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Chronic suppurative otitis media – comorbidities, management and return to sports activities

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Abstract

Chronic suppurative otitis media (CSOM) remains a significant clinical challenge in otorhinolaryngology, characterized by prolonged inflammation of the middle ear and mastoid space, accompanied by a perforated tympanic membrane and persistent discharge for a minimum of two weeks. Despite its often viral origin, bacterial colonization is common, with frequent involvement of pathogens such as Pseudomonas aeruginosa, Staphylococcus aureus and Klebsiella pneumoniae. CSOM affects over 300 million individuals worldwide, primarily in low socio-economic communities, and is prevalent among children due to acute otitis media (AOM) or congenital disorders. In adults, it is often associated with conditions such as cholesteatoma or polyps. Approximately 60% of CSOM patients suffer from conductive

hearing loss, which can impair speech development in children. This review discusses the etiological factors, associated complications, and treatment options for CSOM, emphasizing the importance of accurate diagnosis and comprehensive management, including potential surgical interventions. The persistent and recurrent nature of AOM, anatomical abnormalities, presence of polyps, primary ciliary dyskinesia, and cholesteatoma are highlighted as significant contributors to the development and perpetuation of CSOM. To complete discussion, there is a brief review of management in recovery after elaborated conditions with special regards to returning to physical activities.

Key words: chronic suppurative otitis media; acute otitis media; cholesteatoma; primary ciliary dyskinesia; sports activities;

1. Introduction and purpose

Chronic suppurative otitis media (CSOM) still has its place as a complex problem in the otorhinolarygology, describing inflammation of the middle ear and mastoid space with perforated tympanic membrane and secreting discharge, lasting 2 weeks minimum (1). Despite viral etiology, the bacterial multicolonization is frequent, including Pseudomonas aeruginosa, Staphylococcus aureus (also methicillin- resistant), Klebsiella pneumoniae, Proteus spp and Fusobacterium spp (2, 3). Sometimes, especially in immunocopromised patients, Candida spp or Aspergillus spp can be found (3). This condition has a prevalence of more than 300 milion cases worldwide and most of them occur in low socio-economic status communities (4, 5). It is common mainly in the pediatric population as a sequent of acute otitis media or the congenital disorders, but it can also appear in adulthood, mostly with the comorbidities such as cholesteatoma or polyps. They are either the causes, the consequences or just the risk factors, but certainly they must be diagnosed to provide the patient with

appropriate therapy, which should include both symptomatic and causal treatment, surgical as well (1).

Approximately 60% of patients with CSOM is affected by conductive hearing loss and when it comes to children, one of the consequences is speech impaired development. Therefore, there is still a need for remiding and analysing possible causes of CSOM, related problems and proper solutions, which are briefly listed and described in this review.

2.1. Acute otitis media

CSOM is most frequently a result of recurring or persistant acute otitis media (AOM). The most affected group of patients are infants and children, where almost 40% of them can experience at least 6 AOM to the age of seven and the prevalence is still increasing (6-8). Patients with allergic rhinitis are also more prone to develop AOM and other types of otitis media (9). One of the reasons is the anatomy of childrens' Eustachian tubes - steeper angled and shorter, differing them from the adults' ones and easily transmitting the pathogenes from external to middle ear (7).

The bacterial etiology involves Streptococcus pneumoniae, Moraxella catarrhalis and Haemofilus influenzae, which is different from CSOM. The pathogens in the middle ear area cause epithelium damage and decreased local blood flow, allowing other pathogens to colonize locally and altering effect of medicines (10).

It develops rapidly and is charactized by symptoms typical for inflammation: fever, pain, purulent otorrhea, balance disturbances and hearing deficit (11). After they first appear, it is recommended to wait 48 hours before any action that requires more than analgesics and anti-inflammatories. In case of no improvement, first-line antibiotic is amoxicillin, 80-90 mg/kg/day in two divided doses for 5-7 days (7). It cannot be topical antibiotic because of not reaching the middle ear through the membrane. AOM can recur in 15-30 days or it can cause tympanic membrane rupture, which surely predisposes to CSOM due to chronic irritation and inflammation. In this situation, the antibiotic therapy must be continued or repeated and should match the antibiogram to prevent further development (11). Quinolones, ceftazidime, vancomycin, trimethoprim-sulfamethoxazole, imipenem and aztreonam seem to be the most effective substances in resistant colonies (10, 12). In patients with serious complications, such as cerebral thrombosis, cerebral abscess, meningitis or facial nerve palsy, the

tympanomastoidectomy has to be taken into consideration, sometimes being a life-threatening act (6, 10, 13).

Additionally, in this place it should be also mentioned that ventilation tube placement, as a treatment to otitis media with effusion (OME), can also lead to inflammation due to colonization of discharge and then recurrent otitis media with similar consequences as AOM (6, 14).

2.2. Anatomical abnormalities

In many cases of CSOM where the root of the problem is difficult to identify, it appears to lay in the anatomy. The Eustachian tube is the key element there, because its improper alignment leads to dysfunction and has an impact on middle ear (5). Despite congenital anomalies, adenoid hypertrophy or sinusitis are prevalent reasons of its obstruction (15). Furthermore, microenvironment in this location changes due to easier access of pathogens normally not present in the middle ear but in the nasopharynx, where they are transmitted from during regurgitation as a result of improper opening of the Eustachian tube (10, 16). This process is very often in midface abnormalities and the most common examples are cleft palate (CP), submucous as well (SMCP), Down's syndrome and other anomalies leading to weakening of the soft palate muscles and velopharyngeal insufficiency (15). Approximately 1:1000 newborns has a CP and 1:1250 to 1:6000 – SMCP (16, 17). Moreover, SMCP can be nonsyndromic (it is diagnosed among the age of 3), with noticeable for the patient only the results of OME or CSOM, more frequent in SMCP than CP, and that is why it is important to detect (16, 18).

Treatment includes antibiotics, glucocorticosteroids and ventilation tube insertion – as a symptomatic therapy, similarly as in every other case of CSOM. In addition, depending on etiology, there can be necessity of performing surgery to take action causally, especially in CP and SMCP, when it solves many coexisting effects of one anomaly. The operations possible to consider are posterior pharyngeal flap, double opposing z-palatoplasty and radical intravelar veloplasty (19).

2.3. Polyps

Some data indicate that the development of otitis media with effusion may be considered as an additional indicator of the severity of the inflammatory disease that leads to nasal polyposis (NP)(20). Older subjects (≥50 years) with chronic rhinosinusitis with nasal polyps are more likely to have chronic otitis than the younger population, which doesn't show any signs of association (21). Patients with NP and otitis media with effusion disease who had undergone surgery (radical bilateral sphenoidectomy) have similar outcomes to patients without and should be treated similarly (22). A novel biological treatment, Dupilumab, can potentially be a new treatment for otitis media with effusion in patients with asthma with nasal polyps (23), but further analysis is needed.

2.4. Primary ciliary dyskinesia

Primary Ciliary Dyskinesia (PCD) is a genetic disease described by Kartagener in 1933 (24). It is characterized by ciliary dysfunction and results in various clinical conditions, including chronic otitis media, chronic sinusitis, chronic bronchitis, and infertility (25). Recurrent acute otitis media was significantly more common in patients in the central complex group than in the outer (ODA) and inner (15) groups, with no significant differences between the ODA and IDA groups. The CC group had a higher incidence of repeated tympanostomy tube placement, tympanostomy tube-induced otorrhoea, and recurrent otorrhoea. The CC group included the two patients with a retraction pocket or cholesteatoma (26). Sommer et al. showed that 81% of children with PCD had a history of recurrent otitis media, and as many as 38% of patients required more than 30 antibiotic treatments in their lifetime (27). Middle ear disease in PCD remained severe throughout childhood and did not improve until after the age of 18, despite continuous antibiotic therapy (26). Tympanostomy tube insertion is the first step in treatment in patients with PCD, and all patients with grommets developed at least one episode of otorrhea. Some of them had tympanic perforation and then required tympanoplasty (26). One of the novel potential methods used for screening PCD can be Temporal bone CT-based deep learning models, such as the Google net-trained model, which has an accuracy of 0.99 (28).

2.5. Cholesteatoma

Cholesteatoma represents an aggressive form of chronic otitis media (COM) (29). A number of factors may give rise to cholesteatoma, with serous otitis media appearing to be the precursor in the majority of instances (30). It's essential to be aware that acquired cholesteatoma is most commonly found in patients with posterior and marginal perforation, followed by anterior perforation. Another risk factor for cholesteatoma formation is the adhesion of perforation edges. The eustachian tube also plays a vital role in the ventilation of the middle ear (31). Akarcay et al. found more ossicular chain erosions in chronic otitis media patients with cholesteatoma than in patients without cholesteatoma (32). In elderly patients, surgical treatment for chronic otitis media with and without cholesteatoma is safe and effective (33). Extracorporeal high hydrostatic pressure therapy autogenous ossicles could be employed for middle ear reconstructions even in the event of contact with the cholesteatoma matrix or infiltration by keratinized squamous cell epithelia (34). It has been demonstrated that the differentiation of COM with and without cholesteatoma with the aid of artificial intelligence modelling can be achieved with highly accurate diagnosis rates through the utilisation of CT images (29).

2.6. Return to sports activities after ear conditions

Sports, such as swimming, can cause inflammation of the external ear but normally do not affect the middle ear unless there is this perforation that we previously mentioned. Patients with acute otitis media should not return to swimming, diving, or air travel until tympanic mobility has returned to normal, as demonstrated by pneumatic otoscopy, to prevent superinfection and recurrent inflammation with difficulty in healing (35). In water as shallow as 4 ft, pressure changes can be great enough to rupture the eardrum (36). There is little or no benefit from preventive measures such as earplugs or ear drops when bathing or swimming (37). However, in case of the presence of ventilation tube, there is no need to avoiding water sports if they are surface. The underwater sports are safe with no prolonged exposure, nonetheless diving is still not recommended, especially in young athletes (38). The same applies to recovery after any surgical performance (cholesteatoma and polyps) or in presence

of anatomical abnormalities with possible impact on pressure in Eustachian tube. It includes avoiding strenuous exerises (e.x. intensive weight lifting) to prevent increased pressure and excessive bloodflow in nasopharynx and simply decrease the pain. Even seemingly non-invasive sports such as yoga must be considered individually due to excercises performed with inverting the body with head below the heart and hips (39). Therefore during returning to activities, it is recommended to have a continuous supervision of otorhinolaryngologist (40).

3. Conclusions

Chronic suppurative otitis media (CSOM) remains a pervasive and challenging condition, particularly affecting individuals in low socio-economic communities and children with recurring or persistent acute otitis media (AOM). The multifaceted etiology of CSOM, including bacterial and fungal pathogens, necessitates a comprehensive approach to diagnosis and treatment. Key factors contributing to CSOM include anatomical abnormalities, primary ciliary dyskinesia, nasal polyps, and cholesteatoma. Effective management of CSOM requires a dual approach that addresses both symptomatic relief and underlying causes. Antibiotic therapy remains a cornerstone of treatment, tailored to the specific pathogens involved, while surgical interventions are essential in cases of anatomical abnormalities or severe complications. The prevalence of conductive hearing loss among CSOM patients underscores the importance of timely and accurate treatment to prevent long-term consequences such as impaired speech development in children. Advancements in diagnostic techniques, including the use of artificial intelligence and deep learning models, show promise in improving the accuracy of CSOM diagnosis and the differentiation of related conditions. Continued research and development of novel therapies, including biological treatments, are crucial for enhancing patient outcomes. It is important to consult the exercises and individual conditions with a specialist during recovering after otitis media, ear surgeries or if there is any anatomical abnormality in nasopharyngeal area, to prevent another infection, barotrauma or even hearing loss. In summary, addressing the complex interplay of factors leading to CSOM, along with a commitment to advancing diagnostic and therapeutic strategies, is essential for reducing the global burden of this condition and improving the quality of life for affected individuals.

Author's contribution

Conceptualization, JO, and WK; methodology, WM, BK, and MS; software, DB, ZC, WK, JO and BK; check, WM and MS; formal analysis, MP, BK, JO, WK and DB; investigation, ZC and BR; resources, WM and BR; data curation, JO and ZC; writing - rough preparation, WM, WK, BK, MP, BR and JO; writing - review and editing, WK, BR, JO, MP, BK, ZC and DB; visualization, MS and DB; supervision, WK and MS; project administration, MP and BR; All authors have read and agreed with the published version of the manuscript.

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