

## Unconventional Cause of Pneumocephalus

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### Abstract

Pneumocephalus is the presence of gas within the cranial cavity. Trauma is the most common cause of pneumocephalus including car or motorcycle accident, bullet injuries and other penetrating neck wounds. The objective of this report is to describe a case of a 30 year old male patient who presented to our accident and emergency department with three self-inflicted injuries, one of which was through an anterior approach into his neck causing pneumocephalus, an injury that has not previously been described in clinical literature.

**Keywords:** Pneumocephalus; Stab Wound; Neck; Trauma

### Introduction

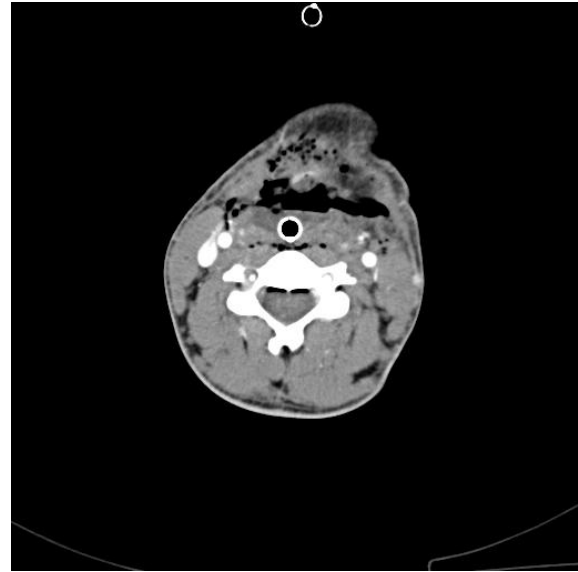
Pneumocephalus defined as an intracranial gas collection, is a rare complication and may be caused by head trauma, infection, barotrauma, following scuba diving and surgery involving the sinuses, orbits, nasal passages or intracranial space [1,2]. Erosions from extracranial infections or tumours may also lead to pneumocephalus [2]. Some cases are idiopathic [2]. The most common cause is either trauma (75–90%) or surgery [2]. Only 0.5% to 1% of all episodes of head trauma result in pneumocephalus [2]. In the vast majority of cases of pneumocephalus the intracranial gas is air. However, in the absence of craniofacial trauma and a neurosurgical procedure, bacterial meningitis can be a rare cause of pneumocephalus [3]. Computed Tomography (CT) is currently the best modality for visualizing pneumocephalus [4]. The clinical literature described a number of cases of pneumocephalus following a stab wound to the neck: four cases in adults and one case in a child. In the vast majority of these cases, the injury was to the posterior region of the neck [5–9].

We present the first case of a patient with a pneumocephalus secondary to a self-inflicting neck stab wound from an anterior approach with the penetrating injury reaching the epidural space of the cervical spine.

### Case Presentation

A 30-year-old man with a history of mental health illness was admitted to the accident & emergency department at our hospital with three self-inflicted stab wounds using a 10-cm blade knife. The patient demonstrated penetration injuries inferiorly to his left nipple, into his abdomen and into the anterior aspect of his neck. Clinical examination revealed a conscious, alert and orientated patient with stable vital signs who was struggling to speak. He denied any headache, neck stiffness, visual or auditory difficulties. The wound below the left nipple was only 2-cm in length, superficial and did not require any further management apart from wound cleaning and dressing immediately delivered at the emergency department. The abdominal injury showed a 3-cm wound approximately 5-cm right lateral to the umbilicus associated with a soft tissue like structure outside of the abdominal wall.

The neck examination revealed a 5-cm large entry point an-



**Figure 1:** Axial image of the neck demonstrating the level of the knife penetration immediately below the hyoid with extensive traumatic emphysema at the anterior and mid aspects of the neck. (Note is made of air in prevertebral space and in anterior epidural space).



**Figure 2:** Sagittal reconstruction of the neck demonstrating the knife penetration tract from the anterior approach. Significant amount of air in the anterior subarachnoid space caused by the penetration injury.

teriorly between thyroid cartilage and hyoid bone (Figures 1 & 2). No obvious foreign body or damage to the major vessels was found. However, a significant and severe air leak was discovered through the wound. Following accurate wound assessment, the penetration entry point was covered with gauze protection to stop the air leak. The patient was then pre-oxygenated for five minutes and intubated with rapid sequence intubation (RSI) using Propofol 140 mg, Fentanyl 100 mcg and Suxamethonium 100 mcg. A 7.5-endotracheal tube (ETT) was used. After stabilisation, the patient was transferred to the radiology department and underwent a post contrast CT study of head, neck, thorax, abdomen and pelvis. The CT scan revealed a significant amount of air within the anterior epidural space of the cervical spine caused by the penetration injury with the tip of the knife reaching the anterior spinal canal (Figures 1 & 2).

The patient was taken to the emergency theatre as a joint case for both ENT and general surgery. The abdominal wound was found to be superficial and was cleaned and dressed by the surgeons in theatre. He also had an exploratory laparotomy that found small pieces of damaged omentum that were excised. At neck exploration the ENT surgeon found a deep laceration of the posterior hypopharyngeal wall at the level of the base of epiglottis with exposed cartilage, completely transected epiglottis at its base and probable exposure of spinal ligaments. A size eight tracheostomy tube was surgically inserted in view of these injuries. Patient had an uneventful recovery on ICU for two days followed by few further days recovery on a normal ward before he was discharged.

## Discussion

There have been reports of pneumocephalus since 1884, when Chiari [10] reported a case discovered at autopsy. Luckett [11] was the first to report the appearance of air in the ventricles in a patient with a skull fracture involving the right frontal sinus. In a 1967 review of the literature, Markham [12] listed 295 cases with various causes of pneumocephalus; trauma (fractures of skull involving either the sinuses or skull base) was the most common among them. Four cases prior to 1967 were reported separately and were not included in the review by Markham. Twelve other cases were reported between 1986 and 2010. Intracranial gas collection can be divided by location into intra-axial and extra-axial cavities. Intra axial location includes parenchymal, intra ventricular and intra vascular spaces. Extra axial location includes epidural, subdural and subarachnoid spaces. Air entering the epidural space as a result of basal skull fracture comes from the sinuses in the floor of the anterior or middle cranial fossa, or the orbit. If the dura is breached, air will reach the subdural space; this occurs in about 28% of cases of pneumocephalus. Tearing of the arachnoid will allow air to enter the subarachnoid space. Distinction of subdural and subarachnoid air can be difficult if the two coexist [4]. CT scan is extremely sensitive, and can identify as little as 0.5 cc of air in intracranial space [13]. Air in the epidural space appears as biconcave collection of gas not changing with movement. Subdural air tends to outline the contour of the skull and moves with a change in position of the head [4]. The neck reveals a complex anatomy containing many vital structures including carotid arteries, jugular veins, larynx, trachea, recurrent laryngeal nerves, spinal cord, thyroid, and parathyroids.

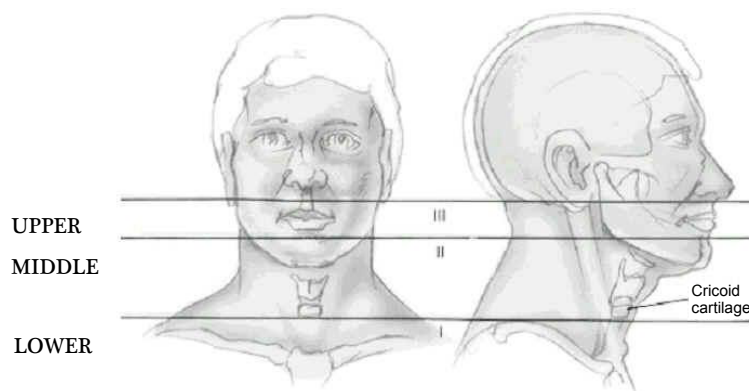


Figure 3: Images of the neck demonstrating the anatomic neck zones.

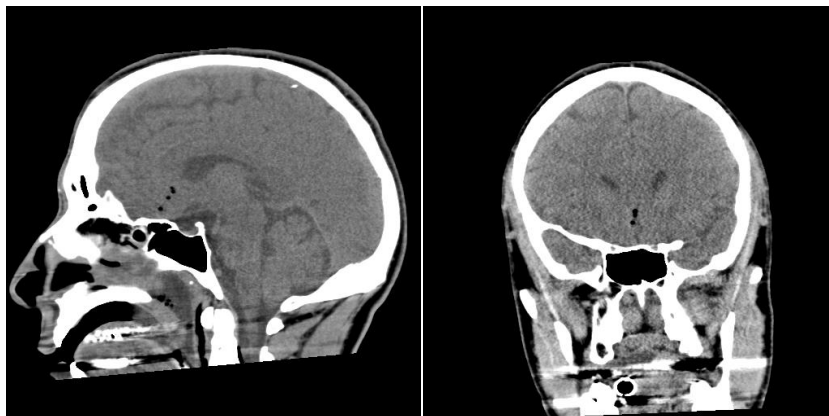


Figure 4 & 5: Sagittal and coronal reconstructions of brain demonstrating pneumocephalus in anterior fossa.

The neck is divided into three anatomic zones to better evaluate the complexity of neck pathologies and injuries. Zone I is the area between the clavicle/suprasternal notch and the cricoid cartilage. Zone II is the area between the cricoid cartilage and the angle of the mandible. Zone III is the area between the angle of the mandible and the base of the skull (Figure 3). With the neck protected by the spine posteriorly, the head superiorly and the chest inferiorly, the anterior (larynx and trachea) and lateral region are most exposed to trauma [14]. Penetrating neck injuries represent approximately 5-10% of all trauma cases that present to the emergency department and result in significant mortality [15,16]. A stab wound to the neck is a rare cause of pneumocephalus as only a few cases have been reported to date, four adult patients [5-8] and one child [9]. Our case is the first case in the clinical literature reporting a pneumocephalus caused by stab wound with an anterior approach with the blade reaching the anterior subarachnoid space of the cervical spine at C4 level. The tip of the knife entered into the anterior compartment of the spinal canal. Epidural gas was found in the cervical spine, in upper thoracic spine and in the cranial space (Figures 2,4 & 5). Pneumocephalus although usually asymptomatic can however present with symptoms including hypotension, bradycardia, coma, hemiparesis and generalized tonic clonic seizures [17]. CSF rhinorrhoea is the most common sign found in patient with post-traumatic pneumocephalus [4]. Pneumocephalus is a rare complication of stab wound injuries. However, physicians should be aware of the symptoms, the potential risks and the best imaging modality to diagnose this condition.

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