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Original Research Paper

Neurosurgery

PEDIATRIC SPINAL INJURIES IN EASTERN INDIA. AN INSTITUTIONAL EXPERIENCE

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ABSTRACT

Observations & results: A total of 42 patients were included in the study. The mean age of the cohort was 8.6 years. The cohort was distributed with a sex ratio of 1.21: 1 (Male: Female). Most common mode of injury was Road traffic accident (RTA) seen amongst 50% (n = 21) whilst the most common mechanism of injury was found to be Hyperflexion seen in 35.71% (n = 15). Most common segment involved was Cervical spine in 57.14% (n= 24). Radiological evaluation revealed SCIWORA in 35.71% (n = 15) and subluxation in 23.80% (n = 10). Clinically, most common presentation was Quadriparesis, seen in 47.61% (n = 20). Polytrauma was seen in 38% (n = 16) with head injury being the most common amongst 68.75% (n = 11). Surgical intervention done in 35.71% (n = 15) ranging from Cervical lateral mass fixation to Laminectomy.

Conclusion: The study illustrates the epidemiological profile of Pediatric spinal injuries. Though incidence is low, yet they hamper quality of life. High index of suspicion is necessary to diagnose them, and appropriate protocol should be used to mobilize such patients. Awareness amongst health care workers is essential to reduce associated complications from neurological deficit in pediatric spinal injuries.

KEYWORDS : Spinal injury, pediatric trauma, poly trauma, head injury, pediatrics

INTRODUCTIONS:

Pediatric spinal trauma can be a devastating and life-threatening injury. The emotional as well as economic impact on the family of the injured child can be immense. The incidence of pediatric spinal trauma in different studies ranges from 1% to 10% of all spinal injuries [1]. Data from major pediatric spinal trauma centers indicates that injury to the juvenile spine differs from its adult counterpart [2]. These relatively uncommon injuries can be characterized by four distinct injury patterns: fracture only, fracture with subluxation, subluxation only, and spinal cord injury without radiographic abnormality. The immature pediatric spine has several anatomical and biomechanical features that distinguish it from the mature adolescent spine. Seventy five percent of the injury occurs in the cervical region between the age of infancy and eight years, but the incidence decreases with increasing age. Beyond 14 years, the incidence follows the adult pattern [3].

Management depends upon the age, severity, level of injury and degree of neurological deficits. Surgical techniques like fusion and instrumentation can be successfully used in children also. The pattern of spinal injury in children is related to age and the mechanism of injury. Traffic-related incidents are a leading cause of injury across all age groups, older children, particularly boys, sustain spinal trauma in sporting and recreational activities. clinical manifestations are unique, one of which is the Spinal Cord Injury Without Radiological Abnormality [4]. With the advent of high-quality MRI and CT scan along with digital X-ray, it is now possible to exactly delineate the anatomical location, geometrical configuration, and the pathological extent of the injury.

AIMS & OBJECTIVES:

(1) Analyze the incidence, mechanism of injury in the pediatric age group;
(2) Treatment and outcome of spinal injuries in the pediatric population treated at our institute.

MATERIAL & METHODS:

The study titled 'Pediatric spinal injuries in Eastern India. An institutional experience' was carried out in the Department of Neurosurgery, at BANGUR INSTITUTE OF NEUROSCIENCES & SSKM HOSPITAL, IPGME & R, Kolkata from 2016 to 2018. A total of 42 Patients having spinal injuries in the age group (0 –14 years) who were admitted and treated in the neurosurgical wards of the Institute of Post Graduate Medical Education and Research, Kolkata.

INCLUSION CRITERIA:

Individuals of age group (0 -14 years) who have a suspected spine injury (DURING STUDY TIME LINE).

EXLUSION CRITERIA:

(1) Individuals not willing to participate in the study.
(2) Individuals with Patients having associated brachial plexopathy, peripheral nerve injuries or extensive fractures of the upper and lower extremities were excluded from this study.

Clinical assessment of all patients was done immediately after admission and at the time of discharge using the ASIA impairment scale.

Radiological assessment of the level, type of injury and degree of cord compromise was done using Digital X-ray, CT scan and MRI of the appropriate region. Flexion – extension films were also taken to assess degree of instability under the guidance of a neurosurgeon.

OBSERVATIONS & RESULTS:

Mean age of the cohort was found to be 8.6 years.

The cohort of 42 patients was found to have a sex ration of 1.21: 1 (Male: Female).

Table 1: Mode of injury:

Cause of injury	No. of patients by age		
Age group	0-9 (Group 1)	10-14 (Group 2)	Total
RTA	10	11	21
Fall from height	3	11	14
Sports	1	3	4
Penetrating	2	0	2
Miscellaneous	1	0	1
Total	17	25	42

The most common mode of injury was found to be Road traffic accident (RTA), seen in 50% (n = 21) patients. This was followed by Fall from height amongst 33% (n = 14). Sports related trauma was seen only in 10% (n = 4).

Table 2: Mechanism of Injury;

Nature of injury	No. of patients by age		
Age group	0-9 (Group 1)	9-14 (Group 2)	Total
Hyper flexion	7	8	15
Hyper extension	4	7	11
Compressive	2	9	11
Penetrating	2	0	2
Miscellaneous	1	1	2
Total	17	25	42

The mechanism of injury varied amongst the population based on the age of patient. Although flexion – extension injuries were most common, seen amongst 61% (n = 26); Compressive forces played a role in 26% (n = 11). Hyperflexion was the single most common mechanism observed in both age groups.

Table 3: Vertebral Level of Injury:

Level of injuries	No. of patients by age		
Age group	0-9 (Group 1)	9-14 (Group 2)	Total
Upper Cervical	7	5	12
Lower Cervical	5	7	12
Thoracic	1	3	4
Thoraco-lumbar	2	0	2
Lumbar	4	8	12
Total	17	25	42

Although cervical spine stands out to be the most common segment of vertebral column affected in trauma, Lumbar spine was found to be the 2nd most common site of injury, especially in older children.

Table 4: Radiological Classification of bony injuries:

Radiological feature of spinal injury.	No. of patients by age		
Age group	0-9 (Group 1)	9-14 (Group 2)	Total
Fracture	1	8	9
Subluxation	5	5	10
Fracture Subluxation	2	2	4
SCIWORA	7	8	15
Miscellaneous	2	2	4
Total	17	25	42

All patients underwent digital x-ray, Computed tomography and an MRI scan for complete evaluation. Spinal injuries were noted and classified by authors. SCIWORA (41%) and Subluxation/dislocation (29%) are the two commonest radiological patterns of injuries noted in younger children. Fracture (32%) and SIWORA (32%) along with Subluxation/dislocation (20%) constitute most of the radiological presentation in older children.

Fig 1 – Radiological Presentation of Cohort

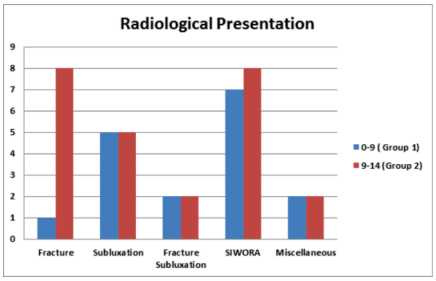
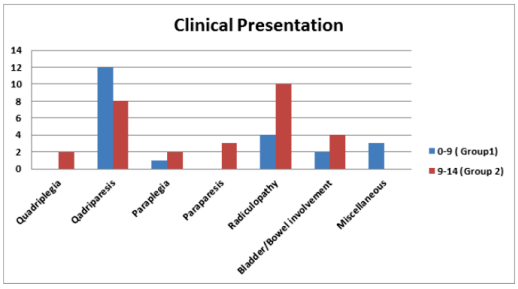


Table 5: Clinical presentation:

Clinical Presentation	No. of patients by age		
Age group	0-9 (Group1)	9-14 (Group 2)	Total
Quadriplegia	0	2	2
Quadriparesis	12	8	20
Paraplegia	1	2	3
Paraparesis	0	3	3
Radiculopathy	4	10	14
Bladder/Bowel involvement	2	4	6
Miscellaneous (Regression of milestone, Penetrating injury)	3	0	3

Fig – 2 Clinical Presentation of Cohort



Quadriparesis was the most common clinical outcome in patients with spinal injuries. Quadriplegia occurred in older children. Isolated radiculopathy was noted to be 2nd most common clinical presentation.

Table 6: Associated Injuries:

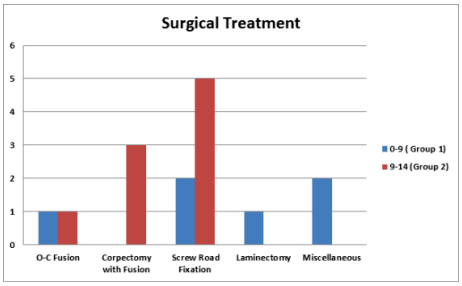
Associated Injuries	No. of patients by age (n = 42)		
Age group	0-9 (Group 1)	9-14 (Group 2)	Total
Head	3	8	11*
Chest	0	3	3*
Fractures	2	2	4*
Miscellaneous	1	2	3*
Without Associated Injury	11	15	26
*Polytrauma was observed in 16 patients.			

Polytrauma was seen in 16 patients, with head injury being the commonest associated injury in 68.75% (n = 11).

Table 7: Surgical intervention:

Surgical treatment	No. of patients by age		
Age group	0-9 (Group 1)	9-14 (Group 2)	Total
Occipito – cervical stabilization	1	1	2
Corpectomy/Discectomy with Fusion	0	3	3
Lateral mass Screw Road Fixation	2	5	7
Laminectomy	1	0	1
Miscellaneous	2	0	2
Total	6	9	15

Fig – 3 Type of surgical intervention done



Total 17 patients required surgical intervention out of which 2 patients guardian refused surgical intervention. 3 patients operated via anterior approach while 12 patients operated via posterior approach.

Table 8: ASIA Score:

Operated Patients (9)	ASIA score at Admission	ASIA score at 6 months follow up
A	2	0
B	0	0
C	0	1
D	7	2
E	0	6

Conservative Patients (17)	ASIA score at Admission	ASIA Score at 6 months follow up
A	10	8
B	2	1
C	1	6
D	2	0
E	2	2

ASIA scoring system was used to clinically grade patients at the time of admission and follow up. Surgical intervention in n = 9 patients showed significant improvement in ASIA scores at 6 months of follow up. Comparatively, patients who underwent conservative treatment had little change in their ASIA scores at 6 months of follow up.

DISCUSSION:

The epidemiological features of pediatric SCI show that these injuries are relatively uncommon, and that the mechanism of injury is different depending upon the age at time of injury and compared to the adult population. Neurological recovery appears to be better than in adults, although large cases series are rare [5].

Pediatric spinal cord injuries are receiving increasing attention over the last two decades. The incidence ranges from 1 to 10% of all spinal injuries. Data from major pediatric spinal trauma centers indicates that injury to the juvenile spine differs from its adult counterpart in anatomic and biomechanical features, mechanism of injury, response to deformation, injury pattern and outcome. With the increase in the number of road traffic accidents, there has been a major change in the pattern of injury sustained by children and adolescents [2] [6] [7] [8].

In our study total 2446 pediatric trauma patients were attended at our institute in the study period of 2 year 3 months (August 2016 – November 2018). Out of which 42 (1.7%) patients had spinal cord injury, like the incidence found in study conducted by Martin et al (3.4%) in 2004 [9]. In our study total of 24 (1%) patients suffered cervical cord injury like study conducted by Patel et al., 2001 [10].

In our study RTA (50%) and fall (33%) are major factors causing spinal injuries in pediatric age group. In international studies conducted by Orenstein et al [11], RTA appears to be major cause followed by sports related activities; where as in studies conducted in India by Ajit et al [12] fall followed by RTA appears to be two major causes. In our study 2 patients (4.7%) suffered from penetrating type of injuries.

Most injuries in the younger patient category (group –1) were caused by whiplash (41%) and hyper flexion (23%) which can be attributed to higher head size to body size ratio in younger children, which creates greater force on the neck when the head is involved in a violent jerky motion. Compressive injuries (11%) and penetrating (11%) injury are other important patterns of injury in Group-1. In the older patients (group – 2) compressive (36%) injuries are most common, followed by whiplash (24%) hyper flexion (20%), hyper extension (16%). There is a notable shift in the pattern of injury from whiplash to compressive in the two groups.This shift can be attributed todecreasing spinal elasticity and increasing spinal rigidity along with age related maturation of spinal column and ossification of vertebral column.

In our study cervical spine is most common segment involved (57.1%) involved over all followed by lumber (28.5%). Out of 24 cervical injuries 12 (28.5%) belongs to upper cervical and 12 (28.5%) belongs to lower cervical. Upper cervical spine involved more commonly in Group-1 (41.1%), while in Group-2 lower cervical (28%) and lumbar spine (32%) involvement is more common. This shift in pattern of injury from upper cervical to lower cervical and lumber in Group-1 and Group-2 corresponds with change in biomechanics of pediatric spine, along with age [13] [14] [15] [16]. Over all cervical involvement (57.1%) (70.5% in Group-1 and 48% in Group-2) appears to be more common particularly in children <9 years of age (70.5%). Comparative results were found in other studies Bilston et al, Eleraky et al, and Dhal et al [17] [18] [19].

Most injuries in the younger patient category (group –1) were caused by whiplash (41%) and hyper flexion (23%) which can be attributed to higher head size to body size ratio in younger children. In the older patients (group – 2) compressive (36%) injuries are most common, followed by whiplash (24%) hyper flexion (20%), hyper extension (16%). In children of 9 years of age or less the spine retains its immature features. Between the ages of 10 and 16 years however, the vertebrae become more like those of adults.There are fewer fractures in children younger than age 10 years. The vertebrae start to ossify and mature when the child reaches approximately 9 years of age. Anteriorly, the vertebral body loses its wedge shape and becomes more rectangular. The orientation of the facts becomes less horizontal and more vertical and the uncinate process begins to protrude [6] [20] [21] [22].

Overall, four patterns of injury were recognized on radiographic studies in our study population. Fracture alone was seen in 9 cases (21.4%), while 10 cases (23.8%) had Subluxation/dislocation, 4 cases (9.5%) presented fracture along with subluxation/dislocation. Whiles 15 (35.7%) patients did not showed any radiological injury but presented with signs of spinal cord injury (SCIWORA), which were further evaluated and diagnosed with the help of MRI. Incidence of subluxation/dislocation is seen decreasing along with increasing age from 29% in Group-1 to20% in Group 2. This can be attributed to increasing stability of facet joints and increased strength of various ligaments as mentioned earlier. As observed in Group-1 SIWORA accounts to 41% and in Group-2 it accounts to 32%. This is like the incidence reported in various studies, which ranges from 4% to 50% [2] [17] [20] [21] [22].

In our study 5 (11.9%) patients had complete spinal cord injury, 23 patients (54.8%) had incomplete spinal cord injuries and 14 patients (33.3%) were neurologically intact and presented with radiculopathy or penetrating injuries. Ajit et al reported

31% patients with complete spinal cord injury, 50% with incomplete injuries and 19% were intact neurology [12].

Total 16 patients (38.1%) had associated injuries, out of them 5 (31.3%) had polytrauma, 11 patients (68.7%) had head injuries, 3 patients (18.8%) had chest injuries, 4 patients (25%) had associated fractures and 3 (18.8%) patients had other injuries. Similar association was noted in studies conducted by Dhal et al and Ajit et al [12] [19]. In our studies most common association was noted with lower cervical cord injury. This can be because of under reporting of upper cervical injuries in severe head injury patients in which prime focus is given to the evident head injury or no diagnosis owing to poor general condition of limiting evaluation at time of admission.

In our study Out of 42 spinal injury patients 17 patients required surgical intervention out of which 2 patients guardian refused consent to the surgery. Out of 15 operated patients 6 patients were below age of 9 years and 9 patients are from age group from 9 to 14 years. Anterior approaches were used in 20% and involved corpectomy with Titanium Cage + Plate reconstruct. Posterior approaches varied from simple laminectomy to complex fusion constructs using Pedicle screws and Transforaminal Interbody fusion grafts. Occipito – cervical fusion was done in 2 patients for traumatic subluxation of C1, C2. Harm's technique not used due to institutional limitations. Implant failure was seen in 1 patient only due to recurrent trauma.

In group 1, 76.4% (13/17 patients) had incomplete injury (ASIA Grade B,C,D) , 11.6%(2/17 patients) had complete injury (ASIA Grade A) and 11.6%(2/17 patients) were neurologically intact(ASIA Grade E) at time of admission. In group 2, 60% (15/25 patients) had incomplete injury (ASIA Grade B,C,D), 16% (4/25 patients) had complete injury (ASIA Grade A) and 16% (4/25 patients) were neurologically intact (ASIA Grade E) at time of admission. Amongst 26 patients who followed up at 6 months, only 9 had undergone surgical intervention and showed dramatic improvement in ASIA score.

CONCLUSION:

Pediatric spinal cord injuries are relatively uncommon injuries but associated with significant morbidity. Incidence and severity are relatively increasing with increasing modernization of the society. RTA and fall comprise most common mode of injuries.

SCIWORA constitute major component at presentation which can be easily missed in poly trauma patients, which may constitute a reason of underreporting of spinal injuries in polytrauma patients. High index of suspicion is necessary for diagnosis and treatment of such patients. Level of spinal segment involvement and severity of spinal injury vary with age at presentation. Treatment should be devised individually based on age, mode of injuries, nature of injury, presentation of injuries.

Overall outcome looks favorable in incomplete spinal cord injury patients and even slight neurological improvement is seen in patients with complete spinal cord injury patients with timely intervention in younger age group patients. With increasing availability of encouraging reports more and more patients are stabilized surgically. There is needed of large-scale multicenter studies to device uniform management protocol.

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