# Deep subcutaneous cervical emphysema related to mastoid fracture in an adolescent patient - case report

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**Abstract**

A fracture of the mastoid bone should be considered in the work-up of a head and neck traumatic injury. A well-pneumatized mastoid can absorb forceful impacts, protecting middle and inner ear structures. Fractures of the mastoid, followed by Valsalva maneuver can lead to subcutaneous cervical emphysema.

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**key words** : mastoid fracture, valsalva maneuver, cervical emphysema, hockey puck injury

**Introduction**

Subcutaneous emphysema is a condition in which air becomes trapped underneath the dermal layers of skin. The development of subcutaneous air is a benign symptom or an indication of a deeper, more concerning pathologic disease state. A history of head and neck injury can raise suspicion and lead towards the identification of the cause of subcutaneous air collection. Though temporal bone fractures are a commoner entity in otorhinolaryngologic traumatology, published cases of traumatic mastoid fractures are extremely rare in English literature.

Air may enter the subcutaneous neck tissues via penetrating or closed non-penetrating external neck injuries. Air can also be intraluminally dispersed in the neck and chest iatrogenically, or due to rupture of a preexisting anatomical abnormality. Cervical and mediastinal emphysema has been reported in a few cases post-tonsillectomy. Last but not least, facial trauma and dental or maxillofacial procedures can have a similar result. [1,2].

In our report, we present a case of mastoid apex fracture caused by a high-velocity impact trauma leading to bilateral subcutaneous cervical emphysema. Though unclear from the anamnesis, we believe the Valsalva maneuver performed by the patient during nose-blowing, caused the spread and entrapment of air through the soft tissue layers of the neck.

**Case Report**

A 16-year old adolescent male patient presented to our otorhinolaryngologic emergency service a few hours after being struck by a hockey puck to the left mastoid during a recreational hockey match for further

evaluation. The patient denied any discharge from the left ear, any signs of dizziness, vertigo, dysphagia, dyspnoea, chest pain, vision problems, or problems with equilibrium. By report, immediately after the hit, he lost his hearing on the left ear for approximately 3 to 5 minutes, describing this period as "a feeling of ear fullness". Subsequently, he describes a subjective restoration of hearing on the left ear, with no tinnitus or earache. The patient has repeatedly blown his nose a few minutes after the injury incident, but fails to recall whether it was due to the ear fullness or because of a feeling of blocked nose.

Physical examination revealed a 3x3.5cm ecchymosis around the left mastoid tip which was tender on palpation, but differed from a Battle's sign. Crepitus was not palpable over the mastoid, while only after meticulous palpation was minor crepitation identified posteriorly to the upper third of the sternocleidomastoid muscle ipsilaterally to the injury site. Further palpation revealed minor crepitation cranially at the posterior triangle of the neck contralaterally, with the patient describing a sense of "feeling as if there is something present" when the emphysematous cavities were palpated - but no tenderness was described. Neck movement was free and painless in all directions. Physical examination did not reveal any focal neurologic findings or deficits, and the function of the facial nerve was normal (House-Brackmann grade 1). No hematoma or swelling was present on the left external auditory canal and the left tympanic membrane was intact. There was no fluid collection present in the middle ear. Rinne test was positive bilaterally, Weber test showed no lateralization, while tympanometry was of A-type, with stapedial reflex being present ipsilaterally at 85dB/500Hz bilaterally. For suspicion of subcutaneous emphysema and a temporal bone fracture, a High-Resolution Computed Tomography (HRCT) scan was ordered.

The HRCT scan of the head and neck demonstrated no intracranial injury. No mass effect or midline shift on the brain was observed. No temporal bone fracture was present, but an isolated left linear mastoid apex fracture with a compromise of the pneumatization of the surrounding air cells was observed on the left side (FIGURE 1,2). Extensive left deep cervical emphysema extending from the fracture to involve the skull base (at the level of C1-C2) ipsilaterally and the cervical soft tissues bilaterally along with the adjacent suboccipital musculature was identified.(FIGURE 3,4). There was no involvement of the lower neck, below the level of the thyroid cartilage. There was no violation of the otic capsule and ossicular alignment was normal.

Chest X-ray image demonstrated no mediastinal extension of the cervical emphysema.

The patient was admitted for monitoring, while intravenous analgesia and antibiotic treatment (amoxicillin/clavulanate) were administered. The hospitalization lasted for three days and was uneventful. The patient had no signs of respiratory distress and did not complain of pain at any instance. He was restricted to bed as well as strongly advised to refrain from coughing or nose blowing. Seventy-two hours after the accident an ultrasound of the neck revealed a hardly detectable amount of air, while the control chest x-ray was again without any pathological findings. At 10-day outpatient otorhinolaryngologic follow-up, he was asymptomatic, demonstrating no oto/audiological or other sequelae from the injury, with his audiogram being normal.

**Discussion**

Subcutaneous Cervical Emphysema (CSE) due to mastoid fracture is a rare entity, with only 4 reported cases in the English literature to date[1,3,4,5]. The most common pathologies connected with mastoid fractures are CSF leakage and pneumocephalus[6]. In our case study, the injury has been caused by blunt force trauma by a hockey puck. A standard hockey puck can weigh around 0.16kg and can travel with a speed of around/more than 80km/h and is able to cause a very high impact force injury. Two of the reported cases include exertion of physical violence with direct hits to the mastoid area being suffered by the patient [4,5], while one case was caused after some accidental sharp object penetration injury [3]. Various cases have been reported in the published literature with head and neck subcutaneous emphysema (SE) formation as a complication of athletic trauma. Impact of play objects/balls (e.g. baseball, tennis ball, hockey puck) which can travel with high velocity, leads to the transfer of high amounts of energy to the impacted area, resulting in trauma and fractures[1,3]. There are also reports of SE following fall or dive-related injuries [7,8]. Due to its air cell

honeycomb-like pattern, it has been hypothesized that a function of the mastoid air cell system (MACS) is to act as a damping barrier, protecting the middle ear and its contents, the brain, and the otic capsule. Also, the higher the pneumatization, the better the protective effects the MACS can provide. [9]. The degree of pneumatization in our case was extensive. It is our belief that this case study is another proof of the protective cushioning the mastoid bone provides, similar to one provided by the paranasal sinuses.

This present case features a high-velocity injury with focal impact to the mastoid bone that resulted in a minor linear fracture. As far as mastoid impact fractures are concerned, the impact can displace mastoid air into the soft tissues. The amount of exerted force (e.g. severe high-velocity impact), as well as the extent of mastoid fracture (e.g. comminuted large fracture), can have an impact on the amount of air leaking out the mastoid, as seen in the published literature[1,3-5,10].

The extent of the injury in our case though does not fully correspond to the amount of air dispersed throughout the cervical soft tissue structures. We believe that air was propagated only after the patient performed the Valsalva maneuver when he blew his nose. By performing the Valsalva maneuver, the air is forced through the Eustachian tube, past the non-compressible middle ear, finally reaching the MACS with the existing air content of the mastoid cells being transiently pressurized. In the case of a mastoid fracture, a decompression valve is formed and air can be squeezed out and dissected through the fascial planes and the attached musculature [11,12].

Our patient did not have any injury to the temporal bone or otic capsule, nor did he present with any clinical detectable facial weakness. We believe that the transient hearing loss was a result of the pressure difference created following air mobilization from the mastoid to the middle ear. Audiological measurement has shown normal hearing, also without any other sequelae like tinnitus.

Upon encountering a patient with trauma of the facial skeleton or the temporal bone, careful physical examination is of paramount importance. Crepitus can be many times revealed only after meticulous palpation of the soft tissues, while pain and limitation of movement can be present, but not in every case. A thin slice/high-resolution CT scan is recommended, as a careful evaluation of the temporal bone is crucial. In addition, temporal bone fractures most probably will present with indirect findings like the presence of emphysema on the surrounding area. Evaluation of other facial structures on the CT scan is also vital, since fractures of the facial skeleton may cause cervical emphysema [13].

Management of SCE varies according to the cause and associated conditions. In cases of open facial fractures, reduction, fixation, and antibiotics may be indicated. A consultation by the neurosurgical service is always an option. Prophylactic antibiotics are advisable in complicated mastoid fractures, while there is a controversy of opinions regarding uncomplicated ones. The SCE cavity may be filled with fluid and get inflamed, but the course of most SCE is to resolve spontaneously. The patients should be strictly advised to keep their mouth open during sneezing, coughing as well as to avoid wind instruments, nose-blowing and air traveling for a few weeks[2,5].

**Conclusion**

The present case study describes a high-velocity mastoid bone injury-causing SCE. A fracture of the mastoid bone should be included in the workup of a head and neck traumatic injury. A well-pneumatized mastoid can absorb forceful impacts, protecting middle and inner ear structures. On the set of a mastoid fracture, the Valsalva maneuver can have a catalytic effect on SCE formation but is not a prerequisite, since an adequate force of impact can by itself disseminate air from the mastoid to the surrounding soft tissues. Patients may initially present with minimal symptoms, but their condition may deteriorate rapidly or insidiously, especially in settings of mediastinal emphysema.

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Conflict of interest

None declared.

Author contributions

Dimitrios Paouris: contributed to writing—original draft. Jana Barkociová: contributed to project administration, writing - review, visualization. Irina Šebová: contributed to supervision

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