Intracranial air from an extracranial aetiology: a further unusual cause

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Introduction

Intracranial air is easily demonstrated on CT scan. However intracranial air is not a diagnosis in itself. It is merely a manifestation of an associated abnormality and the diagnosis is not complete until the cause has been established.

Case report

The patient was assaulted. He sustained multiple scalp lacerations without penetrating head injury. He was also stabbed in the dorsal spine and rendered paraplegic (clinically T4 level).

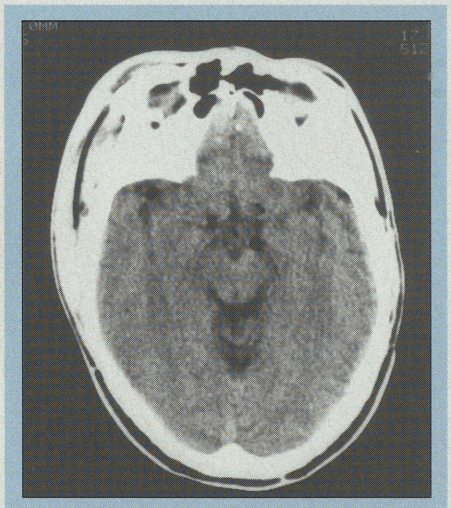

Figure 1 (a): Axial CT scan showing air-loculi in basal cisterns

CT scan of the brain showed several small intracranial air loculi within the basal cisterns (Figure 1a). No penetrating injury was shown. The right maxillary antrum was noted to be opaque. There was however no evidence of injury to the paranasal sinuses (namely ethmoid, frontal and sphenoid) which share a bony wall with the floor of the anterior cranial fossa. There was also no evidence of injury to the mastoids.

CT scan of the dorsal spine showed air within the thecal sac at the T3 level (Figure 1b). An incised fracture (representing the knife track) through the right T3 lamina is also shown (Figure 1c).

Figure 1 (b): Axial CT scan through body of T3 showing air-loculi within spinal thecal space

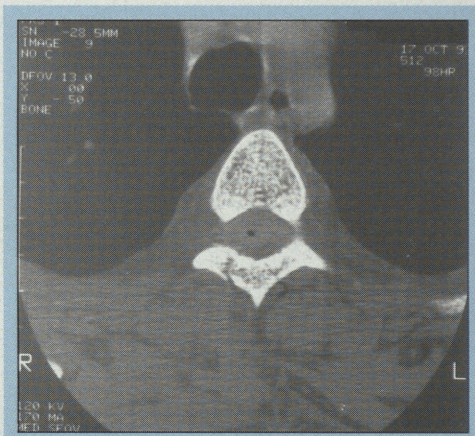

Figure 1 (c): Axial CT scan through body of T3 six millimetres distal to B. Note the incised fracture of the left lamina representing the knife track. A further air-loculus is noted within the spinal theca

From the clinical and CT findings it is concluded that the intracranial air is due to cephalad migration of intrathecal air introduced at the time of the penetrating injury to the dorsal spinal cord and theca.

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Discussion

Pneumocephalus is a not uncommon finding in association with acute head injury. Air may enter directly through a scalp wound with underlying skull fracture but is more usually seen in association with a fracture involving the air-spaces within the petrous temporal bones or paranasal sinuses. Post surgical air-loculi are common - particularly over the brain surface following evacuation of subdural haematoma. A number of rare extracranial causes of intracranial air have been described. These include:

- Epidural anaesthesia[1]
- After intrapartum rupture of a myelo-meningocoele (in a newborn)[2]
- Broncho-pleural-epidural-cutaneous fistula (occurring in a patient who had undergone radiation treatment and resection of a locally recurrent right superior sulcus tumour complicated by post-operative infection)[3]
- Bronchopleural-subarachnoid fistula (occurring in a patient who had radiation treatment and surgical resection of a Pancoast tumour)[4]
- Bronchopleural-subarachnoid fistula occurring following irradiation (without surgery) for epidermoid lung carcinoma [5,6]
- As a complication of ventriculo-peritoneal shunting where the tip of the shunt has perforated bowel. (Seen only where the shunt concerned is of the non-valved type).

Intracranial air may be deliberately produced by intrathecal air injection following lumbar puncture. This is the basis of air encephalography which was widely practised until the introduction of CT scanning in the 1970s. A modified technique was subsequently used to provide air contrast during CT scan of the cerebello-pontine angles.[7,8] This has now been largely rendered superfluous by the introduction of modern CT scanners (with high resolution and less loss of detail due to beam hardening artefact) and also by the exquisite detail of this region which is possible with MRI.

All these extracranial causes of intracranial air have in common egress of air into the spinal intrathecal space (the continuation of the cerebral subdural space) by breach of the theca. A traumatic mechanism appears to be the final common factor in most cases. Trauma mechanisms implicated include penetrating injury due to stab or deliberate needle puncture; compressive trauma applied to an abnormal cord and theca resulting in rupture of myelo-meningocoele; and trauma due to surgery. The cases reported by Lerner and Bilaniuk[5] and by Swaid *et al*[6] however indicate that other mechanisms including local tumour invasion and/or necrosis after radiotherapy may also produce fistulae by which air may enter the subarachnoid space.

Conclusion

Determining the cause of intracranial air may present a diagnostic challenge. Where no obvious cause is shown on CT scan of the brain and where the clinical setting does not suggest the presence of infection due to a gas forming organism, awareness of possible extracranial causes of intracranial air may solve an otherwise difficult diagnostic problem.

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been established. Its major uses have been to treat non-resectable or incompletely excised tumours locally or metastatic disease.[7]

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