CLINICAL IMAGES

Migrating intracranial missile

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A 27-year-old man presented to the trauma unit of a regional hospital after sustaining a single gunshot wound to the head. Although the exact range and calibre were unknown, the patient confirmed seeing the assailant use a handgun. A brief period of depressed consciousness following the injury was reported. However, on presentation the patient was alert with a Glasgow Coma Score of 15/15. No seizures were reported. On examination, a right parietal bone entrance wound was noted, with no obvious exit wound. No cerebrospinal fluid otorrhoea or rhinorrhoea was noted. The patient also had a left hemiparesis and left upper motor neuron facial nerve palsy. No other abnormalities were noted. A computed tomography (CT) scan was performed (Figs. 1(a) and (b)).

At the time it was decided to manage the patient conservatively and since his condition did not deteriorate he was discharged after 3 days. Within 2 weeks the patient returned, complaining of severe headaches with fever. No seizures were reported. He was still alert with a Glasgow Coma Score of 15/15, with the persistent left-sided weakness noted previously. In view of his deteriorating condition a repeat CT scan was performed (Figs. 2(a) - (c)).

A diagnosis was made of a septic comminuted skull vault fracture and associated intracerebral abscess. The abscess formation with resultant brain softening had probably resulted in the gravity-dependent migration of the bullet fragment into the middle cranial fossa.

In view of the follow-up CT scan findings a craniectomy and debridement of the fracture site was performed and the devitalised bone chips were removed. Twenty cubic centimetres of pus was drained from the brain abscess seen on the follow-up CT scan. The bullet was not removed. A pus swab specimen was taken and this yielded *Staphylococcus aureus*. Postoperative intravenous cloxacillin ensured a good recovery, with improvement noted in the left-sided weakness on discharge (Fig. 3).

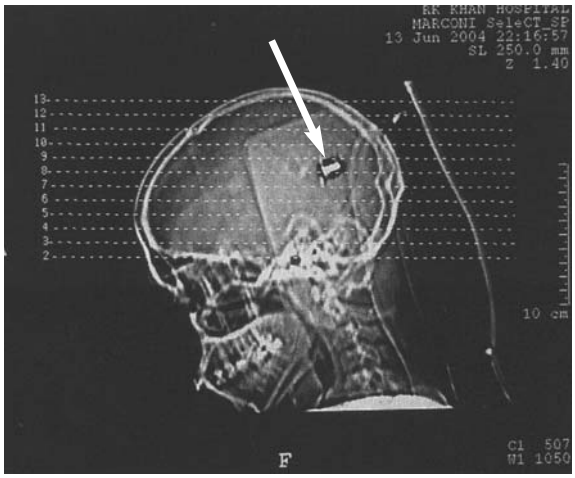

Fig. 1(a). Scout view from initial CT brain demonstrating the position of the bullet fragment (⟶) in the parietal area.

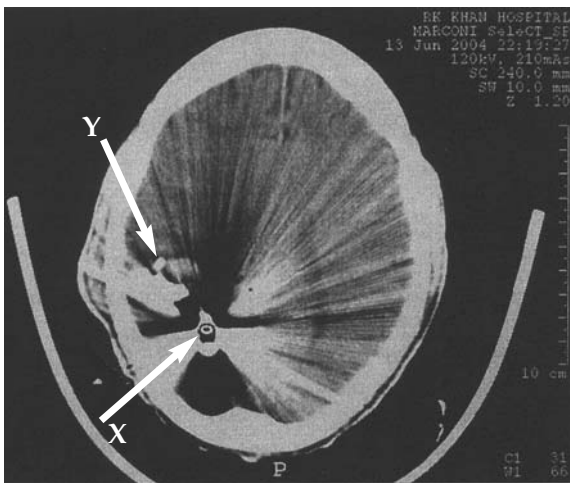

Fig. 1(b). Axial CT slice demonstrating the bullet fragment (X) in the right parietal lobe with associated metallic artefact and in-driven bone fragments (Y) at the level of the lateral ventricles. The long axis of the bullet fragment is in the sagittal plane.

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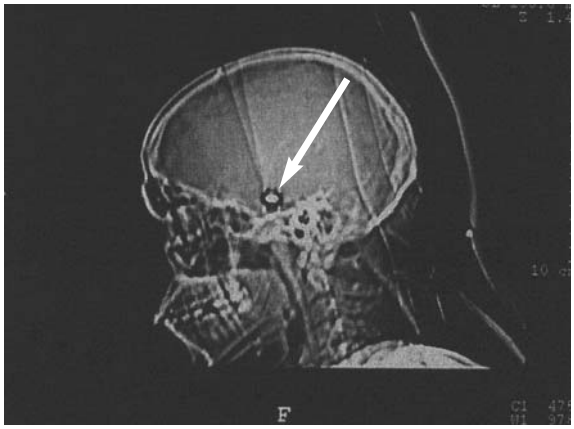

Fig. 2(a). Scout view from follow-up CT scan of the brain demonstrating the new position of the bullet fragment (⟶) in the region of the skull base in the middle cranial fossa.

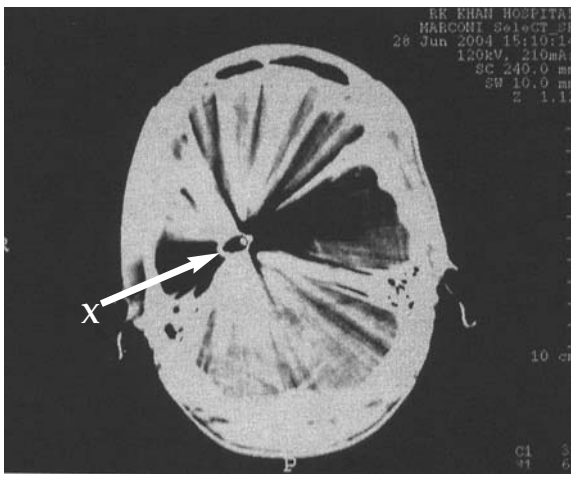

Fig. 2(b). Axial CT slice showing the inferiorly located bullet fragment (X) in the floor of the middle cranial fossa. Version of the fragment has occurred with change of the long axis of the bullet to the coronal plane.

Discussion

Penetrating craniocerebral injury (PCCI) is one of the leading causes of death in the violent tempo of modern society. Current statistics reveal that 50% of trauma-related deaths are due to traumatic brain injury, with craniocerebral gunshot wounds accounting for 35%.

A penetrating missile injury refers to traumatic brain injury where the projectile breaches the cranium but does not exit it. Damage to the brain depends on the following factors: kinetic energy imparted (this is proportionate to the velocity of the missile), the projectile's trajectory, the presence of in-driven bony fragments, local cerebral cavitation, shock-wave effects and several other secondary mechanisms of injury.[1,2]

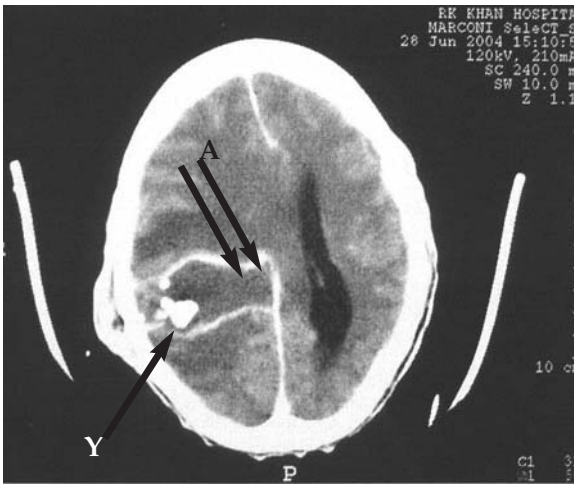

Fig. 2(c). Axial contrast-enhanced CT scan slice at the same level as Fig. 1(b) showing an intracerebral abscess (A), in-driven bone fragments (Y) and absence of the bullet fragment at this original level of bullet impaction.

Fig. 3. Post-surgical axial enhanced CT scan at the approximate level noted in Fig. 1(b) and Fig. 2(c) showing absence of the bullet and the in-driven skull vault fragments with a resolving abscess.

The retention of bullet and bone fragments as well as scalp and hair tissue within the cerebral substance following PCCI often presents a management dilemma to the neurosurgeon. The 'Infection in Neurosurgery' Working Party of the British Society of Antimicrobial Chemotherapy recommended that for civilian PCCI, antimicrobial prophylaxis should include broad-spectrum intravenous antibiotics.[3] However, this is not routine practice in many centres. In the case reported here intravenous antibiotic prophylaxis was not instituted on initial presentation at the referring hospital. It has been well documented that retained bullet fragments can lead to infective complications on the basis of foreign body reaction and missile migration.[4]

In 1916 Wilvandre and Morgan[5] described this concept of missile migration. Subsequent sporadic reports on this phenomenon have been noted in the literature.[6-8] The spontaneous migration of intracerebral bullet fragments is influenced by the specific gravity of the bullet, proximity to the cerebrospinal fluid spaces, cerebral softening with loss of tissue resistance, gravitational force and brain pulsation effects.[8] Some authors[4,5] propose that bullet migration may lead to cerebral abscess formation, whereas others maintain that bullet migration may be a consequence of cerebral white matter devitalisation, necrosis and focal softening. In our opinion the migration of projectile fragments merely served to exacerbate an existing local inflammatory process.

Rengarchary *et al*.[6] reported a case of spontaneous bullet fragment migration to an inferoposterior location over a short time period. Generally most reported cases (90%) of bullet fragment migration and abscess formation occur within 6 weeks of injury.[9] In the case reported here we noted spontaneous extraventricular caudal migration with little posterior displacement. Migration to a dependent posterior position is to be expected if the patient lies in the supine position in the first 2 weeks following injury.[10] On questioning the index patient it was established that he had spent most of the day seated in a chair rather than in bed, and this explains the predominant caudal migration.

Projectiles reaching the internal cerebrospinal fluid spaces may migrate through the ventricular system. Furlow *et al*.[7] reported spontaneous intraventricular migration of a bullet fragment. Ventricular obstruction with secondary hydrocephalus has been observed in such cases.

Immediate management of the patient with projectile migration and cerebral abscess includes urgent debridement, removal of migrating fragments and drainage of the abscess with intravenous antibiotic therapy for a week. A lodged missile in special motor areas may preclude surgical removal for fear of greater iatrogenic brain damage. Intraoperative ultrasound is a useful tool to locate deep-seated migrating fragments. Pus swabs taken from the abscess before drainage allow specific organisms to be identified and appropriate sensitivity-directed antimicrobial therapy to be instituted.

Conclusion

PCCI mandates prophylactic antibiotic therapy. The presence of retained bullet fragments raises the possibility of fragment migration and secondary abscess formation, a rare consequence of PCCI. Repeat contrast-enhanced CT scanning is the best imaging modality to demonstrate this phenomenon and helps guide the surgical approach to management of these patients. Current opinion dictates that the migrating fragments should be removed along with careful local debridement.

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