CASE SERIES

Traumatic tension pneumocephalus: a series of 4 cases managed in Zaria

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ABSTRACT

Tension pneumocephalus is the accumulation of air in the intracranial cavity with attendant neurological changes. Though a neurosurgical emergency, it could present in a delayed form requiring a high index of suspicion. We report a series of four cases; two of which were managed operatively and two non-operatively with good outcome.

Keywords*: Aerocele, imaging, otorrhoea, outcome, rhinorrhoea, trauma*

INTRODUCTION

Pneumocephalus, the accumulation of air in any of the intra-ventricular, intra-parenchymal, subdural, sub-arachnoid or epidural spaces could present as a neurosurgical emergency. Most literature from Africa report single or few cases.[1,2] The development of neurological changes with tension pneumocephalus signals the presence of a potentially life-threatening lesion.[3,4] Since

the classic work by Dandy in 1926, several authors have reported their experience on this subject.[5,6,7]

Trauma is the most common cause of pneumocephalus, but other reported aetiological factors include craniotomy, infectious, following some diagnostic procedures (e.g. lumbar puncture) and following endoscopic sinus surgery among others.[1,2,8] Tension pneumocephalus exerts a mass effect which makes it difficult to be differentiated from intracranial haemorrhage. The presentation may include headache, cerebrospinal fluid (CSF) rhinorrhoea, CSF otorrhoea, nausea, vomiting and altered level of consciousness. In rare cases the patient may present with *bruit hydro-aerique*, a splashing sound heard by the patient on movement of the head caused by a succussion splash within the cranium.[1,4] Brain CT scan is the standard for diagnosis.[9]

We present a series of four cases with symptomatic pneumocephalus managed successfully in our Centre as a follow up to an initial case report.[10]

CASE SUMMARIES

Case 1

A thirty-nine year old man was referred to our service with a 6-week history of rhinorrhoea from the left nostril, with a 4-week history of headache and abnormal behavior following rider motorcycle accident two months prior to presentation. He had a history of loss of consciousness and an episode of generalized, tonic-clonic convulsions. Two weeks later, he developed left CSF rhinorrhoea, with headache and some personality changes. No meningeal symptoms. Other systems were normal. On presentation, he had a Glasgow Coma Score (GCS) of 14/15 (E4, V4, M6) with no obvious focal neurological deficits.

Skull x-rays and brain computed tomographic (CT) scan showed a depressed skull fracture of the frontal bone, a huge bi-frontal aerocele that was increasing progressively in size on repeat x-rays with enlargement of both lateral ventricles (Figures 1aand b). The patient was worked up for surgery. The intra-operative findings were depressed fracture of frontal bone, dural tear, frontal aerocele and markedly thinned out cerebral cortex. He had bi-frontal craniotomy, denudation of the mucosa of the frontal air sinus (cranialisation and exenteration of the frontal air sinus), decompression of the pneumocephalus with brain canula and duroplasty. The frontal sinus was obliterated with fat, which was harvested from the anterior abdominal wall, after exenteration of the mucosa. He had an uneventful post-operative recovery and he was discharged home on anticonvulsants after 11 days.

Figure 1a. Pre-operative skull x-ray

Figure 1b. Pre-operative brain CT scan

Figure 1c. Post-operative lateral view skull Radiograph; note the burr hole sites

Figure 2a. Lateral view radiograph

Figure 2b. AP view of skull radiograph showing air in the ventricles

Case 2

This was a 25-year old farmer who was first admitted with loss of consciousness, CSF rhinorrhoea and right supra-orbital laceration 3 hours after a rider motorcycle accident. His GCS on admission was 8/15 (E1, V2, M5), and there were peri-orbital swelling and Panda eye sign. His vital signs were stable.

Brain CT scan revealed depressed frontal and multiple facial bone fractures. He responded to non-operative management with antibiotics, analgesics, anticonvulsants, and other head injury management protocols, and was discharged home on head injury advice after 17days of admission.

He re-presented 11days later with recurrence of rhinorrhoea, fever, headache, neck stiffness and deteriorating consciousness, with a GCS of 10/15 (E2, V2, M4). Urgent skull x-ray was requested on clinical suspicion and it showed bilateral pneumo-ventricle; *see Figures 2A and 2B*. He could not afford brain CT scan. He was worked up for surgery, and intra-operative findings included fractures of the right frontal bone, cribriform plate, sphenoid bone, ethmoid bone and the medial wall of the right orbit. There was a dural tear and massive pneumocephalus. Bi-frontal craniotomy was done, the lateral ventricles were decompressed and dura repaired. He did well post-operatively with a resolution of the pneumocephalus on repeat radiograph (Figure 2c), and was discharged home after 6 weeks on anticonvulsants.

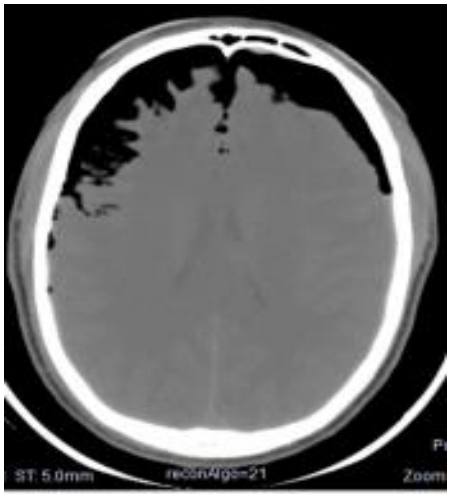
Figure 2c. Post-operative skull radiograph Showing a resolution of pneumocephalus

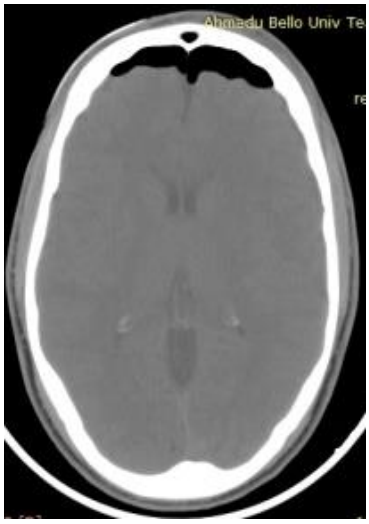
Case 3

A 27 year-old man who presented with severe frontal headache and right CSF otorrhoea following pedestrian motor vehicle accident. He transiently lost consciousness but his GCS on admission was 15 with right facial nerve

palsy. Vital signs were stable. Urgent brain CT scan showed classical "Mount Fuji Sign" (Fig 3a). He was managed conservatively. Serial skull x-rays were done to monitor the pneumocephalus as the patient could not afford repeat brain CT scan. The rhinorrhoea ceased spontaneously on the 10th day post trauma. He was discharged home after 13 days on admission with clinical and radiological evidence of pneumocephalus resolution (Fig 3b).

Figure 3a. Brain CT showing Mount Fuji sign





Case 4

A 21-yearold undergraduate who was a pedestrian, knocked down by a motor vehicle. He lost consciousness immediately and regained it fully after two hours. He developed severe frontal headache with associated nausea. There was no convulsion, bleeding from any cranio-facial orifices, CSF leaks, or differential limb weakness.

He had right sub-conjunctival hemorrhage and left peri-orbital edema, admission GCS of 15with no obvious focal neurological deficits or signs of meningeal irritation. His vital signs were stable. Frontal pneumocephalus was confirmed with Brain CT scan (Figure 4a), and was managed non-operatively. Serial skull x-rays showed progressive decrease in air volume with resolution of symptoms. He was discharged after 8days of admission.

Figure 4a. Brain CT scan showing frontal pneumocephalus

DISCUSSION

Though Lecat seemed to have described pneumocephalus since 1741, the literature generally ascribes to Chiari the first report of aerocele in 1884, and to Luckett, the first radiographic demonstration of pneumocephalus in 1913.[11] Ali, *et al,* found pneumocephalus in 10% of brain CT scans of moderate and severely head injured patients.[12] However, tension pneumocephalus is a rare condition. Though trauma is a common cause of tension pneumocephalus, several other causes have been reported in the literature.[12,14,15,16,17,18]

Two mechanisms have been commonly proposed in the formation of tension pneumocephalus: the ball-valve mechanism described by Dandy, and the inverted-bottle mechanism of Horowitz.[5,18] In the former mechanism, air enters through a dural defect after increases in nasopharyngeal pressure, such as coughing or sneezing, but cannot escape through that area . The latter mechanism proposes that CSF leakage through the dural defect creates negative pressure in the intracranial space that allows air to move along a pressure gradient from the atmosphere to the cranial cavity. As little as 2mls of air can irritate the brain resulting in headache.[4]

The accumulation of intracranial air can be acute (<72 hours) or delayed (≥72 hours).[19] The reason for the latent period, which may vary from days to months has not been

determined, however, immediate surrounding haemorrhage and edema may prevent passage of air in to the subdural space and pneumocephalus manifests after their resolution usually in three to four weeks after trauma.[20] Brain CT scan is the gold standard for diagnosis and can detect as little as 0.5mls of air. The presence of tension pneumocephalus may show the findings of "Mount Fuji" or "Bubbling Brain sign.[3,4,16,21,22]

Trauma is the most common cause of tension pneumocephalus.[1,21] We observed both early (<72 hours) and delayed presentations (≥72 hours), and also noted that patients with deteriorating level of consciousness, convulsion and recurrent CSF rhinorrhoea turned out to be more severely affected and required surgical intervention. Classical Cushing's triad was not demonstrated in any of our patients. Spontaneous resolution without recurrence was more likely in otorrhoea consistent with established evidence.[23] The fourth patient had no clinical or radiological evidence of skull fracture, and no CSF leaks. A small defect might account for this finding.[8]

The presence of "Mount Fuji" sign was not observed to be an absolute indication for surgical intervention, thus, we allude to earlier observations that a combination of clinical and radiologic features are required to take a final decision.[3] Plain Skull x-rays played a useful role in the diagnosis and follow up (due to financial constraints) as it is a cheaper, more readily available, and simpler diagnostic aid when brain CT scan is not available or affordable.[24]Conservative management involving elevation of head of bed to 30^0, avoidance of Valsalva manoeuvres in cases of CSF leaks, analgesics and antibiotics (where necessary) is the recommended first line of treatment. Low threshold for surgical intervention should be entertained, aimed at decompression and repair of torn dura (by open or endoscopic method).[2,3,4,6,8,11,21,25] Outcome in all our patients was very good.

CONCLUSION

Tension pneumocephalus could present in an immediate or delayed fashion, with features requiring high index of suspicion for diagnosis to be made. Brain CT scan is the investigation of choice. Plain skull radiograph could be of tremendous help in both diagnosis and follow up. Management by initial conservative measures with low threshold for surgical intervention would give satisfactory outcomes. Our experience needs to be further evaluated with a larger sample size for logical conclusions to be made.

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