Chronic Otitis Media in Children: An Evidence-Based Guide for Diagnosis and Management

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Abstract

Aim: To provide an easy-to-follow evidence-based diagnostic and therapeutic algorithm for the management of chronic otitis media (COM) in children. **Materials/Methods**: Literature review and critical analysis of the available evidence in Medline and other scientific database sources. **Data synthesis**: Otorrhea and hearing loss are the cardinal symptoms of COM, while oto-microscopy and imaging techniques can confirm the diagnosis. Conservative treatment is acceptable to some extent (i.e. mild cases of COM without cholesteatoma). It involves topical drops (quinolones as first choice drugs- strength of recommendation B), as well as performing aural toilet (strength of recommendation B), and avoiding water ingress. Tympanoplasty without mastoidectomy is expected to improve hearing in cases of non-cholesteatomatous COM (strength of recommendation C), and positively affect the children's quality of life (strength of recommendation B). Less experienced surgeons and inflamed, wet middle ear mucosa represent the two most important factors, which could lead to reperforations (strength of recommendation C). The surgical management of COM with cholesteatoma tends to employ the least invasive surgical technique, in order to obtain a small self-cleaning mastoid cavity, as well as good hearing results (strength of recommendation C). **Conclusion**: The treatment of choice in most cases of pediatric COM is surgery. Figure 1 proposes a detailed and easy-to-follow evidence-based algorithm with regard to the diagnosis and management of COM in children.

Keywords

children, pediatric, ear, chronic otitis media, otorrhea, hearing loss, cholesteatoma, tympanoplasty

Introduction

Chronic otitis media (COM) is a common disease in childhood and, in case of improper or undertreatment, may cause severe complications, which can seriously affect the child's quality of life. Indeed, communities with more than 4% of the children affected by chronic tympanic membrane (TM) perforation can be considered as having a major public health problem (high-risk populations).[1] In addition, a high rate of chronic TM perforation occurs among indigenous children and is estimated to be as high as 80% in some countries. Reduced access to medical care, lower socioeconomic status, and remote living conditions mean that the levels of early childhood hearing loss associated with COM may be underestimated. This may have implications for early childhood speech and language development and education.[2]

COM comprises a spectrum of pathologies; hence the diagnosis is often difficult, and the various methods of management do not apply to all children or remain a matter of debate. The aim of the present article is to provide an easy-to-follow, evidence-based diagnostic and therapeutic algorithm for the management of COM in children.

Definition

Chronic otitis media is the term used to describe a variety of signs, symptoms, and physical findings that usually result from long-term damage to the middle ear by

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Table 1. Complications of Chronic Otitis Media.

Intratemporal	Mastoiditis
	Labyrinthitis
	Petrositis
	Facial nerve palsy
Intracranial	Meningitis
	Sigmoid sinus thrombosis
	Intracranial hypertension
	Abscess (extradural, parenchymal)

infection and inflammation. These include a combination of the following:

1. Perforation of the TM
2. Retraction pocket in the TM
3. Atelectasis (the TM is attached to one of the walls of the middle ear)
4. Ossicular erosion in the middle ear
5. Chronic or recurring discharge from the middle ear (otorrhea)
6. Middle-ear mucosal disease (granulations)
7. Cholesteatoma (the presence of keratinized squamous epithelium in the middle ear)

In addition, COM can be divided into 2 main categories; active, when the ear demonstrates active inflammation, and there is a purulent discharge, and inactive, when there is no otorrhea, although this may happen at any time.[3-5]

In the majority of cases, COM is associated with a permanent perforation of the TM. This perforation can be either in the superior (pars flaccida) or in the inferior part (pars tensa) and central (when all margins of the perforation are within the TM) or peripheral (when at least 1 of the margins of the perforation involves the ear canal wall).

The inflammation may not only affect the mucosa of the middle ear but can also erode the ossicular chain, with a serious impact on the child's hearing. It is also worth considering that the inflammation can go beyond the middle ear and cause severe or even life-threatening complications (Table 1). Therefore, in addition to ENT surgeons, general practitioners, pediatricians, neurosurgeons, and other medical specialties may be involved in the management of COM. Pediatricians and general practitioners are usually the physicians who first examine children with COM and have the overall responsibility for their care.

Etiology

The etiology of COM remains unclear, although Eustachian tube dysfunction is supposed to be the underlying mechanism.[6] However, this is not yet well documented.[7,8] In addition, and especially in active COM, bacteria and/or viruses may play a significant role.[9]

The 2 main aerobic bacteria isolated in COM are *Pseudomonas aeruginosa* and *Staphylococcus aureus*. However, *Proteus* species, *Escherichia coli*, or *Klebsiella* species may also be found. In addition, active COM can also be caused by anaerobic bacteria, including *Bacteroides* or *Fusobacterium*. Finally, fungi (*Aspergillus* spp and *Candida* spp) may be isolated in some cases, especially in immunosuppressive patients or following overtreatment with steroid-containing antibiotic drops. It is well known that the bacteria associated with CSOM differ substantially from those found in acute otitis media, which is usually caused by *Streptococcus pneumoniae, Haemophilus influenzae, Moraxella catarrhalis*, or viruses (eg, respiratory syncytial virus).[10,11]

Other contributing factors to COM include genetic predisposition; gender (male predominance); congenital midfacial anomalies; Down syndrome; cleft palate; perinatal factors (ie, precocity and lack of breastfeeding); environmental factors (more common in the winter); recurrent acute otitis media, especially when the episodes occur early in life; low socioeconomic status; smoking; allergic rhinitis; nasopharyngeal diseases (ie, adenoid hypertrophy and tumors); sinusitis; immunodeficiency (primary or acquired); barotrauma; gastroesophageal reflux; and so on.[12-16]

Symptoms

Two are the most common symptoms in COM; otorrhea (intermittent or continuous) and hearing loss. As a general rule (but in no way an absolute one), in mild cases, the otorrhea is profuse but mucousy. In more severe cases, the otorrhea is usually in small amounts but purulent, with an unpleasant odor, and sometimes combined with otalgia. The latter may represent a secondary otitis externa or a complication. Of course, a serious complication may also present with very mild symptoms from the middle ear and vice versa. Discharge may not be present for a long time, but the disease may reappear following water ingress in the ear (ie, swimming and showering) or a bout of rhinitis or rhinopharyngitis. Polyps may also be present during otoscopy and may conceal a more serious pathology (eg, cholesteatoma).

The patient may also present with conductive hearing loss as a result of the TM perforation. This is usually mild. However, in cases of ossicular erosion, the hearing loss may be moderate to severe and reach 50 to 70 dB and become permanent. The latter highlights the importance of early and timely diagnosis and management because late or inadequate treatment, especially in bilateral cases, may affect the ability of speech in a young child and be associated with cognitive/communication disorders and deterioration in his/her quality of life.[17-20]

Table 2. Levels of Evidence Regarding the Primary Research Question in Studies That Investigate the Results of a Treatment (http://www.cebm.net/index.aspx?o=1025).

Category of Evidence	Study Design
Level I	• High-quality randomized trial with statistically significant difference or no statistically significant difference but narrow confidence intervals
	• Systematic review of level I randomized control trials (and study results were homogeneous)
Level II	• Lesser-quality randomized control trial (eg, <80% follow-up, no blinding, or improper randomization)
	• Prospective comparative study
	• Systematic review of level II studies or level I studies with inconsistent results
Level III	• Case control study
	• Retrospective comparative study
	• Systematic review of level III studies
Level IV	• Case series
Level V	• Expert opinion

Diagnosis

The diagnosis of COM is based on past medical history, the clinical examination and follow-up, and the CT scan findings. Previous history of middle-ear disease and surgical interventions should be recorded. COM may be incidentally diagnosed in asymptomatic patients in some cases; however, the main symptoms are otorrhea and hearing impairment (as previously described). In addition, the patient may complain of otalgia, nasal congestion, or upper-respiratory tract infection. In the presence of cholesteatoma, the otorrhea is usually "smelly" and may contain blood. Other more serious symptoms or signs may suggest the presence of a complication (ie, headache, nystagmus, vertigo, sensorineural hearing loss, facial nerve palsy, signs of meningitis, mastoid protrusion, or central nervous system disorders).

Otoscopy with the assistance of a microscope (otomicroscopy) should always be performed, and a meticulous "microsuctioning" or debridement is mandatory. This may allow a better view of the TM perforation or retraction and also visualization of possible ossicular lesions, polyps, cholesteatoma, granulation tissue, or mucosal edema. Examination of the nose and the nasophraynx may reveal signs of rhinitis, adenoid hypertrophy, or adenoiditis. The tympanogram is usually type B (with a large ear canal volume), and audiometric evaluation, including Weber and Rinne tests, is necessary in older children, and may reveal a conductive, or in some cases mixed, hearing loss.[21,22]

High-resolution CT imaging of the temporal bone (slices less than 1 mm in thickness) may provide important information regarding the status of the middle ear and the surrounding structures, the ossicles, and the presence of cholesteatoma or granulation as well as possible intratemporal or intracranial complications. The latter usually give alarming clinical signs[23] even before the imaging findings, although this may not always be the case. However, the reliability of a CT scan is sometimes questionable because it may overestimate or underestimate the middle-ear status in patients with COM.[24] New MRI techniques may have better reliability in the differential diagnosis of COM with and without cholesteatoma and assess the related complications better.[25-27]

Management

Appropriate COM management aims to provide symptomatic relief, dry ear, hearing restoration (if possible), and above all a "safe ear" (a ear with a low risk of complications).

Conservative treatment involves topical drops, preferably quinolones with or without steroids, because these constitute the only nonototoxic antibiotic drops, as well as avoiding water ingress. Indeed, there is good evidence (evidence-based medicine [EBM] I and II) that quinolones are better than other otic antibiotic drops and other oral antibiotics in terms of the overall cure rate, and they are well tolerated.[28-33] Drawing on the evidence, because the study population in most of these studies included adults as well as children, the strength of the respective recommendation is B (Tables 2-4). Performing aural toilet may also significantly increase the proportion of improved ears (EBM II, strength of recommendation B).[34]

Other antibiotic drops, such as aminoglycosides, and antiseptics, such as alcohol vorique, may be very effective in achieving a dry ear but have the potential complication of ototoxicity. However, this is considered to be very rare in cases of middle-ear inflammation because at least aminoglycosides may not be able to penetrate the inner ear through the oval or round windows when infection is present.[36-39]

Another important parameter, which is not usually taken into account by general practitioners and pediatricians, is the

Table 3. Strength of Recommendation by Category of Evidence for Guideline Development.[35]

Strength of Recommendation	Category of Evidence
A	Directly based on category I evidence
B	Directly based on category II evidence or extrapolated recommendation from category I evidence
C	Directly based on category III evidence or extrapolated recommendation from category I or II evidence
D	Directly based on category IV evidence or extrapolated recommendation from category I, II, or III evidence

Table 4. Treatment of Children With Chronic Otitis Media.[a]

Statement Involving the Treatment Pathway	Category of Evidence	Strength of Recommendation
1. Aural toilet may significantly increase the proportion of improved ears in children with chronic otitis media	II	B
2. Quinolones are better than other otic antibiotic drops and other oral antibiotics in the overall cure rate of children with chronic otitis media	I and II	B
3. Tympanoplasty without mastoidectomy is expected to positively affect the child's quality of life in cases of noncholesteatomatous chronic otitis media	II	B
4. Tympanoplasty without mastoidectomy is expected to improve hearing in children with noncholesteatomatous chronic otitis media	III	C
5. Less-experienced surgeons and inflamed, wet middle-ear mucosa during the primary surgery are the 2 most important factors for reperforation in children with noncholesteatomatous chronic otitis media	III	C
6. Less-invasive surgical techniques are used in children with cholesteatomatous chronic otitis media to obtain a small self-cleaning mastoid cavity as well as good hearing results	III	C

[a]See also Figure 1.

fact that any resistance found in isolates from the middle-ear discharge may not always reflect the actual potential of the related antibiotic drops because these contain high concentrations of the antibiotic, which acts directly in the infected area and is not distributed through the blood stream. Hence, quinolone resistance in a culture result does not necessarily mean that it will be ineffective when given as ear drops.[36]

Systemic treatment is rarely necessary because of the rather limited concentration in the middle-ear cleft in comparison to drops, whereas oral or intravenous quinolones are generally contraindicated in children.[40] However, in persistent cases, ceftazidime and aminoglycosides (for short-term treatment and with close follow-up for nephrotoxicity and ototoxicity) may be used intravenously to treat the discharge in the ear.[10,33,41-43]

The aforementioned conservative treatment is sufficient to drain the ear for short or longer periods of time in many cases, giving the opportunity for further investigation with a CT scan (as a first choice in current clinical practice) if the otorrhea is persisting or there appears to be mucosal pathology, aural polyps, or suspicion of cholesteatoma during the otomicroscopic examination (algorithm, Figure 1). In contrast, when clean and healthy middle-ear mucosa is seen through the perforation and there is no clinical suspicion of cholesteatoma, the option of surgical management (tympanoplasty without mastoidectomy),[44,45] with the related pros and cons, should be thoroughly discussed with the parents. This operation is expected to improve hearing in cases of noncholesteatomatous COM (EBM III, strength of recommendation C)[46] and positively affect the child's quality of life (EBM II, strength of recommendation B).[47] Less-experienced surgeons and inflamed, wet middle-ear mucosa during the primary surgery represent the 2 most important factors that could lead to surgical failure and reperforations (EBM III, strength of recommendation C).[48] It is worth mentioning that many surgeons take the status of the contralateral ear and its Eustachian tube function, as well as the age of the child into consideration, before recommending a surgical intervention.

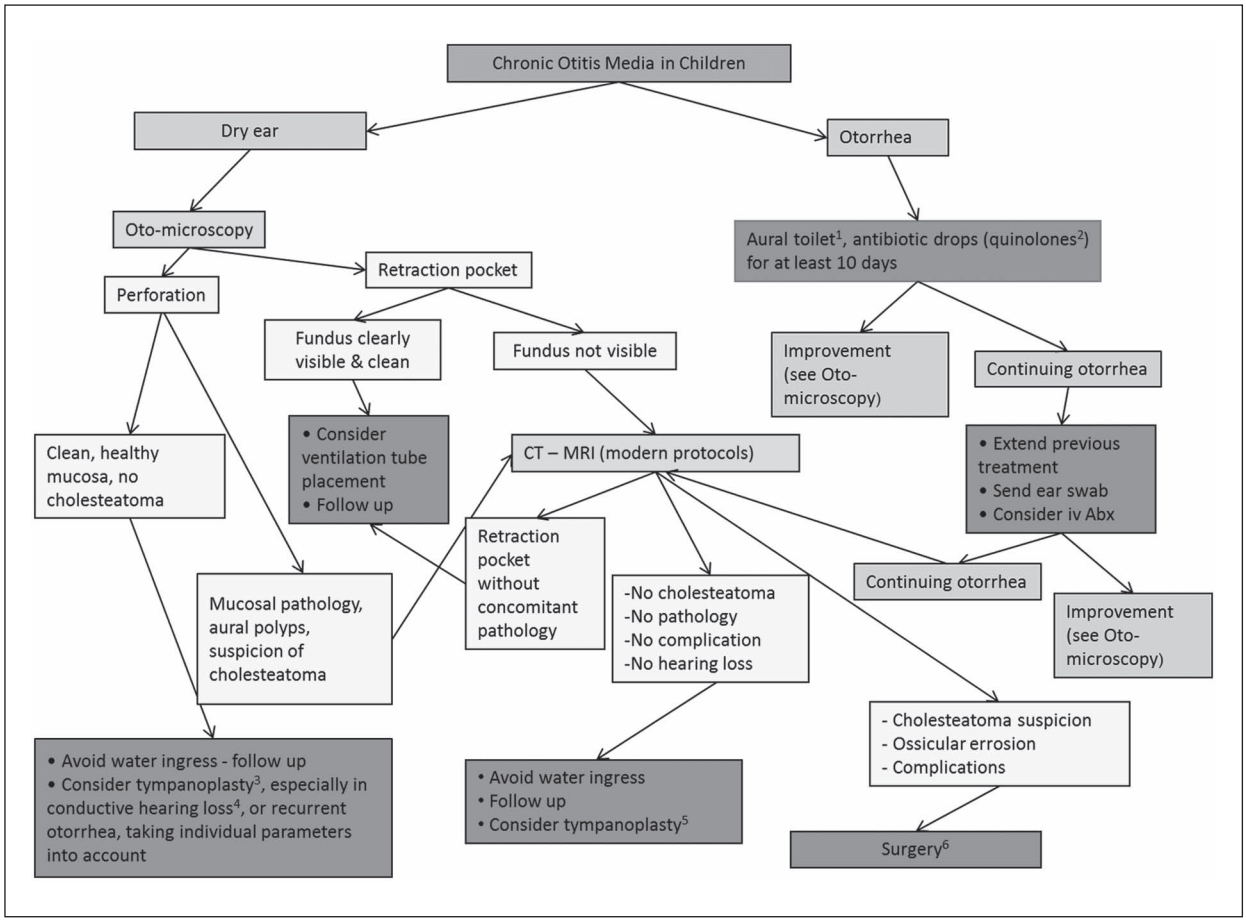

Figure 1. Diagnostic and treatment algorithm for children with chronic otitis media (please refer also to Table 4 regarding the available evidence).

A more conservative surgical approach seems to be warranted in the presence of TM retraction pockets. Although specific evidence from randomized clinical trials are lacking, when the fundus of the retraction pocket is visible and clean, tympanostomy tube placement and regular follow-up should be attempted. Middle-ear imaging should be considered in deeper retraction pockets when there is uncertainty about the condition of the fundus.

The surgical management of COM with cholesteatoma aims to eradicate the middle-ear pathology, create a "safe ear" with a low risk of future complications, improve the ventilation of the middle ear and mastoid cavity, and restore the perforation of TM and the hearing mechanism, if possible.

The operations vary according to the disease, the patient, the center, and the surgeon (ie, ear canal wall up vs ear canal wall down mastoidectomy, atticotomy, etc) and may be followed by a tympanoplasty even during the first operation, in an attempt to restore or improve hearing.[46,49,50] There is a trend to use the less-invasive surgical technique in children (ie, ear canal wall up mastoidectomy or atticotomy with limited mastoidectomy), trying to obtain a small self-cleaning mastoid cavity as well as good hearing results (EBM III, strength of recommendation C).[51] However, the cholesteatoma may be more aggressive in children, and residual or recurrent disease may not be rare; thus sometimes necessitating more radical or several reoperations.[52-59]

Even though all these parameters should be taken into account and discussed with parents and children during the treatment plan, performing an operation in cases of cholesteatoma is ultimately necessary and should even be considered as urgent when complications arise or are likely to occur.

Conclusion

COM may be more aggressive in children and seriously affect their quality of life. However, it may present with

minimal long-standing symptomatology until permanent hearing loss or complications appear. Clinicians have a great responsibility regarding diagnosis and treatment. Figure 1 provides a detailed and easy-to-follow algorithm with regard to the diagnosis and management of COM. Otorrhea and hearing loss are the cardinal symptoms of the disease, and otomicroscopy and imaging techniques may contribute to the differential diagnosis. Conservative treatment is acceptable to some extent, especially in mild cases of COM without cholesteatoma, and provided that this practice achieves a dry ear, with good hearing, and without complications. However, the treatment of choice in most cases of pediatric COM, especially in the presence of cholesteatoma, is surgery. Contemporary surgical techniques aim to achieve a dry ear, improve the hearing of the young patients if possible, and reduce the risk of complications and recurrence.

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Authors' Note

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