1. Introduction

The pediatric cervical spine is very vulnerable to traumatic injuries. The complex bony vertebral alignment is stabilised with anterior, posterior and inter-vertebral ligaments. Disruption of these ligamentous structures can result in vertebral dislocation or distraction injuries. A cervical distraction injury occurs when two vertebral bodies are pulled in opposite directions. In the pediatric population, cervical spine injuries account for 60–80% of all vertebral injuries.1,3,12 These injuries result in a mortality rate between 16 and 35%.6

We present a case of a 7-year-old female involved in a motor vehicle collision that sustained a C4–C5 distraction injury. This is the first documented case of a pediatric cervical spine craniocaudal distraction at the C4–C5 level. We describe the patient's history, possible mechanism of injury and a review of the literature.

2. Case report

The patient is a 7-year-old female that was a restrained rear seat passenger involved in a motor vehicle collision. She was sitting behind the driver in a booster seat with both lap and shoulder harness in place. The victim's pick-up truck was apparently struck by a car on the passenger's side. The booster seat appeared to be unscathed as per police reports.

At the scene of the accident she was found to be in cardiac arrest and advance cardiac life support (ACLS) was initiated. The patient was placed on a backboard with cervical immobilisation and transferred to the nearest hospital. At this community hospital a tachyarrhythmia was obtained with epinephrine and atropine. She was placed on a norepinephrine drip to maintain her blood pressure and underwent computed tomography (CT) scans.

The CT scan of her head showed a subarachnoid haemorrhage with findings of early communicating hydrocephalus, haemorrhage within the fourth ventricle and basal cisterns and diffuse cerebral edema. Cervical spine CT scan revealed a fracture of the superior end plate of C5 with complete dissociation with the remainder of the vertebral body. The C4–C5 distraction measured approximately 2 cm (see Fig. 1). There was also a large haematoma which completely obliterated the cervical canal at the same level.

The patient was airlifted to the Trauma Center at Jersey Shore University Medical Center.

Upon receiving the patient she was bradycardic, hypotensive and hypothermic. The patient's haemoglobin was 7.3 mg/dl without evidence of any major haemorrhage on examination or CT scan. At this point we believed that the patient was in neurogenic shock. The patient was initially resuscitated with crystalloid and two units of packed red blood cells (PRBC) followed by vasopressors (phenylephrine and epinephrine) to maintain the blood pressure (BP).

The patient's physical examination revealed, bilateral fixed and dilated pupils and a laceration to the left forehead. The patient's Glasgow Coma Scale (GCS) was 3/15. There was no rectal sphincter tone.

The patient was admitted to the pediatric intensive care unit (PICU) with a grave prognosis. She was maintained on vasopressors and transfused four more units of PRBCs, two units of fresh frozen plasma and one pack of platelets. Her neurologic status did not improve. She had absence of brainstem function with fixed and dilated pupils, absent gag and absent corneal, oculocephalic, and oculovestibular reflexes. A confirmatory cerebral blood flow examination with Technetium-99m demonstrated absent intracerebral blood flow. She was pronounced brain dead approximately 18 h after the accident and organs were harvested.

3. Discussion

Cervical spine injuries can be devastating for a pediatric trauma patient. Injuries may include fracture, dislocation, distraction, or a
combination. The majority of these patients are involved in a motor vehicle collision (MVC).

The level of injury is more characteristic in certain age groups. Adolescents tend to incur lower cervical injuries while younger children incur upper cervical injuries. Younger children have disproportionately large heads and comparatively weak neck musculature. This results in the fulcrum of cervical motion to lie at C2–C3 in young children, whereas it lies at C5–C6 in adolescents. In two large case series of pediatric cervical spine injuries, patients 9 years and younger sustained upper cervical injuries (occiput to C2) in 69–78% of the cases. On the contrary, 70–73% of older children, 10 years and above, sustained lower cervical spine injuries (C3–C7).

The mechanism of pediatric subaxial cervical spine injury is predominantly MVC with 52% of these patients being unrestrained passengers. The most common location of cervical spine injury is at C6–C7. In our case, the patient was a 7-year-old female on a booster seat with restraints and the location of the injury was at the C4–C5 level.

Severe central nervous (brain and/or spinal cord) injury can present as neurogenic shock. The triad of hypotension, bradycardia, and hypothermia is pathognomonic for neurogenic shock. There is a sudden loss of the sympathetic nervous system signals to the smooth muscle in vessel walls. Sudden vascular dilatation and a dramatic decrease in peripheral vascular resistance leads to the precipitous decrease in blood pressure. This results in a reduction in venous return and a subsequent decrease in cardiac output. The lack of sympathetic tone results in unopposed vagal tone and leads to bradycardia. Our patient presented with the classic description of neurogenic shock. Case reports of distraction injuries in the literature describe patients at the scene of an accident in cardiac arrest and apneic. Likewise, our patient was apneic at the scene and in cardiac arrest.

What was the cause of such a traumatic injury? The patient was restrained and sitting in a booster seat. She was a rear passenger in a large pickup truck and was located on the opposite side of the impact. Her older brother was sitting in the front seat and was not injured even though the impact occurred on the passenger’s side. There may be two plausible mechanisms. The first and most likely is the shoulder harness acted as a noose and fulcrum. The momentum of the accident caused the head and superior cervical spine to stay in motion while the inferior cervical spine was fixed. The second possibility is that the patient’s head stuck the front seat and caused severe hyperextension with subsequent distraction. With relatively weak musculature and ligamentous structures the force of the accident caused a severe distraction injury.

Traumatic cervical spine distraction injuries are very rare with only case reports documented in the literature. The reported cases are all adults involved in a MVC, or were pedestrian or bicyclist struck by a car. Our unfortunate patient is the first documented C4–C5 cervical spine distraction injury in the literature.

References