CLINICAL REPORT

Survivor of a traumatic atlanto-occipital dislocation

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Abstract
Atlanto-occipital dislocation is a devastating ligamentous injury that most often turns fatal. However, because of on-site resuscitation improvements, the emergency teams are increasingly dealing with this condition. We report a rare case of atlanto-occipital dislocation (AOD) in a surviving patient with more than one-year follow-up. The mechanism of injury appears to be an extreme hyperextension applied to the head. This injury occurs more frequently in children since they are anatomically predisposed (flat articulation between the occiput and the atlas, increased ligamentous laxity). The diagnosis should be suggested by severe neurological injury after high trauma but also post-traumatic cardiorespiratory deficit. There have been reports of atlanto-occipital dislocations without neurologic impairment. A radiographic examination must be performed and lateral cervical radiographs should be acquired. However, additional imaging with CT or MRI may be required to aid diagnosis of AOD in cases in which radiographic findings are equivocal. Once the diagnosis of AOD has been confirmed, an anatomical classification should be made according to the magnitude of displacement. Fatal lesions are of neurological and vascular origin and some authors advocate the systematic use of angiography. Consensus regarding the management of AOD in adults has been achieved. Occipito-cervical arthrodesis is the recommended treatment option. We advocate a two-stage surgery: the patient is initially fitted with a halo vest then occipitocervical fusion is performed. Surgical treatment should be combined with cardiorespiratory management. The emergency teams should get familiar with this injury since they will be increasingly confronted to it. Early recognition and standard appropriate management is essential to avoid delayed treatment and complications.

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Introduction

Traumatic craniocervical injuries account for one-third of all cervical spine injuries [1]. Atlanto-occipital dislocation (AOD) is a severe and usually fatal ligamentous injury which explains its under-estimated frequency. This is a rare medical condition which incidence is about 0.7 to 1.3% of all cervical spine injuries [2–4]. The initial trauma is commonly the result of a high-speed motor vehicle or pedestrian collision. According to the literature, between 8 and 31% of the patients dying in a road accident are found to have AOD at postmortem examination [5–7]. However, due to improved on-scene resuscitation, immobilization, transportation and efficient management in the emergency department, an increasing number of AOD survivors has been reported. We present a rare case of AOD with one-year follow-up. The purpose of this article is to provide an overview of this rare injury and to discuss its therapeutic strategy in an attempt to alert trauma teams to this type of pathology and potentially improve patient outcome.

Case report

A 20-year-old patient involved in a high-speed quad accident was admitted in our hospital in September 2007. He sustained a severe head trauma with frontal impact, thus suggesting a hyperextension mechanism and was injured in the right thigh. Upon arrival of the emergency team at the scene of the accident, the patient was conscious with symptoms suggesting a right-sided hemiplegia. He was intubated on-site as he demonstrated neurological abnormalities. The initial clinical evaluation on admission confirmed the high-energy cranial trauma associated with frontal wound and raised the suspicion of right femoral fracture. Standard radiographic examination (pelvis and right lower limb) with additional plain CT scans evidenced a right mid-diaphyseal femoral fracture, a bilateral anterolateral AOD (Fig. 1), a frontal subarachnoid hemorrhage, a fracture of the anterior arch and right lateral mass of the atlas, a C1–C2 dislocation and a congenital malformation of right pedicles of C5 and C6 with congenital block vertebra C5–C6. The frontal impact associated with hyperextension of the head on the spine were at the origin of the anterior tear of the median and lateral occipito-odontoid ligaments, of the median and lateral atlanto-occipital ligaments and of the anterior common spine ligament, of the occipito-odontoid capsules and of the dura mater. However, sagittal images suggested that posterior structures were probably intact with damages to the articular surfaces. The cervical spine was immobilized in a halo thoracic vest allowing the patient’s manipulation and femoral osteosynthesis with no risk. After femoral osteosynthesis, the patient was woken up and remained intubated in order to perform a neurological clinical assessment. This examination revealed a brachial plexus injury with damage to C5–C6–C7 and the absence of any neurological impairment of the lower limb. The MRI examination revealed: a perimedullary hematoma of C1–C3, torn ligaments at the craniocervical junction, a C1–C2 diastasis and fluid collection between the clivus and C1–C2 which raised the suspicion of a dural tear (Fig. 2). An occipitocervical plate and screw fixation (occipital screws and cervical hooks) was performed on the fourth week (Fig. 3), with the patient immobilized in the halo thoracic brace. During this arthrodesis, avivement of C1 and C2 was performed with gouge forceps without avivement of the articular surfaces. A corticospinous bone graft harvested from the right posterior iliac crest was used. After four weeks, the posterior capsuloligamentous elements could be hardly visualized, only an old hematoma that had infiltrated the whole soft tissues could be detected. Once the patient had woken up, he was extubated and his breathing controlled, the immobilization device was removed. The outcome was satisfactory despite a transitory postoperative diplopia. At 18 months follow-up, cervical C5–C6–C7 demonstrated symptoms with
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Figure 2  Early MRI of atlanto-occipital dislocation, sagittal T2-weighted images. Broken arrow: detachment of the posterior dura mater; full arrow: Tear of the Membrana Tectoria with suffusion of cerebro-spinal fluid; dotted arrow: rupture of alar and apical ligaments; asterisk: precervical C1—C3 haematoma.

Discussion

The AOD is a severe ligamentous injury. This condition is usually fatal after vascular lesion mainly at the level of the vertebral artery but also the carotid artery [4,8,9] or after cervical medullary injury at the level of C4 associated with asphyxia secondary to phrenic or bulbar nerve palsy [4,5]. Many of the patients with traumatic AOD will die immediately or within the first hours after injury. The main improvements achieved involve early initial management but also new diagnostic techniques and a higher index of suspicion. However, on-scene intubation is at high risk which constitutes a paradox: either it kills or it saves. Since the first report on AOD made by Blackwood [10] in 1908, many reports have been published in the literature. More recently, Labler et al. [1] have conducted a meta-analysis over a period from 1948 to 2003 and have reported 211 cases published, of which 131 involved children (62%) and 56 were adults (26.5%). To our knowledge, several cases have been published in the literature since 2003 [1,11—29]. The last few years have witnessed a great amount of publications which does not account for the increased frequency of this injury but rather the increase in number of patients sustaining AOD admitted to the emergency department. These cases reported by the literature usually have a short follow-up, whereas our clinical observation is based on a one-year follow-up.

AOD occurs more frequently in children since they are anatomically predisposed: small congruence between the occipital condyles and the flat surface of the lateral masses of the atlas, combined with a loose ligamentous capsule surrounding this atlanto-occipital articulation.

The clinical pattern is extremely variable. Usually, the prominent symptoms are of neurologic or cardiovascular origin. Clinical neurologic signs may vary from the absence of neurologic deficits to tetraplegia [1,30—32]. Peripheral damages, particularly in the long bone of the limbs, may mimic neurological symptoms. In the present case, the femoral fracture wrongly raised the suspicion of a right hemiplegia. Moreover, any patient experiencing respiratory insufficiency or cardiorespiratory arrest

Figure 3  Standard postoperative radiograph of the occipito-cervical fusion: osteosynthesis using an occipital screwed plate and cervical hooks. A: A/P radiograph. B: lateral radiograph.

after sustaining a high-speed accident should suggest the diagnosis of AOD in the emergency department [1,12—14,33]. This diagnosis must be confirmed. Radiographic diagnosis is usually obvious on the initial lateral cervical radiographs. Various methods for diagnosing AOD on lateral cervical radiographs have been developed, the Power ratio [4] (Fig. 4) and the Harris et al. method [34] (Fig. 5) being the most commonly used. However, both methods lack sensitivity since good quality radiographs are difficult to acquire in multiple-injured patients [35]. Therefore, supplemental imaging such as CT scan or MRI should be performed [1,36]. This will accurately confirm the diagnosis. Moreover, these modalities help in the evaluation of bone and nervous structures. Besides the diagnosis, this radiographic assessment will aid in the classification of AOD according to Traynelis et al. [31]. Type I, which corresponds to our case, is the most frequent and involves anterior displacement of the occiput with respect to the atlas. Type III which is the most uncommon, denotes posterior displacement of the occiput on the atlas. Type II, which is the most unstable, involves a longitudinal distraction. This pathology has a very bad prognosis since it involves neurological and vascular injuries; therefore, some authors advocate the use of angiography in patients suffering from vascular impairment [8].

There is a general consensus on the necessity to perform reduction and surgical stabilization in the adult patients. Fixation by fibrous ankylosis performed in children after long-term immobilization in a halo vest [1,37,38] appears inappropriate in adults. There is a risk of major persistent residual chronic laxity. Therefore, most authors recommend surgical management, and whatever the selected mean of fixation, it should correspond to an occipito-cervical fusion [30,31,39—44]. In type I or III AOD, reduction with traction applied in the axis and temporary fixation in a halo vest could be considered but should be followed by surgical fixation. In unstable type II AOD, traction is not recommended and early surgical stabilization should be preferred. We advocate the use of a two-stage surgical treatment starting with a long-term halo vest stabilization. This therapeutic option has not been reported in the literature yet. It allows thorough clinical and radiographic (MRI) examination of the lesions. As in our case, such immobilization encourages proper healing of dural defects, offers good conditions for joint fusion and reduces the risks which could occur during osteosynthesis of peripheral bony lesions. Preoperative manipulation as well as patient installation are thus facilitated. Moreover, proper functional positioning of upper cervical spine may be tested prior to definitive fixation. It is obvious that this two-stage surgical management is only conceivable in the absence of any medullary compression. Removal of the halo vest will be postponed after assessment of spontaneous breathing and extubation. There is no need for any supplemental immobilization. An intensive cardiorespiratory resuscitation should be associated to these surgical options.

**Conclusion**

AOD has historically been associated with very poor prognosis. However, with improvements in early on-scene management and quality of care in the emergency department, the initial survival rate seems to have increased among patients. Therefore, spine surgeons will be dealing increasingly with this pathology. Early and accurate AOD recognition is essential. Proper knowledge of diagnostic techniques associated with CT scan performed in case of doubt is essential for early detection of AOD and will prevent delayed treatment. This therapeutic management should be standardized with cardiorespiratory resuscitation.
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early and surgical fixation. In the absence of any medullary compression, we advocate the use of a two-stage surgical treatment: the patient should be fitted in a halo vest prior to the occipitocervical joint fusion.

Conflict of interest statement

None.

References


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