

Original Research Article

PATHOGENIC MICROBIOLOGICAL FLORA IN MIDDLE EAR MUCOSA OF CHRONIC OTITIS MEDIA INACTIVE MUCOSAL DISEASE: RELEVANCE IN SURGICAL OUTCOME OF TYMPANOPLASTY: A PILOT STUDY

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Abstract

Background & Aim: Chronic Otitis Media (COM) is a common curable cause for hearing impairment in developing countries. Eradication of disease from middle ear and repair of tympanic membrane perforation reduces the progression of hearing loss due to infection induced osteitis of ossicles. Tympanoplasty is usually done in quiescent stage of COM. Eustachian tube function, allergies and duration of disease affect the outcome of surgery. Our study aimed to assess middle ear mucosa for microbiological flora in COM Mucosal disease Inactive stage and its influence on outcome.

Methods: Prospective investigatory study involving 30 consecutive patients with COM, inactive Mucosal disease posted for Tympanoplasty. Per-operatively, rim of remnant tympanic membrane and middle ear mucosa was taken for microbiological aerobic bacterial culture. Patients were followed up at 3 and 6 weeks post-operatively to check the status of neotympanum and complications.

Results: All 30 patients, (Male: Female = 17:13), showed positive microbial growth of tympanic remnant middle ear mucosa. Three patients had graft rejection following type 1 Tympanoplasty, of which two of them (7%) had *Pseudomonas aeruginosa* and one (3%) had *Acinetobacter baumannii* on culture. Of the 27 successful tympanoplasty patients, 15 (50%) grew *Staphylococcus aureus* and 12 (40%) *Staphylococcus epidermidis*.

Conclusion: In this pilot study, the 3/30 patients, who had failure of graft uptake did not have any known factor for failure of surgery other than positive microbial cultures. Our study revealed pathological micro-organisms in the middle ear mucosa of patients with COM mucosal disease Inactive stage, which probably had impact on outcome of Tympanoplasty.

Keywords: Chronic otitis media inactive stage, aerobic bacterial culture, tympanoplasty, graft uptake

Introduction

Chronic Otitis Media (COM) mucosal disease, is an inflammatory condition affecting the mucoperiosteal lining of the middle ear cleft with a permanent abnormality of tympanic membrane and is a common cause of treatable hearing impairment, especially in developing countries. Hearing loss in COM is commonly conductive impairment due to reduction in the vibratory surface area of the perforated tympanic membrane and ossicular erosion due to osteitis. Various factors like malnutrition, overcrowding and poor hygiene, in-adequate health care and recurrent upper respiratory infection make its prevalence high. In spite of advances in health care, India still falls under high prevalence zone with an average prevalence of COM is 5.2% [1]. *Pseudomonas aeruginosa* and *Staphylococcus aureus* were the predominant isolates in most of the studies on active stage of COM. Other common aerobic isolates were *Klebsiella* spp., *Proteus* spp., *Escherichia coli*, *Bacteroides fragilis*, *Prevotella* spp., *Candida* spp., and *Aspergillus* spp. However, there was no significant geographical variation of pathogens in India [2,3].

Chronic otitis media mucosal disease, can be managed in two stages, conservative medical treatment to control the infection and surgical treatment for hearing reconstruction of the conductive component. Topical antibiotics and aural toileting is the initial therapy for uncomplicated COM of Mucosal type [4].

As the duration of the disease increases, the chance of spontaneous healing of the perforation of the tympanic membrane reduces, due to the edges of the perforation getting covered by stratified squamous epithelium, when it becomes permanent. Acute exacerbations of otitis media occur due to infection entering the middle ear via a perforated tympanic membrane or Eustachian tube. So, repair of the pars tensa perforation is vital to reduce the recurrence of middle ear infections and improve hearing. It helps progression of hearing loss which can occur due to resorptive osteitis of ossicles in chronically discharging ears [5].

Tympanoplasty includes removal of disease from the middle ear and reconstruction of the conductive hearing mechanism by grafting the tympanic membrane, alone, or in combination with ossiculoplasty, with or without mastoidectomy [4]. Factors influencing the successful treatment include reconstructive middle ear surgery with special regard to presence of microbial flora, which is increasingly gaining importance [6]. This study was aimed to identify any significant microbiological flora in the middle ear mucosa of patients with chronic otitis media, mucosal disease inactive stage and the outcome of surgery in presence of any identified microbial organisms.

Methodology

This was a prospective, investigational single group study spanning over one year, involving 30 patients who were admitted with chronic otitis media, mucosal disease, inactive stage (no ear discharge for 6 months) for Tympanoplasty, at a tertiary care hospital.

After obtaining approval from the *Institutional Ethics Committee (PIMS/Ethics/2008-24)*, thirty consecutive patients with COM mucosal disease inactive stage, willing to undergo Tympanoplasty, were recruited. *Informed consent from all the patients, regarding the participation in this prospective study was taken.* They were assessed pre-operatively by detailed medical history and clinical examination. In addition to routine blood tests, Diagnostic nasal endoscopy, Pure tone audiometry and Tympanometry were done to assess the hearing and eustachian tube function. Patients with history of nasal allergy, other sinonasal or throat illnesses or any systemic co-morbidities were appropriately treated before taking up for ear surgery. Patients with actively discharging ears, septic foci in the nose, paranasal sinuses, nasopharynx and throat, eustachian tube dysfunction, sensorineural component of deafness, stapes fixation to the oval window and coagulation disorders, any intake of antibiotics for last 6 weeks for any infections were excluded from the study.

After written informed consent, patients were taken up for Tympanoplasty under general anaesthesia. While surgically preparing the operative site, a sterile cotton ball was placed in the external auditory canal to prevent antiseptic solution (Povidone iodine 5%) from entering the middle ear. At the beginning of the surgery, the margins of the perforation was excised and sent for microbiological culture under sterile conditions. Aerobic culture of the middle ear mucosa was also done. Specimen was also inoculated into thioglycolate broth and incubated for 7 days. Repeat subcultures were done from the broth on solid media to isolate the organisms. All patients in our group underwent Type 1 Tympanoplasty via post aural approach, underlay technique with autologous temporalis fascia graft.

Patients were followed up, at regular intervals at 3 and 6 weeks post-operatively. Status of the graft, along with any evidence of complications was noted. Hearing assessment was made with tuning fork tests and confirmed by Pure tone audiogram at 6 weeks. Intact neotympanum was recorded postoperatively at 6 weeks and considered as successful tympanoplasty.

The collected data was tabulated and analyzed by descriptive statistics using Microsoft excel 2019 version. [Table 1].

Results

Total of 30 cases were included, of which, 17 were male patients and 13 were female patients. The age ranged from 10 to 55 years (Mean= 30 years). [Figure 1a, 1b].

All patients who underwent tympanoplasty, and samples from middle ear mucosa with the edges of the TM perforation, sent for microbiological culture, showed growth in all 30 (100%) samples. There was growth of *Staphylococcus aureus* from 15(50%) specimens, *Staphylococcus epidermidis* in 12 (40%), *Pseudomonas aeruginosa* in 2 (7%) and *Acinetobacter baumannii* in 1 (3%). [Figure 2].

3 weeks postoperatively, only one (3%) patient developed postaural wound infection, and, 29 (97%) patients out of 30 which, healed well without any infection. [Figure 3].

On analysing the graft take up, at routine 6 weeks follow up, 27 (90%) patients had a good graft up-take- "intact neotympanum" whereas 3 (10%) of them had a poor surgical outcome. Among the 27 patients who had intact neotympanum, 15(55%) of them showed growth of *Staphylococcus aureus* and 12(44%) of them showed *Staphylococcus epidermidis* from the peroperative middle ear mucosal specimen.

Of the 3 patients who had a poor graft up-take at the end of 6 weeks, two of them (7%) showed *Pseudomonas aeruginosa* growth on culture and one (3%) showed *Acinetobacter baumannii*.

Strobe

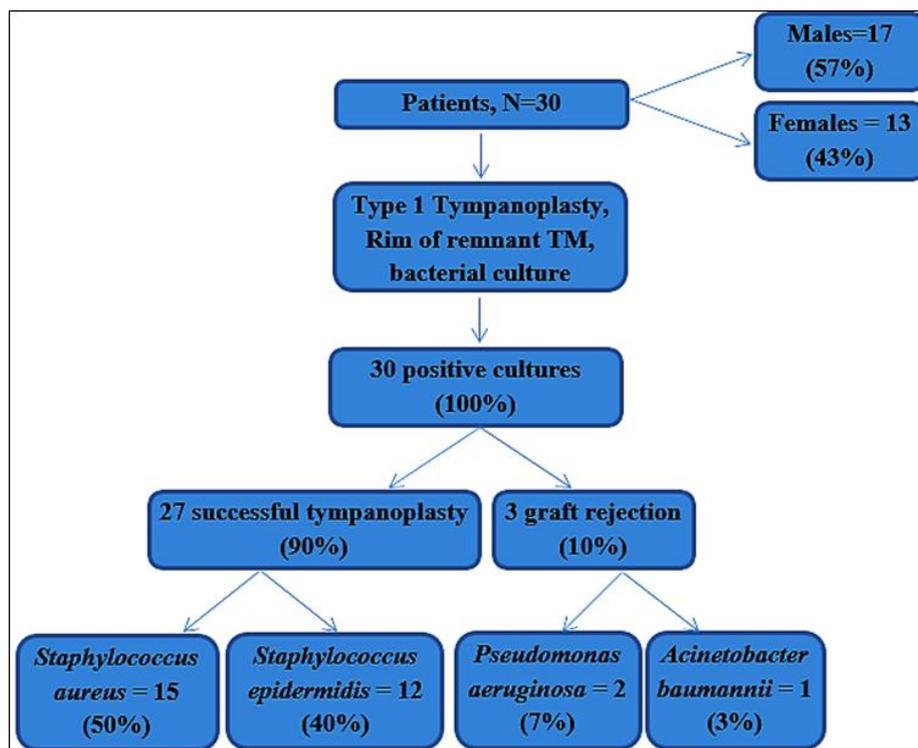


Table 1: Baseline Characteristics of participants

Parameters	Study participants, (n=30)
Age	10 yrs to 55 yrs
Gender	
Males (n)	17 (57%)
Females (n)	13 (43%)
Culture of Middle ear mucosa	
<i>Staphylococcus aureus</i>	15 (50%)
<i>Staphylococcus epidermidis</i>	12 (40%)
<i>Pseudomonas aeruginosa</i>	2 (7%)
<i>Acinetobacter baumannii</i>	1 (3%)
Postoperative wound	
Infection	1 (3%) <i>Pseudomonas aeruginosa</i>
No infection	29 (97%)
Graft Status (6 weeks follow up)	
Graft healed well	27 (90%)
Graft rejection	3 (10%) <i>Acinetobacter baumannii</i> , <i>Pseudomonas aeruginosa</i>

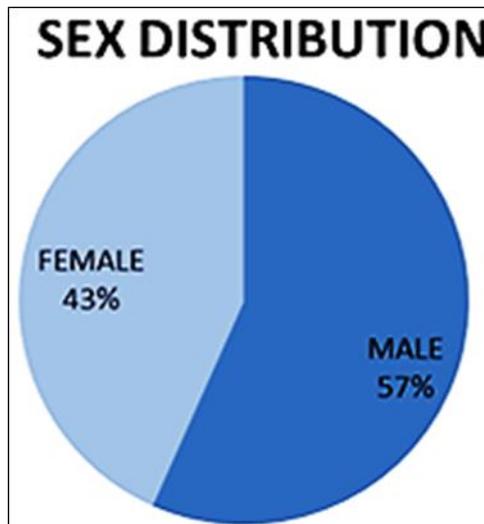
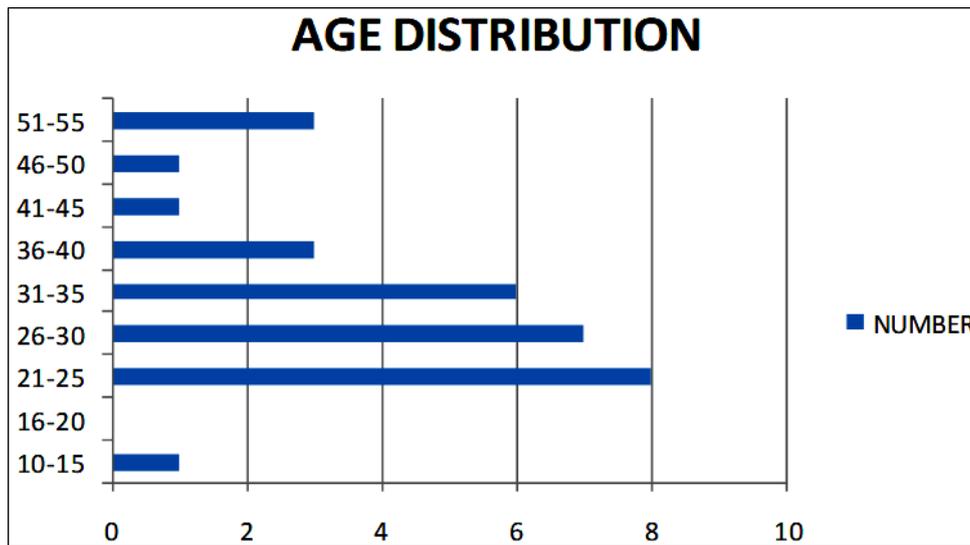


Fig 1a, 1b: Age and Gender distribution of participants

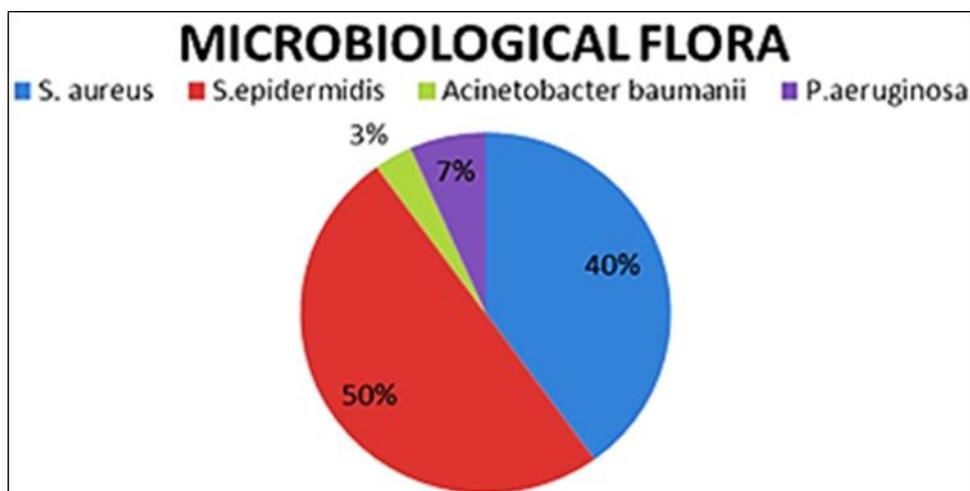


Fig 2: Microbiological flora identified in COM Mucosal disease, inactive stage, rim of remnant TM and middle ear mucosa culture.

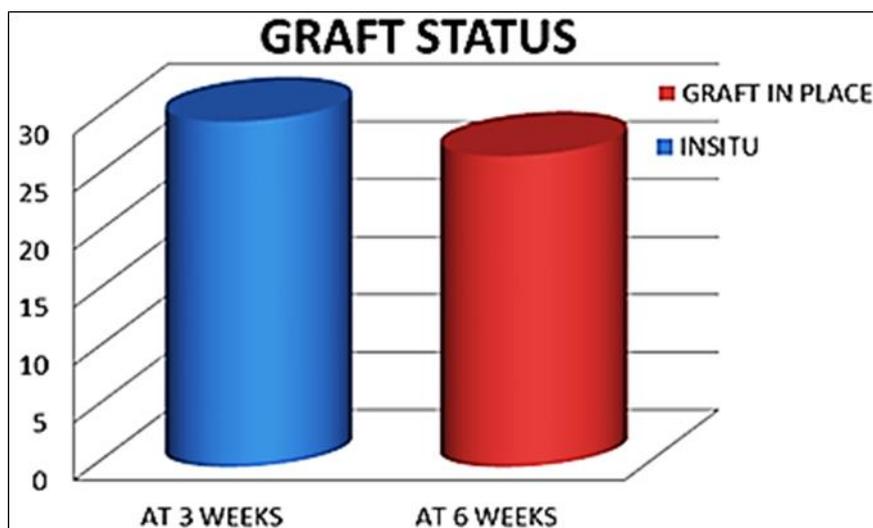


Fig 3: Graft status postoperatively at 3 and 6 weeks follow up.

Discussion

Tympanoplasty is a commonly performed reconstructive otologic surgery, with good success rate both anatomically and functionally. It aims to improve hearing, prevent recurrent infection and minimize after care. However, failures do occur. Factors like Eustachian tube function, duration of disease, allergies, smoking, size of the perforation etc, influence the success of Tympanoplasty. Our present study was an attempt to know if the bacteriology of COM mucosal disease, in its inactive stage had a role in the outcome of Type 1 Tympanoplasty.

Most of the patients with COM in our study belonged to third decade especially in male gender as reported by Loy AHC *et al.* [7]. The male predominance may be because of their more exposed way of life. It is presumed that multiple factors such as poor sanitation, unhygienic living conditions, overcrowding, malnutrition, illiteracy and lack of health consciousness in low socio-economic status may contribute to the increased prevalence of otitis media.

There are a number of studies conducted regarding the culture positivity and microbiological flora in COM active stage (with ear discharge), at various parts of the country. Some of them include Harshika *et al.* [8], Kashyap *et al.* [9], Deb *et al.* [10] and Prakash *et al.* [11] All these studies have reported varying positivity rate viz. 89%, 73.45%, 53% and 91.18% respectively with *Pseudomonas aeruginosa*, *Staphylococcus aureus* being the most common organisms followed by *Klebsiella* and *Proteus* spp. *Staphylococcus epidermidis* and coagulase negative *Staphylococcus aureus* are known skin commensals, the isolation of these bacteria on prolonged incubation probably reflects that in light of the fact that they did not produce infection in the post-operative period [12].

Studies by Chirwa M showed an equal number of mixed and pure cultures, with *Proteus mirabilis*, *Escherichia coli*, *Pseudomonas aeruginosa*, *Staphylococcus aureus* and aerobic-anaerobic mixtures mainly of *Bacteroides* spp., *Peptostreptococcus* spp. and *Clostridium* spp. [13]. The variation might be due to the difference in their locality and socioeconomic profile.

In our study, of all the 30 patients' middle ear mucosa aerobic bacterial culture (culture positivity of 100%) taken during type 1 Tympanoplasty, 15 (50%) grew *Staphylococcus aureus*, 12 (40%) grew *Staphylococcus epidermidis* and 3 of those patients whose postoperative graft up-take was poor at 6 weeks follow up, two of them had *Pseudomonas aeruginosa* (7%) and one, *Acinetobacter baumannii* (3%).

The higher numbers of isolates of *Staphylococcus aureus* in the middle ear infections can be attributed to their ubiquitous nature in the external auditory canal and upper respiratory tract, while organisms like *Pseudomonas* are considered mostly as secondary invaders into middle ear via a defect in tympanic membrane causing acute episodes. Although *coagulase negative Staphylococcus* is considered non-pathogenic, their associations in some cases can be attributed to the extreme lowering of resistance in middle ear due to invasion by other organisms. Under these circumstances they assume pathogenic role either singly or more often in combination with other micro-organisms.

In our series, the overall success rate of type 1 Tympanoplasty was 90% for dry ears with microorganisms identified in culture. The success rate in our study is similar to others like Vartianen *et al.* [14] who reported success rates of 87.5% for dry ears and 89% by Shankar *et al.* [15] in a series of 35 patients.

It has been recently established that biofilms produced by particular group of microbes have a role in the persistence of smoldering infection in COM [16, 17]. *Staphylococcus aureus* and *Pseudomonas aeruginosa* were the most common microorganisms isolated in the biofilm detected in the active stage of COM by Banu *et al.* [18]. Bacteria are in a planktonic form when they form biofilms, where they remain dormant and protected from host immunity and antibiotics. It is likely that the bacteria surviving as biofilms in the middle ear and tympanic membrane remnant convert to the free planktonic form in the post-operative middle ear field which has a free fascial graft in a hypoxic area which are now capable of causing infection and play an important role in the outcome of Tympanoplasty.

Our pilot study on microbiological culture of middle ear mucosa and remnant tympanic membrane in COM mucosal type, inactive stage showed pathogenic bacteria and its probable influence in the outcome of Tympanoplasty, which has not been documented in literature so far. However, the sample size in our study is very small to definitely conclude about the dependence of pathogenic micro-organisms grown in patients with COM mucosal disease inactive stage, on the success rates of Tympanoplasty. Larger samples are needed to be studied to find a stronger association of microbial growth and outcome of Tympanoplasty in COM inactive stage.

Conclusion

Staphylococcus aureus and *Staphylococcus epidermidis* were the commonest aerobic bacteria isolated in inactive stage of mucosal type of COM in our study. Postoperative infection and graft failure in a previously uninfected (dry) ear with central perforation were noted when the middle ear samples showed growth of *Pseudomonas aeruginosa* and *Acinetobacter baumannii*. These findings might point to viable bacteria probably in a biofilm, surviving only to infect the ear when conditions are favourable as in the presence of a relatively hypoxic free graft. Our study identified the presence of pathogenic bacteria in cultures of middle ear mucosa of ears with COM mucosal disease inactive stage, (ears devoid of discharge for 6 months), which probably contributed to the overall outcome of Tympanoplasty. Studies with advanced diagnosis of biofilms (electron microscopy and RNA) are needed for assessing the significance of biofilms of pathogenic bacteria in establishing the factors for a successful outcome of Tympanoplasty.

Institutional ethics committee: PIMS/Ethics/2008-24.

Compliance with ethical standards: This study was conducted in accordance with the Declaration of Helsinki (revised 2013).

Informed consent for human participants; Obtained

Conflicts of Interest: None.

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