Case Report

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# Pediatric intracranial internal carotid artery aneurysm masquerading as meningitis: a case report

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**Introduction and importance:** Intracranial aneurysms in children are very rare vascular lesions that often have atypical clinical features that differ from those of adult cases. Pediatric intracranial internal carotid artery aneurysm (PIICAA) is particularly uncommon and may be confused with other neurological or infectious conditions, delaying timely diagnosis.

**Case presentation:** This report describes a case of a dissecting PIICAA in a 10-year-old boy who initially presented with fever, seizures, headache, and meningeal signs, leading to a misdiagnosis of meningitis. The infectious etiology was not confirmed with conventional imaging or cerebrospinal fluid analysis, and finally, a diagnosis was made via magnetic resonance imaging and angiography.

**Clinical discussion:** The diagnostic complexity of pediatric internal carotid artery aneurysms is highlighted in this case, especially when symptoms are suggestive of central nervous system infection.

**Conclusion:** The rarity of such cases, coupled with their nonspecific presentation, highlights the importance of keeping cerebral aneurysm in mind as a life-threatening differential diagnosis for neurological syndromes.

**Keywords:** internal carotid artery aneurysm, meningitis, pediatrics

## Introduction

Pediatric intracranial aneurysms are exceptionally rare, representing 1–5% of all intracranial aneurysms in the general population. They are characterized by male predominance, moderate association with trauma, and better clinical grades than adults[1]. Pediatric intracranial aneurysms most commonly occur at the intracranial internal carotid artery and middle cerebral artery bifurcation, differing markedly from adult distribution patterns[2]. Clinically, while subarachnoid hemorrhage (SAH) is a critical manifestation, nonhemorrhagic presentations such as mass effect, headaches, seizures, or focal neurological deficits are frequently observed and may constitute a significant proportion of cases, contrasting sharply with adult populations where SAH predominates[3]. Since intracranial aneurysms lack distinct clinical and imaging characteristics, diagnosis remains difficult despite technological advancements and imaging

## HIGHLIGHTS

- This case report describes a rare pediatric intracranial internal carotid artery aneurysm (PIICAA) in a 10-year-old boy that mimicked meningitis, initially leading to a misdiagnosis and delayed treatment.
- The patient presented with fever, seizures, headache, and meningeal signs, but conventional tests for infection, including cerebrospinal fluid analysis and CT scan, failed to reveal the true cause.
- Definitive diagnosis was achieved only after advanced imaging with magnetic resonance imaging and digital subtraction angiography, which identified a dissecting aneurysm at the left internal carotid artery bifurcation.
- Endovascular embolization with micro-coils was successfully performed, resulting in complete occlusion of the aneurysm and symptom resolution at 3-month follow-up.
- The case underscores the diagnostic complexity of PIICAA, emphasizing the importance of considering vascular anomalies in the differential diagnosis of pediatric neurological syndromes with nonspecific or misleading symptoms.

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studies. The diagnosis can be suspected in patients with a subtle presentation, slowly progressing symptoms, and neurologic deficit that appears to be secondary to the lesion mass effect, which is characterized by rounded, heterogeneous lesions with calcification toward the periphery, flow voids, and heterogeneous reinforcement with contrast that appears to diminish toward the periphery in MRI and/or CT scans[4].

Therefore, these challenges can lead to misdiagnosis and delay in initiating treatment, given the rarity of this disease in pediatrics. This highlights the importance of the correct and timely use of diagnostic modalities, as the timing of treatment of ruptured intracranial aneurysms clearly influences short-term and long-term outcomes[5]. Therapeutic strategies for pediatric intracranial aneurysms must account for their unique challenges. Surgical clipping remains a cornerstone, yet endovascular coiling has gained traction, particularly for anatomically intricate or high-risk lesions[6].

Herein, we report a rare case of a pediatric intracranial internal carotid artery aneurysm (PIICAA) presenting with clinical features highly suggestive of meningitis, highlighting the diagnostic challenges and the importance of maintaining a broad differential diagnosis when evaluating children with prolonged fever, seizures, and meningeal signs unresponsive to conventional therapy. The study followed the Case Report (CARE) reporting guideline. This work was conducted without the use of artificial intelligence tools, in compliance with the TITAN Guidelines 2025[7].

## Case presentation

A 10-year-old boy presented to the emergency room with a complaint of seizure, headache, and fever for the past 2 weeks. He was initially admitted to another hospital, where he received empiric antibiotic therapy, but had no improvement in symptoms. He had had three episodes of generalized tonic-clonic seizures in the past 2 weeks, a severe generalized headache, and photophobia. The patient mentioned nausea and vomiting. He did not mention a history of recent head trauma or any respiratory infectious diseases.

His past medical history was significant for a minor head trauma 5 years prior, resulting in a small intracranial hemorrhage that was managed conservatively without residual symptoms. He had no notable allergic, familial, or drug history. On physical examination, his vital signs were blood pressure: 110/70 mmHg, heart rate: 98 beats/minute, respiratory rate: 20 breaths/minute, temperature: 39°C, $SpO_2$: 94% while breathing ambient air. He was awake, lethargic, oriented to time, place, and person, and appeared ill. The examination was notable for neck stiffness, positive Brudzinski's sign, and Kernig's sign. His eye examination was normal and had no papilledema and hemorrhage on fundoscopy. A comprehensive neurological examination revealed no abnormalities in his cranial nerves, motor and sensory function, and reflexes. Blood tests at presentation were normal (Table 1).

Initially, a CT scan was taken of the patient's head, which revealed no acute hemorrhage, mass effect, or hydrocephalus (Fig. 1). Electroencephalography did not reveal any abnormal electrical activity. A spinal tap was done, which revealed no signs of bacterial meningitis (Table 2).

**Table 1**

**Blood tests at presentation**

| Parameter | Value | Units | Reference range |
|---|---|---|---|
| WBC | 8 | ×1000/mm$^3$ | 4–10 |
| RBC | 5.29 | million/mm$^3$ | 4.5–6.3 |
| Hemoglobin | 13.0 | g/dL | 12–16 |
| Platelets | 255 | ×1000/mm$^3$ | 140–440 |
| ESR | 22 | mm/hour | 0–15 |
| Sodium | 139 | mEq/L | 135–145 |
| Potassium | 3.5 | mEq/L | 3.5–5 |
| BUN | 10 | mg/dL | 6–20 |
| Creatinine | 0.7 | mg/dL | 0.6–1.2 |
| CRP | 24 | mg/L | 0–6 |
| Blood glucose | 99 | mg/dL | 70–99 |
| LDH | 200 | U/L | 140–280 |
| Total protein | 7.3 | g/dL | 6–8 |

WBC, white blood cells; RBC, red blood cells; ESR, erythrocyte sedimentation rate; BUN, blood urea nitrogen; CRP, C-reactive protein; LDH, lactate dehydrogenase.

Finally, a head magnetic resonance imaging (MRI) with contrast suggested a brain aneurysm (Fig. 2). A six-vessel digital subtraction angiogram (DSA) revealed a dissecting aneurysm measuring 5 × 5 mm at the left intracranial internal carotid artery bifurcation with superior projection. The aneurysm was completely embolized using three micro-coils. Control DSA was normal.

The fever resolved within 48 hours after treatment, and negative blood and CSF cultures with normal inflammatory markers excluded an infectious etiology. He was discharged with a prescription of levetiracetam for 7 days to prevent future seizures. On a telephone follow-up 3 months after discharge, he did not report any symptoms.

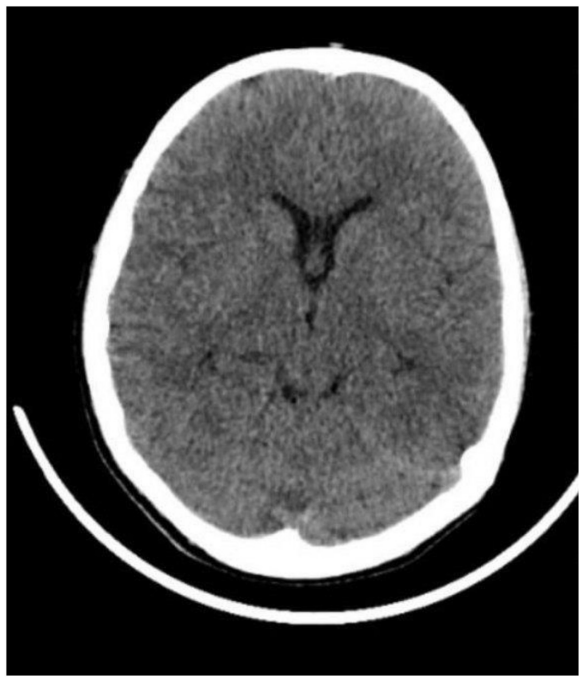

**Figure 1.** Initial CT scan does not show any findings in favor of vascular lesions or cerebral hemorrhage.

**Table 2**

**Cerebrospinal fluid analysis**

| Tests | Results |
|---|---|
| Appearance | Clear |
| Color | Colorless |
| WBC | 15 cells (PMN: 90%) |
| RBC | 70 cells |
| Glucose | 50 mg/dL |
| Protein | 33 mg/dL |
| LDH | 68 U/L |
| Gram stain | No microorganisms seen |
| Culture | No growth after 72 hours |

WBC, white blood cells; RBC, red blood cells; LDH, lactate dehydrogenase; PMN, polymorphonuclear leukocytes.

## Discussion

In the current study, we have described a rare case of the PIICAA, providing compelling insight into the diagnostic challenges of the disorder. Although these lesions are rare, healthcare providers must recognize when further evaluation is needed despite misleading symptoms so that these children have the most favorable possible outcomes.

An internal carotid artery aneurysm is defined as a local increase in vessel diameter of >50%, compared to reference values for the appropriate vessel segment[8]. PIICAAs are uncommon arterial lesions, accounting for approximately 1% of all intracranial aneurysms[1]. The location, etiology, demographics, clinical manifestations, and radiological features of PIICAA cases differ from those of adult cases. However, the small number of reported cases made it difficult to determine the exact incidence, etiologies, and prognosis of these aneurysms. PIICAA is more common in males than in females among prepubertal children, and in the postpubertal period, as in adults, the prevalence is higher in females than in males. Most cohorts reported a mean age of 10–14 years for PIICAA[9]. The historic cohorts show the mortality rate of PIICAA ranged from 1.3% to 10.4%[1,10]. In contrast to the most common cause of internal carotid artery aneurysm in adults being atherosclerosis (34–42%), followed by trauma (35–51%), only 5–10% of childhood aneurysms are related to head trauma. Most of these are due to nontraumatic causes, particularly infectious causes[3,11]. Dissecting aneurysms and saccular aneurysms are the most common intracranial nontraumatic aneurysm types in children and adolescents, respectively[2]. Although the patient had a remote history of mild head trauma 5 years earlier with a small intracranial hemorrhage that resolved without intervention, no vascular abnormality was documented at that time. However, it is possible that this event caused focal arterial wall weakening, predisposing to delayed dissection. In children, intracranial aneurysms can arise from minor trauma[12].

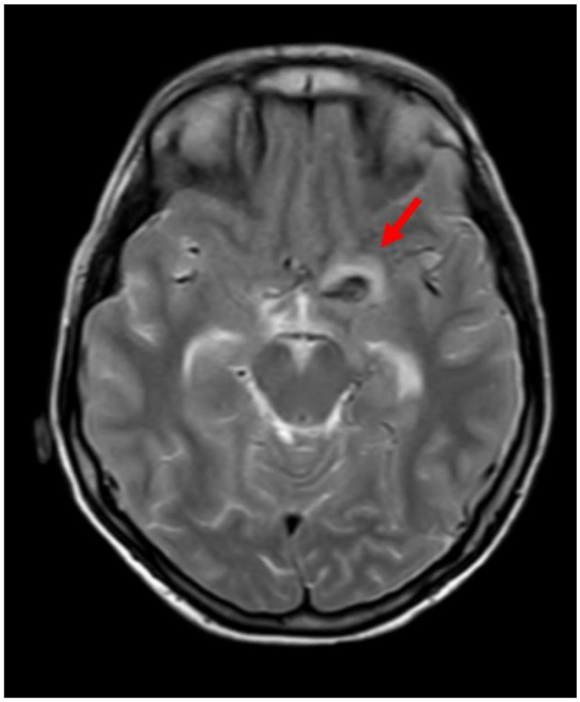

**Figure 2.** MRI T2-weighted image of brain shows horizontal section of the left internal carotid artery aneurysm.

Studies show that the most common presenting features of pediatric intracranial aneurysms include headache (82%), seizures (21%), ictal loss of consciousness (27%), and motor/cranial nerve deficits (22.6 %)[6]. The neurological presentations of PIICAA are prevalent and depend on the direction of extension. These manifestations often present with focal symptoms, including strokes, transient ischemic attacks, transient amaurosis, and anopsia. Less frequently reported manifestations include diplopia, ptosis, Horner's syndrome, and sixth-nerve paralysis associated with an extension into the cavernous, and vertigo, dizziness, hearing loss, and pulsatile tinnitus due to an extension into the tympanic cavity[13,14].

Computed tomograms revealed SAH in 58% of patients, which can cause neck stiffness due to irritated meninges by blood and cerebrospinal fluid around the brain[6]. All of this evidence suggests that PIICAA can be widely misdiagnosed as other disorders due to its various symptoms. Several reports indicate that the early symptoms of PIICAA can mimic those of other disorders, such as glomus jugular tumor, craniopharyngioma, mood disorder, cervical paraganglioma, migraine, and peritonsillar abscess, as well as this case in which the symptoms of meningitis were mimicked[11,15–17].

There are a variety of diagnostic modalities available to differentiate between PIICAA and other differential diagnoses. Ultrasound imaging can be used to make the first diagnosis of an extracranial carotid aneurysm. If there is no life-threatening hemorrhage that requires rapid repair, MRI with angiography is useful for operational planning. Brain CT scans can confirm or rule out ischemic events in patients with neurologic symptoms. Ultrasound has many advantages, including high patient tolerance, lack of necessity for sedation, no exposure to ionizing radiation, and the ability to visualize vascular diameter effectively. However, ultrasound's limited ability to reach the skull base is a significant drawback. Another noninvasive imaging technique that can discriminate between aneurysms, hemangiomas, masses, abscesses, and other structural anomalies is MRI, which offers multiplanar imaging capabilities[13,18]. Angiography is essential to confirm arterial involvement, evaluate collateral circulation, and guide the design of carotid ligation or the occlusion of certain arteries, which is mostly used for

embolization treatment. However, because of its invasiveness and ionizing radiation, angiography is usually not the first test, which can delay the correct diagnosis[4].

If there are other systemic findings such as lethargy, fever, abdominal pain, or cutaneous findings, further etiologic workup, such as C-reactive protein and the erythrocyte sedimentation rate, should be checked in parallel with neuroimaging to consider underlying infectious and systemic inflammatory conditions such as Takayasu arteritis, Kawasaki disease, and Behçet disease[19].

Treatment decisions should be made by a multidisciplinary team, based on the aneurysm type and the associated natural history. Operative repair should be performed for carotid aneurysms, given the high risk of stroke and a reported rupture rate as high as 40%[20]. Starting with Sir Ashley Cooper, who ligated the internal carotid artery for a cervical aneurysm for the first time, three treatment modalities for intracranial aneurysms in children, like in adults, are described as conservative, endovascular, and microneurosurgical[21]. For patients with ruptured intracranial aneurysms, endovascular treatment is now the first line of treatment. The International Subarachnoid Aneurysm Trial demonstrated that the probability of independent survival at 1 year was significantly higher after endovascular treatment than after neurosurgical intervention[22]. Research has shown better results of embolization procedures with lower rates of complications, but a higher rate of recanalization is still a major drawback of endovascular coiling. Favorable outcomes are observed in 72% of endovascular interventions for aneurysms[6]. In pediatric intracranial aneurysms, long-term outcomes reveal a 62% favorable recovery rate, 35% mortality, and a 5% risk of symptomatic *de novo* aneurysms; a favorable prognosis correlates with anterior circulation location, complete aneurysm closure, and absence of vasospasm, while survivors often achieve functional independence but face lifelong risks of recurrence[10].

## Conclusion

This case documents a rare presentation of PIICAA mimicking meningitis, leading to initial misdiagnosis and treatment delay. Vascular anomalies in children with unexplained neurological symptoms should be considered as a differential diagnosis for successful diagnosis through advanced imaging and effective management. The case serves as an example of the diagnostic difficulties caused by nonspecific symptoms and the necessity for increased clinical suspicion. It is important to identify early and accurately in order to prevent complications and achieve optimal outcomes. Multidisciplinary evaluation and timely intervention remain key in managing such complex cases. Future research should focus on refining well-diagnostic pathways and developing evidence-based treatment guidelines for the recognition and care of PIICAA.

## Ethical approval

Code of ethics is not applicable for this case report. This study was conducted with the informed consent of the patient and her legal guardians and under the supervision of the Ethics Committee of Firozabadi Hospital.

## Consent

Written informed consent was obtained from the patient's parents/legal guardian for publication and any accompanying images, and the patient's personal information will not be disclosed in any way. A copy of the written consent is available for review by the Editor-in-Chief of this journal on request. The patient consent form is the official form of Firoozabadi Hospital and is available for the patient.

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## Author contributions

All authors have made significant contributions to this case report study. M.R.: designed the work and wrote the main manuscript text. A.K.: wrote the main manuscript text. M.K.: supervised the implementation of the plan and edited the main manuscript text. F.S. supervised the implementation of the plan. A.S.M., S.A.S., M.T., and M.V. collected the patient data.

## Conflicts of interest disclosure

The authors declare no conflict of interest in the creation and publication of this article. Our aim is to provide accurate and unbiased information, adhering to strict ethical standards. This work is based on thorough research and analysis, and any potential sources of influence have been fully disclosed. We are committed to maintaining transparency and integrity in all our endeavors, fostering the trust and confidence of our readers.

## Research registration unique identifying number (UIN)

This study is not a clinical trial, there was no intervention, and it was done only by observing existing documents.

## Guarantor

Mohammad Rezazadeh.

## Provenance and peer review

Not commissioned, externally peer-reviewed.

## Data availability statement

All information (without personal information of the patient, such as name and surname) is available for review by the Editor-in-Chief of this journal on request.

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## Presentation

None.

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