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James Hooper, Elizabeth Moss, Nihal Abosaif

ABSTRACT

A 67-year-old female was presented with severe headache and runny nose. She was referred to the acute medical unit as her blood pressure was 213/94 mmHg and a computed tomography scan of her head was booked to rule out subarachnoid haemorrhage (SAH). She was found to have a rare condition which necessitated referral to the neurosurgical unit for further investigations and treatment. She was found to have a rare disease called pneumocephalus which was extensive on her CT scan of head images. She was not as symptomatic as it was expected and patient had no history of head injury, ear or meningeal infections. She was treated for meningeal leak and was put on meningitis prophylaxis. She improved after two weeks of treatment and was kept under neurosurgical team.

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CASE REPORT

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Keywords: Headache, Petrous bone fracture, Pneumocephalus, Rhinorrhea, Subarachnoid hemorrhage

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INTRODUCTION

Pneumocephalus is the presence of air or gas within the cranial cavity. It is usually associated with disruption of the skull; after head and facial trauma, tumors of the skull base, after neurology or otorhinolaryngology, and rarely, spontaneously. Pneumocephalus can occur in scuba diving, but is very rare in this context.

This rare condition can be dangerous if changes to tension pneumocephalus or introduces infection through the skull base leading to severe meningitis.

CASE REPORT

A 67-year-old female was admitted with a gradual onset occipital headache, neck stiffness and a runny nose. This was ongoing for a week prior to admission but was more pronounced on the day of admission especially the clear odorless fluid coming out of her nose. She had a background of sciatica, hypertension, hypercholesterolaemia, gout and type 2 diabetes. Her medications included aspirin, simvastatin, metformin, allopurinol, furosemide and losartan, with no known allergies.

Observations of the patient were stable apart from high blood pressure of 213/94 mmHg. Her clinical examination showed normal power, tone and cranial nerves with no signs of cerebellar involvement or sensory loss. She had an element of meningeal irritation in the form of neck stiffness and positive Kernig's sign. Cardiac, chest and abdominal examination were entirely normal.

The patient was given 5 mg of amlodipine to correct her blood pressure and improve the headache symptoms. Also broad spectrum antibiotics to guard against meningitis were given because of the meningeal irritation. Her investigations revealed chronic kidney disease stage 3 with a creatinine of 108 $\mu\text{mol/L}$, normal liver function tests, a normocytic hypochromic anemia with a hemoglobin of 84 g/L, MCV 85.5 fl and a C-reactive protein of 11 mg/L. Normal white cell count and platelets.

Computed tomography scan of head showed extensive and diffuse parenchymal and intraventricular pneumocephalus (Figure 1). The source of the leak was not identified initially and a skull base CT-head to look for an osteolytic lesion was recommended.

The patient became more unwell later on and started to develop a fever of 38–39°C and more neck stiffness. Discussion with microbiology about antibiotics cover suggested adding an anti-fungal therapy to prevent any fungal infection because of being diabetic and high suspicion of malignancy.

A reformat of the CT head to look at the skull base was done and an osteolytic lesion was found in the right petrous bone with a mucocoele in the right nasal sinus. The petrous apex lesions are lytic expansile and well defined - likely “petrous apex cephaloceles” (not consistent with metastases/myeloma/cholesterol granuloma). Other features of idiopathic intracranial hypertension noted (empty sella and dilated subarachnoid space around the optic nerves). The right petrous apex cavity has likely eroded into the sphenoid sinus causing pneumocephalus (Figure 2).

Figure 1: Non-contrast computed tomography scan of head showing diffuse parenchymal and intraventricular pneumocephalus with little to no CSF.

Figure 2: Non-contrast computed tomography scan of head showing the petrous bone fracture in the base of the brain.

Progression of the case

The patient was referred to neurosurgical and ENT team and was discussed in their multidisciplinary team meeting when a CT thorax, abdomen and pelvis was performed to rule out any disseminated malignancy or other bony lesions e.g., multiple myeloma or plasmacytoma. Her CT scan was normal with no evidence of other types of malignancy. She continued on the intravenous antibiotics (@Cefuroxime 2 g intravenously twice per day and @aciclovir 800 mg intravenously three times per day) for two weeks then oral antibiotics (@Co-amoxiclav 625 mg three time per day) and was discharged home for another follow-up in six weeks' time. Her repeat CT scan of head showed resolution of her pneumocephalus except for a very small intraventricular lesion (Figure 3).

DISCUSSION

Pneumocephalus can be divided into extra-axial and intra-axial with further sub-classifications:

- Extra-axial: subarachnoid, subdural and epidural.
- Intra-axial: intravascular, intraventricular and parenchymal.

By far the most common cause of pneumocephalus is trauma, followed closely by iatrogenic i.e., neurosurgery or ENT surgery. Following on from this would be barotrauma and otogenic pneumocephalus. With sinus pathology (i.e., malignancy or pneumosinus dilatans) or meningitis caused by gas forming organisms (for

Figure 3: Improvement of pneumocephalus after six weeks of oral antibiotics.

instance *Clostridium perfringens* [1]) being the next most prevalent causes. A dangerous complication of pneumocephalus is tension pneumocephalus - where pneumocephalus leads to raised intracranial pressure and decreased cerebral perfusion due a valve like mechanism.

An interesting neuroradiological sign caused by subdural pneumocephalus compressing the frontal lobes bilaterally is called the silhouette of Mount Fuji sign [2]. The most common extra-axial form of pneumocephalus caused by neurosurgery appears to be subdural. Of the extra-axial subdural pneumocephalus cases caused by neurosurgery the frontal lobes are the most commonly effected followed by the occipital and temporal [3].

Symptoms of pneumocephalus range from mild headaches to “worst-ever” headaches, nausea, vomiting, dizziness and even seizures. A disturbing symptom described by one patient following nasal CPAP was a ‘gurgling’ sensation in the head [4]. There has even been a case of Alien Hand syndrome described in literature from pneumocephalus resulting from a defect in the anterior cribriform plate [5]. Other signs include cranial nerve palsies, meningism and papilloedema.

Management

This depends on the underlying aetiology and whether there is tension pneumocephalus, which requires urgent cranial decompression to maintain cerebral perfusion. Interestingly, air is toxic to neurons, causing cerebral edema and can lead to encephalomalacia [6].

Whilst investigations are carried out, the patient should be given antibiotics to cover meningitis or invasive sinusitis, anti-epileptics, anti-emetics and analgesia. Consider anti-fungal coverage in those at risk or immunocompromised. The patient should be managed on a neurosurgical ward, head tilt of 30 degrees, with neuro-observations to monitor for any sign of deterioration.

There are two schools of thought to using hyperbaric oxygen, studies have supported its use, with shortened length of hospital stay and decreased incidence of complications [7]. However, the defect has to be closed and there have been case reports showing deterioration of pneumocephalus with hyperbaric oxygenation [8]. A probable good compromise would be the use of 100% oxygen via mask to aid nitrogen reabsorption into the blood stream. Indeed most cases of pneumocephalus are managed conservatively with spontaneous reabsorption of the air into the blood stream.

High resolution CT scan should be able to delineate the cause of the pneumocephalus. However, sometimes this is not obvious. Other authors have used fluorescein, indigo carmine, CT myelography, radionuclide cisternography and MRI scan in order to find the cause of pneumocephalus [9]. With CT myelography appearing to be the gold standard for investigation [10, 11].

CONCLUSION

Pneumocephalus is a rare presentation of headache on the acute medical unit. An urgent head scan showed the pneumocephalus picture which helped to manage her quickly and accurately and referral to the proper specialty was performed. We suggest investigating all cases of headache meticulously and thoroughly. All cases of suspicious headache should also be discussed with neurologists or neurosurgeons accordingly.

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Author Contributions

James Hooper – Substantial contributions to conception and design, Acquisition of data, Analysis and interpretation of data, Drafting the article, Revising it critically for important intellectual content, Final approval of the version to be published

Elizabeth Moss – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Nihal Abosaif – Analysis and interpretation of data, Revising it critically for important intellectual content, Final approval of the version to be published

Guarantor

The corresponding author is the guarantor of submission.

Conflict of Interest

Authors declare no conflict of interest.

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