American Journal of Otolaryngology and Head and Neck Surgery
Clinical Presentation
Published: 25 Nov, 2022

Skull Base Osteomyelitis: Not Just Pseudomonas

Reshma SA* and Noushad M

Dr Noushad's ENT Hospital and Research Center, India

Abstract

Introduction: Skull base osteomyelitis is a rare life-threatening condition which affects the temporal, sphenoid or occipital bone that can pose a challenge to diagnose because of its nonspecific symptoms, long clinical course, and radiologic findings that mimic those of other entities like malignancies.

Prompt diagnosis by early tissue sampling and appropriate treatment is of utmost importance to prevent or limit long term morbidity or complications such as intracranial extension, empyema, or death. This study upholds a higher patient number and hence helps to bring to light, the organisms most likely to cause a skull base osteomyelitis which helps to outline the antibiotic treatment regimen and the probability of it being other invasive species like fungi or tuberculosis and the different course of management that ensues.

Objective: To validate the different organisms attributing to skull base osteomyelitis.

Materials and Methods: A retrospective study conducted in a tertiary hospital in Cochin, Kerala over a period of 2 year, September 2020 to September 2022 where 50 patients who presented with features suggestive of skull base osteomyelitis, confirmed radiologically, whose pus/tissue was sent for bacterial culture and sensitivity, fungal KOH staining and culture, TB Ziehl Neelsen staining and culture and histology to rule out malignancy were retrieved from data base.

Results: Out of 50 patients, 21(42%) patients pus/tissue culture grew strictly *Pseudomonas aeruginosa* while 10 (20%) showed no growth in any of the culture medium. Sixteen percentage of the culture was positive for fungi, with *Candida* species being the most prominent followed by invasive *Aspergillosis* and *Mucor*. Only 1 case of Tuberculosis was reported in our study.

Conclusion: The observation of the varying pattern of the organisms cultured from various patients diagnosed with skull base osteomyelitis will definitely prove fruitful in determining antibiotic protocol.

Keywords: Osteomyelitis; Aspergillosis; Otogenic

OPEN ACCESS

Correspondence:
Reshma Saerah Abey, Dr Noushad's ENT Hospital and Research Center, Kochi, India,
E-mail: docsaerah@gmail.com

Received Date: *31 Oct 2022*
Accepted Date: *22 Nov 2022*
Published Date: *25 Nov 2022*

Citation:
Reshma SA, Noushad M. Skull Base Osteomyelitis: Not Just Pseudomonas. Am J Otolaryngol Head Neck Surg. 2022; 5(10): 1215.

Copyright *© 2022 Reshma SA. This is an open access article distributed under the Creative Commons Attribution License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original work is properly cited.*

Introduction

Skull base osteomyelitis was first described by Meltzer and Kelemenv in 1959 in patients with pyocyaneus chondritis and osteomyelitis of the External Auditory Canal (EAC) [1]. Skull base osteomyelitis is an infection involving one or multiple bones of skull like Temporal, Sphenoid or in extensive cases can involve the occipital bone and caused due to infections which can be bacterial or fungal [2].

Anatomy

The skull base has a complex anatomy formed by the frontal, temporal, occipital, ethmoid, and sphenoid bones. From an endocranial view, the skull base can be subdivided into three regions: Anterior, central, and posterior. The anterior to central skull base regions are separated by the posterior margin of the lesser wing of the sphenoid bone, the anterior clinoid processes, the Tuberculum sellae, and the anterior margin of the greater wing of the sphenoid bone. The border between the central and posterior skull base regions is the superior margin of the petrous part of the temporal bone and the dorsum sellae. Skull base has multiple for Amina's and vascular structures and the extension and involvement of these structures due to the disease can result in single or multiple palsies and other complications [3].

Another important structure that is involved in skull base osteomyelitis is cavernous sinus. The cavernous sinus works as a conduit and encompasses cranial nerves leaving the brainstem travel before entering the orbit to innervate extraocular and intrinsic eye muscles. The nerves of the cavernous sinus are the oculomotor nerve (CN III), trochlear nerve (CN IV), ophthalmic

nerve (V1), maxillary nerve (V2), abducens nerve (CN VI), and the sympathetic plexus around the internal carotid artery.

Multiple diseases can imitate skull base osteomyelitis in presentation hence radiological imaging and hence high index of clinical suspicion is required.

Skull base osteomyelitis is generally caused due to chronic or insufficient treatment of otogenic, sinusogenic or odontogenic infections.

More than 50 % of otogenic skull base osteomyelitis has been attributed to *Pseudomonas aeruginosa* as the causative factor [4].

Other atypical causes of infection involve other bacteria like *Streptococcus* species, *Staphylococcus aureus* and fungi like *Aspergillus*, *Candida*, *Cryptococcus neoformans*, *Blastomyces* species, *Mucor* species, and *Rhizopus* species [5].

Clinical Presentation

Patients presenting to our outpatient department exhibited multiple clinical presentations depending on the site of involvement for instance patients diagnosed with otitis externa, presents with headache, severe otalgia, facial pain, purulent otorrhea, and conductive hearing loss. On the other hand, sinus origin infection progressing to skull base osteomyelitis presents with nasal congestion, rhinorrhea, headache, and fever [2,6].

The involvement of cavernous sinus, petrous apex and brain stem results in multiple cranial nerve palsies and their respective clinical presentations.

Individuals who are highly susceptible are generally immunocompromised or on immunosuppressants.

Objective

To determine various organisms that result in the uncommon but deleterious skull base osteomyelitis this in turn can help to understand the appropriate antibiotic for treatment.

Materials and Methods

A retrospective study was done in our tertiary hospital spanning over a period of 2 year involving 50 patients that presented to our outpatient department with features suggestive of skull base osteomyelitis or malignancy.

For each patient, clinical information was recorded on a standardized form and included: Patient demographics, comorbidities and predisposing factors within the preceding 1-year, likely source of infection (ear, sinus, other), clinical features, results of microbiological and histopathological investigations and treatment. Patients also underwent Computed Tomography (CT), Magnetic Resonance Imaging (MRI) or positron emission tomography to determine the extent of the disease.

Results

Age

In the proposed study, 36 (72%) were above the age of 60 years with average age group falling between 65 to 70 years.

Comorbidities

In this study, out of 50 patients, 40 patients were diabetic, 1 had parkinsonism, 5 patients had associated hypertension and 3 with chronic kidney disease including 1 post-transplant patient on immunosuppressants.

Table 1: Patients most commonly presented with chronic ear discharge or acute ear pain.

Fever	9
Headache	7
Ear discharge	17
Ear Pain	17
Nasal stuffiness/ Discharge	5
Granulation in the ear	10
Oedema of ear canal/ excoriation	4
Cranial nerve palsy	11 (total)
Abducens	1
Facial palsy	8
Glossopharyngeal	1
Vagus	3
Hypoglossal nerve	1

Table 2: 21 Patients pus/tissue culture grew strictly Pseudomonas Aeruginosa while 10 (20%) showed no growth in any of the culture medium. 10% staph 16% fungi.

Number	Bacteria	Fungi	Others
10			No growth
21	*Pseudomonas aeruginosa*		
5	*Staphylococcus aureus*		
1	*Escherichia coli*		
1	*Citrobacter koseri*		
1			Tuberculosis
1	*Morganella morgagni*		
1	Coagulase negative *Staphylococcus*		
5		*Candida albicans* species- *parapsilosis*, *albicans* and non *albicans*	
2		*Aspergillus* species	
1		Mucormycosis	
1	Mixed flora: *Klebsiella pneumonia*, *Pseudomonas aeruginosa* and *enterococcus faecalis*		
1	Mixed flora: *Pseudomonas Aeruginosa* and *Serratia marcescens*		

Clinical features

Patients most commonly presented with chronic ear discharge or acute ear pain and findings in a long-standing case of ear discharge in the affected ear was granulations, edema or excoriation of skin of the external auditory canal (Table 1).

Severe cases of skull base osteomyelitis presented with single or multiple cranial nerve palsy. The most common affected being facial nerve.

Out of 50 patients, 21 (42%) patients pus/tissue culture grew strictly *Pseudomonas aeruginosa* while 10 (20%) showed no growth in any of the culture medium. 10% staph 16% fungi (Table 2).

Table 3: Treatment.

Therapy Received	TOTAL
Conservative	16
Mastoid Exploration	20
Endoscopic Sinus Surgery	13
Discharged Against Medical Advice	1

Those patients whose ear/nasal pus culture grew flora were initiated on appropriate antibiotics and responded well was treated conservatively. The other patients included in the study that showed no response to antibiotics underwent preoperative work-up and radiological investigations which includes computed tomography and Positron emission tomography. These patients later underwent either Mastoid exploration or endoscopic sinus surgery for disease clearance and swabs sent for culture and sensitivity from the involved site along with biopsy for histology to rule out malignancy and other chronic diseases like tuberculosis.

Discussion

SBO, usually a complication of uncontrolled otogenic, odontogenic or sinus infection [7]. A total of 50 patients were included in our study who showed signs and symptoms relating to skull base osteomyelitis which was further confirmed by radiological investigation like PET scan, MRI or a CT scan. Currently, there is no consensus about the best therapeutic option while some physicians opt for a more conservative approach while others prefer surgical clearance of disease to reduce load of necrotic debris and improved antibiotic penetrance. In our study, Majority of the culture (42%) grew pseudomonas aeruginosa, in some cases, pseudomonas organism where resistant to first line broad spectrum and hence the emphasis on initiating appropriate antibiotics and preventing further resistance down the road. Study by Blyth [2] and Gomes et al. and Conde- Diaz et al. [8], showed similar data supporting pseudomonas being the most commonly cultured organism. Another major bite of the pie is taken by 'NO GROWTH' seen in (20%) 10 patient which on further discussion with the microbiologist could be attributed to cocktail of antibiotic patients have been treat with by multiple doctors before they are referred to our tertiary center which limits the growth of organism on culture media. Our study also sheds light on occurrence of fungus (16%) with *Candida* species being the most common followed by invasive *Aspergillus* and Mucormycosis). Fungal SBO has been reported in multiple studies mostly caused by *Aspergillus*, and less commonly, *Scedosporium* species [7,9,10].

A recent case report published rare fungus *Apophysomyces elegans* from a diabetic patient [11].

Fungal skull base osteomyelitis was initiated with liposomal amphotericin B, voriconazole or Posaconazole. *Mycobacterium tuberculosis* in skull base osteomyelitis is a rare occurrence in our study but an infected site with pale granulation and pus not responding to empirical treatment should raise a suspicion of TB skull base osteomyelitis with additional radiological investigation of chest and sputum examination need to be executed and patient initiated on ATT drugs.

Skull base osteomyelitis generally occurs in immunocompromised patient and our study supports the same evidence with 40 out of 50 patients (80%) involved in the study were diabetic and 1 person on immunosuppressive drug post renal transplant and falling in the older age group category of above 60 years (72%) while a study by Furkan Özer et al. [12], 78.1% individuals suffering from skull base osteomyelitis were diabetic proving SBO mainly affects the immunocompromised individuals.

Conclusion

Despite improvements in antibiotic therapy, SBO remains as a significant cause of morbidity and mortality, as well as a treatment challenge. Our study highlights the different organisms that are cultured from the infected site and importance of starting antibiotics that is most sensitive to the cultured organism.

References

1. Meltzer PE, Kelemen G. Pyocyaneous osteomyelitis of the temporal bone, mandible and zygoma. 1959;69(10):1310-16.
2. Blyth C, Gomes L, Sorrell T, Da Cruz M, Sud A, Chen S-A. Skull-base osteomyelitis: Fungal *vs.* bacterial infection. Clin Microbiol Infect. 2011;17(2):306-11.
3. Raut A, Naphade PS, Chawla A. Imaging of skull base: Pictorial essay. Indian J Radiol Imaging. 2012;22(4):305-16.
4. Rubin J, Yu VL. Malignant external otitis: Insights into pathogenesis, clinical manifestations, diagnosis and therapy. Am J Med. 1988;85(3)391-98.
5. Vlastos IM, Helmis G, Athanasopoulos I, Houlakis M. Acute mastoiditis complicated with bezold abscess, sigmoid sinus thrombosis and occipital osteomyelitis in a child. Eur Rev Med Pharmacol Sci. 2010;14(7):635–8.
6. Bastianpillai J, Chaudhry S, Vijendren A. Rare case of a 3-year-old with Candida skull base osteomyelitis: Lessons to be learnt. BMJ Case Rep. 2019;12(4):e228026.
7. Lee S, Hooper R, Fuller A, Turlakow A, Cousins V, Nouraei R. Otogenic cranial base osteomyelitis: A proposed prognosis-based system for disease classification, Otol Neurotol. 2008;29(5):666-7.
8. Conde-Díaz C, Llenas-García J, Parra Grande M, Terol Esclapez G, Masiá M, Gutiérrez F. Severe skull base osteomyelitis caused by *Pseudomonas aeruginosa* with successful outcome after prolonged outpatient therapy with continuous infusion of ceftazidime and oral ciprofloxacin: A case report. J Med Case Rep. 2017;11(1):48.
9. Kountakis SE, Kemper JV, Chang CY, DiMaio DJ, Stiernberg CM. Osteomyelitis of the base of the skull secondary to *Aspergillus*. Am J Otolaryngol. 1997;18(1):19-22.
10. Stodulski D, Kowalska B, Stankiewicz C. Otogenic skull base osteomyelitis caused by invasive fungal infection. Case report and literature review. Eur Arch Otorhinolaryngol. 2006;263(12):1070-6.
11. Stephen S, Subashini B, Thomas R, Philip A, Sundaresan R. Skull base osteomyelitis caused by an elegant fungus. J Assoc Physicians India. 2016;64(2):70-71.
12. Özer F, Pamuk AE, Atay G, Parlak S, Yücel T. Skull base osteomyelitis: Comprehensive analysis and a new clinicoradiological classification system. Auris Nasus Larynx. 2021;48(5):999-1006.