Blowing the Brain: A Rare Case of Pneumocephalus Associated with Non-Invasive Ventilation

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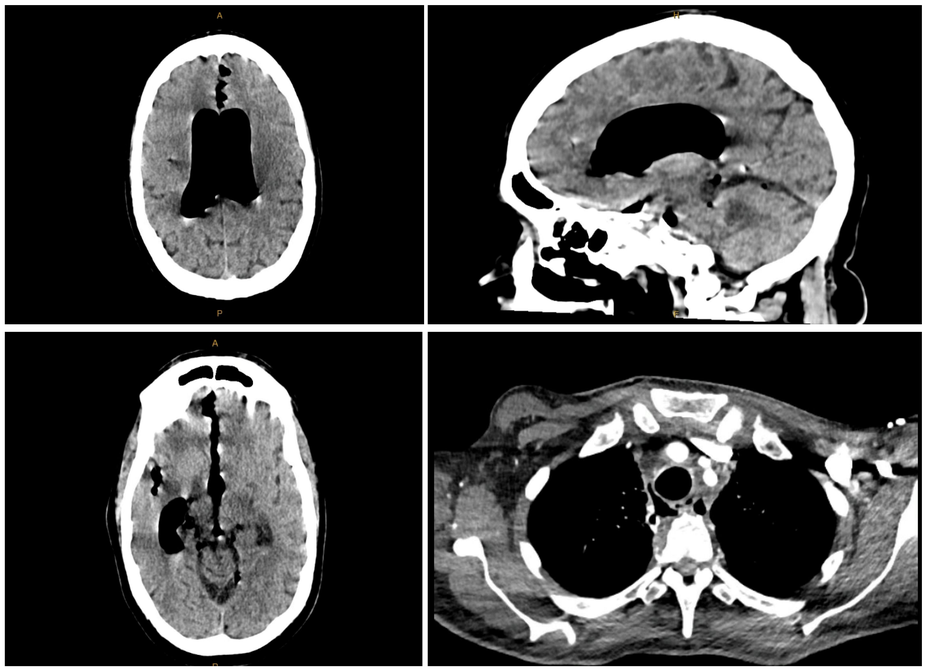
- Pneumocephalus is defined as the presence of free air within the cranial cavity. It is most associated with head trauma, neurosurgical procedures, or skull base fractures.
- Spontaneous (non-traumatic) pneumocephalus is far less common and has been described in association with CNS infections, sinonasal pathology, and barotrauma.
- Reported incidence following cranial surgery ranges from 3.9% to 9.7%, while spontaneous cases remain rare and diagnostically challenging.
- Positive airway pressure therapies (CPAP/BiPAP) have been implicated in isolated cases, typically in patients with ventriculoperitoneal shunts or skull base defects.

Imaging



Discussion

- Spontaneous pneumocephalus is an uncommon but important complication of BiPAP therapy in patients with structural vulnerabilities.
- In this patient, several structural vulnerabilities increased susceptibility. Prior chemoradiation likely caused mucosal and bony thinning, while remote cocaine use predisposed to septal ischemia and tissue damage. It is plausible that BiPAP high pressures amplified air leakage through the esophageal defect, further promoting intracranial air accumulation.
- Clinically, sinonasal integrity and proper history and high degree of suspicion should be considered before initiating non-invasive ventilation. Any new neurological changes following BiPAP should prompt immediate neuroimaging.
- Conservative management with high-flow oxygen may suffice in stable patients, while surgical intervention should be reserved for severe or progressive cases of pneumocephalus.
- Surgical options for pneumocephalus include burr hole or craniotomy decompression, endoscopic repair of skull base or sinonasal defects, closure of aerodigestive tract perforations, and ventricular or subdural drainage in cases of tension or persistent air leaks.

Case Description

Admitted

65 yrs old male

- Complains of Breath Shortness for 2 days

Medical History

- Squamous cell carcinoma (TxN1M0)of the cervical esophagus and Pyriform Sinus (treated with chemoradiation in 2016, complicated by esophageal stenosis)
- atrial fibrillation,
- asthma,
- remote intranasal cocaine and tobacco use,
- hypothyroidism, and
- hypertension.

Initial Treatment and Moved to ICU

Admitted with diagnosis of Asthma Exacerbation

- Started with systemic steroids and inhaled bronchodilators.
- Initiated on 2L NC

Worsening Respiratory Distress

- Moved to ICU for closer monitoring.
- Blood gas analysis showed hypercapnic, hypoxic respiratory failure.
- Initiaed of bilevel positive pressure ventilation (BiPAP)

Over next 24 Hours

Patient's Condition - 3 Hrs Later

- Blood GAs showed improved hypercapnia.
- patient was placed back on nasal canula.
- Patient communicative but started to be lethargic

Patient's Condition

- Progressively lethargic,
- Less communicative, and
- Developed altered mental status.

Further Investigations

Initial Investigation

- Blood Gas Analysis
- No any abnormalities

Next Investigation

- CT Scan of the Head

Findings

- Large volume Pneumocephalus
- Majority of the gas in intraventricular system

Consulting

Neurology and NeuroSurgery Consulting

- Placed on 100% oxygen with non-rebreather mask,
- Head of bed was kept flat

EVD Consideration

- Considered external ventricular drain (EVD) placement.
- But aborted the plan
  - clinical improvement and good mentation
  - decreasing pneumocephalus in repeat scan

ENT Consulting

- Fiberoptic nasal endoscopy revealed a **~1 cm** septal perforation

Complication during treatment Course

Patient's Status

- Had a witnessed aspiration event and acute altered mental status
- Gas showed severe hypercapnia
- Intubated for airway protection

Aspiration Pneumonia and Asthma

- Started on braod spectrum antibiotics.
- Patient continued on 100% FiO2 with regular consultation from Multidisciplinary team.

Investigation and Hypothesis

Diagnosis and Investigation

- Conducted multiple imaging
- No definitive air source identified

Hypothesis

- Has possible **cribriform plate micro-perforation**
- Secondary to cocaine

Consulting

Further Exploration

- Retrospective review of prior imaging demonstrated **Pneumomediastinum** and air tracking in the prevertebral space,
- Raising concern for **proximal esophageal perforation** withextension toward T1

Beyond

Poor Surgical Candidate

- Area of Concern very proximal for stenting.
- history of multiple radiations

Further

- Discussion with Multidisciplinary Team done for possible extubation and options.
- Elective extubation trialed but unsuccessful
- Patient ultimately underwent Tracheostomy after prolonged Ventilation.

Conclusion

Spontaneous pneumocephalus is a rare but serious complication of BiPAP, requiring vigilance, early imaging, and tailored management in high-risk patients.

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