ABSTRACT
Atlanto-occipital dislocation (AOD) is a devastating condition that frequently results in prehospital cardiorespiratory arrest and accounts for 15% of fatal spinal trauma. Atlanto-occipital dislocation occurs 5 times more commonly in children than adults, and is believed to be caused by hyperextension. Because of improvements in prehospital resuscitation, more victims with AOD now survive to reach the emergency department. Neurologic injury is usually severe secondary to ligamentous disruption that allows the cranium to move with respect to the cervical spine, and associated facial and head injuries are common. There are, however, reports of survivors without neurologic deficits. We present the case of a 46-year-old woman who suffered an AOD after a motor vehicle crash and we discuss the diagnosis of this condition. The signs of AOD are often subtle, and the possibility of this diagnosis must be kept in mind in all patients with a neck injury, even in the absence of neurologic signs. A systematic approach to assessing the cranio-cervical relationship on the lateral cervical x-ray and the appropriate use of CT scanning is essential to identifying AOD. Through this case report we hope to familiarize clinicians with mechanisms of injury and appropriate imaging interpretation that will assist in the diagnosis of AOD.

Key words: atlanto-occipital dislocation; spinal trauma; neurologic injury; diagnosis of AOD

CASE REPORT • OBSERVATIONS DE CAS

Atlanto-occipital dislocation: case report and discussion

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Case report

A 46-year-old unrestrained female passenger was ejected from her seat following a high speed motor vehicle crash. She was unconscious at the scene and developed respiratory arrest en route to hospital, necessitating intubation and ventilation by the paramedic team. On arrival at the emergency department (ED) she had a Glasgow Coma Scale score of 7, and no spontaneous respirations. Her blood pressure, pulse and oxygen saturation were stable, and her only external sign of injury was a submental laceration.

A lateral cervical spine radiograph showed pre-vertebral soft tissue widening, malalignment between the cranium and cervical spine, and widening of the atlanto-occipital joint space to greater than 5 mm (Fig. 1). A cervical spine CT scan was performed that confirmed an atlanto-occipital dislocation (AOD).

The patient underwent operative fixation to stabilize the atlanto-occipital joint, and was weaned from ventilatory support over the subsequent 2 weeks. Her clinical status continued to gradually improve following operative fixation.

Discussion

Atlanto-occipital dislocation accounts for 15% of all fatal spinal trauma, occurs 5 times more frequently in children than in adults, and is usually associated with severe brain injury. Motor vehicle crashes are the most common cause of AOD; however falls, direct trauma and forceps delivery can also result in this injury.1,2 The mechanism of AOD is believed to be hyperextension, and there is a high incidence of associated mandibular fractures and submental lacerations.2 Traumatic disruption of the apical and alar ligaments, and the tectorial membrane, allows the cranium to move with respect to the cervical spine. The most common patterns of occipito–vertebral dissociation are concomitant anterior displacement and distraction seen in 65%, purely distracted in 19%, purely anterior in 13% and purely posterior seen in 3%.3 As a result of occipito–vertebral dissociation the medulla oblongata is left vulnerable to injury and can even be transected.1,3 Injury to this area frequently results in cardiorespiratory arrest at the accident scene, and is the reason why most victims of AOD do not survive.

Because of improvements in prehospital resuscitation, more victims with AOD now survive to reach the ED.4–6 Neurological injury is usually severe but there are reports of survivors without neurologic deficits.1,6,7 The stability of the cervical spine is provided by 3 columns: the anterior and posterior longitudinal ligaments maintain the structural integrity of the anterior and middle columns; while the posterior column is held fixed by the ligamenta flava, capsular ligaments, and the nuchal ligament complex. When 2 or all 3 columns are disrupted the spine may move as 2 separate units, increasing the likelihood of spinal cord injury. In AOD without a neurologic deficit, this instability may cause patients to experience the sensation that their “head is falling off.” Unstable injuries of the cervical spine, where this is more likely to occur, include a rupture of the transverse ligament of the atlas, a fracture of the odontoid (dens), and a burst fracture with posterior ligamentous disruption (a flexion teardrop fracture).

The radiographic signs of AOD are often subtle and require scrutiny of the lateral cervical spine radiograph for malalignment between the cranium and the spine (Fig. 1). Massive soft-tissue swelling, with widening of the prevertebral soft tissues, is virtually always seen.1,6 However, the determination of prevertebral soft-tissue widening can be unreliable if the patient has an endotracheal or nasogastric tube in situ.

AOD results in disruption of the normal relationship between the basion (the anterior lip of foramen magnum, and the base of clivus) and the odontoid. In 65% of AOD cases...
there is anterior dislocation and distraction of the cranium with respect to the cervical spine. 3

A systematic approach to assessing the cranio-cervical relationship is essential for detecting AOD. The following suggest the presence of AOD on the lateral cervical radiograph.

1. The gap between the occipital condyles and the condy- lar surface of the atlas is widened to more than 5 mm. 3
2. The “Wackenheim’s Clivus Line,” (Fig. 2) a line drawn along the posterior clivus, does not intersect or is not tangential to the odontoid. 1,7,8
3. The “Power’s Ratio” is abnormal. This requires identi- fication of 4 bony landmarks. As seen in Figure 3, A is the anterior tubercle of the atlas; B is the basion; C is the spinolaminar line of the atlas; and O is the opisthion (posterior lip of foramen magnum). The value of BC/AO should be less than 1. 3
4. Harris Criteria: 7,8
   a) The basion is not within 12 mm of the superior con- tinuation of a line drawn along the posterior cortex of the body of the axis (the posterior–axial line) (Fig. 4).
   b) The distance between the basion and the tip of the odontoid is more than 12 mm.

All the radiologic criteria described above have limita- tions, however, because the bony landmarks may not be clearly seen. CT, particularly with sagittal and coronal re- formatting, is the definitive imaging modality to diagnose and evaluate AOD.

Conclusions

Atlanto-occipital dislocation is a devastating condition that frequently results in prehospital cardiorespiratory arrest and has a high mortality rate. Because of improvements in prehospital care, more patients with AOD now survive to reach the ED. The diagnosis of AOD on plain radiography can be difficult and requires a systematic approach to assessing the cranio–cervical relationship. CT is the defini-
ative imaging modality for the diagnosis and evaluation of AOD.

**Competing interests:** None declared.

**References**


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