Post-operative Infection in Myringoplasty: Reviewing the Evidence

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Introduction

Myringoplasty is one of the most commonly performed otologic procedures in paediatric otolaryngology. The aim of myringoplasty is to achieve closure of tympanic membrane perforations and by doing so, prevent further infection and restore hearing. The term myringoplasty was first coined by Berthold in 1878 \(^1\) and refers to the surgical repair of the tympanic membrane in isolation. Tympanoplasty denotes repair of the eardrum in conjunction with surgery on the middle ear cleft, for example, exploration of the middle ear, ossiculoplasty or the division of adhesions. The works of both Zollner \(^2\) and Wullstein \(^3\) began the modern era of tympanoplasty and subsequently many techniques and grafting materials have been described.

There are three recognized approaches to myringoplasty and tympanoplasty: transcanal, endaural and post-auricular. The choice of incision is generally based on the size and position of the perforation, the anatomy of the meatus and the extent of disease \(^4\). Graft technique is described as underlay, inlay or overlay, according to its position relative to the tympanic membrane. Storrs was the first to establish the use of temporalis fascia graft. Given the ease of harvesting at time of surgery and close resemblance to the native tympanic membrane, this has become a popular choice \(^5\). Tragal perichondrial grafts are used for similar reasons. Other materials employed include cartilage (tragus or conchal bowl), fat, vein, periosteum and even Alloderm \(^6\).

In children, success rates of 35% to over 90% are reported in the literature \(^7-10\). Many factors contribute to the outcome of myringoplasty, including: age of the patient; site and size of the perforation; presence or absence of infection at the time of surgery; eustachian tube function; surgical technique employed; skill of the surgeon; and status of the contralateral ear. Much of the existing literature is based on retrospective observation. Reported results are often conflicting and as such there remain many issues on which a consensus has yet to be reached.

This review aims to evaluate the data available in the literature with respect to the role of post-operative infection in the etiology of reperforation. We will look at the potential effect of infection on tympanic membrane healing, the age of the patient as a risk factor for recurrent infection, the potential implications of otorrhoea at the time of surgery and whether or not this is a predictor of post-operative infection, and finally the role of perioperative antibiotics and adenoidectomy in reducing infection.

Infection and tympanic membrane healing

The tympanic membrane has a marvelous propensity for regeneration, which
is believed to be attributable to its epithelial structure and the unique migratory activity of its epithelial cells. Much work has been performed studying these patterns of cellular migration. Magnoni was the first to describe how the cells migrate radially away from the umbo and confirmed that the main generation center is located on the drumhead. Alberti further validated this work in 1964 by establishing the rate of migration to be 0.07 mm per day. This work was instrumental in clarifying the self-cleansing methods of the tympanic membrane and external auditory canal.

Tympanic membrane healing begins in the same way as other tissues with the development of a hemostatic platelet plug and the initiation of an inflammatory response. In other tissues this leads to proliferation of fibroblasts and the development of granulation tissue, which permits epithelialization. In the tympanic membrane these processes appear to occur in reverse: the squamous epithelial layer undergoes hyperplasia, forming a scaffold across the wound, with subsequent formation of fibrous tissue. Experiments have demonstrated that tympanic membrane regeneration occurs distant to the site of injury and cells migrate in a centripetal fashion to ultimately close the defect. The basal cell layer has a critical role in controlling this process with the mucosal layer also involved to some degree. The fibrous layer is usually the last to migrate and often doesn’t fully do so, leaving a dimeric neomembrane.

This process of tympanic membrane healing is hindered in chronic perforations. Histologically, the squamous epithelium grows over the edge of the perforation, meeting the inner mucosal layer and theoretically preventing epithelial migration. Infection is often implicated, particularly virulent agents such as Streptococcus sp, which is still a commonly isolated pathogen in childhood otitis media. Streptococcal infection results in myringal necrosis and consequent chronic perforation. These perforations tend to be large and it has been postulated that larger perforations take longer to heal.

Age

The optimal age for myringoplasty in children has been heavily debated. Poor eustachian tube function, recurrent upper respiratory tract infections and consequently recurrent otitis media, are thought to contribute to higher failure rates. Some studies suggest that waiting until the child is older is associated with better surgical outcomes. However, it appears that good results are not precluded in younger children. There have been numerous studies that show no statistical difference between outcomes in older versus younger patients. A more recent meta-analysis found that age-specific data was only available for a small proportion of the cases identified in their review however there was little to suggest that advancing age was associated with higher closure rates. Neither age-specific analysis nor index age analysis demonstrated a statistically significant correlation between age and closure rates.

Otorrhea

Many published studies have assessed whether otorrhea at the time of surgery has implications for the likelihood of graft failure. The presence of microbes on the surface of middle ear mucosa in conjunction with an active inflammatory
process could hypothetically reduce graft take. However the condition of the ear at the time of surgery has not been found to be a reliable predictor of subsequent post-operative infection. Some studies have demonstrated that best results are obtained in dry, uninfected ears. Conversely, others have shown that similar results can be achieved in discharging ears and the presence or absence of otorrhea at the time of surgery is not a consistent predictor of success. One study found that patients with pre-operative otorrhoea had more favorable results. This finding has not yet been replicated in any subsequent studies.

It is our preferred practice to operate on dry perforations. In order to achieve this we use a combination of topical quinolone antibiotics with or without betadine ear toilet pre-operatively in discharging ears. A Cochrane review showed that topical quinolones are favorable in reducing otorrhoea caused by chronic suppurative otitis media. Ear toilet is of uncertain benefit but quality of evidence is poor and more conclusive studies are required. Another more recent review looked specifically at the evidence for these treatments in children and found there to be a paucity of high-quality studies. It concluded that neither treatment was of proven benefit compared with placebo or other treatments. It also ascertained that topical antibiotics were better than topical antiseptics in reducing otorrhoea but again, further work needs to be done.

**Perioperative antimicrobial therapy**

A great deal of research has been conducted on the use of perioperative antimicrobial therapy in otologic surgery. Prophylactic antibiotics aim to enhance host defense mechanisms at the time of inoculation before they have the opportunity to cause infection. They must therefore be present in high concentrations in the serum before the surgery begins and parenteral drugs are preferable. The drug of choice should be directed towards the most likely infecting organism. In ear surgery the most commonly isolated pathogens in post-operative wound infections are gram-positive cocci, particularly *Staphylococcus aureus*.

Most otologic procedures are considered clean but those taking place in a patient who has active chronic suppurative otitis media (CSOM) are considered contaminated. Traditionally, antimicrobial prophylaxis in any clean surgery that does not involve an implant is not recommended. In contaminated procedures there may be a reduction in infection rates depending on the procedure in question, and with specific reference to otology, there are those that would advocate their use in such operations.

Uncertainty regarding both the efficacy and cost-effectiveness of antimicrobial prophylaxis in ear surgery prompted a revised Cochrane review in 2009. Verschuur and colleagues reviewed 11 randomized control trials (RCTs) including, among others, a landmark study by Jackson, the largest study on the topic. The review concluded that there was no evidence to support the continued use for antimicrobial prophylaxis in clean and clean-contaminated ear surgery. However, they also suggested that a further sufficiently powered RCT concentrating on a subgroup of specific patient populations could provide further information, with specific reference to pediatric patients. To date, no such study has been conducted. Vijay et al performed a double-blinded RCT in
2014 34, evaluating the use of perioperative-only versus extended antimicrobial prophylaxis in 78 patients who underwent tympanomastoid surgery. They compared two groups of patients undergoing type I tympanoplasty with cortical mastoidectomy. Group I received 24 hours of parenteral cefuroxime, whereas group II received the same dosing regimen of cefuroxime followed by eight days of oral cefixime. The authors concluded that there was no advantage to extended prophylaxis with regard to wound infection rate. Additionally, length of hospital stay was longer in the extended coverage group with a higher incidence of adverse effects including gastrointestinal disturbance 34. It is important to note that this study excluded patients under 12 years of age, who are at higher risk of infection. With only 78 patients included in the trial, it is insufficiently powered to draw any great conclusions either way.

The role of adenoidectomy

Pharyngeal surgery and its role in the treatment of middle ear disease is controversial but has been shown to be of benefit in a number of well-designed studies 35, 36. The fact that middle ear effusion often resolves subsequent to the removal of hypertrophied adenoids suggests that mechanical obstruction is an etiological factor in the condition 37. However, adenoidal involvement in recurrent acute otitis media and rhinosinusitis implies that an adenoidal pad of any size may act as a reservoir for pathogenic bacteria, contributing to eustachian tube dysfunction 38. Biofilm has been detected on the middle ear mucosa of children with chronic suppurative otitis media 39, 40. Dense biofilm has also been shown to be present in far greater magnitude on the adenoids of children suffering from recurrent otitis media compared with those suffering from obstructive sleep apnea, suggesting its role in the pathogenesis of recurrent infection 41. It therefore seems logical that adenoidectomy would improve results in tympanoplasty; however, this hypothesis has not been validated by the literature. One small study by Gianoli suggested potentially favorable results 42 but this has been refuted by others 43, 44.

Conclusion

It seems that much of the current literature fails to define a precise role for post-operative infection in the etiology of reperforation within the population of pediatric patients undergoing myringoplasty. There is suggestion of a causal relationship but few conclusive answers. Much of the evidence fails to comment in any meaningful way on the exact incidence of post-operative infection. There is a need for a well-designed, sufficiently powered pediatric study to further evaluate the impact of factors such as patient age, otorrhoea at the time of surgery and the role of adenoidectomy. There is currently no evidence to support the use of perioperative antibiotics in clean-contaminated ear surgery in the general population but further investigation is warranted to evaluate if they have a place specifically in children with recurrent otitis media. It is possible that agents such as dornase alpha that breakdown biofilm 45 may have a role in improving post-operative outcomes for patients undergoing myringoplasty and this is to become a focus of future research in our unit.
References


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