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Case Reports & Case Series

Mount Fuji sign following nasal polypectomy: Conservative management of pneumocephalus

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ABSTRACT

Pneumocephalus is seen in conjunction with a variety of conditions, particularly traumatic injury, neurosurgical, and ears, nose, and throat (ENT) procedures. We describe the successful, non-operative management with supplemental oxygen of symptomatic pneumocephalus following polypectomy without further complication. This case adds to other case reports of pneumocephalus but differs in the non-invasive, conservative management with supplemental oxygen obviating the need for more invasive neurosurgical intervention such as decompressive craniectomy, burr holes, or drain placement.

1. Background

Pneumocephalus is seen in conjunction with a variety of conditions, particularly traumatic injury, neurosurgical, and ENT procedures. Typically, small amounts of air within the intracranial region do not cause significant neurologic effect and can be managed conservatively. On the other hand, when the volume of air results in intracranial hypertension the ensuring mass-effect can cause significant neurologic decline and potential herniation requiring immediate surgical intervention.

2. Case report

A 59 year-old male without significant past medical history presented to the emergency department with intense headache and nausea after he woke approximately 8 h after removal of a large nasal polyp. He denied any focal weakness or paresthesias, bowel or bladder incontinence, rhinorrhea, or change in smell or vision. Head computed tomography (CT) revealed significant pneumocephalus resultant from ethmoid roof fracture with the presence of Mount Fuji sign (Fig. 1 and Fig. 2). Despite signs of tension pneumocephalus on imaging, clinically the patient was alert and oriented with normal neurologic exam and without evidence of cerebrospinal fluid leak.

He was admitted to the intensive care unit for frequent neurologic exams, pain control, and conservative management with inhaled oxygen by facemask. Serial CT scans were performed on hospital days 2 (Fig. 3), 4, and 5 (Fig. 4) which showed progressive resolution of pneumocephalus. The patient's symptoms progressively resolved and he was discharged home to complete a seven day course of prophylactic antibiotics along with outpatient neurosurgery and otolaryngology follow-up.

3. Discussion

Commonly, small amounts of intracranial air are seen following intracranial surgery and trauma and typically this air is asymptomatic. Endoscopic sinus surgery also poses a risk of iatrogenic introduction of air into the intracranial space via skull base injury. CT is the gold standard for determining the presence of air within the cranial vault and when the volume of air becomes significant, it can separate the frontal tips creating the so-called Mt. Fuji sign. This sign indicates the pressure of air is greater than the surface tension of cerebral spinal fluid (CSF) between the frontal lobes [1,2].

Basic anatomy dictates the anterior ethmoid area is in close proximity to the skull base. As such, the insertion of the anterior middle turbinate on the lateral lamella of the cribriform plate [4], if avulsed, can result in communication between the outside environment leading to possible infection and/or pneumocephalus.

The theories behind the mechanism for the development of pneumocephalus fall into two categories, the “ball valve” effect and the “soda bottle” effect. It is postulated the air enters through a defect when the pressure extracranially exceeds the intracranial pressure and air is then unable to exit due to overlying tissue [3]. The “inverted soda bottle” effect is thought to result from a continuous CSF leak which

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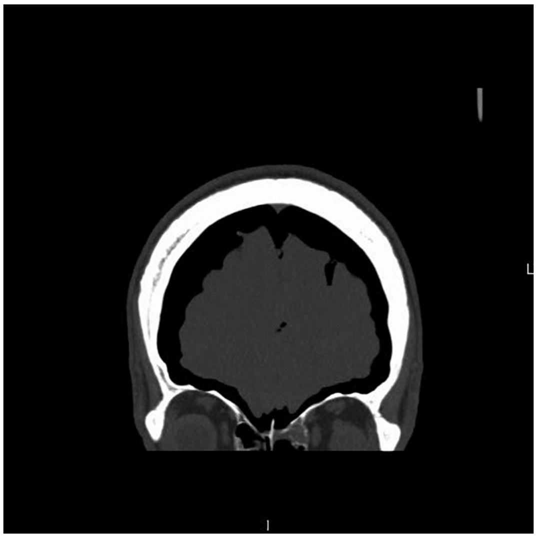

Fig. 1. CT brain coronal view bone window. Left ethmoid roof fracture.

Fig. 2. CT brain axial. Hospital day 1, pneumocephalus with Mount Fuji sign.

Fig. 3. CT brain axial. Hospital day 2, resolving pneumocephalus with supplemental oxygen by facemask.

Fig. 4. CT brain axial. Hospital day 5, pneumocephalus resolved with hygroma formation.

generates a negative pressure intracranially allowing air to replace CSF.

Similar to the treatment of a pneumothorax, the intracranial air will reabsorb with the use of supplemental oxygen by increasing diffusion gradient for nitrogen between the air collection and the surrounding cerebral tissue [5]. It goes without saying pressurized systems such as high flow nasal cannula or bilevel positive airway pressure should not be used if there is concern for continued communication as this may introduce more air intracranially. Oxygen delivery by nasal cannula or simple facemask at a concentration of 40% decreased time of pneumocephalus absorption by 80% according to Dexter et al., and further increases in F_iO_2 would result in additional decrease in time to absorption.

Due to the relatively uncommon incidence of significant tension pneumocephalus, there are no randomized trials evaluating which management strategy, surgical vs non-surgical, is superior. The clinical exam should dictate the treatment strategy with the need for more aggressive interventions such as burr hole placement or partial craniectomy for those who show signs of progressive neurologic decline from presumed elevated intracranial pressure. For those that have a non-focal neurologic exam which is stable over time, we feel a watch and wait strategy with symptomatic management is more prudent.

3.1. Outcome and follow up

In this case report, the nasal polyp which was resected was large and deeply rooted to the underlying tissue. The polyp location and challenging removal resulted in fractures in the ethmoid roof with resultant communication with the skull base and development of pneumocephalus. Imaging findings were concerning for tension pneumocephalus but the patient did not exhibit signs of neurologic impairment or express severe symptoms which is why he was managed conservatively rather than with a more invasive procedure (i.e. burr hole) to evacuate the intracranial air. Following serial CT imaging which revealed progressive resolution of intracranial air, he was discharged to home on hospital day five with routine outpatient follow up.

4. Conclusion

Tension pneumocephalus may develop following various neurosurgical, maxillofacial and ENT procedures as well as with trauma. Treatment with supplemental oxygen and close neuromonitoring can result in excellent outcomes with complete resolution of the

pneumocephalus.

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