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Post-traumatic Gradenigo syndrome: An uncommon complication in the antibiotic era?

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ABSTRACT

Gradenigo syndrome (GS) is a rare complication of otitis media, secondary to infection spreading to the petrous apex, with potential involvement of cranial nerves V and VI. We present the unusual case of a previously healthy 5-year-old boy who developed GS after a penetrating trauma to the left ear caused by a schoolmate. The patient presented severe ear pain, purulent otorrhea, and horizontal diplopia with VI cranial nerve palsy and hemifacial hypoesthesia. CT showed petrous bone erosion, and MRI showed meningeal enhancement without abscesses. Antibiotic therapy and transtympanic ventilation tubes were placed, with complete clinical resolution. This case illustrates a rarely reported trigger of GS in pediatrics, highlighting the importance of considering this entity in complicated post-traumatic otitis, where early clinical suspicion, a multidisciplinary approach, and the timely use of imaging studies were decisive for a successful outcome.

Keywords: *petrositis; ear; wounds and injuries; pediatrics.*

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INTRODUCTION

Gradenigo syndrome (GS) was first described by Giuseppe Gradenigo in 1904 and later expanded upon in 1907, characterizing a classic triad consisting of retro-orbital pain, diplopia secondary to VI cranial nerve palsy, and purulent otorrhea in the context of otitis media complicated by petrositis.[1] Since its original description, the frequency of the syndrome has decreased significantly thanks to the introduction of effective antimicrobial therapy, which has contributed to it being frequently underestimated in current clinical practice.

However, GS continues to represent a condition with high neurological morbidity and mortality when diagnosis is delayed or management is inadequate. Despite advances in neuroimaging and the widespread use of broad-spectrum antibiotics, it remains a significant complication, with atypical presentations that primarily affect immunocompetent pediatric patients. Reports often describe cases in previously healthy children with predisposing factors such as chronic otomastoiditis.

CLINICAL CASE

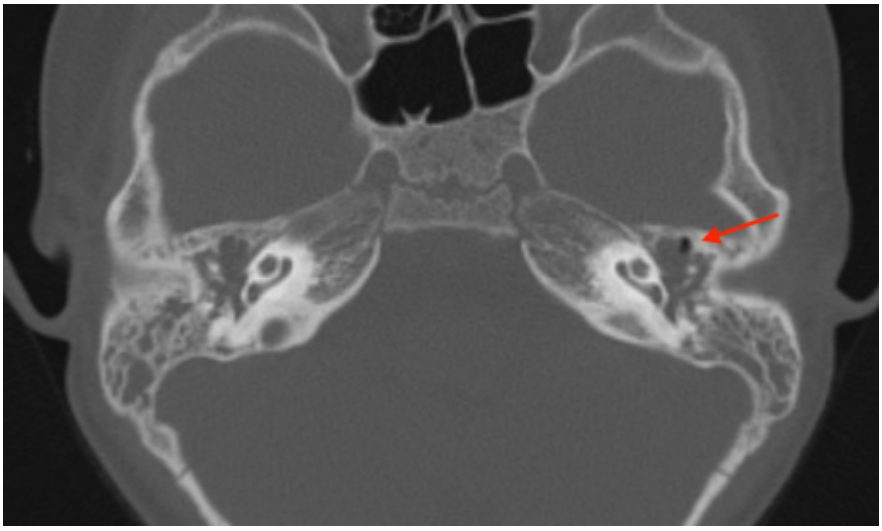
A healthy 5-year-old boy with no relevant medical history or otolaryngological history of recurrent otitis media, tympanic perforations, or previous surgical interventions, presented on August 4, 2023, with a penetrating trauma to the left ear with a pencil, which occurred at school. The following day, he developed left ear pain, and within 48 hours, purulent otorrhea.

He was initially evaluated at a primary care center, where complicated otitis media was suspected. Computed tomography (CT) of the temporal bones showed occupation of the left middle ear with air-fluid levels and bilateral mastoid effusion (*Figure 1*), after which treatment with intravenous ceftriaxone (dose not documented) was initiated. On August 11, the child presented with fever, retro-orbital pain, diplopia, and paralysis of the left VI cranial nerve, for which reason he was referred to our institution.

Upon admission, he was febrile, with left hemifacial pain, no meningeal signs, and an ENT examination that revealed left tympanic perforation with active suppuration; material was obtained for culture, which subsequently showed no bacterial growth. Given the clinical picture, differential diagnoses such as cavernous sinus thrombosis, osteomyelitis of the skull base, intracranial abscess, neoplastic lesions of the cavum, petrositis, and Gradenigo syndrome were considered.

Contrast-enhanced magnetic resonance imaging (MRI) and magnetic resonance angiography (MRA) showed inflammatory osteitis of the left petrous apex with meningeal enhancement in the pontocerebellar cistern and retroclival region, with no evidence of venous

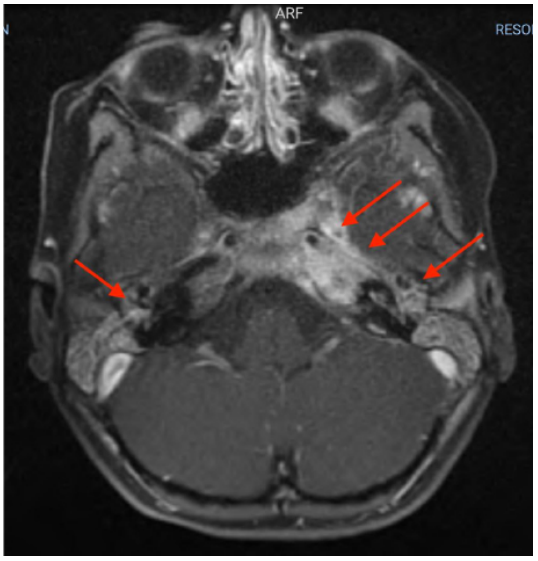
Figure 1. Ear tomography



Ear tomography with evidence of occupation of the left middle ear with air-fluid levels without visualization of the tympanic membrane, edema of the external auditory canal, and bilateral mastoid effusion.

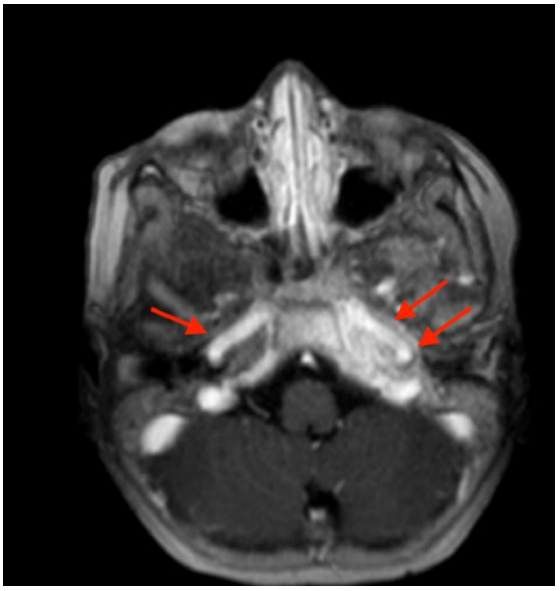
sinus thrombosis or abscesses; these findings were considered consistent with petrositis in the context of traumatic Gradenigo syndrome (*Figures 2, 3,* and *4*). Considering the nature of the trauma and the likely contamination of the penetrating object, intravenous ceftriaxone was initiated at 50 mg/kg every 12 hours, with expected coverage for *Streptococcus pneumoniae*, *Staphylococcus aureus,* and Gram-negative bacilli. Bilateral tympanostomies

Figure 2. Brain magnetic resonance imaging



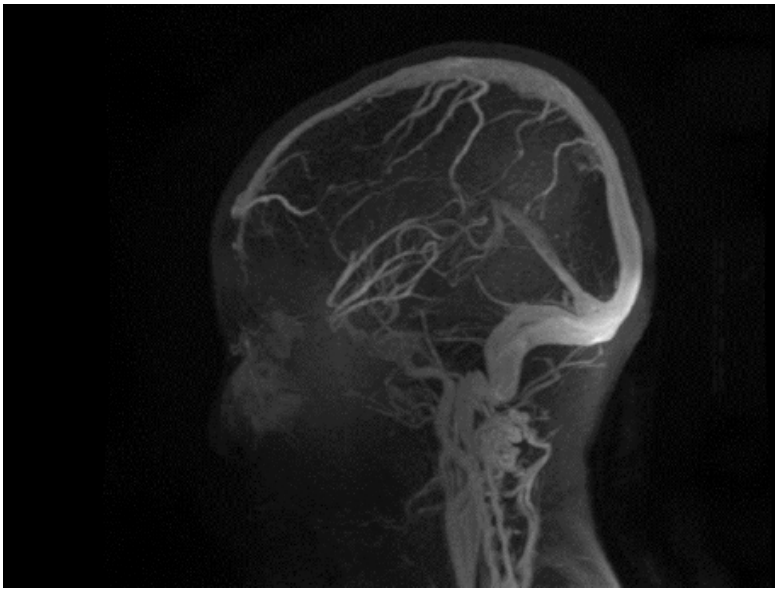
Contrast-enhanced brain MRI showing evidence of bilateral otomastoiditis with signs of periosteal irritation, enhancing with contrast toward the walls of the left internal auditory canal, as well as extension to the retroclival periosteal region and at the level of the pontocerebellar cistern.

Figure 3. Contrast-enhanced brain MRI



Contrast-enhanced brain MRI, with blurring of the mastoid cells and tympanic cavities due to an acute inflammatory process, such as otomastoiditis, with contrast enhancement, findings consistent with the clinical picture of Gradenigo syndrome.

Figure 4. Angioresonance



Angioresonance with no evidence of associated thrombotic processes.

with ventilation tube placement supplemented treatment on September 9, 2023.

The patient completed 42 days of intravenous treatment, with progressive resolution of the VI pair deficit and complete clinical recovery.

DISCUSSION

Gradenigo syndrome (GS) is a rare entity whose incidence has decreased significantly since the introduction of antibiotics, with approximately 2 cases reported per 100,000 people and a morbidity and mortality rate associated with apical petrositis of roughly 2.3%.[1] Up to 85% of children have at least one episode of acute otitis media during childhood, making them a population particularly vulnerable to infectious complications of the middle ear.[1] The pathophysiology of GS is explained by the complex anatomy of the petrous temporal bone, in proximity to cranial nerves V and VI, which facilitates the intracranial spread of infections originating in the middle ear. However, only between 13% and 42% of patients with petrous apex involvement develop the classic triad: otitis media with otorrhea, VI cranial nerve palsy, and retroocular or facial pain.[2,3]

In the pediatric population, pneumatization of the petrous apex is often incomplete, which is a significant risk factor because it facilitates the medial spread of middle ear infections into this region. This favors the development of petrositis and contributes to the onset of GS.[4] Although cranial nerve involvement may take between one week and two months to manifest in the context of acute ear infection;[5] in this case, the onset was unusually rapid. The history of penetrating ear trauma acted as a gateway for the infection and precipitated the early onset of the syndrome. To our knowledge, there are no previous reports of the sudden onset of GS after penetrating trauma in a previously healthy child with no history of chronic otitis, which emphasizes the rarity of the case presented.

The diagnosis of GS requires a high index of clinical suspicion and the appropriate use of imaging studies. Computed tomography (CT) is essential for characterizing bone involvement and demonstrating destruction associated with infectious or infiltrative processes. At the same time, magnetic resonance imaging (MRI) allows evaluation of the extent of central structures, meningeal uptake, vascular involvement, and lesional content.[3] When GS is suspected, it is necessary to rule out complications such as cerebral venous thrombosis, especially of the cavernous or sigmoid sinus. In this case, magnetic resonance angiography enabled prompt exclusion of these complications and appropriately guided treatment.

Initial treatment of SG is usually conservative, involving broad-spectrum intravenous

antibiotics and, in many cases, the placement of transtympanic ventilation tubes. This strategy has proven effective in most patients, avoiding the need for invasive surgical procedures; complete resolution with antibiotic treatment alone has been reported in up to 50% of cases.[1,5] However, in the presence of intracranial complications, such as abscesses or clinical deterioration under medical treatment, surgical intervention is indicated. Although there is no consensus on the optimal duration of treatment, prolonged regimens of 4 to 6 weeks are recommended because of the analogy between infectious petrositis and temporal osteomyelitis.[3] In the case presented, intravenous antibiotic therapy was instituted, and joint management with otolaryngology was performed by placing transtympanic ventilation tubes, which resulted in a favorable outcome and discharge in stable condition.

Finally, it is worth mentioning that, according to recent literature, in cases of penetrating trauma to the external auditory canal, antibiotic prophylaxis may be considered to reduce the risk of secondary infection.[6] Although the evidence is not conclusive, this recommendation is relevant when analyzing cases such as the one presented, where trauma acted as a gateway for a severe infection.

Gradenigo syndrome, although rare today, remains a clinically relevant entity due to its potential severity and variable presentation. This case demonstrates an atypical form of onset, associated with penetrating trauma in a previously healthy child, highlighting the need to maintain a high index of suspicion even in non-classical scenarios. Early identification of clinical signs, appropriate use of diagnostic tools such as CT and MRI, and a timely, multidisciplinary therapeutic approach are essential to prevent severe neurological complications. In contexts where otitis media is accompanied by VI paralysis or facial pain, recognition of this entity should be a priority. This case broadens the clinical spectrum of Gradenigo syndrome and reinforces the importance of considering uncommon diagnoses in the evaluation of complicated ear infections in the pediatric population. ■

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