CASE REPORT

Traumatic C2 Fracture in a 10-month-old Infant: Controversies and Hurdles in Management

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Abstract

Cervical spine injuries (CSIs) in children are relatively rare, representing only about 2% of all spinal trauma.[1] The pattern, severity, and level of these injuries are age dependent. Evaluation and management of CSIs in children are difficult. Neurological deficits in young children are uncommon with good potential for recovery; however, it carries potential risk of catastrophic permanent neurological disability. We describe a rare case of C2 fracture due to high speed road traffic accident in a 10-month-old child. The child underwent posterior C1–C2 fixation and required prolonged ventilatory support, but was ultimately able to survive with improving residual hemiparesis.

Keywords: C2 fracture, Infant, Management, Quadriparesis.

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Introduction

Cervical spine injuries (CSIs) in children are relatively rare, representing only about 2% of all spinal trauma.[1] The pattern, severity, and level of these injuries are age dependent. Although they are rare, healthcare providers often evaluate children for potential CSIs caused by blunt trauma. Understanding CSI patterns and their relationship to the mechanism, treatment, and neurologic outcomes in children is important. We report a case of CSI with spinal cord edema in a 10-month-old child who required stabilization by wiring and long intensive care management for recovery.

Case Report

A 10-month-old child presented with a history of high-speed road traffic accident. The child was seated on the mother's lap in the front seat of a car during the accident. The child was taken to a nearby hospital for treatment. There was no evidence of any external injury. The Glasgow coma scale (GCS) of the child was 15/15, bilateral pupils were equally reacting to light, the child was moving all four limbs, and there were no apparent neurological deficits. Computed tomography (CT) imaging of the brain was normal. After 12 hours of admission, the child had two episodes of convulsions and developed difficulty in breathing. The child was intubated, electively ventilated, and referred to our center on ventilation with cervical collar for further management. On clinical examination at our center, the child was conscious, opening eyes spontaneously, its bilateral pupils equally reacting to light with decreased movement of the right upper limb and lower limb with no movement in the left upper and lower limb. Hematological examinations were normal and chest X-ray showed no abnormality. Magnetic resonance imaging (MRI) of the brain was suggestive of post-traumatic contusions and edema over medulla. CT scan of cervical spine was suggestive of displaced fracture of the base of odontoid. The odontoid was displaced anteriorly with dens tilted posteriorly. The anterior arch of atlas showed anterior displacement as compared to the occiput and rest of the cervical spine (Fig. 1). MRI of cervical spine was suggestive of fracture of dens of C2 with posterior displacement of the body of C2 causing compression over the cervicomedullary junction, cord contusion, and edema up to the C4 vertebral level. Prevertebral hematoma from base of the skull to the C4 vertebral level with widening of space between the posterior arch of C1 and C2 with adjacent edema representing ligament injury was seen (Fig. 2).

Neurosurgical opinion was taken for further management. In view of severe C2 displacement and breathing insufficiency,

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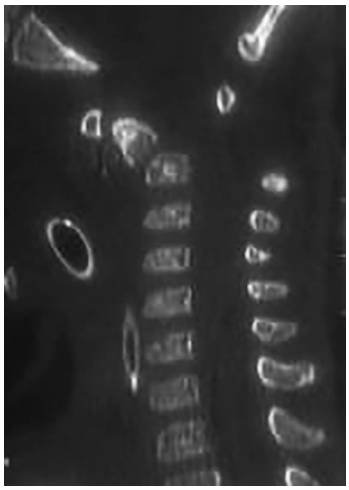

Fig. 1: CT scan of cervical spine suggestive of displaced fracture of the base of odontoid. The odontoid is displaced anteriorly with dens tilted posteriorly

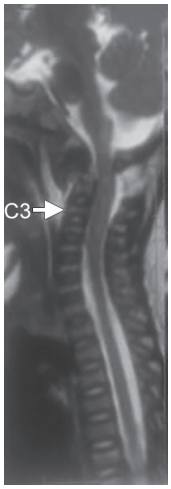

Fig. 2: T2 image of MRI cervical spine suggestive of fracture of dens of C2 with posterior displacement of the body of C2 causing compression over the cervicomedullary junction, cord contusion, and edema up to the C4 vertebral level. Prevertebral hematoma from base of the skull to the C4 vertebral level with widening of space between the posterior arch of C1 and C2 with adjacent edema representing ligament injury was seen

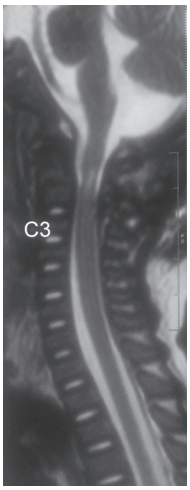

Fig. 3: Postoperative T2 image of MRI cervical spine suggestive of good alignment of dens over the body with reduced cord edema

the child was sedated, electively ventilated, and cervical traction applied for correction of subluxation. In view of no correction of displacement and constant compression over the cord, the child underwent C1–C2 transfixation with subaxial wiring with a posterior approach. After 2 days of surgery, the child was extubated but required re-intubation within 4 hours as there were inadequate respiratory efforts. The child had three trials of failed extubation. Postoperative MRI of cervical spine was suggestive of significant resolution of edema and correction of subluxation with realignment of odontoid and dens (Fig. 3). In view of long-standing elective ventilation, the child underwent tracheostomy. After tracheostomy, the child required minimal ventilatory support in the form of alternate synchronised intermittent mandatory ventilation (SIMV) and continous positive airway pressure (CPAP) mode. Gradually, the child was weaned off from the ventilator and kept on minimal O_2 support which was also weaned off over a period of 1 week. Tracheostomy removed after 1 week. Child discharged after total 55 days of pediatric intensive care unit (PICU) stay with established oral feed and normal sensorium. At the time of discharge, the child had complete movement in right upper and lower limbs, and left upper and lower limb hemiparesis was present which improved later on follow-up. After 3 months follow-up, the child has normal sensorium, takes feeds normally, stands with support, and has only mild weakness in the left upper limb.

Discussion

To date, our knowledge of pediatric CSI has been based on either large adult trials with limited numbers of children or single-center pediatric case series.[2] Children less than 2 years of age are particularly underrepresented in the literature.[2] CSIs in children are unique in both the wide anatomic differences and the variety of mechanisms of injury. In children, the head is larger relative to the body, resulting in a higher center of gravity and fulcrum of neck motion. There are multiple vertebral ossification centers and the ligamentous structures are also lax. These differences affect the epidemiology of spine injuries in children, of which 60% to 80% occur in the cervical region, whereas among adults, CSIs account for only 30% to 40% of all spine injuries.[3–6] Furthermore, in young children, CSIs are reported to occur most often in the upper cervical spine and are associated with higher morbidity and mortality.[7] The CSI pattern is also unique in children depending on the age. For children <2 years, 74% had CSIs involving the axial region, with atlanto-occipital dislocation being the most common injury. For children of 2 to 7 years, 78% of CSIs occurred in the axial region; atlantoaxial rotatory subluxation (AARS) and atlanto-occipital dislocation were the most common injuries. Among children of 8 to 15 years, subaxial injuries were more prevalent (53%), with subaxial vertebral body fractures being the most common. Spinal cord injury without radiographic abnormality (SCIWORA) was uncommon in the younger age groups, but accounted for 16% of the injuries in children of 8–15 years.[8]

The treatment of pediatric CSIs has traditionally been conservative. Unstable pediatric spinal injuries are increasingly being treated operatively.[9,10] Operative fixation in young children still has the challenge of appropriate implants and instrumentation. Several fixation methods had been described for the fixation of pediatric cervical spine. This included wiring, locked plates, rods and wires, and even sutures. In this report, C1–C2 subaxial wiring was preferred as a simple and effective method for posterior fixation. Children have very rapid healing power, and fusion is expected in a short time with low risk of metal failure. Conservative treatment has a significant role in the management of stable pediatric CSIs. In a study of unstable upper pediatric spine injury by Duhem et al.,[11] 21 of 28 children were treated conservatively. The indications for surgery were persistent instability in spite of halo traction, neurological deterioration, and irreducible fracture-dislocation.

The use of traction in very young children has not been well studied. The thin calvaria in this population increases the risk of skull penetration with pin placement. Low body weight decreases the resistance to traction, while lax ligaments and underdeveloped musculature increase the risk of over distraction. In our patient, we used biparietal traction by weight starting from 1/2 kg and then gradually increased depending on alignment on serial X-ray. Traction was kept for total 5 days. Methylprednisolone use is debated, but still used by some because of the catastrophic nature of cervical spine injury (CSI), paucity of treatment options, and legal ramifications. Dose of methylprednisolone was given after wire fixation of C2 to prevent postoperative edema of the spinal cord. Reduced edema of the spinal cord was evident significantly on MRI in our case. Significant cord edema and medullary contusions lead

to prolonged elective ventilation due to inadequate respiratory efforts. Gradually, the child was weaned off from the ventilator and discharged after tracheostomy removal with good neurological recovery. This signifies that early recognition of spinal cord injury, spinal immobilization, an appropriate approach to its management, and a team approach is the core for such catastrophic injury.

Conclusion

The treatment of pediatric CSIs should be individualized. Children with stable injuries do well with nonoperative management; however, operative treatment is recommended for unstable injuries. Early recognition of spinal injuries, spinal immobilization, and a multimodal approach involving a neurosurgeon and a pediatric intensivist is the core for such catastrophic injury.

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