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Research Article

Extensive Multilevel Spinal and Extraspinal Involvement in a Case of Calvarial Tuberculosis: A Rare Disseminated Presentation

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Abstract

Calvarial tuberculosis (TB) is an uncommon manifestation of skeletal TB, and its progression to disseminated involvement of multiple systems is exceedingly rare. We report a unique case of a patient initially diagnosed with calvarial TB, who subsequently developed widespread involvement of the cervical and lumbar spine, bilateral paraspinal soft tissues, the right psoas muscle, and pulmonary parenchyma. Imaging studies demonstrated intraosseous abscesses, soft tissue masses, and compressive epidural components, consistent with disseminated TB. This case emphasizes the importance of early clinical suspicion, prompt imaging, and microbiological confirmation-particularly GeneXpert and drug susceptibility testing (DST)-which facilitated timely diagnosis of MDR-TB and improved prognosis. These steps represent a key aspect of diagnostic strategy in pediatric extrapulmonary TB.

Keywords

Calvarial Tuberculosis, Disseminated TB, Spinal TB, Psoas Abscess, Drug-resistant Tuberculosis, Vertebral Osteolysis

1. Introduction

Tuberculosis (TB) continues to pose a significant global health challenge, with extra pulmonary forms accounting for approximately 15-20% of all cases as per World Health Organization, Global Tuberculosis Report 2023. Among these, skeletal TB is relatively uncommon and can present with diverse clinical manifestations depending on the site of involvement. Calvarial tuberculosis is particularly rare, comprising less than 1% of skeletal TB cases, and its dissemination to the spine or soft tissues is even more exceptional. In this report, we present a unique case of disseminated TB initially manifesting as calvarial involvement, later progressing to include extensive vertebral, paravertebral, and pulmonary disease. While isolated calvarial TB has been described, the development of multi-regional spinal and extra spinal involvement in a pediatric patient is exceedingly rare. This case adds to the limited literature by outlining a detailed diagnostic approach and treatment strategy for pediatric disseminated MDR-TB.

2. Case Presentation

A 6-year-old child presented to the emergency department following a fall from a significant height, landing on the occipital region of the head. At the time of injury, the child was

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conscious and neurologically intact. A non-contrast computed tomography (CT) scan of the brain was performed, which did not reveal any acute intracranial abnormalities, skull fractures, or significant soft tissue injury. The child was managed conservatively and discharged with instructions for follow-up.

Two weeks later, the patient was brought back with a gradually enlarging, non-tender swelling over the occipital region. The parents reported no fever, weight loss, or neurological symptoms, but noted that the swelling had progressively increased in size without signs of redness or warmth. On examination, the swelling was firm, fluctuant, and localized to the midline occipital region, without overlying skin changes or signs of infection.

A repeat CT scan of the head, now with bone window settings, revealed a well-defined lytic lesion involving the midline occipital bone. The lesion caused cortical thinning and expansion, with a defect noted in the inner and outer tables of the skull. There was an associated soft tissue component extending extracranially, but no evidence of intracranial extension. Magnetic resonance imaging (MRI) was subsequently performed for further characterization. The lesion appeared hypointense on T1-weighted images and hyperintense on T2-weighted sequences, with no significant post-contrast enhancement.

Based on the radiological features and the absence of systemic symptoms, an intradiploic epidermoid cyst was initially considered the most likely diagnosis.

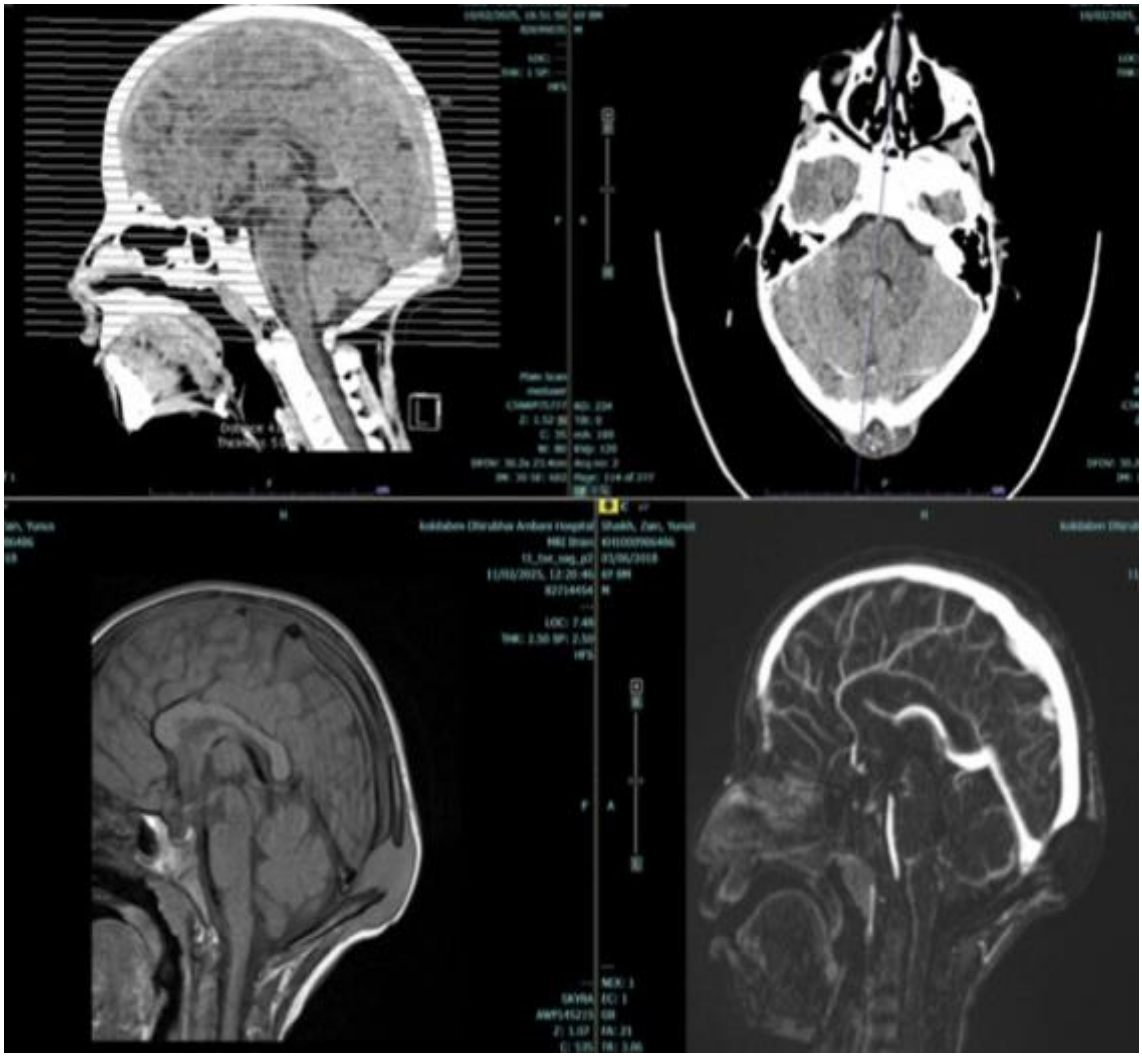

Figure 1. *a) CT Brain. b) MRI Brain suggestive of a midline occipital bone defect is occupied by a soft tissue lesion.*

The patient subsequently underwent a sub occipital craniotomy for excision of the occipital lesion. Intraoperatively, a lytic bone defect was noted in the midline occipital bone, containing caseous material. The underlying dura appeared intact, and there was no communication with intracranial structures. The soft tissue mass was excised along with debridement of the affected bone. Histopathological examination of the excised tissue revealed granulomatous inflammation characterized by epithelioid cell granulomas with central caseation necrosis and Langhans-type giant cells, consistent with a diagnosis of tuberculous osteomyelitis of the calvarium. Ziehl-Neelsen staining confirmed the presence of acid-fast

bacilli, establishing a definitive diagnosis of calvarial tuberculosis [10, 11]. The patient was started on a standard four-drug antitubercular therapy (ATT) regimen, consisting of isoniazid, rifampicin, pyrazinamide, and ethambutol. A follow-up MRI of the brain and skull, performed one month postoperatively, demonstrated near-complete resolution of the extracranial and extradural soft tissue components, with no new lesions or recurrence at the surgical site. Despite the encouraging local response, the clinical team opted to perform a whole-spine MRI to assess for possible systemic dissemination, given the atypical presentation and potential for hematogenous spread in pediatric TB. Surprisingly, the spinal imaging revealed extensive abnormalities involving both the cervical and lumbar regions of the spine. These included:

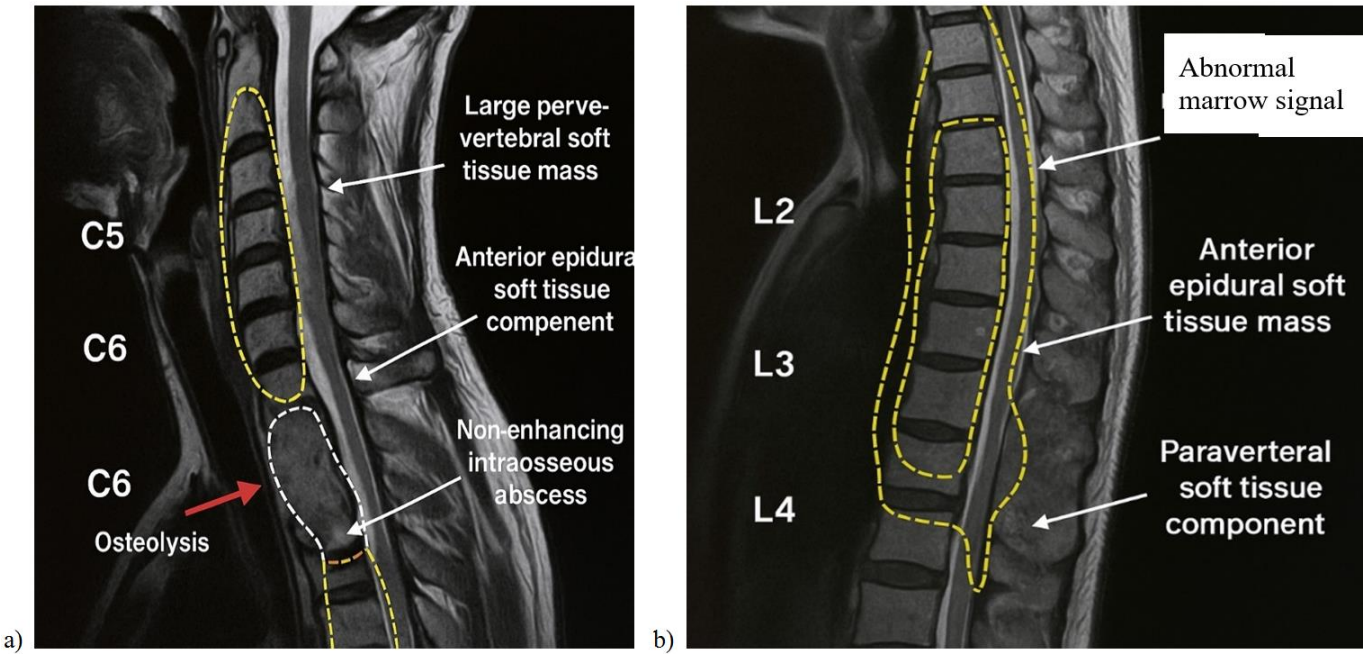

Figure 2. *a) Abnormal signal intensity was noted in the C5-C7 vertebral bodies, with heterogeneous post-contrast enhancement. The C6 vertebral body showed osteolysis, and a non-enhancing intraosseous abscess was identified. An anterior epidural soft tissue component was compressing the anterior subarachnoid space. A large paravertebral soft tissue mass extended from C2-C3 levels. b) L2-L4 vertebral bodies showed abnormal marrow signal with heterogeneous enhancement and areas of non-enhancement, suggesting necrosis or abscess formation. An anterior epidural soft tissue mass at L2 compressed the thecal sac, and a paravertebral soft tissue component was observed at L4.*

Additional findings included a large right psoas abscess and pulmonary involvement with cervical and mediastinal lymphadenopathy commonly seen in disseminated spinal TB. In view of the extensive spinal and paraspinal involvement noted on MRI, and considering the possibility of atypical progression despite first-line therapy, *tuberculous drug resistance* was suspected. Although the patient had shown partial local response at the calvarial site, the emergence of multifocal spinal lesions raised concern for *multidrug-resistant tuberculosis (MDR-TB)* or suboptimal drug penetration to extrapulmonary foci.

To further evaluate the microbial sensitivity profile, CT-guided aspiration of a paraspinal abscess was advised. Under sterile conditions and imaging guidance, purulent material was aspirated from one of the lumbar paraspinal collections and sent for GeneXpert MTB/RIF assay, line probe assay, mycobacterial culture, and drug susceptibility testing (DST).

The aspirated paraspinal fluid was positive for Mycobacterium tuberculosis on GeneXpert MTB/RIF assay, which also detected rifampicin resistance, suggesting a multidrug-resistant tuberculosis (MDR-TB) strain. This was later confirmed by line probe assay and conventional culture-based drug susceptibility testing (DST), which demonstrated resistance to both isoniazid and rifampicin, with sensitivity to fluoroquinolones and second-line injectable agents. In light of these findings, the patient was diagnosed with disseminated MDR-TB involving the calvarium, cervical and lumbar spine, and paraspinal soft tissues. Given the severity of the disease and the patient's age, a tailored second-line antitubercular therapy regimen was initiated in accordance with the World Health Organization (WHO) guidelines for pediatric MDR-TB [14]. The regimen included:

1. Levofloxacin (fluoroquinolone)
2. Amikacin (aminoglycoside)
3. Ethionamide
4. Cycloserine
5. Pyrazinamide (continued as it remained sensitive)
6. Linezolid, added for its CNS penetration and efficacy in complicated MDR-TB cases.

3. Discussion

Calvarial tuberculosis (TB) remains one of the rarest forms of skeletal TB, accounting for less than 1% of all bone tuberculosis cases. Ramdurg et al. [1] and Diyora et al. [2] reported series of patients with calvarial TB, highlighting variable presentations such as painless scalp swellings, bone erosion, and abscesses. These reports reinforce the diagnostic challenge posed by nonspecific clinical and radiological features, often mimicking epidermoid cysts or other lytic skull lesions. Jain et al. [12] emphasized the utility of MRI in delineating bone and soft tissue involvement. Turgut et al. [10] highlighted its role in identifying spinal TB complications such as epidural abscess or cord compression. However, MRI findings alone are not pathognomonic, making histopathological or microbiological confirmation essential. Unlike typical presentations, our case demonstrated multi-region spinal and extraspinal TB in a child with minimal systemic symptoms, making early diagnosis more challenging. Dissemination to multiple spinal levels and extraspinal sites such as the psoas muscle and lungs is exceedingly rare [3-5]. In pediatric patients, dissemination of TB from calvarial sites to spine, psoas, or lungs is exceedingly rare. Most case reports describe localized skull involvement, with very few describing multifocal skeletal dissemination in a single case. Bernaerts et al. [11] suggested that such extensive dissemination may be underdiagnosed. Garg et al. [13] noted that this is especially true in resource-limited settings where early imaging or microbiological tools are not routinely used. Spinal TB usually affects contiguous vertebral segments, and extensive multi-regional involvement-as seen in this case-is atypical [8, 9]. The presence of a large psoas abscess, epidural extension, and lung involvement raises suspicion of drug-resistant TB or hematogenous spread from a primary pulmonary focus [7]. The need for early microbiological confirmation, culture, and drug susceptibility testing is emphasized to guide targeted therapy [9]. This case also highlights the importance of considering tuberculosis in differential diagnosis of unusual scalp swellings and skull lesions, especially in endemic regions [6, 7]. This report is limited by its single-patient design. Furthermore, while microbiologic testing confirmed MDR-TB, limited access to serial cultures or resistance monitoring in some settings may pose challenges to broader applicability of the diagnostic strategy. Additionally, very few reports describe *multidrug-resistant TB (MDR-TB)* presenting as calvarial or spinal lesions in children. This makes our case distinct, as early microbiological confirmation (GeneXpert, DST) led to tailored treatment and potentially prevented long-term complications such as deformity or neurological deficits. This case not only reinforces the importance of early suspicion and systemic evaluation in skeletal TB but also contributes to the limited literature on disseminated, drug-resistant calvarial TB in the pediatric population.

4. Conclusion

This case highlights the critical need for a high index of suspicion and comprehensive systemic evaluation in cases of skeletal tuberculosis, especially when initial lesions are detected in uncommon sites such as the calvarium. Calvarial tuberculosis is an exceedingly rare manifestation, often misdiagnosed due to its nonspecific presentation and radiologic resemblance to other benign lesions, such as epidermoid cysts or Langerhans cell histiocytosis.

Our patient's progression from an isolated calvarial lesion to widespread vertebral, paraspinal, and pulmonary involvement illustrates the *potential for hematogenous dissemination* and the *multifocal nature of extrapulmonary TB*, particularly in pediatric populations. This underscores the importance of *whole-body imaging*, including spinal MRI, in the workup of skeletal TB-even when the primary lesion appears localized. Most crucially, this case demonstrates the necessity of *early microbiological confirmation*, including *GeneXpert MTB/RIF testing and full drug susceptibility profiling*, in any patient with progressive or multifocal TB, to detect *drug-resistant strains*. Early detection of MDR-TB allowed for timely initiation of second-line therapy, likely preventing severe complications such as spinal cord compression, neurological deficits, or deformity.

Abbreviations

ATT	Antitubercular Therapy
CT	Computed Tomography
DST	Drug Susceptibility Testing
MDR	Multidrug Resistant
MRI	Magnetic Resonance Imaging
RIF	Rifampcin
Tb	Tuberculosis

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Author Contributions

Harsh Patel: Conception and design of the study.

Preeti Singh: Data analysis and drafting of the manuscript.

Abhaya Kumar: Critical revision of the manuscript for important intellectual content.

Ethics Approval and Consent to Participate

The study is exempted from institutional ethics committee (IEC). Written consent has been taken from the participant parents to publish the study.

Consent for Publication

All authors have reviewed and approved the final version of the manuscript.

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Conflicts of Interest

The authors declare no conflicts of interest.

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