, this difference can be due to the relatively small population (1.4 million) and the number of patients analysed in this study. The male/female ratio is 3.5:1, and this is also a common finding.<sup>4</sup>

One of the characteristic features of SCI in Novosibirsk is the low mean age of the patients (34.7 years in males and 32.2 years in females, compared to 48.3 years and 49.2 years in Japan, respectively). This fact can be understood if the distinction between the causes of injuries in other regions is taken into account. The high incidence of SCI due to diving into shallow water (23.2%) and sport injuries (9.7%) which are typical for younger people may be an explanation.

Another feature that distinguishes our study from others is that the most frequent cause of injury was a fall from a height, while in other reports traffic accidents have been predominant. There are several reasons for this discrepancy. Firstly, traffic in Russia has some peculiarities (speed limit 60 km h<sup>-1</sup>, absence of motorways, etc); also, the number of cars per person in Russia is significantly lower than in other countries. On the other hand the above-mentioned features (high incidence of SCI due to diving and sports) can also contribute to this discrepancy. Finally, as was shown by Japanese investigators, elderly people are often injured in traffic accidents, which are not very common in Russia. The point is that very few people at this age drive a car; also, life expectancy in Russia is less than that it is in Japan.

Regarding the mortality rate in our series of patients with SCI of the cervical spine, it is comparable to data reported from around the world.<sup>5</sup> However, the overall mortality in SCI patients treated in our clinic is slightly higher than that reported from other countries.<sup>6</sup> There are at least two factors which may contribute to this fact, the first being that our clinic is the only hospital in Novosibirsk which provides comprehensive medical care for SCI patients. Therefore, we admit a high proportion of patients who had been previously hospitalized in other clinics and had received inadequate treatment.

We also consider that our concept (according to which all patients who do not have a contraindication to surgery should, as soon as possible, undergo operative decompression of the spinal cord and stabilisation of the injured part of the spine) may also influence our

mortality rate. During the past few years it has been shown that operation itself is not likely to improve the neurological abnormalities, and the value of surgical intervention is disputable.<sup>6-12</sup> This approach can certainly be justified, but only on the condition that a well-organised rehabilitation system is provided. Unfortunately, the facilities which are necessary to enable a patient to have prolonged bed rest during the time required for consolidation and stabilization of spine at the level of injury are not available in our clinic, and the percentage of complications (pressure sores, infections of respiratory and urinary tract) in conservatively treated patients is very high. As a consequence, the results of conservative treatment are unsatisfactory, and the mortality rate considerably exceeds that in the patients who had operative treatment. This is the reason why we consider the wide use of surgery in SCI patients to be warranted.

Other data obtained in our study are consistent with results previously published.<sup>4</sup> In particular, the most severe spine lesions involved the cervical spine, and more than 80% of the lesions of the spine were unstable. Concerning lesions of the thoracic and lumbar spine, fractures at the level of T12-L1 were the most frequent.<sup>13</sup>

This study of the epidemiology of SCI in Novosibirsk was the first attempt to carry out an epidemiological survey in the Siberian region. As the number of SCI patients hospitalised in our clinic is constantly growing and we started to provide medical care for SCI patients not only from Novosibirsk, but also from the Novosibirsk region (1.8 million), the epidemiological data are becoming much more important. Therefore, the Department of Epidemiology of SCI and our department are now carrying out a new, more comprehensive epidemiological study.

Analysis of the causes of SCI injuries, and results of

treatment (which are not promising to far), clearly show that the importance of the prevention of SCI, especially in younger patients, must be emphasized. A campaign for the prevention of SCI which has been started in Japan should also be organized in Russia. We should be happy to collaborate with our Japanese colleagues in this field.

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