Transorbital Penetrating Brain Injury with a Large Foreign Body

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A 30-year-old man presented with forward protrusion of the left globe one hour after falling in a ditch of wooden sticks. Except for a minor headache, no other neurological abnormality was reported. The patient was well oriented in time, place and person without any neurological deficit. Glasgow coma scale (GCS) score was 15 and all vital signs were within normal limits.

Ophthalmic examination revealed visual acuity of no light perception in the left eye while the left globe was proptotic and displaced temporally. Movements of the left eye were restricted in all directions and eyelid closure was inadequate. A 1.5 cm laceration was present in the medial part of the left upper eyelid, yet no foreign body was detected. Upon presentation, the left ocular surface was covered with blood clots which disclosed conjunctival congestion and chemosis after cleaning. The left pupil and fundus were not visible because of hyphema and consensual light reflex was absent in the right eye (Fig. 1). Ocular examination was normal in the fellow eye. A diagnosis of post-traumatic retrobulbar hemorrhage was made based on the clinical presentation, and orbital and cranial CT scans were requested accordingly.

CT scan demonstrated an elongated, well-defined and extremely low-attenuation area within a thin rim of high density in the medial aspect of the left orbit, passing through the superior orbital fissure into the ipsilateral temporal lobe lateral to the sellar region and almost juxtaposing the brainstem posteriorly. The above-mentioned features were suggestive of an orbitocranial foreign body which appeared to be a bamboo stick measuring 11x0.8 cm. A bone fragment was noted at the superior orbital fissure which was consistent with fracture of the greater sphenoid wing. Moreover, intracerebral hemorrhage was present in the left temporal lobe (Fig. 2).

With a diagnosis of orbitocranial penetrating injury through the superior orbital fissure the patient was further observed and followed by neurosurgeons.

DISCUSSION

Penetrating brain injuries constitute 0.4% of all head injuries and are usually the result of falls, motor vehicle collisions and explosions. Intraorbital foreign bodies are usually associated with high-velocity orbital injuries. Orbitocranial penetrating injuries caused by low-velocity trauma are rare. Due to its specific anatomic configuration, the orbit constitutes a predilective...
pathway for low-velocity foreign bodies entering the skull. The pyramidal shape of the orbit may deflect objects entering it towards the apex, where the superior orbital fissure and optic canal allow passage to the middle cranial fossa. Presentation depends on the entry route; if the penetration path is parallel to the orbital roof, the object may penetrate the cranium through the superior orbital fissure or optic canal but does not usually result in bone fracture. Upward penetration of a foreign body however, would easily cause orbital roof fracture due to its thinness, eventually penetrating the frontal lobe.4,6

Except for high velocity injuries, most penetrating cranial injuries, regardless of the size of the penetrating bodies, are rarely associated with major neurological symptoms. Due to the absence of neurological signs, an intracranial penetrating body is sometimes difficult to suspect. Chibbaro et al7 reviewed 18 cases of penetrating non-missile foreign bodies and reported GCS of 14-15 in 50% of subjects without obvious evidence of intracranial injury. Therefore, even in the presence of a trivial orbital wound, a thorough ophthalmological examination and neurological evaluation is mandatory.

Intracranial complications of penetrating orbitocranial injuries include immediate structural injuries which may lead to permanent neurological deficits and may even be potentially fatal.8 Vascular complications may include hemorrhage, thrombosis and occlusion. Ocular laceration, retrobulbar hematoma, proptosis and optic nerve damage with resultant severe loss of vision are among the ocular complications.9,10 Infective complications are more common and usually occur late.

In a literature-review of 42 retained intracranial wooden foreign bodies, Miller et al11 reported permanent neurological sequelae in 74% and brain abscesses in nearly half of the cases. Additionally, a mortality rate of 25% was revealed in 28 cases in the post-antibiotic era. Infections with versatile organisms may develop 3 to 6 weeks after trauma. Infection-related complications following this type of injury can be due to the porous structure and organic consistency of wood, which provide a natural reservoir and appropriate culture medium for microbial agents.9 Diagnostic imaging determines the presence and nature of foreign material, and associated bony or soft tissue injuries. Plain radiography is not useful in detecting intraorbital wooden foreign bodies. Most foreign bodies, with the exception of wood, are well-demonstrated by orbital CT scan. Metallic foreign bodies take a typical high-density appearance on CT scan. A single piece of wood may acquire a wide variety of radiodensities.4 Physical density of freshly cut wood is relatively high due to its significant

Figure 2. Axial (a) and coronal (b) CT scans of the orbit and brain reveal a high-density elongated foreign body (measuring 11x0.8 cm) containing air, passing through the superior orbital fissure and juxtaposing the brainstem. A bony fragment of the greater sphenoid wing was dragged with the foreign body and is visible at its tip (smaller arrow, top image). Intracerebral hemorrhage is present in the temporal lobe (larger arrow, top image).
water content; as it dries up, its water content is reduced and replaced by gas. During this drying process, CT attenuation values decrease and mimic those of muscle, water, fat and air.

In this case, the large foreign body on CT scan appeared as a cylindrical air-filled structure of high-density, the typical appearance of a bamboo stick. Yang et al\textsuperscript{12} described similar features in a case with bamboo stick thigh injury.

Nakata et al\textsuperscript{13} reviewed CT scan features of two cases with bamboo foreign bodies in lung parenchyma. Chest radiography showed a linear opacity in the left upper lobe and a large cystic opacity with air-fluid level in the left lower lobe. CT scan findings revealed cylindrical structures of high density, highly suggestive of bamboo. Unlike most wooden foreign bodies, bamboo appears to maintain its original cylindrical structure inside the body for many years.

To differentiate air (as in sinuses) from dry wood in CT scan images, wide bone window setting should be employed (4000 H width/400 H level). Magnetic resonance imaging (MRI) could be advantageous when plain radiography, ultrasonography and CT scan are not confirmatory.\textsuperscript{14,15}

It has been established that patients with higher GCS scores may benefit from early management, however the presence of an intracranial foreign body per se and its location in the middle cranial fossa are associated with poor prognosis. Foreign bodies in the anterior cranial fossa may be associated with a better prognosis.\textsuperscript{16} A transorbital or transcranial approach can be chosen for neurosurgery depending on the location of the fragment.\textsuperscript{17}

Herein, we present a unique case of severe, low-velocity penetrating brain injury with a large foreign body juxtaposing the brainstem causing optic nerve injury, fracture of the greater wing of the sphenoid and intracerebral hemorrhage in the temporal lobe without any neurological symptoms. Our observations illustrate that both a thorough examination and a high-index of suspicion are essential in any orbital injury even in cases with no neurological signs and symptoms. Clinical presentation in our patient was not severe which could be due to non-involvement of the brainstem. Besides, the condition did not cause fatal bleeding, neither did it dislodge a large bone segment and affected only a non-eloquent area of the brain.

The severity of penetrating trauma to the orbit is often underestimated by physical examination. The medical team should focus on recognizing the actual extent of injury in order to appropriately manage the condition by employing appropriate imaging modalities for identification and evaluation of an orbital foreign body. Aggressive and timely work-up as well as expeditious surgical management are crucial in these settings and can produce exceptionally good outcomes despite major trauma.

Conflicts of Interest
None.

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