Basavaraju and Ranjani
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Efficacy of combination of acetic acid and ciprofloxacin eardrops versus only ciprofloxacin eardrops in achieving dry ears in chronic suppurative otitis media

K. P. Basavaraju[1] and S. K. Ranjani[1*]

Abstract

Background As per WHO, the chronic inflammatory condition involving the middle ear and mastoid cavity, resulting in recurrent ear discharge, otherwise known as otorrhoea, through perforation of the eardrum or tympanic membrane, is known as chronic suppurative otitis media (CSOM). Recurrent middle ear infections are known to produce a myriad of intracranial and extracranial complications. CSOM is considered a biofilm disease, wherein biofilms are found to be the most prevalent microbial form, playing a crucial role in the chronicity of the infections and observed resistance to antibiotics. Thus disruption of the biofilm layer is necessary for the management of CSOM. This can be achieved by aural toileting and topical 2% acetic ear drops.

Aim To study the efficacy of the combination of acetic acid and ciprofloxacin eardrops versus only ciprofloxacin ear drops in achieving dry ears in chronic suppurative otitis media.

Materials and methods Sixty-three patients diagnosed with CSOM (mucosal type) were randomly divided into two groups: Group A — who received both 2% acetic acid and ciprofloxacin ear drops and Group B — who received only Ciprofloxacin ear drops; thrice daily. Additionally, both groups received systemic oral antibiotic being tab. ciprofloxacin 500 mg twice daily for 14 days. Weekly follow-up was done for 2 weeks and compared on the basis of otological symptom score.

Results Both combination of acetic acid with ciprofloxacin and only ciprofloxacin ear drops significantly reduced the amount of ear discharge ($P < 0.001$) by the second visit, but the reduction in the amount of otorrhoea in Group A was found to be more significant than in Group B ($P = 0.014$). Also, the former was significantly more effective in achieving and maintaining dry ears by the third visit ($P < 0.001$).

Conclusion Combination of acetic acid and ciprofloxacin ear drops was found to be more effective than only ciprofloxacin ear drops in achieving and maintaining dry ears while treating CSOM.

Keywords Chronic suppurative otitis media (CSOM), 2% Acetic acid, Ciprofloxacin, Otological symptom score, Dry ears

*Correspondence:
S. K. Ranjani
ranjaniskrishnamurthy@gmail.com
[1] Department Of Otorhinolaryngology, J J M Medical College, Davangere, Karnataka, India

Background

As per WHO, the chronic inflammatory condition involving the middle ear and mastoid cavity, resulting in recurrent ear discharge, otherwise known as otorrhoea, through the perforation of the eardrum or tympanic membrane, is known as chronic suppurative otitis

media (CSOM) [1]. Recurrent middle ear infections are known to produce a myriad of intracranial and extracranial complications, ranging from reduction or complete loss of hearing, inflammation of the mastoid, abscesses in the brain and mastoid, inflammation of meninges, sepsis, labyrinthine involvement to even death [2]. It is, thus, essential to medically manage CSOM to achieve dry ear before surgical management of the same. This reduces potential failure of surgery and recurrence rates apart from reducing the possibility of complications.

Staphylococcus aureus, followed by *Pseudomonas aeruginosa*, are amongst the most commonly found organisms isolated from cultures of ear discharge in CSOM [3]. As per drug sensitivity patterns, most of the isolates have been found to be sensitive to the fluoroquinolone drug, ciprofloxacin. Other sensitive drugs identified are amikacin, gentamicin, cephalosporins, and other penicillins [4, 5]. The documented ototoxicity, nephrotoxicity, and contraindications of systemic aminoglycosides and quinolones [6, 7], led to the topical quinolones gaining prominence in the medical management of CSOM.

With respect to CSOM, several studies have attributed chronicity of the infections and observed resistance to antibiotics to biofilm formation, which were found to be the most prevalent microbial form with the potential for even fungal growth, thus naming CSOM as one of the biofilm diseases [8–11]. Hence, disruption of the biofilm layer is necessary in the management of CSOM. This can be achieved by aural toileting and topical 2% acetic ear drops [12].

This study was conducted with the intention to study the efficacy of the combination of acetic acid and ciprofloxacin ear drops versus only ciprofloxacin ear drops in achieving and maintaining dry ears in CSOM.

Methods

A prospective study was conducted on 63 patients who visited Outpatient Department of Otorhinolaryngology and Head and Neck Surgery of our tertiary care hospital for a duration of 2 months. The study was commenced following the approval by the Institutional Ethical Committee.

Patients, irrespective of age and sex, diagnosed to have the active mucosal type of CSOM, presenting with ear discharge of duration more than 3 months and a permanent perforation of tympanic membrane on otoscopy, were chosen for this study, after taking consent.

In the case of patients with bilateral actively discharging ears, only one ear was considered and included in the study, despite both ears receiving the same treatment.

Patients having—dry or inactive or quiescent ear, those with CSOM with an aural polyp, CSOM of squamosal type, any pathology in the external auditory canal, any existing malignancy of the ear, vertigo, or having a positive history of antibiotic treatment in the previous 1 week or mastoid surgery within the previous year or known hypersensitivity to acetic acid or drug allergy to any of the medications and/or immunocompromised state; were all excluded from the study.

They were randomly allotted into 2 Groups, such that consecutive patients were allotted into different groups. A total of 63 patients were included in this study of whom 32 were assigned into Group A, receiving both ciprofloxacin and acetic acid ear drops and 31 patients were assigned into Group B, receiving only ciprofloxacin ear drops.

All patients received a complete otorhinolaryngological examination following detailed history with emphasis on ear discharge (otorrhoea), and ringing sensation (tinnitus). The amount and consistency of ear discharge were taken into consideration. Also, thorough aural toileting via suctioning and dry mopping under a microscope was performed on all patients. On the first visit, at the time of initial evaluation, otological symptom score [13, 14] was assessed to know the baseline before treatment (Table 1).

Group A patients received both 2% acetic acid and ciprofloxacin ear drops, while Group B received only ciprofloxacin ear drops (3 drops thrice daily) [15] for a duration of 1 week. In Group A, the 2% acetic acid drops (2 drops thrice daily) [16–18] was used close to half an hour before ciprofloxacin ear drops (3 drops thrice daily). All patients received the same medical line of management with the systemic oral antibiotic being Tab. ciprofloxacin 500 mg (twice daily) for a duration of 14 days. [19]

Patients were followed up after 1 week, a second visit, and again at 2 weeks, a third visit, where the ear was assessed for dryness and ringing sensation. Otological

Table 1 Otological symptom score

Signs and symptoms	Score 0	Score 1	Score 2	Score 3
Amount of discharge	No discharge	Confined to the middle ear	Entering into EAC	Completely filling EAC
Type of discharge	Absent	Mucoid	Mucopurulent	Purulent
Tinnitus	Absent	Mild	Moderate	Severe

symptom score was assessed again during subsequent visits with special emphasis on any change in the amount or consistency of ear discharge, even that of complete absence of the same. During the third visit, recurrence or persistence of ear discharge was documented, if the ear otherwise was not found to be dry.

Results

A total of 63 patients were included in this study of whom 32 were assigned to Group A, receiving both ciprofloxacin and acetic acid ear drops and 31 patients were assigned to Group B, receiving only ciprofloxacin ear drops, randomly.

The mean age in Group A was 34.16 ± 13.36 years, while in Group B, it was 42.55 ± 17.00 years, with minimum and maximum ages in Group A being 12 years and 65 years, respectively, while in Group B being 10 years and 78 years, respectively. Group A had 20 male and 12 female patients, while Group B had 19 male and 12 female patients. During the period of study, patients showed no adverse effects to the topical or oral drugs used in either group.

The baseline otological symptom scores were comparable, with no significant difference between the two groups, during the first visit (4.59 ± 1.60, 4.35 ± 0.99, respectively, with $p = 0.478$).

An intragroup analysis of Group A showed a significant improvement with a reduction of discharge amount ($p = < 0.001$), consistency symptom score ($p = < 0.001$), and total otological symptom score ($p = < 0.001$) during follow-up on the second visit. No significant improvement was seen with respect to tinnitus between the two visits ($p = 0.083$) (Fig. 1).

An intragroup analysis of Group B also showed a significant improvement with a reduction of discharge amount ($p = < 0.001$), consistency symptom score ($p = < 0.001$), and total otological symptom score ($p = < 0.001$) during follow-up on the second visit. No significant improvement was seen with respect to tinnitus between the two visits ($p = 0.305$).

Intergroup analysis between the two groups on the second visit showed that Group A, receiving both ciprofloxacin and acetic acid ear drops, is significantly more efficient in reducing the amount of discharge ($p = 0.014$), consistency score ($p = 0.038$) and total otological symptom score ($p = 0.041$), than Group B, receiving only ciprofloxacin ear drops. There was no significant difference between the two groups with respect to tinnitus on follow-up ($p = 0.960$) (Fig. 2).

Apart from these, on the third visit, out of 32 patients of Group A, 29 (90.6%) showed absence of ear discharge, while, 03 (9.4%) showed presence of ear discharge. In Group B, among 31 patients, 14 (45.2%) showed the absence of ear discharge and 17 (54.8%) showed the presence of ear discharge at the third visit despite treatment for 2 weeks. That is, significantly more number of patients had wet ear, either due to persistence or recurrence of ear discharge, at the third visit in Group B ($p = < 0.001$) (Fig. 3).

Discussion

Management of otorrhoea in CSOM has become challenging of late due to emerging resistance to antibiotics, aggressive excessive usage of systemic antibiotics and their toxicity, poor patient compliance for long-term

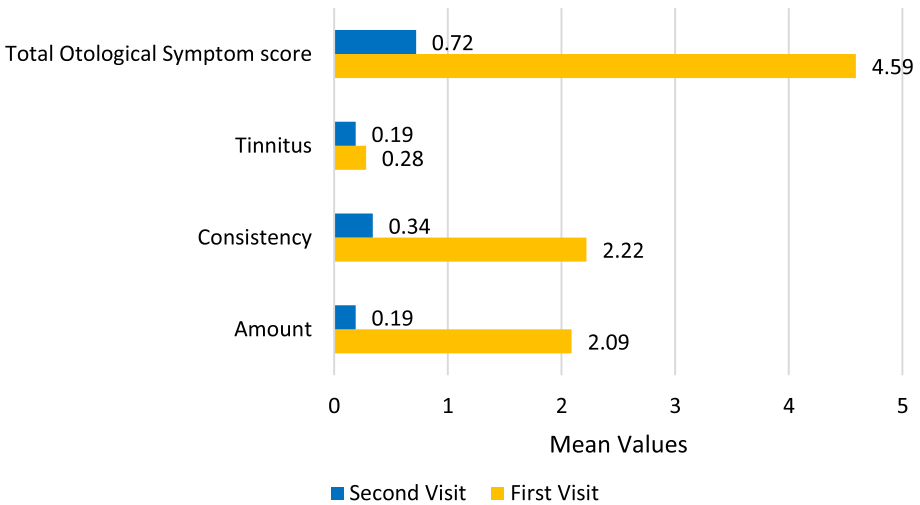

Fig. 1 Comparison of amount, consistency, tinnitus, and total otological symptom score between the first and second visit of Group A. Group A showed a significant improvement with a reduction of discharge amount ($p = < 0.001$), consistency symptom score ($p = < 0.001$) and total otological symptom score ($p = < 0.001$)

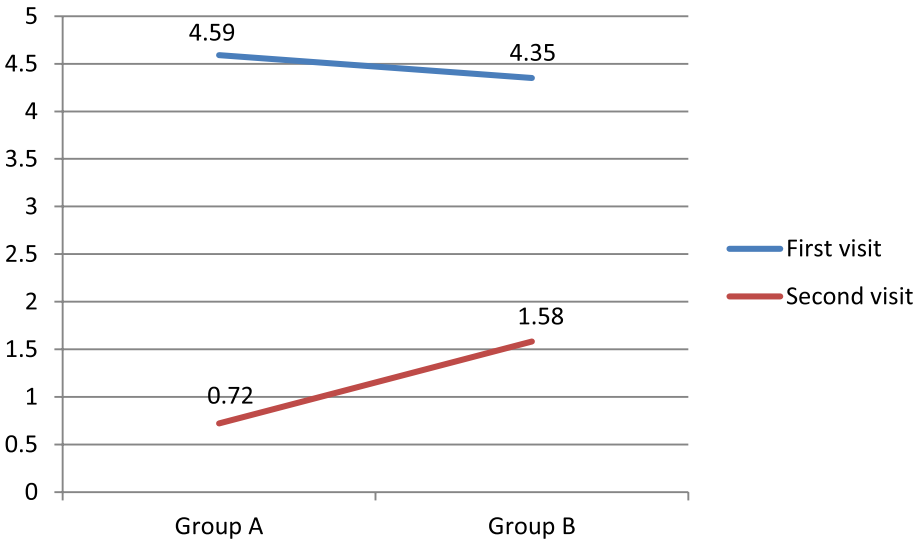

Fig. 2 Comparison of mean total otological symptom score between the groups. There was a significant reduction in the amount of discharge ($p=0.014$), a change in consistency score ($p=0.038$), and in total otological symptom score ($p=0.041$)

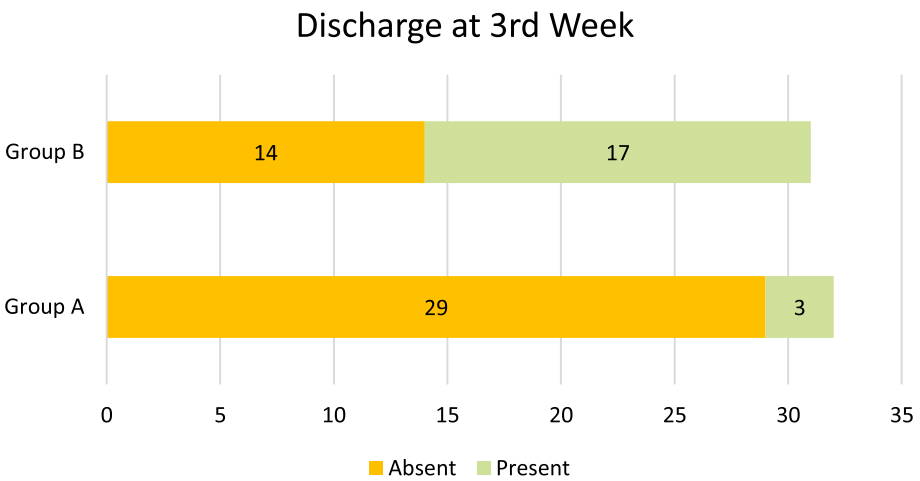

Fig. 3 Presence of discharge at the third week. Significantly more number of patients had wet ear, either due to persistence or recurrence of ear discharge, at the third visit in Group B ($p=<0.001$)

treatment, and biofilm formation by organisms. There have been various studies in the past regarding the usage of topical antiseptics in the treatment of active CSOM cases to achieve dry ear.

Acetic acid is an antiseptic with a broad spectrum of action against both gram-positive and gram-negative organisms with the ability to treat infections caused by bacteria and/or fungus. It does not directly treat a middle ear infection (otitis media), but is indirectly beneficial due to its action against biofilms. While it is used frequently as an irrigation antiseptic at a concentration of 1.5% or 2%, patients might find it difficult to be compliant due to the frequency of said irrigations and the copious amount that needs to be used per irrigation.

Head K et al. [20] compiled studies on the treatment of CSOM and concluded that topical quinolones resulted in better ear discharge resolution than boric acid. Due to the inadequacy of data, conclusions pertaining to the merits of other topical antiseptics or topical antibiotics were not derived from this review.

Study conducted by Arslan Akhtar et al. [21] compared the efficacy of 2% acetic acid versus 0.3% ciprofloxacin ear drops in CSOM, to achieve dry ears and concluded that the former was significantly more efficient than the latter ($p<0.0001$).

The study by Bhavya Kanakarajulu et al. [14] in CSOM treatment using acetic acid irrigation versus topical and systemic antibiotics concluded that frequent aural

cleaning along with irrigation of dilute 1.5% acetic acid was more effective than topical and oral antibiotics. Acetic acid irrigation was found to achieve 88% of dry ears.

The study performed by Chhavi Gupta et al. [22] to compare the efficacy of aural cleansing and irrigation with dilute acetic acid versus treatment with topical and systemic antibiotics, yielded the results in favor of the former with resolution of otorrhoea seen in 84%.

A study by Kirti Vishwakarma et al. [13] assessing the role of topical Acetic Acid in comparison to Gentamicin in the management of CSOM concluded that Acetic acid when used topically was equally effective as topical Gentamicin sulfate with a success rate of 92% and 88% respectively.

There have not been many studies about the combination of topical antibiotics and topical antiseptics versus only topical antibiotics. Also, there have been more studies on the usage of acetic acid as irrigation than on ear drops. Thus, our study was conducted with the intention to study the efficacy of the combination of acetic acid and ciprofloxacin ear drops versus only ciprofloxacin ear drops, in the management of CSOM.

In our study, we found that on the second visit, both ciprofloxacin-only ear drops and a combination of ciprofloxacin and 2% acetic acid ear drops were significantly efficient in achieving dry ears in patients with CSOM ($p = < 0.001$ for both). But on intergroup analysis, a combination of ciprofloxacin and acetic acid ear drops was found to be significantly better than ciprofloxacin-only ear drops ($p = 0.041$). Also during follow-ups, the combination of ciprofloxacin and acetic acid eardrops was significantly more efficient than only ciprofloxacin ear drops in maintaining dry ears by preventing persistence and/or recurrence ($p = < 0.001$).

Conclusion

Alteration of pH by reduction into an acidic one in the ear canal and disruption of biofilm help in achieving dry ears. This in a long run can be beneficial in planning surgeries for CSOM, without fear of recurrent ear discharge. Thus, medical management of the mucosal type of CSOM using a combination of 0.3% topical ciprofloxacin and 2% acetic acid can be a more desirable choice than only 0.3% ciprofloxacin ear drops, in addition to systemic oral antibiotics and aural toileting. Despite additional expense to the patient, this combination can still be recommended due to the significant advantage of maintenance of dry ear, which is favorable for early surgery.

Acknowledgements
Not applicable.

Code availability
The data was compiled and analyzed using.

Authors' contributions
All authors contributed to the study conception and design. Material preparation, data collection, and analysis were performed by Dr. K. P. Basavaraju and Dr. S. K. Ranjani. The first draft of the manuscript was written by Dr. S. K. Ranjani and all authors commented on previous versions of the manuscript. All authors read and approved the final manuscript.

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Availability of data and materials
The data used in this study was not used/published in any other publications.

Declarations

Ethics approval and consent to participate
The study was done after approval of the Institutional Ethics committee from JJM Medical College, Davangere, Karnataka, India, dated 27/06/22, Reference number: JJMMC/IEC-53–2022, in accordance with ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards. Consent to participate: Written informed consent was taken from all the patients including written consent from parents/legal guardians of patients less than 16 years of age.

Consent for publication
Not applicable.

Competing interests
The authors declare that they have no competing interests.

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References

1. WHO. Chronic suppurative otitis media. Burden of illnessand management options. 2004.https://apps.who.int/iris/bitstream/handle/10665/42941/9241591587.pdf;jsessionid=DDBC6635D63AC5FDD8DBF5895B121CB7?sequence=1
2. Sharma N, Jaiswal AA, Banerjee PK et al (2015) Complications of Chronic Suppurative Otitis Media and Their Management: a single institution 12 years experience. Indian J Otolaryngol Head Neck Surg 67:353–360. https://doi.org/10.1007/s12070-015-0836-5
3. Ahmad S (2013) Antibiotics in chronic suppurative otitis media: a bacteriologic study. Egypt J Ear, Nose, Throat Allied Sci 14:191–194
4. Iqbal S, Udaipurwala IH, Hasan A, Shafiq M, Mughal S (2006) Chronic suppurative otitis media: disease pattern and drug sensitivity. J Surg Pak 11:17–19
5. de Miguel MI et al (2005) Aetiology and therapeutic considerations in chronic otitis media. Analysis of a 5 year period. Acta Otorrinolaringol Esp 56:459–462
6. Davidson SS (2002) Davidson's Principles and Practice of Medicine. Churchill Livingstone, London, England
7. Onali MA, Bareeqa SB, Zia S, Ahmed SI, Owais A, Ahmad AN (2018) Efficacy of Empirical Therapy With Combined Ciprofloxacin Versus Topical Drops Alone in Patients With Tubotympanic Chronic Suppurative Otitis Media: A Randomized Double-Blind Controlled Trial. Clin Med Insights Ear Nose Throat 11(11):1179550617751907. https://doi.org/10.1177/1179550617751907. PMID:29348711;PMCID:PMC5768256
8. Roland PS (2002) Chronic suppurative otitis media: a clinical overview. Ear Nose Throat 81:8–11
9. Post JC, Hiller NL, Nistico L, Stoodley P, Ehrlich GD (2007) The role of biofilms in otolaryngologic infections (Update 2007). Curr Opin Otolaryngol Head Neck Surg 15(5):347–351
10. Jones CE, Kennedy JP (2012) Treatment options to manage wound biofilm. Adv Wound Care (New Rochelle) 1(3):120–126
11. Macassey E, Dawes P (2008) Biofilms and their role in otorhinolaryngological disease. J Laryngol Otol 122:1273–1278

12. Youn C, Jun Y, Jo E, Jang S, Song H, Cho S (2018) Comparative efficacies of topical antiseptic eardrops against biofilms from methicillin-resistant Staphylococcus aureus and quinolone-resistant Pseudomonas aeruginosa. J Laryngol Otol 132(6):519–522. https://doi.org/10.1017/S0022215118000932
13. Vishwakarma K, Khan FA, Nizamuddin S, Yadav L (2015) Role of topical acetic acid in comparison togentamicin for the management of chronic-suppurative otitis media. Int Arch BioMed Clin Res 1(1):13–16
14 Kanakarajulu B, Sowmya L (2021) Teja. Role of 1.5% acetic acid irrigation and medical management in chronic persistent suppurative otitis media. Int J Otorhinolaryngol Head Neck Surg 7:1010–4
15. C Jaya, Anand Job, Elizabeth Mathai, B Antonisamy. Evaluation of topical povidone-iodine in chronic suppurative otitis media. Arch Otolaryngol Head Neck Surg 2003;129:1098–1100. https://doi.org/10.1001/archotol.129.10.1098
16. NHS Nottinghamshire Area Prescribing Committee, Acute and Chronic Otitis Externa V2.1, 2022. https://www.nottsapc.nhs.uk/media/1796/otitis-externa-acute-and-chronic.pdf
17. Sander R (2001) Otitis externa: a practical guide to treatment and prevention. Am Fam Physician 63(5):927–36, 941-2 (PMID: 11261868)
18. van Balen FAM, Smit WM, Zuithoff NPA, Verheij TJM (2003) Clinical efficacy of three common treatments in acute otitis externa in primary care: randomised controlled trial. BMJ 327:1201. https://doi.org/10.1136/bmj.327.7425.1201
19. Renukananda GS, U P S, George NM. Topical vs Combination Ciprofloxacin in the Management of Discharging Chronic Suppurative Otitis Media. J Clin Diagn Res. 2014;8(6):KC01–4. https://doi.org/10.7860/JCDR/2014/8038.4421. Epub 2014 Jun 20. PMID: 25121008; PMCID: PMC4129342
20. Head K, Chong LY, Bhutta MF, Morris PS, Vijayasekaran S, Burton MJ, Schilder AGM, Brennan-Jones CG.Antibiotics versus topical antiseptics for chronic suppurative otitis media.Cochrane Database Syst Rev. 2020;1:CD013056. https://doi.org/10.1002/14651858.CD013056.pub2
21. Akhtar A, Ali SM, Naqi SA, Aziz T, Shinwari W, Shah SFH. Efficacy of acetic acid versus ciprofloxacin eardrops in achieving dry ears in chronic suppurative otitis media in adult population of Islamabad, Pakistan: a non-randomized control trial. Gomal J Med Sci 2019;17(3): 90–4. https://doi.org/10.46903/gjms/17.03.2007
22. Chhavi Gupta, Anjana Agrawal, Narendra Dutt Gargav. Indian J Otolaryngol Head Neck Surg. 2015;67(3):314–318 https://doi.org/10.1007/s12070-014-0815-2

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