

CEREBRAL VENOUS SINUS THROMBOSIS AS A COMPLICATION OF MASTOIDITIS – A CASE REPORT WITH LITERATURE REVIEW

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Abstract: Introduction: Mastoiditis is the inflammation of the mastoid part of the temporal bone, specifically the mastoid air cells. It most commonly occurs as a complication of middle ear infection. Mastoiditis is a clinical diagnosis, and antibiotics play a central role in its treatment. Cerebral venous sinus thrombosis is a rare intracranial complication of acute mastoiditis. Case Presentation: A 49-year-old patient presented with tinnitus in the left ear, vertigo accompanied by nausea and vomiting, and stiffness on the left side of the neck. A general clinical and neurological examination was performed, which was normal at that time. Otoscopic examination of both ears was also normal. The patient was afebrile. Symptomatic treatment was prescribed, including analgesics, muscle relaxants, Betahistine, and a B-complex vitamin. Two days later, the patient returned with worsened symptoms, including a feeling of fullness and pain in the left ear, occasional discharge from the same ear, and severe pain and stiffness in the left side of the neck. Due to significant pain, the clinical examination was limited. Inspection revealed retroauricular swelling in the area of the left mastoid and the left side of the neck. The patient was urgently referred for consultation with an otorhinolaryngologist and neurologist at a regional hospital, who indicated an urgent non-contrast CT of the endocranium and laboratory tests. A contrast-enhanced CT of the endocranium confirmed the presence of venous sinus thrombosis along with inflammation of the left mastoid air cells. Radical trepanation of the temporal bone/mastoidectomy on the left side was performed. During hospitalization, parenteral antibiotic, anticoagulant, and supportive therapy were administered. The patient reported subjective improvement with the treatment, and follow-up clinical, laboratory, and CT findings indicated regression of the inflammatory process. Conclusion: In patients with ear pain, the most common symptom of middle or outer ear infection, it is important during the examination to identify typical signs of retroauricular inflammation (swelling, redness, and tenderness) as an indication of mastoiditis. Mastoiditis is the second most common complication of acute otitis media. Timely diagnosis and appropriate treatment of mastoiditis reduce the risk of complications, such as cerebral venous sinus thrombosis.

Keywords: otitis media, cerebral veins, otalgia

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Mastoiditis is an inflammation of the mastoid part of the temporal bone, specifically the mastoid air cells. Since children are more susceptible to middle ear infections, they are at an increased risk of developing acute mastoiditis compared to adults. Most commonly, acute mastoiditis is a complication of acute otitis media (middle ear infection). Subacute middle ear infections cause subacute mastoiditis. Although rare, other causes of mastoiditis lead to an infection of only the mastoid air cells, which is called early mastoiditis.

Mastoiditis can be divided into three categories based on the mechanism of infection:

- Early Mastoiditis: Involves infection of only the mastoid air cells without spreading into the middle ear cavity.
- Acute Mastoiditis (the most common form): Infection of the epithelial mucosa with erosion through the bony septations of the mastoid air cells. This erosion can progress to the formation of an intracavitary abscess, which may further spread to adjacent structures.
- Subacute Mastoiditis: Occurs after a persistent middle ear infection or repeated episodes of acute otitis media with inadequate antimicrobial therapy, leading to a persistent infection and

erosion of the bony septations between the mastoid air cells. [1].

With the advent of antibiotics, the development of acute mastoiditis and progression to dangerous complications is unlikely. However, if left untreated, mastoiditis can lead to life-threatening complications, including meningitis, intracranial abscess, and venous sinus thrombosis [2].

The most common pathogen in mastoiditis is *Streptococcus pneumoniae*. Other common pathogens include *Staphylococcus aureus*, *Streptococcus pyogenes*, and *Haemophilus influenzae*. Risk factors for mastoiditis include age under two years, immunocompromised conditions, recurrent acute otitis media, or incomplete pneumatization of the mastoid process [3].

In adults, the most common symptoms of mastoiditis are otalgia (ear pain), otorrhea (ear discharge), and hearing loss, with typical retroauricular signs of mastoiditis usually present (i.e., swelling, erythema, tenderness in the retroauricular area).

Otосcopy will reveal bulging of the posterior superior wall of the external auditory canal and bulging with pus behind the tympanic membrane. The tympanic membrane is often perforated, with drainage of purulent material. A normal tympanic membrane generally, but not always, rules out acute mastoiditis [4].

Mastoiditis is a clinical diagnosis. Laboratory tests and radiological imaging methods are used as adjuncts when the diagnosis is uncertain or when complications of acute mastoiditis are being considered. Laboratory analyses include a complete blood count (CBC) with leukocyte formula, erythrocyte sedimentation rate (ESR), and C-reactive protein (CRP). Typically, an elevated white blood cell count and increased inflammatory markers (ESR, CRP) are observed. Radiological assessment of acute mastoiditis involves CT and MRI imaging [5].

Antibiotics play a central role in the treatment of mastoiditis. Additional invasive therapeutic measures, including myringotomy, tympanostomy, and mastoidectomy, may be indicated depending on the severity of the infection [5].

Complications of mastoiditis occur when the infection spreads outward toward the periphery or inward toward the brain. Depending on the direction, extracranial

complications may include subperiosteal abscess, facial nerve paralysis, labyrinthitis, petrositis, and Bezold's abscess, while intracranial complications include meningitis, intracranial abscesses, and cerebral venous sinus thrombosis [6,7]. These patients often present clinically with seizures, neck stiffness, headache, and altered mental status.

Cerebral Venous Sinus Thrombosis (CVST) is a rare complication of acute mastoiditis, with a declining incidence in the post-antibiotic era [8]. It involves partial or complete occlusion of a sinus or cerebral vein. The earliest description dates back to the first half of the 19th century. Since then, it has become increasingly recognized due to the widespread availability of advanced imaging techniques, such as CT venography, MR venography, and digital subtraction angiography [9].

The most common sites of occlusion are the transverse sinuses (44–73%), superior sagittal sinus (39–62%), sigmoid sinus (40–47%), deep venous system (10.9%), and cortical veins (3.7–17.1%) [10].

The clinical presentation of CVST is variable. Headache is typically the most common symptom (88.8%), followed by seizures (39.3%) and paresis (37.2%). It may also present with other focal neurological deficits or altered mental status. Intracranial hemorrhage occurs in 30–40% of patients [11].

CASE REPOST

A 49-year-old patient presented to a general practice clinic complaining of tinnitus in the left ear for the past 7 days, vertigo accompanied by nausea and a single episode of vomiting, as well as stiffness in the left side of the neck. Upon reviewing the patient's medical records, it was noted that he had been treated for left middle ear infection on several occasions over the past year. He has arterial hypertension, which is well-controlled with regular antihypertensive therapy. He has no other known medical conditions.

A general clinical and neurological examination was performed, both of which were unremarkable at that time. Otосcopy of both ears was also normal. The patient was afebrile. Symptomatic treatment was prescribed, including analgesics, muscle relaxants, betahistine, and a vitamin B complex.

Two days later, the patient returned with worsening of the described symptoms, including a feeling of fullness and pain in the left ear, as well as intermittent discharge from the same ear. There was also severe pain and stiffness in the left side of the neck. Due to the patient's intense pain and poor cooperation, the clinical examination was limited. Inspection revealed swelling in the area of the left mastoid and left side of the neck. The patient was urgently referred for consultation with an otorhinolaryngologist (ENT specialist) and a neurologist at the regional hospital. They recommended an urgent non-contrast CT of the endocranium and laboratory tests, which showed: CRP: 224.5 mg/L; Leukocytes: $15 \times 10^9/L$; Platelets: $41 \times 10^9/L$; Erythrocytes: $3.6 \times 10^{12}/L$; Hemoglobin: 120 g/L; Hematocrit: 0.33 L/L. The CT scan revealed the presence of gas inclusions tracking in the region of the jugular canal and the lumen of the left jugular vein, indicating venous sinus thrombosis. The left mastoid air cells and inner ear were filled with hypodense material, most likely inflammatory in nature, consistent with mastoiditis.

The patient was transported on the same day to the Emergency Center of UKCV, where laboratory tests were repeated: CRP: 231.6 mg/L; PCT: 135.58 ng/mL; Leukocytes: $9.47 \times 10^9/L$; Erythrocytes: $3.7 \times 10^{12}/L$; Hemoglobin: 119 g/L; Hematocrit: 0.34 L/L; Platelets: $42 \times 10^9/L$. A contrast-enhanced CT of the endocranium was also repeated. The scan showed complete opacification of the left mastoid air cells, primarily of inflammatory etiology. Post-contrast delayed studies revealed that the sigmoid sinus, along with the adjacent bony structures, did not opacify, unlike the contralateral side, with visible gas particles within the sinus—indicative of left venous sinus thrombosis. Additionally, in continuity with the left sigmoid sinus, the left transverse sinus was observed to be partially thrombosed with visible gas particles.

An urgent admission to the ENT Clinic and Head and Neck Surgery was indicated. Upon clinical examination at admission, it was noted that the left mastoid was slightly swollen and painful on palpation. Otomicroscopic examination of the left external auditory canal revealed it to be filled with a large amount of purulent material, which was irrigated. The skin of the ear canal showed no changes. Whitish

deposits were present pre-tympanically, and the tympanic membrane displayed pronounced vascularization with a diffuse light reflex. A paracentesis was performed, yielding a small amount of purulent material. An urgent radical mastoidectomy (trepanation of the temporal bone) was performed on the left side, and the surgical material was sent for pathohistological verification. The findings were: Inflammatio phlegmonosopurulenta acuta mucosae (acute phlegmonous-purulent inflammation of the mucosa). Additionally, cholesteatomatous debris was found in the examined material. Intraoperatively, a swab of the purulent material was taken, and *Actinomyces* spp. was isolated. During hospitalization, the patient received parenteral antibiotic therapy, anticoagulant therapy (LMWH), and supportive care. Laboratory parameters and CT scans of the endocranium (native and with contrast) were regularly monitored. The patient reported subjective improvement with the applied therapy, and follow-up clinical, laboratory, and CT findings indicated regression of the inflammatory process. Upon completion of hospitalization, the patient was advised to continue treatment with oral antibiotics and LMWH, with a transition to oral anticoagulants (Acenocoumarol). The LMWH was overlapped with Acenocoumarol for about five days to achieve a PT/INR ratio of 2.0–3.0, with INR monitored in the therapeutic range. On follow-up visits over the next six months after hospitalization, the patient reported feeling well, with normal clinical and laboratory findings.

DISCUSSION

Since ear pain is the most common sign of middle or external ear inflammation, patients often first present to their primary care physician or the on-duty doctor at the emergency service. It is crucial that during the examination, the presence of typical signs of retroauricular inflammation (swelling, redness, and retroauricular tenderness) is recognized, as these may indicate the presence of mastoiditis. This is important because mastoiditis is the second most common complication of acute otitis media, after tympanic membrane perforation. Timely diagnosis and appropriate treatment of mastoiditis reduce the risk of developing potentially fatal complications. Palma et al., in a retrospective study of 62 patients with mastoiditis, reported that out of

the total number of patients, 48.4% exhibited typical retroauricular signs of inflammation and bulging of the posterior-superior wall of the external auditory canal. In 51.6% of patients, signs of retroauricular inflammation were not observed, and the diagnosis was based on CT findings.

Typical signs of retroauricular inflammation were observed in 53.4% of cases where mastoiditis developed as part of acute otitis media, and in 36.8% of cases where mastoiditis occurred with subacute otitis media. Of the total number of patients, 50% had a fever upon admission, and 21% had a temperature of 38°C [12]. This study supports the notion that in a significant number of patients, mastoiditis can be easily overlooked, even with a careful clinical examination.

If a patient presents with clinical signs and symptoms of acute mastoiditis, they should be referred for an urgent ENT consultation, as the patient will likely require hospital admission for parenteral antibiotics, myringotomy, tympanostomy tube placement, and possibly mastoidectomy. For patients who present with frequent episodes of acute otitis or chronic otitis media who are otherwise stable and show no signs of mastoiditis, an outpatient ENT consultation is recommended to discuss the risk and prevention of mastoiditis [13].

Most patients with uncomplicated acute mastoiditis resolve their symptoms with conservative measures, including antibiotics, corticosteroids, and myringotomy (tympanic membrane incision, paracentesis), without the need for mastoidectomy. It is crucial to monitor patients closely, especially in the first 48 hours of treatment. If the patient's clinical status does not improve or worsens after admission, mastoidectomy is indicated [14]. There is ongoing debate among physicians regarding the treatment of otitis media, specifically the use of antibiotics and the consequences of untreated infections. As mentioned, otitis media can progress to mastoiditis, which may lead to fatal complications.

Many cases of otitis media are viral, yet patients are often prescribed antibiotics. From a physician's perspective, it is extremely difficult to determine whether a patient's infection is bacterial or viral based on physical examination alone. Patient history can aid in diagnosis, but it remains a significant challenge. This uncertainty may lead to the overprescription of antibiotics

and subsequent antibiotic misuse, contributing to the development of antibiotic-resistant infections. On the other hand, physicians must consider the consequences of untreated infections. Ultimately, to improve patient outcomes, physicians must:

Take a detailed medical history,

Perform an adequate physical examination,

Consult an ENT specialist in unclear cases, as even a seemingly simple ear infection can result in a fatal outcome.

To enhance the overall healthcare system's performance, further studies should investigate the outpatient management of uncomplicated acute mastoiditis. Avoiding hospital admission can prevent iatrogenic complications, improve patient satisfaction, and reduce healthcare costs [13].

Cerebral venous sinus thrombosis (CVST) is a rare form of venous thromboembolism (VTE) in the adult population, with an incidence of 3–4 per 1,000,000, and it is more common in women, with a 3:1 ratio compared to men [15].

Acute otitis and mastoiditis are significant risk factors for CVST due to the spread of infection from small venules draining the mastoid air cells into the sigmoid sinus, leading to the direct spread of inflammation. This process can cause occlusion of cerebral veins and dural venous sinuses, delaying cerebrospinal fluid (CSF) absorption, which in turn increases venous pressure, resulting in elevated intracranial pressure, also known as intracranial hypertension [16].

Other risk factors include: Oral contraceptive use, Puerperium, Head trauma, Direct injury during neurosurgical procedures. Women on oral contraceptives and patients with active cancer are in a prothrombotic state, further increasing the risk of cerebral sinus thrombosis [17].

Clinical manifestations of CVST vary: 30% present acutely within 48 hours of blockage, 50% present subacutely (between 48 hours and 30 days), 20% may present anytime between 30 days and six months [15]. Ipsilateral headache is present in nearly 90% of adult patients diagnosed with CVST [15,17]. In addition to headache, CVST patients may exhibit: Edema and tenderness over the mastoid process (Griesinger's sign), Nausea and vomiting, Altered mental status, Seizures, Focal motor deficit, Diplopia, Otagia [15–17].

Reports indicate that 13.2% of patients may experience visual deficits, likely due to papilledema from increased intracranial pressure [15,16,18]. Ophthalmoplegia may also occur due to paralysis of the oculomotor, abducens, or trochlear nerves, often associated with eye pain [15–17]. If untreated, elevated intracranial pressure can lead to life-threatening complications, including: Permanent blindness, Status epilepticus, Coma, Death from cerebral herniation [17].

When clinical suspicion is high, a definitive diagnosis requires neuroimaging. Brain MRI combined with MR venography (MRV) is the most sensitive and best modality for diagnosis [17,19]. Computed Tomography Venography (CTV) and MRV both have a sensitivity of 95% [15]. Interestingly, a study in the literature describes the use of ultrasound in identifying complications of mastoiditis. In a population of 10 patients, ultrasound identified complications in 9 cases. Currently, CT scanning is the standard of care; however, given the promising results of this study, further research into using ultrasound to identify mastoiditis complications should be considered.

This is especially important for the pediatric population, as it may prevent unnecessary radiation exposure from CT scans. Even if ultrasound serves only as an adjunct for screening patients who eventually undergo CT scanning, the benefit is significant for both the pediatric population and overall healthcare costs [20]. When a diagnosis of cerebral venous sinus thrombosis (CVST) is made, it is imperative to initiate anticoagulation (AC) with heparin. A meta-analysis showed that starting heparin is associated with an absolute reduction in mortality of 13% [15,17].

The most commonly used anticoagulants are unfractionated heparin (UFH) or low molecular weight heparin (LMWH). Due to practical advantages, LMWH is recommended over UFH [15]. There is insufficient evidence regarding the use of new anticoagulants.

For individuals with transient risk factors, such as infection, trauma, or pregnancy, the duration of anticoagulation therapy is typically three months, or three to six months [15]. For those with predisposing prothrombotic conditions, such as active cancer, the duration is longer—approximately six to twelve months [15].

Endovascular thrombolysis for rapid recanalization and decompressive craniotomy may be considered in life-threatening cases that do not respond to anticoagulant therapy [15].

Historically, CVST was associated with a high mortality rate due to life-threatening complications. However, with advances in neuroimaging and early treatment, mortality rates have decreased to less than 3% [16]. The prognosis for CVST is generally favorable.

Preter et al. conducted a retrospective study examining the long-term outcomes in 77 patients diagnosed with CVST. The study reports that 85% of patients did not experience long-term neurological sequelae during a 77.8-month follow-up. Additionally, the study found that 14.5% of patients with neurological impairment suffered from seizures, cognitive deficits, and focal neurological deficits [21].

CONCLUSION

In patients presenting with ear pain, the most common symptom of middle or outer ear infection, it is crucial during examination to identify the presence of typical signs of retroauricular inflammation (swelling, redness, and tenderness behind the ear) as an indication of mastoiditis. This is important because mastoiditis is the second most common complication of acute otitis media.

Timely diagnosis and appropriate treatment of mastoiditis significantly reduce the risk of complications, such as cerebral venous sinus thrombosis (CVST).

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