Original Article

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Pediatric Spine Injuries : A 5 Years Experience at a Tertiary Care Centre

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Abstract

Objective: The purpose of this study was to analyse 5 years data on incidence of mechanism of injury, pattern of injury and other variables of pediatric spine injuries at a tertiary care centre in India. *Methods*: We retrospectively reviewed the medical records, a total of 78 patients were identified over 5 years period. Patients were divided into 3 age groups, 0-9, 10-14 and 15-18 years. *Results*: There were 13 patients in 0-9 year, 15 in 10-14 year and 50 in 15-18 year age groups.The mean age was 12 ± 2.5 years (range 3 to 18 years). Incidence of spine injury increased with age. Boys were 4.5 times more injured compared to girls. Fall from height was most common mechanism of injury (45%), followed by road traffic accidents (35%). Cervical spine was most commonly involved spinal segment. Fractures with subluxation was most common pattern of injury, observed in 49% patients, followed by fractures 22%. Incidence of pure subluxation and spinal cord injury without radiographic abnormality (SCIWORA) was equally documented, 13% patients in each. Younger children more likely had incomplete spinal cord injury. Forty two percent patients were managed surgically by various decompression and stabilization procedures. At the time of discharge, 9% patients had one to two grades improvement in their neurological status. *Conclusion*: Our findings suggest predominant involvement of cervical spine. The incidence of SCIWORA was similar to other studies. Complication rates were higher in polytrauma and in complete spinal cord injury patients. Young children had good recovery rate compared to older children.

Keywords: Pediatric; Spine Injury; SCIWORA.

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Introduction

In pediatric patients, spine injuries are quite uncommon. The incidence of spine injuries ranges from 2.5%–9 %[1-3] and the cervical spine is involved in 60- 80 % cases.[4] The biomechanics of pediatric spine is different from the adult spine.[5] Therefore; injury patterns, mechanism of injury and outcomes are different. The spine injury includes injury of spinal column as well as spinal cord. There are distinctive patterns of pediatric spine injuries like spinal cord injury without radiographic abnormality (SCIWORA) and ligamentous injuries as a result of greater deformation of spinal column in comparison to the spinal cord. The objective of this study is to analyse 5 years data of pediatric spine injuries to determine epidemiology, mechanism of injury, level of injury, type of injury, management and outcome at discharge.

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Materials and methods

The electronic patient database at the Department of Neurosurgery was searched for spine injury in children up to 18 years of age who were admitted between January 2015 to December 2019 in Neurotrauma ward, Trauma Centre at King George's Medical University, Lucknow. A total of 78 medical records were found adequate. We reviewed all the medical records and radiology

including plain radiographs, computerized tomography and MR Imaging. Neurological status were graded according to American Spinal Injury Association (ASIA) impairment scale.[6] Medical records were analysed in terms of age, gender, mechanism of injury, level of injury, type of injury, severity of injury, associated injuries, treatment received and outcome at discharge.

Patients were categorised in 3 age groups 0-9,10-14 and 15-18 years, for better comparison of prevalence of mechanism of injury, injury patterns and other variables.

Results

A total of 78 children with spine injury were treated at our centre over a 5 years period. There were 13 patients (17 %) in 0-9 year, 15 (19 %) in 10-14 year and 50 (64%) 15-18 year age group. The mean age was 12± 2.5 years (range 3 to 18 years). Spine injuries were most common in 15-18 year age group (64 %). The male female ratio was 4.5:1. Boys 64 (82%) sustained spine injuries more than girls 14 (18%). Gender distribution among age groups is shown in Table 1.

Fall from height (FFH) was most common mechanism of injury, followed by road traffic accidents (RTA), fall of objects over the head and diving into river/swimming pool (Table 2). Thirty five (45%) patients sustained spine injuries by FFH like fall from roof, stairs and tree. Of the FFH related injuries 28 (80%) were boys and 7 (20%) were girls. The FFH was most common mechanism of injury in both 0-9 year and 10-14 year age groups, whereas RTA was most common cause in 15-18 year children.

The most common involved spinal segment was cervical, observed in 71 (91%) patients. Upper cervical region was involved in 14 (18%) patients and lower cervical region in 57 (73%) patients (Table 3). In-volvement of thoracic and lumbar segments was not common. Multiple level involvement was seen in 4 (5%) patients. In female patients only cervical region was affected. Fractures with subluxation was most common pattern of injury, seen in 38 (49%) patients, followed by fractures 17 (22%). Incidence of pure subluxation and SCIWORA (Fig. 1) was equally documented, 10 (13%) patients in each. SCIWORA was more prevalent in 0-9 year age group 5 (6%) patients, followed by 3 (4%) patients in 10-14year age group and 2 (3%) patients in 15-18year age group (Table 4). Two (3%) patients had post traumatic prolapsed intervertebral disc (PIVD) in cervical region and 1 (1%) patient had spinal extradural hematoma (EDH) extending from C3 to L3 after FFH with bleeding disorder. Most common associated injury was long bone fractures in 8(10%) patients, followed by head injury in 2(3%) patients, brachial plexus injury in 1 (1%) patient and facial injuries in 1 (1%) patient.

The spinal cord injury was documented in 75 (96%) patients. Thirty one (40%) had complete and 47 (60%) had incomplete injuries. Thirty one (40%) patients had ASIA grade A injury. ASIA grade C and grade D were equally distributed among 20 (26%) patients respectively (Fig. 2). All boys 9 (12%) in 0-9 year age group had incomplete injury and the most common mode was FFH whereas complete injury was more common in older boys 20 (26%) and most of these sustained injury by RTA.

Table 1: Gender distribution among age groups, Total 78 patients.

Gender	0-9 y	10-14 y	15-18y	Total
Male	9(12%)	10(13%)	45(58%)	64(82%)
Female	4(5%)	5(6%)	5(6%)	14(18%)
Total	13(17%)	15(19%)	50(64%)	78(100%)

Table 2: Frequency of mechanism of injury , Total 78 patients

Mechanism	0-9y	10-14y	15-18y	Total
FFH	8(10%)	10(13%)	17(22%)	35(45%)
RTA	3(4%)	2(3%)	22(28%)	27(35%)
Fall of objects	0	1(1%)	5(6%)	6(8%)
Diving	0	1(1%)	2(3%)	3(4%)
Fall from train	0	0	2(3%)	2(3%)
Machine injury	1(1%)	0	1(1%)	2(3%)
Firearm injury	1(1%)	1(1%)	0	2(3%)
Assault	0	0	1(1%)	1(1%)

Table 3: Level of injury among age groups, Total 78 patients

Level	0-9y	10-14y	15-18y	Total
Upper cervical	6(8%)	3(4%)	5(6%)	14(18%)
Lower cervical	5(6%)	11(14%)	41(53%)	57(73%)
Thoracic	0	1(1%)	1(1%)	2(3%)
Lumbar	1(1%)	0	0	1(1%)
Multiple	1(1%)	0	3(4%)	4(5%)

Table 4: Pattern of spine injury in age groups, Total 78 patients

Pattern	0-9y	10-14y	15-18y	Total
Fractures	3(4%)	3(4%)	11(14%)	17(22%)
Subluxation	3(4%)	0	7(9%)	10(13%)
Fractures & subluxation	1(1%)	9(12%)	28(36%)	38(49%)
SCIWORA	5(6%)	3(4%)	2(3%)	10(13%)
PIVD	0	0	2(3%)	2(3%)
Spinal EDH	1(1%)	0	0	1(1%)

Table 5: Surgical procedures among different age groups, Total 33 patients

Procedure	0-9y	9-10y	15-18y	Total
ACCF	0	5(6%)	14(18%)	19(24%)
ACDF	0	0	6(8%)	6(8%)
Posterior decompression & fixation	2(3%)	1(1%)	2(3%)	5(6%)
Odontoid screw	0	0	2(3%)	2(3%)
Odontoid screw with ACCF	0	0	1(1%)	1(1%)

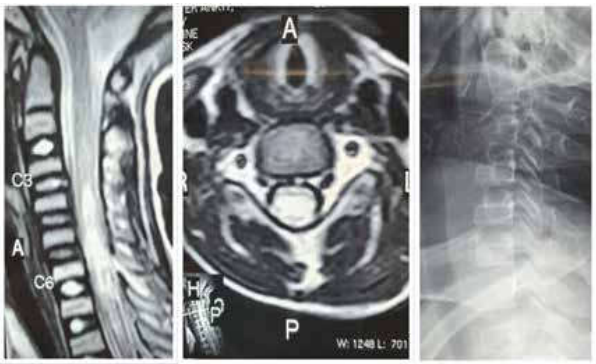

Fig. 1: Spinal cord injury without radiographic abnormality – cord contusion /edema from C4-C7 levels without bony injury

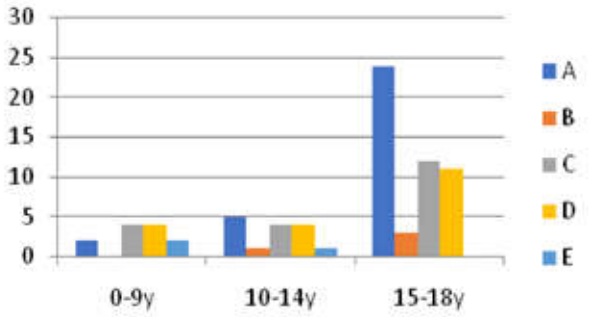

Fig. 2: Distribution of ASIA grades among age groups

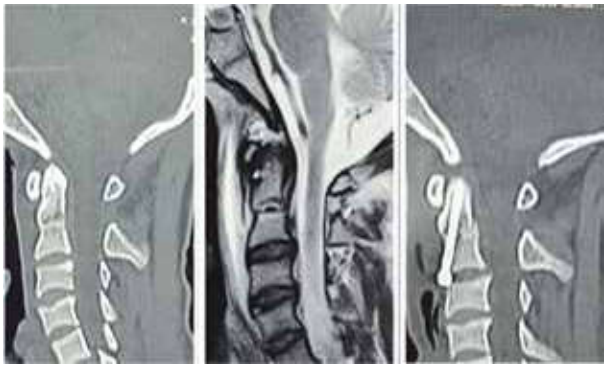

Fig. 3: Preoperative CT and MRI cervical spine showing type 2 odontoid fracture & postoperative CT scan showing anterior odontoid screw insitu.

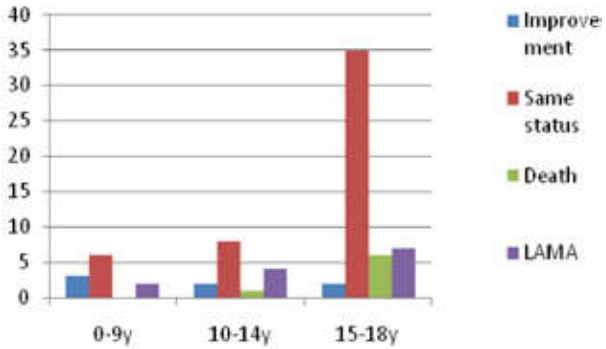

Fig. 4: Status at discharge among age groups

Patients were managed surgically 33 (42%) and conservatively 45 (58%). Among surgical arm, anterior cervical corpectomy and fusion (ACCF) was most commonly performed procedure in 19 (24%) patients, followed by anterior cervical discectomy and fusion (ACDF) in 6 (8%) patients (Table 5). Posterior decompression and fixation was done in 5 (6%) patients. Anterior odontoid screw placement (Fig. 3) was performed in 2 (3%) patients and 1 (1%) patient underwent anterior odontoid screw placement with ACCF. Patients who were managed conservatively had a short course of steroids, external orthosis and limb physiotherapy.

At the time of discharge, 7 (9%) patients had improvement in their neurological status and 50 (64%) were discharged in the same status (Fig. 4). Two patients had improvement from ASIA grade A to grade C, 3 patients grade C to D and 2 patients grade D to E. Among surgically managed patients, 3 had improvement in their neurological grade while 4 patients who were managed conservatively had better grades at discharge. In-hospital expiry was documented in 8 (10%) patients, 5 patients were expired before surgery, all were having ASIA grade A injuries with involvement of respiration. Two patients expired after surgery while 1 conservatively managed patient succumbed to death. Thirteen (17%) patients went leave against medical advice (LAMA) after knowing poor prognosis and financial constraints. All the boys in 0-9 year age group, either improved or remained in same status, none of them expired. Among patients who had SCIWORA, 2 (20%) improved, 5 (50%) remained in same status and 3 (30%) went LAMA.

Discussion

In contrast to the adult spine, the pediatric spinal column is more elastic to external forces. This hypermobility permits significant movement between spinal segments without damage, but spinal cord suffers deformation poorly. It was documented in a study by Leventhal that spinal column could lengthen by 2" without damage while spinal cord by 0.25".[7] Therefore , in very young children spine trauma can inflicts spinal cord damage much earlier than the vertebral column injury. Pediatric spine is unique in comparison to the adult spine. The ligaments and joint capsules are elastic, facet joints are shallow and more horizontal, expensile intervertebral disc, anteriorly wedged vertebral bodies and delicate neck muscles.[8] These features make pediatric spine injury profile different than the adult one.[9,10]

Classification of patients in 3 age groups allows for better comparison of incidence of mechanism of injury, injury patterns and other variables. Birth to 9 year represents immature spine, 15-18 year signifies mature spine which is closely similar to the adult spine and 10-14 year exhibit intermediate group.

In our study, incidence of spine injuries was significantly higher in boys 82%(n=64) compared to girls 18% (n=14) , male female ratio was 4.5:1. This was not in accordance with other studies by Kim C et al.[11] where male female ratio was 1.4:1 and 1.1:1 in the study by Carreon LY et al.[12] This may represents occurrence of more outdoor activities by boys compared to girls.

Most common mechanism of injury in this study was FFH 45%(n=35), followed by RTA 35%(N=27). This was similar to the findings documented by Bansal et al.[13] but different from Western literature where RTA is most common mechanism of spine injuries.[2,14,15] Most of the young children had history of fall from roof or stairs but in older children besides this also had history of fall from tree, fall into a pit , fall of objects over the head and machine injury. Though most common mode was RTA in older children.[11,12,13]

Incidence of cervical spine injury was similar to other studies.[2,16,17,18] Upper cervical spine involvement was more common in younger children[10] while lower cervical spine injury was more common in older children. Our study has less proportion of thoracic and lumbar injuries. This may be attributed to the refferrral pattern at our centre. In this study prevalence of SCIWORA was 13%(n=10) similar to the other studies.[2,18,19] The average age of SCIWORA in our study was 10.1 years which was in accordance with current literature. Distribution of SCIWORA in 0-9 year was 6% compared to 4% in 10-14 year and 3% in 15-18 year age group. This finding reflects the hypermobility of spinal column in comparison to the spinal cord in young children.[10,20] Fractures and subluxation were more common 38% (n=28) in 15-18 year age group children. This finding was not in line with other studies.[12,13] Our series has 2 patients with post traumatic PIVD, both were of 15-18 year age group. They were initially managed conservatively and discharged with advice to

follow up in OPD. The reporting of post traumatic PIVD is not common in the literature.[21]

In our study, 38% (n=30) had complete, 62% (n= 48) had incomplete injuries and 4% (n=3) were intact. Eleven children out of 13 in 0-9 year age group had incomplete injury. None of the boy in 0-9 year age group had complete injury.

In the current study, 42% (n=33) were managed surgically by various stabilization procedures. Patients who were managed conservatively had a short course of steroids, external orthosis and limb physiotherapy. External orthosis used in our study were Philadelphia collar for cervical injuries and Taylor's brace & ASH brace for thoracolumbar injuries. Although halo vest provides better stabilization, but it was not used in children as it is associated with high rate of complications, as high as 68%.[22]

The overall complication rate was 19% (n=15) in those who had survived, most common complication was pneumonia 6%, followed by pressure sores 5%. The complication rate was comparable to other studies.[12,13] The mortality rate was 10% (n=8), most of the patients who expired had complete injuries. Two patients had polytrauma, 5 patients had pneumonia related death and 1 patient had grade 4 pressure sore with infection. Mortality rate in our series was less compared to other studies 45%[2] to 58%.[14]

Limitations

The major limitation of the study is being retrospective in nature. We propose a prospective,multicentric study for better understanding of pattern of injury, treatment and outcomes of pediatric spine injuries. Other limitations are lack of long term follow up, lesser proportion of thoracic and lumbar injuries.

Conclusion

Our study documented FFH as most common mechanism of pediatric spine injury in contrast to Western literature. The finding of predominant involvement of cervical region was in accordance to most of the previous studies. Young children had good recovery rate compared to older children. Complication rates were higher in polytrauma and complete spinal cord injury patients.

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