

Comparison of The Efficacy of Single Antibiotic Ear Tampon Versus Combination Antibiotic–Steroid Ear Tampon in Patients with Acute Diffuse Otitis Externa

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Abstract

Acute diffuse otitis externa is an acute inflammatory condition of the external auditory canal commonly associated with otalgia and ear canal oedema. Standard management includes aural toilet, pain control, and topical antimicrobial therapy, which may be administered using ear tampons with or without corticosteroids. This study aimed to compare the effectiveness of single-antibiotic ear tampons versus antibiotic–steroid combination ear tampons in reducing pain and ear canal oedema in patients with acute diffuse otitis externa. This double-blind randomized controlled clinical trial analyzed 40 patients with acute diffuse otitis externa who completed follow-up and were assigned to receive either single-antibiotic ear tampons or antibiotic–steroid combination ear tampons. Pain intensity was assessed using the Visual Analog Scale, and ear canal oedema was evaluated using the Brighton scale at baseline and on days 1, 3, and 5 after tampon insertion. Longitudinal analysis was performed using repeated-measures models. Both treatment groups demonstrated significant improvement in pain and oedema over time. However, longitudinal analysis showed that the antibiotic–steroid combination group experienced a significantly faster reduction in pain than the single-antibiotic group, whereas the trajectory of oedema improvement did not differ significantly between groups. Multivariable longitudinal analysis confirmed that treatment type and baseline pain severity were associated with pain outcome, while baseline oedema severity was strongly associated with oedema outcome. Both treatment regimens were effective over time, but antibiotic–steroid ear tampons provided faster pain relief, while oedema improvement remained comparable between groups.

Keywords: Acute Diffuse Otitis Externa, Ear Tampon, Antibiotics, Corticosteroids, Pain, Ear Canal Edema

1. Introduction

Acute diffuse otitis externa is an acute inflammatory disorder of the skin and subcutaneous tissue of the external auditory canal, most commonly caused by bacterial pathogens, particularly *Pseudomonas aeruginosa* and *Staphylococcus aureus*, and clinically characterized by otalgia, pruritus, ear canal edema, and occasional otorrhea. It is one of the most frequently encountered external ear conditions in primary health care settings, with a global prevalence of approximately 4 per 1,000 population per year, predominantly affecting children aged 7–12 years and young adults with frequent water exposure. The incidence is

highest in hot and humid climates and increases during the summer months, as environmental moisture, swimming activity, mechanical trauma from cotton bud use, and underlying dermatologic conditions facilitate microbial growth and infection of the external auditory canal.^{1,2}

National data on the incidence of otitis externa in Indonesia remain limited; however, available local studies indicate that otitis externa is one of the most common conditions managed in otorhinolaryngology outpatient clinics. A study conducted at Sanglah General Hospital, Denpasar, reported that during the 2015–2016 period, otitis externa was most frequently observed among

individuals aged 15–49 years, accounting for 55.9 percent of cases, and was slightly more prevalent in females at 52.4 percent. The most common presenting symptom was ear pain, reported in 67.9 percent of patients, followed by otorrhea in 55.9 percent, a sensation of ear fullness, pruritus, tinnitus, and hearing impairment. Mechanical trauma, particularly improper ear cleaning practices, was identified as the most frequent etiological factor, followed by bacterial or fungal infections. These findings underscore that otitis externa remains a significant ear health problem, especially among the productive-age population in tropical countries such as Indonesia.^{3,4}

The management of acute diffuse otitis externa primarily involves aural toilet, adequate pain control, and topical antimicrobial therapy. Topical antibiotics delivered as ear drops or ear tampons constitute the mainstay of treatment and may be combined with topical corticosteroids to reduce inflammation. Systemic analgesics such as paracetamol or ibuprofen are indicated in cases of moderate to severe pain. In patients with significant edema of the external auditory canal, ear tampon insertion is often necessary to ensure optimal drug penetration and sustained contact with the infected area. Single-antibiotic ear tampons, containing agents such as neomycin, gentamicin, ofloxacin, or ciprofloxacin, provide high local drug concentrations with minimal systemic effects and a lower risk of antibiotic resistance compared with oral therapy; however, the absence of anti-inflammatory properties may result in slower resolution of pain and edema.

Combination ear tampons containing antibiotics and corticosteroids have demonstrated superior efficacy in reducing pain and inflammation compared with

single-antibiotic preparations. Corticosteroids reduce edema, erythema, and pain, thereby accelerating symptomatic improvement, particularly in cases with marked canal narrowing. Several studies have reported faster clinical recovery, fewer follow-up visits, and reduced need for second-line antibiotics with antibiotic–steroid combination tampons. Despite these advantages, prolonged topical steroid use may be associated with adverse effects, including skin atrophy and an increased risk of otomycosis. This study aimed to compare the effectiveness of single antibiotic ear tampons with combination antibiotic-steroid ear tampons in reducing pain and ear canal edema, which are clinical symptoms in patients with acute diffuse otitis externa.

2. Methods

Study Design

This study was a randomized controlled clinical trial designed to compare the effectiveness of single-antibiotic ear tampons versus combination antibiotic–steroid ear tampons in patients with acute diffuse otitis externa treated at Mohammad Hoesin Hospital, Palembang.

Study Setting and Period

The study was conducted at the Otolaryngology Division of the Department of Otorhinolaryngology–Head and Neck Surgery and the Emergency Department of Mohammad Hoesin Hospital, Palembang, over two months from October to November 2025.

Study Population and Sample

The study population consisted of patients diagnosed with acute diffuse otitis externa who presented to the Otolaryngology Division or Emergency Department of Mohammad Hoesin Hospital. The study

sample included eligible patients meeting the inclusion criteria. Sample size calculation was performed using the formula for comparison of two means with a 90 percent confidence level, a standard deviation of 5, and a clinically meaningful mean difference of 2.62, resulting in a minimum of 20 subjects per group. To anticipate potential loss to follow-up, an additional 10 percent was added, yielding a target recruitment of 22 subjects per group and a total planned sample of 44 participants. The final number of analyzed participants depended on completion of follow-up through day 5 according to the predefined dropout criteria.

Inclusion, Exclusion, and Dropout Criteria

Inclusion criteria were patients diagnosed with acute diffuse otitis externa, Brighton Grade II or III, who provided written informed consent and were cooperative during examination. Exclusion criteria included prior topical or systemic treatment for otitis externa within the preceding 14 days, Brighton Grade I or IV disease, otitis media, otomycosis, malignant or chronic otitis externa, tympanic membrane perforation or any condition indicating loss of tympanic membrane integrity on otoscopic and/or teleendoscopic examination, non-cooperative patients, refusal of ear tampon therapy, known drug allergies, and other contraindications to topical gentamicin therapy. Dropout criteria included failure to attend follow-up before day five after tampon insertion, refusal to continue tampon therapy, inability to be contacted for follow-up, or development of adverse reactions during treatment, including allergic reactions, local dermatitis, symptoms suggestive of ototoxicity, or secondary otomycosis.

Study Variables

The independent variable was the type of ear tampon treatment, either single-antibiotic or antibiotic–steroid combination. The dependent variables were pain intensity and ear canal oedema. Prespecified covariates included age, sex, baseline VAS score, and baseline Brighton score, as appropriate for the longitudinal models. Diabetes mellitus was recorded descriptively but was not included in the final multivariable analysis because no participant in the study had diabetes.

Operational Definitions

Acute diffuse otitis externa was defined as acute inflammation of the skin and subcutaneous tissue of the external auditory canal characterized by pain, pruritus, edema, and possible otorrhea, diagnosed through history taking and physical examination. Pain was defined as an unpleasant sensory and emotional experience related to tissue inflammation and was measured using the Visual Analog Scale at baseline, day one, day three, and day five. Ear canal edema was defined as inflammatory swelling assessed through otoscopic and teleendoscopic examination using the Brighton grading scale. Sex, age, and diabetes mellitus history were recorded through anamnesis and medical records. The antibiotic–steroid ear tampon contained gentamicin combined with fluocinolone acetonide, while the single-antibiotic tampon contained gentamicin alone.

Sampling Technique and Randomization

Subjects were recruited using consecutive sampling until the minimum required sample size was reached. Eligible participants were randomized in a 1:1 ratio into two treatment groups using block randomization. The randomization sequence was generated in Microsoft Excel

by an independent individual who was not involved in subject enrollment, clinical evaluation, or outcome assessment. Allocation concealment was ensured by restricting access to the randomization list to the independent individual responsible for preparing the interventions. The study was conducted in a double-blind manner, such that both participants and investigators remained unaware of treatment allocation throughout the study period. To ensure blinding, both interventions were placed in identical containers labeled A and B without any distinguishing external characteristics. The coded interventions were prepared by an independent individual, while ear tampon insertion was performed by the investigator according to the assigned code.

Data Collection Methods

Data were collected using standardized instruments and materials, including single-antibiotic and antibiotic-steroid ear tampons, syringes, Visual Analog Scale rulers, otoscopy and teleendoscopy equipment, and sterile procedural tools. After providing written informed consent, eligible patients underwent baseline pain assessment using the Visual Analog Scale and clinical evaluation of the affected ear canal by otoscopic and teleendoscopic examination. An aural toilet was performed when necessary before intervention. Before ear tampon insertion, tympanic membrane integrity was carefully assessed by otoscopy and teleendoscopy to confirm the absence of perforation. Patients with otitis media, otomycosis, tympanic membrane perforation, or any other contraindication to topical gentamicin therapy were excluded from the study. Based on the randomized allocation, a standardized

gauze ear tampon with a uniform size and topical volume was inserted into the affected ear canal.

Pain intensity and ear canal condition were evaluated at baseline and during follow-up visits on days 1, 3, and 5. During each follow-up visit, the tampon was removed, and the ear canal was reassessed clinically. Adverse events and complications, including allergic reactions, local dermatitis, secondary otomycosis, and symptoms suggestive of ototoxicity, were monitored throughout the study period. As concomitant analgesic therapy, all participants received oral paracetamol according to the same standardized regimen (e.g., 500 mg three times daily for five days, unless contraindicated), and its administration was monitored during follow-up.

Outcomes

The primary endpoint of the study was the change in pain intensity, assessed using the Visual Analog Scale from baseline to day 5 after ear tampon insertion. Secondary endpoints included changes in ear canal edema assessed using the Brighton scale at days 1, 3, and 5, as well as the comparative trajectory of symptom improvement between treatment groups during follow-up.

Data Processing and Statistical Analysis

Baseline characteristics were summarized descriptively. Normally distributed continuous variables are presented as mean $\pm$ standard deviation, whereas ordinal or non-normally distributed variables are presented as median and interquartile range, as appropriate. Categorical variables are presented as frequencies and percentages.

Because pain intensity and ear canal oedema were measured repeatedly in the same participants at baseline and on days

1, 3, and 5, the primary analysis used a longitudinal repeated-measures approach. For the VAS pain score, a Gaussian generalized estimating equation model was applied with treatment group, time, and treatment $\times$ time interaction as predictors, with age and sex included as covariates. For the Brighton oedema score, an ordinal generalized estimating equation model was used with treatment group, time, treatment $\times$ time interaction, baseline Brighton score, age, and sex as covariates. Effect estimates are reported with 95% confidence intervals.

For multivariable longitudinal analysis, treatment was coded as a single binary indicator variable (0 = single-antibiotic therapy, 1 = antibiotic-steroid therapy). Baseline VAS score and baseline Brighton score were included in the respective models where appropriate. Diabetes mellitus was not included in the final multivariable analysis because no participant had diabetes. A two-sided p -value <0.05 was considered statistically significant.

The primary analysis was conducted using a per-protocol approach, including only participants who completed follow-up assessments through day 5 and had complete outcome data for analysis. Participants who met the predefined dropout criteria or had incomplete follow-up data were excluded from the final analysis, and missing data were handled using complete-case analysis.

3. Results

Demographic Characteristics

A total of 44 patients were enrolled and randomized, with 22 allocated to the single-antibiotic group and 22 to the antibiotic-steroid group. During follow-up, four participants were excluded from the final analysis because they did not complete the assessment through day 5

according to the predefined dropout criteria. Consequently, 40 participants completed the study and were included in the per-protocol analysis, with 20 participants in each group. The detailed participant flow is presented in Figure 1.

Among the 40 participants included in the final analysis, 21 (52.5%) were female, and 19 (47.5%) were male. The mean age was 34.90 ± 15.95 years in the single-antibiotic group and 30.75 ± 13.75 years in the antibiotic-steroid group. No participant had a history of diabetes mellitus. Most participants had a university-level education, and the most commonly reported behavioral factors were ear picking and earphone or earplug use, each reported by 50% of participants. No treatment-related adverse events were observed during follow-up. Specifically, no participants developed allergic reactions, local dermatitis, symptoms suggestive of ototoxicity, or secondary otomycosis.

Longitudinal Analysis of VAS Score

Longitudinal analysis of VAS score was performed using a Gaussian GEE repeated-measures model with treatment group, time, treatment $\times$ time interaction, age, and sex as covariates. The analysis showed a highly significant overall effect of time (Wald $\chi^2 = 399.52$, $p < 0.001$), indicating that pain scores decreased significantly during follow-up in both groups. Importantly, the treatment $\times$ time interaction was also significant (Wald $\chi^2 = 90.71$, $p < 0.001$), demonstrating that the trajectory of pain reduction differed between groups. Compared with the single-antibiotic group, the antibiotic-steroid combination group showed a significantly greater decline in VAS score at day 1 ($\beta = -1.900$, 95% CI -2.428 to -1.372, $p < 0.001$), day 3 ($\beta = -2.250$, 95% CI -2.991 to -1.509, $p < 0.001$), and day 5 ($\beta = -1.100$, 95% CI -1.870 to -0.330, $p = 0.005$). The

main effect of the treatment group at baseline was not statistically significant ($p = 0.094$), suggesting that the groups were

broadly comparable at the starting point. Age and sex were not significantly associated with longitudinal VAS outcome.

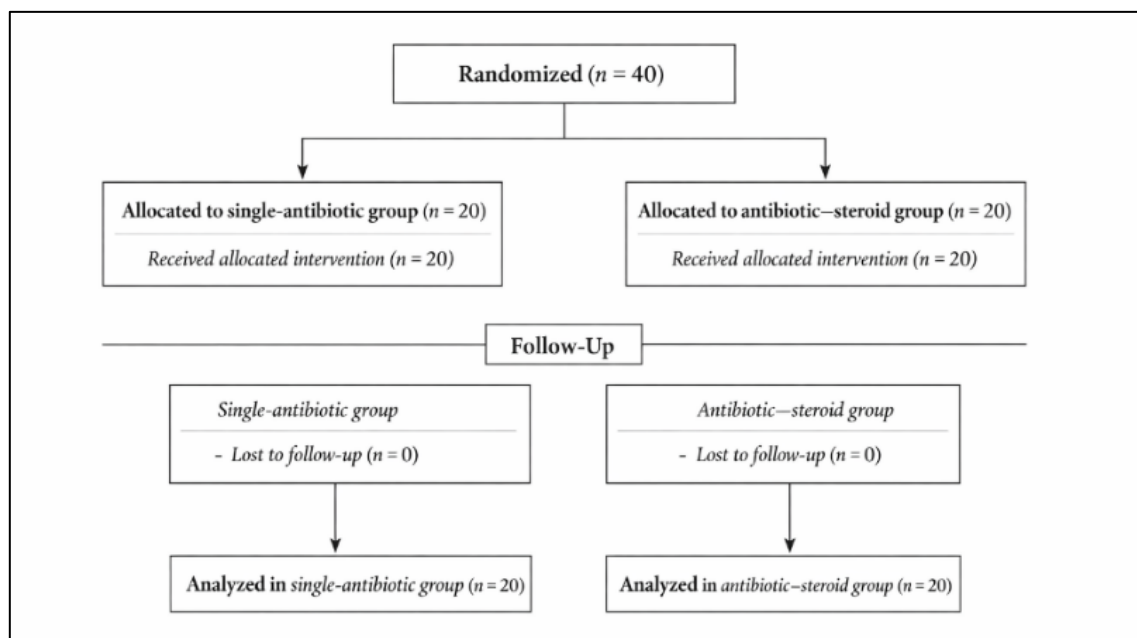


Figure 1. CONSORT Flow Diagram of Participant Randomization, Allocation, and Follow-Up

Table 1. Demographic Characteristics

Demographic Characteristics	Single-Antibiotic Group	Antibiotic-Steroid Group	Total n (%)
Sex (n, %)*			
Male	13 (65%)	6 (30%)	19 (47.5%)
Female	7 (35%)	14 (70%)	21 (52.5%)
Age, median (IQR) years	33.0 (13%)	30.5 (19%)	31.5 (15.5%)
History of Diabetes Mellitus			
Yes	0 (0%)	0 (0%)	0 (0%)
No	20 (100%)	20 (100%)	40 (100%)
Education Level			
No formal education	0 (0%)	0 (0%)	0 (0%)
Primary school	2 (10%)	3 (15%)	5 (12.5%)
Junior high school	1 (5%)	5 (25%)	6 (15%)
Senior high school	9 (45%)	4 (20%)	13 (32.5%)
Bachelor's degree	8 (40%)	8 (40%)	16 (40%)
Master's degree	0 (0%)	0 (0%)	0 (0%)
Doctoral degree	0 (0%)	0 (0%)	0 (0%)
Behavioral Factors			
Ear picking	8 (40%)	12 (60%)	20 (50%)
Earphone/earplug use	12 (60%)	8 (40%)	20 (50%)

*Data are presented as n (%) unless otherwise stated. Age is presented as median (IQR)

Longitudinal Analysis of the Brighton Scale for Oedema

Longitudinal analysis of the Brighton oedema score was performed using an ordinal GEE repeated-measures model with treatment group, time, treatment $\times$ time interaction, baseline Brighton score, age, and sex as covariates. The analysis demonstrated a significant overall effect of time (Wald $\chi^2 = 25.04$, $p < 0.001$), indicating that oedema improved progressively during follow-up in both groups. However, the treatment $\times$ time interaction was not significant (Wald $\chi^2 = 0.216$, $p = 0.898$), showing that the trajectory of oedema reduction did not differ significantly between the single-antibiotic and antibiotic-steroid groups. In the model,

the odds of having a higher oedema score were lower in the antibiotic-steroid group than in the single-antibiotic group at the reference follow-up point (Day 1) (OR = 0.116, 95% CI 0.019 to 0.699, $p = 0.019$). Oedema severity also decreased significantly over time, with lower odds of a higher oedema score at Day 3 (OR = 0.083, 95% CI 0.023 to 0.300, $p < 0.001$) and Day 5 (OR = 0.016, 95% CI 0.003 to 0.081, $p < 0.001$) compared with Day 1. Baseline Brighton score was strongly associated with follow-up oedema severity (OR = 12.307, 95% CI 3.258 to 46.487, $p < 0.001$). Age showed a modest positive association, while sex was not significantly associated with longitudinal oedema outcome.

Table 2. Longitudinal Analysis of VAS Score

Variable	Coefficient (β)	95% CI	p-value	Wald χ^2
Time Day 1 vs Baseline	-1.400	-1.615 to -1.185	<0.001	
Time Day 3 vs Baseline	-2.450	-2.829 to -2.071	<0.001	
Time Day 5 vs Baseline	-3.900	-4.313 to -3.487	<0.001	
Treatment group, combination vs single	0.641	-0.109 to 1.390	0.094	
Treatment $\times$ Day 1	-1.900	-2.428 to -1.372	<0.001	
Treatment $\times$ Day 3	-2.250	-2.991 to -1.509	<0.001	
Treatment $\times$ Day 5	-1.100	-1.870 to -0.330	0.005	
Age	0.007	-0.007 to 0.021	0.309	
Sex, female vs male	-0.176	-0.559 to 0.208	0.369	
Effect				
Time			<0.001	399.52
Treatment $\times$ Time interaction			<0.001	90.71

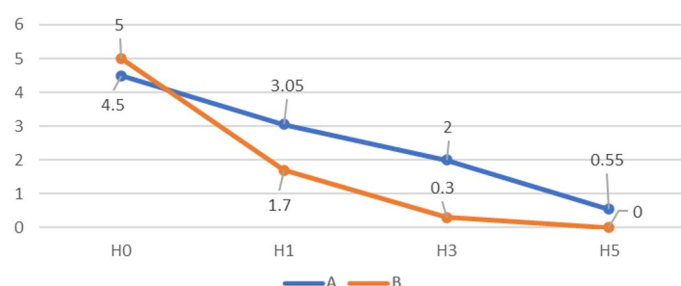


Figure 1. Comparison of pain score reduction between the two groups from days 0, 1, 3, and 5, A: single-antibiotic group, B: antibiotic-steroid group

Table 3. Longitudinal Analysis of Brighton Scale

Variable	OR	95% CI	p-value	Wald χ^2
Time, Day 3 vs Day 1	0.083	0.023 to 0.300	<0.001	
Time, Day 5 vs Day 1	0.016	0.003 to 0.081	<0.001	
Treatment × Time, Day 3	1.485	0.270 to 8.172	0.650	
Treatment × Time, Day 5	1.228	0.119 to 12.707	0.863	
Baseline Brighton score	12.307	3.258 to 46.487	<0.001	
Age	1.042	1.003 to 1.083	0.035	
Sex, female vs male	2.954	0.788 to 11.067	0.108	
Effect				
Time			<0.001	25.04
Treatment × Time interaction			0.898	0.216

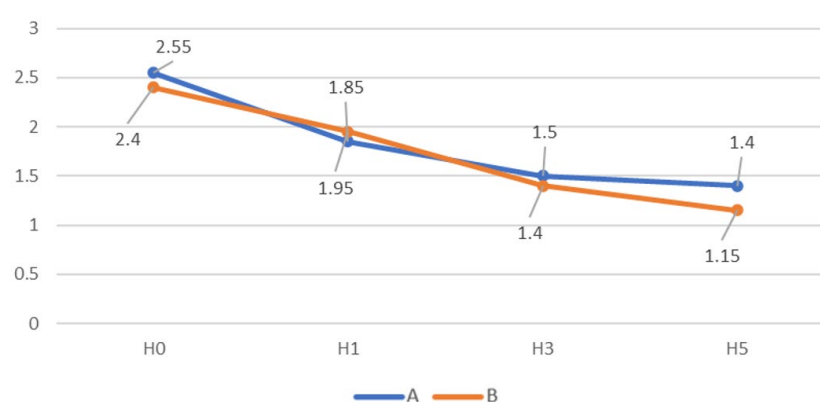


Figure 2. Comparison of edema scale reduction between the two groups from days 0, 1, 3, and 5, A: single-antibiotic group, B: antibiotic–steroid group

Multivariate Longitudinal Analysis

For the VAS pain score, the linear mixed-effects model demonstrated a significant overall effect of time ($p < 0.001$) and a significant treatment × time interaction ($p < 0.001$), indicating that the trajectory of pain reduction differed significantly between treatment groups. Compared with the single-antibiotic group, the antibiotic–steroid group showed lower follow-up pain scores overall ($\beta = -1.496$, 95% CI -1.875 to -1.116, $p < 0.001$).

Baseline VAS score remained a significant predictor of longitudinal pain outcome ($\beta = 0.275$, 95% CI 0.172 to 0.378, $p < 0.001$), whereas age and sex were not significantly associated with pain trajectory. For the Brighton oedema score,

the ordinal GEE model showed a significant overall effect of time ($p < 0.001$), confirming progressive oedema improvement during follow-up in both groups. However, the treatment × time interaction was not significant ($p = 0.898$), indicating that the pattern of oedema reduction over time did not differ significantly between the single-antibiotic and antibiotic–steroid groups. Baseline Brighton score was strongly associated with follow-up oedema severity (OR = 12.307, 95% CI 3.258 to 46.487, $p < 0.001$), and age showed a modest association (OR = 1.042, 95% CI 1.003 to 1.083, $p = 0.035$), while sex was not significantly associated with oedema trajectory.

Table 3. Linear Mixed-Effects Model for VAS Pain Score

Variable	Estimate (β)	95% CI	p-value
Treatment group, combination vs single	-1.496	-1.875 to -1.116	<0.001
Time, Day 3 vs Day 1	-1.050	-1.344 to -0.756	<0.001
Time, Day 5 vs Day 1	-2.500	-2.794 to -2.206	<0.001
Treatment $\times$ Time, Day 3	-0.350	-0.766 to 0.066	0.099
Treatment $\times$ Time, Day 5	0.800	0.384 to 1.216	<0.001
Baseline VAS score	0.275	0.172 to 0.378	<0.001
Age	0.003	-0.006 to 0.013	0.468
Sex, female vs male	0.025	-0.265 to 0.316	0.864

Table 4. Ordinal GEE Model for Brighton Oedema Score

Variable	OR	95% CI	p-value
Treatment group, combination vs single	0.116	0.019 to 0.699	0.019
Time, Day 3 vs Day 1	0.083	0.023 to 0.300	<0.001
Time, Day 5 vs Day 1	0.016	0.003 to 0.081	<0.001
Treatment $\times$ Time, Day 3	1.485	0.270 to 8.172	0.650
Treatment $\times$ Time, Day 5	1.228	0.119 to 12.707	0.863
Baseline Brighton score	12.307	3.258 to 46.487	<0.001
Age	1.042	1.003 to 1.083	0.035
Sex, female vs male	2.954	0.788 to 11.067	0.108

4. Discussion

The demographic characteristics demonstrate a balanced distribution between the two treatment groups, each comprising 20 participants, with a slightly higher overall proportion of female subjects (52.5%) and a mean age ranging from the early to mid-third decade of life (34.90 ± 15.95 years in the single-antibiotic group and 30.75 ± 13.75 years in the antibiotic–steroid group), and no history of diabetes mellitus. This profile is consistent with the typical clinical epidemiology of acute diffuse otitis externa, which predominantly affects adolescents and young adults of both sexes. Regarding behavioral factors, half of the participants reported habitual ear picking, and the other half regular use of earphones or earplugs, while none reported frequent swimming, suggesting a risk pattern dominated by local mechanical irritation rather than water exposure.^{5,6,7} Although

this differs from several studies identifying swimming as a major precipitating factor, it aligns with evidence indicating that canal trauma, intracanal device use, and microenvironmental disruption of the external auditory canal play significant roles in disease development, particularly in urban populations with distinct lifestyle patterns.^{8,9,10}

The longitudinal analysis demonstrated that pain intensity decreased significantly over time in both treatment groups, confirming that ear tampon therapy was effective in relieving pain associated with acute diffuse otitis externa. However, the reduction in pain was significantly greater and more rapid in the antibiotic–steroid group than in the single-antibiotic group, as reflected by the significant treatment-by-time interaction. This finding indicates that the addition of a corticosteroid provided an important anti-inflammatory effect beyond the

antibacterial action alone, thereby accelerating pain relief during follow-up. Clinically, this is consistent with the observation that the combination group showed sharper early improvement and achieved complete pain resolution by day 5, whereas mild residual pain remained in some patients in the single-antibiotic group. These findings are in line with previous reports showing that topical antibiotic–steroid combinations may shorten recovery time, improve symptom control more rapidly, and reduce the need for further intervention in patients with acute otitis externa.^{10,11,12}

The stronger effect on pain reduction can be explained by the pathophysiology of acute diffuse otitis externa itself. Pain in this condition is not caused solely by structural edema of the external auditory canal, but also by intense inflammatory mediator release, nociceptor sensitization, and pressure within the confined canal space. Antibiotics alone reduce pain indirectly by controlling bacterial growth and decreasing infection-driven inflammation over time. In contrast, the addition of a steroid more directly suppresses the inflammatory cascade, reduces local hyperemia, and dampens pain-related mediator activity, resulting in faster symptomatic improvement. This mechanism may explain why the longitudinal model showed a clear difference in pain trajectory between groups, even though both groups improved overall.^{8,11,12}

The longitudinal analysis of the Brighton oedema score showed that oedema improved progressively over time in both groups, indicating that both single-antibiotic and antibiotic–steroid ear tampons were effective in reducing inflammatory swelling of the external auditory canal. However, unlike the pain outcome, the treatment-by-time

interaction for edema was not statistically significant. This indicates that although edema decreased during follow-up, the overall pattern of improvement did not differ significantly between the two treatment groups. In other words, both regimens were associated with comparable longitudinal edema resolution.^{12,13,14}

This finding suggests that control of infection itself plays a major role in the resolution of canal swelling. Topical antibiotics may be sufficient to reduce bacterial colonization, lower the inflammatory burden, and gradually restore the local canal environment, thereby allowing edema to resolve even in the absence of added steroids. Although corticosteroids theoretically provide stronger anti-inflammatory action through reduction of capillary permeability and tissue swelling, this advantage may not always translate into a clearly measurable difference in short-term edema scores, particularly within a relatively brief observation period such as five days. It is therefore plausible that steroids exert a more evident and immediate effect on pain perception than on the structural resolution of edema.^{12,13,14}

Baseline VAS score also remained significantly associated with follow-up pain severity, indicating that the initial intensity of symptoms contributed to subsequent pain outcomes. In contrast, age and sex were not significantly associated with longitudinal pain reduction, suggesting that the therapeutic effect was relatively consistent across demographic subgroups in this study population. For edema, the multivariable longitudinal model demonstrated that improvement over time was significant overall, but the treatment-by-time interaction remained non-significant after adjustment. Baseline Brighton score was strongly associated

with subsequent edema severity, which indicates that the initial degree of canal swelling was an important determinant of follow-up outcome. Age showed only a modest association, whereas sex was not significant. Taken together, these findings support the interpretation that edema resolution in acute diffuse otitis externa is more strongly influenced by baseline local inflammatory severity and individual tissue response than by the specific choice between single-antibiotic and antibiotic–steroid therapy.^{15,16}

The multivariable longitudinal findings reinforce the main clinical message of this study. The addition of a steroid to topical antibiotic ear tampon therapy appears to provide a clear advantage in accelerating pain relief, whereas its additional benefit for edema reduction is less pronounced and not statistically significant in longitudinal analysis. This distinction is clinically plausible, as pain improvement may respond more rapidly to suppression of inflammatory mediators, whereas structural resolution of edema may require more time and may depend on a broader range of local tissue factors. Because oral paracetamol was administered as concomitant analgesic therapy in both groups, some reduction in pain scores may have been influenced by systemic analgesia; however, this effect was minimized by applying the same regimen to all participants.

5. Conclusion

Both single-antibiotic and antibiotic–steroid ear tampons were effective in improving pain and ear canal oedema in patients with acute diffuse otitis externa over time. However, the antibiotic–steroid combination achieved a significantly faster reduction in pain, while oedema improvement was comparable between

groups in longitudinal analysis. Multivariable longitudinal modeling showed that treatment type was an important determinant of pain improvement, whereas oedema outcome was more strongly influenced by baseline oedema severity than by treatment group alone. Antibiotic–steroid ear tampons may therefore be preferred when rapid pain relief is the main therapeutic goal, while single-antibiotic ear tampons remain a reasonable alternative. Further studies with larger samples, longer follow-up, and microbiological assessment are warranted.

6. Acknowledgment

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