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IP International Journal of Medical Microbiology and Tropical Diseases

Journal homepage: https://www.ijmmtd.org/

Review Article

Calvarial tuberculosis - A review on an uncommon presentation of a common infection

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ARTICLE INFO

Article history:
Received 21-08-2024
Accepted 19-10-2024
Available online 12-12-2024

Keywords:
Calvarium
Diagnosis
Management
Skull tuberculosis
Tuberculosis

ABSTRACT

Calvarial tuberculosis is one of the rare infectious diseases that are reported scantily in the literature. This disease could be a rare variety of skeletal tuberculosis affecting the skull. The disease is seen predominantly in developing countries because of malnutrition, poor socio-economic status, immune deficiency disorders, etc. The disease is additionally found occasionally in developed countries because of the migration of individuals. We undertook a systematic review in drafting this review article. We have searched PubMed / MEDLINE, EMBASE, SCOPUS and Google scholar for studies published as original research article, case report, case series and review articles on Calvarial tuberculosis between 2000 and 2024. We also manually searched the reference lists of the included articles to include further studies on this topic. In this review, we briefly discuss the pathogenesis, clinical features, radiological features, diagnosis, and management of calvarial tuberculosis. Knowledge, awareness, and a tall file of doubt are required for early and prompt diagnosis of this scantily reported disease.

1. Introduction

In developing countries, tuberculosis is one of the most common endemic diseases. Tuberculosis caused by Mycobacterium tuberculosis, is a multisystem disorder which can involve any part of the human body including digestive system, reproductive system, musculoskeletal system, etc.[1,2] A rare entity namely calvarial tuberculosis, primarily affecting the calvaria, accounts for about 0.01% of patients with mycobacterial infection.[3] There have been even outlying reports of calvarial tuberculosis with multiple intracranial tuberculomas without any focus of infection anywhere in the patient's body.[4]

Calvarial tuberculosis is commonly secondary to a pulmonary tuberculosis and can even be connected with cervical tuberculous lymphadenitis.[5] Calvarial tuberculosis affecting an immunocompetent person in his young or middle age, without any evidence of tuberculosis anywhere in his body is a rare possibility.[6,7] The main factors which caused a rise in the incidence of calvarial tuberculosis are poor socio-economic status, immunocompromised conditions, the need for mindfulness, delay in looking for restorative exhortation and malnutrition. The social disgrace related to the infection can't be downplayed.In many cases, skull base tuberculosis is secondary to tuberculosis of the lung. However, there are various reports suggesting its undeviating spread from the mastoid air cells and sinuses,

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https://doi.org/10.18231/j.ijmmtd.2024.052

particularly the paranasal.[8,9] The infection is composed by a fibrotic envelope layer arrangement, or it might expand through each boundary. Other common risk factors for acquiring the infection include ethanol abuse, intravenous misuse, older age, and diabetes mellitus.[10] Tuberculosis osteitis depends on the immune response of the host and virulence of the organism. The presence of sclerosis represents secondary infection.[11] The disease rarely affects infants due to the lesser amount of cancellous bone during infancy. There is no sex predilection and 80% of cases occur at any age.[12]

2. Methodology

This systematic review article followed the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) guideline. Only peer reviewed journal articles reporting cases on calvarial tuberculosis were included in this review. Original research article, case report, case series and review articles were included. Conference papers, book reviews, book chapters, newspaper articles, opinions and comments were excluded. The inclusion criteria were: (i) must be original, (ii) relevant to the topic – Calvarial tuberculosis, (iii) must be peer reviewed and published in journals between 2000 and 2024.

2.1. Data source

We have searched PubMed / MEDLINE, EMBASE, SCOPUS and Google scholar for studies published as original research article, case report, case series and review articles on Calvarial tuberculosis between 2000 and 2024. Keywords used in the search included “calvarial tuberculosis” or “diagnosis” or “management” or “skull tuberculosis” or “tuberculosis”. We also manually searched the reference lists of the included articles to include further studies on this topic. In the end, 30 articles were included in this systematic review.

2.2. Pathogenesis

Tuberculous osteomyelitis commonly can affect any bone in the skull, the commonly affected bones are the parietal and frontal whereas the sphenoid and occipital being rarely affected.[13] This is due to a greater cancellous portion with diploic channels in the former areas. Bacilli lodging within the diploic of cranium is the first step in the pathogenesis, expanding haematogenously from the extracalvarial source. The tuberculous granulation tissue involves both the inner and the outer tables and is surrounded by proliferating fibroblasts. After the inoculum is implanted in the diploes marrow, the contamination destroys the bones and causes the development of granulation tissue. Sequestration may form leading to the radiographic images of “bone sand”. The expansion of granulation cannot be averted by cranial sutures. The dura functions as a robust hurdle against intracranial spread.Involvement of the outer table presents as a subgaleal swelling with sinus discharge and the inner table is connected with the emergence of underlying extradural granulation tissue.[3,14]

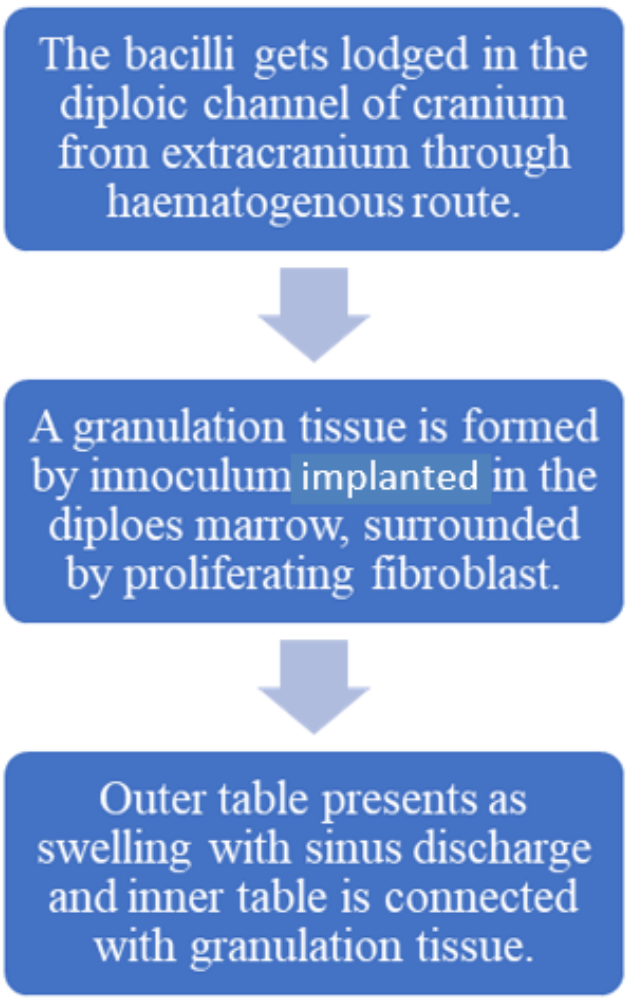

Figure 1: Pathogenesis of calvarial tuberculosis

2.3. Epidemiology and clinical features

A case of cranial tuberculosis was first reported in 1842 by Ried et al.[15] Around 370 cases of calvarial tuberculosis were reported till December 2019.[3,16–19] The disease can also affect the children.[16,19] Recently, tuberculosis of parietal bone has been reported from an Indian boy.[20]

Often, the patients with calvarial tuberculosis present with sinus discharge and a fluctuant scalp swelling with an immovably connected base.[21] Late characteristics include connection to the skin, discolouration and sinus configuration. The common complaints include headaches, seizures, frank meningitis, a low-grade evening rise in temperature, and other neurological deficits which are infrequent. Extension of the disease to the orbit usually

presents as red and watery eyes. At times, a sebaceous cyst can even be misinterpreted for a scalp enlargement caused by tubercular osteomyelitis. Symptoms associated with an intracranial extension are rare.

On gross examination, the cheesy material of the pilar cyst looks just like the caseous matter of tubercular origin.More often, the external border involvement is visible as a painless, soft, palpable nodule, with or without fistula formation. Extradural area granulation occurs if there is a lesion in the inner border.[22] Scalp involvement is usually associated with erosion of the underlying bone.

2.4. Laboratory diagnosis

Calvarial tuberculosis is frequently missed or misdiagnosed. To forestall complications like intracranial extension, empyema, or death, it is important to undertake prior tissue sampling, commence relevant treatment, and initiate prompt surgical intervention.[23]

An elevated Erythrocyte sedimentation rate (ESR) and a raised white blood cell (WBC) count together with a positive Mantoux test are usually found in tuberculosis patients. A plain skull x-ray is obliging. During early stage of this infection rarefaction is noticed, which can afterwards grow to be punched-out lesions with central sequestrum later on.[11] Punched-out lesions within the cranium is the most significant radiographic feature.Radiographs of the cranium may show variable and nonspecific features. Both osteolytic and osteoblastic areas are also seen. An X-ray of the skull is just suggestive in the case of calvarial tuberculosis, but it is not diagnostic.[24] However, these tests are not the only tests which contribute to diagnosis. There are other tests like Enzyme linked immune sorbent assay (ELISA) or Polymerase chain reaction (PCR) which may assist in the diagnosis.[3,25]

Contrast-enhanced Computed Tomography [CECT] can be used to diagnose the tuberculosis of the skull bone. It often shows soft tissue swelling and an extra-dural collection with accompanying destruction of the calvarium.[3,12] Additionally, the degree of intracranial involvement, amount of bone destruction, etc. can be assessed by using Computed tomography (CT).[26] Intradural lesion such as subdural empyema or tuberculoma can be ruled out by CT.[3,12]

There are three forms of CT findings:

1. "Circumscribed lytic lesions" are small punched-out lesions with connective tissue covering both the inner and outer tables of the calvaria.It is related to little tendency to spread and there's no associated periosteal reaction.[27]
2. In a "circumscribed sclerotic type lesion", the bone thickens significantly due to decrease in blood supply to the affected bone.
3. In "Diffuse type lesion", widespread involvement of diploe with the destruction of inner table and epidural granulations occur.

The first type is the most typical, while the second type is the least common. The extradural collection upgrades the peripheral contrast administration. An extradural compression is seen on CT scan and an intradural lesions can be ruled out.[12]

Magnetic resonance imaging (MRI) is considered as a very useful mode of diagnosis. An adjacent soft tissue changes can be seen by MRI. A high signal intensity soft tissue mass inside the deformity within the bone is visualized by proton density and T2- weighted images. This might extend into the subgaleal and/or epidural spaces and on contrast-enhanced imaging, they would appear as a peripheral capsular enhancement.[28,29]

A definitive indicator of tuberculosis infection is the presence of caseous necrosis, epithelial granulomas, Langhans type giant cells in the pus smear and identification of acid –fast bacilli by the Ziehl-Neelsen staining technique. On Microscopic examination, lymphocytic preponderance, Langhans giant cells, and polymorphonuclear cells with proliferating blood vessels can be visualized. Fine needle aspiration cytology (FNAC) should be done on worn-out lesions with overlying intact skin.Proper radiological examination and FNAC are often very helpful in the diagnosis. Hot spots are visible on the bone scan within the relevant parts of the cranium.

2.5. Management of calvarial tuberculosis

Even though there are few reports within the literature favouring anti-tuberculous treatment alone, combination therapy along with surgical intervention is suggested to be healthier, because surgical removal could cease the infection source. The most common management for cranial bone tuberculosis is surgical excision and was performed widely prior to the rise of anti-tuberculous chemotherapy. However, the most effective treatment is a combination of surgical debridement in addition to antituberculosis medications.[23,26]

Indications for surgery: to determine the diagnosis, to get rid of extradural granulation and necrotic bone, and sinus discharge patients, extension to intracranium and mass caused by huge caseous material collection. Surgery is not indicated for smaller lesions with or without sequestrum, if the response is good with chemotherapy.Surgery can be performed in patients who have huge collection in extradural area causing midline shift, with neurologic deficits with the possibility of secondary infections. The involvement of the cortical area with substantia alba oedema is also due to bacilli penetration through the dura.

Surgical management involves a skin incision, raising the flap and excision of pus or necrotic tissue, affected bone

and extradural granulations. Dura should not be disturbed. The sinus should be excised with primary skin closure. Sometimes, total removal of infected bone and connective tissue with the extirpation of the sinus tract is advocated. Anti-tubercular drug treatment for the management of cranial tuberculosis for minimum two years has been recommended. Anticonvulsants are not recommended as they are controversial.

Prognosis depends upon the time of diagnosis, immunosuppressed conditions, the beginning of anti-tubercular treatment and adherence to that, and neurosurgical intervention whenever necessary, associated tuberculosis lesion and therefore the local extent of the disease.

2.6. Differential diagnosis

Calvarial tuberculosis may be misdiagnosed as other diseases like syphilis, bacterial osteomyelitis, aneurysmal bone cyst, histiocytosis, malignancies, etc.[30] The malignant conditions like epithelial cell carcinoma, various lymphomas, nasopharyngeal carcinoma and non-malignant conditions like Wegener's granulomatosis, syphilis, fibrous dysplasia, etc. may also have MRI findings similar to skull base osteomyelitis. CT imaging findings are generally very difficult to differentiate between pyogenic osteomyelitis, calvarial metastasis, myeloma, or aneurysmal bone cyst.

3. Conclusion

Calvarial tuberculosis is one of the uncommon presentations of a common disease. This could be included as a medical diagnosis of lytic lesions of the skull presenting with discharging sinuses, especially in endemic areas. Conventional CT and MRI are useful in arriving at a diagnosis. Excision biopsy can assist in the early diagnosis. Awareness and a high degree of suspicion are needed for the rapid diagnosis and treatment of cases. A mixture of surgical intervention and adequate antitubercular therapy is the preferred treatment. Surgery is designated in cases of enormous extradural collections with mass effect, neurological deficits, and cosmetic issues. Calvarial tuberculosis could be a potentially curable disease with early diagnosis and effective management.

4. Source of Funding

None.

5. Conflict of Interest

None.

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Cite this article: Singaravelu HPD, Krishnasamy L, Rengarajan S. Calvarial tuberculosis - A review on an uncommon presentation of a common infection. *IP Int J Med Microbiol Trop Dis* 2024;10(4):298-302.