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Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review

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ABSTRACT

Chronic suppurative Otitis Media (CSOM) is inflammation of the middle ear mucosa and mastoid space that lasts more than 2 months characterized by perforation of the tympanic membrane and continuous or intermittent discharge from the ear canal. Secretion in the form of watery or thick clear or pus. CSOM with cholesteatoma is characterized by a perforation that is located marginally or can be tampered with the bone and often causes dangerous complications. CSOM is still a major health problem, especially in developing countries. The incidence of CSOM cases is estimated at more than 20 million people worldwide. Of these, approximately 5 million patients suffer from chronic otitis media with cholesteatoma, although the overall number of cases of chronic otitis media with cholesteatoma appears to be decreasing. The prevalence of CSOM worldwide is around 65-330 million people with complaints of watery ears, 60% of them (39-200 million) suffer from significant hearing loss. The incidence of chronic otitis media with cholesteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults.

1. Introduction

Chronic suppurative otitis media (CSOM) is inflammation of the middle ear mucosa and mastoid space that lasts more than 2 months characterized by perforation of the tympanic membrane and continuous or absent fluid discharge. arise from the ear canal. Secretion in the form of watery or thick clear or pus. CSOM with cholesteatoma is characterized by a perforation that is located marginally or can be tampered with the bone and often causes dangerous complications.[1,2] CSOM is still a major health problem, especially in developing countries. The incidence of CSOM cases is estimated at more than 20 million people worldwide. Of these, approximately 5 million patients suffer from chronic otitis media with cholesteatoma, although the overall number of cases of chronic otitis media with cholesteatoma appears to be decreasing. The prevalence of CSOM worldwide is around 65-330 million people with complaints of watery ears, 60% of them (39-200 million) suffer from significant hearing loss. The incidence of chronic otitis media with cholesteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults. In the male sex more in women with a ratio of 1.4:1. In young adults, chronic otitis media with cholesteatoma is more common than in patients aged 50 years or older. The Caucasian race is a race that has a high prevalence of chronic otitis media with cholesteatoma.[3-5]

The study by Mahadevan et al. (2012) reported the prevalence of CSOM in Indonesia at 5.4%, and in Thailand, Philippines, Malaysia, and Vietnam ranging from 2-4% compared to 0.01-0.03/1000 cases in America, Anggraeni R et al reported that 3.4% of 7005 children -Children suffer from CSOM in Indonesia.

Data from WHO states that Western Pacific countries have the highest prevalence (2.5% to 43%), followed by Southeast Asia (0.9% to 7.8%), Africa (0, 4% to 4.2%), South and Central America (3%), Eastern Mediterranean (1.4%), and finally Europe (average prevalence 0.4%). The results of the 2013 Basic Health Research in India showed ear morbidity in the form of otorrhoea as much as 2.4% and in the province of East Java by 2.7%. In 2017-2018 the number of CSOM patients at the Ear Nose Throat-Head Neck (ENT-KL) polyclinic at the Regional General Hospital (RSUD) Dr. Saiful Anwar, Malang was 267 and 46.4% were CSOM with cholesteatoma. The incidence of CSOM at Kariadi Hospital Semarang was found in 21% of cases from all visits to the otology clinic in 2010. Several studies reported that CSOM with cholesteatoma was often accompanied by the presence of granulation tissue. In Abdullah et al's study, it was found that 57% of the study population had cholesteatoma, 21% of the cholesteatoma population with granulation tissue, and 22% of the population without both. In Ghanie et al's study, at RSMH Palembang for the period April 2015- to 2018, there were 103 patients (40.87%) with cholesteatoma and granulation tissue patients, of which 99 patients (39.28%) with cholesteatoma, 42 patients (16.67%) with granulation tissue, and 8 patients (3.18%) without cholesteatoma and granulation tissue.[6-9]

Etiology of CSOM with Cholesteatoma

The incidence of chronic otitis media is influenced by multifactorial factors, including viral or bacterial infections of the upper respiratory tract, age, socioeconomic level, immunity, comorbidities such as diabetes mellitus, autoimmune disease, malignancy, and nutritional status. The cause of CSOM is usually polymicrobial (52.5%), where the most common pathogens are a mixture of *Proteus mirabili*s and *Klebsiella pneumoni*a (16.7%), while single microbial growth includes *Escherichia coli* and *Staphylococcus aureu*s. Overall, the most common bacteria found were Gram-negative bacteria (59.7%) and the least was *Candida albicans* (14.7%). Among Gram-negative bacteria, the most common was *Klebsiella pneumoniae* (33.8%), while among Gram-positive bacteria *Staphylococcus sp* (54.5%) was the most common. The cause of CSOM with cholesteatoma, which is mostly about 66%, is caused by the bacterium *Pseudomonas aeruginosa*. This is consistent with research conducted in Bandung, Shymala et al in India, and Iqbal et al in Pakistan. Risk factors can weaken the immune system and increase and promote infection. Risk factors for otitis media include mechanical obstruction of the Eustachian tube (e.g., sinusitis, adenoid hypertrophy, nasopharyngeal carcinoma), immunodeficiency, ciliary dysfunction, congenital midfacial anomalies (e.g., palatoschisis, Down's syndrome), and nasopharyngeal reflux. Other significant risk factors for CSOM include a history of recurrent AOM and parents with a history of CSOM. Allergies are also a risk factor because several studies have shown the presence of allergens that obstruct the Eustachian tube and nose. Recent studies have also demonstrated a genetic role in otitis media.[10-14]

Pathophysiology of Acquired Cholesteatoma (Acquired cholesteatoma)

Acquired cholesteatoma (*Acquired cholesteatoma)* is usually caused by dysfunction of the *eustachian tube*. Acquired cholesteatoma is different from congenital cholesteatoma, where acquired cholesteatoma is not present at birth. The theory of cholesteatoma obtained is explained by several theories, including the *retraction pocket* theory and the *non-retraction pocket theory*. Based on EAONO / JOS explains to establish the diagnosis of *acquired cholesteatoma* with clinical symptoms that can cause damage to surrounding structures or not with or without retraction or perforation of the tympanic membrane with or without otorrhoea, hearing loss or not, computer tomography or *MRI* where there is a mass showing cholesteatoma or destruction of the ossicles and mastoid. [15,16]

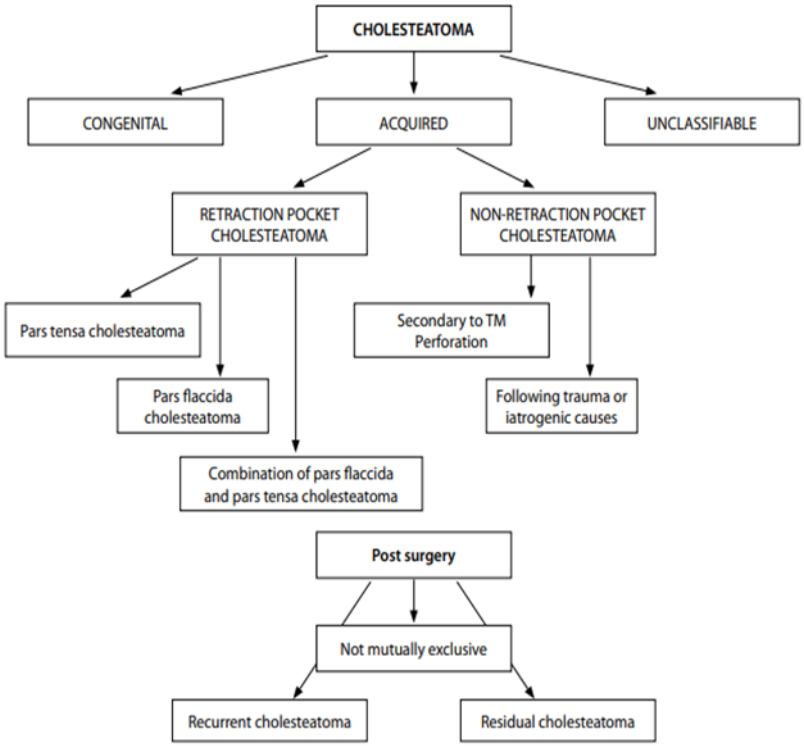

Figure 1. Classification schematic of cholesteatoma

The theory of retraction pocket in *acquired cholesteatoma* that occurs in dysfunction of the eustachian tube which causes a vacuum in the tympanic cavity, thus pulling a segment of the tympanic membrane (most often the pars flaccida) to form a pocket. The pars flaccida of the tympanic membrane is the most common site for cholesteatoma, due to its thinner layer than the pars tensa. Vacuum conditions in the middle ear can cause retraction of the tympanic membrane, but if this process is prolonged in the epitympanum, the aditus ad antrum will become blocked early in the course of the disease and will fill with mucus or inflammatory tissue (such as granulation). [17,18]

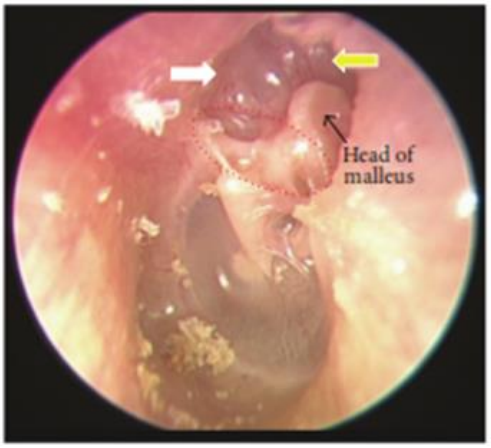

Figure 2. The white arrow shows retraction of the pocket at the tinker and the red circle indicates atelectasis in the Prussack space and the yellow arrow shows scutum erosion

The theory of Non-retraction pocket is referred to as *acquired cholesteatoma* secondary theories that explain the formation of cholesteatoma include the theory of migration, metaplasia, and basal cell hyperplasia. Migration theory occurs when the perforated tympanic membrane as the originator of the squamous epithelium in the tympanic membrane migrates to the middle ear area. As a result of trauma, the result of surgery or foreign bodies or iatrogenic factors can lead to the development of cholesteatoma. In the theory of squamous metaplasia, inflammation of the middle ear triggers the transformation of the mucous layer of the ear. This theory involves the change or transformation of a simple cuboidal into keratinized squamous epithelium as a result of recurrent chronic otitis media. In the hyperplasia theory, that is, keratinocyte basal cells are thought to proliferate and penetrate the basement membrane and extend along the *pseudopodia* into the subepithelial space. Although inflammation can trigger proliferation, there is no supporting evidence for what causes these basal cells to migrate medially rather than laterally.[19,20]

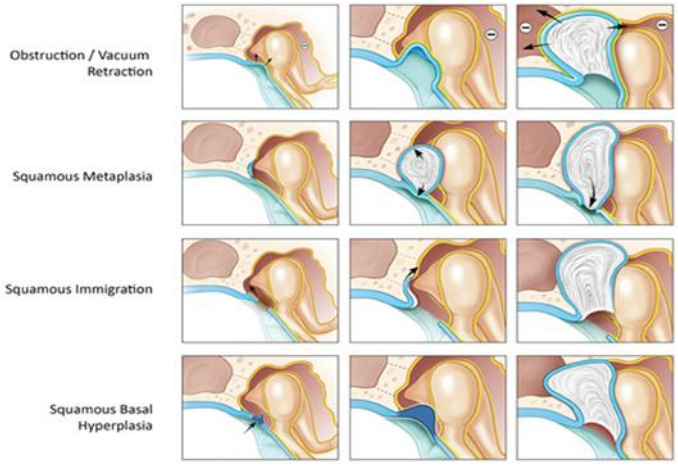

Figure 3. Acquired cholesteatoma formation

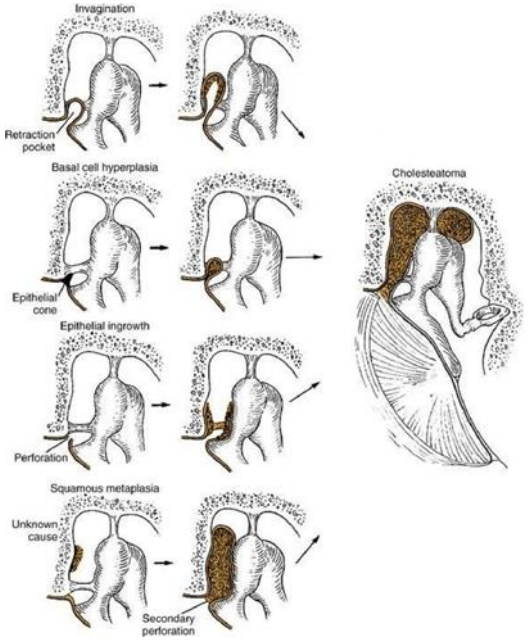

Figure 4. Pathogenesis of cholesteatoma formation

Classification CSOM

CSOM can be divided into two types, namely benign type CSOM (safe type) or commonly called tubotympanic type, involving the anterior inferior part of the middle ear cleft and associated with permanent central perforation. This type of CSOM does not cause serious complications. Malignant CSOM, also called atikoantral type or danger type involves the attic and posterosuperior areas of the middle ear cleft. In this type, perforation is attic or marginal in the posterosuperior quadrant. This type is associated with ossicular erosion due to cholesteatoma, granulation tissue, or osteitis. Complications that arise from malignant CSOM are quite dangerous, one of the complications of malignant CSOM is facial nerve paresis, due to the growth of tympanic cholesteatoma which is progressive, destructive, and is a hallmark of malignant CSOM.[21.22]

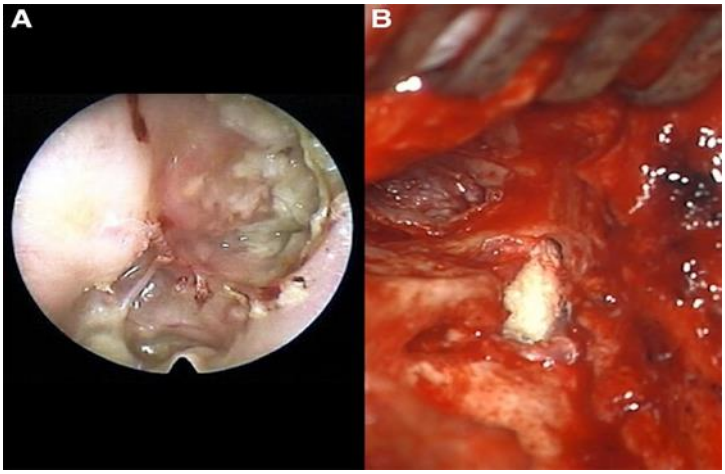

Figure 5. Cholesteatoma in the atic region and intraoperative cholesteatoma picture

Diagnosis of CSOM with cholesteatoma

The diagnosis of CSOM with cholesteatoma is based on history, physical examination, and investigations. Anamnesis to determine the onset of the disease, previous disease history, risk factors, and clinical symptoms. Clinical signs may be intermittent or persistent. The discharge can be purulent or mucoid and has a characteristic odor (cholesteatoma aroma). Another complaint is hearing loss. A basic ear, nose, and throat examination can help in establishing the diagnosis. Examination of the nose is carried out considering the relationship between the nose and the ear. Examination of our ears is assessed by inspection, palpation, and otoscopy. On inspection, the condition of the outer ear is assessed for abnormalities of the auricle, examination of the preauricular and retro auricular areas to assess for swelling, followed by an examination of the ear canal for abnormalities and also assessing perforation of the tympanic membrane. In CSOM with cholesteatoma, it is necessary to pay attention to whether there is a preauricular fistula. The condition of the ear canal and discharge from the ear canal also needs to be assessed. The presence of secretions needs to be cleaned before assessing the condition of the tympanic membrane. The discharge may be purulent or mucoid. The discharge is very smelly, grayish-yellow, suggesting a cholesteatoma.[23-25]

On otoscopic examination, it is necessary to assess the type of perforation of the tympanic membrane. In acquired cholesteatoma, an inspection of the flaccid area and the anterosuperior mesotympanic quadrant should be carried out for the presence of white, round lesions with thin walls such as macerating (wet) substances. It should also be assessed whether there is granulation, granulation tissue may arise from the affected outer wall of the bone or the scutum and the

posterior wall of the external acoustic meatus. In CSOM with cholesteatoma, the tympanic membrane the pneumatization of the mastoid, how the process in it, and the state of the lateral sinus. tomography (*CT scan*) is effective in demonstrating the anatomy of the temporal bone and cholesteatoma and in determining its extent. Through computer tomography, anatomical variations of the temporal bone can be assessed perforation is usually in the attic or marginal area. X-ray examination of the mastoid (*Schuller*) allows seeing including the appearance of scutal erosion, expansion of the antrum with damaged air cells, and characteristics of soft tissue density. Other features include ossicular destruction, facial canal erosion, low tegmen tympani, and erosion of the semicircular canals.[26-28]

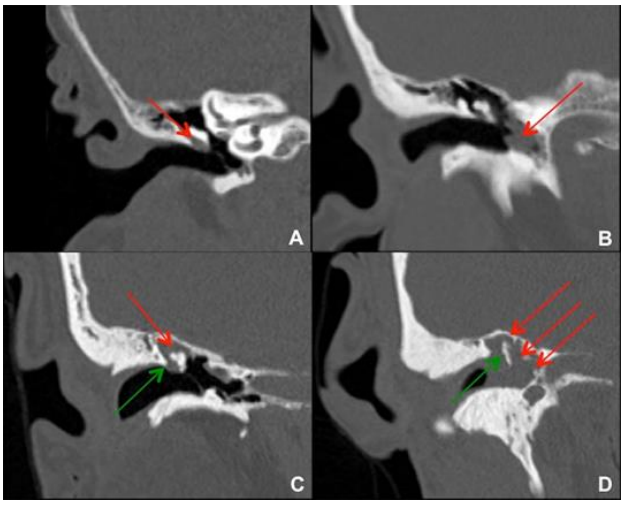

Figure 6. Cholesteatoma seen on computer tomography

The examination of Magnetic Resonance Imaging /MRI is important for detecting middle ear cholesteatoma. Various variations of Diffusion Weighted Imaging (DWI) to deteski cholesteatoma that apply the principle of molecular diffusion to produce contrast. Keratin debris in cholesteatoma limits water diffusion and produces high signal intensity. Mucosal edema, fibrosis and granulation tissue can cause low signaling. With this latest MRI technique can detect cholestetoma with a high level of sensisivity.[29]

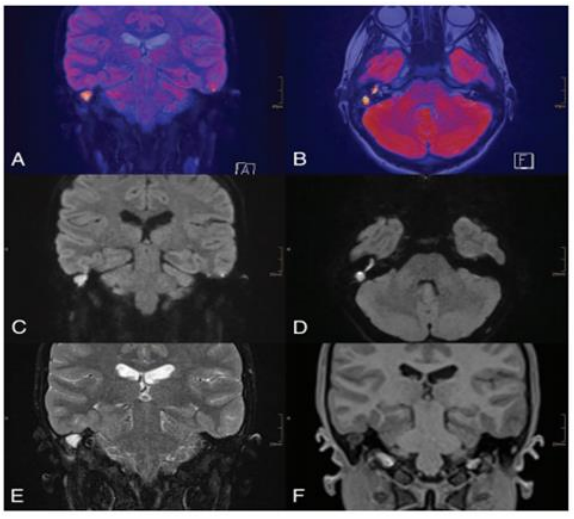

Figure 7. Description of cholesteatoma on MRI

Examination of ear discharge swab culture is important to determine the bacteria that cause CSOM with cholesteatoma and to determine the appropriate use of antibiotics. Gram-negative, gram-positive aerobic and anaerobic bacteria play a role in CSOM with different incidences. Pure tone audiometric examination of patients with CSOM is used to determine the hearing loss in CSOM. Audiogram images in CSOM usually show conductive hearing loss, but mixed or sensorineural hearing loss can also be found.[29-31]

Management of CSOM with Cholesteatoma

Management of CSOM can be done with medication and surgery. Medical treatment with aural toilet, systemic antibiotics, and topical antibiotics. The selected antibiotic must have efficacy to eradicate *Pseudomonas aeruginosa* and *Staphylococcus aureus*, which are the most common pathogens that cause CSOM. Systemic antibiotics that are widely used are ciprofloxacin, amoxicillin with clavulanic acid, and cefixime because based on several previous studies they are sensitive to bacteria that cause CSOM. Topical antibiotics that can be given are ciprofloxacin ear drops and ofloxacin ear drops. Ofloxacin is effective in reducing clinical signs and symptoms in patients with active CSOM. Research shows that ofloxacin and ciprofloxacin are equally effective in reducing clinical symptoms of the number of secretions and perforations and can improve the degree of hearing. However, only topical preparations available in Indonesia are ofloxacin ear drops, while ciprofloxacin ear drops are not available in Indonesia.[29,30]

Surgical therapy is an ideal therapy for the management of CSOM patients with cholesteatoma to eradicate the disease, dry ears, improving hearing function, and for cosmetic reasons. Several studies have investigated several techniques for the management of CSOM with cholesteatoma. Mastoidectomy techniques performed to achieve the definitive goal of CSOM are collapsing wall mastoidectomy (CWD) and intact wall mastoidectomy (CWU). The choice of this operation depends on the extent of the cholesteatoma and the destruction of the ossicles that occur. The CWD technique is usually chosen if the infection has spread extensively, cholesteatoma has spread to the mastoid and tympanic cavum, the presence of severe and very severe hearing loss, pneumatization, destruction of the ossicles, and complications. Collapsed wall mastoidectomy surgery approach (usually including modified radical mastoidectomy) is to tear down the boundary wall between the outer ear canal and the middle ear with the mastoid so that these three areas become one space. Patients with extensive cholesteatoma may have damage to the attic and canal walls. This surgery aims to get a dry ear by removing all pathological tissue and preventing complications to the intracranial but the improvement of hearing function is not the main goal of this surgery. Modification of this operation is to install a graft in the operating cavity and make a wide meatoplasty so that the operating cavity is permanently dry but the outer ear canal meatus becomes wider. The full-wall mastoidectomy (CWU) approach is now more widely used. CWU mastoidectomy while preserving the posterior wall of the external ear canal with or without a posterior tympanostomy. procedure *Canal wall up* in malignant CSOM is indicated in patients with limited cholesteatoma in the epitympanum, intact ossicles, and good drainage between the mastoid cavity and tympanic cavity. Relative contraindications to the CWU procedure include sclerotic mastoid labyrinthine fistula, in the only hearing ear, and poor eustachian tube function. In the study of *Ghanie et al.*, the most frequently performed surgery was CWD because of the high prevalence of cholesteatoma in cases.[31-33]

Complications of CSOM with Cholesteatoma

Various factors influence the occurrence of complications in CSOM. It is very important to know the anatomy of the site of infection, the route of spread, and the characteristics of the disease itself. The

primary pathogenesis of complications is the interaction between the causative microorganism and the host. The host will respond by forming tissue edema edema in the narrow space between the mesotympanum and the epitympanum and in the aditus between the epitympanum and the mastoid antrum inhibits normal aeration pathways and reduces oxygenation and vascularity.[1,27,30]

Complications in chronic suppurative otitis media are divided into two, namely intratemporal (extracranial) and intracranial complications. Intratemporal complications include mastoiditis, petrositis, labyrinthitis, facial nerve paresis and labyrinthine fistula. Intracranial complications include abscess or extradural granulation tissue, sigmoid sinus thrombophlebitis, brain abscess, otic hydrocephalus, meningitis, and subdural abscess. When complications occur, symptoms usually develop rapidly. Fever indicates an intracranial infectious process or extracranial cellulitis.[1,27,30]

Prognosis of CSOM with Cholesteatoma

CSOM Safe type or malignant type can be directly related to hearing loss. From this study, the malleus was the most resistant to erosion, while the incus was the bone that often eroded. In malignant type CSOM, and granulation tissue. When an infection in the middle ear and mastoid is not resolved, mucosal edema persists, exudate increases and gland mucus. Mucosal there is a tendency for more hearing loss to occur compared to safe type CSOM. Serious complications caused by malignant CSOM can cause hearing loss. Several studies have used the *Middle Ear Risk Index* (MERI) or Middle Ear Risk Index as a reliable measuring tool to evaluate the likelihood of the outcome of the ossicular reconstruction. MERI was developed by Becvarovski and Kartush who divided intrinsic factors (eustachian tube function, disease severity, and status of the remaining ossicular chain) and extrinsic factors, namely the expertise of the surgeon (surgical technique, *staging*, design, and composition of *grafts* and prostheses) for assessing the severity of the disease by assigning a specific value to each risk factor and the total number (maximum score = 12). Low risk with a value of 1-3, moderate risk 4-6, and high risk 7-12. MERI classifies these factors into prognostic categories. The higher the MERI score, the more severe the disease, the lower the success rate of graft/ossicle reconstruction, the higher the degree of hearing loss, and the worse the patient's quality of life. It is useful to explain to patients before surgery to prepare them psychologically.[32-34]

Table 1. Middle Ear Risk Index (MERI)

Risk factors	Risk value
Othorrhoea	
1. Dry	0
2. Wet	1
3. Wet (occasionally)	2
4. Wet (persistent)	3
5. Always wet (cleft palate)	
Perforation	
None	0
Exist	1
Cholesteatoma	
None	0
Exist	1
Osicular Status	
a) M +I+S	0
b) M+S+	1
c) M +S-	2
d) M-S+	3
e) M-S-	4
f) Fixed ossicle head	2
g) Fixed stapes	3
Middle ear (granulation or effusion)	
None	0
Exist	1
Previous surgical history	
None	0
Gradual	1
Revision	2

2. Conclusion

Chronic suppurative otitis media (CSOM) is inflammation of the middle ear mucosa and mastoid space that lasts more than 2 months characterized by perforation of the tympanic membrane and continuous or intermittent discharge from the ear canal. Secretion in the form of watery or thick clear or pus. CSOM with cholesteatoma is characterized by a perforation that is located marginally or can be tampered with the bone and often causes dangerous complications.

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