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Case Series

Challenges in Diagnosis and Management of Skull Base Osteomyelitis: A Case Series

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ABSTRACT

Background and Importance: Skull Base Osteomyelitis (SBO) is a complex disease process often confused with malignancy due to clinical and radiological masquerade. Extensive changes have recently occurred in the clinical course and management of the disease, attributed to improvements in neurosurgical procedures, diagnostic modalities, and the introduction of new antibiotics and management techniques thus reducing the associated morbidities and mortalities. However, SBO continues to pose a major challenge in the form of early diagnosis and management and can be the cause of devastating complications and high fatality associated with the disease.

Case Presentation: Here we provide the clinical profile, investigation, management, and outcome of 5 cases of SBO, all of whom were thoroughly examined for neurological deficit, complete blood count, inflammatory markers, and radiographic imaging. Biopsy and microbiological culture reports were collected and patients were followed up.

Conclusion: Early diagnosis and culture-specific antibiotic treatment have been shown to provide good outcomes. Due to its rarity, large case series of SBO are insufficiently found in the literature.

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Highlights

- Skull base osteomyelitis (SBO) is a rare and life-threatening disease, often characterized by multiple cranial nerve palsies.
- There is a need to differentiate it from other conditions such as brain stem gliomas, and multiple sclerosis.
- Early diagnosis and culture-specific treatments have a good prognosis.
- A high index of suspicion should be kept in immunocompromised patients with multiple cranial nerve palsy.

Plain Language Summary

Skull Base Osteomyelitis (SBO) is a rare and life-threatening disease. The causative organisms include bacteria and fungi. Diagnosis is challenging due to non-specific clinical presentation that includes multiple cranial nerve palsy. It is mostly seen in immunocompromised patients. It is usually confused with various clinical conditions, such as brain stem gliomas and multiple sclerosis. However, the management of SBO is entirely different from those previously mentioned. Early diagnosis and treatment are the goals of management in these cases due to high mortality. This study is a series of five cases that were managed over two years and presents an overview of the presentation, diagnostic modalities, management, and microbiological profile of SBO that enable the diagnosis and management of such cases.

Background and Importance

Skull Base Osteomyelitis (SBO) is a rare life-threatening condition that occurs mostly in diabetic, elderly or immunocompromised individuals [1]. The main cause of SBO in 98% of cases is P. aeruginosa [2]. Patients present with headache, fever, multiple cranial nerve palsies, and raised inflammatory markers, such as Erythrocyte Sedimentation Rate (ESR), C reactive protein (CRP), and Total Leucocyte Count (TLC) [3]. Imaging studies, such as Computer Tomogram (CT) scans, Contrast-Enhanced Magnetic Resonance Imaging (CEMRI), and Positron Emission Tomogram (PET) scans help in the anatomical localization of lesions [4]. Biopsy and culture are necessary to rule out malignancy and start appropriate antibiotics [5]. Due to the high mortality and morbidity associated with the condition, early diagnosis, and treatment of the condition are essential. Here we present a series of five patients who were treated at our institute in the last two years.

Case Presentation

Case 1

The first case was a 65-year-old woman with no known co-morbidities who presented with features of a recent change in voice, facial deviation, and headache. On examination, she had right-sided seventh, ninth, and tenth nerve palsy. She was evaluated with CEMRI brain which showed contrast enhancement in anterior ethmoidal cells and maxillary sinus. She was evaluated by a specialist for Ear, Nose, and Throat diseases (ENT) for vasculitis, and multiple biopsies were taken from her nasal sinus mucosa which were indeterminate. However, her blood investigations were suggestive of raised inflammatory markers (Erythrocyte Sedimentation Rate (ESR), and C Reactive Protein (CRP). Her biopsy sample was positive for Ig4 and she was started on steroids to which she responded and was discharged. However, one month later, she was readmitted with severe stridor, dysphagia, facial deviation, and ocular paresis. She underwent an emergency tracheostomy and was placed on ventilator support. Her brain CEMRI this time showed extensive contrast enhancement of the anterior cranial fossa extending to the clivus (Figure 1). Pseudomonas aeruginosa was cultured from enhancing mucosa of the paranasal sinus sensitive to vancomycin and she was started on appropriate antibiotics however expired after one week.

Case 2

The second case was a 42-year-old known uncontrolled diabetic with right nasal stuffiness, bleeding, diplopia, and decreased vision in the right eye. On examination, it was found that he had right-sided visual acuity of 6/60 with chemosis and right-sided third,

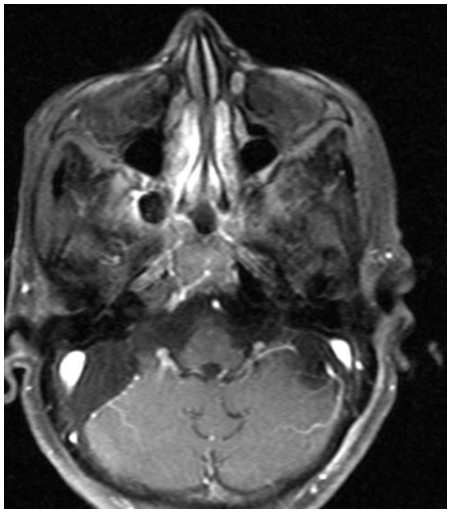

Figure 1. Axial contrast Magnetic Resonance Imaging (MRI)

and 4th nerve palsy. On nasal examination, the hypertrophied middle nasal turbinate and mass in the right maxillary sinus were eroding the inferior orbital wall. The patient underwent right maxillary sinus exenteration with enucleation of the right eye. Biopsy showed fungal granuloma-aspergillosis. He was eventually discharged. However, six months later, he was readmitted with complaints of nasal stuffiness and left seventh nerve palsy, and headache. In the brain CEMRI, a contrast-enhancing lesion existed on the anterior cranial fossa and a subdural empyema on the right frontotemporoparietal region (Figure 2). He underwent right frontotemporoparietal craniectomy and abscess drainage. The abscess culture was sterile for any bacteria, fungi, or mycobacterium. He recovered well after the operation but later expired from other conditions.

Case 3

The third case was a 36-year-old known diabetic who presented with a history of headache, decreased hearing left ear and pus discharge, and slurring of speech. On examination, he had left moderate sensorineural hearing loss, and left 9^{th}, 10^{th}, 11^{th}, and 12^{th} cranial nerve palsy. On CEMRI he had an enhancing lesion extending from the left maxillary sinus, preclival, clival, petrous, and jugular foramen (Figure 3). The patient underwent Functional Endoscopic Sinus Surgery (FESS) and drainage of the left maxillary sinus. His biopsy showed Candida parapsilosis. He was treated with insulin and fluconazole for six weeks and improved significantly.

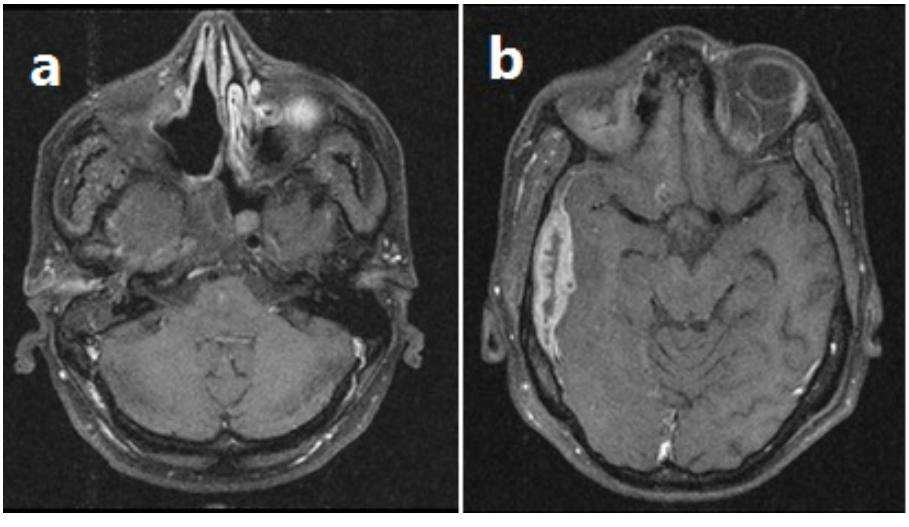

Figure 2. Axial contrast Magnetic Resonance Imaging (MRI)

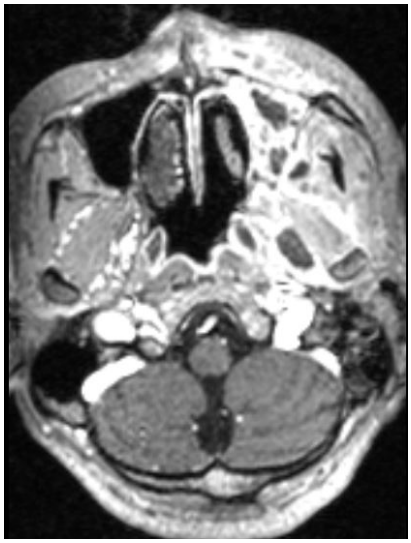

Figure 3. Axial contrast Magnetic Resonance Imaging (MRI)

Case 4

The fourth case was a 73-year-old female without any known co-morbidities who presented with left frontal and periorbital headache, drooping of the left eyelid, and diplopia. On examination, she had left eye visual acuity of 6/36 and left 3rd nerve, 5th, and 6th nerve palsy. Her CEMRI showed enhancing lesion involving the left posterior ethmoid, sphenoid sinus, and petrous apex (Figure 4). She was empirically started on broad-spectrum antibiotics ceftazidime and ciprofloxacin and recovered well.

Case 5

The fifth case was an 83-year-old known diabetic who presented with headache, dysphagia, hoarseness of voice, and facial deviation. On laryngoscopy, it was found that he had bilateral vocal cord abductor palsy and underwent an emergency tracheostomy. He started with Ryles tube feed. His CEMRI showed enhancing lesions involving the left anterior cranial fossa, sella, bilateral petrous, and clival region (Figure 5). His Positron Emission Tomogram was suggestive of hypermetabolic foci in bilateral petrous bone (Figure 6). He initially underwent a biopsy of nasal mucosa by ENT but reports

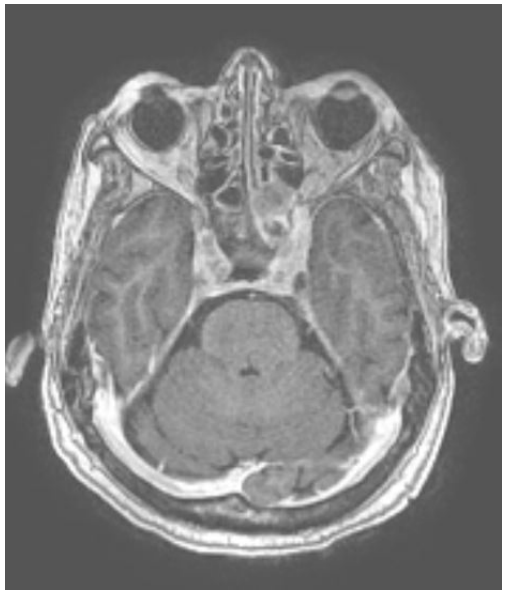

Figure 4. Axial contrast Magnetic Resonance Imaging (MRI)

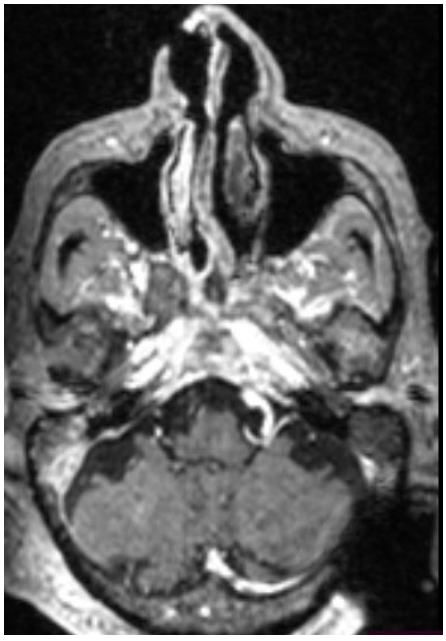

Figure 5. Axial contrast Magnetic Resonance Imaging (MRI)

were indeterminate and he later underwent a microscopic transnasal transsphenoidal biopsy from clivus (Figures 7 & 8) which demonstrated osteomyelitic bone. The culture revealed that Pseudomonas aerogonisa sensitive to Ceftazidime and Piperacillin was treated with appropriate antibiotics and the patient was discharged in good health. Table 1 presents the summary of all treated cases.

Discussion

As seen in most of our cases, diabetic and immunocompromised patients are more susceptible to SBO [1]. Reduced chemotaxis and phagocytosis of polymorphonuclear leukocytes (PMNs), monocytes, and macrophages can be attributed to it [6]. All cases in our series had a headache and cranial nerve deficits and raised inflammatory markers which are similar to other avail-

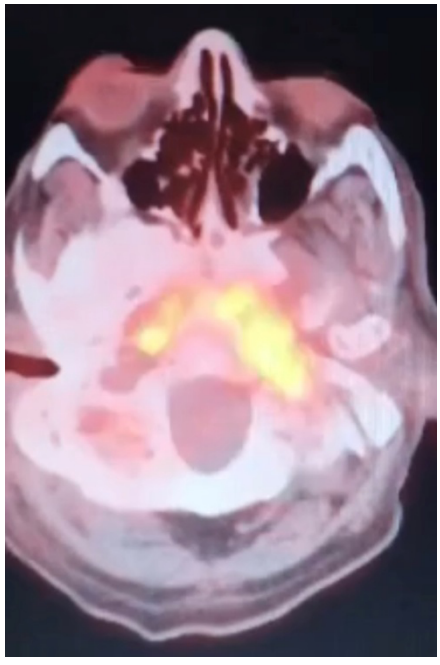

Figure 6. Positron Emission Tomogram (PET) Computer Tomogram (CT) showing hypermetabolic foci in bilateral petrous apex

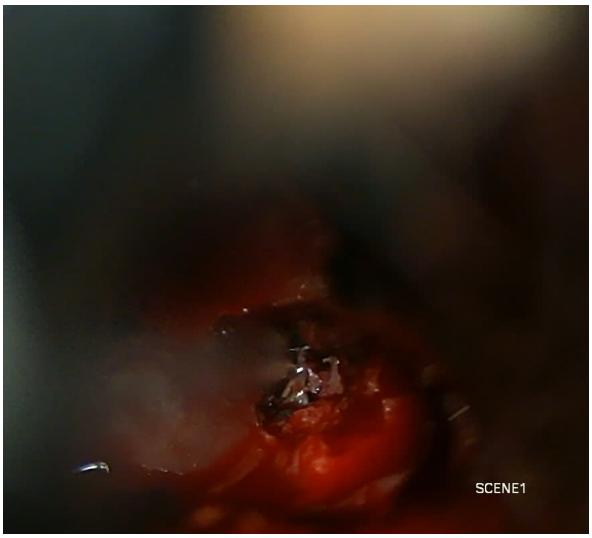

Figure 7. Intraoperative microscopic view of biopsy from clivus

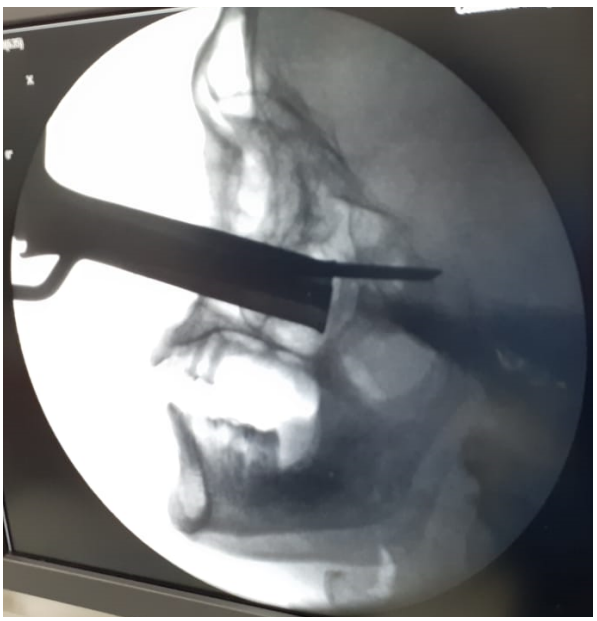

Figure 8. C armview of transnasal transphenoidal clival biopsy

able articles [3]. Thus patients with diabetes or immunocompromised states with headaches and multiple cranial nerve deficits should be evaluated for infectious etiologies by neuroimaging. Four out of five cases in this series had contiguous foci for the spread of infection, as reported in studies conducted by Chandler JR [7] in 1989. Contrast MRI was performed in all the cases and helps delineate heterogeneously enhancing areas and also pointed out the marrow signal changes in all our cases thereby helping us to plan the biopsy from the most easily accessible target area. Similar MRI findings were also detected by Muranjan et al. in their case series [8]. Difficulty in clinical diagnosis of such cases due to non-specific clinical signs and symptoms led to clinical differentials, such as granulomatous lesions in the first case and fungal sinusitis in the second case. Also multiple non-specific biopsy results in cases one and five lead to delayed diagnosis as reported by Chang et al. [9]. Therefore, SBO should be kept as a differential diagnosis in patients with suspected granulomatous lesions or malignancy. The fourth case was empirically started with antibiotics due to the high index of suspicion of SBO and poor anesthetic risk for the patient. We found Pseudomonas aeruginosa as the most common

Table 1. Summary of Skull Base Osteomyelitis (SBO) cases

No	Age/Sex	Immunocompromised Condition	Symptoms	Examination	Biopsy	Imaging	Organisms	Antimicrobial	Remarks
1.	Sixty-five/female	On steroid	Headache voice change facial weakness	CN 7^{th}, 9^{th}, 10^{th}	Paranasal sinus	Anterior ethmoidal. clinoid, paraclinoid, clivus	P Aeurogi-nosa	Vancomycin and ciprofloxacin	Expired
2.	Forty-two/male	Diabetes	Headache, nasal stuffiness, facial weakness	2^{nd}, 3^{rd}, 4^{th}, 6^{th}	Paranasal sinus, dura	Bilateral maxillary	Aspergillous	Amphotericin B, fluconazole	Expired due to other condition
3.	Thirty-six/male	Diabetes	Headache, decreased hearing, otorrhea, slurring of speech	7^{th}, 9^{th}, 10^{th}, 11^{th}, 12^{th}	Paranasal sinus	Maxillary sinus, preclival, clival, petrous and jugular foramen	Candida parapsilopsis	Fluconazole	Recovered
4.	Seventy-three/female	Nil	Headache, drooping of left eyelid, diplopia	2^{nd}, 3^{rd}, 5^{th}, 6^{th}	No	Posterior ethmoid, sphenoid sinus, and petrous apex	Nil	Ceftazidime and ciprofloxacin	Recovered
5.	Eighty-three/male	Diabetes/ CA prostrate (optd)	Headache, dysphagia, voice change, stridor, facial weakness	7^{th}, 8^{th}, 9^{th}, 10^{th}, 11^{th}, 12^{th}	Clivus	Ethmoidal air cell, sphenoid sinus, clinoid, paraclinoid, petrous, clivus, jugular foramen	P aeurogi-nosa	Ceftazidime and Levofloxacin	Recovered

CN: Cranial Nerve

organism as Prasad et al. [2]. As recommended [10], patients responded well to six weeks of antimicrobial therapy in most of our cases.

Conclusion

SBO is a life-threatening disease. A multidisciplinary approach of the patient involving a neurosurgeon, ENT, opthalmologist, intensivist, physician, and physiotherapist is required to manage such patients. Diabetic or immunocompromised patients with headaches and multiple cranial nerve palsy and raised inflammatory markers in blood should be empirically started on antibiotics and SBO ruled out by neuroimaging. Contrast MRI can delineate the margins of involved bone and soft tissues and help in the planning of the biopsy. SBO diagnosis essentially follows biopsy and also guides in the appropriate antibiotic therapy.

Ethical Considerations

Compliance with ethical guidelines

Written informed consent was obtained from the patients and their identity was not disclosed compatible with the ethical guidelines.

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Authors' contributions

Conception, design, and data collection: Tamajyoti Ghosh; Data analysis and interpretation: Subir Dey; Drafting the article and critically revising the article, reviewing the submitted version of the manuscript, approving the final version of the manuscript: Both authors.

Conflict of interest

The authors declare no conflict of interest.

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