

Occult orbito-cranial penetrating injury by pencil: Role of beta tracer protein as a marker for cerebrospinal fluid leakage

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Orbito-cranial foreign bodies present a treacherous situation that can escape detection. The only evidence of these foreign bodies may be the entry wound in the form of a small lid laceration. A two-year-old boy presented with right upper lid laceration following a fall two hours back. Analysis of the fluid around the wound revealed a beta-tracer protein (beta-TP) value of 33.5 mg/l suggestive of cerebrospinal fluid (CSF). Three-dimensional computed tomography (CT) scan revealed a foreign body measuring 4.2 cm x 0.8 cm passing from the orbital roof to the frontal lobe. The foreign body tract was explored through the eyelid laceration and a broken pencil was removed followed by dural patch graft. The patient developed no ocular or intracranial complications. Beta-TP, a highly specific marker of CSF is routinely used in screening patients of neurosurgery and otolaryngology with CSF leaks, however, its use has never been reported in ophthalmic literature based on an online PubMed search.

Key words: Beta-tracer protein, cerebrospinal fluid leakage, three-dimensional computed tomography.

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Injury by orbito-cranial foreign bodies mostly presents dramatically but sometimes may be subtle and occult. Low suspicion for intracranial extension leads to delay in diagnosis and may result in life-threatening intracranial complications.^[1-5] We report a rare case of occult penetrating orbito-cranial injury by a pencil presenting as upper lid laceration. Beta-tracer protein (beta-TP), a highly specific marker for cerebrospinal fluid (CSF) was detected in the fluid around the wound margins suggestive of a CSF leak. Detection of beta-TP facilitated early diagnosis of occult penetrating orbito-cranial injury in our patient which resulted in proper and timely intervention with no ocular or intracranial complications.

Case Report

A two-year-old boy presented with a right upper eyelid laceration, two hours after a fall from a table. The child was playing with color pencils with his brother during which he sustained the injury.

Ophthalmic examination revealed a laceration measuring 1.5 cm x 0.5 cm involving the central part of the right eyelid with minimal edema [Fig. 1A]. The rest of the ocular examination was normal, except that on testing the extraocular movements of the right eye, the child was uncooperative for elevation due to pain. Neurological examination revealed no abnormality. The patient was taken under general anesthesia for a detailed examination and lid laceration repair. However, on the operation table minimal clear fluid coming out through the wound margins was observed. Analysis of fluid revealed a beta-tracer protein value of 33.5 mg/l, suggestive of cerebrospinal fluid (CSF). The patient underwent an urgent computed tomography (CT) scan of the orbit and brain which revealed a linear hyperdense shadow with surrounding hypodensity measuring 4.2 cm x 0.8 cm, suggestive of a broken pencil [Fig. 1B-D]. Three-dimensional (3D) reconstruction documented that the pencil had penetrated the right frontal lobe through the orbital roof ending just anterior to the anterior horn of the lateral ventricle [Fig. 2A-D]. A multidisciplinary approach consisting of an orbital surgeon and a neurosurgeon was used to manage this patient. After neurosurgical clearance, the orbital surgeon explored the upper eyelid wound and the pencil was removed from the foreign body tract followed by laceration repair [Fig. 3A]. A craniotomy was then performed by the neurosurgeon which revealed laceration at the base of the right frontal lobe. The defect in the dura was closed with a pericranial graft from the right frontal bone. The patient was started on intravenous third-generation cephalosporin (Ceftriaxone Rocephine®) for

seven days and had an uneventful recovery.

Postoperatively there was minimal ptosis of the right upper lid which resolved in a month [Fig. 3B]. Three months following surgery patient underwent a complete neurological examination which was normal. Magnetic resonance imaging of brain showed a cortical and subcortical fibrotic lesion measuring 1 mm at the base of the right frontal lobe corresponding to the laceration. At the last follow-up, two years after surgery the patient had no ocular or neurological abnormality.

Discussion

Orbito-cranial injuries by foreign bodies are occult if the

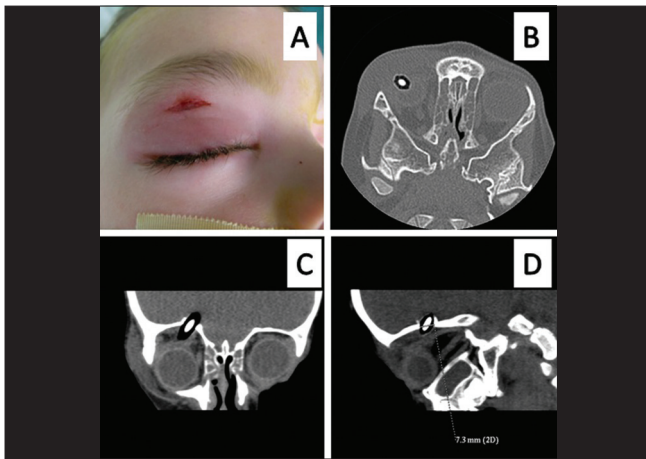


Figure 1: A Clinical photograph of the patient showing the eyelid laceration on the right central upper eyelid measuring 1.5 cm x 0.5 cm. B, C, D Computed tomography (axial, coronal and sagittal) of the brain and orbit showing a linear hyperdense foreign body with hypodensity all around it, measuring 4.2 cm x 0.8 cm in the right orbit, piercing the orbital roof and the dura, and entering the right frontal lobe. These features were suggestive of a broken pencil, the hyperdensity was due to the central core of the pencil made of lead and the hypodensity surrounding it was due to the wood

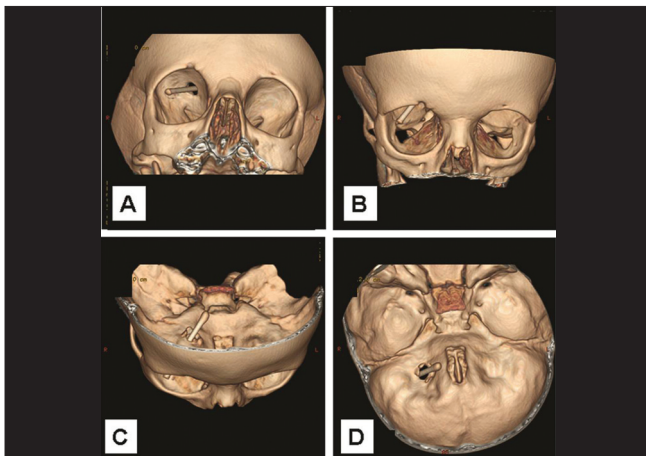


Figure 2: A-D Three-dimensional computed tomography scan showing the trajectory of the pencil. The pencil had penetrated the right frontal lobe through the orbital roof causing a defect in the dura. The tip of the pencil was just anterior to the anterior horn of the lateral ventricle. There was no disruption of major cerebral blood vessels

presenting injury is deemed minimal and the ophthalmological and neurological evaluation are otherwise within normal limits.^[1] The roof of the orbit provides one of the easiest entry routes for a foreign body into the brain as it is relatively thin in this location.

Trivial-appearing eyelid lacerations may camouflage occult deep penetrations and are frequently sutured without further investigation.^[6-8] CSF leakage is associated with a 20% risk of life-threatening meningitis hence its detection and management is essential to prevent possible life-threatening infections of the central nervous system.^[9] In a review of the literature on occult orbito-cranial injuries complications like frontal lobe abscess,^[2] meningitis,^[2] encephalomeningocele^[3] and retained foreign body^[4] have been reported.

Beta-TP is a highly specific marker for CSF, produced mainly in the epithelial cells of the choroid plexus. It has a sensitivity of 93–100% and a specificity of 100% for detecting CSF leaks.^[10] The technique involves centrifuging the fluid sample at 2000 g for 10 min. The BN II nephelometer and the N Latex β TP[®] test (Dade Behring, Marburg Germany) are used. Samples (5 μ l) are diluted to a total volume of 500 μ l with diluents buffer (Dade Behring, Marburg, Germany) and measured on the nephelometer. The concentration in normal CSF is 5.4–23.8 mg/l and for serum it is 0.2–0.7 mg/l.^[10] The detection of beta-TP from the fluid around the wound margins in our patient was suggestive of CSF leak from an occult penetrating orbito-cranial injury.

The reason we took the patient under general anesthesia before a definitive radiological procedure is that firstly it gave us a chance to examine the wound thoroughly as the initial ophthalmic examination did not reveal any suspicion of an intraorbital foreign body and secondly a positive beta-TP intra-operatively gave us a very strong indication for ordering a definitive radiological investigation following which a three-dimensional CT scan and further management were performed in the same sitting.

A coordinated team approach between an ophthalmologist and neurosurgeon is essential for managing these injuries.^[5] We removed the foreign body through the laceration, as this

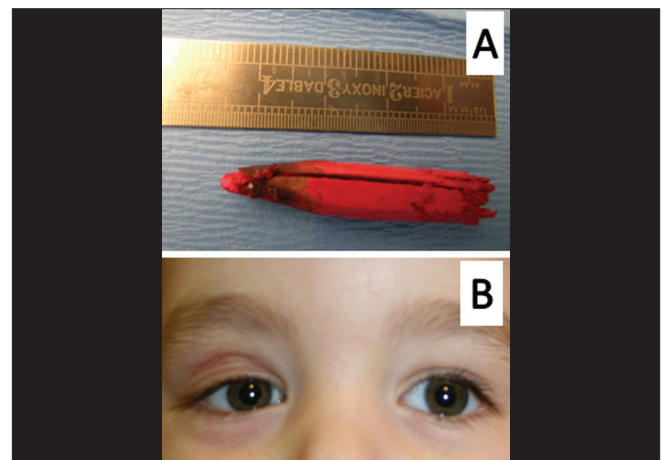


Figure 3: A The broken pencil measuring about 4.2 cm x 0.8 cm. B Postoperative photograph of the patient at the time of discharge with minimal ptosis of the right upper lid

approach gives a faster, less invasive way to extract the foreign body than a craniotomy, and the recovery time is reduced.

The detection of beta-TP is currently been used in the field of neurosurgery and otolaryngology to diagnose CSF leaks following head injuries, skull base or paranasal sinus surgeries.^[9] An online PubMed search was carried out which revealed that the application of beta-TP has never been reported in ophthalmic literature. The detection of beta-TP is simple, rapid (within 15 min) and relatively inexpensive, hence we recommend it to be used as a screening procedure before definitive radiological procedures are planned in cases where CSF leaks are suspected.

References

1. Turbin RE, Maxwell DN, Langer PD, Frohman LP, Hubbi B, Wolansky L, *et al.* Patterns of transorbital intracranial injury: A review and comparison of occult and non-occult cases. *Surv Ophthalmol* 2006;51:449-60.
 2. Bursick DM, Selker RG. Intracranial pencil injuries. *Surg Neurol* 1981;16:427-31.
 3. Sebag J, Shillito J, Robb R. Transorbital penetrating injuries to the frontal lobe. *Ophthalmic Surg* 1986;17:631-4.
 4. Gottlieb RD, Meiteles LZ, Liebeskind AL, Kimmelman CP. Foreign body of the skull base due to transorbital penetrating trauma. *Otolaryngol Head Neck Surg* 1992;107:800-2.
 5. Fezza J, Wesley R. The importance of CT scans in planning the removal of orbital-frontal lobe foreign bodies. *Ophthal Plast Reconstr Surg* 1999;15:366-8.
 6. Bard LA, Jarrett WH. Intracranial complications of penetrating orbital injuries. *Arch Ophthalmol* 1964;71:332-43.
 7. Duffy GP, Bhandari YS. Intracranial complications following transorbital penetrating injuries. *Br J Surg* 1969;56:685-8.
 8. Guthkelch AN. Apparently trivial wounds of the eyelids with intracranial damage. *Br Med J* 1960;2:842-4.
 9. Petereit HF, Bachmann G, Nekić M, Althaus H, Pukrop R. A new nephelometric assay for β -trace protein (prostaglandin D synthase) as an indicator of liquorrhoea. *J Neurol Neurosurg Psychiatry* 2001;71:347-51.
 10. Decock CE, Breusegem CM, Van Aken EH, Leroy BP, Van Den Broecke CM, Delanghe JR. High beta-trace protein concentration in the fluid of an orbital cyst associated with bilateral colobomatous microphthalmos. *Br J Ophthalmol* 2007;91:836.
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