

Chronic Suppurative Otitis Media Pathogenesis and Surgical Management with Emphasis on Myringoplasty and Cortical Mastoidectomy

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Abstract

Background: Chronic suppurative otitis media (CSOM) is an inflammation of the middle ear cleft that manifests as recurrent ear discharge that lasts between six weeks and three months and comes from a rupture in the tympanic membrane. Chronic suppurative otitis media can be categorized into two types; benign CSOM (safe type) or commonly called tubo-tympanic type, associated with permanent central perforation, which does not cause serious complications, and malignant CSOM, also called attico-antral type.

Objective: There are a number of studies in the literature highlighting the advantages and disadvantages of performing mastoidectomy in the surgical treatment of mucosal type of chronic otitis media.

Conclusion: Role of mastoidectomy in the repair of tympanic membrane perforation has long been debated. Mastoidectomy was regarded as a means of surgically creating an air reservoir and eradicating sequestered mastoid disease. Myringoplasty is a repair of the perforation of the tympanic membrane. Cortical mastoidectomy involves the eradication of the source of infection in the mastoid and improves pneumatization although it has a risk of squamous epithelium ingrowth, injury to vital structures like facial nerve and inner ear structure. Aeration of the middle ear and pressure regulation is achieved by the mastoid. Mastoid will act as infection nidus if there is a failure to relieve the atticoantral block leading to surgical failure.

Keywords: Chronic Suppurative Otitis Media; Safe Type; Myringoplasty; Cortical Mastoidectomy; Tympanic Membrane Perforation.

Introduction

Chronic suppurative otitis media is an inflammation of the middle ear cleft that manifests as recurrent ear discharge that lasts between six weeks and three months and comes from a rupture in the tympanic membrane. This syndrome can develop as a result of acute otitis media or as a result of retraction pocket formation and eustachian tube dysfunction. As a result of a spontaneous tympanic membrane perforation, the pathogenesis may begin in childhood ⁽¹⁾.

Chronic suppurative otitis media can be categorized into two types; benign CSOM (safe type) or commonly called tubo-tympanic type, associated with permanent central perforation, which does not cause serious complications, and malignant CSOM, also called attico-antral type. This type is associated with ossicular erosion due to cholesteatoma, granulation tissue, or osteitis. Complications that arise from malignant CSOM are quite dangerous ⁽²⁾.

Myringoplasty is an operative procedure, in which the reconstructive procedure is limited to repair of tympanic membrane perforation. Implicit in the definition is that the ossicular chain is intact and mobile, and the middle ear is disease free. There are a number of studies in the literature highlighting the advantages and disadvantages of performing mastoidectomy in the surgical treatment of mucosal type of chronic otitis media.

Role of mastoidectomy in the repair of tympanic membrane perforation has long been debated. Mastoidectomy was regarded as a means of surgically creating an air reservoir and eradicating sequestered mastoid disease ⁽³⁾.

Myringoplasty is a repair of the perforation of the tympanic membrane. Cortical mastoidectomy involves the eradication of the source of infection in the mastoid and improves pneumatization although it has a risk of squamous epithelium ingrowth, injury to vital structures like facial nerve and inner ear structure. Aeration of the middle ear and pressure regulation is achieved by the mastoid.5 Mastoid will act as infection nidus if there is a failure to relieve the attic-antral block leading to surgical failure. Fig and Fig show the intraoperative images when mastoidectomy is performed ⁽⁴⁾.

Definition and Types

Chronic suppurative otitis media is an inflammation of the middle ear cleft that manifests as recurrent ear discharge that lasts between six weeks and three months and comes from a rupture in the tympanic membrane. This syndrome can develop as a result of acute otitis media or as a result of retraction pocket formation and eustachian tube dysfunction. As a result of a spontaneous tympanic membrane perforation, the pathogenesis may begin in childhood ⁽¹⁾.

Chronic suppurative otitis media can be categorized into two types; benign CSOM (safe type) or commonly called tubo-tympanic type, associated with permanent central perforation, which does not cause serious complications, and malignant CSOM, also called attic-antral type. This type is associated with ossicular erosion due to cholesteatoma, granulation tissue, or osteitis. Complications that arise from malignant CSOM are quite dangerous ⁽²⁾.

Epidemiology and Etiology

Previous epidemiological reviews of CSOM are based on limited number of published literature. A 2004 study by the World Health Organization (WHO) estimated prevalence at anywhere between 65 and 330 million individuals, and a 2012 systematic review based on data up until 2008 estimated this at 200 million ⁽⁵⁾.

These studies may no longer reflect current disease burden, with the 2004 study based on data now more than 40 years old, and the 2012 study utilising a broad and imprecise definition of CSOM. Updated estimates can help guide healthcare resource allocation and policy interventions, particularly in low- and middle-income countries (LMICs) where CSOM is a major cause of preventable hearing loss ⁽⁶⁾.

A global CSOM prevalence of 3.8%. Of those affected, 85% live in LMICs, with the highest prevalence found in low-income countries. This principal finding confirms CSOM as a major global disease, and emphasizes the need for heightened awareness, and a need for increased health resources and public health approaches to combat disease. Beyond its clinical impact, CSOM also carries economic implications (particularly in LMICs), through healthcare treatment costs, chronic disability affecting employment and education ⁽⁶⁾.

Etiology

Genetic, environmental, and eustachian tube (ET) anatomical and functional traits are all part of the multifactorial pathophysiology of CSOM ⁽⁷⁾. Even if the relationship between acute and chronic otitis media may seem uncertain the development of CSOM is typically insidious. Frequent episodes of acute otitis media, various respiratory tract infections, and traumatic tympanic rupture are risk factors for CSOM. Living situations with inadequate resources, such as overcrowding, poor nutrition, and hygiene, as well as persistent infectious diseases, are other contributing factors ⁽⁸⁾.

Children with eustachian tube dysfunction (as in cases of cleft palate and Down's syndrome, as well as a patulous ET allowing nasopharyngeal reflux), mucosal immune system (MIS) deficiencies (specific to URT mucosa immunity and atopy), systemic immune deficiency (abnormalities of humoral immune system and cell-mediated immunity), and inadequate mastoid pneumatization are among the patients who are most susceptible to CSOM ⁽⁹⁾.

The microbiota identified in chronic suppurative otitis media (CSOM) include potential pathogens such as aerobes, anaerobes, and fungi. Nonetheless, the reported profile and frequency of these microorganisms vary depending on the patient's age, location, and the presence of complications like cholesteatoma ⁽¹⁰⁾.

A polymicrobial etiology is common. *Staphylococcus aureus* (MRSA) is the most frequent microbial species identified in this condition. Other pathogens that can cause the disease include *Pseudomonas aeruginosa*, *Proteus* species, *Klebsiella* species, *Bacteroides* species, and *Fusobacterium* species. *Aspergillus* spp. and *Candida* spp. are less common microbes that are more usually detected in immunocompromised people ⁽¹¹⁾. Chronic suppurative otitis media can also be caused by tuberculosis; however, it is more typical in regions where the disease is prevalent ⁽¹²⁾.

Several risk factors can contribute to the development of CSOM. It is more commonly observed in children, especially those in lower socioeconomic groups. The immature immune system and higher susceptibility to infections in children increase their risk. Other risk factors include frequent or untreated acute otitis media, inappropriate treatment for ear infections, poor hygiene, and environmental factors such as living in an unclean or overcrowded environment, low socioeconomic status, limited access to healthcare facilities, inadequate healthcare resources, genetic predisposition, malnutrition, and structural abnormalities like cleft palate ⁽¹³⁾.

Other unique factors that increase the likelihood of CSOM include frequent AOM and parents who have had CSOM in the past. Further, allergies can be considered another risk factor, given that certain research studies have indicated the existence of allergens causing hindrance to both the Eustachian tube and nasal passages ⁽¹⁴⁾.

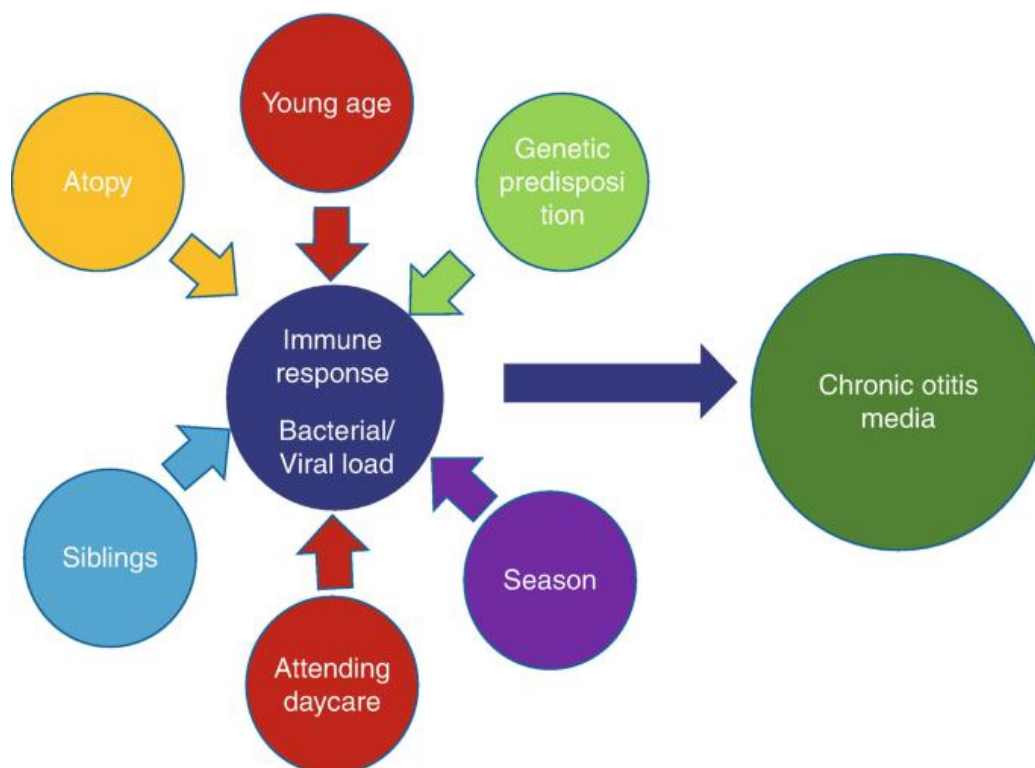


Figure 7. Risk factors for chronic otitis media ⁽¹⁵⁾.

Pathogenesis

Chronic Suppurative Otitis Media (CSOM) is considered a multifactorial disease resulting from a complex series of interactions between environmental, bacterial, host and genetic risk factors ⁽¹⁶⁾. It is important to identify the genes that contribute to CSOM susceptibility, which will provide insights into the biological complexity of this disease and ultimately contribute to improve the methods of prevention and treatment ⁽¹⁷⁾.

Innate host immune mechanisms such as the TLR4/MyD88 pathway are particularly important in eliciting protective immune responses against bacteria ⁽¹⁸⁾. On the other hand, the transforming growth factor- β pathway helps in balancing the adverse outcome of an exaggerated pro-inflammatory response. The roles of these pathways have been extensively studied in AOM; however, no studies are available in relation to CSOM ⁽¹⁹⁾.

Bacterial biofilms have gained attention in the pathogenesis of CSOM. Biofilms are resistant to antibiotics and other antimicrobial compounds ⁽²⁰⁾. Therefore, they are difficult to eradicate and hence could lead to recurrent infections. In addition, biofilms attach firmly to damaged tissue, such as exposed osteitic bone and ulcerated middle ear mucosa, or to otological implants such as tympanostomy tubes, further aggravating the problem of eradication ⁽²¹⁾.

Although biofilms have been demonstrated in the middle ear of CSOM patients, their precise role in the pathophysiology of the disease is yet to be determined. Furthermore, the molecular mechanisms leading to biofilm formation in the middle ear during CSOM are also poorly understood ⁽²²⁾.

Cytokines have also been implicated in the pathogenesis of OM. Most of the studies addressing the role of cytokines are in relation to AOM, and there are very limited studies available demonstrating the role of cytokines in the pathogenesis of CSOM. High levels of inflammatory cytokine such as IL-8 have been demonstrated in the middle ear effusion of CSOM patients ⁽²³⁾. IL-8 plays a role in the development of chronicity of OM and has also been related to bacterial growth. Increased mRNA as well as protein levels of TNF- α , IL-6, IL-1 β and IFN- γ have been found in the middle ear mucosa of CSOM patients compared with healthy individuals. The upregulation of these pro-inflammatory cytokines can cause tissue damage as well as transition from acute to chronic OM. Additional studies are warranted to investigate the role of cytokines in the pathogenesis of CSOM ⁽²⁴⁾.

Management

CSOM carries potential risks of serious complications, some of which may be mortal. If there is an infection and discharge in the middle ear, first step of the management is to control the infection and dry the middle ear. Controlling the infection by a medical treatment is needed not only for increasing the life quality of the patient but also avoiding from complications.

Medical Treatment

The initial treatment for acute episodes of CSOM should be the topical use of antibiotics. The mostly preferred antibiotics are fluoroquinolones, such as ciprofloxacin and ofloxacin. One or two weeks of use is adequate in most of the cases. However, the efficacy of the long-term treatment is unknown regarding the protection of the ear from recurrent infections ⁽²⁵⁾. In addition to the antibiotic ear drops, topical steroids are commonly used to alleviate the inflammation within the middle ear. However, evidence of low certainty suggests that certain topical antibiotics alone may be more effective than combinations of topical antibiotics with steroids at resolving discharge ⁽²⁶⁾. Also, some magistral antiseptic ear drops, such as Boric acid, Burow's, and Castellani's solutions, are used as alternatives for the topical treatment of ear discharge in CSOM patients ⁽²⁷⁾. However, antibiotic ear drops seem to be more effective than topical antiseptics in resolving the discharge ⁽²⁸⁾.

An important point to emphasize is the potential ototoxicity risk of topical ear drops when the eardrum is perforated. Aminoglycosides, known for their ototoxicity, are contraindicated for topical use in these patients. Conversely, quinolones are deemed safe and are the only antimicrobials approved by the United States Food and Drug Administration (FDA) for topical use on a non-intact tympanic membrane ⁽²⁹⁾. Although data on the ototoxic potential of common antiseptics like boric acid and acetic acid are limited and inconclusive, it is prudent to avoid those in the treatment of CSOM when possible. Despite several reports on the ototoxic potential of antiseptic ear drops, the applicability of animal studies to human ototoxicity must be carefully considered due to significant anatomical and physiological differences ⁽³⁰⁾.

Current evidence does not strongly support the use of systemic antibiotics for the treatment of discharge in CSOM, as their effectiveness and side effects remain poorly understood, with little indication that they improve outcomes when used alongside topical treatments. However, systemic use of antibiotics is suggested in complicated CSOM ⁽³¹⁾.

Table 1. Examples of antibiotics classes and agents with anti-Pseudomonas activity ⁽³¹⁾.

Class of antibiotics	Examples	Route of administration
Quinolones	Ciprofloxacin, ofloxacin, levofloxacin	Oral, intravenous, topical
Aminoglycosides	Gentamicin, tobramycin	Topical or parenteral
Aminoglycosides	Neomycin/framycetin	Only topical
Cephalosporins	Ceftazidime	Parenteral
Penicillins	Ticarcillin plus clavulanic acid	Parenteral
Monobactams	Aztreonam	Parenteral

Surgery for CSOM

However, surgery is necessary if there is an infectious condition that requires evacuation or decompression to reduce infection, reconstruct, prevent, and treat infections and complications. Some researchers believe that middle ear and mastoid surgery should be performed on children who fail on maximal medical therapy including IV antibiotics, or recurrent in a relatively short time of about six to eight weeks ⁽³²⁾. The surgery can be performed based on the CSOM type, such as canal wall up and canal wall down, particularly on CSOM with cholesteatoma ⁽³³⁾.

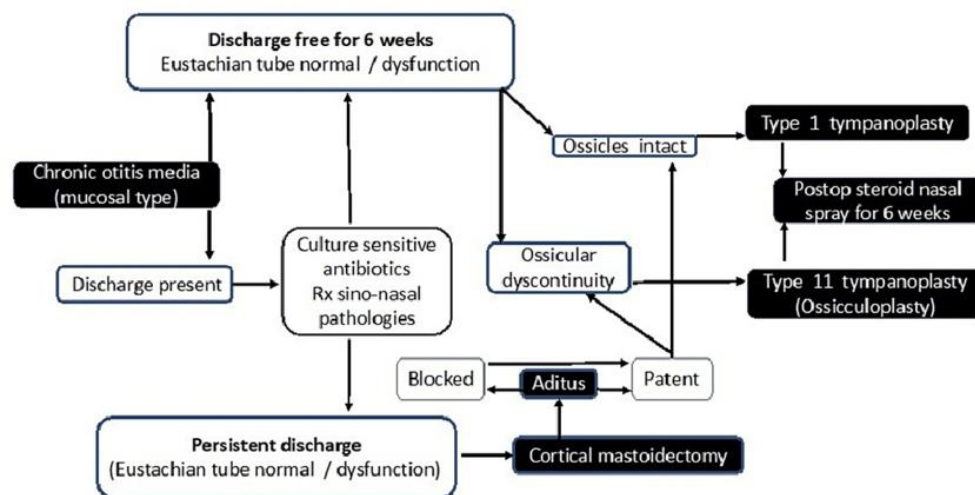


Figure 13. Suggested surgical treatment guidelines for chronic otitis media mucosal disease ⁽³⁴⁾.

Myringoplasty

Myringoplasty

Myringoplasty is a surgical operation to graft and repair a persistent perforated tympanic membrane. Common causes for a perforated tympanic membrane are trauma, infection, and tympanostomy tube extrusion. Persistence of the perforation can lead to hearing impairment and chronic otorrhoea. The indications for myringoplasty are to stop chronic otorrhoea, to waterproof the middle ear, and to improve conductive hearing loss. The outcome of myringoplasty success is achievement of an intact tympanic membrane and a dry, self-cleansing ear, with improvements of hearing loss ⁽³⁵⁾.

With regards to myringoplasty outcomes in the United Kingdom (UK), a 3-year prospective myringoplasty national audit was undertaken and reported in 2015 which evaluated the 3-6 month postoperative outcomes for 33 ENT surgeons and 495 procedures across the UK. The results were that the overall closure rate for myringoplasty

was 89.5% (90.6% for primary surgery and 84.2% for revision surgery, respectively). The average hearing gains for successful primary and revision myringoplasty were 9.14 dB and 7.86 dB, respectively ⁽³⁶⁾.

Indications and Contraindications

Indications ⁽³⁷⁾:

Dry tympanic perforations with normal middle ear mucosa

Marginal perforations

Conductive hearing loss due to the tympanic defect

Eardrum perforation is a risk factor for skin migration from the external auditory canal to the middle ear, with consequent development of a cholesteatoma. Thus, it is strongly recommended to treat it ⁽³⁸⁾.

Contraindications⁽³⁷⁾

Contralateral severe hearing loss should be taken in consideration before approaching the affected ear.

Age <6 years old (relative contraindication): immaturity of the rhino-tympanic tube would affect the surgical results and the reduced size of the EAC could make the transcanal approach more difficult.

Unstable perforations, associated with recurrent otorrhea with or without the appearance of granulation in the tympanic cavity (relative contraindication): these perforations should be addressed after an adequate medical therapy and a consistent period of clinical stability.

Any kind of inflammation of the EAC (i. e., acute eczema): these perforations should be addressed after an adequate medical therapy and a consistent period of clinical stability.

Nasal and rhino-pharyngeal diseases (i. e., allergic chronic rhinitis, adenoid hypertrophy) and/or poor Eustachian tube function: these conditions should be addressed first; nevertheless, in selected cases, when myringoplasty has to be performed, cartilage graft has to be preferred for reconstructing the eardrum as they can provide additional certainty of sealing of the graft.

Surgical Steps of Myringoplasty

The patient lays supine on the surgical table with the head rotated on the contralateral side with respect to the affected ear. It is very important to obtain an angle among the neck and the shoulder as wide as possible during the preoperative setup, in order to facilitate the surgical maneuvers during the procedure. The video equipment should be placed in front of the surgeon. A 15 cm length, 0° angled endoscope (Karl Storz, Tuttlingen, Germany, or similar) is held by the left hand, and the operative instruments by the right hand (for right-handed surgeons). A 3 mm diameter endoscope should be adequate for this kind of surgery. The endoscope is connected to AIDA three-chip high-resolution monitor and camera system (Karl Storz, Tuttlingen, Germany, or similar).

Step 1: Visualization of the Tympanic Membrane and Infiltration of the EAC

Accurate cleaning of the skin of the EAC is mandatory to have a proper view of the tympanic membrane. Infiltration of the skin of the EAC with mepivacaine 3% and 1:1000 epinephrine solution can be performed to reduce bleeding in the canal. This infiltration should be performed at the posterosuperior quadrant of the EAC, where the skin is thicker, and it should be performed slowly in order to determine progressive hydro-dissection of the skin from the bony EAC. External auditory canal hair trimming can be executed while the adrenalized solution becomes effective. This avoids continuous necessity to clean the tip of the endoscope during in and out movements through the external auditory canal.

Step 2: Scratching of the Edges of the Perforation

A crescent-shaped scalpel, a hook, or a sickle knife can be used to scratch the edges of the perforation in order to remove the fibrotic margins that could jeopardize the graft take. During this step, the size of the perforation could be minimally enlarged. It is very important in this phase to scratch also the medial portion of the edges of the perforation, to facilitate the sealing of the defect

Step 3: External Auditory Canal Incisions

An incision is made about 0.5–1 cm lateral to the fibrous annulus. The incision is made from the 10 o'clock to the 4 o'clock position (considering the view of the tympanic membrane through a traditional surgical position, with the posterior wall of the ear canal located inferiorly). It can be made with a round knife or with powered instruments, such as a molecular resonance scalpel (Vesalius TeleaMedical, Sandrigo, Vicenza, or similar) or a flexible CO2 laser, in order to reduce bleeding in the EAC. In case of an anterior perforation, the superior incision is made anteriorly to the malleus to allow the surgeon to elevate a wider flap with a good control of the anterior border of the tympanic defect.

Step 4: Tympanomeatal Flap Elevation and Access to Tympanic Cavity

The tympanomeatal flap can be dissected from lateral to medial, completely releasing the handle of the malleus from tympanic residues (especially for anterior perforations). At the end of this step the tympanomeatal flap should be in contact only with the anterior portion of the neck of the malleus, retaining a fibrous pedicle on the anterior annulus. This procedure offers a wide access to the entire tympanic cavity and excellent control of the anterior annulus for the endoscopic placement of the fascia with underlay technique (medially to the bony and fibrous annulus).

Step 5: Detachment of the Flap from the Handle of the Malleus

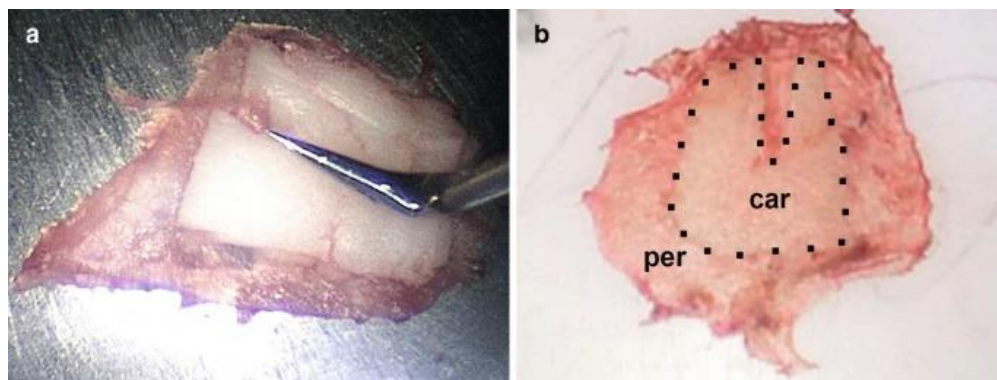
The pars flaccida can be moved toward the handle of the malleus by means of alligator forceps, until the lateral process of the malleus is uncovered.

The dissection of the flap from the handle of the malleus is performed with a crescent-shaped scalpel or a hook in subperiosteal plane. This step might be quite difficult, because it is important to avoid excessive stimulation on the ossicular chain. The umbo of the tympanic membrane can be finally detached from the malleus, especially for anterior or subtotal perforations, to allow the correct graft positioning in underlay and over malleus fashion

It is extremely important to make sure that epidermis is not present in the middle ear cavity and for this reason the endoscopic approach is particularly indicated. An exploration of the whole tympanic cavity (with the aid of a 45° endoscope) should be carried out before the insertion of the graft. When epidermis is found in the tympanic cavity, it must be removed with appropriate instruments under endoscopic view. Moreover, the ossicular chain mobility has to be checked in order to exclude ossicles hypomobility or fixation.

Step 6: Sampling and Preparation of the Graft (Fig 14)

The size of the perforation has to be measured by means of a hook with angled tip, in order to evaluate the appropriate size of the graft that has to be created.



(Figure 14) (a) The island cartilage graft is prepared and the size is measured with a hook to correctly allocate it in underlay fashion. (b) The posterior layer of perichondrium is left attached to the cartilage and a groove for the malleus is created with a small round knife. Black dots represent the schematic shape of the cartilage. car cartilage, per perichondrium

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Different autologous grafts can be harvested:

Temporalis muscle fascia. A 3 cm incision is made in the superior portion of retroauricular area and the temporal muscle fascia is exposed; a small fragment of fascia is harvested, appropriately shaped, thinned and dried. This graft is subsequently modeled according to the defect ⁽³⁷⁾.

Cartilage and/or tragal perichondrium. A small incision is made in the posterior aspect of the tragus and the cartilage with the perichondrium is exposed. If only perichondrium is needed, a delicate sub-perichondral dissection is performed in order to detach it from the underlying cartilage. When cartilage is needed, the perichondrium is left attached to both faces of the cartilage (front and rear) and a suitable fragment of this tissue is collected. Then, one layer of perichondrium (usually the anterior layer) is gently removed with a round knife, while the other perichondral layer (usually the posterior layer) is kept attached to the cartilaginous surface. The cartilage is then remodeled in order to obtain a circumferential island at the center of the perichondral layer. The size of the island of cartilage is shaped according to the defect of the tympanic membrane. A groove for the handle of the malleus can be made, in order to better fix the graft over the ossicular chain. Moreover, the other layer of perichondrium previously detached from the cartilage is dried before its positioning and can be used to further seal the perforation (especially anteriorly).

Another option is to perform the removal of both perichondral layers from the cartilage graft in order to create a sort of pacman-shaped graft by cutting a small groove for the handle of malleus. The two layers of perichondrium can be used after the positioning of the cartilaginous graft in order to reinforce the reconstruction, especially at the anterior quadrants.

Step 7: Graft Insetting

The technique for the graft insertion is the same for all the grafts. Of course, cartilage graft is more rigid and dry than fascia, so it bends less, but it is extremely important to precisely measure the size of the graft in order to avoid bulging of the cartilage that can lead to a difficult positioning.

The anterior end of the graft (i. e., anterior perichondral edge of the composite graft) should be held with Hartmann forceps and brought into the EAC. Then, thanks to a micro-hook with a bended tip, a sickle knife, or a small round knife, the graft is delivered underlay to the tympanomeatal flap and over the ossicular chain. Utmost care should be applied to the placement of the anterior end of the graft in order to cover the whole perforation extent. In case of a composite (i. e., cartilage and perichondrium) graft, the cartilage should be placed in contact with the ossicular chain, while the perichondral side should be placed medial to the tympanic remnants. In this case the graft should be positioned by sliding it onto the handle of the malleus, being in contact with the medial aspect of the residual eardrum (underlay–over malleus technique). The anterior portion of the graft is positioned medially to the anterior fibrous annulus. Middle ear cavity can be packed with absorbable sponges (i. e., Gelfoam, Spongostan) in order to sustain the graft during the healing process of the tympanic membrane, limiting the risk of a medialization of the graft. This aspect might be more important for soft tissue grafts (i. e., perichondrium, autologous and heterologous fascia), whereas cartilaginous graft can keep its position thanks to its thickness.

Step 8: Tympanomeatal Flap Repositioning

The tympanomeatal flap is positioned back at its initial position and the appropriateness of the graft position is verified. The graft has to be in contact with the tympanic membrane and the defect has to be entirely covered.

Factors Associated With Failure of Myringoplasty

According to Vartanen and Nuutinen ⁽³⁹⁾ the most decisive factor influencing myringoplasty results appeared to be the surgeon's experience. A study by Black ⁽⁴⁰⁾ showed that operative success as defined by graft integrity was significantly affected by grade of surgeon performing the procedure. Consultants had 90.6% success rate

while registrars had 67.2% success rate in his study. He suggested that myringoplasty is a beneficial procedure in the hand of a skilled and experienced surgeon. According to Emir et al. ⁽⁴¹⁾.

Cortical Mastoidectomy

Cortical Mastoidectomy is a common otology procedure typically used to treat chronic otitis media with or without cholesteatoma. It is also the initial step of cochlear implant surgery and various lateral skull base operations. As such, it is a compulsory procedure in otology training ⁽⁴²⁾.

However, this is a challenging procedure, especially for trainees, due to the complex anatomy of the temporal bone and anatomical variability between individuals. During the procedure, the surgeon navigates around vital anatomical structures, such as the facial nerve, sigmoid sinus, dura of the middle fossa, semicircular canals, and incus ⁽⁴³⁾.

Therefore, a good understanding of the three-dimensional (3D) positional relationship between anatomical structures, as well as high precision during the procedure is required, which imposes a significant cognitive load on surgeons. As such, feedback and guidance during the surgery, as well as assessment of performance at its completion, are important factors when training this surgery. This will enable trainees to simultaneously grasp the concept of the standard being aimed for, compare their performance to the standard, and perform appropriate actions to lessen the gap ⁽⁴⁴⁾.

In surgical training, feedback is usually provided verbally by experts in real-time and in the form of manually scored summative feedback at the end of the session. Surgical competency and technical skills are typically assessed using training assessment reports, oral examination and direct observation by expert surgeons ⁽⁴²⁾

Indications

There are multiple indications for mastoidectomy. The common philosophy in mastoid surgery is to create a safe and dry ear. The main indications for performing a mastoidectomy include acute mastoiditis, chronic mastoiditis with its sequelae, and cholesteatoma ⁽⁴⁵⁾

Mastoidectomy can be performed in coordination with tympanostomy tube placement in patients with complications of chronic otitis media or acute otitis media. Mastoidectomy also serves as a key surgical approach for many otological procedures, including labyrinthectomy, endolymphatic sac surgery, facial nerve surgery, cochlear implantation, petrous apex lesions, and lateral skull base tumors ⁽⁴⁵⁾.

Broadly, there are two major types of mastoidectomy: canal wall up and canal wall down. Canal wall up mastoidectomy preserves the posterior bony external auditory canal, which separates the ear canal from the mastoid cavity. Typically, patients will undergo a canal wall up mastoidectomy for their initial episode of acute mastoiditis ⁽⁴⁵⁾.

Canal wall down mastoidectomies are usually reserved for patients who have had persistent chronic otitis media or recurrent cholesteatoma. The final decision regarding which type of procedure to perform depends on many factors, including the inherent anatomy, the overall extent of disease, management of risk to hearing and/or balance function, and the patient's likelihood to follow up consistently. A canal wall down the mastoid cavity requires patient cooperation with reliable follow-up for mastoid cleaning visits ⁽⁴⁵⁾.

Complications

Complications of mastoidectomy include facial nerve injury, hearing loss, vertigo, taste disturbance, cerebrospinal fluid leak, need for revision surgery, postoperative infection, and bleeding. Facial nerve injury is a rare but devastating complication with lifelong consequences to the patient. Unfortunately, acute mastoiditis or chronic mastoiditis that is not treated appropriately can also progress and cause similar complications. Knowledge of anatomy and surgical practice is mastered to ensure facial nerve risk is decreased as much as possible ⁽⁴⁵⁾

Myringoplasty Alone Versus Myringoplasty With Cortical Mastoidectomy

Mastoidectomy is one of the most common otological operations performed today. Indications for mastoidectomy range from eradication of chronic infection to approaches for various neurotological procedures.

Mastoidectomy was first described by Louis Petit in the 1700s, although the concept did not gain wider acceptance until 1958, the cortical mastoidectomy was popularized by William House. This procedure attempted to avoid the common problems with radical mastoidectomy ⁽⁴⁶⁾

Myringoplasty is an operative procedure, in which the reconstructive procedure is limited to repair of tympanic membrane perforation. Implicit in the definition is that the ossicular chain is intact and mobile, and the middle ear is disease free. There are a number of studies in the literature highlighting the advantages and disadvantages of performing mastoidectomy in the surgical treatment of mucosal type of chronic otitis media.

Balyan et al in 1997 did a retrospective study of 323 patients to evaluate the role of mastoidectomy in non-cholesteatomatous CSOM. They observed no statistically significant difference in hearing outcome when mastoidectomy was done ⁽⁴⁷⁾

Mishiro et al in 2001 reviewed 251 cases of non-cholesteatomatous chronic otitis media, to determine whether mastoidectomy is helpful when combined with tympanoplasty for these conditions. A total of 147 patients were treated by tympanoplasty with mastoidectomy and 104 were operated on without mastoidectomy. There was no statistically significant difference between the two groups ⁽⁴⁸⁾

Bhat et al in 2008 compared outcomes for mastoidotympanoplasty and for tympanoplasty alone in cases of quiescent, tubotympanic CSOM. There were no statistically significant differences in hearing improvement. In 2012, Albu et al found that cortical mastoidectomy offers no additional benefit regarding hearing gain over myringoplasty ⁽⁴⁹⁾.

Jackler and Schindler in 1984 studied 48 patients with chronic otitis media with tympanic perforations who underwent myringoplasty with mastoidectomy. In their study, it was found that simple mastoidectomy was found to be an effective means of re-pneumatizing the sclerotic mastoid and restoring the hearing ⁽⁵⁰⁾.

Sheehy in 1985 recommended performing simple cortical mastoidectomy routinely for all tympanoplasties because it is “good practice” and because “it’s better to be safe than sorry.” ⁽⁵¹⁾

Albu et al in 2012 presented a paper of 320 consecutive adult patients treated by either myringoplasty with cortical mastoidectomy or myringoplasty only. They found that three factors were significant in predicting success rate, that is, healthy opposite ear, a long dry period preceding the operation, and non-smoker status. The only factor attaining significance in the multivariate analysis was a dry period longer than 3 months. They concluded that cortical mastoidectomy offers no additional benefit in myringoplasty performed on patients with persistent or intermittent discharging CSOM and no evidence of cholesteatoma or mucosal blockage within the antrum ⁽⁴⁹⁾

Role of mastoidectomy in the repair of tympanic membrane perforation has long been debated. Mastoidectomy was regarded as a means of surgically creating an air reservoir and eradicating sequestered mastoid disease ⁽³⁾.

Myringoplasty is a repair of the perforation of the tympanic membrane. Cortical mastoidectomy involves the eradication of the source of infection in the mastoid and improves pneumatization although it has a risk of squamous epithelium ingrowth, injury to vital structures like facial nerve and inner ear structure. Aeration of the middle ear and pressure regulation is achieved by the mastoid.5 Mastoid will act as infection nidus if there is a failure to relieve the atticointral block leading to surgical failure. Fig and Fig show the intraoperative images when mastoidectomy is performed ⁽⁴⁾.



(Fig 15): Mastoidectomy being performed intraoperatively⁽⁵²⁾



(Fig 16): Completed mastoidectomy intraoperatively ⁽⁵²⁾

Holmquist and Bergstrom's study from 1978 claimed that mastoidectomy increased the likelihood that patients with noncholesteatomatous chronic otitis media would have a successful tympanoplasty⁽⁵³⁾

pre- and post-operative pure-tone average was compared and the statistical difference between tympanoplasty group and tympanoplasty combined with cortical mastoidectomy group was statistically significant ⁽⁵⁴⁾.

Conclusion

Role of mastoidectomy in the repair of tympanic membrane perforation has long been debated.

There are a number of studies in the literature highlighting the advantages and disadvantages of performing mastoidectomy in the surgical treatment of mucosal type of chronic otitis media.

Cortical mastoidectomy involves the eradication of the source of infection in the mastoid and improves pneumatization although it has a risk of squamous epithelium ingrowth, injury to vital structures like facial nerve and inner ear structure.

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