We present four patients who had sustained a traumatic dislocation of the atlanto-occipital joint. The diagnosis was initially missed in two patients. One patient, who was neurologically intact, was treated non-operatively. The remaining three recovered neurologically after an occipitocervical fusion. Early recognition of the injury, especially in multiply-injured patients with head injuries, and timely management may improve survival and neurological recovery.

Traumatic dislocation of the atlanto-occipital joint is often fatal. Even in survivors, severe persistent neurological deficit is common. A high index of suspicion, early resuscitation, and the use of newer diagnostic techniques contribute to an improved outcome.

Patients and Methods

We treated four multiply-injured patients (two men, two women), who had traumatic dislocation of the atlanto-occipital joint (Table I). Their mean age was 36 years (23 to 43). In three the injuries followed a motor-vehicle collision; in the fourth a steel beam had landed on the patient’s neck. Three who had sustained a concomitant head injury (Glasgow coma scale range 9 to 12) were intubated at the scene of the accident. One patient (case 4) sustained a fracture of the mandible and two (cases 1 and 2) developed an haemopneumothorax following multiple rib fractures. One (case 2) had cranial nerve palsies (6th, 9th, 10th and 12th) with normal neurological function of the limbs.

The diagnosis, which was initially missed in two patients (cases 1 and 2), was confirmed at nine and five days after the accident (Fig. 1). CT and MRI were used to evaluate the injuries in three patients (Figs 2 and 3). After making the diagnosis, all patients were initially immobilised in a halo thoracic brace, but reduction was achieved in only two (cases 1 and 4). Occipitocervical fusion was successful in three patients and one, who refused surgery, was treated non-operatively in a halo body jacket for three months (Table I).
Coronal CT image showing a rotatory dislocation of the atlanto-occipital joint (arrows).

Fig. 2

T2-weighted sagittal MR scan showing cerebral spinal fluid in the retropharyngeal space (arrow) and compression at the cervicomedullary junction after an anterior dislocation.

Fig. 3

Radiographs showing a) distraction injury of the atlanto-occipital joint and b) occipitocervical fusion with partial reduction of the atlanto-occipital joint.

Fig. 4a

Fig. 4b

Table 1. Clinical details of four patients with atlanto-occipital dislocation

<table>
<thead>
<tr>
<th>Case</th>
<th>Gender</th>
<th>Age  (yrs)</th>
<th>Type of injury</th>
<th>Initial neurology</th>
<th>Treatment</th>
<th>Neurology at follow-up</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>F</td>
<td>23</td>
<td>Posterior dislocation</td>
<td>Left hemiparesis</td>
<td>Occipitocervical fusion</td>
<td>Normal</td>
</tr>
<tr>
<td>2</td>
<td>M</td>
<td>39</td>
<td>Anterior dislocation</td>
<td>Intact. Cranial nerve palsies (6th, 9th, 10th, 12th)</td>
<td>Occipitocervical fusion</td>
<td>Normal</td>
</tr>
<tr>
<td>3</td>
<td>F</td>
<td>43</td>
<td>Distraction</td>
<td>Quadriparesis</td>
<td>Occipitocervical fusion</td>
<td>Mild spasticity of lower limbs</td>
</tr>
<tr>
<td>4</td>
<td>M</td>
<td>42</td>
<td>Rotatory dislocation</td>
<td>Normal</td>
<td>Non-operative with halo body jacket</td>
<td>Normal</td>
</tr>
</tbody>
</table>

Results

The mean follow-up was 3.7 years (1 to 9). Bony fusion and neurological recovery were achieved in three patients (Fig. 4). Flexion, extension and rotation of the neck were restricted by 50% in two patients (cases 2 and 3). The patient who had been treated non-operatively experienced minor discomfort only at the extremes of neck movement (Fig. 5). All patients returned to their pre-accident employment.
Discussion

The outcome of traumatic atlanto-occipital dislocation is often fatal, but in the past two decades an increasing number of survivors have been reported. This has been attributed to improvements in on-site resuscitation, rapid transportation to hospital with the head supported and an increasing awareness of this injury.1,2,4,6-7 The injury has been noted to be three times commoner in children than in adults, which may be attributed to anatomical differences.3 The craniovertebral junction in children is inherently less stable than in adults because of the relatively small occipital condyles and the horizontal orientation of the articulation between the cranium and the atlas.8,9

After the injury, prevertebral soft-tissue swelling at the occipitocervical junction is a consistent finding on the lateral radiograph. The diagnosis was not appreciated at the initial examination of two patients in our study and in one third of previous reports of patients who have survived.4 A meticulous clinical and imaging evaluation is essential in order to exclude atlanto-occipital dislocation in the multiply-injured patient with an associated head injury. Study of the occipitocervical junction by plain radiography has several shortcomings related to magnification factors, variation in the position of the neck, identification of landmarks and concomitant fractures of the atlas.1,3,10 In a report of patients with undiagnosed atlanto-occipital dislocation, 36% deteriorated neurologically because of inadequate cervical immobilisation.9

Atlanto-occipital dislocation has been classified radiologically into three types: longitudinal distraction with axial separation of the occiput, rotational injuries and anterior or posterior displacement of the occiput with respect to the atlas.11 Distraction and rotational injuries are difficult to diagnose on plain radiographs, but the prevertebral soft-tissue swelling which is usually present warrants further investigation. CT with reformatted sagittal and coronal images may show widening of the atlanto-occipital joint or dislocation of the occipital condyles.1 Subarachnoid haemorrhage at the craniocervical junction is often associated with atlanto-occipital dislocation and should raise the suspicion of severe craniocervical ligamentous injury.9 MRI is the investigation of choice to outline the anteroposterior relationship of the cranium with respect to the spinal axis. In addition, the integrity of the medulla, cervical cord and the vertebral arteries can be demonstrated.3-5 In one patient (case 2), MRI also showed a leak of cerebrospinal fluid, which illustrated the severity of the injury.

The initial neurological evaluation of these patients is always difficult because of concomitant head injury, blunt thoracic and abdominal trauma and fractures of the limbs.9 Severe neck pain, which was noted in two patients (cases 1 and 4), may be the only manifestation of this injury in patients who are neurologically intact.12 The mechanism of injury to the lower cranial nerves may be axial traction on both the medulla and the nerves as a result of the displacement.1,3,4 This emphasises the hyperextension mechanism of injury which, in addition, may cause facial laceration.
Associated injury to the vertebral arteries may lead to vascular compromise and secondary neurological deficit. In one patient (case 1) the transient left-sided weakness associated with rotation of the neck may have been caused by kinking of the vertebral artery at the cranio-cervical junction. Magnetic resonance angiography was not undertaken due to the presence of stainless steel implants. The high mortality associated with this injury is probably due to medullary trauma, which may cause bradycardia, hypertension and cardiopulmonary instability. In our study, the prompt on-site resuscitation and stabilisation may have contributed to a satisfactory outcome, despite a delayed diagnosis in two patients.

The extent of fusion which should be undertaken in patients with traumatic disruption of the atlanto-occipital junction is controversial. A posterior fusion extending from the occiput to the axis is usually recommended for patients with an extensive neurological deficit. Apart from restriction of neck movement after an occipitoaxial fusion, patients who are neurologically intact may have an increased risk of later degenerative change in the lower cervical spine. Although a successful outcome after non-operative treatment in an adult has not been previously reported, immobilisation in a halo-thoracic brace resulted in a similar outcome in a child.

Atlanto-occipital dislocation is uncommon and frequently fatal. The prognosis for survival and neurological recovery can be improved with early recognition and appropriate treatment.

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References