ORIGINAL ARTICLE

Epidemiological profile of a pediatric population with acquired spinal cord injury from AACD: São Paulo/Brazil

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Objective: To provide a retrospective analysis of pediatric patients with Spinal Cord Injury (SCI), who were admitted for treatment and rehabilitation in a reference Brazilian medical center during the past 6 years.

Methods: This retrospective analysis included 106 patients 16 years of age or younger who were admitted with SCI in our Rehabilitation Medical Center between April 2002 and June 2008. The patients admitted were analyzed according to their gender, age, origin region, cause and level of injury and clinical complications.

Results/Conclusions: The frequency corresponded to 5.4% of the total of SCI cases studied. The 106 patients reviewed included 67 boys (63.2%) and the mean age of 8.6 years. In all, 50.9% of the SCI have traumatic etiology. The most frequent causes were gunshot 42.6%, traffic accident 38.9%, diving 9.3% and fall 3.7%. The nontraumatic etiologies corresponded to 49.1% of the total patients. Overall, tumor (36.5%) and infection (19.2%) were the most frequent cause of spinal injuries. The average time between SCI event and arrival at the rehabilitation medical center was 27 months. The majority of patients were paraplegic (76.4%). In the first assessment 64.2% patients showed clinical complications, such as orthopedic deformity (69.1%), pressure ulcers (35.3%), spasticity (8.8%), obesity (2.9%). Pediatric SCI is a rare but devastating condition affecting the patient, patient's family and society. An understanding of the etiology and the frequency of pediatric SCI can improve prevention and treatment. *Spinal Cord* (2010) **48**, 118–121; doi:10.1038/sc.2009.130; published online 6 October 2009

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Introduction

Spinal Cord Injury (SCI) is uncommon in children as compared with the adult population.^{1–7} The frequency of traumatic SCI in children ranges from 1 to 13%.^{2–4} The main etiologies are: car accidents, falls from heights, sports injuries and gunshots.^{1–6} Nontraumatic causes are rarely cited in literature but the main ones cited are tumors and infections. The distribution of injury etiologies also varies according to the child's age. Among adolescents, injuries caused by diving into shallow water and sports are common, while falls from heights are more common in younger patients. Car accidents prevail in all age groups.^{4,5}

Despite the lower frequency of SCI in children, the mortality rate is higher than that in adults and the life expectancy is shorter, proportional to the age of onset.^{2,5,8} Furthermore, the family, social and economic impacts seem to be as great as or greater than those of other age groups.^{1,2}

The child finds him or herself severely disabled before full physical and psychological development.^{5,9}

The Association of Assistance to the Disabled Child (AACD) with headquarters in São Paulo, Brazil, is one of the reference centers for the rehabilitation of patients with SCI. Roughly 350 individuals with SCI from many parts of the country are assessed and screened yearly.

Childhood SCI can be prevented and treated more successfully, and better rehabilitation and resocialization can be provided if the characteristics of the patients, etiology of the injuries and main complications are known.^{2,5}

The objective of this work is to describe the epidemiological profile of a pediatric population (aged 0–16 years) with acquired SCI seen in AACD, São Paulo, Brazil, from April 2002 to June 2008. This work also aims to contribute new data to medical literature to improve prevention programs and care given to this group of patients.

Methods

The following data from patients aged 0–16 years with a diagnosis of SCI were collected during their clinical

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screening at the SCI clinic of AACD, São Paulo from April 2002 to June 2008: gender, age, origin and SCI level, duration, etiology and complications. Urological complications were not investigated because their diagnoses require laboratory tests, which would not be ready during the first screening. The data were then statistically analyzed and compared with information from the national and international medical literature.

Results

From April 2002 to June 2008, 1953 patients were seen at the SCI screening clinic of AACD, São Paulo. Of these, 106 patients were aged 16 years or less. Therefore, this study found a frequency of SCI in this age group of 5.4%.

The mean age of the group was 8.6 years (median = 9 years), most were men (63.2%, Figure 1), 63.2% lived in the metropolitan area of the city of São Paulo, 29.2% lived in other cities of the state of São Paulo and 7.5% lived in other states. Mean injury duration was 27 months (median = 12 months, Table 1). The most common injury level was paraplegia, affecting 76.4% of the children.

Nearly half (50.9%) of the SCI were traumatic. They were caused by gunshots (42.6%), car accidents (25.9%), diving accidents (9.3%), being run over (9.3%), direct traumas (5.6%), motorcycle accidents (3.7%) and falls from heights (3.7%). Nontraumatic injuries corresponded to 49.1% of the cases and were caused by tumors (36.5%), infections (19.2%),

vascular diseases (15.9%), spinal malformations (11.5%) and syringomyelia (3.8%); in 13.5%, the etiology had not yet been established (Tables 2 and 3).

In the first assessment, 64.2% of the patients already had one or more complications, such as: orthopedic deformities (69.1% or $n=47$), pressure ulcers (35.3% or $n=24$), severe spasticity (8.8% or $n=6$), obesity (2.9% or $n=2$), neuropathic pain (1.5% or $n=1$) and associated head trauma (1.5% or $n=1$).

Discussion

One to ten percent of all SCI occur in children.¹⁻⁴ Although children rarely experience SCI and information regarding SCI in children in the medical literature is limited, the medical costs and the social and emotional impacts on the patient and family are quite significant.⁴ Physical and psychosocial wellbeing is challenged, creating a range of needs for intervention from the rehabilitation services.⁹ This study found a rate of 5.4% of traumatic and nontraumatic SCI in children aged 16 years or less.

According to some published studies, the low frequency of traumatic injuries can be justified by the anatomical differences of this age group as compared with adults.^{1,2,6,7} The spine of a child is more flexible and capable of absorbing the impact of a trauma. There are also characteristics such as ligamentous laxity, incomplete development of the paravertebral muscles, a disproportion between the size of the child's head and body, convex-shaped vertebrae and horizontal orientation of the facets which make spinal injuries in children differ from those in adults.^{3,7} Anatomic differ-

Distribution of the patients by age

Figure 1 Distribution of the patients by age.

Table 1 Injury duration

Injury duration (months)	N	Percentage
1-6	34	32.1
7-12	25	23.6
13-18	6	5.7
19-24	7	6.6
25-30	4	3.8
31-36	4	3.8
More than 36	26	24.5
Total	106	100

Mean: 27 months.

Median: 12 months.

Table 2 Traumatic causes of acquired spinal cord injury

Traumatic etiologies	N	Percentage
Gunshot	23	42.6
Car accidents	14	25.9
Diving accident	5	9.3
Being run over	5	9.3
Direct trauma ^a	3	5.6
Motorcycle accident ^b	2	3.7
Fall from height	2	3.7
Total	54	100

^aFor example, a collapsing wall.

^bPassengers.

Table 3 Nontraumatic causes of acquired spinal cord injury

Nontraumatic etiologies	N	Percentage
Tumor	19	36.5
Infection	10	19.2
Vascular diseases	8	15.4
Spinal deformities	6	11.5
Syringomyelia	2	3.8
To be established	7	13.5
Total	52	100

A patient may have one or more complications.

ences between the pediatric and adult cervical spine are prominent until approximately 8 years of age and persist to a lesser degree until approximately 12 years of age.¹⁰

Consistent with the literature, most of the children in our study were male patients (63.2%).^{1,3-5} It is known that male patients are more exposed to accidents, contact sports, among others and this men-to-women ratio increases during adolescence as boys get involved earlier and more often in risky situations such as driving a car or using dangerous objects, such as a firearm.^{2,9}

The mean age of the children was 8.6 years and 40.6% were 7 years of age or younger, which is quite smaller than the mean ages reported in the literature (older than 12 years of age).¹⁻⁵ This can be explained by the fact that many studies only include traumatic injuries, which peak more often during adolescence and do not include etiologies such as tumors and infections which were quite common in our study (49.1%) and may have a more even age distribution, or may be encountered more commonly in young children.⁹

The fact that 36.7% of the patients came from other cities within the state of São Paulo or other states is likely because AACD is a national reference center for the rehabilitation of individuals with SCI, as mentioned earlier. However, this also shows that there is a scarcity of rehabilitation centers outside state capital cities, reinforcing the need to invest and create facilities that can provide quality and effective care to those in need throughout the country.

Mean injury duration was 27 months with a median of 12 months. This number was greatly influenced by some children who took a very long time to visit a rehabilitation center for the first time. Only 55.7% of the patients were seen up to 1 year after onset and 24.5% of the patients were seen 3 or more years after onset (Table 3). This shows that there is a significant delay in referring these patients to rehabilitation and a need to inform the population and health professionals about the importance of rehabilitation to prevent further injuries and complications.

At the spinal cord clinic of our association, all patients are classified according to the standard neurological classification of the American Spinal Injury Association (ASIA). As the physical examination depends on the child's collaboration and ASIA is more time-demanding, it was not possible to determine the ASIA level during the first screening session. Consequently, the children were classified as having paraplegia or quadriplegia. Contrary to most of the data reported in the literature, the most common injury level found in this study was paraplegia (76.4%). However, again this can be justified by the fact that many studies include only traumatic injuries in their research. Lee *et al.*⁹ suggested that the thorax is more likely to be injured than any other segment of the column simply because it is longer. According to Kewalramani *et al.*,⁷ SCI in children under 10 years of age are 2.5 times more likely to result in quadriplegia than paraplegia, which can be explained by anatomical characteristics of children, such as the disproportion between head size and body size. Thus, taking into account traumatic and nontraumatic causes, structural differences would not affect these values, but tumor or infection location would and these vary according to tumor type or pathogen.

Among traumas (50.9%), gunshot was the most common cause of SCI totaling 42.6% of the cases. This finding reflects the exponential increase in violence, especially in big cities such as São Paulo. Road accidents were responsible for 38.9% of the traumatic injuries in which 25.9% were car accidents, 9.3% were run over and 3.7% were motorcycle accidents. This shows the importance of campaigns that promote the correct use of child safety seats, seat belts and the caution needed when allowing minors to drive. Other causes were less common, such as diving accidents (9.3%), direct traumas (5.6%) and falls (3.7%). Studies from other countries report the following causes in descending order: road accidents, falls and sports/recreation accidents, which can be justified by the social and cultural differences among countries.

In agreement with Lee *et al.*⁹ findings in a study with 48 children with SCI, this study revealed that nontraumatic etiologies were responsible for 49.1% of SCI and are, therefore, of great epidemiological importance. Tumors were the main nontraumatic cause (36.5%), followed by infections (19.2%), vascular diseases (15.9%), spinal deformities (11.5%) and syringomyelia (3.8%). The etiology had not yet been established in 13.5% of the cases.

Some of the tumors found were astrocytomas ($n=4$), neuroblastomas ($n=2$), lymphomas ($n=2$), neurofibromatosis ($n=2$) and primitive neuroectodermal tumors ($n=2$). Ernest *et al.*¹¹ state that the most common spinal tumors found in children are neuroblastomas, sarcomas and astrocytomas. Both studies found that the most common symptoms were muscle weakness, changes in sensibility, pain and sphincter dysfunction. Both studies reported a neurological improvement, with a possibility of walking, in more than half of the patients. Spinal deformity was a frequent complication in these patients.^{11,12}

On the first assessment, 64.2% of the patients already presented some kind of complication, such as: orthopedic deformities (69.1%), pressure ulcers (35.3%), severe spasticity (8.8%), obesity (2.9%), neuropathic pain (1.5%) and associated head injury (1.5%). The most common orthopedic deformities were hip flexion, equinus deformity of the ankle and scoliosis; the common sites for pressure ulcers were sacrum, ischium and greater trochanter. Urinary tract complications are known to occur frequently but they were not investigated in this study because their diagnoses would require further testing, such as urine culture or ultrasound. These tests are requested during the screening process but analyzed only when the patient returns to the institution. The high frequency of preventable complications, as orthopedic deformities and pressure ulcers, found in this study is most likely related to the delay in seeking a rehabilitation facility and improper care given during the acute phase of the injury.

Conclusion

The frequency of childhood SCI found in this study was 5.4% and most of the affected children were male. The mean age of the sample was 8.6 years. Most patients lived in the metropolitan area of the city of São Paulo (62.3%), some

lived in other cities of the same state (29.2%) and a few lived in other states (7.5%). The mean injury duration before starting rehabilitation was 27 months. The most common injury level was paraplegia, affecting 76.4% of the children. Trauma was responsible for slightly more than half (50.9%) of the SCI with gunshots (42.6%) and car accidents (25.9%) being the most common. Nontraumatic injuries were responsible for 49.1% of the cases and the most common were tumors (36.5%) and infections (19.2%). Most of the patients (64.2%) already had some complication on the first assessment and the most common complications were orthopedic deformities (69.1%) and pressure ulcers (35.3%).

Conflict of interest

The authors declare no conflict of interest.

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