



Complications of Acute Otitis Media in the Pediatric Population: Recognition, Management, and Prevention



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Abstract

Acute otitis media (AOM) is one of the most common childhood infections and a leading reason for antibiotic prescriptions and urgent-care visits. Although most cases resolve without sequelae, a subset progresses to local suppurative disease, extracranial extension, intracranial infection, or long-term functional impairment. Complications are now uncommon in many high-income settings, but they remain clinically important because delayed recognition can lead to permanent hearing loss, neurodevelopmental impact, or life-threatening disease. This review summarizes the pathophysiology and epidemiology of AOM complications in children, classifies intratemporal, extracranial, and intracranial

manifestations, and outlines contemporary approaches to diagnosis, imaging, and management. Particular attention is given to acute mastoiditis as the most frequent serious complication, facial nerve palsy, labyrinthitis, and cerebral venous sinus thrombosis. Finally, prevention strategies – including vaccination, accurate diagnosis, and antibiotic stewardship – are discussed.

Keywords

Acute otitis media; children; complications; mastoiditis; intracranial complications; hearing loss; facial palsy; venous sinus thrombosis.

1. Introduction

Acute otitis media is a self-limited infection for most children, but it occupies a disproportionate place in pediatric morbidity because of its high incidence and potential for progression to suppurative complications. Classic descriptions of otitis media emphasize its frequency in early childhood and the interplay of viral upper respiratory infection, Eustachian tube dysfunction, and bacterial superinfection. Large reviews have highlighted otitis media as a global contributor to healthcare use and antibiotic exposure in children. [1, 2] Contemporary clinical guidelines emphasize accurate otoscopic diagnosis and selective antibiotic use, reflecting both the generally favorable natural history and the need to reduce antimicrobial resistance. [3, 4]

Despite improvements in vaccination coverage, access to care, and antibiotics, complications have not disappeared. They are described as „rare” in modern guidance, yet the consequences can be profound when they occur – ranging from tympanic membrane (TM) perforation with otorrhea to acute

mastoiditis, meningitis, intracranial abscess, or venous sinus thrombosis. [4, 5] For clinicians, the key challenge is recognizing which child with ear pain and fever is deviating from an uncomplicated course.

This publication reviews the spectrum of AOM complications in children, with practical emphasis on red flags, diagnostic pathways, and management principles that reduce morbidity.

2. Brief Pathophysiology and Microbiology

AOM typically follows a viral upper respiratory infection, which promotes Eustachian tube edema and impaired middle ear ventilation. Negative pressure and mucosal inflammation permit pathogen entry and effusion formation. The middle ear communicates with mastoid air cells through the aditus ad antrum; therefore, mastoid involvement can occur early, and „otomastoiditis” is sometimes used to reflect the continuum of disease. [6]

Microbiology varies by setting, age, vaccination era, and antibiotic exposure. Classic bacterial pathogens include *Streptococcus pneumoniae*, non-typeable *Haemophilus influenzae*, and *Moraxella catarrhalis*. Severe or complicated disease may involve *Streptococcus pyogenes*, *Staphylococcus aureus*, and anaerobes. Reviews of acute mastoiditis note shifts in etiology with vaccination and the emergence of non-vaccine pneumococcal serotypes and other organisms. [6, 7] In the pneumococcal conjugate vaccine era, some studies report reductions in pneumococcal mastoiditis among young children, alongside relative increases in non-vaccine serotypes or culture-negative disease. [8]

3. Epidemiology and Risk Factors for Complications

In many high-income countries, serious complications are uncommon. Guidance aimed at primary care emphasizes that most children improve within ~3 days without antibiotics and that serious complications such as mastoiditis are rare.[4] However, rarity does not mean negligible risk at the individual level – especially in children with severe symptoms, prolonged fever, immunocompromise, craniofacial anomalies, or barriers to follow-up.

Risk factors associated with complicated courses include:

- Young age (especially <2 years), due to immature immunity and Eustachian tube anatomy.[3]
- Severe otalgia, high fever, or systemic toxicity at presentation.
- Persistent symptoms beyond 48–72 hours, or deterioration after initial improvement. [3, 4]
- Recurrent AOM, daycare exposure, tobacco smoke exposure, and lack of pneumococcal vaccination (population-level risk). [2, 8]
- Delayed access to care and limited imaging/surgical resources (important contributors to morbidity globally). [2, 5]

Population evidence suggests antibiotics may reduce the already-small risk of some serious outcomes, but the number needed to treat to prevent one complication is typically very large – supporting guideline recommendations for selective prescribing rather than universal therapy. [4, 9]

4. Classification of AOM Complications

AOM complications are often organized into:

1. **Intratemporal complications** (within the temporal bone and middle/inner ear structures)
2. **Extracranial complications** (extension beyond the temporal bone into adjacent soft tissues/neck)
3. **Intracranial complications** (meninges, brain, venous sinuses)

This structure mirrors disease spread pathways: via mucosal continuity, bone erosion/coalescence, venous channels, or direct extension.

5. Intratemporal Complications

5.1. Tympanic Membrane Perforation and Acute Otorrhea

TM perforation may occur when middle ear pressure rises in purulent AOM, producing sudden otorrhea and sometimes transient pain relief. Many perforations heal spontaneously, but persistent perforation increases risk of chronic otitis media and conductive hearing loss. Guidelines and evidence reviews note perforation as a recognized complication, while emphasizing that severe outcomes are rare. [4]

Clinical considerations:

- Otorrhea in AOM warrants careful ear canal cleaning (as tolerated), assessment for otitis externa, and close follow-up.
- Antibiotics are commonly used when otorrhea is present, especially if systemic symptoms exist or follow-up is uncertain.

5.2. Acute Mastoiditis (Most Common Serious Suppurative Complication)

Acute mastoiditis arises when infection spreads from the middle ear to mastoid air cells, potentially progressing from mucosal inflammation to osteitis and coalescent mastoiditis with bony septae destruction. [6, 10] It remains the most common suppurative complication and the key „can't miss" diagnosis in children with worsening symptoms. [6, 10]



Presentation: postauricular pain, erythema, swelling, auricular protrusion, persistent fever, and otoscopic evidence of AOM (often with bulging TM).[6] ENT-oriented resources emphasize these red flags and the need for urgent evaluation. [11]

Diagnosis and imaging:

- Imaging is not required for uncomplicated AOM, but is often indicated when mastoiditis is suspected, symptoms are severe, or intracranial extension is a concern.
- CT of the temporal bone can identify coalescence and subperiosteal abscess; MRI is superior for intracranial complications and venous sinus thrombosis.

Management:

- Hospital admission is typical.
- IV antibiotics targeting likely organisms; drainage procedures (myringotomy ± tympanostomy tube) may be required.[6,10]

Subperiosteal abscess or failure to improve may necessitate mastoidectomy.[6,10]

5.3. Facial Nerve Palsy

Facial nerve palsy is an infrequent but alarming complication. Proposed mechanisms include inflammation-induced nerve edema within the fallopian canal, ischemia, or toxin-mediated neuritis. Recent pediatric reviews suggest most cases recover fully with conservative measures, particularly timely antibiotics and, in selected cases, corticosteroids; surgery is generally reserved for associated mastoiditis or nonresponse.[12,13]

5.4. Labyrinthitis and Inner Ear Involvement

Inflammation can extend to the inner ear via the round/oval windows, causing vertigo, nystagmus, nausea, and sensorineural hearing loss. This may occur with or without TM perforation and can be reversible or permanent. Because pediatric vertigo may be subtle (irritability, gait disturbance), clinicians should consider labyrinthitis when a child with AOM develops imbalance or vomiting out of proportion to fever.

5.5. Hearing Loss and Long-Term Sequelae

While not always categorized as an “acute complication,” hearing impairment is among the most meaningful outcomes for children and families.

Middle ear effusion following AOM can persist and cause transient conductive hearing loss. Recurrent infections and chronic effusion can affect speech and language development in vulnerable children, reinforcing the need for follow-up and hearing assessment when symptoms persist. [2]

6. Extracranial Complications

6.1. Subperiosteal Abscess

A subperiosteal abscess typically arises from coalescent mastoiditis when purulence erodes the mastoid cortex. Clinically it appears as fluctuant postauricular swelling with pinna displacement. This is a surgical disease in many cases, requiring ENT input for drainage and mastoid management alongside IV antibiotics. [6, 10]

6.2. Bezold Abscess and Deep Neck Infection

Inferior extension through the mastoid tip into the sternocleidomastoid can create a Bezold abscess, manifesting as neck swelling, torticollis, and systemic toxicity. Though uncommon, it exemplifies the need to examine the neck and mastoid region in children with severe AOM symptoms.

7. Intracranial Complications

Intracranial complications are rare but carry high stakes. Reviews of otitis media complications emphasize prompt diagnosis and multidisciplinary management. [5, 10] Contemporary observational studies of pediatric mastoiditis report meaningful proportions of intracranial complications among referred hospitalized cases, underscoring that while rare in the community, they are concentrated among severe presentations. [14]

7.1. Meningitis

Otogenic meningitis may occur via direct extension or hematogenous spread. Symptoms include severe headache (if age-appropriate), photophobia, neck stiffness, altered mental status, or seizures. In infants, signs may be nonspecific (poor feeding, lethargy, bulging fontanelle). Any concern warrants urgent emergency evaluation, blood cultures, and lumbar puncture when safe, with empiric IV antibiotics.

7.2. Intracranial Abscess and Empyema

Temporal lobe or cerebellar abscess can result from contiguous spread; subdural empyema may occur as well. Warning signs include persistent fever, focal neurological deficits, seizures, papilledema, or failure to improve despite treatment. MRI with contrast is often preferred for detection and surgical planning.

7.3. Cerebral Venous Sinus Thrombosis (Sigmoid/Transverse Sinus Thrombosis)

Otogenic venous sinus thrombosis is a classic and still-relevant complication, often linked to mastoiditis. Children may present with severe headache, vomiting, papilledema, cranial nerve palsies, persistent fever, or signs of raised intracranial pressure. Recent literature continues to discuss the balance of surgery, antibiotics, and anticoagulation; pediatric series suggest anticoagulants can be used safely when carefully selected and monitored, potentially preventing thrombus propagation. [15, 16]

Diagnosis: MR venography or CT venography.

Management principles: IV antibiotics, source control (myringotomy ± mastoidectomy as indicated), neurology/neurosurgery input, and individualized anticoagulation decisions. [15, 16]

8. Diagnostic Approach and „Red Flags” in Clinical Practice

8.1. When AOM Is Likely Uncomplicated

Primary care guidelines emphasize strict diagnostic criteria based on otoscopic findings – especially moderate-to-severe TM bulging or new-onset otorrhea not due to otitis externa – because overdiagnosis leads to overtreatment.[3] A child who is improving within 48–72 hours, has no postauricular findings, and lacks neurological symptoms is unlikely to have a serious complication.

8.2 Red Flags Suggesting Complication or Alternative Diagnosis

Urgent evaluation (often ED/ENT) is warranted for:

- Postauricular swelling, erythema, tenderness, or pinna displacement (mastoiditis/subperiosteal abscess). [6, 10]

- Persistent high fever, systemic toxicity, or worsening pain after 48–72 hours. [3, 4]
- Cranial nerve deficits (facial weakness, diplopia), severe headache, meningismus, altered mental status, seizures, or vomiting suggestive of intracranial involvement. [5, 14]
- Vertigo, nystagmus, or sudden hearing deterioration (labyrinthitis/inner ear involvement).
- Suspected immunodeficiency, cochlear implant, or craniofacial anomaly – lower threshold for referral.

9. Management Principles Across Complications

9.1. Antibiotic Stewardship vs. Early Treatment in High-Risk Cases

Evidence reviews find antibiotics provide modest symptomatic benefit for many children with AOM and limited evidence regarding prevention of rare complications due to low event rates. [17, 18] Observational data suggest antibiotics may reduce the risk of serious sequelae, but with very high numbers needed to treat. [9] This supports guideline approaches: treat children at higher risk or with severe illness promptly, while using watchful waiting when appropriate and follow-up is reliable. [3, 4]

9.2. Source Control and Surgery

Once complications occur, „source control” becomes central:

- Myringotomy ± tympanostomy tube can decompress the middle ear, obtain culture, and improve drainage in severe cases.
- Mastoidectomy is considered for coalescent mastoiditis, subperiosteal abscess, or failure of medical therapy.[6,10]
- Neurosurgical drainage may be needed for abscess or empyema.

9.3. Imaging Strategy

- **No imaging** for routine uncomplicated AOM.
- **CT temporal bone:** useful for bony mastoid disease, coalescence, abscess localization.
- **MRI/MRV:** best for intracranial infection, dural enhancement, brain abscess, and venous sinus thrombosis.[15,16]



10. Prevention and Public Health Considerations

Prevention operates at multiple levels:

- **Vaccination:** Pneumococcal conjugate vaccines have altered AOM ecology; studies suggest reductions in pneumococcal mastoiditis in young children after PCV13 introduction, though overall mastoiditis trends can vary by region and pathogen replacement. [8, 19]
- **Accurate diagnosis:** Stricter otoscopic criteria reduce unnecessary antibiotics and focus treatment on true bacterial AOM. [3]
- **Follow-up and safety-netting:** Clear return precautions for worsening pain, swelling behind the ear, persistent fever, neurologic symptoms, or poor intake can prevent delayed diagnosis of complications. [4]
- **Address risk factors:** smoke exposure reduction, breastfeeding support, and minimizing

unnecessary daycare exposure when feasible can modestly reduce AOM incidence. [2]

11. Conclusion

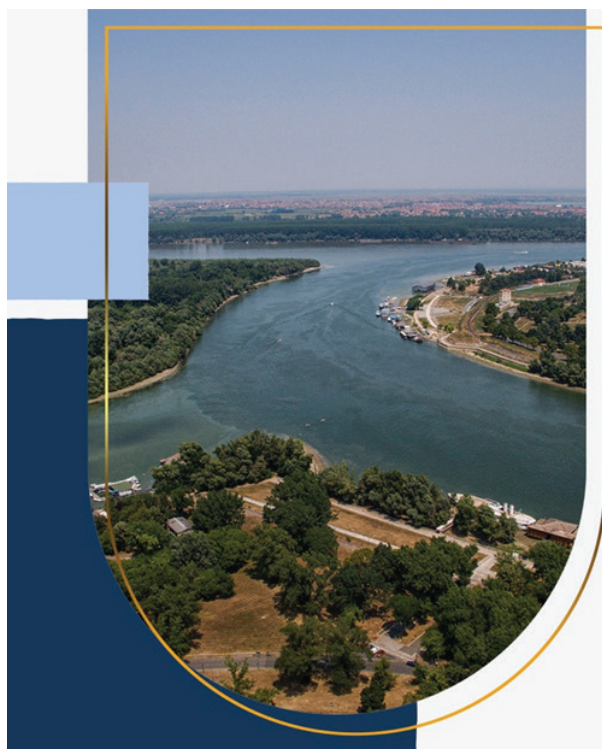
Complications of AOM in children are uncommon but clinically significant. Acute mastoiditis remains the most frequent serious suppurative complication and a gateway diagnosis because it can precede intracranial spread. Facial nerve palsy, labyrinthitis, meningitis, intracranial abscess, and venous sinus thrombosis represent high-acuity outcomes requiring prompt recognition, imaging when indicated, and multidisciplinary management. In practice, the goal is to balance antibiotic stewardship with early treatment of severe disease, anchored by accurate otoscopic diagnosis and robust safety-netting. Ongoing shifts in pathogen ecology in the conjugate vaccine era and the continued presence of rare but severe complications justify sustained clinical vigilance.

Table-Summary. Complications of Acute Otitis Media in the Pediatric Population

Category	Complication	Pathophysiology	Key Clinical Features	Diagnostic Approach	Management Principles
Intratemporal	Tympanic membrane perforation	Increased middle-ear pressure leads to rupture of TM	Sudden otorrhea, transient pain relief, conductive hearing loss	Otoscopy	Antibiotics if symptomatic; most heal spontaneously
Intratemporal	Acute mastoiditis	Spread of infection to mastoid air cells with bony erosion	Postauricular pain, swelling, erythema, auricular protrusion, fever	Clinical exam; CT temporal bone	Hospitalization, IV antibiotics, myringotomy ± mastoidectomy
Intratemporal	Subperiosteal abscess	Cortical bone erosion with pus collection	Fluctuant postauricular mass, ear displacement	CT temporal bone	Surgical drainage and IV antibiotics
Intratemporal	Facial nerve palsy	Inflammatory edema or ischemia of facial nerve	Facial asymmetry, inability to close eye	Clinical exam; imaging if severe	IV antibiotics ± corticosteroids
Intratemporal	Labyrinthitis	Extension of infection to inner ear	Vertigo, nystagmus, nausea, hearing loss	Clinical assessment; MRI if uncertain	IV antibiotics; vestibular support
Intracranial	Meningitis	Direct extension or hematogenous spread	Headache, neck stiffness, seizures	Lumbar puncture; MRI/CT	IV antibiotics, ICU care
Intracranial	Venous sinus thrombosis	Septic thrombophlebitis from mastoid veins	Severe headache, papilledema	MR or CT venography	IV antibiotics ± anticoagulation

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