Pneumocephalus: an unusual cause

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SYNOPSIS A 60 year old male had an open thoracotomy for bronchogenic carcinoma. On the twelfth hospital day he became obtunded and complained of headache. Radiographs revealed intracranial air. It was thought that the pneumocephalus in this patient was most likely secondary to a tension pneumothorax continuously forcing air through a dural tear sustained at the time of initial surgery. The causes of pneumocephalus are reviewed and no similar case report has been found in the literature.

Cranial aerocoele (pneumocephalus) was first fully described by Chiari (1844). Markham (1967), in a thorough review of the literature, listed the various causes as follows: trauma (fractures of the skull involving either the sinuses or base), 73.9%; neoplasm, 12.9%; infection, 8.8%;

surgical intervention, 3.7%; and idiopathic, 0.6%. He reviewed a total of 295 cases from 1884 to 1967. Postoperative pneumocephalus has been largely secondary to sinus surgery or intracranial procedures. Kessler and Stern (1962) reported a case that occurred after ventriculo-pleural shunt for hydrocephalus with development of a bronchoventricular fistula. Taverner

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FIG. 1. *Anteroposterior radiograph of the skull*
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FIG. 2. *Lateral radiograph of the skull*
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and Phillips (1947) described a somewhat similar case in a soldier during the Second World War in which a bullet entered the thoracic cavity, ascended subcutaneously, and finally lodged in the posterior fossa.

The present case represents what appears to be the first report of pneumocephalus after a purely thoracic surgical procedure.

CASE HISTORY

A 60 year old white male was admitted to the Episcopal Hospital on 17 November 1970, because of severe rib pain. A diagnosis of bronchogenic carcinoma had been made by open thoracotomy in May 1970. The carcinoma had been unresectable and the patient subsequently received a course of radiation therapy. There was no evidence at that time of distant metastasis. There was no history of past head trauma, cerebrospinal fluid rhinorrhoea, or sinus disease.

Physical examination revealed normal vital signs in a cachectic white male. The patient was alert and in moderate distress secondary to the rib pain. Positive findings were limited to decreased breath sounds and dullness to percussion over the right side of the chest. The neurological examination was normal.

Because of the intractable pain, the patient under-

went open thoracotomy on 19 November. The tumour was found to be localized to the right upper lobe and closely adherent to ribs 1-6. These were removed along with the transverse processes of the 1st to 6th thoracic vertebrae. A small cerebrospinal fluid leak was noted upon removal of the transverse processes. The pathological diagnosis was mixed bronchogenic carcinoma.

Postoperatively, the patient developed a transitory rise in temperature but remained alert. There was serosanguineous drainage from the chest tubes until the fifth day when an air leak was demonstrated radiologically with a 20% pneumothorax. This resolved and the chest tubes were removed. On the twelfth day the patient was noted to be obtunded and complained of headache. Radiographs of the chest again revealed a right pneumothorax which was reduced by tube thoracotomy. Because of persistent complaints of headache, a radiograph of the skull was obtained which revealed intracranial air (Figs 1 and 2). The patient continued to be intermittently obtunded without focal neurological signs. Drainage from the chest tubes after three days was clear and watery.

The patient subsequently developed a temperature of 38.9° C (102° F) with thickened pulmonary secretions, and was started on antibiotics. A repeat radiograph of the skull on 24 December showed a significant increase in the intracranial air (Figs 3 and 4).

FIG. 3. Anteroposterior radiograph of the skull (24 December 1970)

FIG. 4. Lateral radiograph of the skull (24 December 1970)

FIG. 5. Coronal section of brain through temporal tips

despite improvement in the pneumothorax. An EEG revealed diffuse slowing with 6–7 Hz theta and 1–3 Hz delta activity. He followed a rapidly deteriorating course and died on 28 December, 30 days post-operatively. Neurological examination one day before his death revealed him to be stuporous with a right Horner's syndrome and slight increase in the deep tendon reflexes on the right. Fundoscopic examination was normal.

At necropsy, subcutaneous emphysema was noted on the lower neck, supraclavicular space and upper chest on the right. There was no fluid in the thoracic cavity and both lungs revealed bronchopneumonia. Examination of the brain revealed moderate oedema and mild dilatation of the ventricles (Fig. 5). Multiple sections revealed only a small area of haemorrhage in the left frontal lobe adjacent to the cingulate gyrus measuring 1×0.5 cm. Microscopic examination of the brain of this area was consistent with a haemorrhagic infarct of relatively recent onset. The remainder of the histopathology was negative.

was most probably secondary to the tension pneumothorax that was continuously forcing air through a dural tear sustained at the time of initial surgery and not allowing absorption to take place. One can only speculate on the role played by the pneumocephalus in his death. There was no evidence of tentorial or cerebellar herniation, nor were there signs of infection intracranially. The pneumocephalus may have contributed to his decreased level of alertness, and this, coupled with the usual postoperative splinting of chest surgery, made him a prime candidate for a pulmonary infection.

We would therefore suggest that any patient developing persistent headaches after major thoracic procedures involving the posterior ribs is a suspect for cerebrospinal fluid leak through a traumatized dura mater. If pneumothorax is present, radiographs of the skull should be obtained to rule out intracranial air.

COMMENT The pneumocephalus in this patient

One method of demonstrating a cerebrospinal

fluid leak would be to inject a dye, such as fluorescein, into the lumbar subarachnoid space with subsequent observation of the chest tube drainage. This was planned but the patient died before it could be accomplished. Therapy, as originally suggested by Dandy (1926), should be directed towards surgical closure of the fistula or leak. Interestingly, traumatic pneumocephalus gave Dandy the idea of carrying out pneumoencephalograms.

In the experience of one of the authors (T.J.O.), while performing many hundreds of radical thoracoplasties for tuberculosis requiring complete resection of transverse processes of vertebrae, it was common to observe leakage of cerebrospinal fluid at the site of emergence of the intercostal nerves. In none of these cases was

there any syndrome similar to the one presented here, although routine radiographs of the skull were not performed. Routine radiographs of the skull are planned for future operations of this nature.

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