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Non-traumatic pneumocephalus caused by increased depth of olfactory fossa

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Abstract

We report a case of unilateral Keros type III variant of the cribriform plate (olfactory fossa >7 mm deep) that caused non-traumatic pneumocephalus. A 61-year-old male patient presented to the emergency room complaining of acute-onset headache after blowing his nose. Computed tomographic (CT) examination showed a massive pneumocephalus; a CT scan from three months before showed a Keros type III variant. The defect was repaired endoscopically with mucoperichondrial and mucoperiostal grafts. Pneumocephalus that has developed in a Keros type III variant has been theorised about, but never reported to our knowledge. Radiologists should be familiar with the Keros classification so that they can identify patients who are at increased risk of fractures of the cribriform plate.

Keywords: CT; pneumocephalus; anatomical variant; Functional Endoscopic Sinus Surgery

Introduction

Pneumocephalus usually occurs after trauma, neurosurgery, or otorhinolaryngological procedures,[1] but some anatomical conditions could predispose to spontaneous pneumocephalus. We report the case of a patient who presented with a rare critical variant of the cribriform plate: the olfactory fossa more than 7 mm deep (Keros type III).

Case report

A 61-year-old man presented to the emergency room complaining of headache of acute onset that was particularly intense in the frontal region, radiated to the nose, and occurred after he had blown his nose. He reported two similar episodes that had occurred during the past months and always resolved in a few hours. His only serious known coexisting condition was mild arterial hypertension, which was treated with an ACE-inhibitor. Physical examination showed a body mass index of 24; heart rate of 88 bpm; and blood pressure 140/90 mmHg. Pertinent laboratory values were normal. Unenhanced computed tomography (CT) of the head (Fig. 1) was reported as within normal limits by the radiologist. The pain settled without treatment, and he was discharged with instructions to modify his current treatment to improve control over his blood pressure.

Three months later he returned to the emergency room complaining of the sudden onset of intolerable, non-traumatic pain in the frontal region. Physical and laboratory findings did not differ significantly from his previous visit. The CT was repeated, and showed a massive pneumocephalus in the subdural space and the lateral ventricles (Fig. 2). There was a fluid level in the maxillary sinuses with density comparable to

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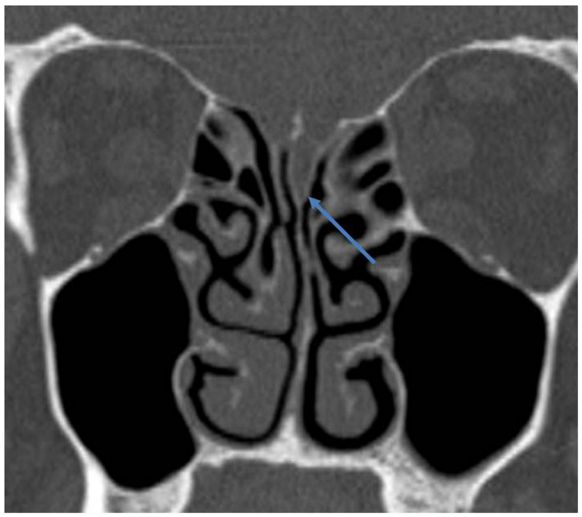

Fig. 1. Unenhanced computed tomographic image of the head, coronal plane, three months before the pneumocephalus. Even though the examination was reported as within normal limits, there is an anatomical variant in the cribriform plate with a left olfactory fossa 8 mm deep (Keros type III variant) (arrow).

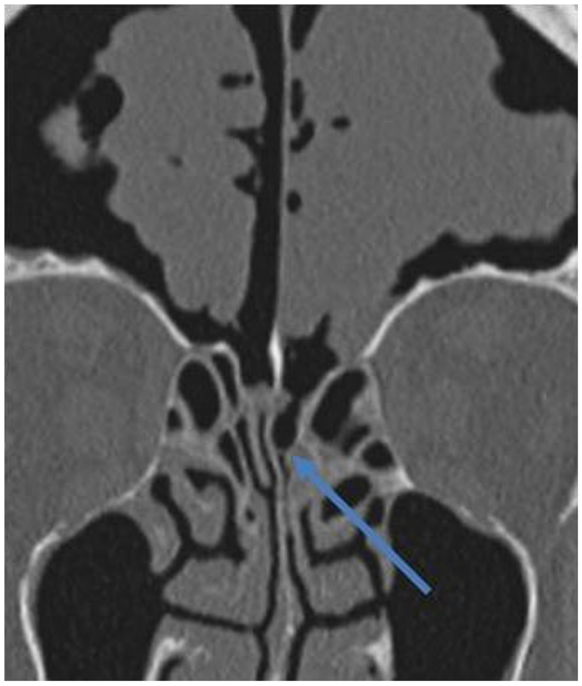

Fig. 2. Unenhanced head computed tomographic image of the head, coronal plane. A massive pneumocephalus is present in the subdural space. An interruption in the cribriform plate is also present (arrow), in exactly the same place as the anatomical variant.

that of cerebrospinal fluid (Fig. 3). The patient was admitted to the neurosurgical department urgently for investigations.

When the first unenhanced head CT was reviewed, an anatomical variant was noted in the cribriform plate where the left olfactory fossa was 8 mm deep (Keros type III variant) (Fig.1). There was an interruption in the left cribriform plate on the CT taken after the pneumocephalus, in exactly the same place as the anatomical variant (Fig. 2). The nasal cavity was explored endoscopically and bony interruption in the left olfactory fossa confirmed, associated with dural interruption. During the endoscopic procedure the defect was repaired with mucoperichondrial and mucoperiostal grafts. The middle turbinate was removed, and he also had a maxillary sinusostomy and ethmoidectomy. CT one month postoperatively showed no residual pneumocephalus.

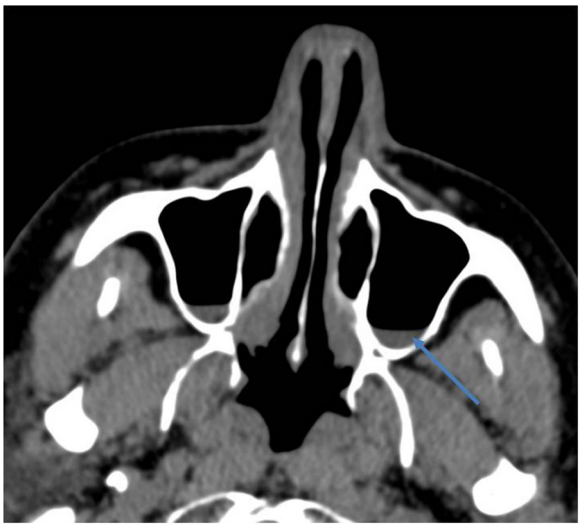

Fig. 3. Unenhanced computed tomographic image of the head. There is a fluid level in the maxillary sinuses, with fluid-compatible density (11 Hounsfield units) (arrow). This finding confirms the presence of damage to the cribriform plate.

Discussion

Pneumocephalus is defined as the presence of gas within the cranial cavity, and usually occurs after trauma or surgical procedures. [1] Spontaneous massive pneumocephalus is rare, and in our patient was caused by a rare critical variant in the cribriform plate that was already visible in the first CT scan, but not recognised.

The olfactory fossa is a depression in the anterior cranial fossa on the superior surface of the ethmoid bone on each side of the crista galli; it is formed by the crista galli (located in the midline) and the medial and lateral lamella of the cribriform plate, with the cribriform plate forming the floor of the fossa.[2] The depth of the olfactory fossa is considered normal when it is less than 3 mm (Keros type I), slightly increased between 3 and 7 mm (Keros type II), and considerably increased if it is >7 mm (Keros type III).[3,4] The lateral lamella is the thinnest and most fragile part of the olfactory fossa, and the unilateral type III variant in particular is associated with increased risk of fractures of the lateral lamella. These lesions have been reported after minor trauma, and during Valsalva manoeuvres or barotrauma.[1]

Endoscopic procedures can be the cause of iatrogenic damage to the olfactory fossa and lateral lamella

in all patients, and particularly in those who present with Keros type III.[4] Fracture-related complications are ascending meningitis, intracranial hypotension, and a meningoencephalocele.[1] Keros type III has been reported to be a possible cause of non-traumatic spontaneous pneumocephalus, although to our knowledge no cases have yet been described.

Radiologists should be familiar with the Keros classification so that they can identify patients who are at increased risk of fracture of the cribriform plate or dehiscence of the anterior skull base, particularly in those who are to have medical procedures such as endoscopic sinus surgery.

Conflict of interest

We have no conflicts of interest.

Ethics statement/confirmation of patient's permission

We have ethics approval for this report, together with the consent of the patient to publication.

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