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Tension pneumocephalus following external ventricular drain insertion

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Abstract
We report a rare case of the development of tension pneumocephalus after the placement of an external ventricular drain in a 4-year-old child with gross hydrocephalus and residual posterior fossa tumor. The child had developed hydrocephalus in the postoperative period after being operated for the posterior fossa tumor. The tension pneumocephalus resulted in delayed recovery in the child. The possible mechanism of the cause of pneumocephalus is discussed.

Key words Gross hydrocephalus · External ventricular drain · Tension pneumocephalus · Delayed recovery

The development of pneumocephalus following craniotomy is often encountered in neurosurgical practice. The most common causes of intracranial air are head trauma and neurosurgical procedures. Less common etiologies include infection due to gas-forming organisms, mucoceles, tumors, congenital neuroenteric cysts, dural defects, and lumbar drain insertion. Rare cases of pneumocephalus in a shunted patient [1] and following deep brain-stimulation surgery [2] have also been reported. We encountered a case of tension pneumocephalus following the placement of an external ventricular drain (EVD) in a child operated for posterior fossa tumor. To our knowledge, no such case has been published in the literature.

A 4-year-old male child, weighing 12 kg, operated on for medulloblastoma 1 month previously was brought to the casualty department with complaints of altered sensorium of 1-day duration. On admission, his Glasgow Coma Scale (GCS) was 5/15, with no eye opening, a verbal score of 2, and a motor response score of 2. The airway was immediately secured with a tracheal tube and the lungs were mechanically ventilated. A computed tomography (CT) scan was performed; this revealed a residual posterior fossa tumor, with calcifications and gross hydrocephalus and periventricular ooze. The patient was immediately taken to the neurosurgical intensive care unit (ICU). Under local anesthesia, an external ventricular drain (EVD) was placed to relieve the hydrocephalus. The EVD was expected to improve the condition produced by the raised intracranial pressure due to the hydrocephalus. However, 2 h later, the child continued to remain unresponsive, with no change in the motor response. A repeat CT scan was carried out; this now showed decompressed ventricles and a large bifrontal pneumocephalus (Fig. 1). The patient was taken back to the ICU. Mechanical ventilation of the lungs was continued with medical air and 100% oxygen. The child's response gradually improved over the next 24 h. The motor response improved to a score of 5, with spontaneous eye opening.

A subsequent CT scan showed resolving pneumocephalus. Although the child improved neurologically, he developed a chest infection and septicemia over the next few days. He succumbed to septicemia on the tenth day of admission to the ICU.

Pneumocephalus develops whenever there is a possibility of air retention in the cranial cavity. It has been reported that pneumocephalus may develop de novo in the postoperative period in patients who have a residual dural defect and communication between the nasal sinuses and the intracranial space [3]. Delayed pneumocephalus is a rare but well-reported complication of cerebrospinal fluid diversion procedures. In most cases the air enters the intracranial cavity via a skull-base defect [4].

While it can be anticipated after a craniotomy, the occurrence of tension pneumocephalus after an EVD placement is unusual. We believe that, in the present patient, sudden decompression of the ventricles by the drain compressed the brain and created a vacuum. The negative pressure inside may have "sucked in" air from

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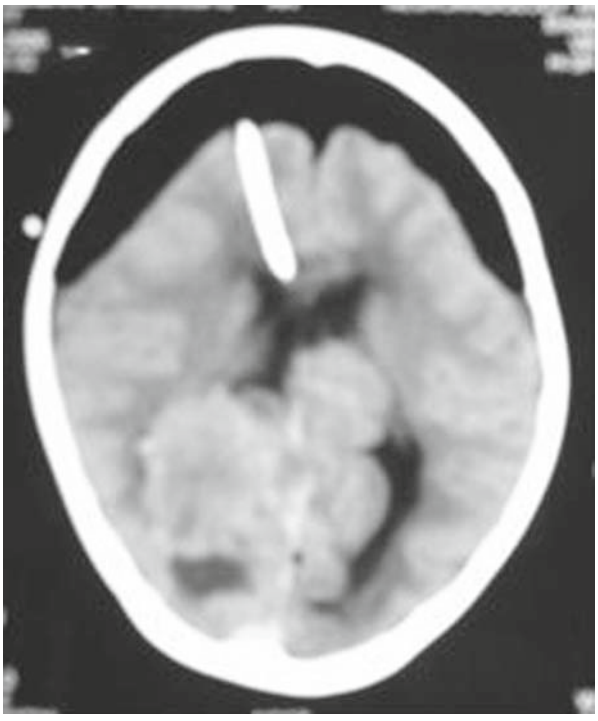

Fig. 1. Computed tomography scan, showing bifrontal pneumocephalus, with external ventricular drain in situ

outside by a one-way valve mechanism in the dura mater. Failure of air to leave the cranial vault led to the development of tension pneumocephalus. As a result, no change was observed in the neurological status of the patient. However, gradual absorption of the air decreased the effects of the pneumocephalus, and the sensorium of the child improved. The complication could possibly have been avoided by slow drainage of cerebrospinal fluid from the ventricles.

After the placement of the EVD, it was expected that the patient's response would improve. However, no improvement was seen. Because the post-EVD scan showed a large air collection, it was believed that the air was under some tension. Pneumocephalus itself usually remains asymptomatic unless it is large enough to cause a mass effect or neurological signs. The clinical signs in our patient became confusing, as it was difficult to differentiate whether the low GCS was because of his existing poor neurological condition on admission or whether it was a result of the pneumocephalus. Therefore, no immediate intervention was carried out. Mechanical ventilation was continued with 100% oxygen. As the subsequent CT scans showed resolving pneumocephalus, coinciding with an improvement in the neurological patient's condition, a probable diagnosis of tension pneumocephalus was made.

In summary, we report the development of pneumocephalus following the drainage of cerebrospinal fluid via an EVD in a patient with gross hydrocephalus. Sudden decompression of the ventricles resulted in pneumocephalus, which delayed the neurological recovery of the patient.

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