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SHORT COMMUNICATION

Case report

Trans-orbital intra-cranial air gun injury

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PURPOSE. *To describe a case of trans-orbital intra-cranial air gun injury with a discussion on air gun related morbidity and mortality.*
METHODS. *Case report and literature review.*
RESULTS. *The air gun pellet travelled through the orbit without penetrating the globe. It passed into the middle cranial fossa through the superior orbital fissure and lodged in the temporal lobe. The patient was managed conservatively with antibiotics and antiepilectis.*
CONCLUSIONS. *Air gun design has changed in recent years resulting in an increased morbidity and mortality. Stricter legislation on the sale and use of these weapons needs to be implemented. (Eur J Ophthalmol 2003; 13: 320-3)*

KEY WORDS. *Orbit, Airgun, Cranial, Trans-orbit*

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INTRODUCTION

Air guns are non-powder firearms that use compressed gas to propel a metallic pellet at high speed and are available to children of all ages. Air gun related injuries remain a significant cause of mortality and morbidity in the Western World despite efforts to improve safety standards and legislation (1, 2). When shot at close range, these weapons provide sufficient momentum for a pellet to penetrate through the skull, resulting in serious and sometimes fatal intra cranial injuries (3). The skull may provide sufficient resistance to prevent direct intra cranial entry when air guns are fired from a distance. However, the superior orbital fissure and the relative weakness of the lesser wing of the sphenoid at the orbital apex leave the middle cranial fossa vulnerable to entry via the orbit. We describe a case of temporal lobe injury via a trans-orbital route. To the best of our knowledge, such a case has not been reported in the literature.

Case report

A 13-year-old boy was accidentally shot in the left orbit with an air gun, from several feet away. A friend while playing at home fired the gun. He was assessed within a few hours of the injury. The visual acuity was 6/6 in the right eye and hand movements in the injured left eye. There was a moderate degree of swelling of both lids laterally. The site of pellet entry was noticed at the lateral canthal conjunctiva. The cornea and lens were clear with a mild anterior chamber reaction. The intra ocular pressure was normal and, anteriorly no scleral entry or exit wound was identified. Examination of the fundus showed extensive macular haemorrhage, retinal oedema, and haemorrhage into the overlying vitreous. Extra-ocular movements were full and lid function was intact. Neurological evaluation was normal.

An orbital X ray showed a radioopaque intracranial foreign body. A CT scan showed multiple fragments of pellet tracking along the lateral orbital wall, lateral to the lateral rectus. One fragment was seen at the orbital apex lodged in the lesser wing of the sphenoid bone (Figs.1, 2). The most striking finding on the CT scan was that the largest fragment of pellet had lodged in the left temporal lobe, sparing the surrounding blood vessels (Figs.1, 2). Air was seen tracking up the sub arachnoid space laterally and superiorily into the left parietal and frontal regions. A repeat CT scan one

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Fig. 1 - *Axial CT section showing fragments of the pellet lodged in the lesser wing of sphenoid and the middle cranial fossa.*

Fig. 2 - *Coronal CT section showing fragments of the pellet lodged in the lesser wing of sphenoid and the middle cranial fossa.*

Fig. 3 - *Left fundal photograph showing extensive scarring and disruption of the macular region. The optic disc is pale temporally.*

week later showed disappearance of this air and no evidence of abscess formation. Streak artefact reduced the quality of the CT images.

Surgical removal of the intra cranial pellet was considered inappropriate and the conservative management included prophylactic anti-epileptics and antibiotics. There was no visual recovery and the vitreous haemorrhage resolved leaving extensive retinal pigment epithelium disruption and choroidal scarring (Fig. 3). During the follow up period, the parents noticed some behavioural changes with increased frequency of temper tantrums. Despite this, the patient is coping satisfactorily at school, both academically and physically.

DISCUSSION

In this patient the pellet entered the orbit through the lateral conjunctiva and continued in the lateral part of the orbit. At the apex it deflected off the lesser wing of sphenoid, changed its direction, then passed through the cranial meninges and into the temporal lobe. The superior orbital fissure lies at the apex and provides a passage for cranial nerves III, IV, VI and Vi into the middle cranial fossa. The lesser wing of sphenoid forms the supero-medial border of the superior

orbital fissure and part of the orbital roof. The orbital roof is the thinnest wall of the orbit and the most common entry site, of projectile foreign bodies, into the middle cranial fossa (4). There was no clinical or radiological evidence of damage to orbital nerves or extra ocular muscles. The extensive intra ocular damage was most likely due to the concussion force created by the pellet.

An air gun pellet shot from a distance, as in our case, will not contain sufficient momentum to penetrate the skull and cause intracranial and brain injury. However the orbit and the superior orbital fissure may function as a conduit into the middle cranial fossa for projectiles which have less momentum (5). Alexandrakis et al reported a case of trans-orbital intra cranial entry by an air gun pellet where the pellet passed through the superior orbital fissure and lodged in the cavernous sinus (5).

Although plain X-ray may confirm the presence of an intra cranial foreign body, tomographic imaging is needed to identify the exact location. Most air gun pellets are non ferromagnetic but some may contain iron (6). We performed a CT scan as information on the composition of the pellet was not available. Lakits et al demonstrated that accurate localisation is possible with spiral CT imaging (7). Angiographic evaluation may become necessary to rule out traumatic aneurysm or embolus. One disadvantage of CT scanning is metal induced streak artefacts (8). MRI has the advantage of less artefact, better soft tissue definition and no radiation dose to the lens. However, the composition of the pellet must be known before opting for MRI imaging, as intra cranial ferromagnetic material may cause fatalities during scanning (6).

A wide range of ocular injuries and secondary complications have been documented following air gun pellet injuries. These include traumatic hyphaema, secondary glaucoma, retinal detachments, choroidal rupture and endophthalmitis. Less common manifestations include ocular siderosis, sympathetic ophthalmia and gaze-evoked amaurosis (9, 10). Intraocular foreign bodies in the posterior segment carry a relatively poor prognosis (11).

Direct intra-cranial air gun pellet injuries carry an extremely high morbidity and mortality (3). In a recent epidemiological study, 30% of children with intra-cranial injuries secondary to air gun pellets died, with a further 20% suffering long-term neurological deficits (12). The most common complications are intra-cerebral haematoma, carotico-cavernous fistula, intra-cranial aneurysms, intraventricular haemorrhage, brain stem injury, abscess formation and pneumocephalus. Rarer complications include internal carotid artery embolisation and spontaneous migration of the pellet in the brain (13).

Air gun incidents are predominately accidental, although a small percentage are attempted suicide or assault. The most common victim of air gun injury is the adolescent male (12, 14). These devastating injuries occur in a significant number (15, 17, 18). Shuttleworth et al reported 19 cases of ocular injury from air weapons in the south west region of the UK (16). This report is only a tip of the iceberg. In our department we have managed 5 cases of severe ocular injury and several minor ocular injuries resulting from air gun pellet fire in the past two years.

Thirty years ago air guns were constructed using a coil and spring method to propel the pellets forward. This rarely caused serious injury, as the forces involved were relatively small. Today pump action pneumatic chambers are used which fire the pellet at speeds of up to 350 ft/second. Velocities of 150 ft/second and 200 ft/second are required to penetrate skin and bone, respectively (19). The modern day air gun is a lethal weapon. Its use kills one person every year in the UK and leads to significant morbidity in the young population (1).

In Europe children under 14 can use an airgun if supervised by a person over 21 (2). Parents are not always aware of the potential to cause serious injury and allow their children to play with these dangerous weapons unsupervised and in an irresponsible manner (20). Tighter regulation of the sale and use of these so-called ‘toys’ is needed.

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