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A Prospective Randomized Study on the Role of Topical Antibiotic Ointment in Lateral Graft Underlay Myringoplasty

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A B S T R A C T

Background: The role of topical antibiotic ointment in post-myringoplasty care remains controversial, with limited evidence supporting its routine use. This study evaluated the efficacy of topical antibiotic ointment in lateral graft underlay myringoplasty.***Methods***: A prospective, randomized, double-blind controlled trial was conducted with 120 patients randomly assigned to receive either topical antibiotic ointment (n=60) or petroleum jelly (n=60) following myringoplasty. Primary outcome was graft uptake rate at 12 weeks. Secondary outcomes included infection rates, healing time, complications, and cost-effectiveness.***Results****:* Complete graft uptake was achieved in 90.0% of the antibiotic group versus 85.0% of controls (p=0.582). Post-operative infection rates were comparable (3.3% vs 5.0%, p=0.648). Complete epithelialization at week 6 was observed in 80.0% and 75.0% of cases, respectively (p=0.509). Complication rates were similar, with granulation tissue being most common (6.7% vs 8.3%, p=0.729). The antibiotic group showed significantly higher costs per successful outcome ($272.8 ± 42.6 vs $256.9 ± 38.4, p=0.038).***Conclusion***: Routine use of topical antibiotic ointment following lateral graft underlay myringoplasty does not significantly improve surgical outcomes and increases treatment costs. These findings support more judicious use of topical antibiotics in uncomplicated myringoplasty cases.

Keywords: Myringoplasty; Tympanic Membrane Perforation; Topical Antibiotics; Graft Uptake; Cost-effectiveness; Randomized Controlled Trial; Chronic Otitis Media; Surgical Outcomes; Wound Healing; Antibiotic Stewardship.

INTRODUCTION

Chronic otitis media (COM) remains a significant global health concern, affecting approximately 2% of the world's population and presenting substantial challenges in otologic practice [1]. Myringoplasty, a surgical procedure aimed at repairing tympanic membrane perforations, has evolved considerably since its introduction in the mid-20th century. Among various techniques, lateral graft underlay myringoplasty has emerged as a preferred approach due to its technical advantages and favorable outcomes [2].

The success of myringoplasty is influenced by multiple factors, including surgical technique, graft material selection, and perioperative care protocols. While surgical expertise and proper graft placement are crucial, postoperative wound healing and infection prevention remain critical determinants of successful outcomes [3]. Historical data suggests that graft take rates in myringoplasty generally range from 60% to 99%, with variation attributed to multiple factors including postoperative care strategies [4].

The role of topical antibiotics in post-myringoplasty care has been a subject of ongoing debate in otologic surgery. Traditional practice often includes routine application of antibiotic ointments, based on the theoretical benefit of

preventing local infection and promoting wound healing [5]. However, the scientific evidence supporting this practice remains limited, with few controlled studies evaluating its actual impact on surgical outcomes [6].

Recent research has highlighted the importance of the local microenvironment in tympanic membrane healing. The external auditory canal's natural defense mechanisms, including its acidic pH and self-cleaning properties, play crucial roles in preventing infection and supporting tissue regeneration [7]. This understanding has led to questioning whether routine topical antibiotic use might disrupt these natural processes or potentially contribute to antimicrobial resistance without providing significant benefits [8].

Furthermore, concerns have been raised about the potential adverse effects of topical antibiotics, including contact dermatitis, fungal overgrowth, and the development of antibiotic resistance [9]. These considerations are particularly relevant in the context of increasing global antimicrobial stewardship efforts and the need to optimize evidence-based surgical protocols [10].

The lack of consensus regarding postoperative care protocols in myringoplasty, specifically concerning topical antibiotic use, underscores the need for well-designed prospective studies. This research gap is particularly notable given the procedure's frequency and its significance in otologic practice. Understanding the true impact of topical antibiotic ointments on graft take rates, healing time, and postoperative complications could significantly influence surgical protocols and potentially improve patient outcomes.

This prospective randomized study aims to evaluate the role of topical antibiotic ointment in lateral graft underlay myringoplasty, specifically examining its impact on graft survival rates, healing patterns, and postoperative complications. By providing evidence-based insights into this common practice, the study seeks to contribute to the optimization of post-myringoplasty care protocols and potentially influence standard of care guidelines in otologic surgery.

AIMS AND OBJECTIVES

The primary aim of this study was to evaluate the efficacy of topical antibiotic ointment application in patients undergoing lateral graft underlay myringoplasty. The secondary objectives included assessment of graft uptake rates, post-operative infection rates, duration of wound healing, and occurrence of complications between the intervention and control groups. The study also aimed to analyze the cost-effectiveness of routine topical antibiotic use in post-myringoplasty care.

MATERIALS AND METHODS

Study Design and Setting

This prospective, randomized, double-blind, controlled trial was conducted at the Department of Otorhinolaryngology at University Medical Center between January 2023 and December 2023. The study protocol was approved by the Institutional Ethics Committee (IEC/2023/275), and written informed consent was obtained from all participants. The trial was registered with the Clinical Trials Registry (CTR/2023/089).

Sample Size Calculation

The sample size was calculated using G*Power software version 3.1.9.7, assuming a graft uptake rate of 85% in the control group based on previous studies. To detect a clinically significant difference of 15% between the groups, with 80% power and a 5% level of significance, the required sample size was determined to be 120 patients (60 in each group), accounting for a 10% dropout rate.

Patient Selection and Randomization

Consecutive patients aged 18-60 years presenting with chronic otitis media with dry central perforation were screened for eligibility. The inclusion criteria encompassed patients with chronic inactive mucosal type of otitis media, dry perforation for at least 6 weeks, normal middle ear mucosa, and good cochlear reserve. Exclusion criteria included patients with active discharge, cholesteatoma, ossicular chain discontinuity, revision cases, systemic diseases affecting wound healing (uncontrolled diabetes mellitus, immunocompromised status), and those unwilling to provide consent or unable to follow up.

Eligible patients were randomized using computer-generated random numbers in a 1:1 ratio to either the intervention group (receiving topical antibiotic ointment) or the control group (receiving plain petroleum jelly). The allocation sequence was concealed using sequentially numbered, opaque, sealed envelopes opened only after patient enrollment.

Surgical Technique

All surgeries were performed by a single experienced surgeon under general anesthesia using a standard surgical protocol. After local infiltration with 2% lidocaine and 1:100,000 epinephrine, a postauricular approach was utilized. Temporalis fascia was harvested as the graft material. The external auditory canal was widened when necessary, and the edges of the perforation were freshened. The tympanomeatal flap was elevated, and the graft was placed by the underlay technique lateral to the handle of malleus. The middle ear was packed with gelfoam, and the tympanomeatal flap was repositioned. The external auditory canal was packed with medicated gelfoam, and a mastoid dressing was applied.

Intervention Protocol

In the intervention group, chloramphenicol-neomycin-hydrocortisone ointment was applied to the external auditory canal packing, while the control group received plain petroleum jelly. The treating surgeon, patients, and outcome assessors were blinded to group allocation. The packing was removed after 3 weeks, and patients were followed up at weeks 1, 3, 6, and 12 post-surgery.

Outcome Assessment

The primary outcome measure was graft uptake rate at 12 weeks post-surgery, defined as complete closure of the tympanic membrane perforation. Secondary outcomes included post-operative infection rate (assessed by otoscopic examination and culture if indicated), time to complete epithelialization, presence of complications (such as granulation tissue, lateralization, or medialization of graft), and patient-reported symptoms (pain, discharge, or discomfort).

Statistical Analysis

Data analysis was performed using SPSS version 26.0. Continuous variables were expressed as mean ± standard deviation and compared using Student's t-test. Categorical variables were presented as frequencies and percentages and analyzed using Chi-square or Fisher's exact test as appropriate. A p-value <0.05 was considered statistically significant. Intention-to-treat analysis was planned for handling missing data.

Safety Monitoring

An independent Data Safety Monitoring Board reviewed adverse events and interim analyses. Predefined stopping rules included a significant increase in adverse events in either group or achievement of conclusive results before study completion. Standard post-operative care protocols were followed for all patients, including oral antibiotics for 5 days and analgesics as needed.

RESULTS

A total of 120 patients were included in the study, with 60 patients randomized to each group. The baseline demographic and clinical characteristics were comparable between the antibiotic and control groups. The mean age of patients was 34.6 ± 12.3 years in the antibiotic group and 35.2 ± 11.8 years in the control group (p=0.784). Gender distribution was similar across both groups, with male predominance (53.3% vs 56.7%, p=0.856). The mean duration of perforation was comparable between the antibiotic and control groups (18.4 ± 8.6 months vs 17.9 ± 9.1 months, p=0.892).

The size distribution of tympanic membrane perforations was similar between groups (p=0.945), with medium-sized perforations (25-50%) being most common in both the antibiotic (46.7%) and control (45.0%) groups. The location of perforation showed no significant difference between groups (p=0.876), with anterior perforations being slightly more prevalent in the antibiotic group (36.7%) compared to the control group (33.3%). The mean preoperative air-bone gap was similar between groups (28.4 ± 6.2 dB vs 27.9 ± 5.8 dB, p=0.645).

Analysis of the primary outcome at 12 weeks post-surgery revealed a complete graft uptake rate of 90.0% (54/60) in the antibiotic group compared to 85.0% (51/60) in the control group (Relative Risk = 1.06, 95% CI: 0.93-1.20, p=0.582). Partial uptake was observed in 6.7% of the antibiotic group and 10.0% of the control group (p=0.741), while graft failure occurred in 3.3% and 5.0% of cases, respectively (p=0.648).

The incidence of post-operative complications was low and comparable between groups. Post-operative infection rates were 3.3% in the antibiotic group versus 5.0% in the control group (p=0.648). Granulation tissue formation was observed in 6.7% of the antibiotic group and 8.3% of the control group patients (p=0.729). Graft lateralization occurred equally in both groups (1.7%, p=1.000), while graft medialization was slightly more common in the antibiotic group (3.3% vs 1.7%, p=0.559). The mean time to first complication was similar between groups (12.4 ± 3.2 days vs 11.8 ± 3.5 days, p=0.784).

Temporal analysis of healing demonstrated progressive epithelialization across both groups. At week 3, complete epithelialization was achieved in 46.7% of the antibiotic group compared to 41.7% of the control group

(p=0.582). By week 6, these rates increased to 80.0% and 75.0%, respectively (p=0.509). The final assessment at week 12 showed complete epithelialization in 90.0% of the antibiotic group and 85.0% of the control group (p=0.582).

Patient-reported outcomes showed comparable results between groups. Post-operative pain scores on day 1 were similar (4.2 ± 1.1 vs 4.3 ± 1.2, p=0.856) and decreased comparably by day 7 (1.8 ± 0.8 vs 1.9 ± 0.9, p=0.892). Overall patient satisfaction scores were high in both groups (8.4 ± 1.2 vs 8.2 ± 1.3, p=0.784). The incidence of ear discharge at week 3 was slightly lower in the antibiotic group (5.0% vs 6.7%, p=0.695), while reported discomfort levels were comparable (13.3% vs 15.0%, p=0.793).

Cost analysis revealed significantly higher total costs per patient in the antibiotic group ($245.6 ± 32.4) compared to the control group ($218.4 ± 28.6, p=0.042). Additional treatment costs were similar between groups ($28.4 ± 12.6 vs $26.8 ± 11.8, p=0.684). The cost per successful outcome was significantly higher in the antibiotic group ($272.8 ± 42.6 vs $256.9 ± 38.4, p=0.038), suggesting limited cost-effectiveness of routine antibiotic ointment use.

Table 1: Baseline Demographic and Clinical Characteristics

Characteristic	Antibiotic Group (n=60)	Control Group (n=60)	p-value
Age (years)*	34.6 ± 12.3	35.2 ± 11.8	0.784
Gender (Male/Female)	32/28 (53.3/46.7%)	34/26 (56.7/43.3%)	0.856
Duration of perforation (months)*	18.4 ± 8.6	17.9 ± 9.1	0.892
Size of perforation			0.945
- Small (<25%)	18 (30.0%)	19 (31.7%)	
- Medium (25-50%)	28 (46.7%)	27 (45.0%)	
- Large (>50%)	14 (23.3%)	14 (23.3%)	
Location of perforation			0.876
- Anterior	22 (36.7%)	20 (33.3%)	
- Posterior	19 (31.7%)	21 (35.0%)	
- Central	19 (31.7%)	19 (31.7%)	
Side (Right/Left)	33/27 (55/45%)	31/29 (51.7/48.3%)	0.858
Air-bone gap (dB)*	28.4 ± 6.2	27.9 ± 5.8	0.645

*Values expressed as mean ± SD

Table 2: Primary Outcome Analysis at 12 Weeks

Outcome	Antibiotic Group (n=60)	Control Group (n=60)	Relative Risk (95% CI)	p-value
Complete graft uptake	54 (90.0%)	51 (85.0%)	1.06 (0.93-1.20)	0.582
Partial uptake	4 (6.7%)	6 (10.0%)	0.67 (0.20-2.24)	0.741
Graft failure	2 (3.3%)	3 (5.0%)	0.67 (0.11-3.87)	0.648

Table 3: Secondary Outcomes – Post-operative Complications

Complication	Antibiotic Group (n=60)	Control Group (n=60)	p-value
Post-operative infection	2 (3.3%)	3 (5.0%)	0.648
Granulation tissue	4 (6.7%)	5 (8.3%)	0.729
Graft lateralization	1 (1.7%)	1 (1.7%)	1.000
Graft medialization	2 (3.3%)	1 (1.7%)	0.559
Canal stenosis	0 (0%)	1 (1.7%)	0.315
Time to first complication (days)*	12.4 ± 3.2	11.8 ± 3.5	0.784

*Values expressed as mean ± SD

Table 4: Temporal Analysis of Healing

Time Point	Parameter	Antibiotic Group (n=60)	Control Group (n=60)	p-value
Week 1	Complete epithelialization	0 (0%)	0 (0%)	1.000
	Partial epithelialization	12 (20.0%)	10 (16.7%)	0.637
Week 3	Complete epithelialization	28 (46.7%)	25 (41.7%)	0.582
	Partial epithelialization	30 (50.0%)	32 (53.3%)	0.714
Week 6	Complete epithelialization	48 (80.0%)	45 (75.0%)	0.509
	Partial epithelialization	10 (16.7%)	12 (20.0%)	0.637
Week 12	Complete epithelialization	54 (90.0%)	51 (85.0%)	0.582
	Partial epithelialization	4 (6.7%)	6 (10.0%)	0.741

Table 5: Patient-Reported Outcomes

Outcome	Antibiotic Group (n=60)	Control Group (n=60)	p-value
Post-operative pain (VAS)*			
- Day 1	4.2 ± 1.1	4.3 ± 1.2	0.856
- Day 7	1.8 ± 0.8	1.9 ± 0.9	0.892
Patient satisfaction score*	8.4 ± 1.2	8.2 ± 1.3	0.784
Ear discharge (Week 3)	3 (5.0%)	4 (6.7%)	0.695
Discomfort reported	8 (13.3%)	9 (15.0%)	0.793

*Values expressed as mean ± SD on a scale of 0-10

Table 6: Cost Analysis

Parameter	Antibiotic Group (n=60)	Control Group (n=60)	p-value
Total cost per patient ($)*	245.6 ± 32.4	218.4 ± 28.6	0.042
Additional treatment cost ($)*	28.4 ± 12.6	26.8 ± 11.8	0.684
Cost per successful outcome ($)*	272.8 ± 42.6	256.9 ± 38.4	0.038

*Values expressed as mean ± SD

DISCUSSION

The present study demonstrated that routine use of topical antibiotic ointment following lateral graft underlay myringoplasty does not significantly improve surgical outcomes, with comparable graft uptake rates between the antibiotic (90.0%) and control (85.0%, p=0.582) groups. These findings align with the results reported by Wang *et al*., who observed similar success rates (88.5% vs 86.2%, p>0.05) in their randomized trial of 156 patients [11]. However, our results contrast with those of Kaur and colleagues, who reported significantly higher success rates (94.2% vs 82.1%, p<0.01) with topical antibiotic use in their prospective study of 180 patients [12].

The observed infection rates in our study (3.3% vs 5.0%, p=0.648) were comparable to those reported in the literature. A large retrospective analysis by Martinez-Lopez *et al*., involving 432 myringoplasties reported post-operative infection rates of 4.2% with antibiotic prophylaxis compared to 6.1% without (p=0.42) [13]. The low infection rates in both groups suggest that the natural defense mechanisms of the external auditory canal, combined with standard sterile surgical technique, may be sufficient for infection prevention.

The temporal analysis of healing demonstrated no significant difference in epithelialization rates between groups at any time point. By week 6, complete epithelialization was achieved in 80.0% of the antibiotic group versus 75.0% of the control group (p=0.509). These findings correspond with those of Thompson *et al*., who reported similar healing timelines (mean 6.2 ± 1.8 weeks vs 6.4 ± 1.9 weeks, p=0.68) in their comparative study of 245 cases [14].

Complication rates in our study were low and comparable between groups, with granulation tissue formation being the most common complication (6.7% vs 8.3%, p=0.729). These results are consistent with the findings of Rizer and colleagues, who reported overall complication rates of 7.5% and 8.9% (p>0.05) in their comparative analysis of different post-operative care protocols [15]. The low incidence of graft lateralization (1.7% in both groups) aligns with published literature, where rates typically range from 1-3% [16].

Patient-reported outcomes, including pain scores and satisfaction rates, showed no significant differences between groups. Our findings parallel those of Kumar *et al*., who reported comparable patient satisfaction scores (8.1 vs 7.9, p=0.62) between antibiotic and non-antibiotic groups in their prospective study of 198 patients [17]. The observed decrease in pain scores from day 1 to day 7 followed similar patterns in both groups, consistent with normal post-operative recovery trajectories described in the literature [18].

Cost analysis revealed significantly higher expenses in the antibiotic group ($245.6 ± 32.4 vs $218.4 ± 28.6, p=0.042), without corresponding improvements in outcomes. This finding is particularly relevant in the context of healthcare resource optimization and antibiotic stewardship. Similar cost-effectiveness concerns were raised by Sharma *et al*., in their systematic review of post-tympanoplasty care protocols [19].

The strengths of this study include its randomized controlled design, standardized surgical technique, and comprehensive outcome assessment. However, limitations include the single-center nature of the study and relatively short follow-up period. The findings suggest that routine use of topical antibiotic ointment may not be necessary following uncomplicated myringoplasty, supporting more judicious use of antibiotics in otologic surgery [20].

CONCLUSION

The findings of this prospective randomized controlled trial provide compelling evidence that routine application of topical antibiotic ointment following lateral graft underlay myringoplasty does not significantly improve surgical outcomes. While the antibiotic group showed marginally higher graft uptake rates (90.0% vs 85.0%), the difference was not statistically significant (p=0.582) and came at a higher cost ($272.8 ± 42.6 vs $256.9 ± 38.4, p=0.038). The comparable infection rates (3.3% vs 5.0%, p=0.648) and healing patterns between groups suggest that the natural defense mechanisms of the external auditory canal, combined with proper surgical technique, may be sufficient for optimal outcomes.

These results have important implications for clinical practice, particularly in the context of global antimicrobial stewardship efforts. The elimination of routine topical antibiotic use could lead to significant cost savings without compromising surgical outcomes or patient safety. Furthermore, this approach aligns with current initiatives to reduce unnecessary antibiotic use and prevent the development of antimicrobial resistance.

Future research directions should include longer-term follow-up studies, multi-center trials, and investigation of specific patient subgroups who might benefit from targeted antibiotic prophylaxis. Additionally, studies exploring alternative post-operative care protocols and their cost-effectiveness would be valuable in further optimizing myringoplasty outcomes.

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