Pneumocranium secondary to halo vest pin penetration through an enlarged frontal sinus

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Abstract We present a case report of a patient with pneumocranium secondary to halo vest pin penetration and a review of literature. The objectives of this study are to report a rare complication of halo vest pin insertion and to discuss methods of prevention of this complication. Halo vest orthosis is a commonly used and well-tolerated upper cervical spinal stabilizing device. Reports of complications related to pin penetration is rare and from our review, there has been no reports of pneumocranium occurring from insertion of pins following standard anatomical landmarks. A 57-year-old male sustained a type 1 traumatic spondylolisthesis of C2/C3 following a motor vehicle accident. During application of the halo vest, penetration of the left anterior pin through the abnormally enlarged frontal sinus occurred. The patient developed headache, vomiting and CSF rhinorrhoea over his left nostril. He was treated with intravenous Ceftriaxone for 1 week. This resulted in resolution of his symptoms as well as the pneumocranium. In conclusion, complications of halo vest pin penetration are rare and need immediate recognition. Despite the use of anatomical landmarks, pin penetration is still possible due to aberrant anatomy. All patients should have a skull X-ray with a radio-opaque marker done prior to placement of the

halo vest pins and halo vest pins have to be inserted by experienced personnel to enable early detection of pin penetration.

Keywords Halo vest · Complications · Pneumocranium

Introduction

The halo vest was first introduced in 1959 by Perry and Nickel [3]. Although it was initially intended for post-operative use, it is currently used in the treatment of unstable upper cervical fractures. The halo vest is relatively well tolerated with high union rates [7]. However, numerous complications have been reported which includes pin loosening, pin site infection, pressure sore, dysphagia and loss of reduction [1]. We present a case report of a rare complication of halo vest pin application due to pin penetration through an enlarged frontal sinus and a review of the literature in an attempt to identify the morphological characteristics of the frontal sinus.

Case report

A 57-year-old man was involved in a motor vehicle accident. He complained of pain over the upper neck. There was no weakness or numbness of the upper or lower limbs. Examination revealed tenderness over the upper cervical spine. There was no neurological deficit. Radiograph and computed tomography examination of the cervical spine showed a Levine and Edwards type 1 traumatic spondylolisthesis of C2/C3 (Fig. 1).

He was admitted at the ward and was treated initially with a hard cervical collar. Halo vest was planned as the

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Fig. 1 Computed tomography showing Levine and Edwards type 1 traumatic spondylolisthesis of C2/C3

definitive treatment for this patient. The location of the anterior halo vest pins was inserted through standard anatomical landmarks. The two anterior pins are inserted in the safe zone [1] and the two posterior pins are inserted just superior to the pinna. The safe zone is described as 1 cm above the orbital rim and at the outer half of the eyebrow.

The pins were first tightened by hand until it engages at the cranium. Then the pins were tightened in pairs diagonally (right anterior with left posterior, left anterior with right posterior) with a torque screw-driver. The pins were progressively tightened by 2 inch-pounds increments until it reaches 6 inch-pounds [4]. In this case, as the left anterior pin was tightened further, there was a sudden loss of torque from 4 to 2 inch-pounds.

At this point, the pin was removed and the track was evaluated through tactile examination. It was determined that the pin had penetrated the cranium as the end of the track was soft. The pin was then reinserted 2 cm lateral to the initial pin track (Fig. 2). Insertions of the other three pins were uneventful.

The patient then complained of severe pain over the left anterior pin site. However, he did not have any other symptoms. After about 6 h, the patient started to have vomiting and CSF rhinorrhoea over the left nostril. A CT scan was done and showed that there was a breach of the cranium through an abnormally large left frontal sinus causing a pneumocranium (Fig. 3)

He was observed closely for any occurrence of fever, any increase in headache as well as any drop in his Glasgow Coma Score. Intravenous Ceftriaxone 1 g bd was prescribed for a week. Subsequently, his headache, vomiting and rhinorrhoea resolved and he was discharged home. A repeat CT scan was done 1 week after discharge

Fig. 2 The location of the initial pin which penetrated the left frontal sinus and the new location of the pin sited 2 cm lateral to it

Fig. 3 Computed tomography showing a breach of the cranium through an abnormally large left frontal sinus causing a pneumocranium

which showed complete resolution of the pneumocranium (Fig. 4).

Discussion

There had been various reports of halo vest complications in the literature [1]. Intracranial pin penetration after halo vest insertion is a rare complication. It is usually associated with falls, improper placement of the pin and over tightening of the pin [2]. However, a search of the literature did not reveal any pneumocranium as an initial complication during halo vest pin insertion.

Traditionally, the location of the anterior pins is approximately 1 cm superior to the orbital rim and at the outer half of the eyebrow. This is to avoid frontal sinus

Fig. 4 Computed tomography done 1 week later showing complete resolution of the pneumocranium

penetration as well as injury to the supraorbital and supratrochlear nerve. The location of the frontal sinus was investigated by Tubbs et al. [6] in his cadaveric study which showed that the frontal sinus does not extend beyond 5 mm lateral to the mid pupillary line and 12 mm superior to the superior orbital ridge.

However, there seems to be variation in the anatomy of the frontal sinus. A computed tomography analysis of the frontal sinus [5] showed that the left frontal sinus is larger in 100% of their subjects and interestingly the frontal sinus was also significantly larger in males.

In this patient, despite the fact that the left anterior pin was inserted lateral to the mid-pupillary line, the pin still penetrated the left frontal sinus. This shows that standard anatomical landmarks might not provide enough safety margins for halo vest pin insertion. This is particularly so for the left anterior pin whereby the frontal sinus is potentially larger.

Therefore, we propose that a radiograph of the skull with a radio-opaque marker indicating the intended insertion point or a computed tomographic evaluation of the skull and the frontal sinus is a prerequisite prior to halo vest pin insertion. Furthermore, tactile evaluation during insertion is critical to detect penetration as in this case. A loss of torque during insertion should alert the surgeon of potential penetration of the cranium.

Conclusion

Complications of halo vest pin penetration are rare and need immediate recognition. Despite the use of anatomical landmarks, pin penetration is still possible due to aberrant anatomy. All patients should have a skull X-ray with a radio-opaque marker or a computed tomography of the skull done prior to placement of the halo vest pins. Halo vest pins also have to be inserted by experienced personnel to enable early detection of pin penetration.

Conflict of interest statement None of the authors has any potential conflict of interest.

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