

Cerebral Tuberculomas Mimicking A Brain Tumor: Report of Two Cases

Arwinder Singh Gill^{1,2}, **Muhammad Firdaus**¹, **Yosafat Kurniawan Sugiarto**³,
Farilaila Rayhani⁴, **Rini Andriani**⁵, **Ahmad Faried**^{3*}

¹ Department of Neurosurgery, Dharmais Cancer Hospital – National Cancer Center, Jakarta, Indonesia

² Faculty of Medicine, Tarumanagara University, Jakarta, Indonesia

³ Department of Neurosurgery, Faculty of Medicine, Universitas Padjadjaran – Dr. Hasan Sadikin Hospital, Bandung, Indonesia

⁴ Department of Anatomical Pathology, Dharmais Cancer Hospital – National Cancer Center, Jakarta, Indonesia;

⁵ Department of Neurology, Dharmais Cancer Hospital – National Cancer Center, Jakarta, Indonesia

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***Corresponding author:**

Ahmad Faried

Department of Neurosurgery, Faculty
of Medicine, Universitas Padjadjaran,
Jl. Pasteur No. 38, Bandung 40161,
West Java, Indonesia.
ahmad.faried@unpad.ac.id

ABSTRACT

Introduction: Cerebral tuberculoma, a seldom encountered and severe manifestation of tuberculosis (TB), arises from the dissemination of *Mycobacterium tuberculosis* through the bloodstream. Its symptoms and radiological characteristics lack specificity, often resulting in diagnostic errors. Management predominantly involves medical intervention, with the treatment duration for cerebral tuberculoma ranging from 6 to 36 months. In specific instances, surgical intervention may be advised.

Case Presentation: We reported two cases of cerebral tuberculoma occurring in patients who presented with seizures, with space-occupying lesions evident on magnetic resonance imaging of the brain. There were no symptoms of concurrent extra cranial TB. Surgery was performed on both of the cases and anti-TB treatment began as soon as the diagnosis was made with corticosteroid as adjuvant treatment.

Conclusions: A combination of clinical, radiological, and histopathological examination is needed to confirm the diagnosis and determine the appropriate therapy. If ICP is increased as a result of the lesion and medical therapy has failed, surgical excision is required.

INTRODUCTION

Tuberculosis (TB) stands as among the most ancient infectious ailments in human history, attributed to *Mycobacterium tuberculosis*. Its prevalence persists notably in developing nations, impacting a considerable segment of the global populace. TB has the capability to afflict nearly all bodily tissues, encompassing the central nervous system, where it manifests as one of the most severe variants [1].

The 2020 WHO global report revealed that Southeast Asia (43%), Africa (25%), and the Western Pacific (18%) regions harbored the highest incidences of TB cases, while smaller proportions were observed in the Eastern Mediterranean (8.3%), the Americas (3.0%), and Europe (2.3%). The primary impact of the COVID-19 pandemic on TB was a substantial decrease globally in newly diagnosed TB cases reported in 2020 compared to 2019. Indonesia, ranking second only to India, significantly contributed to this global decline from 2019 to 2020.

Despite Indonesia's progress, it remains third in the world for new TB cases. Pulmonary TB is the predominant clinical presentation, accounting for 85.67% of cases, contrasting with extrapulmonary TB at 14.75%. Extrapulmonary TB, particularly affecting the central nervous system (CNS), represents one of the most severe manifestations, afflicting approximately 2-15% of cases, with the highest incidence among individuals with acquired immunodeficiency syndrome (AIDS) [1].

We report two cases of intracranial tuberculoma without any prior history of immunodeficiency. Both cases were managed surgically due to refractory seizures and the mass effect of space-occupying lesions. Anti-TB treatments were administered in both cases with corticosteroid as adjuvant therapy.

CASE PRESENTATION

This case report has been reported in line with the SCARE 2020 criteria [2] and has been approved by our

ethics committee No LB.02.01/X.6.5/69/2022. Patients provided written consent for the publication of this report and the accompanying images.

Case 1

A 59-year-old woman presented to the neurology clinic with focal seizures in her left limb. An episode of clonic-type seizure was reported, without loss of consciousness during the seizure. She disclosed a history of night sweats and weight loss. He denied having ever experienced a fever, a seizure, or a lost consciousness. The patient had no substantial family history, no history of surgery, or daily medication. He had a healthy immune system and had never used immunosuppressive drugs or experienced repeated infections. Neurological examination showed that the patient was fully conscious with peripheral left side cranial nerve VII, cranial nerve XII central, left cranial nerve IX, and X palsy with a slight motoric weakness on left upper limb (motor strength 5/5/4/5). No sensory or autonomy deficit was found. 5 years before this visit, the patient had a history of pulmonary TB and had completed the anti-TB treatment for 6 months. The patient has had a chest X-ray done and there is no sign of TB in the lungs. The HIV test's serology came out negative, and the ESR (erythrocyte sedimentation rate) increased by 62 mm/hour. The patient's brain MRI revealed a well-defined nodular lesion with a hemorrhagic component in the right parietal lobe which enhanced significantly after contrast was delivered. The size of the lesion was 2.3 ×

1.8 cm, with significant perifocal edema and compression of the right lateral ventricle as seen in **Figure 1**.

The patient underwent surgery for excision of the tumor mass and histopathological examination of the specimen acquired. The tumor was brownish white filled with yellowish pus. Tuberculoma was confirmed with granulomatous inflammation, locally visible tubercle formation consisting of epithelioid proliferation, caseous necrosis, and indistinct multinucleated giant cells. Anti-HIV examination, expert genes, and cerebrospinal fluid (CSF) culture showed negative results. Anti-TB medication with isoniazid, rifampicin, pyrazinamide, and ethambutol for 18 months with the addition of streptomycin for 2 initial months was administered with dexamethasone as adjuvant treatment. The patient's symptoms improved after being given dexamethasone adjuvant therapy. There were no adverse events and the frequency of the seizures decreased gradually and eventually stopped. At the end of the treatment, another serial brain MRI was performed for evaluation, and the granulomatous lesion of the right parietal lobe was resolved (**Figure 2**).

Case 2

A 28-year-old man presented to the neurosurgery clinic with weakness in his left limb and a history of uncontrolled focal seizure despite already being on medication for six months. With no medical history, presented with the first seizures in her life and a history of fever, headache, vertigo, nausea, vomiting, and tendencies to fall to the right side when standing.

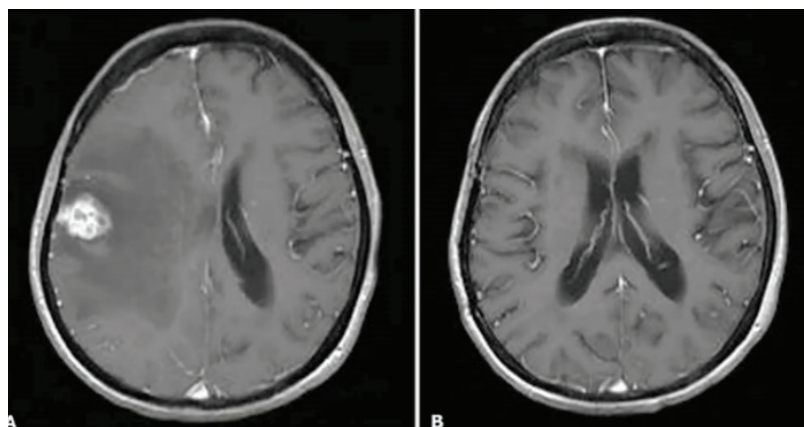


Figure 1. Axial section T1-weighted image with gadolinium contrast on magnetic resonance imaging (MRI). (A) Preoperative; (B) Evaluation after anti-tuberculosis treatment for 18 months was completed.

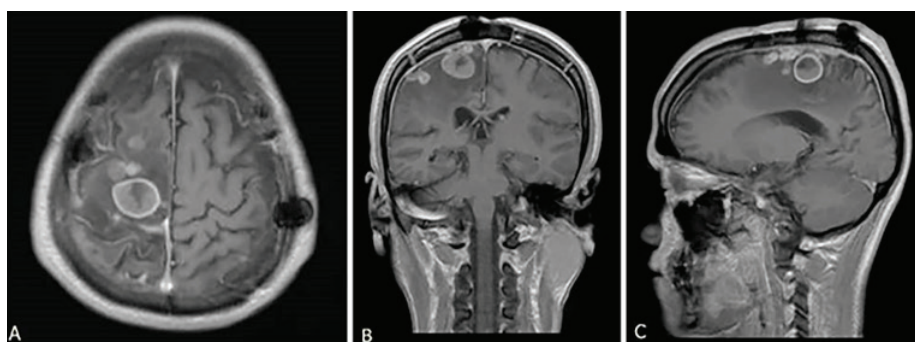


Figure 2. T1-weighted image with gadolinium contrast on MRI before the surgery. (A) Axial Section; (B) Coronal Section; (C) Sagittal Section.

A neurological examination revealed a normal cerebellar function test. Neurological examination showed that the patient was fully conscious with motoric weakness on the left lower limb. No sensory or autonomy deficit was found. Cranial nerve examinations were normal without any deficit. He had previously undergone craniotomy at another hospital 6 months before the visit with histopathology concluding an astrocytoma. The sample was re-assessed at our center and the new result was tuberculoma (**Figure 3**).

The patient never had a previous history of TB. There were continuous focal seizures of the left limb which could not be controlled by antiepileptic drugs. The patient had done a chest x-ray and no new cavitation was found in the lung. The HIV test's serology came out negative, and the erythrocyte sedimentation rate (ESR) increased by 72 mm/hour. Brain MRI on T1-weighted image showed multiple hyperintense lesions predominantly on the right parietal region with perifocal edema. The main lesion was 2.4 x 2.1 cm in size surrounded by smaller lesions of 1.3 x 1.3 cm. A craniotomy was decided as the lesion was not typical for the diagnosis of astrocytoma. The tumor was firm in consistency with clear margins and had necrotic fluid draining from the center of the lesion. The tumor was removed microscopically and the large draining veins were preserved as seen in **Figure 4**.

A cerebrospinal fluid culture was performed and showed microorganisms and gram stain results were negative. HIV testing showed negative results and blood sugar levels were within normal limits which ruled out

immunocompromised risk in the patient. Anti-TB treatment was started as soon as the diagnosis was made with a combination of isoniazid, rifampicin, pyrazinamide, and ethambutol scheduled for 12 months with the addition of streptomycin for the 2 initial months. The patient also had dexamethasone therapy for 1 month. The patient symptoms clinically improved after dexamethasone adjuvant therapy. Throughout the treatment, episodes of seizure still occurred but with longer intervals compared to pre-surgery conditions.

DISCUSSION

Tuberculosis stands as one of the deadliest infectious diseases globally. While it typically affects the respiratory system, CNS TB accounts for approximately 5 to 15% of extrapulmonary cases, posing the highest risks of morbidity and mortality. Central nervous system TB can be categorized into three types: tuberculous meningitis (TBM), spinal arachnoiditis, and cerebral tuberculoma, as exemplified in the cases discussed in our report [3,4,5].

It is widely believed that the bacilli enter the central nervous system through the bloodstream, typically as a result of tuberculosis occurring elsewhere in the body. Rich and McCordock's initial description proposed that tuberculous lesions form in the brain during the bacteremia stage [6]. In theory, tuberculosis has the potential to breach the blood-brain barrier (BBB) either as a free organism outside cells or through monocytes/neutrophils carrying the bacilli [7]. The rupture of one or multiple lesions can lead to the development of CSF

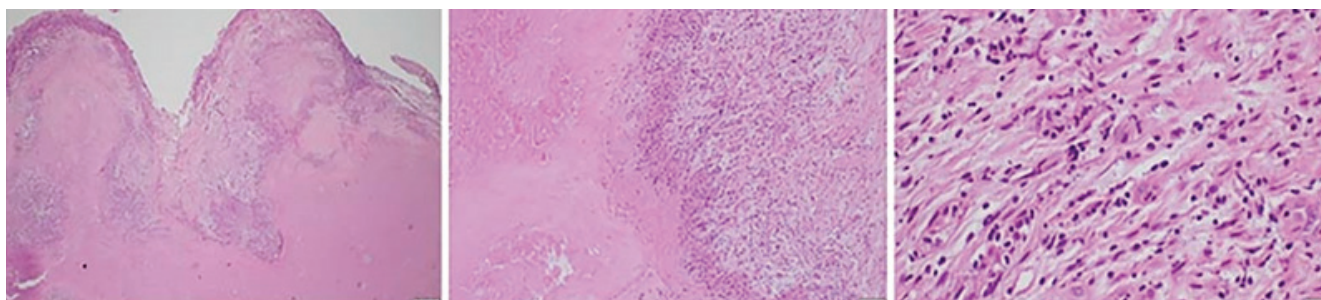


Figure 3. The preparation showed tubercles made up of histiocyte cells, epithelioid cells, lymphocyte cells, and an extensive case of necrosis in the brain tissue. Blood vessels can be found in some of them with original magnification of 4x, 10x, and 40x, respectively.

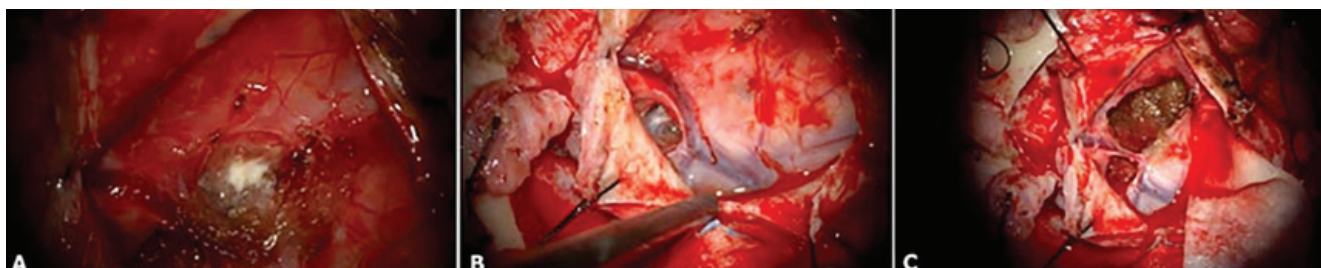


Figure 4. (A) Necrotic fluid at the center of the mass which was yellowish; (B) The large tumor was firm with marked borders that were adherent to the draining vein; (C) Careful lesion dissection showed total removal with preservation of the vein.

TB. These lesions commonly originate in the meninges, subpia, or subependymal surface of the brain. The growth of these lesions is understood to be influenced by the immune system [8]. Individuals diagnosed with human immunodeficiency virus (HIV) infection face a significantly heightened risk of tuberculoma, approximately five times greater than those without HIV. Immunodeficiency, whether due to HIV or organ transplantation and subsequent prolonged use of immunosuppressive drugs, increases the susceptibility to tuberculosis. For recipients of solid organ transplants, the likelihood of developing TB rises by 20–74%. Additionally, approximately 8% of tuberculoma cases are linked to patients having concurrent diabetes [9].

In instances where a tuberculoma grows to a considerable size, it may resemble a brain tumor, exerting pressure on nearby brain tissue and eliciting symptoms indicative of heightened intracranial pressure (ICP), such as headaches, nausea, and vomiting. Seizures are typically the primary symptom upon presentation with tuberculoma, as observed in our case. Distinguishing granulomas from other brain-expansive lesions based solely on neurological symptoms is challenging, as these symptoms are contingent upon the location and size of the lesion. Manifestations of intracranial hypertension and seizures are commonly encountered [1,11]. Cerebral tuberculomas are solid, non-vascular, rounded growths ranging in size from 2 to 10 cm in diameter. They exhibit well-defined boundaries, and the adjacent brain tissue, under pressure, may exhibit swelling and gliosis. Within the mass, there are regions of necrotic caseation where tubercle bacilli may be detected [12]. These are the primary attributes of these lesions, which were also observed during surgical intervention in our cases. They were successfully excised due to their clearly demarcated borders from the adjacent brain structures.

Considering tuberculoma in the list of possible diagnoses is crucial when encountering solitary intracranial mass lesions. However, diagnosing it poses challenges because the neuroimaging presentations can vary and lack specificity. Tuberculomas typically appear on brain scans as isodense or hyperdense lesions, sometimes with calcifications, and exhibit ring enhancement following contrast administration. The presence of calcifications on CT scans along with ring enhancement, termed the “target sign,” is regarded by some authors as potentially specific to tuberculoma. MRI is more adept than CT scans at identifying small tuberculomas and those situated in the brainstem. Typically, tuberculomas display intermediate or low signal intensity on T1-weighted images, accompanied by ring enhancement post-injection of gadolinium. On T2-weighted sequences, they typically exhibit low signal intensity with surrounding edema [1,12]. The lesion locations align with documented literature, as they can manifest as solitary or multiple

growths and tend to occur more frequently in the frontal and parietal lobes [13].

The inflammatory reaction triggered by TB infection is characterized by granulomatous inflammation, featuring epithelioid macrophages and Langhans’ giant cells, alongside lymphocytes, plasma cells, a small number of PMNs, fibroblasts with collagen, and distinctive caseous necrosis at the core. This inflammatory response is driven by a type IV hypersensitivity reaction [7,8,13]. Current treatment for CNS TB typically involves medical therapy, comprising a regimen including isoniazid, ethambutol, pyrazinamide, rifampicin, and steroids. This treatment regimen often leads to a reduction in tuberculoma size and complete resolution within three months, although in some cases, a longer duration of up to three years may be necessary. Patients with elevated intracranial pressure should undergo immediate neurosurgical evaluation. Surgical resection may be necessary for tuberculomas to alleviate mass effect, as prompt removal can significantly enhance overall outcomes, even in cases of drug resistance or paradoxical worsening, affecting up to 25% of treated TB patients. However, this study’s limitation lies in its inability to establish a causal relationship between adjuvant steroids and patient outcomes, as well as the impact of surgery on symptom improvement. Future studies, such as larger case series or multicenter research, are warranted. The choice of surgical approach may vary based on factors including tuberculoma location, surrounding vascular and nerve structures, cortical involvement, and surgeon preference [1,10,13,14].

CONCLUSIONS

Over the past few decades, there has been a remarkable improvement in the prognosis of cerebral tuberculoma, shifting from a prognosis nearly fatal to one where over 80% of patients survive with timely treatments. Considering the possibility of tuberculoma is essential when evaluating CNS masses, even in patients without a history of TB elsewhere, to ensure prompt and appropriate treatment. While imaging studies are supportive, they do not conclusively confirm the diagnosis of brain tuberculoma, and both prognosis and treatment differ from other brain lesions. A histological diagnosis achieved through surgical excision not only confirms the diagnosis but also helps alleviate symptoms of increased intracranial pressure.

DECLARATIONS

Competing of Interest

The authors declare no competing interest in this study.

Acknowledgment

Not applicable

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