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Case Report
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Challenges in Cranial Trauma Surgery Cranial Base Fractures, A Case Report

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Abstract

Cranial base fractures are complex injuries that pose a significant challenge in neurotrauma ology due to severe complications that might follow, such as cranial nerve damage or cerebrospinal fluid leaks. The case of a 45-year old female patient who sustained multiple traumatic injuries, including fractures of the right parietal and temporal bones, a posterior cranial fossa base fracture with scattered mastoid bony fragments, subarachnoid and subdural hemorrhages, pneumocephalus, a facial nerve lesion and serial rib fractures, is presented. The patient's recovery was prolonged and complicated by an unexpected course of her pre-existing conditions. Initially, urgent surgery was performed to address the subdural hemorrhage and bony fragments, followed by conservative treatment. Despite multiple follow-up surgeries to manage persistent nasal congestion, a sense of ear fullness and pain as well as difficulties with compensation, significant symptom relief was only achieved after addressing concomitant septal deformity and chronic inflammation with septoplasty. The aim of this case report is to highlight the importance of considering concomitant diseases during the healing process, as overlapping symptoms can mislead clinicians and complicate posttraumatic management.

Keywords: Cranial - Ear Trauma, Joint Neurosurgical - ENT Surgery, Nasal Septum Deformity

Introduction

Cranial base fractures are relatively uncommon injuries, found in about 4% of patient who suffer severe head injuries. Despite their rarity, they comprise approximately 19-21% of all skull fractures [1]. These injuries usually occur due to high-impact events such as car accidents, falls or physical assaults. The clinical significance of cranial base fractures stems from their location near critical structures, which increases the risk of serious complications [2].

A fracture can occur in various parts of the cranial base, including the anterior, middle, and posterior cranial fossae, each carrying distinct clinical implications. Fractures of the anterior cranial fossa are often associated with nasal cerebrospinal fluid leakage and orbital injuries, while fractures of the middle cranial fossa frequently involve the temporal bone and can lead to hemotympanum, hearing loss and cranial nerve injuries, as well as carotid artery damage. Fractures of the posterior cranial fossa, although less frequent, carry significant risks for brainstem and spinal injury, making them particularly dangerous.

A crucial aspect in the management of cranial base fractures is the integrity of the dura mater. Breaches in the dura can result in cerebrospinal fluid leaks, which not only increase the risk of infections such as meningitis but also complicate the clinical management of these injuries. Bone wax, popularized by Sir Victor

Horsley, is a crucial tool in neurosurgery for controlling bleeding from the bone, particularly from emissary and diploic veins, as well as preventing cerebrospinal fluid leaks. It is widely used for hemostasis which is achieved through the physical properties of the wax. It acts as a tamponade, stopping blood flow from damaged trabecular bone vessels and promoting clot formation. Known for its availability, ease of use and immediate action in controlling bleeding, bone wax remains a staple in both cranial and spinal procedures. Despite its benefits, complications such as inflammation, infection and impaired bone healing have been reported, prompting the development of various alternatives. Nonetheless, bone wax continues to play a vital role in ensuring effective management of complex neurosurgical cases, emphasizing the need for prompt and effective treatment to prevent long-term complications and improve patient outcomes [3-5].

This case report explores the challenges in diagnosing and managing cranial base fractures, particularly when compounded by multiple traumatic injuries and pre-existing conditions. The necessity of a comprehensive approach to treatment is highlighted, emphasizing the importance of considering all concurrent pathologies in the recovery process.

Case Report

A 45-year-old female patient was involved in a car accident which resulted in multiple traumatic injuries, including fractures of the right parietal and temporal bones, a posterior cranial fossa base fracture with scattered mastoid bony fragments, subarachnoid and subdural hemorrhages, pneumocephalus, a facial nerve lesion (HB score IV) and serial rib fractures (Figs. 1A, 1B and 1C). Upon arrival, exhibiting significant neurologic compromise, she was urgently taken for a surgical intervention. The initial surgery involved the removal of subdural hematoma and small bony fragments, with bone wax used to fill the bone gap and control bleeding. No cerebrospinal fluid leakage or dural tear was noted during the procedure. Postoperatively, the patient was managed conservatively, with a focus on neurological monitoring and symptomatic treatment for her other injuries.

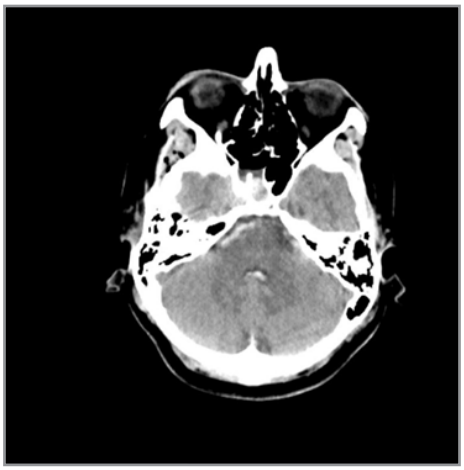

Figure 1: A. (CT scan: fractures of the right parietal and temporal bones, a posterior cranial fossa base fracture with scattered mastoid bony fragments, subarachnoid and subdural hemorrhages and pneumocephalus)

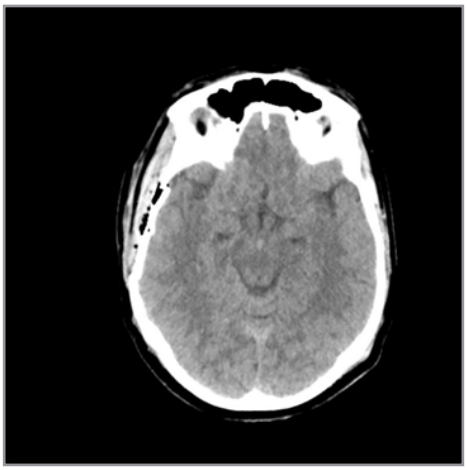

Figure 1: B. (CT scan: fractures of the right parietal and temporal bones, a posterior cranial fossa base fracture with scattered mastoid bony fragments, subarachnoid and subdural hemorrhages and pneumocephalus)

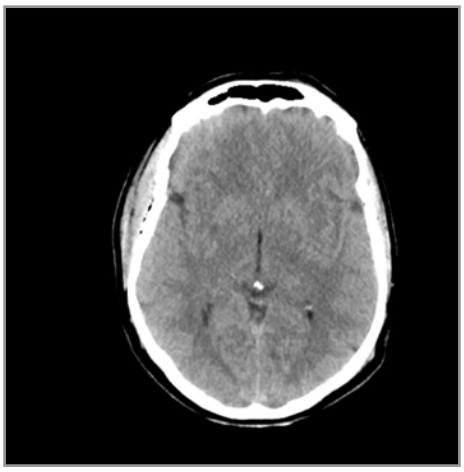

Figure 1: C. (CT scan: fractures of the right parietal and temporal bones, a posterior cranial fossa base fracture with scattered mastoid bony fragments, subarachnoid and subdural hemorrhages and pneumocephalus)

In the following weeks, the patient showed signs of neurological recovery, but complications related to the cranial base fracture persisted. These included right-sided facial palsy (HB score IV), hemotympanum with impaired hearing and a sense of ear fullness and pain, suggestive of persistent mastoid cell issues. MRI scans revealed the presence of liquid or viscous content in the remaining mastoid cells, prompting an otorhinolaryngological evaluation and subsequent surgery (Fig. 2). Six months after the injury, the patient underwent a mastoidectomy, which revealed an abundance of bone wax and reactive adhesions. Adhesions were cut and the bone wax protruding to the mastoid till the facial genu was removed. Only the part holding the menings was left. Decompression of the facial nerve was made. Postoperatively otoscopic examination revealed normal finding with intact tympanic membrane and HB score III. Despite this intervention, the patient's symptoms persisted and repeated MRI scans continued to show liquidy content in the mastoid cells (Fig. 3).

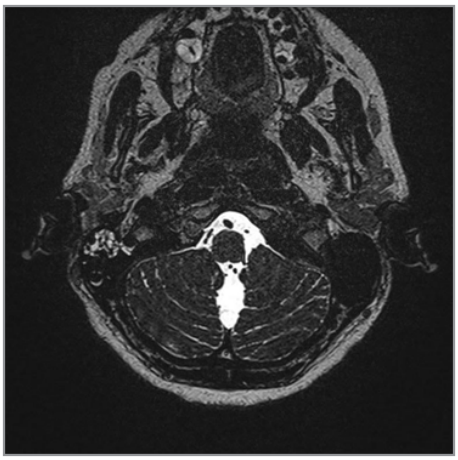

Figure 2: (MRI scan: liquid and viscous content in the remaining mastoid cells)

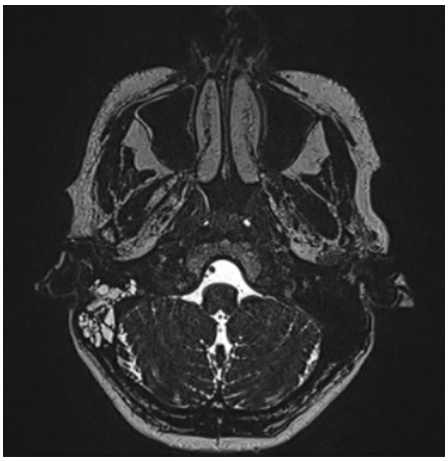

Figure 3: (MRI scan: persistence of liquidy content in the mastoid cells)

A year later, a second surgery was performed. During operation it was noted that mastoid tegmen bone almost closed, without liquor rhea. There was new formation of inflammatory tissue, with mucus and scarring. Inflammatory tissue and residual bone wax were removed.

Postoperatively tonal audiogram showed hearing within normal limits, while the tympanometry showed curve C. After the second operation HB score remained stationary (III).

However, the MRI findings remained unchanged. A revision of the mastoidectomy along with a potential neurosurgical evaluation for a possible CSF leak was considered but ultimately refused by the patient (Fig. 4). Concurrent with these interventions, nasal endoscopic finding showed septal deviation to the right side, hypertrophy of the inferior nasal turbinate s, while ostiomeatal complex, sphenoethmoidal recess and epipharynx appeared normal. MRI showed chronic inflammatory changes of paranasal sinuses (Fig. 5), but no fistula was detected on CT scan of paranasal sinuses and beta trace protein test was negative. Given the persistent and overlapping symptoms, she decided to undergo a surgical correction. Remarkably, three years post-trauma, the patient experienced immediate substantial relief of her symptoms following the septoplasty, despite unresolved posttraumatic mastoid changes.

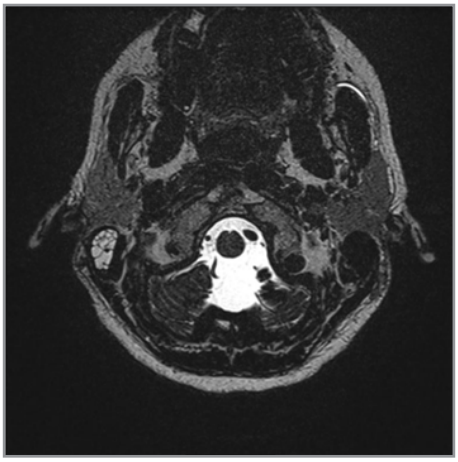

Figure 4: (MRI scan: stationary)

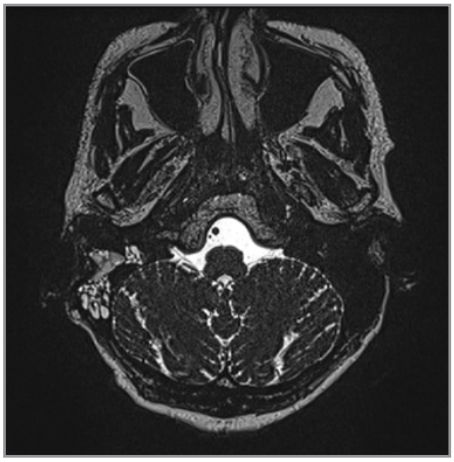

Figure 5: (MRI scan: chronic inflamatory changes of paranasal sinuses)

Discussion

The precise effect of septoplasty on the relief of the patient's symptoms remains the main mystery of this case. Existing literature offers insights that possibly help answer this question.
A study conducted by Kaya et al. (2018) indicated that nasal septal deviation might affect Eustachian tube function and middle ear ventilation. Their findings suggested that septoplasty could have a beneficial effect on these functions, potentially restoring normal middle ear pressure and improving related functions [6].

Similarly, Duran et al. (2014) explored middle ear pressure levels in patients with isolated nasal septum deviation before and after septoplasty. They found that middle ear pressure on the side of nasal obstruction was lower but remained within reference ranges. After septoplasty, there was an approximate 30% improvement in middle ear pressure. This improvement highlights the potential impact of correcting nasal septal deviation on alleviating middle ear issues, which may account for the significant symptom relief our patient experienced after septoplasty [7].

Nanda et al. (2017) conducted a study to determine the impact of septoplasty on hearing and middle ear function. They reported that a deviated nasal septum can adversely affect hearing and middle ear ventilation due to altered Eustachian tube function, leading to ear fullness and hearing impairment. Their findings showed that septoplasty led to improvements in hearing and middle ear function, with noticeable benefits occurring 8 to 12 weeks post-surgery. This supports the hypothesis that addressing nasal septal deviation can have a profound impact on related auditory symptoms, which aligns with our patient's significant improvement after undergoing septoplasty [8].

A meta-analysis by Son et al. (2022) further substantiates these findings. They examined the relationship between nasal septal deviation, Eustachian tube function and middle ear pressure. The study found that the narrowed side of the nasal cavity in nasal septal deviation is often related to Eustachian tube dysfunction. Septoplasty was shown to help restore Eustachian tube function and normalize middle ear pressure. These results suggest that the anatomical correction achieved through septoplasty can directly influence the adjacent structures, improving symptoms related to middle ear dysfunction [9].

In our patient's case, the persistent post-traumatic symptoms despite multiple surgeries for mastoid cell issues highlight the complexity of cranial base fractures and their complications. The notable symptom relief following septoplasty suggests that the chronic inflammation and septal deformity likely played a significant role in her ongoing discomfort. Addressing these conditions likely alleviated the underlying issues affecting her middle ear function and overall symptomatology.

Conclusion

This case stresses the complexity of managing cranial base fractures and the importance of considering coexisting conditions in posttraumatic management. Overlapping symptoms led us to erroneous solving of posttraumatic complications and ignoring septal deformity and chronic inflammation, while addressing this problem proved successful for the patient's symptoms, although posttraumatic mastoid changes remained unsolved. This outcome underscores the potential impact of septal correction on middle ear function and overall symptomatology, as supported by relevant studies in the literature. Therefore, a comprehensive, multidisciplinary approach is crucial in treating patients with complex traumatic injuries to ensure all potential contributing factors are identified and managed appropriately. Integrating expertise from neurosurgery, otorhinolaryngology and other specialties can lead to a good outcome and a more effective resolution of persistent symptoms.

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