Case report of cranio-cervical dislocation in a child

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Abstract
This case report covers cranio-cervical dislocation in a child and the role of imaging to arrive at a diagnosis [1-3]

Keywords: spine; trauma; distraction.

Case report

A 10-year boy was referred from a regional hospital to the neurosurgical department at our institution with the history of having fallen from a shopping trolley with a sudden drop of Glasgow Coma Scale (GCS) to 3/15. Upon resuscitation the GCS increased to 7/15.

A computed tomography (CT) scan of the brain done at the regional hospital revealed diffuse cerebral injury and a subarachnoid hemorrhage in the prepontine cistern. Trauma assessment of the cervical spine did not reveal any abnormality.

On arrival at our institution the patient was haemodynamically stable and intubated with good saturations and a respiratory rate of 23 beats per minute. His GCS was E3M5Vt with equal pupils and normal right pupillary reflex.

On review of the CT scan, subarachnoid hemorrhage with features of diffuse brain injury was confirmed by the neurosurgeons. A right frontal burr hole craniotomy for insertion of the intracranial pressure monitor was performed.

In the intensive care unit he subsequently dropped his GCS to E2M6Vt and became a complete quadriplegic. The clinical diagnosis at the time was that of spinal cord injury without observable radiologic abnormality with a possible odontoid peg fracture. He was maintained on a cervical collar and his GCS improved. A tracheostomy was done for airway maintenance.

Radiological involvement at our institution commenced when magnetic resonance imaging (MRI) of the cervical spine was requested and performed nine days later. It revealed a type 1 cranio-cervical dislocation with a psuedomeningocoele.

The patient was subsequently discussed with the orthopedic unit at a local hospital for further management. He was to be transferred to be seen by the head of the said orthopedic unit but two days before transfer he vomited 500mls of frank blood and aspirated. Resuscitative measures failed.

Non-enhanced CT images (Figure 1) demonstrate prepontine cistern subarachnoid hemorrhage with features of raised intracranial pressure. On review of the scout image (Figure 2) a dislocation should have been queried.

MRI findings (see Figures 3, 4, 5, 6). Type 1 occipito-cervical dislocation (anterior dislocation of the occipital condyles on the atlas) is noted with narrowing of the spinal canal at that level and compression of the upper cervical cord at C1/2 level by the odontoid process. Increased T2 signal within the cord is in keeping with compressive myelopathy. Basal cistern and prepontine cistern subarachnoid hemorrhage is noted. In the anterior vertebral space of C1-3, a CSF intensity collection is noted which does not demonstrate contrast enhancement and is suggestive of a CSF leak.
No arterial dissection is noted.

Discussion

Cranio-cervical junction injuries may be uni or bilateral and involve the occiput and C1; and or C1 and C2. It is an osseoligamentous injury and is grossly unstable with significant associated neurological and vascular compromise. The clinical presentation is variable; survival and prevention of secondary injury may depend on accurate diagnosis [1]. It usually follows high speed motor vehicle accidents and is a combination of rotational and shearing injury [2] with disruption of the three stabilizing ligaments at that level.

Dislocation is defined as complete loss of articular contiguity with varying degrees of distraction. Subluxation is less severe as some of the articular contiguity is retained. Cranio-cervical dislocation is uncommon but more prevalent (2,5 times) in children [1]. They are most at risk because of increased ligamentous laxity; increased head to body ratio, horizontal orientation of the atlanto-occipital joints and hypoplastic occipital condyles [2,3]. Assessment of cranio-cervical dislocation in a child is complicated further because of the variability of the bone ossification at the cranio-cervical junction, especially at the dens [2]. The normal fulcrum for cervical motion is at C2-3 in a child compared with C5-6 in an adult [3].

Failure of the atlanto-occipital ligaments is due to avulsion, fracture of bony attachments or an intrasubstance tear [2].

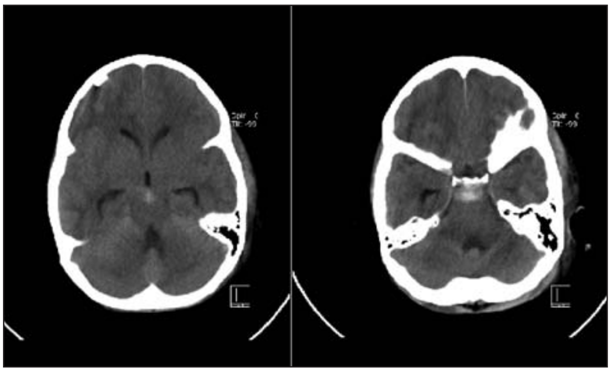

Figure 1: NECT

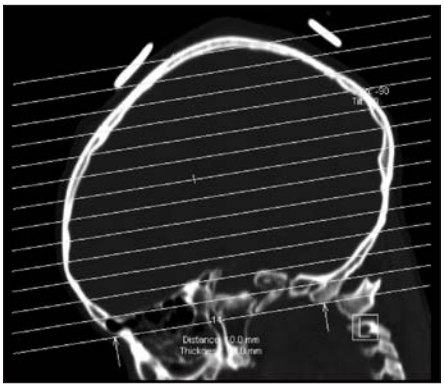

Figure 2: Scout for CT

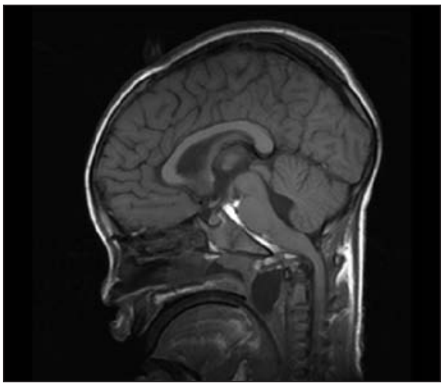

Figure 3: T1W sagittal image

Occipital condyle fractures are rare [3] and can be unilateral, bilateral or form a ring around the foramen magnum. They are classified as impaction fractures, extension of occipital skull fractures or avulsion fractures at the insertion of the alar ligaments. The latter fracture is unstable especially if there is displacement with the occipital condyle. Fracture palsies of the lower cranial nerves, especially the 12^{th} may occur due to fracture through the hypoglossal canal. These are best seen on CT scan.

The basion-dens interval is unreliable in patients less than 13 years of age. However the basion-posterior axial line is reproducible. A line drawn along the posterior longitudinal ligament extends <12mm posterior or < 4mm anterior to the dens.
A helpful feature is that of pre-vertebral soft tissue swelling which is normally flat or concave and measures less than 6mm at the C2 vertebrae.
The atlanto-occipital articulation normally measures 1-2mm.

The tectorial membrane and transverse membrane are well seen on MR images but the alar ligaments are difficult to visualize due to lack of

Figure 4: T2W axial

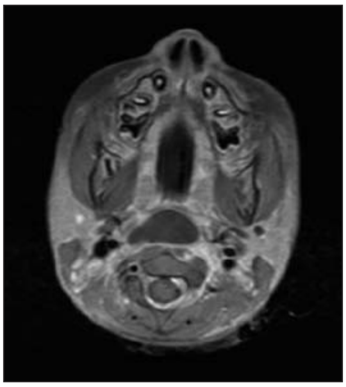

Figure 5: T1W CE

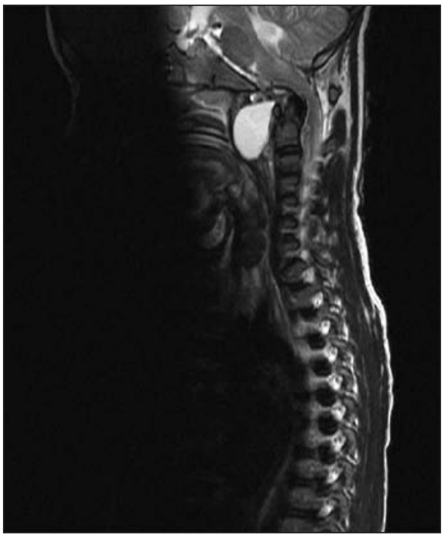

Figure 6: T2W sagittal

contrast from adjacent structures. The tectorial membrane is the cranial continuation of the posterior longitudinal ligament and inserts into the basion. The transverse ligament of the atlas holds the dens in place against the anterior arch of C1.

The alar ligaments extend from the lateral margin of the dens vertically to the ipsilateral occipital condyles and or the superior margin of the lateral mass of C1 and limit axial rotation. If there is blood or edema adjacent to the ligament then a tear may be well seen. A secondary helpful feature is displacement of the dens to the contra-lateral side. In the setting of an isolated post-traumatic alar ligament tear, significant added mobility of the atlantoaxial joint can result in reduced flow in the contra-lateral vertebral artery.

The role of MR imaging is in the evaluation of extent of ligamentous injury especially in patients with neurological deficit or those requiring closed reduction of a post traumatic spinal subluxation, those with altered sensorium, morbid obesity or suspicion of malingering. It is primarily used to assess the extra-dural space, the integrity of the ligaments [3] and spinal cord injury which is of prognostic value.

The MR imaging protocol includes a sagittal T1, STIR, GRE, fat sat FSE T1, STIR and axial FSE GR T2. In addition to the three stabilizing ligaments, the following need to be assessed:

- The bone marrow signal intensity,
- The atlanto-occipital junction,
- The atlanto axial junction,
- Preveretebral soft tissue,
- Epidural haematoma,
- Nuchal ligament, interspinous ligament signal intensity and,
- Spinal cord.

Complications include:

- Subdural hemorrhage,
- Subarachnoid hemorrhage: common but small,
- Epidural haematoma,
- Spinal cord injury,
- Brainstem compression, laceration of the pontomedullary junction, contusion or laceration of the caudal medulla or rostral spinal cord, stretch or laceration of the midbrain,
- Vasospasm or dissection of the internal cerebral arteries or vertebral arteries.

In view of the high fatality rate and increased prevalence in children a high index of suspicion is needed to ensure detection and appropriate management. The latter entails a fusion of the occipital condyles to either C1 or C2 [3].

Abnormal basion axial or basion dental interval [4], pre-vertebral soft tissue swelling with an abnormal anterosuperior upward oblique contour [4], divergent articular processes and widened posterior aspect of the disc space, are indications of pediatric spinal instability [3].

Careful review of the lateral radiograph and scout image in all children who have CT brain examinations is a good place to begin. Increased survival needs immobilization of the spine, and prompt referral to a trauma unit.

References

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An African Region Special Event: Human Resources Development In Radiation Oncology, In The Context Of Cancer Control Programmes.

Hosted by Groote Schuur Hospital and the University of Cape Town in collaboration with the African Regional Training Institutes.

11 to 15 December 2006

The Nobel Peace Prize for 2005 was awarded to the International Atomic Energy Agency (IAEA) and its Director, Mohamed El-Baradei. The IAEA has decided to use part of the prestigious prize to improve cancer management in the developing world, starting with the this special event for Africa. It aims at drawing the attention of health policy makers to why comprehensive cancer control is so essential for enhancing the effectiveness of cancer treatment by radiotherapy, as well as to encourage the planning for and investments in *Regional Cancer Training Networks* to alleviate the severe shortage of cancer control professionals worldwide

The opening session will be hosted by Dr Ebrahim Rasool, Premier of the Western Cape and will include appropriate IAEA and local dignitaries as well as representatives of organizations involved in Cancer Training and Cancer Patient Care, including the International Atomic Energy Agency (IAEA) and the World Health Organization (WHO).

Program Outline:
Days 1 and 2 (11, 12 December) will outline the cancer problem in Africa, a regional plan of action for comprehensive cancer control and human resource development in the field of Radiation Oncology.
Days 3 to 5 (13 - 15 December) will cover core topics in Radiation Oncology, including:

- Comprehensive cancer control including prevention and early detection.
- Regional cancer training networks
- Education, training and clinical research
- Evidence-based radiation oncology
- Emerging technologies in radiation oncology

Attendees will be international and local speakers as well as African decision-makers and managers in charge of cancer management in their countries. The event will form a multidisciplinary team involved in cancer management at national and regional levels.

The association of this event with the Noble Peace Prize resonates with a special time in South African History. The venue at the renowned Waterfront area of Cape Town contains the nearby Nobel Peace Prize Square, with statues of the four South African Nobel Peace Prize winners.

Raymond Abratt: Course Director. Steering Committee: David Dent, Penelope Engel-Hills, Leon Gouws, Saadiq Kariem, Vuvu Mtsutwana

(see registration form overleaf)