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

1. Proofread document received (March 4th, 2022)
   -Document from proofreading service
2. Submitted to the journal “Archives of The Medicine and Case Reports" (March 9th, 2022)
3. Peer Reviewer results: Revision Required (March 17th, 2022)
4. Revised version received by journal (March 25th, 2022)
5. Paper Accepted for publication (March 31th, 2022)
6. Galley proof (April 1st, 2021)
7. Paper published (April 4th, 2021)

-Document from proofreading service

March 4th, 2022

HM Publisher
Jl Sirnaraga No 99, 8 Ilir, Ilir Timur 3, Palembang, South Sumatra, Indonesia

CONFIDENTIAL
March 4th, 2022

Certificate Service Confirmation

To whom it may concern,
HM Publisher provided comprehensive editing services for manuscript entitled Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review. The edit has achieved Grade A: priority publishing; no language polishing required after editing. Should you require any additional information, please do not hesitate to contact me.

Regards,

Khrishna Murti, PhD
Head of Language Institute-HM Publisher
Email: khrishnamurti@gmail.com

Submitted to the journal "Archives of The Medicine and Case Reports" (March 9th, 2022)

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

Rachmat Hidayat[1#]

[1]Department of Biology, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
[#]Email : dr.rachmat.hidayat@gmail.com / rachmathidayat@fk.unsri.ac.id

Abstract

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer from a significant decrease in hearing The incidence of chronic otitis media with colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults.

Keywords : Chronic suppurative otitis media, cholesteatoma, pathophysiology, clinical

Introduction

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer

from a significant decrease in hearing The incidence of chronic otitis media with colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults. In the male sex more in females in a ratio of 1.4:1. In young adults chronic otitis media with cholesteatoma is more prevalent than patients aged 50 years or older. The caucasian race is a race that has a high prevalence of the incidence of chronic otitis media with cholesteatoma. [3-5]

In the research of Mahadevan et al. (2012) reported the prevalence of OMS K in Indonesia was 5.4%, and in Thailand, Philippines, Malaysia and Vietnam ranged from 2-4% compared to 0.01-0.03/1000 cases in America, Anggraeni R et al reported that 3.4% of 7005 children suffer from OMSK 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 America and Central America (3%), the 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 otore as much as 2.4% and in the province of East Java as much as 2.7%. In 2017-2018 the number of OMSK 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% was in the form of OMSK with cholesteatoma. The incidence of OMSK at Kariadi Hospital Semarang obtained 21% of cases from all visits at the otology clinic during 2010. Some studies report OMSK with cholesteatoma is often accompanied by the presence of granulation tissue. In the study of Abdullah et al, 57% of the study population found the presence of cholesteatoma, 21% of the cholesteatoma population accompanied by granulation tissue and 22% of the population without both. In the study of Ghanie et al, at RSMH Palembang for the period of April 2015-2018, 103 patients (40.87%) of cholesteatoma and granulation tissue patients were obtained, 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 OMSK with Cholesteatoma

The incidence of chronic otitis media is influenced by multifactorials including viral or bacterial infections in the upper respiratory tract, age, socioeconomic level, immunity, comorbidities such as diabetes mellitus, autoimmune diseases, malignancies and nutritional status. The cause of OMSK is usually polymicrobial (52.5%), where the most

pathogens are a mixture of *Proteus mirabili*s and *Klebsiella pneumoni*a (16.7%), while single microbial growth includes *Escherichia coli* and *Staphylococcus aureus*. Overall, the more commonly found bacteria were Gram-negative bacteria (59.7%) and the least was the fungus *Candida albicans* (14.7%). Among the most Gram-negative bacteria is *Klebsiella pneumoniae* (33.8%), while among the Gram-positive bacteria type *Staphylococcus sp* (54.5%) is most commonly found. The cause of OMSK with cholesteatoma is the most around 66% caused by the bacterium *Pseudomonas aeruginosa*. This is in accordance 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 encourage the onset of infection. Risk factors in otitis media include mechanical obstruction of the Eustachian tubes (e.g., sinusitis, adenoid hypertrophy, nasopharyngeal carcinoma), immunodeficiency, ciliary dysfunction, midfacial congenital anomalies (e.g. palatoschizis, down syndrome) and nasopharyngeal reflux. Other significant risk factors for OMSK include a recurrent history of OMA and parents with a history of OMSK. Allergies are also a risk factor because several studies have shown the presence of allergens that cause obstruction of the Eustachian tubes and nose. Recent studies have also shown a genetic role in otitis media. [10-14]

Pathophysiology of acquired *cholesteoma formation (Acquired Cholesteatoma*)

Acquired cholesteatoma is usually caused by dysfunction of the *eustachian tubes*. Acquired cholesteatoma is different from congenital cholesteatoma, where acquired cholesteatoma occurs not at birth. The theory of cholesteatoma obtained is explained by several theories, including the theory of pocket retraction and the theory of *non-retraction pocket.* Based on EAONO / JOS explained to establish a diagnosis of *acquired cholesteatoma* with clinical symptoms that can cause damage to the surrounding structures or not with or without retraction or perforation of the tympanic membrane with or absence of otore the presence of hearing loss or not, computer tomography or *MRI* where there are masses that indicate cholesteatoma, or damage to the auditory and mastoid bones. [15.16]

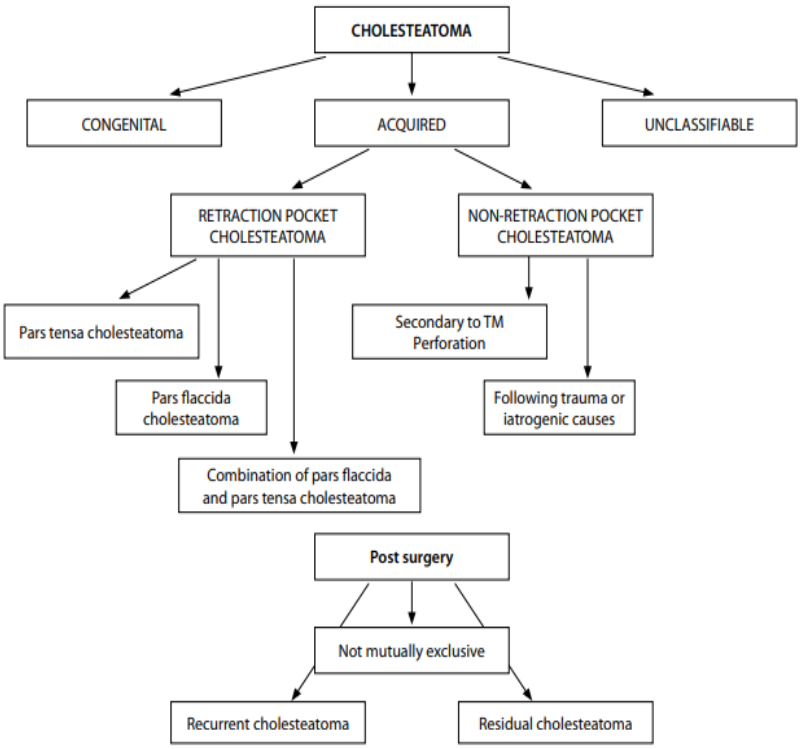


Figure 1 Classification scheme of cholestheatoma

The theory of *pocket retraction* in *primary cholesteatoma* occurs in dysfunction of the eustachian tubes that causes vacuum conditions in the tympanic cavber, thus pulling segments from the tympanic membrane (most often pars flaksida) forming as pockets. The laxicide pars on the tympanic membrane is the most common part for cholesteatoma to occur, due to its thinner layer than the pars tensa. The vacuum condition of the middle ear can cause retraction of the tympanic membrane, however if this process takes longer in the epitimpanum region, the aditus ad antrum will become blocked at the beginning of the course of the disease and will fill with mucus or inflammatory tissue (such as granulation). [17.18]

Figure 2 The image of the white arrow showing the retraction of the poket in the atik and the red circle showing atelectasis in the Prussack space and the yellow arrow showing the erosion of the scutum

The theory of *non-retraction pocket* is referred to as *acquired secondary cholesteatomata*. Theories that explain the formation of this cholestetaoma include the theory of migration, metaplasia and basal hyperplasia of cells. The theory of migration occurs when the perforated tympanic membrane as the originator of the squamous epithelium present in the tympanic membrane migrates to the middle ear region . As a result of trauma, the result of surgery or foreign bodies or iatrogenic factors can result in the occurrence of cholestethoma. In the theory of squamous metaplasia, inflammation of the middle ear provokes a transformation of the mucous lining of the ear. This theory involves the alteration or transformation of the epithelium of a layer of kuboid into a squamous epithelium as a result of chronic recurrent otitis media. In the theory of hyperplasia, basal cells of keratinocytes are thought to proliferate and penetrate the basal membrane and extend along *pseudopodia* into the subepithelial space. Although inflammation can trigger proliferation, there is no supporting evidence for what causes these basal cells to migrate to the medial rather than laterally. [7.20pm]

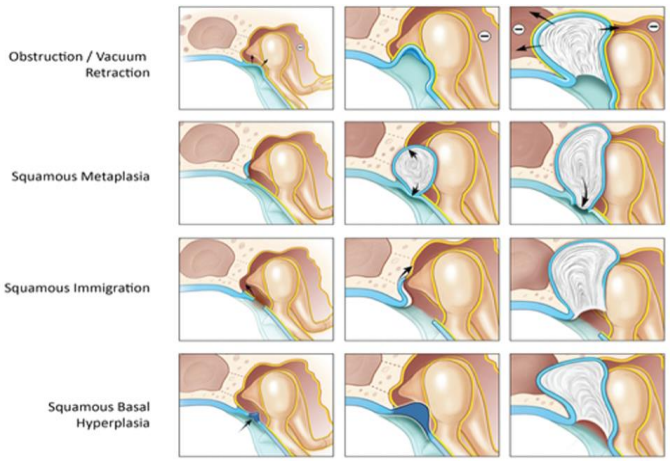


Figure 3 Acquired cholestatoma formation

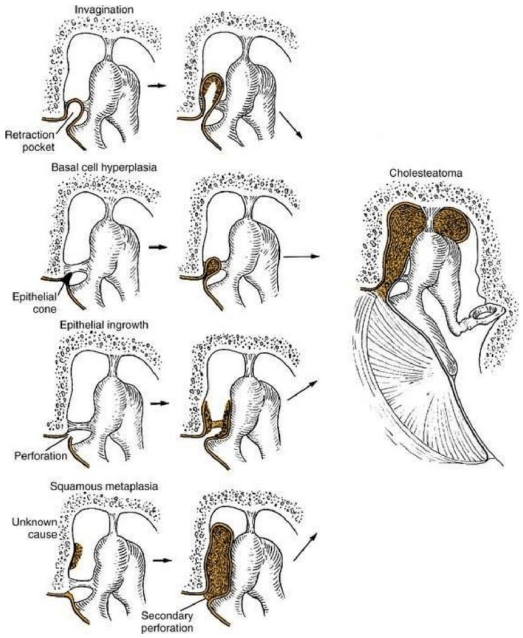


Figure 4 Pathogenesis of cholesteatoma formation

OMSK classification

OMSK can be divided into two types, namely benigna type OMSK (safe type) or commonly called tubotimpani type, involving the anteroinferior part of the middle ear slit and is associated with permanent central perforation. OMSK of this type does not cause serious complications. Malignant-type OMSK is also called the atticoantral type or hazard type, involving the amatic and posterosuperior regions of the middle ear slit. In this type of atik or marginal perforation in the posterosuperior quadrant. In this type is associated with

erosion of the auditory bones due to the presence of cholesteatoma, granulation tissue or osteitis. The complications arising from malignant type OMSK are quite dangerous, one of the complications of OMSK maligna is parese nervus fascialis, due to the progressive, destructive growth of tympanic cholestatoma and is characteristic of omsk maligna. 2 [1.2 2]

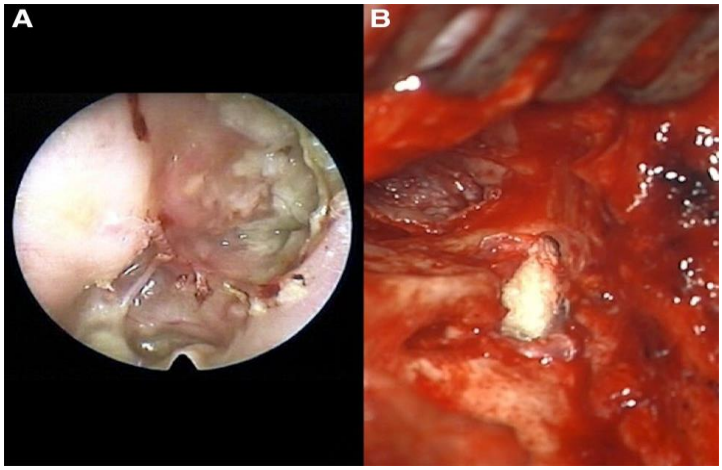


Figure 5. Cholesteatoma in the amatic region and intraoperative cholesteatoma picture

Diagnosis of OMSK with Kolesteatoma

The diagnosis of OMSK with cholesteatoma is established based on anamnesis, physical examination, and supporting examination. Anamnesis to determine the beginning of the disease, previous disease history, risk factors and clinical symptoms. Clinical symptoms can be otore intermiten or persistent. Secretions can be purulent or mucoid and have a characteristic smell (cholesteatoma aroma). Another complaint is hearing loss. Basic ear nose and throat examinations can help in establishing a diagnosis. Nasal examination is carried out in view of the connection between the nose and the ears. Examination of our ears is assessed by inspection, palpation and otoscopy examinations. In the inspection, the outermost ear condition is assessed whether there is an auricle abnormality, pre-auricular and retroauricular area examination to assess whether there is swelling, followed by an ear canal examination whether there are abnormalities and also assessing the perforation of the tympanic membrane. In OMSK with cholesteatoma it is necessary to pay attention to whether there is a preauricular fistula. The condition of the ear canal and secretions coming out of the ear canal also needs to be assessed. The presence of secretions needs to be cleaned first before assessing the state of the tympanic membrane. Secretions can be purulent or

mucoid. A very smelly secretion, grayish-yellow color gives the impression of the presence of cholesteatoma. [23-25]

On otoscopic examination, it is necessary to assess the type of perforation on the tympanic membrane. In the obtained cholesteatoma, an inspection must be carried out on the flaxial region and the anterosuperior mesotimpanum to see the presence of white, round lesions with thin walls like maceration (wet) substances. It is also necessary to assess whether there is granulation, granulation tissue can arise from the bone of the affected outermost wall or scucum and the posterior wall of the octerine aqueousus meatus. In OMSK with cholesteatoama, perforation of the tympanic membrane is usually in the amatic or marginal area. Photo examination of the mastoid (*Schuller*) makes it possible to see the pneumatization of the mastoid, how the processes in it are as well as the state of the lateral sinuses. A computer tomography examination (*CT scan*) is effective in showing the anatomy of the temporal bone and cholesteatoma as well as for determining its expansion. Through computer tomography, it can be assessed variation of temporal bone anatomy including a picture of scure erosion, expansion of the antrum with damaged air cells and soft tissue density characteristics. Other images are osicle digestion, fascial canal erosion, low tympanic segmentation, and semicircular canal erosion. [26-28]

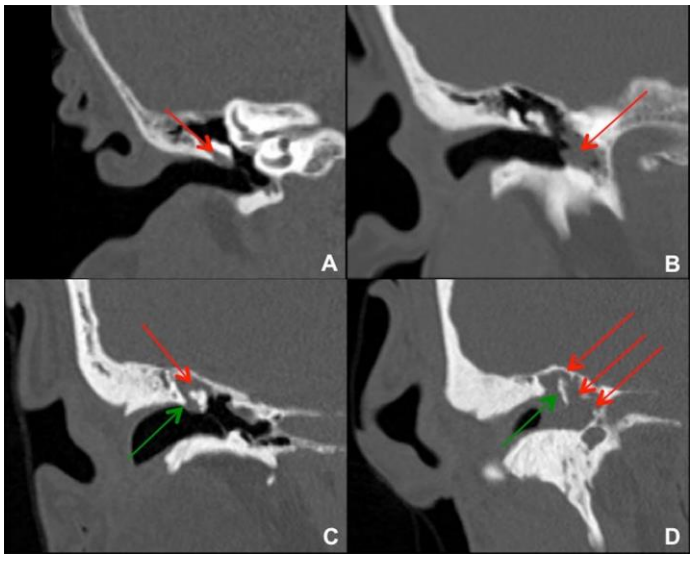


Figure 6 Kolesteatoma appears on computer tomography

Magnetic Resonance Imaging/ MRI examination is useful for detecting middle ear cholesteatoma. A wide variety of *Diffusion Weighted Imaging* (DWI) variations to detect cholesteatoma that apply the principle of molecular diffusion to produce contrast. Keratin debris in cholesteatoma limits water diffusion and results in high signal intensity. Mucosal edema, fibrosis and granulation tissue can cause low signals. With this latest MRI technique, it can detect cholestetoma with a high level of sensitivity. [29]

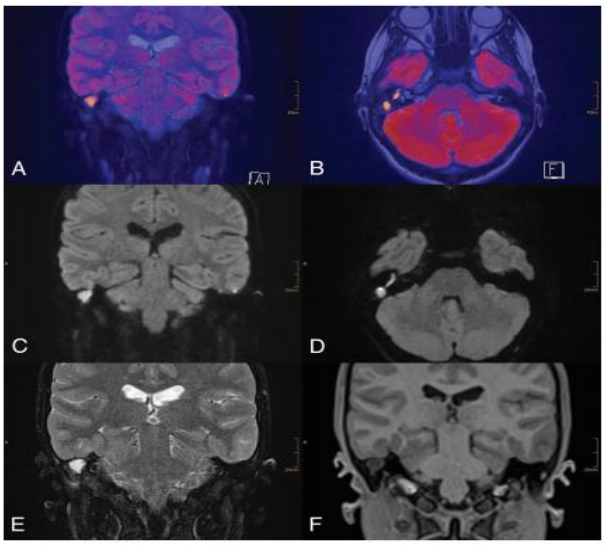


Figure 7. Description of cholesteatoma in MRI

Examination of ear secretion swab cultures is important to determine the bacteria that cause OMSK with cholesteatoma and to determine the appropriate use of antibiotics. Gram-negative, gram-positive aerobic and anaerobic bacteria play a role in OMSK with varying incidences. Audiometric examination of pure tones of OMSK sufferers is used to determine hearing loss in OMSK. Audiogram images in OMSK are usually found with conductive hearing loss, but there can also be mixed or sensorineural hearing loss. [29-31]

Management of OMSK with Kolesteatoma

The management of OMSK can be done with medicamentosa and surgery. Medical treatment with aural toilet, administration of systemic antibiotics and topical antibiotics. The selected antibiotics must have efficacy to irradiate *Pseudomonas aeruginosa* and *Staphylococcus aureu*s, the pathogenic germs that cause OMSK the most. Systemic antibiotics that are widely used are ciprofloxacin, amoxicillin with clavulanic acid and

cefixim because based on several previous studies it has been shown to be sensitive to germs that cause OMSK. Topical antibiotics that can be given are ciprofloxacin ear drops and ofloksasin ear drops. Ofloxacin effectively lowers the symptoms and clinical signs of active OMSK sufferers. Research shows that oplocxacin and ciprofloxacin are equally effective in lowering the clinical symptoms of secretion and perforation and can improve hearing degrees. But the topical preparations that exist in Indonesia are only oplocxacin ear drops while ciprofloxacin ear drops do not yet exist in Indonesia. [29.30]

Surgical therapy is an ideal therapy for the management of OMSK patients with cholesteatoma with the aim of eradication of diseases, dry ears, improvement of hearing function, and for cosmetic reasons. Several studies have integrated several techniques for the management of OMSK with cholesteatoma. Mastoidectomy techniques performed to achieve the definitive goals of OMSK are collapsed wall mastoidectomy (CWD) and intact wall mastoidectomy (CWU). The choice of this surgery depends on the expansion of the cholesteatoma and the digestion of the auditory bone that occurs. The CWD technique is usually chosen when the infection has spread extensively, cholesteatoma that has extended to the mastoid cavum and tympanic cavum, the presence of severe and very severe hearing loss, its pneumatization, destructive hearing bones, and the presence of complications. The surgical approach of collapsed wall mastoidectomy (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 room. Patients with extensive cholesteatoma may have damage to the atics and canal walls. The purpose of this surgery is to obtain a dry ear by removing all pathological tissue and preventing complications to the intracranial but the improvement of the snoring function is not the main goal of this operation. The modification of this operation is to install a tandur (graft) on the operating cavity and make a wide meatoplasty so that the operating cavity is permanently dry but the meatus of the outer ear canal becomes wide. The whole-wall mastoidectomy (CWU) surgery approach is more widely practiced today. CWU mastoidectomy while maintaining the posterior wall of the outer ear canal with or without posterior tympanostomy. The *canal wall up* procedure in OMSK maligna is indicated in patients with limited cholesteatoma in the epitimpanum, the intak auditory bone circuit, as well as good drainage of the mastoid cavity and tympanic cavity. Relative contraindications to the CWU procedure include a sclerotic

mastoid labyrinth fistula, on the only hearing ear, and poor eustachian tube function. In the research of *Ghanie et al*, the most common surgery is CWD because of the high prevalence of cholesteatoma incidence in cases. [31-33]

Complications of OMSK with Cholesteatoma

Various factors influence the occurrence of complications in OMSK. It is very important to know the anatomy of where the infection occurs, the route of spread and the characteristics of the disease itself. The primary pathogenesis of the occurrence of complications is the interaction between the causative microorganism and *the host*. *The host* will respond by forming edema tissue and tissue granulation. When infections in the middle ear and mastoids are not resolved, mucosal edema persists, exudate increases, and mucus spasticity proliferation occurs. Mucosal edema in narrow places between the mesotimpanum and the epithympanum and in the aditus between the epitimpanum and the mastoid antrum inhibits the normal aeration pathway 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, paresis nervus fascialis and labyrinth fistula. Intracranial complications consist of extradural abscesses or granulation tissues, thrombophlebitis of the sigmoid sinuses, brain abscesses, otic hydrocephalus, meningitis and subdural abscesses. When complications occur, symptoms usually develop rapidly. Fever signals the occurrence of an infectious process of intracranial or extracranial cellulitis. [1,27,30]

Prognosis of OMSK with Cholesteatoma

Safe type OMSK or malignant type can be directly related to hearing bone damage. From this study, the maleus bone is the bone that is most resistant to erosion, while the inkus bone is a bone that often occurs erosion. In malignant type OMSK, there is a tendency to more auditory bone erosion than safe type OMSK. Serious complications caused by malignant type OMSK cause damage to the auditory bones . Several studies have used the

Middle Ear Risk Index (MERI) as one of the reliable measuring instruments to evaluate the likelihood of osicle reconstruction results. MERI was developed by Becvarovski and Kartush which divides intrinsic factors (eustachian tube function, disease severity, and status of the rest of the ocicular chain) and extrinsic factors i.e. expertise of the surgeon (surgical techniques, *stagging*, design and composition of grafts and prostheses) to assess the severity of the disease by assigning specific values for each risk factor and the total number (maximum score = 12). Low risk with values 1-3, medium risk 4-6 and high risk 7-12. MERI groups these factors into prognostic categories. The higher the MERI score, the more severe the degree of disease, the lower the success rate of *graft* / occicle reconstruction, the higher the degree of hearing loss and the worse the patient's quality of life. It is useful to explain to the patient before the surgery to prepare them psychologically. [32-34]

Table 1. *Middle Ear Risk Index* (MERI).

Risk Factors	Risk value
Otorea	
1. Dry	0
2. Wet (intermittent)	1
3. Wet (persistent)	2
4. Always wet (there is a palate gap)	3
Perforation	
None	0
Exist	1
Cholesteatoma	
None	0
Exist	1
Occular Status	
a) M+I+S	0
b) M+S+	1
c) M+S-	2
d) M-S+	3
e) M-S-	4
f) Fixed osicle head	2
g) Fixed stapes	3
Middle ear (granulation or effusion)	

None	0
Exist	1
Previous Operation History	
None	0
Gradual	1
Revision	2

Conclusion

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications.

References

1. Ahmed Z, Khan TZ, Rahim DU. Otogenic complications of otitis media: experience at tertiary care hospital. Mr. J Surg. 2016; 32(1):49-53.
2. Abdel A, Razek KA, Ghonim MR, Ashraf B. Computed Tomography Staging of Middle Ear Cholesteatoma. Pol J Radiol. 2015; 80: 328-333.
3. Kuo CL, et al. Updates and Knowledge Gaps in Cholesteatoma Research. Hindawi Publishing Corporation BioMed Research International. 2015: 1-17
4. Chavada PS. Middle Ear Cholesteatoma : A Study of Correlation Between HRCT Temporal Bone and Intraoperative Surgical Findings. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018;4(5):1212-1219
5. Castle JT. Cholesteatoma Pearls: Practical Points and Update. Head and Neck Pathology. 2018; 12(3): 419–429.

6. Prakash M D, Tarannum Afshan. Role of High Resolution Computed Tomography of Temporal Bone in Preoperative Evaluation of Chronic Suppurative Otitis Media. International Journal of Otolaryngology and Head Neck Surgery. 2018; Vol 4: 5.
7. Chatterjee, Pritam, Swagata Khanna, Ramen Talukdar. Role of High Resolution Computed Tomography of Mastoids in Planning Surgery for Chronic Suppurative Otitis Media. Indian J Otolaryngology head and Neck Surgery. 2015; 67(3): 275-280.
8. Gulati M, Gupta S, Prakash A, Garg A, Dixit R. HRCT imaging of acquired cholesteatoma: a pictorial review. Insights into Imaging 2019;10:92.
9. Bluestone, Charles D, et al. Panel reports: Definitions, terminology, and Classification of Otitis Media. Ann Otol Rhinol Laryngol. 2002.
10. Irwan AG, Widyasari F, Suyanti, Gunawan A. Pre and intraoperative findings of chronic otitis media. IOP Conf. Series: Journal of Physics: Conf. Series 1246. 2019.
11. Kartush JM. Ossicular Chain Construction. Otolaryngol Clin North Am. 1994;27:689-715
12. Thangaraj, Ramasundar P, Anandan H. A Study on Ossicular Pathology in Chronic Suppurative Otitis Media. International Journal of Scientific Study. 2017;5 (3): 223-226
13. Rao SR, Rao PR. A Study on Frequency of Ossicular Chain Erosion in CSOM. International Journal of Research in Health Sciences. 2017;5(4):49-53
14. Handoko E, Indrasworo D, Harun A, Salim N. Relationship of cholesteatoma degree to successful radical mastoidectomy surgery in patients with chronic suppurative otitis media. ORLI.2019;49(2): 99-107
15. Wineski LE. Snell's clinical anatomy by regions: head and neck. 10th ed. Philadelphia: Walters Kluwer; 2019.p.1702-13 .

16. Mansour S, Magnan J, Haidar H, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear: middle ear cavity. 2nd ed. London: Springer; 2019.p.19-47.
17. Flint, Paul W, et al. Cummings otolaryngology, Head and Neck Surgery sixth edition vol 1. Elsevier. 2015. p.47-54
18. Frank H. Netter, MD. Atlas of Human Anatomy 7th Edition. Elsevier. 2019.p.35-38
19. Arasan T. New Classification of Ossicular Status and Study In Patients with Ossicular Erosion to be Used for Ossiculoplasty. Otolaryngology online journal. 2017; 7(1):144-53.
20. Luers JC, Huttenbrink KB. Surgical Anatomy and Pathology of the Middle Ear. Journal of Anatomy. 2016;228.p.338-353.
21. Oghalai JS, Brownell WE. Anatomy and Physiology of the Ear. In: Lalwani AK, editor. Current Diagnosis and Treatment Otolaryngology Head and Neck Surgery 4th Edition. New York: Mc Graw Hill.2020.p.715-34.
22. Gacek RR, Gacek MR. Anatomy of the Auditory and Vestibular Systems. In : Wackym, Snow JB, Ballenger JJ. Ballenger'Otorhinolaryngology Head and Neck Surgery 18th Edition. London: People's Medical Publishing House. 2016.p.1-16.
23. Weber PC, Khariwala S. Anatomy and Physiology of Hearing. In: Bailey BJ, Johnson JT, Shawn D editors. Head & Neck Surgery-Otolaryngology 5th Edition Volume 2. Philadelphia : Lippincott Williams & Wilkins. 2014.p.2253-73.
24. Mediawaty D, Widodo P, Ruspita DA. Clinical Effectiveness of Topical Ofloxacin Compared to Oral Ciprofloxacin in Active Chronic Suppurative Otitis Media Therapy. Medica Hospitalia 2017;vol 4 (2):77-83.

25. Ghanie, Abla. Intracranial Complication of Chronic Otitis Media at Mohammad Hoesin Palembang. Journal of Research in Medical and Dental Science. 2017.
26. Aguslia SD. Incidence of Chronic Otitis Media with Cholesteatoma at RSUP Dr. Kariadi Semarang. Medica Hospitalia 2016;vol 4 (1):12-16.
27. Chole RA, Nason R. Ballenger's otorhinolaryngology head and neck surgery: chronic otitis media and cholesteatoma. Wackym PA, editor. USA: PMPH; 2016.p.808-34.
28. Zeitler D, Almosnino G. K.J. Lee's essential otolaryngology head and neck surgery: infections of the temporal bone. 12th ed. Chan Y, Goddard JC, editors. New York: McGraw-Hill Education; 2019. P.402-10
29. Yung, Matthew, et al. EAONO/JOS Joint Consensus Statements on the Definitions, Classification and Staging of Middle Ear Cholesteatoma. The Journal of International Advanced Otology. 2017; 13(1): 1-8
30. Hamed A. Pathogenesis and Bone Resorption in Acquired Cholesteatoma : Current Knowledge and Future Prospectives. Clinical and Experimental Otorhinolaryngology. 2016;9(4): 298-308.
31. Jackler RK, Santa Maria PL, Varav KY, Gguyen A, Blevins NB. A New Theory on Pathogenesis of Acquired Cholesteatoma: Mucosal Traction. Laryngoscope. 2015;125 (4): 1-14
32. Dhingra PL, Shruti D. Diseases of Ear, Nose and Throat 7th Edition. India: Elsevier. 2017.p.3-40
33. Browning GG, Merchant SN, Kelly G, Swan IR, et al. Chronic Otitis Media. In: Gleeson M, Burton JM Editor. Scott-Brown's Otolaryngology 8th Edition. Great Brittain: CRC Press Taylor and Francis Group. 2018.p.3395-445.

34. Fischer N, et al. Readout-Segmented Echo-Planar DWI for the Detection of Cholesteatomas: Correlation with Surgical Validation. AJNR am J neuroradiol . 2019;40:1055–59

Submitted to the journal “Archives of The Medicine and Case Reports"
(March 9th, 2022)

Archives of The Medicine and Case Reports

HM Publisher

Submission acknowledgement

Dear author(s),

Rachmat Hidayat* has submitted the manuscript “Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review“ to Archives of The Medicine and Case Reports. The paper will be screened by editor and reviewed by peer review.

Cordially,

Prof. Paula Magnano, PhD

Editor HM Publisher

(*) Corresponding author

Archives of The Medicine and Case Reports

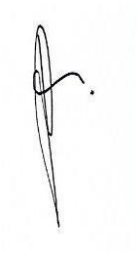
HM Publisher

Peer Review Results

Dear author(s),

Rachmat Hidayat* has submitted the manuscript “Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review“ to Archives of The Medicine and Case Reports. The decision : Revision Required.

Cordially,



Prof. Paula Magnano, PhD

Editor HM Publisher

(*) Corresponding author

Reviewer 1: Revision required

Pathophysiology to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review→1

Rachmat Hidayat[1#]

[1]Department of Biology, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
[#]Email : dr.rachmat.hidayat@gmail.com / rachmathidayat@fk.unsri.ac.id

Abstract→3

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer from a significant decrease in hearing The incidence of chronic otitis media with colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults.

Keywords : Chronic suppurative otitis media, cholesteatoma, pathophysiology, clinical→2

Introduction→4

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer from a significant decrease in hearing The incidence of chronic otitis media with

colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults. In the male sex more in females in a ratio of 1.4:1. In young adults chronic otitis media with cholesteatoma is more prevalent than patients aged 50 years or older. The caucasian race is a race that has a high prevalence of the incidence of chronic otitis media with cholesteatoma. [3-5]

In the research of Mahadevan et al. (2012) reported the prevalence of OMS K in Indonesia was 5.4%, and in Thailand, Philippines, Malaysia and Vietnam ranged from 2-4% compared to 0.01-0.03/1000 cases in America, Anggraeni R et al reported that 3.4% of 7005 children suffer from OMSK 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 America and Central America (3%), the 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 otore as much as 2.4% and in the province of East Java as much as 2.7%. In 2017-2018 the number of OMSK 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% was in the form of OMSK with cholesteatoma. The incidence of OMSK at Kariadi Hospital Semarang obtained 21% of cases from all visits at the otology clinic during 2010. Some studies report OMSK with cholesteatoma is often accompanied by the presence of granulation tissue. In the study of Abdullah et al, 57% of the study population found the presence of cholesteatoma, 21% of the cholesteatoma population accompanied by granulation tissue and 22% of the population without both. In the study of Ghanie et al, at RSMH Palembang for the period of April 2015-2018, 103 patients (40.87%) of cholesteatoma and granulation tissue patients were obtained, 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 OMSK with Cholesteatoma

The incidence of chronic otitis media is influenced by multifactorials including viral or bacterial infections in the upper respiratory tract, age, socioeconomic level, immunity, comorbidities such as diabetes mellitus, autoimmune diseases, malignancies and nutritional status. The cause of OMSK is usually polymicrobial (52.5%), where the most pathogens are a mixture of *Proteus mirabili*s and *Klebsiella pneumoni*a (16.7%), while single

microbial growth includes *Escherichia coli* and *Staphylococcus aureus*. Overall, the more commonly found bacteria were Gram-negative bacteria (59.7%) and the least was the fungus *Candida albicans* (14.7%). Among the most Gram-negative bacteria is *Klebsiella pneumoniae* (33.8%), while among the Gram-positive bacteria type *Staphylococcus sp* (54.5%) is most commonly found. The cause of OMSK with cholesteatoma is the most around 66% caused by the bacterium *Pseudomonas aeruginosa*. This is in accordance 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 encourage the onset of infection. Risk factors in otitis media include mechanical obstruction of the Eustachian tubes (e.g., sinusitis, adenoid hypertrophy, nasopharyngeal carcinoma), immunodeficiency, ciliary dysfunction, midfacial congenital anomalies (e.g. palatoschizis, down syndrome) and nasopharyngeal reflux. Other significant risk factors for OMSK include a recurrent history of OMA and parents with a history of OMSK. Allergies are also a risk factor because several studies have shown the presence of allergens that cause obstruction of the Eustachian tubes and nose. Recent studies have also shown a genetic role in otitis media. [10-14]

Pathophysiology of acquired *cholesteoma formation (Acquired Cholesteatoma*)

Acquired cholesteatoma is usually caused by dysfunction of the *eustachian tubes*. Acquired cholesteatoma is different from congenital cholesteatoma, where acquired cholesteatoma occurs not at birth. The theory of cholesteatoma obtained is explained by several theories, including the theory of pocket retraction and the theory of *non-retraction pocket.* Based on EAONO / JOS explained to establish a diagnosis of *acquired cholesteatoma* with clinical symptoms that can cause damage to the surrounding structures or not with or without retraction or perforation of the tympanic membrane with or absence of otore the presence of hearing loss or not, computer tomography or *MRI* where there are masses that indicate cholesteatoma, or damage to the auditory and mastoid bones. [15.16]

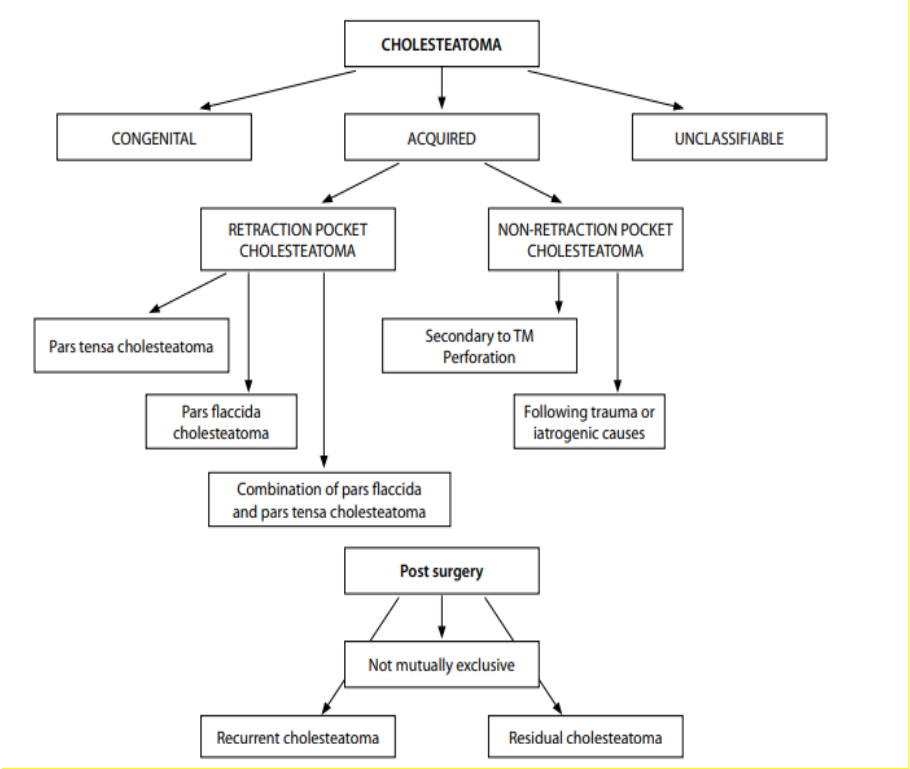


Figure 1 Classification scheme of cholestheatoma

The theory of *pocket retraction* in *primary cholesteatoma* occurs in dysfunction of the eustachian tubes that causes vacuum conditions in the tympanic cavber, thus pulling segments from the tympanic membrane (most often pars flaksida) forming as pockets. The laxicide pars on the tympanic membrane is the most common part for cholesteatoma to occur, due to its thinner layer than the pars tensa. The vacuum condition of the middle ear can cause retraction of the tympanic membrane, however if this process takes longer in the epitimpanum region, the aditus ad antrum will become blocked at the beginning of the course of the disease and will fill with mucus or inflammatory tissue (such as granulation). [17.18]

Figure 2 The image of the white arrow showing the retraction of the poket in the atik and the red circle showing atelectasis in the Prussack space and the yellow arrow showing the erosion of the scutum

The theory of *non-retraction pocket* is referred to as *acquired secondary cholesteatomata*. Theories that explain the formation of this cholestetaoma include the theory of migration, metaplasia and basal hyperplasia of cells. The theory of migration occurs when the perforated tympanic membrane as the originator of the squamous epithelium present in the tympanic membrane migrates to the middle ear region . As a result of trauma, the result of surgery or foreign bodies or iatrogenic factors can result in the occurrence of cholestethoma. In the theory of squamous metaplasia, inflammation of the middle ear provokes a transformation of the mucous lining of the ear. This theory involves the alteration or transformation of the epithelium of a layer of kuboid into a squamous epithelium as a result of chronic recurrent otitis media. In the theory of hyperplasia, basal cells of keratinocytes are thought to proliferate and penetrate the basal membrane and extend along *pseudopodia* into the subepithelial space. Although inflammation can trigger proliferation, there is no supporting evidence for what causes these basal cells to migrate to the medial rather than laterally. 7.20pm

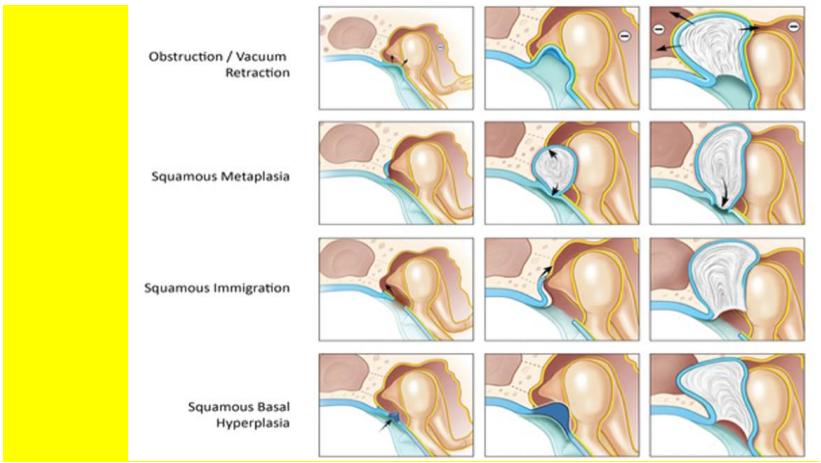


Figure 3 Acquired cholestatoma formation

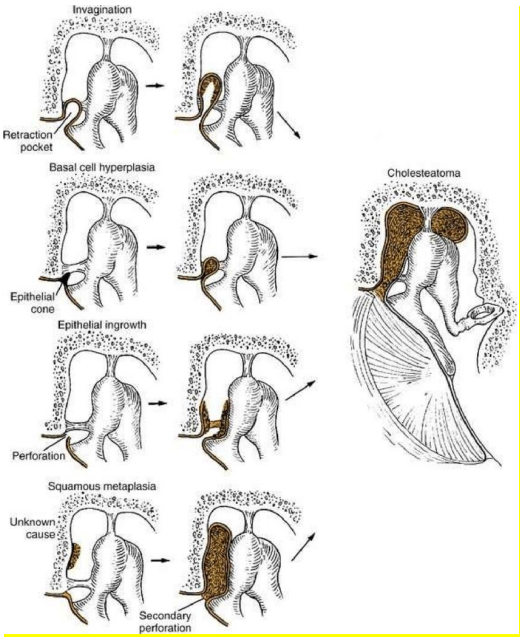


Figure 4 Pathogenesis of cholesteatoma formation

OMSK classification

OMSK can be divided into two types, namely benigna type OMSK (safe type) or commonly called tubotimpani type, involving the anteroinferior part of the middle ear slit and is associated with permanent central perforation. OMSK of this type does not cause serious complications. Malignant-type OMSK is also called the atticoantral type or hazard type, involving the amatic and posterosuperior regions of the middle ear slit. In this type of atik or marginal perforation in the posterosuperior quadrant. In this type is associated with

erosion of the auditory bones due to the presence of cholesteatoma, granulation tissue or osteitis. The complications arising from malignant type OMSK are quite dangerous, one of the complications of OMSK maligna is parese nervus fascialis, due to the progressive, destructive growth of tympanic cholestatoma and is characteristic of omsk maligna. 2 [1.2] [2]

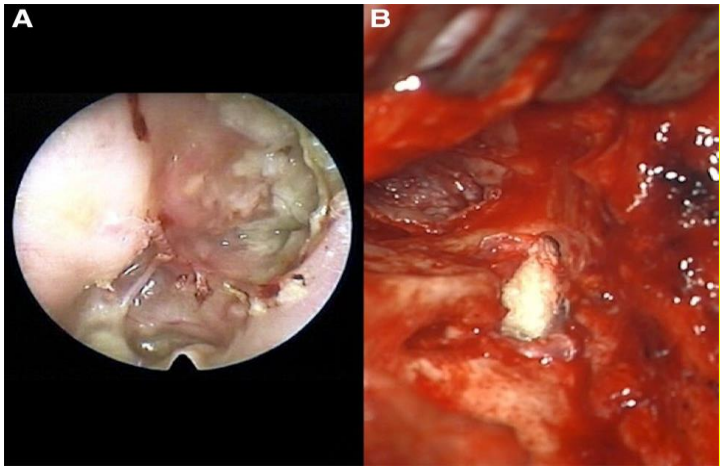


Figure 5. Cholesteatoma in the amatic region and intraoperative cholesteatoma picture

Diagnosis of OMSK with Kolesteatoma

The diagnosis of OMSK with cholesteatoma is established based on anamnesis, physical examination, and supporting examination. Anamnesis to determine the beginning of the disease, previous disease history, risk factors and clinical symptoms. Clinical symptoms can be otore intermiten or persistent. Secretions can be purulent or mucoid and have a characteristic smell (cholesteatoma aroma). Another complaint is hearing loss. Basic ear nose and throat examinations can help in establishing a diagnosis. Nasal examination is carried out in view of the connection between the nose and the ears. Examination of our ears is assessed by inspection, palpation and otoscopy examinations. In the inspection, the outermost ear condition is assessed whether there is an auricle abnormality, pre-auricular and retroauricular area examination to assess whether there is swelling, followed by an ear canal examination whether there are abnormalities and also assessing the perforation of the tympanic membrane. In OMSK with cholesteatoma it is necessary to pay attention to whether there is a preauricular fistula. The condition of the ear canal and secretions coming out of the ear canal also needs to be assessed. The presence of secretions needs to be cleaned first before assessing the state of the tympanic membrane. Secretions can be purulent or

mucoid. A very smelly secretion, grayish-yellow color gives the impression of the presence of cholesteatoma. [23-25]

On otoscopic examination, it is necessary to assess the type of perforation on the tympanic membrane. In the obtained cholesteatoma, an inspection must be carried out on the flaxial region and the anterosuperior mesotimpanum to see the presence of white, round lesions with thin walls like maceration (wet) substances. It is also necessary to assess whether there is granulation, granulation tissue can arise from the bone of the affected outermost wall or scucum and the posterior wall of the octerine aqueousus meatus. In OMSK with cholesteatoama, perforation of the tympanic membrane is usually in the amatic or marginal area. Photo examination of the mastoid (*Schuller*) makes it possible to see the pneumatization of the mastoid, how the processes in it are as well as the state of the lateral sinuses. A computer tomography examination (*CT scan*) is effective in showing the anatomy of the temporal bone and cholesteatoma as well as for determining its expansion. Through computer tomography, it can be assessed variation of temporal bone anatomy including a picture of scure erosion, expansion of the antrum with damaged air cells and soft tissue density characteristics. Other images are osicle digestion, fascial canal erosion, low tympanic segmentation, and semicircular canal erosion. [26-28]

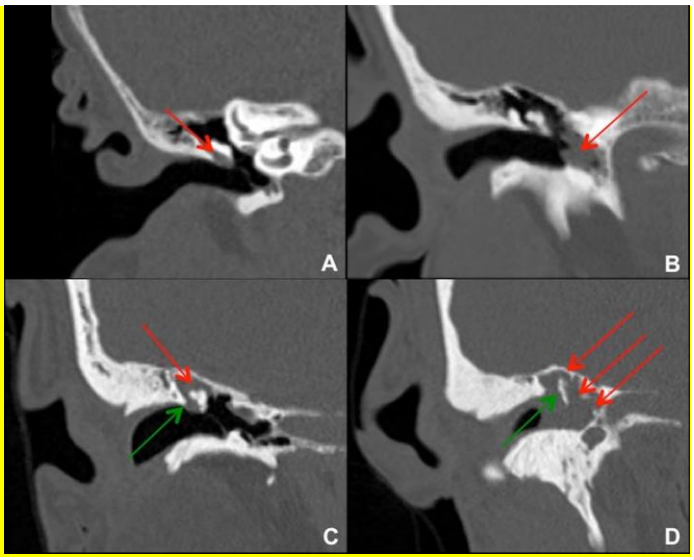


Figure 6 Kolesteatoma appears on computer tomography

Magnetic Resonance Imaging/ MRI examination is useful for detecting middle ear cholesteatoma. A wide variety of *Diffusion Weighted Imaging* (DWI) variations to detect cholesteatoma that apply the principle of molecular diffusion to produce contrast. Keratin debris in cholesteatoma limits water diffusion and results in high signal intensity. Mucosal edema, fibrosis and granulation tissue can cause low signals. With this latest MRI technique, it can detect cholestetoma with a high level of sensitivity. [29]

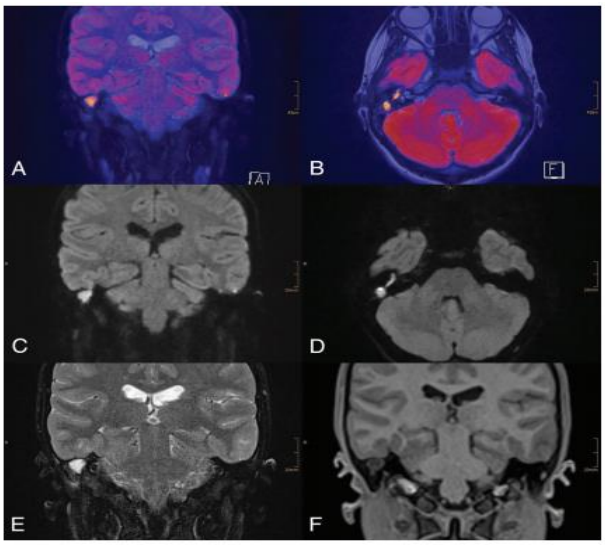


Figure 7. Description of cholesteatoma in MRI

Examination of ear secretion swab cultures is important to determine the bacteria that cause OMSK with cholesteatoma and to determine the appropriate use of antibiotics. Gram-negative, gram-positive aerobic and anaerobic bacteria play a role in OMSK with varying incidences. Audiometric examination of pure tones of OMSK sufferers is used to determine hearing loss in OMSK. Audiogram images in OMSK are usually found with conductive hearing loss, but there can also be mixed or sensorineural hearing loss. [29-31]

Management of OMSK with Kolesteatoma

The management of OMSK can be done with medicamentosa and surgery. Medical treatment with aural toilet, administration of systemic antibiotics and topical antibiotics. The selected antibiotics must have efficacy to irradiate *Pseudomonas aeruginosa* and *Staphylococcus aureus*, the pathogenic germs that cause OMSK the most. Systemic antibiotics that are widely used are ciprofloxacin, amoxicillin with clavulanic acid and

cefixim because based on several previous studies it has been shown to be sensitive to germs that cause OMSK. Topical antibiotics that can be given are ciprofloxacin ear drops and ofloksasin ear drops. Ofloxacin effectively lowers the symptoms and clinical signs of active OMSK sufferers. Research shows that oplocxacin and ciprofloxacin are equally effective in lowering the clinical symptoms of secretion and perforation and can improve hearing degrees. But the topical preparations that exist in Indonesia are only oplocxacin ear drops while ciprofloxacin ear drops do not yet exist in Indonesia. [29.30]

Surgical therapy is an ideal therapy for the management of OMSK patients with cholesteatoma with the aim of eradication of diseases, dry ears, improvement of hearing function, and for cosmetic reasons. Several studies have integrated several techniques for the management of OMSK with cholesteatoma. Mastoidectomy techniques performed to achieve the definitive goals of OMSK are collapsed wall mastoidectomy (CWD) and intact wall mastoidectomy (CWU). The choice of this surgery depends on the expansion of the cholesteatoma and the digestion of the auditory bone that occurs. The CWD technique is usually chosen when the infection has spread extensively, cholesteatoma that has extended to the mastoid cavum and tympanic cavum, the presence of severe and very severe hearing loss, its pneumatization, destructive hearing bones, and the presence of complications. The surgical approach of collapsed wall mastoidectomy (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 room. Patients with extensive cholesteatoma may have damage to the atics and canal walls. The purpose of this surgery is to obtain a dry ear by removing all pathological tissue and preventing complications to the intracranial but the improvement of the snoring function is not the main goal of this operation. The modification of this operation is to install a tandur (graft) on the operating cavity and make a wide meatoplasty so that the operating cavity is permanently dry but the meatus of the outer ear canal becomes wide. The whole-wall mastoidectomy (CWU) surgery approach is more widely practiced today. CWU mastoidectomy while maintaining the posterior wall of the outer ear canal with or without posterior tympanostomy. The *canal wall up* procedure in OMSK maligna is indicated in patients with limited cholesteatoma in the epitimpanum, the intak auditory bone circuit, as well as good drainage of the mastoid cavity and tympanic cavity. Relative contraindications to the CWU procedure include a sclerotic

mastoid labyrinth fistula, on the only hearing ear, and poor eustachian tube function. In the research of *Ghanie et al*, the most common surgery is CWD because of the high prevalence of cholesteatoma incidence in cases. [31-33]

Complications of OMSK with Cholesteatoma

Various factors influence the occurrence of complications in OMSK. It is very important to know the anatomy of where the infection occurs, the route of spread and the characteristics of the disease itself. The primary pathogenesis of the occurrence of complications is the interaction between the causative microorganism and *the host*. *The host* will respond by forming edema tissue and tissue granulation. When infections in the middle ear and mastoids are not resolved, mucosal edema persists, exudate increases, and mucus spasticity proliferation occurs. Mucosal edema in narrow places between the mesotimpanum and the epithympanum and in the aditus between the epitimpanum and the mastoid antrum inhibits the normal aeration pathway 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, paresis nervus fascialis and labyrinth fistula. Intracranial complications consist of extradural abscesses or granulation tissues, thrombophlebitis of the sigmoid sinuses, brain abscesses, otic hydrocephalus, meningitis and subdural abscesses. When complications occur, symptoms usually develop rapidly. Fever signals the occurrence of an infectious process of intracranial or extracranial cellulitis. [1,27,30]

Prognosis of OMSK with Cholesteatoma

Safe type OMSK or malignant type can be directly related to hearing bone damage. From this study, the maleus bone is the bone that is most resistant to erosion, while the inkus bone is a bone that often occurs erosion. In malignant type OMSK, there is a tendency to more auditory bone erosion than safe type OMSK. Serious complications caused by malignant type OMSK cause damage to the auditory bones . Several studies have used the

Middle Ear Risk Index (MERI) as one of the reliable measuring instruments to evaluate the likelihood of osicle reconstruction results. MERI was developed by Becvarovski and Kartush which divides intrinsic factors (eustachian tube function, disease severity, and status of the rest of the ocicular chain) and extrinsic factors i.e. expertise of the surgeon (surgical techniques, *stagging*, design and composition of grafts and prostheses) to assess the severity of the disease by assigning specific values for each risk factor and the total number (maximum score = 12). Low risk with values 1-3, medium risk 4-6 and high risk 7-12. MERI groups these factors into prognostic categories. The higher the MERI score, the more severe the degree of disease, the lower the success rate of *graft* / occicle reconstruction, the higher the degree of hearing loss and the worse the patient's quality of life. It is useful to explain to the patient before the surgery to prepare them psychologically. [32-34]

Table 1. *Middle Ear Risk Index* (MERI).

Risk Factors	Risk value
Otorea	
1. Dry	0
2. Wet (intermittent)	1
3. Wet (persistent)	2
4. Always wet (there is a palate gap)	3
Perforation	
None	0
Exist	1
Cholesteatoma	
None	0
Exist	1
Occular Status	
a) M+I+S	0
b) M+S+	1
c) M+S-	2
d) M-S+	3
e) M-S-	4
f) Fixed osicle head	2
g) Fixed stapes	3
Middle ear (granulation or effusion)	

None	0
Exist	1
Previous Operation History	
None	0
Gradual	1
Revision	2

Conclusion→5

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications.

References→6

1. Ahmed Z, Khan TZ, Rahim DU. Otogenic complications of otitis media: experience at tertiary care hospital. Mr. J Surg. 2016; 32(1):49-53.
2. Abdel A, Razek KA, Ghonim MR, Ashraf B. Computed Tomography Staging of Middle Ear Cholesteatoma. Pol J Radiol. 2015; 80: 328-333.
3. Kuo CL, et al. Updates and Knowledge Gaps in Cholesteatoma Research. Hindawi Publishing Corporation BioMed Research International. 2015: 1-17
4. Chavada PS. Middle Ear Cholesteatoma : A Study of Correlation Between HRCT Temporal Bone and Intraoperative Surgical Findings. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018;4(5):1212-1219
5. Castle JT. Cholesteatoma Pearls: Practical Points and Update. Head and Neck Pathology. 2018; 12(3): 419–429.

6. Prakash M D, Tarannum Afshan. Role of High Resolution Computed Tomography of Temporal Bone in Preoperative Evaluation of Chronic Suppurative Otitis Media. International Journal of Otolaryngology and Head Neck Surgery. 2018; Vol 4: 5.
7. Chatterjee, Pritam, Swagata Khanna, Ramen Talukdar. Role of High Resolution Computed Tomography of Mastoids in Planning Surgery for Chronic Suppurative Otitis Media. Indian J Otolaryngology head and Neck Surgery. 2015; 67(3): 275-280.
8. Gulati M, Gupta S, Prakash A, Garg A, Dixit R. HRCT imaging of acquired cholesteatoma: a pictorial review. Insights into Imaging 2019;10:92.
9. Bluestone, Charles D, et al. Panel reports: Definitions, terminology, and Classification of Otitis Media. Ann Otol Rhinol Laryngol. 2002.
10. Irwan AG, Widyasari F, Suyanti, Gunawan A. Pre and intraoperative findings of chronic otitis media. IOP Conf. Series: Journal of Physics: Conf. Series 1246. 2019.
11. Kartush JM. Ossicular Chain Construction. Otolaryngol Clin North Am. 1994;27:689-715
12. Thangaraj, Ramasundar P, Anandan H. A Study on Ossicular Pathology in Chronic Suppurative Otitis Media. International Journal of Scientific Study. 2017;5 (3): 223-226
13. Rao SR, Rao PR. A Study on Frequency of Ossicular Chain Erosion in CSOM. International Journal of Research in Health Sciences. 2017;5(4):49-53
14. Handoko E, Indrasworo D, Harun A, Salim N. Relationship of cholesteatoma degree to successful radical mastoidectomy surgery in patients with chronic suppurative otitis media. ORLI.2019;49(2): 99-107
15. Wineski LE. Snell's clinical anatomy by regions: head and neck. 10th ed. Philadelphia: Walters Kluwer; 2019.p.1702-13 .

16. Mansour S, Magnan J, Haidar H, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear: middle ear cavity. 2nd ed. London: Springer; 2019.p.19-47.
17. Flint, Paul W, et al. Cummings otolaryngology, Head and Neck Surgery sixth edition vol 1. Elsevier. 2015. p.47-54
18. Frank H. Netter, MD. Atlas of Human Anatomy 7th Edition. Elsevier. 2019.p.35-38
19. Arasan T. New Classification of Ossicular Status and Study In Patients with Ossicular Erosion to be Used for Ossiculoplasty. Otolaryngology online journal. 2017; 7(1):144-53.
20. Luers JC, Huttenbrink KB. Surgical Anatomy and Pathology of the Middle Ear. Journal of Anatomy. 2016;228.p.338-353.
21. Oghalai JS, Brownell WE. Anatomy and Physiology of the Ear. In: Lalwani AK, editor. Current Diagnosis and Treatment Otolaryngology Head and Neck Surgery 4th Edition. New York: Mc Graw Hill.2020.p.715-34.
22. Gacek RR, Gacek MR. Anatomy of the Auditory and Vestibular Systems. In : Wackym, Snow JB, Ballenger JJ. Ballenger'Otorhinolaryngology Head and Neck Surgery 18th Edition. London: People's Medical Publishing House. 2016.p.1-16.
23. Weber PC, Khariwala S. Anatomy and Physiology of Hearing. In: Bailey BJ, Johnson JT, Shawn D editors. Head & Neck Surgery-Otolaryngology 5th Edition Volume 2. Philadelphia : Lippincott Williams & Wilkins. 2014.p.2253-73.
24. Mediawaty D, Widodo P, Ruspita DA. Clinical Effectiveness of Topical Ofloxacin Compared to Oral Ciprofloxacin in Active Chronic Suppurative Otitis Media Therapy. Medica Hospitalia 2017;vol 4 (2):77-83.

25. Ghanie, Abla. Intracranial Complication of Chronic Otitis Media at Mohammad Hoesin Palembang. Journal of Research in Medical and Dental Science. 2017.
26. Aguslia SD. Incidence of Chronic Otitis Media with Cholesteatoma at RSUP Dr. Kariadi Semarang. Medica Hospitalia 2016;vol 4 (1):12-16.
27. Chole RA, Nason R. Ballenger's otorhinolaryngology head and neck surgery: chronic otitis media and cholesteatoma. Wackym PA, editor. USA: PMPH; 2016.p.808-34.
28. Zeitler D, Almosnino G. K.J. Lee's essential otolaryngology head and neck surgery: infections of the temporal bone. 12th ed. Chan Y, Goddard JC, editors. New York: McGraw-Hill Education; 2019. P.402-10
29. Yung, Matthew, et al. EAONO/JOS Joint Consensus Statements on the Definitions, Classification and Staging of Middle Ear Cholesteatoma. The Journal of International Advanced Otology. 2017; 13(1): 1-8
30. Hamed A. Pathogenesis and Bone Resorption in Acquired Cholesteatoma : Current Knowledge and Future Prospectives. Clinical and Experimental Otorhinolaryngology. 2016;9(4): 298-308.
31. Jackler RK, Santa Maria PL, Varav KY, Gguyen A, Blevins NB. A New Theory on Pathogenesis of Acquired Cholesteatoma: Mucosal Traction. Laryngoscope. 2015;125 (4): 1-14
32. Dhingra PL, Shruti D. Diseases of Ear, Nose and Throat 7th Edition. India: Elsevier. 2017.p.3-40
33. Browning GG, Merchant SN, Kelly G, Swan IR, et al. Chronic Otitis Media. In: Gleeson M, Burton JM Editor. Scott-Brown's Otolaryngology 8th Edition. Great Brittain: CRC Press Taylor and Francis Group. 2018.p.3395-445.

34. Fischer N, et al. Readout-Segmented Echo-Planar DWI for the Detection of Cholesteatomas: Correlation with Surgical Validation. AJNR am J neuroradiol . 2019;40:1055–59

Reviewer Comment:

1→ Title of Manuscripts should be explained main review and declared type of literature review: narrative or systematic review.
2→ Keywords should be showed the main words of the study, the authors can use MeSH to develop keywords.
3→ Abstract should be showed the main of background, main of review and conclusion of study.
4→Introduction should be showed the urgency of study (epidemiology data), biological plausibility concept, and lack of knowledge in the study.
5→ Conclusion should more specific and not more showed more review.
6→ Authors must check the references for make update references. References should no more than 10 years.

Reviewer 2: Revision required

Pathophysiology to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review→1

Rachmat Hidayat[1#]

[1]Department of Biology, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia
[#]Email : dr.rachmat.hidayat@gmail.com / rachmathidayat@fk.unsri.ac.id

Abstract→3

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer from a significant decrease in hearing The incidence of chronic otitis media with colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults.

Keywords : Chronic suppurative otitis media, cholesteatoma, pathophysiology, clinical→2

Introduction→4

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications. [1,2] OMSK is still a major health problem especially in developing countries. The incidence of OMSK cases is estimated at more than 20 million people worldwide. Of these about 5 million patients suffer from chronic otitis media with cholesteatoma, although overall the number of cases of chronic otitis media with cholesteatoma is noticeably decreasing. The prevalence of OMSK worldwide is around 65-330 million people with complaints of watery ears, 60% of whom (39-200 million) suffer from a significant decrease in hearing The incidence of chronic otitis media with

colleteatoma is 3 in 100,000 in children and 9.2 in 100,000 adults. In the male sex more in females in a ratio of 1.4:1. In young adults chronic otitis media with cholesteatoma is more prevalent than patients aged 50 years or older. The caucasian race is a race that has a high prevalence of the incidence of chronic otitis media with cholesteatoma. [3-5]

In the research of Mahadevan et al. (2012) reported the prevalence of OMS K in Indonesia was 5.4%, and in Thailand, Philippines, Malaysia and Vietnam ranged from 2-4% compared to 0.01-0.03/1000 cases in America, Anggraeni R et al reported that 3.4% of 7005 children suffer from OMSK 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 America and Central America (3%), the 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 otore as much as 2.4% and in the province of East Java as much as 2.7%. In 2017-2018 the number of OMSK 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% was in the form of OMSK with cholesteatoma. The incidence of OMSK at Kariadi Hospital Semarang obtained 21% of cases from all visits at the otology clinic during 2010. Some studies report OMSK with cholesteatoma is often accompanied by the presence of granulation tissue. In the study of Abdullah et al, 57% of the study population found the presence of cholesteatoma, 21% of the cholesteatoma population accompanied by granulation tissue and 22% of the population without both. In the study of Ghanie et al, at RSMH Palembang for the period of April 2015-2018, 103 patients (40.87%) of cholesteatoma and granulation tissue patients were obtained, 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 OMSK with Cholesteatoma

The incidence of chronic otitis media is influenced by multifactorials including viral or bacterial infections in the upper respiratory tract, age, socioeconomic level, immunity, comorbidities such as diabetes mellitus, autoimmune diseases, malignancies and nutritional status. The cause of OMSK is usually polymicrobial (52.5%), where the most pathogens are a mixture of *Proteus mirabili*s and *Klebsiella pneumoni*a (16.7%), while single

microbial growth includes *Escherichia coli* and *Staphylococcus aureus*. Overall, the more commonly found bacteria were Gram-negative bacteria (59.7%) and the least was the fungus *Candida albicans* (14.7%). Among the most Gram-negative bacteria is *Klebsiella pneumoniae* (33.8%), while among the Gram-positive bacteria type *Staphylococcus sp* (54.5%) is most commonly found. The cause of OMSK with cholesteatoma is the most around 66% caused by the bacterium *Pseudomonas aeruginosa*. This is in accordance 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 encourage the onset of infection. Risk factors in otitis media include mechanical obstruction of the Eustachian tubes (e.g., sinusitis, adenoid hypertrophy, nasopharyngeal carcinoma), immunodeficiency, ciliary dysfunction, midfacial congenital anomalies (e.g. palatoschizis, down syndrome) and nasopharyngeal reflux. Other significant risk factors for OMSK include a recurrent history of OMA and parents with a history of OMSK. Allergies are also a risk factor because several studies have shown the presence of allergens that cause obstruction of the Eustachian tubes and nose. Recent studies have also shown a genetic role in otitis media. [10-14]

Pathophysiology of acquired *cholesteoma formation (Acquired Cholesteatoma*)

Acquired cholesteatoma is usually caused by dysfunction of the *eustachian tubes*. Acquired cholesteatoma is different from congenital cholesteatoma, where acquired cholesteatoma occurs not at birth. The theory of cholesteatoma obtained is explained by several theories, including the theory of pocket retraction and the theory of *non-retraction pocket.* Based on EAONO / JOS explained to establish a diagnosis of *acquired cholesteatoma* with clinical symptoms that can cause damage to the surrounding structures or not with or without retraction or perforation of the tympanic membrane with or absence of otore the presence of hearing loss or not, computer tomography or *MRI* where there are masses that indicate cholesteatoma, or damage to the auditory and mastoid bones. [15.16]

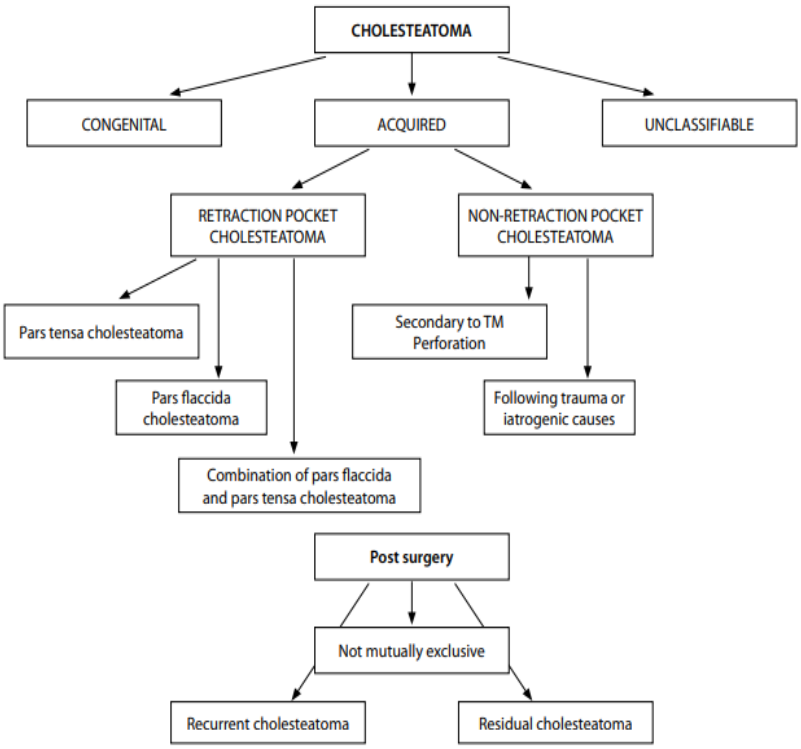


Figure 1 Classification scheme of cholestheatoma

The theory of *pocket retraction* in *primary cholesteatoma* occurs in dysfunction of the eustachian tubes that causes vacuum conditions in the tympanic cavber, thus pulling segments from the tympanic membrane (most often pars flaksida) forming as pockets. The laxicide pars on the tympanic membrane is the most common part for cholesteatoma to occur, due to its thinner layer than the pars tensa. The vacuum condition of the middle ear can cause retraction of the tympanic membrane, however if this process takes longer in the epitimpanum region, the aditus ad antrum will become blocked at the beginning of the course of the disease and will fill with mucus or inflammatory tissue (such as granulation). [17.18]

Figure 2 The image of the white arrow showing the retraction of the poket in the atik and the red circle showing atelectasis in the Prussack space and the yellow arrow showing the erosion of the scutum

The theory of *non-retraction pocket* is referred to as *acquired secondary cholesteatomata*. Theories that explain the formation of this cholestetaoma include the theory of migration, metaplasia and basal hyperplasia of cells. The theory of migration occurs when the perforated tympanic membrane as the originator of the squamous epithelium present in the tympanic membrane migrates to the middle ear region . As a result of trauma, the result of surgery or foreign bodies or iatrogenic factors can result in the occurrence of cholestethoma. In the theory of squamous metaplasia, inflammation of the middle ear provokes a transformation of the mucous lining of the ear. This theory involves the alteration or transformation of the epithelium of a layer of kuboid into a squamous epithelium as a result of chronic recurrent otitis media. In the theory of hyperplasia, basal cells of keratinocytes are thought to proliferate and penetrate the basal membrane and extend along *pseudopodia* into the subepithelial space. Although inflammation can trigger proliferation, there is no supporting evidence for what causes these basal cells to migrate to the medial rather than laterally. [7.20pm]

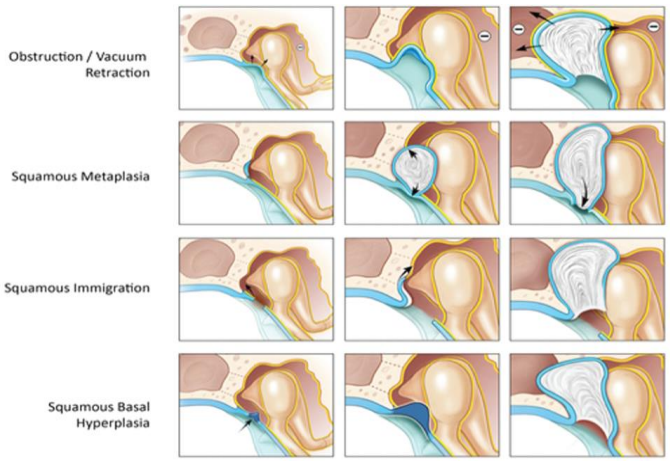


Figure 3 Acquired cholestatoma formation

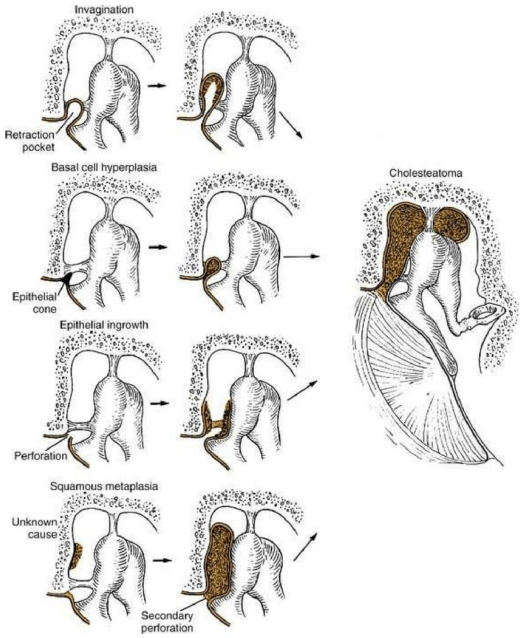


Figure 4 Pathogenesis of cholesteatoma formation

OMSK classification

OMSK can be divided into two types, namely benigna type OMSK (safe type) or commonly called tubotimpani type, involving the anteroinferior part of the middle ear slit and is associated with permanent central perforation. OMSK of this type does not cause serious complications. Malignant-type OMSK is also called the atticoantral type or hazard type, involving the amatic and posterosuperior regions of the middle ear slit. In this type of atik or marginal perforation in the posterosuperior quadrant. In this type is associated with

erosion of the auditory bones due to the presence of cholesteatoma, granulation tissue or osteitis. The complications arising from malignant type OMSK are quite dangerous, one of the complications of OMSK maligna is parese nervus fascialis, due to the progressive, destructive growth of tympanic cholestatoma and is characteristic of omsk maligna. 2 [1.2] [2]

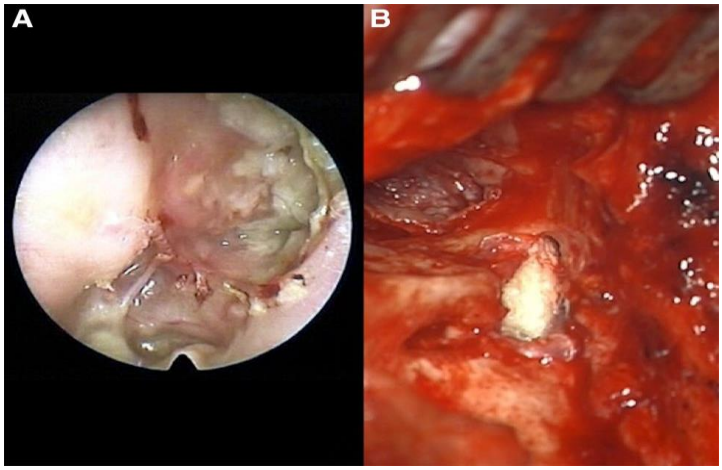


Figure 5. Cholesteatoma in the amatic region and intraoperative cholesteatoma picture

Diagnosis of OMSK with Kolesteatoma

The diagnosis of OMSK with cholesteatoma is established based on anamnesis, physical examination, and supporting examination. Anamnesis to determine the beginning of the disease, previous disease history, risk factors and clinical symptoms. Clinical symptoms can be otore intermiten or persistent. Secretions can be purulent or mucoid and have a characteristic smell (cholesteatoma aroma). Another complaint is hearing loss. Basic ear nose and throat examinations can help in establishing a diagnosis. Nasal examination is carried out in view of the connection between the nose and the ears. Examination of our ears is assessed by inspection, palpation and otoscopy examinations. In the inspection, the outermost ear condition is assessed whether there is an auricle abnormality, pre-auricular and retroauricular area examination to assess whether there is swelling, followed by an ear canal examination whether there are abnormalities and also assessing the perforation of the tympanic membrane. In OMSK with cholesteatoma it is necessary to pay attention to whether there is a preauricular fistula. The condition of the ear canal and secretions coming out of the ear canal also needs to be assessed. The presence of secretions needs to be cleaned first before assessing the state of the tympanic membrane. Secretions can be purulent or

mucoid. A very smelly secretion, grayish-yellow color gives the impression of the presence of cholesteatoma. [23-25]

On otoscopic examination, it is necessary to assess the type of perforation on the tympanic membrane. In the obtained cholesteatoma, an inspection must be carried out on the flaxial region and the anterosuperior mesotimpanum to see the presence of white, round lesions with thin walls like maceration (wet) substances. It is also necessary to assess whether there is granulation, granulation tissue can arise from the bone of the affected outermost wall or scucum and the posterior wall of the octerine aqueous us meatus. In OMSK with cholesteatoama, perforation of the tympanic membrane is usually in the amatic or marginal area. Photo examination of the mastoid (*Schuller*) makes it possible to see the pneumatization of the mastoid, how the processes in it are as well as the state of the lateral sinuses. A computer tomography examination (*CT scan*) is effective in showing the anatomy of the temporal bone and cholesteatoma as well as for determining its expansion. Through computer tomography, it can be assessed variation of temporal bone anatomy including a picture of scure erosion, expansion of the antrum with damaged air cells and soft tissue density characteristics. Other images are osicle digestion, fascial canal erosion, low tympanic segmentation, and semicircular canal erosion. [26-28]

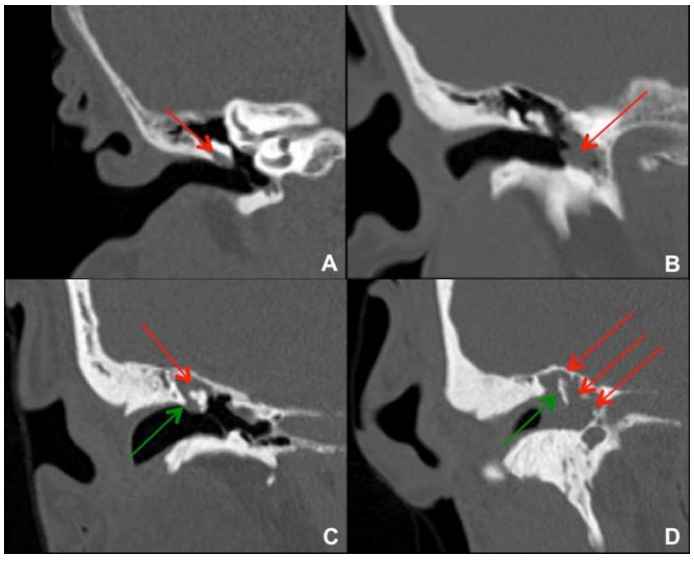


Figure 6 Kolesteatoma appears on computer tomography

Magnetic Resonance Imaging/ MRI examination is useful for detecting middle ear cholesteatoma. A wide variety of *Diffusion Weighted Imaging* (DWI) variations to detect cholesteatoma that apply the principle of molecular diffusion to produce contrast. Keratin debris in cholesteatoma limits water diffusion and results in high signal intensity. Mucosal edema, fibrosis and granulation tissue can cause low signals. With this latest MRI technique, it can detect cholestetoma with a high level of sensitivity. [29]

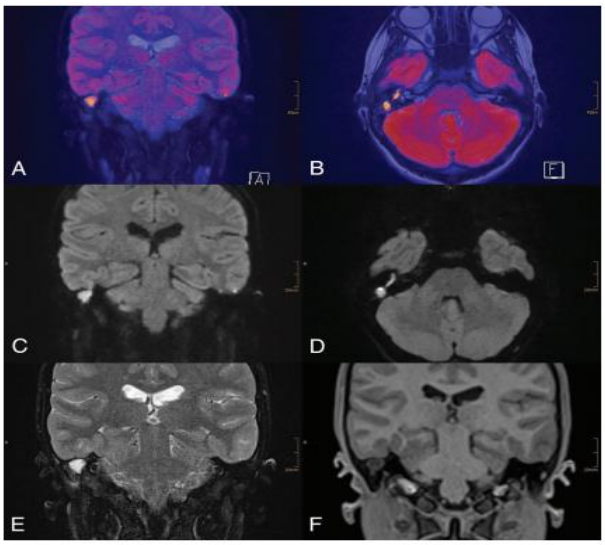


Figure 7. Description of cholesteatoma in MRI

Examination of ear secretion swab cultures is important to determine the bacteria that cause OMSK with cholesteatoma and to determine the appropriate use of antibiotics. Gram-negative, gram-positive aerobic and anaerobic bacteria play a role in OMSK with varying incidences. Audiometric examination of pure tones of OMSK sufferers is used to determine hearing loss in OMSK. Audiogram images in OMSK are usually found with conductive hearing loss, but there can also be mixed or sensorineural hearing loss. [29-31]

Management of OMSK with Kolesteatoma

The management of OMSK can be done with medicamentosa and surgery. Medical treatment with aural toilet, administration of systemic antibiotics and topical antibiotics. The selected antibiotics must have efficacy to irradiate *Pseudomonas aeruginosa* and *Staphylococcus aureu*s, the pathogenic germs that cause OMSK the most. Systemic antibiotics that are widely used are ciprofloxacin, amoxicillin with clavulanic acid and

cefixim because based on several previous studies it has been shown to be sensitive to germs that cause OMSK. Topical antibiotics that can be given are ciprofloxacin ear drops and ofloksasin ear drops. Ofloxacin effectively lowers the symptoms and clinical signs of active OMSK sufferers. Research shows that oplocxacin and ciprofloxacin are equally effective in lowering the clinical symptoms of secretion and perforation and can improve hearing degrees. But the topical preparations that exist in Indonesia are only oplocxacin ear drops while ciprofloxacin ear drops do not yet exist in Indonesia. [29.30]

Surgical therapy is an ideal therapy for the management of OMSK patients with cholesteatoma with the aim of eradication of diseases, dry ears, improvement of hearing function, and for cosmetic reasons. Several studies have integrated several techniques for the management of OMSK with cholesteatoma. Mastoidectomy techniques performed to achieve the definitive goals of OMSK are collapsed wall mastoidectomy (CWD) and intact wall mastoidectomy (CWU). The choice of this surgery depends on the expansion of the cholesteatoma and the digestion of the auditory bone that occurs. The CWD technique is usually chosen when the infection has spread extensively, cholesteatoma that has extended to the mastoid cavum and tympanic cavum, the presence of severe and very severe hearing loss, its pneumatization, destructive hearing bones, and the presence of complications. The surgical approach of collapsed wall mastoidectomy (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 room. Patients with extensive cholesteatoma may have damage to the atics and canal walls. The purpose of this surgery is to obtain a dry ear by removing all pathological tissue and preventing complications to the intracranial but the improvement of the snoring function is not the main goal of this operation. The modification of this operation is to install a tandur (graft) on the operating cavity and make a wide meatoplasty so that the operating cavity is permanently dry but the meatus of the outer ear canal becomes wide. The whole-wall mastoidectomy (CWU) surgery approach is more widely practiced today. CWU mastoidectomy while maintaining the posterior wall of the outer ear canal with or without posterior tympanostomy. The *canal wall up* procedure in OMSK maligna is indicated in patients with limited cholesteatoma in the epitimpanum, the intak auditory bone circuit, as well as good drainage of the mastoid cavity and tympanic cavity. Relative contraindications to the CWU procedure include a sclerotic

mastoid labyrinth fistula, on the only hearing ear, and poor eustachian tube function. In the research of *Ghanie et al*, the most common surgery is CWD because of the high prevalence of cholesteatoma incidence in cases. [31-33]

Complications of OMSK with Cholesteatoma

Various factors influence the occurrence of complications in OMSK. It is very important to know the anatomy of where the infection occurs, the route of spread and the characteristics of the disease itself. The primary pathogenesis of the occurrence of complications is the interaction between the causative microorganism and *the host*. *The host* will respond by forming edema tissue and tissue granulation. When infections in the middle ear and mastoids are not resolved, mucosal edema persists, exudate increases, and mucus spasticity proliferation occurs. Mucosal edema in narrow places between the mesotimpanum and the epithympanum and in the aditus between the epitimpanum and the mastoid antrum inhibits the normal aeration pathway 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, paresis nervus fascialis and labyrinth fistula. Intracranial complications consist of extradural abscesses or granulation tissues, thrombophlebitis of the sigmoid sinuses, brain abscesses, otic hydrocephalus, meningitis and subdural abscesses. When complications occur, symptoms usually develop rapidly. Fever signals the occurrence of an infectious process of intracranial or extracranial cellulitis. [1,27,30]

Prognosis of OMSK with Cholesteatoma

Safe type OMSK or malignant type can be directly related to hearing bone damage. From this study, the maleus bone is the bone that is most resistant to erosion, while the inkus bone is a bone that often occurs erosion. In malignant type OMSK, there is a tendency to more auditory bone erosion than safe type OMSK. Serious complications caused by malignant type OMSK cause damage to the auditory bones . Several studies have used the

Middle Ear Risk Index (MERI) as one of the reliable measuring instruments to evaluate the likelihood of osicle reconstruction results. MERI was developed by Becvarovski and Kartush which divides intrinsic factors (eustachian tube function, disease severity, and status of the rest of the ocicular chain) and extrinsic factors i.e. expertise of the surgeon (surgical techniques, *stagging*, design and composition of grafts and prostheses) to assess the severity of the disease by assigning specific values for each risk factor and the total number (maximum score = 12). Low risk with values 1-3, medium risk 4-6 and high risk 7-12. MERI groups these factors into prognostic categories. The higher the MERI score, the more severe the degree of disease, the lower the success rate of *graft* / occicle reconstruction, the higher the degree of hearing loss and the worse the patient's quality of life. It is useful to explain to the patient before the surgery to prepare them psychologically. [32-34]

Table 1. *Middle Ear Risk Index* (MERI).

Risk Factors	Risk value
Otorea	
1. Dry	0
2. Wet (intermittent)	1
3. Wet (persistent)	2
4. Always wet (there is a palate gap)	3
Perforation	
None	0
Exist	1
Cholesteatoma	
None	0
Exist	1
Occular Status	
a) M+I+S	0
b) M+S+	1
c) M+S-	2
d) M-S+	3
e) M-S-	4
f) Fixed osicle head	2
g) Fixed stapes	3
Middle ear (granulation or effusion)	

None	0
Exist	1
Previous Operation History	
None	0
Gradual	1
Revision	2

Conclusion→5

Chronic Suppurative Otitis Media (OMSK) is an inflammation of the middle ear mucosa and mastoid chamber that lasts more than 2 months characterized by the presence of perforation of the tympanic membrane and continuous or missing discharge arising from the ear canal. Secretions are diluted or viscous clear or pus. OMSK with cholesteatoma is characterized by perforation that is marginally located or in atik can hit the bone and often give rise to dangerous complications.

References→6

1. Ahmed Z, Khan TZ, Rahim DU. Otogenic complications of otitis media: experience at tertiary care hospital. Mr. J Surg. 2016; 32(1):49-53.
2. Abdel A, Razek KA, Ghonim MR, Ashraf B. Computed Tomography Staging of Middle Ear Cholesteatoma. Pol J Radiol. 2015; 80: 328-333.
3. Kuo CL, et al. Updates and Knowledge Gaps in Cholesteatoma Research. Hindawi Publishing Corporation BioMed Research International. 2015: 1-17
4. Chavada PS. Middle Ear Cholesteatoma : A Study of Correlation Between HRCT Temporal Bone and Intraoperative Surgical Findings. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018;4(5):1212-1219
5. Castle JT. Cholesteatoma Pearls: Practical Points and Update. Head and Neck Pathology. 2018; 12(3): 419–429.

6. Prakash M D, Tarannum Afshan. Role of High Resolution Computed Tomography of Temporal Bone in Preoperative Evaluation of Chronic Suppurative Otitis Media. International Journal of Otolaryngology and Head Neck Surgery. 2018; Vol 4: 5.
7. Chatterjee, Pritam, Swagata Khanna, Ramen Talukdar. Role of High Resolution Computed Tomography of Mastoids in Planning Surgery for Chronic Suppurative Otitis Media. Indian J Otolaryngology head and Neck Surgery. 2015; 67(3): 275-280.
8. Gulati M, Gupta S, Prakash A, Garg A, Dixit R. HRCT imaging of acquired cholesteatoma: a pictorial review. Insights into Imaging 2019;10:92.
9. Bluestone, Charles D, et al. Panel reports: Definitions, terminology, and Classification of Otitis Media. Ann Otol Rhinol Laryngol. 2002.
10. Irwan AG, Widyasari F, Suyanti, Gunawan A. Pre and intraoperative findings of chronic otitis media. IOP Conf. Series: Journal of Physics: Conf. Series 1246. 2019.
11. Kartush JM. Ossicular Chain Construction. Otolaryngol Clin North Am. 1994;27:689-715
12. Thangaraj, Ramasundar P, Anandan H. A Study on Ossicular Pathology in Chronic Suppurative Otitis Media. International Journal of Scientific Study. 2017;5 (3): 223-226
13. Rao SR, Rao PR. A Study on Frequency of Ossicular Chain Erosion in CSOM. International Journal of Research in Health Sciences. 2017;5(4):49-53
14. Handoko E, Indrasworo D, Harun A, Salim N. Relationship of cholesteatoma degree to successful radical mastoidectomy surgery in patients with chronic suppurative otitis media. ORLI.2019;49(2): 99-107
15. Wineski LE. Snell's clinical anatomy by regions: head and neck. 10th ed. Philadelphia: Walters Kluwer; 2019.p.1702-13 .

16. Mansour S, Magnan J, Haidar H, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear: middle ear cavity. 2nd ed. London: Springer; 2019.p.19-47.
17. Flint, Paul W, et al. Cummings otolaryngology, Head and Neck Surgery sixth edition vol 1. Elsevier. 2015. p.47-54
18. Frank H. Netter, MD. Atlas of Human Anatomy 7th Edition. Elsevier. 2019.p.35-38
19. Arasan T. New Classification of Ossicular Status and Study In Patients with Ossicular Erosion to be Used for Ossiculoplasty. Otolaryngology online journal. 2017; 7(1):144-53.
20. Luers JC, Huttenbrink KB. Surgical Anatomy and Pathology of the Middle Ear. Journal of Anatomy. 2016;228.p.338-353.
21. Oghalai JS, Brownell WE. Anatomy and Physiology of the Ear. In: Lalwani AK, editor. Current Diagnosis and Treatment Otolaryngology Head and Neck Surgery 4th Edition. New York: Mc Graw Hill.2020.p.715-34.
22. Gacek RR, Gacek MR. Anatomy of the Auditory and Vestibular Systems. In : Wackym, Snow JB, Ballenger JJ. Ballenger'Otorhinolaryngology Head and Neck Surgery 18th Edition. London: People's Medical Publishing House. 2016.p.1-16.
23. Weber PC, Khariwala S. Anatomy and Physiology of Hearing. In: Bailey BJ, Johnson JT, Shawn D editors. Head & Neck Surgery-Otolaryngology 5th Edition Volume 2. Philadelphia : Lippincott Williams & Wilkins. 2014.p.2253-73.
24. Mediawaty D, Widodo P, Ruspita DA. Clinical Effectiveness of Topical Ofloxacin Compared to Oral Ciprofloxacin in Active Chronic Suppurative Otitis Media Therapy. Medica Hospitalia 2017;vol 4 (2):77-83.

25. Ghanie, Abla. Intracranial Complication of Chronic Otitis Media at Mohammad Hoesin Palembang. Journal of Research in Medical and Dental Science. 2017.
26. Aguslia SD. Incidence of Chronic Otitis Media with Cholesteatoma at RSUP Dr. Kariadi Semarang. Medica Hospitalia 2016;vol 4 (1):12-16.
27. Chole RA, Nason R. Ballenger's otorhinolaryngology head and neck surgery: chronic otitis media and cholesteatoma. Wackym PA, editor. USA: PMPH; 2016.p.808-34.
28. Zeitler D, Almosnino G. K.J. Lee's essential otolaryngology head and neck surgery: infections of the temporal bone. 12th ed. Chan Y, Goddard JC, editors. New York: McGraw-Hill Education; 2019. P.402-10
29. Yung, Matthew, et al. EAONO/JOS Joint Consensus Statements on the Definitions, Classification and Staging of Middle Ear Cholesteatoma. The Journal of International Advanced Otology. 2017; 13(1): 1-8
30. Hamed A. Pathogenesis and Bone Resorption in Acquired Cholesteatoma : Current Knowledge and Future Prospectives. Clinical and Experimental Otorhinolaryngology. 2016;9(4): 298-308.
31. Jackler RK, Santa Maria PL, Varav KY, Gguyen A, Blevins NB. A New Theory on Pathogenesis of Acquired Cholesteatoma: Mucosal Traction. Laryngoscope. 2015;125 (4): 1-14
32. Dhingra PL, Shruti D. Diseases of Ear, Nose and Throat 7th Edition. India: Elsevier. 2017.p.3-40
33. Browning GG, Merchant SN, Kelly G, Swan IR, et al. Chronic Otitis Media. In: Gleeson M, Burton JM Editor. Scott-Brown's Otolaryngology 8th Edition. Great Brittain: CRC Press Taylor and Francis Group. 2018.p.3395-445.

34. Fischer N, et al. Readout-Segmented Echo-Planar DWI for the Detection of Cholesteatomas: Correlation with Surgical Validation. AJNR am J neuroradiol . 2019;40:1055–59

Reviewer Comment:

1→ Title of Manuscripts should be explained main review and declared type of literature review: narrative or systematic review.
2→ Keywords should be showed the main words of the study, the authors can use MeSH to develop keywords.
3→ Abstract should be showed the main of background, main of review and conclusion of study.
4→Introduction should be showed the urgency of study (epidemiology data), biological plausibility concept, and lack of knowledge in the study.
5→ Conclusion should more specific and not more showed more review.
6→ Authors must check the references for make update references. References should no more than 10 years.

Revised version received by journal (March 25th, 2022)

Archives of The Medicine and Case Reports Vol 3 Issue 2 2022

Archives of The Medicine and Case Reports
Journal Homepage: https://hmpublisher.com/index.php/AMCR/index
eISSN: 2747-2051

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

Rachmat Hidayat[1#]

[1] Department of Biology, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

ARTICLE INFO

Keywords:
Chronic suppurative otitis media
Cholesteatoma
Pathophysiology
Clinical

***Corresponding author:**
Rachmat Hidayat

E-mail address:
rachmathidayat@fk.unsri.ac.id

The author has reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/AMCR.v3i2.175

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]

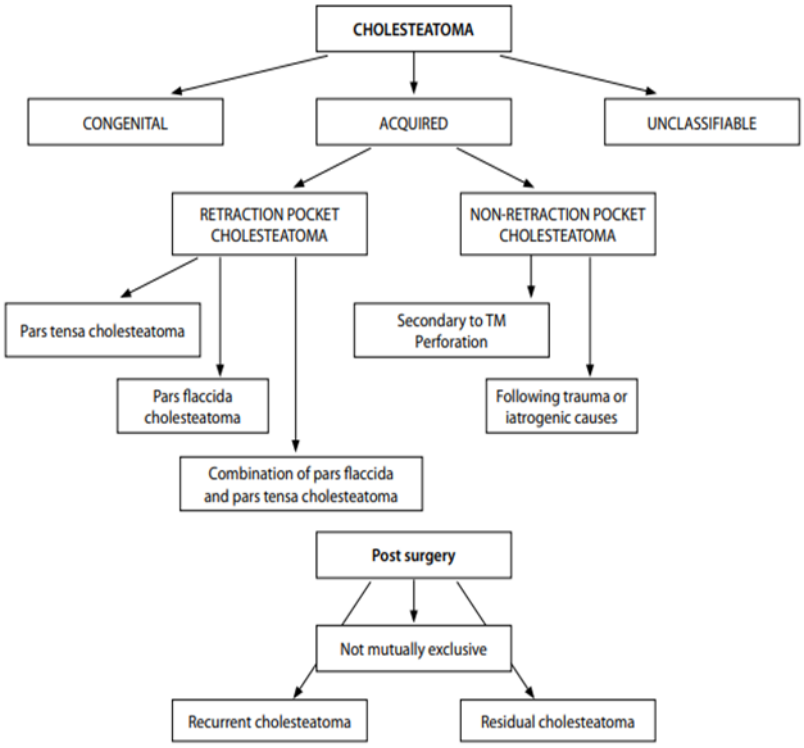


Figure 1. Classification schematic of cholesteatoma

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]

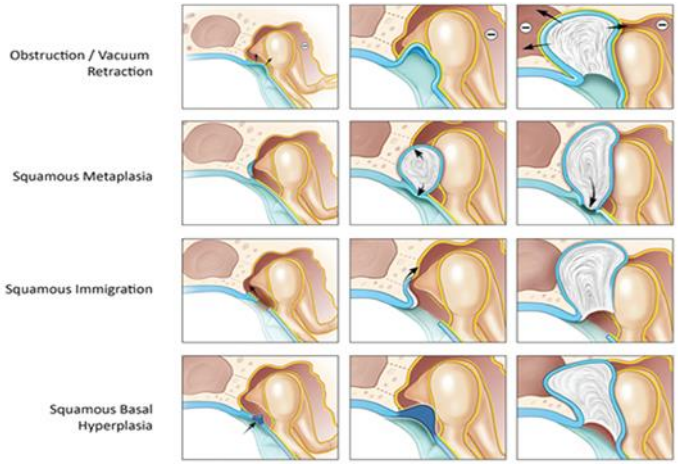


Figure 3. Acquired cholesteatoma formation

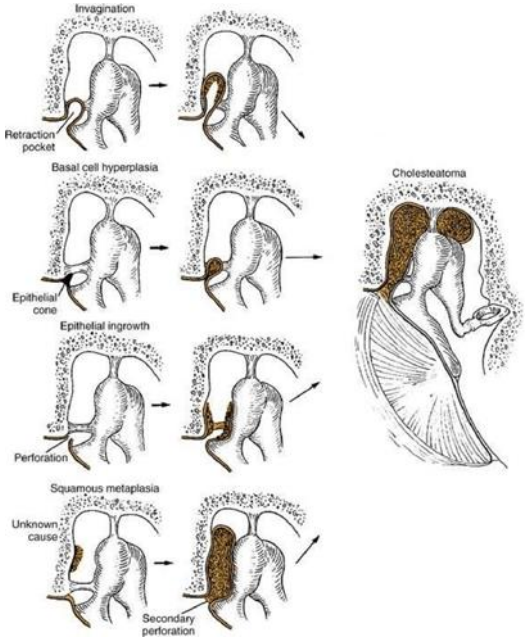


Figure 4. Pathogenesis of cholesteatoma formation

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]

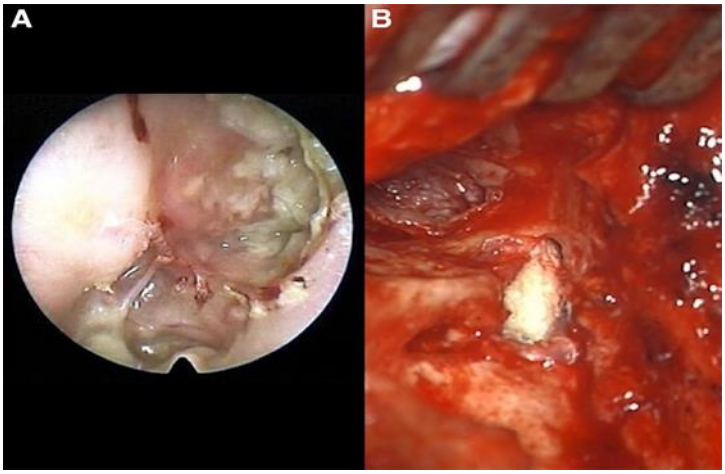


Figure 5. Cholesteatoma in the atic region and intraoperative cholesteatoma picture

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]

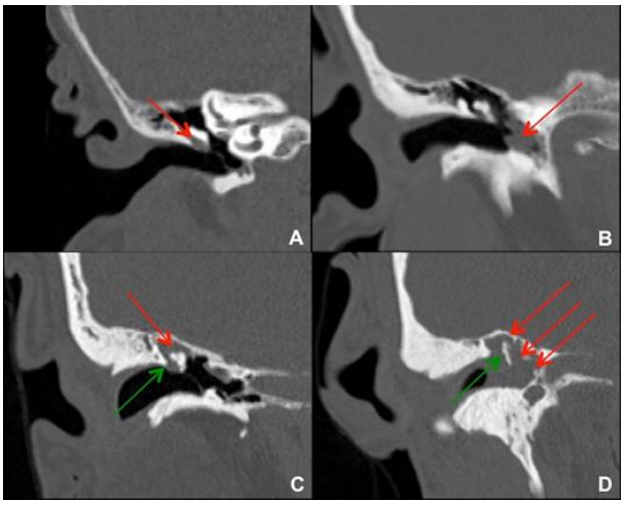


Figure 6. Cholesteatoma seen on computer tomography

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]

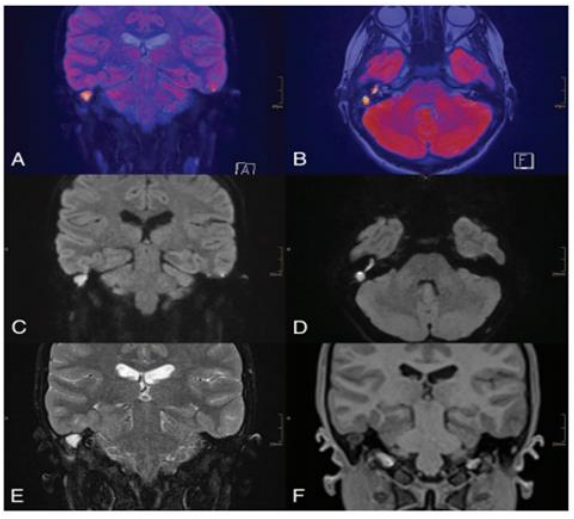


Figure 7. Description of cholesteatoma on MRI

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.

3. References

1. Ahmed Z, Khan TZ, Rahim DU. Otogenic complications of otitis media: experience at tertiary care hospital. Mr J Surg. 2016; 32(1): 49-53.
2. Abdel A, Razek KA, Ghonim MR, Ashraf B. Computed tomography staging of middle ear cholesteatoma. Pol J Radiol. 2015; 80: 328-333.
3. Kuo CL, et al. Updates and knowledge gaps in cholesteatoma research. Hindawi Publishing Corporation BioMed Research International. 2015: 1-17
4. Chavada PS. Middle ear cholesteatoma: A study of correlation between HRCT temporal bone and intraoperative surgical findings. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018; 4(5): 1212-1219
5. Castle JT. Cholesteatoma pearls: Practical points and update. Head and Neck Pathology. 2018; 12(3): 419–429.
6. Prakash MD, Tarannum Afshan. Role of high resolution computed tomography of temporal bone in preoperative evaluation of chronic suppurative otitis media. International Journal of Otolaryngology and Head Neck Surgery. 2018; 4: 5.
7. Chatterjee, Pritam, Swagata Khanna, Ramen Talukdar. Role of high resolution computed tomography of mastoids in planning surgery for chronic suppurative otitis media. Indian J Otolaryngology head and neck surgery. 2015; 67(3): 275-280.
8. Gulati M, Gupta S, Prakash A, Garg A, Dixit R. HRCT imaging of acquired cholesteatoma: a pictorial review. Insights into Imaging 2019; 10:92.
9. Bluestone, Charles D, et al. Panel reports: Definitions, terminology, and Classification of Otitis Media. Ann Otol Rhinol Laryngol. 2002.
10. Irwan AG, Widyasari F, Suyanti, Gunawan A. Pre and intraoperative findings of chronic otitis media. IOP Conf. Series: Journal of Physics: Conf. Series 1246. 2019.
11. Kartush JM. Ossicular Chain Construction. Otolaryngol Clin North Am. 1994; 27: 689-715
12. Thangaraj, Ramasundar P, Anandan H. A study on ossicular pathology in chronic suppurative otitis media. International Journal of Scientific Study. 2017; 5(3): 223-226
13. Rao SR, Rao PR. A study on frequency of ossicular chain erosion in CSOM. International Journal of Research in Health Sciences. 2017; 5(4): 49-53
14. Handoko E, Indrasworo D, Harun A, Salim N. The relationship between the degree of cholesteatoma and the success of radical mastoidectomy in patients with chronic suppurative otitis media. ORLI. 2019; 49(2): 99-107
15. Wineski LE. Snell's clinical anatomy by regions: head and neck. 10thed. Philadelphia: Walters Kluwer; 2019; 1702-13.
16. Mansour S, Magnan J, Haidar H, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear: middle ear cavity. 2nded. London: Springer; 2019; 19-47.
17. Flint, Paul W, et al. Cummings otolaryngology, Head and Neck Surgery sixth edition vol 1. Elsevier. 2015; 47-54.
18. Frank H. Netter, MD. Atlas of human anatomy 7thEdition. Elsevier. 2019; 35-38.

19. Arasan T. New classification of ossicular status and study in patients with ossicular erosion to be used for ossiculoplasty. Otolaryngology online journal. 2017; 7(1): 144-53.
20. Luers JC, Huttenbrink KB. Surgical anatomy and pathology of the middle ear. Journal of Anatomy. 2016; 228: 338-353.
21. Oghalai JS, Brownell WE. Anatomy and physiology of the ear. In: Lalwani AK, editor. Current Diagnosis and Treatment Otolaryngology Head and Neck Surgery 4th Edition. New York: McGraw Hill.2020; 715-34.
22. Gacek RR, Gacek MR. Anatomy of the auditory and vestibular systems. In: Wackym, Snow JB, Ballenger JJ. Ballenger'Otorhinolaryngology Head and Neck Surgery 18th Edition. London: People's Medical Publishing House. 2016; 1-16.
23. Weber PC, Khariwala S. Anatomy and physiology of hearing. In: Bailey BJ, Johnson JT, Shawn D editors. Head & Neck Surgery-Otolaryngology 5th Edition Volume 2. Philadelphia: Lippincott Williams & Wilkins. 2014; 2253-73.
24. Mediawati D, Widodo P, Ruspita DA. Clinical effectiveness of topical ofloxacin compared oral ciprofloxacin in the treatment of active chronic suppurative otitis media. Medica Hospitalia 2017; 4(2): 77-83.
25. Ghanie, Abla. Intracranial complication of chronic otitis media at Mohammad Hoesin Palembang. Journal of Research in Medical and Dental Science. 2017.
26. Aguslia SD. Incidence of chronic otitis media with cholesteatoma in Dr. Kariadi Semarang. Medica Hospitalia 2016; 4(1): 12-16.
27. Chole RA, Nason R. Ballenger's otorhinolaryngology head and neck surgery: chronic otitis media and cholesteatoma. Wackym PA, editor. USA: PMPH; 2016; 808-34.
28. Zeitler D, Almosnino GKJ Lee's essential otolaryngology head and neck surgery: infections of the temporal bone. 12thed. Chan Y, Goddard JC, editors. New York: McGraw-Hill Education; 2019; 402-10
29. Yung, Matthew, et al. EAONO/JOS joint consensus statements on the definitions, classification, and staging of middle ear cholesteatoma. The Journal of International Advanced Otology. 2017; 13(1): 1-8
30. Hamed A. Pathogenesis and bone resorption in acquired cholesteatoma: current knowledge and future prospectives. Clinical and Experimental Otorhinolaryngology. 2016; 9(4): 298-308.
31. Jackler RK, Santa Maria PL, Varav KY, Gguyen A, Blevins NB. A new theory on pathogenesis of acquired cholesteatoma: Mucosal traction. Laryngoscope. 2015; 125 (4): 1-14
32. Dhingra PL, Shruti D. Diseases of ear, nose and throat 7th Edition. India: Elsevier. 2017; 3-40
33. Browning GG, Merchant SN, Kelly G, Swan IR, et al. Chronic otitis media. In: Gleeson M, Burton JM Editor. Scott-Brown's Otolaryngology 8thEdition. Great Brittain: CRC Press Taylor and Francis Group. 2018; 3395-445.
34. Fischer N, et al. Readout-segmented echo-planar dwi for the detection of cholesteatomas: correlation with surgical validation. AJNR Am J Neuroradiol. 2019; 40: 1055–59.

Paper Accepted for publication (March 31th, 2022)

Archives of The Medicine and Case Reports

HM Publisher

Letter of Acceptance

Manuscript "Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review" by Rachmat Hidayat*, has been accepted to publish in Archives of The Medicine and Case Reports Vol 3 issue 2 in April 2022.

Cordially,

Prof. Paula Magnano, PhD

Editor HM Publisher

(*) Corresponding author

The Coresponding Author can access the acount in website :

https://hmpublisher.com/index.php/AMCR/login

User: rachmat_hidayat

Password: 210587

Archives of The Medicine and Case Reports
Journal Homepage: https://hmpublisher.com/index.php/AMCR/index
eISSN: 2747-2051

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

Rachmat Hidayat[1#]

[1] Department of Biology, Faculty of Medicine, Universitas Sriwijaya, Palembang, Indonesia

ARTICLE INFO

Keywords:
Chronic suppurative otitis media
Cholesteatoma
Pathophysiology
Clinical

***Corresponding author:**
Rachmat Hidayat

E-mail address:
rachmathidayat@fk.unsri.ac.id

The author has reviewed and approved the final version of the manuscript.

https://doi.org/10.37275/AMCR.v3i2.175

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 characte rized 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 Ghaz[illegible] 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 (23.8%) 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 mirabilis* and *Klebsiella pneumonia* (16.7%), while single microbial growth includes *Escherichia coli* and *Staphylococcus aureus*. 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]

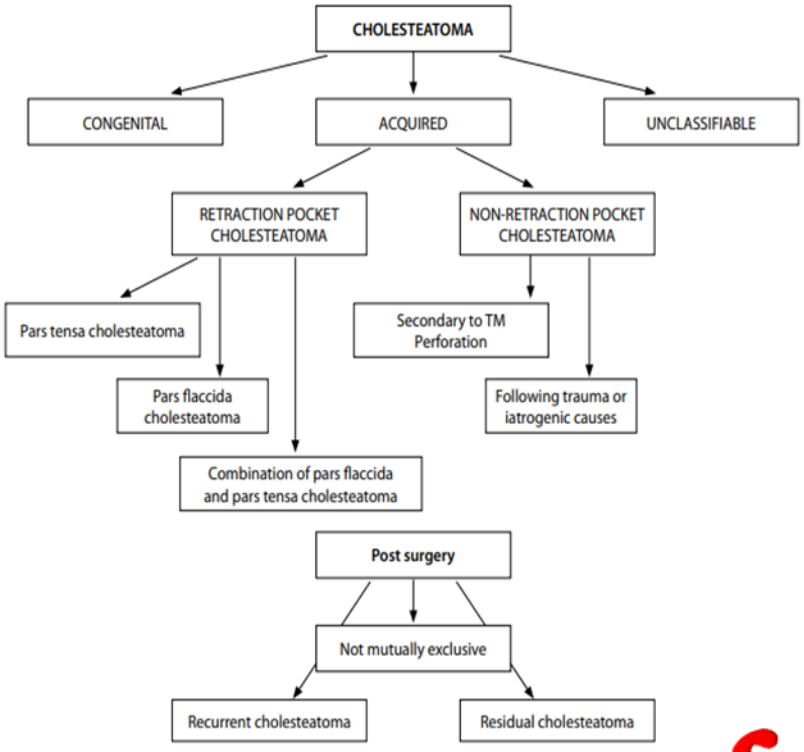


Figure 1. Classification schematic of cholesteatoma

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]

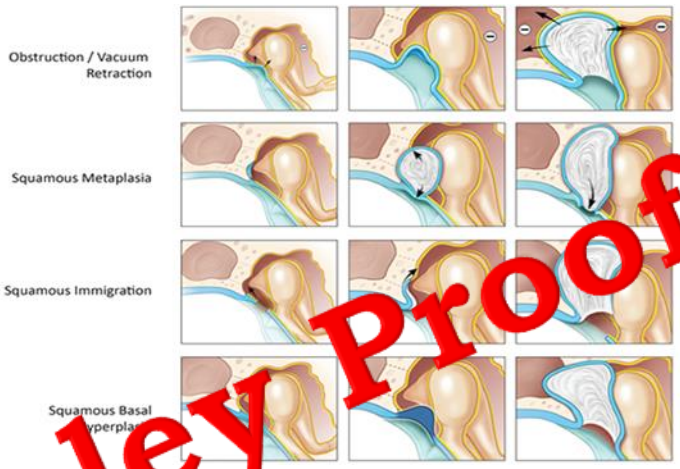


Figure 3. Acquired cholesteatoma formation

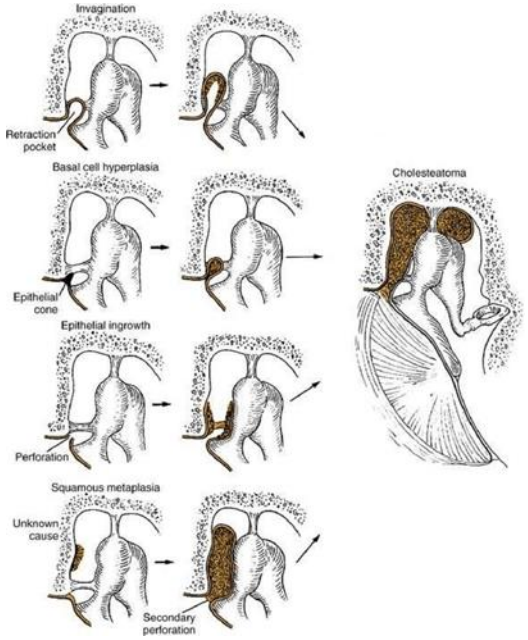


Figure 4. Pathogenesis of cholesteatoma formation

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]

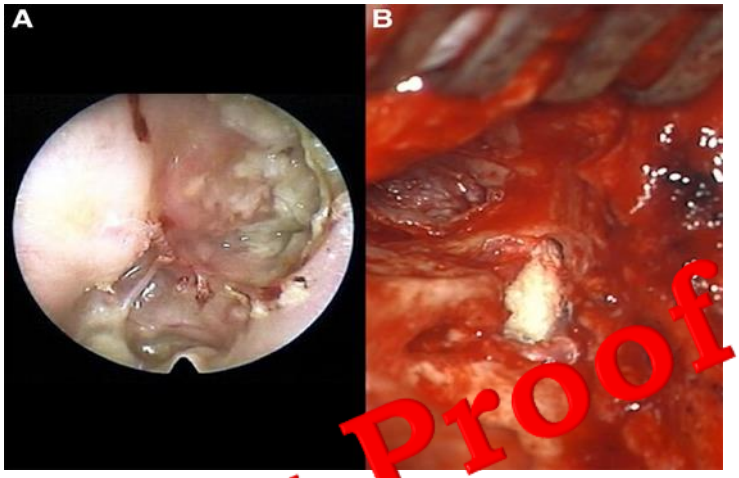


Figure 5. Cholesteatoma in the attic region and intraoperative cholesteatoma picture

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 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 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 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]

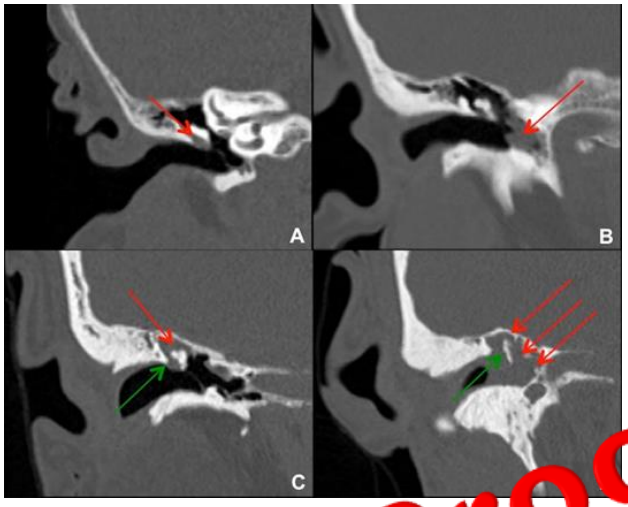


Figure 6. Cholesteatoma seen [illegible] computer tomography

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]

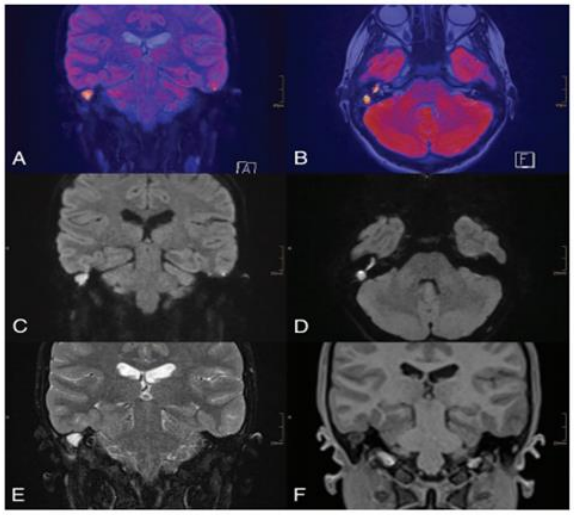


Figure 7. Description of cholesteatoma on MRI

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, 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 the study, the malleus was the most resistant to erosion while the incus was the bone that often eroded in malignant type CSOM, 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 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.

3. References

1. Ahmed Z, Khan TZ, Rahim DU. Otogenic complications of otitis media: experience at tertiary care hospital. Mr J Surg. 2016; 32(1): 49-53.
2. Abdel A, Razek KA, Ghonim MR, Ashraf B. Computed tomography staging of middle ear cholesteatoma. Pol J Radiol. 2015; 80: 328-333.
3. Kuo CL, et al. Updates and knowledge gaps in cholesteatoma research. Hindawi Publishing Corporation BioMed Research International. 2015: 1-17
4. Chavada PS. Middle ear cholesteatoma: A study of correlation between HRCT temporal bone and intraoperative surgical findings. International Journal of Otorhinolaryngology and Head and Neck Surgery. 2018; 4(5): 1212-1219
5. Castle JT. Cholesteatoma pearls: Practical points and update. Head and Neck Pathology. 2018; 12(3): 419–429.
6. Prakash MD, Tarannum Afshan. Role of high resolution computed tomography of temporal bone in preoperative evaluation of chronic suppurative otitis media. International Journal of Otolaryngology and Head Neck Surgery. 2018; 4: 5.
7. Chatterjee, Pritam, Swagata Khanna, Ramen Talukdar. Role of high resolution computed tomography of mastoids in planning surgery for chronic suppurative otitis media. Indian J Otolaryngology head and neck surgery. 2015; 67(3): 275-280.
8. Gulati M, Gupta S, Prakash A, Garg A, Dixit R. HRCT imaging of acquired cholesteatoma: a pictorial review. Insights into Imaging 2019; 10:92.
9. Bluestone, Charles D, et al. Panel reports: Definitions, terminology and Classification of Otitis Media. Ann Otol Rhinol Laryngol. 2002.

10. Irwan AG, Widyasari F, Suyanti, Gunawan A. Pre and intraoperative findings of chronic otitis media. IOP Conf. Series: Journal of Physics: Conf. Series 1246. 2019.
11. Kartush JM. Ossicular Chain Construction. Otolaryngol Clin North Am. 1994; 27: 689-715
12. Thangaraj, Ramasundar P, Anandan H. A study on ossicular pathology in chronic suppurative otitis media. International Journal of Scientific Study. 2017; 5(3): 223-226
13. Rao SR, Rao PR. A study on frequency of ossicular chain erosion in CSOM. International Journal of Research in Health Sciences. 2017; 5(4): 49-53
14. Handoko E, Indrasworo D, Harun A, Salim N. The relationship between the degree of cholesteatoma and the success of radical mastoidectomy in patients with chronic suppurative otitis media. ORLI. 2019; 49(2): 99-107
15. Wineski LE. Snell's clinical anatomy by regions: head and neck. 10thed. Philadelphia: Walters Kluwer; 2019; 1702-13.
16. Mansour S, Magnan J, Haidar H, Nicolas K, Louryan S. Comprehensive and clinical anatomy of the middle ear: middle ear cavity. 2nded. London: Springer; 2019; 19-47.
17. Flint, Paul W, et al. Cummings otolaryngology, Head and Neck Surgery sixth edition vol 1. Elsevier. 2015; 47-54.
18. Frank H. Netter, MD. Atlas of human anatomy 7thEdition. Elsevier. 2019; 35-38.
19. Arasan T. New classification of ossicular status and study in patients with ossicular erosion to be used for ossiculoplasty. Otolaryngology online journal. 2017; 7(1): 144-53.
20. Luers JC, Huttenbrink KB. Surgical anatomy and pathology of the middle ear. Journal of Anatomy. 2016; 228: 338-353.
21. Oghalai JS, Brownell WE. Anatomy and physiology of the ear. In: Lalwani AK, editor. Current Diagnosis and Treatment Otolaryngology Head and Neck Surgery 4th Edition. New York: McGraw Hill.2020; 715-34.
22. Gacek RR, Gacek MR. Anatomy of the auditory and vestibular systems. In: Wackym, Snow JB, Ballenger JJ. Ballenger'Otorhinolaryngology Head and Neck Surgery 18th Edition. London: People's Medical Publishing House. 2016; 1-16.
23. Weber PC, Khariwala S. Anatomy and physiology of hearing. In: Bailey BJ, Johnson JT, Shawn D editors. Head & Neck Surgery-Otolaryngology 5th Edition Volume 2. Philadelphia: Lippincott Williams & Wilkins. 2014; 2253-73.
24. Mediawati D, Widodo P, Ruspita DA. Clinical effectiveness of topical ofloxacin compared oral ciprofloxacin in the treatment of active chronic suppurative otitis media. Medica Hospitalia 2017; 4(2): 77-83.
25. Ghanie, Abla. Intracranial complication of chronic otitis media at Mohammad Hoesin Palembang. Journal of Research in Medical and Dental Science. 2017.
26. Aguslia SD. Incidence of chronic otitis media with cholesteatoma in Dr. Kariadi Semarang. Medica Hospitalia 2016; 4(1): 12-16.
27. Chole RA, Nason R. Ballenger's otorhinolaryngology head and neck surgery: chronic otitis media and cholesteatoma. Wackym PA, editor. USA: PMPH; 2016; 808-34.
28. Zeitler D, Almosnino GKJ Lee's essential otolaryngology head and neck surgery: infections of the temporal bone. 12thed. Chan Y, Goddard JC, editors. New York: McGraw-Hill Education; 2019; 402-10
29. Yung, Matthew, et al. EAONO/JOS joint consensus statements on the definitions, classification, and staging of middle ear cholesteatoma. The Journal of International Advanced Otology. 2017; 13(1): 1-8
30. Hamed A. Pathogenesis and bone resorption in acquired cholesteatoma: current knowledge and future prospectives. Clinical and Experimental Otorhinolaryngology. 2016; 9(4): 298-308.

31. Jackler RK, Santa Maria PL, Varav KY, Gguyen A, Blevins NB. A new theory on pathogenesis of acquired cholesteatoma: Mucosal traction. Laryngoscope. 2015; 125 (4): 1-14
32. Dhingra PL, Shruti D. Diseases of ear, nose and throat 7th Edition. India: Elsevier. 2017; 3-40
33. Browning GG, Merchant SN, Kelly G, Swan IR, et al. Chronic otitis media. In: Gleeson M, Burton JM Editor. Scott-Brown's Otolaryngology 8thEdition. Great Brittain: CRC Press Taylor and Francis Group. 2018; 3395-445.
34. Fischer N, et al. Readout-segmented echo-planar dwi for the detection of cholesteatomas: correlation with surgical validation. AJNR Am J Neuroradiol. 2019; 40: 1055–59.

CERTIFICATE

OF PUBLICATION

For the article titled:

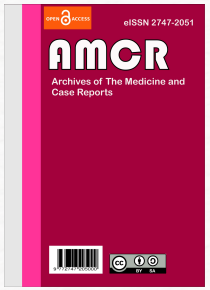
Pathophysiological to Clinical Aspects of Chronic Suppurative Otitis Media (CSOM): Narrative Literature Review

Authored by;

Rachmat Hidayat

Published in

Archives of The Medicine and Case Reports Volume 3 Issue 2 2022



Indexed in:

GARUDA GARBA RUJUKAN DIGITAL

Google Scholar

INDEX COPERNICUS INTERNATIONAL

Dimensions