

Spinal cord injury without radiographic abnormality (SCIWORA) in children : A Kolkata experience

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Abstract : Spinal cord injury without radiographic abnormality can result in severe neurological deficit. Early recognition of this syndrome is important so that treatment can be instituted. This study was carried out to analyze the incidence, clinical features, diagnosis including MRI features, and therapeutic approaches. Out of sixty five cases of spinal injury below 12 years of age admitted in the emergency Neurosurgery ward of IPGMER, Kolkata between August 2006 and December 2008, nine patients diagnosed as SCIWORA were included in this study. The patients were assessed for mechanism of injury, radiographic assessment by X ray of spine in all patients and CT Scan in some patients. All patients underwent MRI. Clinical assessment of patients was done using ASIA impairment scale at the time of admission, discharge and on follow-up at 3 months and 6 months interval. Majority of patients were below 8 years of age (66.67%). Fall was the commonest mode of injury and cervical spine was the commonest site of injury. Majority of patients had an abnormality on MRI. SCIWORA is relatively common in pediatric patients with spinal injury and early treatment is associated with good outcome. MRI is helpful in predicting the outcome.

Keywords: cervical spine, spinal cord, spinal cord injury

INTRODUCTION

Spinal cord injury without radiographic abnormality (SCIWORA) describes an acute spinal cord injury including trauma to nerve roots that may result in some degree of sensory or motor deficit, or both¹ without evidence of vertebral fracture or malalignment on plain radiographs and CT scans^{2,3,4}. The concept of SCIWORA was proposed by Lloyd⁵ in 1907, but the acronym was coined by Pang and Wilberger in 1982⁴.

The diagnosis can be difficult if the potential for its occurrence is not considered as the injury is not identifiable in routine radiographs or CT scans. However, as SCIWORA is most often caused by serious trauma (motor vehicle accident, significant fall, sports injury, child abuse) and can result in serious and irreversible consequences for the patient, the most important challenge to the clinician is to recognize this syndrome as quickly as possible so that treatment can be instituted early⁶. With the increasing use of MRI for investigation and predicting the outcome of patients with spinal injury term SCIWORA has come under criticism⁷. However, there is no uniform consensus regarding classification of SCIWORA based on MRI features. Spinal cord injury

without radiological abnormality (SCIWORA) was defined in the era when magnetic resonance images were not popularly used as diagnostic tools. Although it is generally accepted that MR imaging can effectively illustrate the level and severity of spinal cord injury in the acute phase of trauma, only a few reports of MR imaging studies of SCIWORA have been published⁸. This study was carried out to analyze the incidence, clinical features, diagnosis including MRI features, and therapeutic approaches to emphasize the importance of the early diagnosis and outcome of patients with SCIWORA in the light of existing literature.

MATERIALS AND METHODS

This prospective study was done between August 2006 and December 2008 in a tertiary care centre in Kolkata. Out of sixty five cases of spinal injury below 12 years of age admitted in the emergency Neurosurgery ward of IPGMER, Kolkata during this period, 9 patients diagnosed as SCIWORA were included in this study.

The children with spinal injury without any visible injury on plain radiographs were included in this study. The age and gender of each patient was recorded. The patients were assessed for mechanism of injury, neurological deficit by thorough clinical examination, radiographic assessment by X ray of spine in all patients and CT Scan in some patients. All patients underwent MRI of cervical spine.

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The clinical assessment of patients was done at the time of admission and discharge. The patients were followed up at 3 months & 6 months interval. The clinical neurologic deficit was graded using ASIA impairment scale in each case during the entire follow-up⁹.

Table 1: showing ASIA grade

Grade	Category	Description
A	Complete	Complete loss of motor and sensory function
B	Incomplete	Complete loss of motor function with intact sensation
C	Incomplete	Incomplete loss of motor function with power of majority of key muscles <3
D	Incomplete	Incomplete loss of motor function with power of majority of key muscles >3
E	Normal	Normal sensory and motor function

The patients with following injuries were excluded:

- 1) Radiographically demonstrable fracture and/ or dislocation involving the spine at clinical level of neurodeficit
- 2) Associated plexus injury of the upper or lower limbs
- 3) Peripheral nerve injury
- 4) Extensive fractures of the upper and lower limbs

RESULTS

Among the 65 children of spinal injury, 9(13.85%) were found to have SCIWORA. Among the 9 children with SCIWORA, 7(77.78%) were males while 2(22.22%) were females. The following table shows age-wise distribution of the cases.

Table 2 : showing age-wise distribution of patients

Age	Number of cases
<4 years	2(22.22%)
4-8 years	4(44.45%)
8-12 years	3(33.33%)

The following table shows the mechanism of injury among different cases.

Table 3 : showing mechanism of injury

Mechanism of injury	Number of cases (n = 9)
Road traffic accident	2(22.22%)
Fall from height	6(66.67%)
Fall of object over spine	1(11.11%)

Clinically, 6(66.67%) cases had involvement of cervical spine presenting with quadriparesis while 3(33.33%) had involvement of dorsal spine presenting with paraparesis. Among these 4(44.44%) patients had neurogenic bladder.

Each of these patients had no detectable abnormality on radiography. However, MRI revealed abnormality in 6(66.67%) cases. The following table reveals the MRI features of different patients.

Table 4: showing MRI features of all the cases

MRI Features	Number of cases (n = 9)
Normal	3(33.33%)
Cord edema	5(55.56%)
Cord contusion	1(11.11%)

The patients with MRI abnormality also had extraneural injury. The following table reveals the types of extraneural injury found in our patients.

Table 5 : showing the types of extraneural injury.

MRI Abnormality (extraneural)	No. of cases (n = 6)
Anterior and posterior longitudinal ligament injury	4(66.67%)
Posterior longitudinal ligament injury with Disc herniation	2(33.33%)

The onset of neurodeficit was within 2 hours of the onset of injury in 6 (66.67%) while 3 patients (33.33%) presented with neurodeficit after 24 hours. Earlier onset of neurodeficit was observed in patients with MRI abnormality.

The severity of neurological deficit was graded according to Frankel grade at the time of admission, at discharge, and at 3 months and 6 months follow-up.

The treatment of SCIWORA in this study was conservative which included external rigid immobilization for 12 weeks, bladder and back care. Six children who presented early were administered high dose 24-hour course of Methylprednisolone based on the recommendation of the National Acute Spinal Cord Injury Study II study^{10,11}.

The following table shows the severity of neurological deficit and subsequent improvement during follow-up.

All patients showed improvement in their clinical grading. Seven patients (77.78%) made complete recovery, while 2 (22.22%) showed partial improvement.

Table 6 : showing clinical status of the patients assessed by ASIA grading

ASIA grade on admission	ASIA grade on discharge	ASIA grade at 6 months	ASIA grade at 3 months
A-1	A-1	C-1	D-1
B-1	C-1	D-1	D-1
C-7	C-1, D-6	D-3, E-4	E-7

DISCUSSION

In the present study the frequency of SCIWORA among children with spinal injury was found to be 13.85%. A meta-analysis of 392 published cases in 2005 of patients recently diagnosed with spinal cord injuries without radiographic abnormalities (SCIWORA) estimated the incidence of SCIWORA in the pediatric population from 19–34% of all spinal cord injuries⁶. The lower frequency in the present study could be due to less number of road traffic accident cases. In the present series majority of patients of the patients were between 4 to 8 years of age 44.44% and children below 8 years accounted for 66.66% of cases. Various other studies have also reported SCIWORA more commonly in children below 8 years of age^{4,6,12,13,14}.

The involvement of cervical spine was more common (66.67%) as compared to thoracic spine (33.33%). Children younger than 8 years are more prone to develop cervical spine injury while older children tend to develop lower cervical and thoracic spine injuries⁶. Majority of the cases were younger than 8 years which could account for higher incidence of injury in the cervical spine region. In our series 66.67% of patients had abnormal MRI with cord edema being the commonest abnormality (55.56%) and cord contusion in 11.11%. In 33.33% of our patients MRI was normal. Normal MRI has been reported in upto 25% of SCIWORA patients¹⁵. MRI has been mostly employed to prognosticate the outcome.

All the patients in our study were managed conservatively and showed recovery which is similar to findings in other studies^{6,16}. In our study, one patient with cord contusion showed partial improvement whereas all patients with normal MRI and cord edema except one showed dramatic improvement and returned to normal function. The patients who did not return to normal function however, had partial recovery with motor power of 4. Minor hemorrhage or edema only is associated with moderate to good recovery^{17,18,19,20} and

the absence of any abnormal cord signal suggests the patient will make a complete recovery^{21,22}, which was also found in our study.

With the increasing use of MRI in the evaluation of patients with spinal injury the term SCIWORA has taken ambiguous meaning. At present some researchers believe that 'real-SCIWORA' should be determined as 'Spinal Cord Injury Without Neuroimaging Abnormality' in cases with normal MRI⁷. Three of our patients who had normal MRI fall into this category.

CONCLUSION

SCIWORA is relatively common in pediatric patients with spinal injury, the awareness of which helps in early diagnosis and treatment. Conservative treatment is associated with good outcome. MRI is helpful in predicting the outcome.

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