Journal of Cardiovascular Disease Research

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

ORIGINAL RESEARCH

Comparitive study of type I tympanoplasty efficiency and histopathological changes of tympanic membrane in dry and wet ear

Dr. Gopal Krishna Damle[1], Dr. Neha Swarnkar[2], Dr. Shailendra Gupta[3], Dr. Surjeet Singh[4], Dr. Jaya Sahu[5], Dr. Abhishek Gupta[6]

[1,3]Associate Professor, [2]Assistant Professor, [6]2nd Year PG Resident, Department of ENT, RSDKSD Government Medical College, Ambikapur, Chhattisgarh, India.

[4]Associate Professor, Department of ENT, Lt BRK Memorial Medical College Jagdalpur, Chhattisgarh, India.

[5]Professor, Department of ENT, Late Shri Lakhi Ram Agrawal Memorial Government Medical College, Raigarh, Chhattisgarh, India.

Corresponding Author
Dr. Surjeet Singh, Associate Professor, Department of ENT, Lt BRK Memorial Medical College Jagdalpur, Chhattisgarh, India.

kunjamsingh@gmail.com

Received: 29th Aug, 2024 Accepted: 28th Sep, 2024 Published: 6th Nov, 2024

Abstract:

Background:
Type I tympanoplasty is a surgical procedure commonly performed to repair tympanic membrane perforations and improve hearing outcomes. The presence of a dry or wet ear condition prior to surgery may influence the efficiency of the procedure and induce histopathological changes in the tympanic membrane. This study aims to compare the efficiency of type I tympanoplasty in dry and wet ear conditions and assess histopathological changes in the tympanic membrane.

Materials and Methods:
A total of 60 patients (30 with dry ear and 30 with wet ear) with tympanic membrane perforations were selected for type I tympanoplasty. Patients were assigned to either the dry ear group or the wet ear group based on the status of the ear during the preoperative assessment. Tympanoplasty was performed under general anesthesia, and the tympanic membranes were evaluated histologically postoperatively. Parameters assessed included graft uptake rate, postoperative hearing improvement (measured in decibels), and histopathological changes such as inflammatory cell infiltration, fibrosis, and neovascularization.

Results:
The graft uptake rate was 90% in the dry ear group and 80% in the wet ear group. Postoperative hearing improvement was more pronounced in the dry ear group, with an average gain of 20 dB, compared to a 15 dB gain in the wet ear group. Histopathological examination revealed a higher degree of inflammatory cell infiltration and fibrosis in the wet ear group compared to the dry ear group. Neovascularization was observed in both groups but was significantly greater in the wet ear group ($p < 0.05$).

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

Conclusion:
Type I tympanoplasty demonstrates higher efficiency in dry ear conditions compared to wet ear conditions, as indicated by better graft uptake and hearing outcomes. Histopathological changes, such as increased inflammatory infiltration and fibrosis, are more prominent in wet ears, which may contribute to slightly lower surgical efficiency. Preoperative ear status should be considered to optimize surgical outcomes in tympanoplasty.

Keywords:
Type I tympanoplasty, tympanic membrane, dry ear, wet ear, histopathology, graft uptake, hearing improvement

Introduction

Tympanic membrane perforations are common in cases of chronic otitis media and other middle ear infections, often resulting in hearing loss, recurrent infections, and reduced quality of life (1,2). Type I tympanoplasty, a surgical technique focused on repairing these perforations without involving the ossicular chain, has been widely employed as an effective method to restore tympanic membrane integrity and improve auditory function (3). However, the condition of the ear—whether dry or wet—at the time of surgery may influence surgical outcomes, particularly in terms of graft uptake, hearing improvement, and histopathological changes (4,5).

A “dry ear” is defined by the absence of discharge and inflammation, while a “wet ear” has active discharge or is prone to discharge due to persistent middle ear infection (6). Studies suggest that a dry ear condition generally favors better surgical outcomes due to a lower risk of infection, leading to higher graft uptake rates and enhanced hearing recovery (7). Conversely, wet ears may present with residual inflammation, fibrosis, and tissue changes that could impair graft integration and increase the likelihood of graft failure (8,9). While these outcomes have been observed in clinical settings, comparative studies examining the efficacy of tympanoplasty in both ear conditions remain limited, particularly in terms of histopathological insights.

Histopathological evaluation of the tympanic membrane can provide valuable information on the underlying changes following tympanoplasty, such as levels of inflammatory cell infiltration, fibrosis, and neovascularization. These factors may play a crucial role in the success of the graft and the overall restoration of middle ear function (10,11). Previous research has indicated that inflammatory responses are often more severe in wet ears, potentially leading to poorer surgical outcomes (12).

This study aims to address the gap in literature by comparing the efficiency of type I tympanoplasty in dry versus wet ears and examining the associated histopathological changes in the tympanic membrane. The findings from this study may help refine surgical decision-making and preoperative assessment for patients with tympanic membrane perforations in varying ear conditions.

Materials and Methods

Study Design and Population

This prospective, comparative study was conducted over a period of 12 months in a tertiary care hospital. A total of 60 patients with tympanic membrane perforations due to chronic otitis media were selected for type I tympanoplasty. The study participants were divided into two groups based on the ear condition at the time of surgery: 30 patients with a dry ear and 30

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

patients with a wet ear. Inclusion criteria included patients aged 18-60 years with conductive hearing loss due to a tympanic membrane perforation, who had no history of prior ear surgery, no active ear discharge in the past month for the dry ear group, and the presence of active discharge at the time of surgery for the wet ear group. Patients with coexisting middle ear pathologies or systemic conditions that could affect healing were excluded.

Surgical Procedure

All patients underwent type I tympanoplasty using an underlay technique under general anesthesia. The procedure was performed by the same surgical team to minimize variability. The temporalis fascia was harvested and used as the graft material. The graft was carefully placed under the edges of the perforated tympanic membrane, ensuring optimal coverage. Ear conditions were confirmed immediately before surgery, and appropriate aseptic measures were maintained throughout.

Outcome Measures

1. **Graft Uptake Rate:** The primary outcome was the graft uptake rate, assessed postoperatively at 3 months using otoscopy and tympanometry. Successful graft uptake was defined as complete closure of the perforation and no evidence of residual or recurrent perforation.
2. **Hearing Improvement:** Pure-tone audiometry (PTA) was conducted preoperatively and postoperatively at 3 months to assess hearing improvement. The average air-bone gap (ABG) closure was recorded for both groups.
3. **Histopathological Analysis:** Specimens of the tympanic membrane from the surgery were collected and subjected to histopathological examination. Parameters assessed included inflammatory cell infiltration, fibrosis, and neovascularization. The histological findings were scored based on a semi-quantitative scale: 0 = absent, 1 = mild, 2 = moderate, and 3 = severe.

Statistical Analysis

Data were analyzed using SPSS software version 25.0. Continuous variables, such as hearing improvement (measured in dB) and histopathological scores, were expressed as mean ± standard deviation (SD). Categorical variables, including graft uptake rate, were expressed as percentages. The independent t-test was used to compare mean values between the dry and wet ear groups, and the chi-square test was used for categorical data. A p-value of less than 0.05 was considered statistically significant.

Results

The study included 60 patients with tympanic membrane perforations, divided equally between the dry ear (n=30) and wet ear (n=30) groups. The mean age of the participants was 34.6 ± 10.2 years, with a similar distribution between both groups.

Graft Uptake Rate

The overall graft uptake rate at 3 months postoperatively was higher in the dry ear group compared to the wet ear group. The results are summarized in Table 1.

Table 1: Graft Uptake Rate	Dry Ear (n=30)	Wet Ear (n=30)
Successful Graft Uptake (%)	90% (27/30)	80% (24/30)

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

Failed Graft Uptake (%)	10% (3/30)	20% (6/30)

Hearing Improvement

Hearing improvement, measured by the air-bone gap (ABG) closure, was assessed for both groups. The dry ear group showed a greater improvement in ABG compared to the wet ear group. Results are presented in Table 2.

Table 2: Hearing Improvement (ABG Closure in dB)	**Dry Ear (n=30)**	**Wet Ear (n=30)**
Preoperative ABG (mean ± SD)	35.4 ± 8.3	34.6 ± 9.1
Postoperative ABG (mean ± SD)	15.2 ± 5.6	19.8 ± 7.2
Mean ABG Closure (dB)	20.2 ± 3.4	14.8 ± 4.3
p-value	0.03*	

*Significant difference, $p < 0.05$

Histopathological Findings

Histopathological examination of the tympanic membrane revealed differences in inflammatory cell infiltration, fibrosis, and neovascularization between the two groups. The wet ear group showed higher levels of inflammation and fibrosis. The findings are detailed in Table 3.

Table 3: Histopathological Findings (Scores)	**Dry Ear (n=30)**	**Wet Ear (n=30)**
Inflammatory Cell Infiltration (mean score ± SD)	1.2 ± 0.8	2.1 ± 0.9
Fibrosis (mean score ± SD)	0.9 ± 0.7	1.8 ± 0.8
Neovascularization (mean score ± SD)	1.1 ± 0.6	1.6 ± 0.7
p-value	0.04*	

*Significant difference, $p < 0.05$

The results indicate that type I tympanoplasty had a higher graft uptake rate and more significant hearing improvement in patients with a dry ear compared to those with a wet ear. Histopathological changes, particularly increased inflammatory cell infiltration and fibrosis, were more prominent in the wet ear group, potentially impacting graft success.

Discussion

The results of this study demonstrate that type I tympanoplasty achieves higher graft uptake rates and greater hearing improvement in dry ear conditions compared to wet ear conditions. These findings are consistent with previous studies, which have suggested that preoperative ear conditions significantly influence surgical outcomes in tympanoplasty (1,2).

In this study, the graft uptake rate was 90% in the dry ear group compared to 80% in the wet ear group, a difference that aligns with prior research indicating that a dry ear environment may facilitate better graft integration. Saliba and Alzahrani (3) found that the absence of active discharge in dry ears contributes to a more stable and conducive environment for graft healing, likely due to reduced inflammation and lower bacterial load. In contrast, the persistent discharge in wet ears may introduce a higher risk of infection, impairing graft stability and increasing the likelihood of postoperative complications (4,5).

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

Hearing improvement, measured by air-bone gap (ABG) closure, was also significantly greater in the dry ear group (20.2 dB) compared to the wet ear group (14.8 dB). This difference may be attributed to the lower levels of inflammation and fibrosis observed in dry ears. Inflammation has been associated with structural changes in the tympanic membrane that may impair its vibratory function, thereby reducing the extent of hearing improvement achievable post-surgery (6,7). Bhattacharya et al. (8) similarly reported that ears with lower preoperative inflammation, such as those in a dry condition, demonstrated better hearing restoration following tympanoplasty.

Histopathological findings in this study further support the differences in surgical outcomes between dry and wet ears. The wet ear group exhibited significantly higher levels of inflammatory cell infiltration and fibrosis compared to the dry ear group. This inflammation may result in compromised healing by interfering with the graft's integration into the tympanic membrane tissue. These findings are supported by Alam et al. (9), who observed that fibrosis and chronic inflammation in wet ears increase the risk of graft failure and reduce functional recovery. Increased neovascularization, observed at a greater extent in wet ears, may also contribute to poor graft outcomes by promoting an unstable vascular environment, which can impede tissue remodeling and healing (10).

The practical implications of these findings are significant, as they suggest that preoperative ear status should be carefully assessed in patients undergoing tympanoplasty. Some studies recommend optimizing the ear condition preoperatively—such as through infection control and anti-inflammatory therapies—to achieve a dry status, potentially improving the likelihood of successful graft uptake and hearing improvement (11,12). Additionally, our study's findings underscore the importance of postoperative care, particularly in wet ear patients, where a targeted anti-inflammatory and anti-infective approach may mitigate some of the inflammatory effects observed in histopathology.

While this study provides valuable insights, it is not without limitations. The sample size was relatively small, and future studies with larger populations could provide more definitive evidence. Furthermore, this study did not evaluate the long-term outcomes of tympanoplasty, which could offer a more comprehensive understanding of the impact of ear conditions on graft durability and hearing preservation over time.

Conclusion

This study highlights that dry ear conditions are associated with better graft uptake rates, improved hearing outcomes, and reduced histopathological inflammatory responses following type I tympanoplasty. These findings suggest that optimizing ear conditions preoperatively, particularly by achieving a dry ear status, may enhance surgical outcomes. Future research with larger samples and long-term follow-up could further elucidate these associations and help refine treatment strategies for tympanic membrane perforations.

References

1. Browning GG, Merchant SN, Kelly G, Swan IR, Canter R, McKerrow WS. Chronic otitis media. *BMJ.* 2002;325(7373):1159-1161.
2. Verhoeff M, van der Veen EL, Rovers MM, Sanders EA, Schilder AG. Chronic suppurative otitis media: a review. *Int J Pediatr Otorhinolaryngol.* 2006;70(1):1-12.
3. Saliba I, Alzahrani M. Tympanoplasty in wet versus dry ears: a comparative study. *Indian J Otolaryngol Head Neck Surg.* 2010;62(4):381-386.

ISSN: 0975-3583,0976-2833 VOL15, ISSUE 10, 2024

4. Onal K, Uguz MZ, Kazikdas KC, Gursel B. Functional results of tympanoplasty in patients with dry and wet ears. *Eur Arch Otorhinolaryngol.* 2005;262(10):847-850.
5. Sharma DK, Singh S, Sohal BS, Singh B. A comparative study of tympanoplasty in dry and wet ears. *Indian J Otolaryngol Head Neck Surg.* 2011;63(1):31-34.
6. Tos M, Lau T, Hedegaard B. Tympanoplasty in children: an analysis of late results. *Am J Otol.* 1986;7(1):55-60.
7. Baklaci D, Cingi C. Effect of the ear's preoperative status on the success rate of tympanoplasty. *J Craniofac Surg.* 2018;29(6)
8. Bhattacharya S, Chakraborty S, Mukherjee A, Ghosh M. Wet and dry myringoplasty: a comparative study in terms of graft uptake and hearing improvement. *Indian J Otolaryngol Head Neck Surg.* 2013;65(Suppl 3)
9. Alam MS, Kamran M, Ahmad N, Naseem M. Comparative study of type I tympanoplasty in dry and wet ear. *Pak J Med Sci.* 2013;29(6):1415-1418.
10. Habesoglu TE, Habesoglu M, Gocer C. Effects of middle ear pathologies on the tympanic membrane and hearing. *Ear Nose Throat J.* 2010;89(9)
11. Tos M, Poulsen G. Tympanoplasty in children. *Acta Otolaryngol Suppl.* 1983;398:1-39.
12. Harugop AS, Mudhol RS, Godhi RA. Comparative study of outcomes of type I tympanoplasty in wet and dry ear. *Indian J Otolaryngol Head Neck Surg.* 2008;60(3):207-212.