Original Article

Experience of Cervical Spine Injuries in Children and the Treatment that Follows in Tertiary Care Hospitals

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ABSTRACT

Objective: To assess the incidence, treatment modalities and outcomes of damage to the cervical spine in children within a tertiary care hospital, with a focus on refining clinical protocols and enhancing the overall quality of care.

Study Design: A prospective and observational study.

Place and Duration of Study: This study was conducted at the Department of Neurosurgery Khyber Teaching Hospital from Jan 2018 to December- 2023.

Methods: A thorough examination of pediatric patients with cervical spine injuries was conducted at Khyber Teaching Hospital, a prominent tertiary care hospital. The study encompassed a total of n = 90 patients, all cervical injuries presenting to the hospital from 2018 to 2023. Variables such as age, injury mechanisms, cervical spine injury levels, neurological deficits, treatment approaches (surgical and conservative), and six-month post-treatment outcomes were assessed.

Results: There were 40 females and 50 males included in the study, constituting a total population of 90. Interestingly, 46% of patients presented with lower cervical spine injuries (C3 – C7), while 54% sustained injuries in the higher cervical spine level (C0 – C2). Falls were identified as the predominant cause of cervical spinal traumas, followed closely by motor vehicle accidents. Among the treatment groups, the highest fatality rates were observed in 'ASIA' group A and B. Fatality outcomes were significantly influenced by the neurological state of the individual before treatment and level of cervical spine involved. A notable variability in pre-operative and post-operative neurologic results was observed, as evaluated by 'ASIA' 'scale'.

Conclusion: In some individuals, high cervical spine injuries, and incidents involving high-energy impact trauma emerged as independent risk factors associated with heightened fatality rates. Furthermore, compared to cases with incomplete neurological abnormalities, instances featuring complete neurological disability exhibited a higher fatality risk.

Key Words: Pediatric Trauma, Cervical Spine Injuries, Tertiary Care Hospital, Treatment Outcomes, Morbidity, Fatality, Injury Mechanisms

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INTRODUCTION

Although pediatric spinal injuries are rare among traumatic patients, they nonetheless pose a significant risk to health and well-being.[1] When a kid after trauma, complains of neck pain or tenderness, or exhibits symptoms related to the cord or roots, it is suspected. In the US, there are 7.41 cervical spine injuries for per 100,000 people.[2] Children's cervical spine injuries manifest differently from adult cervical spine injuries.[3-5]

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The most frequent cause of cervical injuries in children is motor vehicle accidents, although other prevalent causes include obstetrical difficulties, crashes, athletic events, swimming mishaps, falls, and abuse of children.[6] Accidents involving bicycles are a prevalent cause of spinal cord damage in children aged 6 years to 10 years, while vehicular crashes and injuries related to sports are the most prevalent causes in individuals older than 10 years. Birth related high cervical injuries although very rare, can causes flaccid paralysis, breathing difficulty and sometimes death.[7]

The discrepancy in the centre of movements makes cervical spine injuries more prevalent in the lower cervical vertebrae over 9 years and commonest from the 'occiput' to C2 in less than 9 years. Injury to the spinal cord or nerve roots is also linked to facet dislocation. Cervical cord injury can cause bladder and bowel problems, but this is uncommon.

The shallower and more horizontally oriented facet joints, insufficient calcification of the odontoid and broad neck muscles, and ligament flexibility all

contribute to the comparatively hypermobile nature of pediatric spines. These characteristics put patients at risk for a cervical spine instability.[8] The pediatric population is prone to injuries from automobile collisions, pedestrian collisions, and self-inflicted wounds.[10] Because of the ligamentous suppleness linked to sports, SCIWORA accidents are also frequent in the pediatric populations.

When compared to adults, the prognosis for cervical cord injury in pediatric patients is better. Additionally, partial cord lesions yield superior results compared to complete cord lesions. It is possible for total spinal cord injuries to leave residual deficits behind. Comparing lumbar and the thoracic spines, the cervical spine is involved in eighty percent of all injury to the spine in children. The most prevalent area of injury in younger children is from the OC junction to C3, and as the kid becomes older, cervical spine injury tends to occur low.[5]

If the patient remains neurologically intact, dynamic X-rays are performed; however, in cases of neurological impairment, MR imaging is employed to assess cervical cord injuries. CT scans serve as a supplementary tool for surgical planning in cervical cord injuries, primarily detecting bony injuries rather than ligamentous ones in the cervical spine. The significant role of MR imaging in the prognosis of cervical spine injuries is evident, as it can effectively identify both ligament and discs injuries[7].

Pseudo sub-luxation frequently occurs in individuals up to 14 years of age. To assess this, a guideline suggests that a distance between the anterior cortex of C2 and the line connecting C1 to C3 should be within 1 mm.[10] In children, spinal instability is manageable compared to elders due to increased ligament flexibility. In children, an unstable spine is indicated by a sub-luxation greater than 4.5 mm and a deviation greater than 7 degrees.[10] Patients with SCIWORA typically exhibit no abnormalities in MR imaging, and the recommended treatment involves immobility for a maximum of three months, followed by 'flexion' and 'extension' radiographs. The higher occurrence of SCIWORA in children is attributed to a more abundant blood supply[11] and increased spinal cord elasticity in this age group.

Surgical intervention is indicated in cases of 'non-reducible' 'dislocation', 'progressive deformity', injury which are not stable, and the need for 'decompression' of 'neural structures'.[11] The selection of the approach is contingent on the location of the compression on the cervical cord.

METHODS

The study design employed was prospective and observational, taking place at Khyber Teaching Hospital in Peshawar. The study duration spanned from January 2018 to December 2023. Ethical approval and informed consent from guardians were obtained before commencing the study.

Patients were grouped based on various parameters, including age, fatality, the cause of injury (such as falls, 'motor vehicle' accidents-'MVA', 'bicycle injuries', and 'sports-related injuries'), the level of 'cervical' 'spine injury', the presence of neurologic deficits, the occurrence of bony injuries (like fractures and dislocations), ligamentous injuries, and SCIWORA (Spinal Cord Injury Without Radiographic Abnormality). The study's inclusion criteria specified individuals aged 5 to 18 years with a traumatic history.

The study excluded individuals older than 18 years, those with co-existing health conditions, congenital anomalies, a history of Pott's disease, or malignancies.

In most cases, the posterior route was used throughout the surgical procedure. Facet dislocation was reduced intra operatively under imaging guidance, and fixation was carried out later. A posterior lateral mass union was done in most surgical patients. Following that, these patients had neurological evaluations. Fractures of the odontoid were treated by screws fixation. Most of them included type II 'odontoid fractures'. However one 'type 3' instance involved a fixed odontoid fracture. For our patients' cervical spine MRI, we used nexus criteria. Neural condition was evaluated by 'ASIA' impairment score and patients were observed after 6 months.

Information was gathered using a form that included key details such as the age range of patients (7 – 10, 11 – 18 years), the cause of trauma ('motor vehicle accident', 'falls', 'bicycle injury', 'sports-related' injury), neural status assessed with the 'ASIA' '(American Spinal Injury Association)' scale, and the cervical spine injury level determined through 'CT' scans/radiographs and MRI '(C0-C1 & C3 –C7)'. Additionally, the 'nexus criteria' (refer to Table 1) were employed to 'guide imaging recommendations' for the individuals.

Data Analysis: IBM SPSS version 26 was used to analyze the data. The test known as the chi-square was utilized to analyze qualitative variables in the separate groups' outcome analysis. A highly significant the probability value was defined as one that was below 0.05.

RESULTS

A total of 90 participants were included in the study group, consisting of 40 females (45%) and 50 males (55%). The mean age was 11.5 ± 4.7 years. Among the participants, 46 (51%) were between the ages of 7 and 10 years, while 44 (49%) were between 11 and 18 years.

Comparing the involvement of the 'cervical spine' at different levels, 47 patients (53%) exhibited issues in the lower cervical spine (C3 – C7), while 43 individuals (47%) showed involvement in the higher cervical spine

level (C0 – C2). The average follow-up time was 4.9 ± 2.6 months.

Among those aged 7 to 10 years, 19 individuals had experienced falls resulting in cervical spine harm, primarily due to car crashes (17 patients). In the 11–18 years age group, the commonest cause of cervical spinal injuries was falling history (19 patients), followed by 'auto accidents' (21 patients). Pedestrian injuries were equally distributed between the age groups, with 7 cases in each. The 'ASIA' score, illustrated in Figure 2, revealed that individuals aged 7-10 years had a higher fatality rate than those aged 11-18 years (p-value 0.0054). In the study, 22 patients expired with a mean follow-up of 4.9 ± 2.0 months, and fatality was more common in men (28 patients) than in the women's group (24 patients). Fatality was higher in the upper cervical spine level compared to the lower cervical spine level (p-value: 0.0084). Specifically, fatality was observed in C0 to C2 levels (27 patients) and C3 to C7 levels (15 patients).

Table No. 1: 'Nexus Criteria'

'Criteria for Nexus'	'Recommended' 'Imaging'
'Presence of midline cervical spine tenderness'	Yes
'Presence of focal neurological deficit'	Yes
'Lack of alertness or intoxication'	Yes
'Presence of distracting injury'	Yes

Table No. 2: Frequency of 'ASIA' Score

Scale	Frequency	Percentage
''ASIA' A'	17.8.4	32
''ASIA' B'	27.8	50
''ASIA' C'	33.3	60
''ASIA' D'	11.1	20
''ASIA' E'	4.4	8
Total	90	100

Table No. 3: 'ASIA' scale with Age groups (7 to 10 and 11 to18 years)

Scale	07-10 yrs	11-18 yrs
''ASIA' A'	9	6
''ASIA' B'	10	9
''ASIA' C'	8	11
''ASIA' D'	15	10
''ASIA' E'	4	8
Total	46	44

Table No. 4: Cervical spine injury level and fatality outcome

Level	Fatality		Total	P value
	Yes	No		
'C0-C2'	15	28	43	
'C3-C7'	9	38	47	0.005

The most common cause of fatality (p-value: 0.043) was automobile accidents, followed by falling history (25 vs. 15 patients). Injuries to pedestrians accounted for 4.9% of mortalities (5 patients), and dive-related incidents contributed to 2.6% of the fatalities (3 patients). No fatalities related to sports were noted. Among the fatality group, 30 patients were identified, with 5 having fractures, 10 having dislocations, and 5 experiencing fatality due to ligament injury. SCIWORA accounted for only one fatality. Among those who received treatment, fatality was highest in individuals who underwent surgery. Deaths were most prevalent in the 'after-treatment ASIA group A' and 'after-treatment ASIA group B'.The participants were followed for 6 months, and fatality was observed in 6 patients at 3 months, increasing to 8 patients at 4 and 6 months. There was a statistically significant difference (p-value < 0.00001) in neurologic results before and after surgical interventions based on the 'ASIA' scale (A to E).

DISCUSSION

Cervical vertebrae trauma is prevalent among individuals with a record of injuries. The upper 'cervical spine' tier (C0-C2) was linked to 43 persons while 47 patients were associated with the lower cervical spine (C3 – C7). In the adolescent age bracket (11 – 18 years), incidents of falling were the predominant cause of 'cervical spine' harm, followed by car collisions accidents.

Among the therapy groups, individuals undergoing surgery experienced the highest mortality rate. The most substantial mortality occurred in 'ASIA' groups A and B post-treatment. The post-therapy neurological status of patients appears to significantly influence mortality. Concerning the 'ASIA' scale, there was a notable disparity in the neurological outcomes of patients before and after the surgical intervention.

As per an other research, children below the age of 10 predominantly experienced cervical spine injuries due to motor vehicle accidents (MVAs), with a higher involvement of upper cervical spinal levels.[12-13] In children aged 10 and above, sports-related injuries emerged as the most prevalent cause of cervical spine injury, aligning with our study's findings. Cervical spine injuries were reported in 55.8% of cases, particularly in the younger age group (< 12 years old). Multiple-level cervical spine injuries were identified in 23.3% of cases. Neurological deficits were present in 22.7% of these children, with an overall mortality rate of 8.3%.

Across all sports, adolescence, and SCIWORA were significant indicators of concurrent Traumatic Brain Injury (TBI).

The increasing frequency of Cervical Spine Injuries (CSI) with age underscores the escalating concerns in competitive youth sports, aligning with recently revised regulations aimed at mitigating sports-related injuries in juveniles.[14-15] Beckmann et al.[2] provided a comprehensive account of the epidemiology and imaging characteristics of cervical spine injuries in children subjected to blunt trauma.

Yadav et al. observed a significantly lower occurrence of cervical spine injuries in younger children.[16] The most common injury mechanism among patients in this age group was falling from a height, followed by those involved in car accidents.

In situations where standardized protocols for managing such conditions are absent, an optimal path for diagnosis and treatment becomes crucial. Early neurologic assessment and 'magnetic resonance imaging' play pivotal roles in treatment outcome determination. To establish uniform methodologies, future randomized controlled trials are imperative, given the considerable variability in the literature concerning diagnosis and treatment.

CONCLUSION

The death rate for people with fractures of the spine was 27.8%. The youngest age groups, greater degrees of cervical spine deformity, and methods of damage including extremely energetic impact trauma, such as crashes involving motor vehicles (MVAs), were all independently linked to increased fatality. In contrast to spinal cord injuries, the mortality rate was greater in cases of bone injuries including fractures and dislocations. The surgical procedures included decompression and both posterior and anterior fusions. Whole neurologic deficiency cases had a greater death rate than inadequate neurological disorder cases.

It was high in Asia A patient with high cervical injuries. The best outcome was in children having SCHIWORA and it is also the most common cervical injury occurring in children after trauma. We observed that in SCHIWORA external immobilization expedites recovery and decreases the pain from soft tissues injury.

Author's Contribution:

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