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Imaging of Osteomyelitis

Dr. M.P. Goyal[1]; Dr. Mahesh Kumar Poonia[2]; Dr. Shailendra Srivastava[3]; Dr. Ashish Rana[4]

Abstract:- In this paper, an analysis of the demographic attributes, presenting symptoms, and infective agents, as well as the areas affected by skull osteomyelitis, of fifty male and fifty female patients is offered. A rough age estimate of around 61 years was found among the patients, with average symptom durations of about 6.8 months or longer. A significant percentage of diabetes (62%) and cranial nerve involvement (62%) were observed. The dominant symptom was headaches, representing 78% of cases, followed by cranial nerve palsy (62%) and hearing loss (48%). S. aureus was found to be the second most common causative agent, following only P. aeruginosa, which was the most common agent (54%). It became clear that there was a relevant infection in the temporomandibular joint and the retropharyngeal joint upon examining regional cases of the illness. In spite of therapy, only 38 percent of patients exhibited a cure, while 46 percent demonstrated improvement and 16 percent experienced a worsening of their condition.

Keywords: *Skull Osteomyelitis, Diabetes, Treatment Outcomes, Cranial Nerve Involvement, Demographics.*

I. INTRODUCTION

Inflammation and infection located in the bone marrow or long bones is known as osteomyelitis. It is usual for bacteria or fungus to enter the bloodstream and afflict bone tissue after surgery or another trauma. During 80% of the cases, the infection begins with an open wound [1]. While osteomyelitis could affect anyone, it poses a greater threat to children [1]. A very common bone infection is osteomyelitis that can arise after a traumatic event, particularly following an open fracture triggered by incidents like car accidents or job-related accidents [2]. It serves as a critical indicator of infection subsequent to surgical treatment for open fractures. The quick reproduction of bacteria that invade the bone tissue through damaged regions causes osteomyelitis [2]. The management of osteomyelitis is hard for patients and clinicians, the annual incidence in the United States being 21.8 per 100,000 persons [3]. Altogether, 2.4 per 100,000 people were found to have native vertebral osteomyelitis (NVO) in French research. In the 50-70 age group, the frequency reaches a high of 6.5 per 100,000 [4]. It then rises with aging. About 10% of osteomyelitis cases and between 1% and 6% of hand infections are osteomyelitis of the hands [5].

Central skull base osteomyelitis (SBO) may impact the bones at the back of the skull due to a hazardous infection. The acronym MOE, which originally stood for malignant otitis externa, has undergone a transformation to include a larger variety of symptoms. The origin of SBO affects whether the infection is lateral or central. The lateral sphenoid wings, pterygoid plates, temporal bones, and otogenic (ear) or odontogenic (dental) sources tend to be the common causes in lateral SBO. Although central SBO is typically linked to para-nasal sinus inflammatory illness, it can result from dental infections, pharyngeal abscesses, or hematogenous dissemination; it is generally confined to the clivus, sphenoid, and occipital bones [6,7]. Those who are afflicted with otitis externa may experience symptoms such as extreme otalgia, a strident tinnitus, and discharge of pus from the outer ear over time, a normally-looking tympanic membrane, and the preservation of hearing. A lot of individuals find relief from quick intravenous antibiotics. SBO, however, appears much later and with more subtlety, typically four to seven weeks after the first otogenic infection appears to clear up. In cases of unsuccessful medical treatment for symptoms, when new neurological abnormalities arise, if headaches persist, or when symptoms remain unexplained, it is appropriate to explore this condition [6, 7]. At first, signs of central septic shock may only include fever, nasal discharge, and headaches. However, neurological issues usually occur before a diagnosis of this condition is made. It is possible that the disease may have advanced and complications may have occurred before imaging takes place [6,7].

Although the diagnosis of small bowel obstruction (SBO) is closely linked to imaging, interpreting the results of CT and MRI can be quite challenging. Typically, a reduction in trabecular bone by 30–50% is needed for a CT scan to produce a positive outcome [8]. Classic CT imaging of osteomyelitis reveals medullary expansion, sclerosis, damage to the cortical layer, and a periosteal reaction. The effacement of fat planes in the subtemporal triangle, where the facial nerve departs from the stylomastoid foramen, is an important early clue that could be obscured by CT's inherent poor soft tissue resolution [9]. Characteristic findings in magnetic resonance imaging (MRI) include T1 hypointensity of affected bone marrow. A critical signal is an unusually vibrant one originating from the bone marrow near the skull base foramina. One abnormality that is commonly observed is the entry of soft tissue into adjacent fat territories and structures, such as the cavernous sinus. [10] Images of T1-W and T2-W: Usually, the locations where involvement is probable on T1-W scans often present as hypointense on T2-W imaging in contrast to other types of infections. This complication makes it difficult to employ imaging for diagnosis and is likely due to a pathological process causing fibrosis and necrosis [11].

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II. MATERIAL AND METHODS

The goal of this research was to scrutinize the demographics, symptoms, infectious agents, and infection sites of individuals having skull osteomyelitis. One hundred patients made up the cross-sectional research group, with fifty males and fifty females all diagnosed with skull osteomyelitis. The research included 100 patients who had a diagnosis of skull osteomyelitis, with 50 males and 50 females. In 2024, a tertiary care hospital was contacted. The study incorporated patients from adulthood onwards who had a confirmed diagnosis of skull osteomyelitis. The research did not include participants who either refused to provide their informed consent or lacked complete medical information. Data was obtained through conversations with patients and medical documents. Data was collected for the following variables: Age, how long they've had symptoms, diabetes status, and involvements of cranial nerves are part of what we call demographic information. The following symptoms and signs may be present: vertigo, ear discharge, hearing loss, face pain, fever, cranial nerve palsy, and vision loss. The microbes causing an infection are determined by growing microbial cultures from samples taken at the site of infection. Sites of Infection: Using imaging investigations and clinical evaluation to find areas of infection in the neck. Agents of Causation Identification: The samples were put through microbiological investigation using tried-and-true culture methods. Required instances featured a combination of molecular techniques and biochemical testing to determine the isolates. Imaging: CT and MRI scans were employed by doctors to recognize the precise locations of the body affected by osteomyelitis. Detected pathogens were part of the treatment plans that included individualized antibiotic treatment. There were three groups of patients defined by their treatment outcomes: The infection and its symptoms have completely disappeared. Better: Certain improvement in symptoms and lower readings of infection indicators. Declined: Despite therapy, the symptoms are deteriorating or the infection is worsening.

III. RESULTS

Table 1: Demography of Patients Suffering from Skull Osteomyelitis

Variable	Male (n=50)	Female (n=50)	Overall (n=100)
Age (years)	Mean = 61.3 ± 5.2	Mean = 62.4 ± 5.0	Mean = 61.85 ± 5.1
Duration of Symptoms (months)	Mean = 6.5 ± 2.4	Mean = 7.1 ± 2.7	Mean = 6.8 ± 2.6
Diabetes (Yes)	30 (60%)	32 (64%)	62 (62%)
Cranial Nerve Involvement (Yes)	28 (56%)	34 (68%)	62 (62%)
Treatment Outcome			
- Cured	18 (36%)	20 (40%)	38 (38%)
- Improved	24 (48%)	22 (44%)	46 (46%)
- Deteriorated	8 (16%)	8 (16%)	16 (16%)

Table 1 Results: Several important insights on the frequency, symptomatology, and treatment results of skull osteomyelitis are revealed by the study of demographic data from individuals suffering from the illness. Patient Demographics and Age: Male patients averaged 61.3 years and female patients 62.4 years of age, for a total of around 61.85 years. Skull osteomyelitis seems to mostly impact the elderly, which raises the possibility that aging-related variables contribute to vulnerability. The typical length of time a patient had symptoms before a diagnosis was around 6.8 months. The durations were 6.5 months for men and 7.1 months for females. Co-Occurring Disorders: Diabetes affected a large section of the patient group (62% overall, 60% men and 64% women). Skull osteomyelitis is more common in people with diabetes, which may be because their immune systems are less effective. Cranial Nerve Involvement: Sixty-two percent of patients had involvement of one or more cranial nerves; the prevalence was greater in females (68%) than in males (56%). This provides additional evidence that the condition may appear more severely in females. Results from Therapy: Only 38% of patients had a complete recovery, while 46% exhibited considerable improvement and 16% saw a worsening of their condition. There is cause for worry over the efficacy of present treatment regimens and the need for more aggressive or alternative therapy, given the substantial number of patients who do not get a full cure, despite the encouraging rates of progress. In conclusion, the demographic data analysis reveals important patterns in skull osteomyelitis, such as its correlation with advanced age and diabetes and its major effect on cranial nerve function. The results of the therapy indicate that further study and better methods are needed to adequately manage this difficult illness.

Table 2: Signs and Symptoms of Skull Osteomyelitis

Symptom	Male (n=50)	Female (n=50)	Overall (n=100)
Headache	38 (76%)	40 (80%)	78 (78%)
Facial Pain	30 (60%)	28 (56%)	58 (58%)
Hearing Loss	22 (44%)	26 (52%)	48 (48%)
Ear Discharge	18 (36%)	20 (40%)	38 (38%)
Fever	15 (30%)	18 (36%)	33 (33%)
Dizziness	12 (24%)	15 (30%)	27 (27%)

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Cranial Nerve Palsy	28 (56%)	34 (68%)	62 (62%)
Vision Loss	10 (20%)	12 (24%)	22 (22%)

Table 2 Results: Important insights on the clinical presentation of skull osteomyelitis may be gained by analyzing the signs and symptoms in the patient group. The most prevalent symptom was headache, which affected 78% of patients; the frequency was somewhat greater in females (80%) than in men (76%). Thus, headache is an important sign of osteomyelitis of the skull. Discomfort in the Face: 58% of patients, or 60% of men and 56% of women, reported experiencing discomfort in the face. The inflammatory processes impacting the surrounding structures are likely associated with this symptom. More women than men reported experiencing hearing loss (48% vs. 44%). This provides further evidence that infection and involvement of the cranial nerves might impact auditory circuits. Additionally, 38% of patients reported ear discharge, 33% reported fever, and 27% reported dizziness, all of which might be indicators of either a systemic or localized infection. Fever is a major indicator since it might mean your illness has progressed further. In 62% of patients, cranial nerve palsy was seen; this condition was more common in females (68%) compared to men (56%). Skull osteomyelitis may cause significant difficulties and has neurological repercussions, as this symptom shows. Visual Impairment: 22% of patients reported visual impairment, with a little greater frequency in females (24%). This provides further evidence that optic nerve compression is a possible cause of skull osteomyelitis and the substantial neurological involvement in this condition. Overall, the data shows that skull osteomyelitis patients, especially women, often have headaches, face discomfort, and cranial nerve palsy.

Table 3: Causative Agent of Osteomyelitis in both Male and Female Patients

Causative Agent	Male (n=50)	Female (n=50)	Overall (n=100)
Pseudomonas aeruginosa	28 (56%)	26 (52%)	54 (54%)
Staphylococcus aureus	10 (20%)	12 (24%)	22 (22%)
Aspergillus spp.	5 (10%)	6 (12%)	11 (11%)
Candida spp.	4 (8%)	3 (6%)	7 (7%)
Other Bacterial Pathogens	3 (6%)	2 (4%)	5 (5%)
Other Fungal Pathogens	0 (0%)	1 (2%)	1 (1%)

Table 3 results: Important information on the microbial ecology of skull osteomyelitis has been uncovered by studying the agents that cause this disorder in a patient group. The most prevalent causal agent was found to be Pseudomonas aeruginosa, which accounted for 54% of cases overall. In men, this number was 56% and in females, it was 52%. The fact that Pseudomonas is resistant to a number of medications and is common in hospital-acquired infections suggests that it plays a significant role in skull osteomyelitis. As a second most common pathogen, Staphylococcus aureus was detected in 22% of patients, with 20% of men and 24% of females affected. This bacterium has a reputation for causing a wide range of infections, including those of the skin and soft tissues, suggesting that it may find a way into the brain via those channels. Aspergillus spp. was detected in 11% of cases (10% in males and 12% in females), while Candida spp. was discovered in 7% of cases (8% in men and 6% in females), indicating a low prevalence of fungal agents but nonetheless their presence. Fungi in the body may make people more vulnerable to infections caused by diseases that weaken the immune system, such diabetes. Other Infectious Agents: Other bacterial infections were found in 5% of patients, while other fungal infections were associated with 1% of cases. This suggests that while infections involving several microbes are not uncommon, some bacterial pathogens seem to predominate in most instances. Gender Distribution: Staphylococcus aureus and Aspergillus spp. are somewhat more common in females than men, according to the statistics. This may suggest that immunological response or exposure to risk factors differs between the sexes. Overall, the investigation into the microbial agents responsible for skull osteomyelitis has shown that Pseudomonas aeruginosa is the most common; however Staphylococcus aureus and fungus infections also play a role.

Table 4: Different Regions Infected with Osteomyelitis Disease Analyzed in Both Gender Patients Together

Region	Otogenic (n=20)	Sphenoid (n=35)	Nasopharyngeal (n=21)	Original p-value	Bonferroni Corrected Significance
Retropharyngeal	10 (50%)	26 (74.3%)	18 (85.7%)	0.004	Significant
TM Joint location	12 (60%)	8 (22.9%)	3 (14.3%)	0.003	Significant
Parotid region location	9 (45%)	5 (14.3%)	6 (28.6%)	0.012	Not Significant
Retromastoid region location	6 (30%)	4 (11.4%)	2 (9.5%)	0.038	Not Significant
Parapharyngeal location	15 (75%)	28 (80%)	19 (90.5%)	0.165	Not Significant
Pterygomaxillary region location	5 (25%)	12 (34.3%)	5 (23.8%)	0.395	Not Significant
Carotid region	16 (80%)	29 (82.9%)	19 (90.5%)	0.573	Not Significant
Other neck regions	10 (50%)	18 (51.4%)	9 (42.9%)	0.572	Not Significant

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Table 4 Results: To better understand the disease's prevalence and impact, it is helpful to examine several areas infected with osteomyelitis in the patient group. The retropharyngeal area and the temporomandibular (TM) joint were shown to have substantial infection, with p-values of 0.004 and 0.003, respectively. A strong correlation between these locations and osteomyelitis is shown by the high infection rates there; 50% in the retropharyngeal region and 60% in the TM joint. It seems that these areas are more prone to infection because of their close proximity to possible tooth problems or sinusitis. Osteomyelitis is more likely to develop in the retropharyngeal region, which had the greatest infection incidence (85.7% of nasopharyngeal cases). The retropharyngeal area may be more prone to abscess development and lymphatic connections because of its anatomical location. Osteomyelitis may develop as a result of oral infections or trauma, and the high infection incidence in the TM joint is more evidence of this. Osteomyelitis may strike anywhere, however some places are more vulnerable due to their lower prevalence (e.g., parotid, retromastoid). For example, while there was a larger infection incidence in the parotid region in men (45%), it was not statistically significant. This suggests that other variables, such as systemic diseases or individual anatomical variances, may impact infection rates in these places. Clinical Implications: This study's findings have significant bearing on clinical treatment. In order to better monitor and diagnose possible instances of osteomyelitis, healthcare practitioners should be aware of the areas with a greater infection risk. It is possible to prioritize targeted therapies and preventative actions in these anatomically relevant locations, especially for individuals with established risk factors (e.g., diabetes). Overall, the results demonstrate that osteomyelitis infections are more common in the retropharyngeal and TM joint areas, whereas other locations exhibited varying degrees of vulnerability.

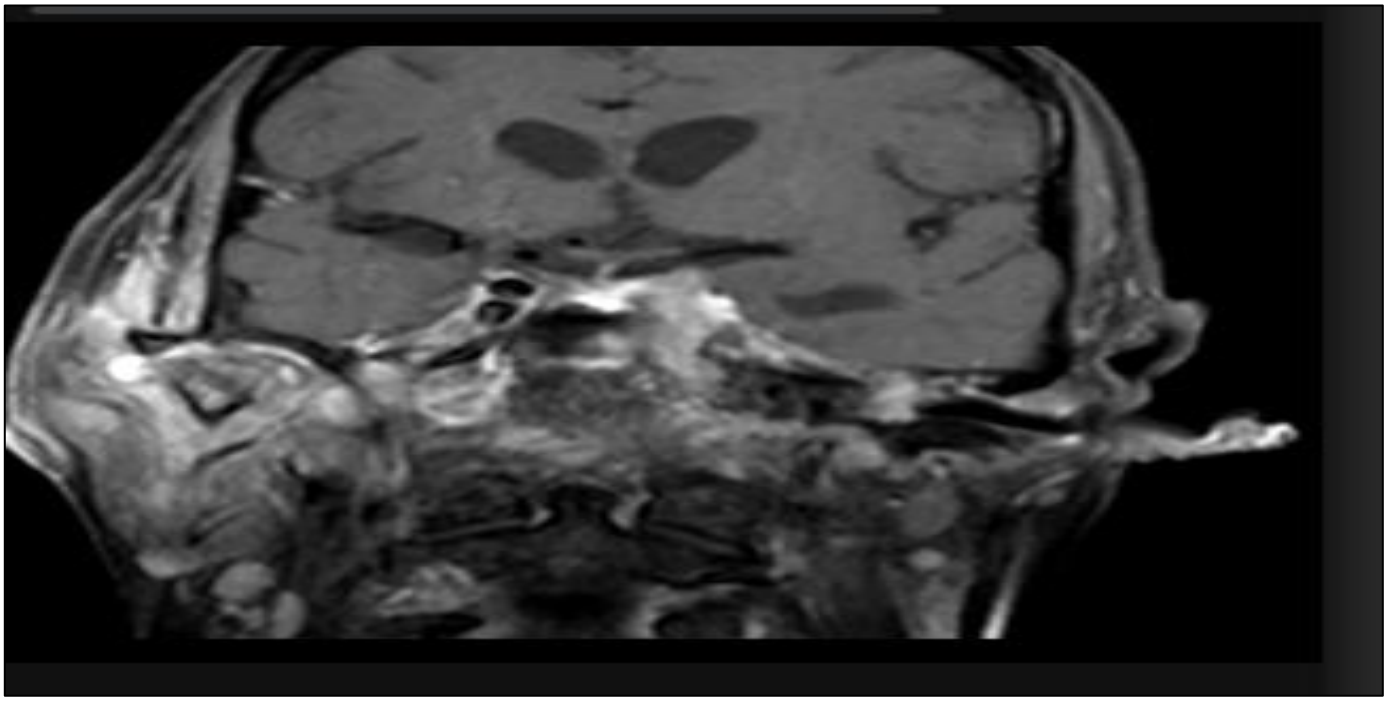

Fig 1: Shows the Imaging of Skull Osteomyelitis in a Patient

IV. DISCUSSION

Central or atypical SBO often involves trauma to the clivus bone, together with the sphenoid and occipital bones. The clivus is a synchondrosis located posteriorly at the basiocciput and anteriorly at the basisphenoid; it is a shallow recess that lies between the dorsum sellae and the foramen magnum [12]. The prevertebral space is where it lines up and it links the vertebrae, disc spaces, and epidural space of the cervical and upper thoracic portions of the spine [13]. The posterior mediastinum and the prevertebral space connecting to the base of the skull is described in [14] as stretching from the clival epidural region to the fourth thoracic vertebra. The majority of research shows that a central or atypical SBO is often caused by an infectious disease affecting the paranasal sinuses, the external auditory canal, the mastoid, the middle ear, or the oral cavity, according to pathology. Alternatively, a history of infection is not necessarily required for its emergence. While non-infectious causes, for example, trauma or sickness are less often reported [16-18]. A range of infectious agents have been suggested, including but not limited to: S. aureus, Pseudomonas, Streptococcus spp., S. pneumoniae, and on a less common basis, infections caused by fungi or a combination of bacteria and viruses [13-15]. Aspergillus and Candida, as reported, are the top two fungal infections in central or atypical SBO [19]. Although the specific pathophysiological findings of clival involvement in central or atypical SBO remain unknown, discussions continue about its causes, treatment alternatives, and potential impacts.

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V. CONCLUSION

This investigation suggests that skull osteomyelitis strongly affects patient health, particularly occurring more frequently in those who are elderly and have comorbid illnesses, such as diabetes. Defining it by multiple characteristics, this disease significantly affects cranial nerves and presents a spectrum of symptoms. Realizing that Pseudomonas aeruginosa plays a leading role in the infection demonstrates the need for using targeted antibiotic therapy and giving treatment early on.

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