

## Original Research Article

# Microbiological pattern in patients with complicated chronic suppurative otitis media requiring surgical intervention

P. Hemalatha<sup>1\*</sup>, R. Shankar<sup>2</sup>

<sup>1</sup>Department of ENT, Government Karur Medical College, Tamil Nadu, India

<sup>2</sup>Department of Preventive Medicine, VMKVMCH, Salem, Tamil Nadu, India

**Received:** 07 July 2021

**Revised:** 21 July 2021

**Accepted:** 22 July 2021

### \*Correspondence:

Dr. P. Hemalatha,

E-mail: shnkradhakrishnan@gmail.com

**Copyright:** © the author(s), publisher and licensee Medip Academy. This is an open-access article distributed under the terms of the Creative Commons Attribution Non-Commercial License, which permits unrestricted non-commercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

## ABSTRACT

**Background:** *Pseudomonas aeruginosa*, *Staphylococcus aureus*, *E. coli*, *Proteus mirabilis*, *Klebsiella spp*, *Streptococcus pyogenes*, *Candida spp* and *Aspergillus spp* were the common pathogens detected in the ear swab of CSOM patients. The aim was to study the microbiological pattern among patients with complicated chronic suppurative otitis media (CSOM) requiring surgical intervention for CSOM and to assess any particular pathogen influences the complications in CSOM.

**Methods:** A prospective longitudinal study was conducted in the department of ENT of a government tertiary care institute in Tamil Nadu for a period of one year. A total of 67 patients requiring surgical intervention for CSOM were taken as our study sample. The microbiological testing was done for each patient by taking two swabs from the ear discharge. Based on their indication all the patients had underwent either tympanoplasty, myringoplasty or mastoidectomy.

**Results:** *P. aeruginosa* was found to be the most common microorganism detected in our patients followed by *S. aureus* and CONS. *S. aureus* and CONS showed a significant association with atico-antral type of CSOM. Majority of the patients reported with no growth had tubotympanic type of CSOM. In majority of the patients who had reported with no growth their ET (eustachian tube) function was found to be normal whereas patients reported with microorganisms such as *Pseudomonas*, *Staphylococcus* and CONS most of them had partial dysfunction of ET or complete absence of ET function.

**Conclusions:** Swab culture for CSOM patients to be done at the early stage and treating them appropriately would prevent further complications due to the disease.

**Keywords:** CSOM, Microbes, Eustachian tube function, Deafness

## INTRODUCTION

Chronic suppurative otitis media (CSOM) is a common pathological condition reported in the department of ENT causing inflammation in middle ear and mastoid cavity presenting with recurrent ear discharge, pain, tinnitus and loss of hearing by causing perforation in the tympanic membrane.<sup>1</sup> Its incidence is high among under developed and developing countries. People living with poor socio-

economic condition, poor hygiene, overcrowding and history of recurrent respiratory tract infections are being considered as major risk factors for the occurrence of CSOM.<sup>2,3</sup>

Tubotympanic or benign type and attico-antral or dangerous type are the two types of CSOM, among which tubotympanic type is found to be more common.<sup>4</sup> The microbiological pathogens reach the middle ear from

nasopharynx through ET and inwards through a non-intact tympanic membrane. Infection can later spread from middle-ear to major vital structures like mastoid, facial nerve, labyrinth, lateral sinus, meninges and brain causing mastoid abscess, facial nerve palsy, hearing loss, lateral sinus thrombosis, meningitis and intracranial abscess.<sup>5,6</sup> Previous studies had shown that the most common bacterial pathogens that were isolated in CSOM patients were *P. aeruginosa* and *S. aureus*. The other common isolates were *E. coli*, *P. mirabilis*, *K. spp.*, *S. pyogenes*, *Candida spp.* and *Aspergillus spp.* The isolation of the pathogen vary according to their geographical area and other demographic factors.<sup>7</sup> Data related to the true prevalence of particular pathogens is very much limited as because of contamination with normal skin flora like *S. epidermidis*, diphtheroids and anaerobic organisms such as *Propionibacterium* acne while performing the swab collection specimen from the patient. Systemic and topical antibiotics along with aural toileting are the main stay of treatment in uncomplicated cases of CSOM.<sup>8</sup> The most common complication of CSOM is tympanic membrane perforation for which surgical intervention in the form of tympanoplasty, myringoplasty or mastoidectomy is the treatment of choice. Understanding the microbiological aspect in CSOM is important for effectively treating the patients and preventing the complications and antibiotic resistance.<sup>9</sup> Studies done so far has seen the microbiological agents in patients presenting with uncomplicated CSOM and not much studies had been conducted in patients with complicated CSOM and so the present study was aimed to study the microbiology among patients with complicated CSOM requiring surgical intervention for CSOM and to assess any particular pathogen influences the complications in CSOM.

## METHODS

A prospective longitudinal study was conducted in the department of ENT of a government tertiary care institute in Tamil Nadu for a period of one year between June 2014 and May 2015. The study was started after getting clearance from the institutional ethical committee. All patients diagnosed with chronic suppurative otitis media of both mucosal and squamous type who were requiring surgical intervention in the form of tympanoplasty, myringoplasty and mastoidectomy were taken as our study subjects. Patients less than 15 years, patients with fungal infection and tumors in the nasopharynx were excluded from the study. A purposive sampling method was followed to determine the sample size, all the patients satisfying the inclusion and exclusion criteria and were reported during the study period were taken as our study sample. Based on the inclusion and exclusion criteria the total sample size taken for our study was 67 patients. Informed consent was obtained from all the study subjects enrolled in the study. A complete ENT

examination was done on all patients and their hearing function was assessed using pure tone audiometry to assess the level of hearing loss in decibels.

The microbiological testing was done for each patient by taking two swabs from the ear discharge which were collected under strict aseptic precautions without surface contamination and were carefully transported to the microbiology department. One swab was used for Gram's staining and the other was inoculated on nutrient agar, blood agar and MacConkey agar for performing the culture. After overnight incubation at 37°C the culture plates were observed for microbiological growth. Single colony was stained using Gram's method from each culture plate and hanging drop method was performed if gram negative bacilli were identified. The cultured bacteria were then subjected to various biochemical tests depending on the presence of the organism like catalase test, oxidase test, urea hydrolysis test, phenol red test.

ET function was assessed by valsalva manoeuvre, seigalization, saccharine test and methylene blue dye test. Otoendoscopic examination and nasal endoscopy was performed to assess the middle ear, ossicles and the ear drum. Based on their indication all the patients had underwent either tympanoplasty, myringoplasty or mastoidectomy. Intravenous antibiotics and the analgesics were given in the postoperative period and the sutures were removed in the 7th or 9th postoperative day depending upon the condition of the wound. After discharge, the patients were reviewed once in 15 days for 3 months and once a month for another 3 months.

The outcome of the surgery was measured as successful: the healed graft with proper middle ear aeration; failure: retracted or atelectatic graft or graft failure secondary to otitis media.

All the data were entered and analysed using SPSS version 24. Mean and SD was derived for all parametric variables and percentage for all frequency variables. Chi-square test was used to derive the statistical inference between the independent and outcome variable.

## RESULTS

The age and gender wise distribution of the study subjects showed that majority of the patients with CSOM were in the age group between 10 and 30 years and only 3% of the study subjects were more than 50 years of age. Females were more commonly involved than males with a male:female ratio of 1:2.1 (Table 1). CSOM type was classified as atico-antral and tubotympanic type. Based on the side of involvement of the ear left side ear is more commonly involved than the right side or bilateral involvement. Atico-antral type of CSOM was more common in unilateral ear involvement whereas tubotympanic type of CSOM was more common in

bilateral ear involvement and it was also seen that tubotympanic type was more common in older age group and atico-antral being more common in younger age group patients (Table 2). Ear swabs were taken for all patients and were sent to microbiology department for isolation of the microorganism. *P. aeruginosa* was found to be the most common microorganism detected in our patients followed by *S. aureus* and CONS and the other less common organisms seen were *Streptococcus*, *Klebsiella*, *Citrobacter* and MRSA. In 30% of the patients with CSOM no growth was reported in the ear swab. No specific age group had shown significant association for any specific microorganism (Table 3). Association between a particular microorganism and the type of CSOM was seen among the study subjects and it was shown that few microorganism had shown a significant association with a particular type of CSOM, *S. aureus* and CONS showed a significant association with atico-antral type of CSOM. Most of the other microorganisms like *Pseudomonas* and *Streptococcus* did not show association with any particular type of CSOM.

Majority of the patients reported with no growth had tubotympanic type of CSOM (Table 4). Similarly association between the microorganism detected and the ET function was seen among the patients with CSOM. It was shown that in majority of the patients who had reported with no growth their ET function was found to be normal whereas patients reported with microorganisms such as *Pseudomonas*, *Staphylococcus* and CONS most of them had partial dysfunction of ET or complete absence of ET function and the association was found to be statistically significant (Table 5). Hearing loss was assessed using pure tone audiometry and it was graded as mild (20-40 db loss), moderate (40-70 db loss) and severe (more than 70 db loss). The presence of microorganism in the ear swab and its association with hearing loss showed that there was no statistical significant association between the type of microorganism and the degree of hearing loss, whereas majority of the patients reported with no growth showed mild to moderate hearing loss and its association was found to be statistically significant (Table 6).

**Table 1: Age and gender wise distribution of the study subjects.**

Age group (in years)	Gender		Total (%)
	Male (%)	Female (%)	
10-20	5 (23.8)	10 (21.7)	15 (22.3)
21-30	9 (42.8)	21 (45.6)	30 (44.7)
31-40	6 (28.5)	10 (21.7)	16 (23.8)
41-50	1 (4.7)	3 (6.5)	4 (5.9)
>50	0	2 (4.3)	2 (2.9)
<b>Total</b>	21 (100)	46 (100)	67 (100)

**Table 2: Distribution of the study subjects based on the type of CSOM.**

Age group (in years)	B/L CSOM		R CSOM		L CSOM		Total (%)
	AA (%)	TT (%)	AA (%)	TT (%)	AA (%)	TT (%)	
10-20	2 (66.6)	1 (6.6)	4 (33.3)	1 (14.2)	6 (28.5)	1 (11.1)	15 (22.3)
21-30	1 (33.3)	10 (66.6)	6 (50)	2 (28.5)	8 (38)	3 (33.3)	30 (44.7)
31-40	0	2 (13.3)	1 (8.3)	3 (42.8)	6 (28.5)	4 (44.4)	16 (23.8)
41-50	0	1 (6.6)	1 (8.3)	1 (14.2)	1 (4.7)	0	4 (5.9)
>50	0	1 (6.6)	0	0	0	1 (11.1)	2 (2.9)
<b>Total</b>	3 (100)	15 (100)	12 (100)	7 (100)	21 (100)	9 (100)	67 (100)

**Table 3: Age wise distribution of the prevalence of various micro-organisms detected among the patients with CSOM.**

Micro-organisms	Age group (in years)					Total (%)
	10-20 (N=15) (%)	21-30 (N=30) (%)	31-40 (N=16) (%)	41-50 (N=4) (%)	>50 (N=2) (%)	
<i>P. aeruginosa</i>	4 (18.1)	12 (54.5)	4 (18.1)	1 (4.5)	1 (4.5)	22 (100)
<i>S. aureus</i>	5 (55.5)	3 (33.3)	1 (11.1)	0	0	9 (100)
<i>S. pneumoniae</i>	0	0	2 (100)	0	0	2 (100)
CONS	3 (33.3)	5 (55.5)	1 (11.1)	0	0	9 (100)
<i>Citrobacter</i>	0	0	1 (100)	0	0	1 (100)
<i>Klebsiella spp</i>	1 (50)	0	1 (50)	0	0	2 (100)
<i>Enterococcus spp</i>	0	1 (100)	0	0	0	1 (100)
MRSA	0	0	0	1 (100)	0	1 (100)
<b>No growth</b>	2 (10)	9 (45)	6 (30)	2 (10)	1 (5)	20 (100)

**Table 4: Distribution of the study subjects based on the various micro-organisms detected and the type of CSOM.**

Micro-organisms	Type of CSOM		Total (%)	P value
	Atico-antral (%)	Tubotympanic (%)		
<i>P. aeruginosa</i>	13 (59)	9 (41)	22 (100)	0.0614
<i>S. aureus</i>	7 (77.7)	2 (22.3)	9 (100)	<0.005
<i>S. pneumoniae</i>	0	2 (100)	2 (100)	0.139
CONS	6 (66.6)	3 (33.3)	9 (100)	0.0217
<i>Citrobacter</i>	1 (100)	0	1 (100)	0.519
<i>Klebsiella spp</i>	1 (50)	1 (50)	2 (100)	1.000
<i>Enterococcus spp</i>	1 (100)	0	1 (100)	0.187
MRSA	0	1 (100)	1 (100)	0.168
No growth	8 (40)	12 (60)	20 (100)	0.0712
<b>Total</b>	<b>37 (55.2)</b>	<b>30 (44.7)</b>	<b>67 (100)</b>	

**Table 5: Distribution of the study subjects based on the various micro-organisms detected and the function of ET.**

Micro-organisms	ET function			Total (%)	P value
	Present (%)	Partial dysfunction (%)	Totally absent (%)		
<i>P. aeruginosa</i>	5 (22.7)	3 (13.6)	14 (63.6)	22 (100)	0.0241
<i>S. aureus</i>	2 (22.2)	0	7 (77.7)	9 (100)	<.05
<i>S. pneumoniae</i>	0		2 (100)	2 (100)	0.165
CONS	2 (22.2)	2 (22.2)	5 (55.5)	9 (100)	0.0614
<i>Citrobacter</i>	0	0	1 (100)	1 (100)	0.154
<i>Klebsiella spp</i>	0	1 (50)	1 (50)	2 (100)	0.189
<i>Enterococcus spp</i>	0	0	1 (100)	1 (100)	0.216
MRSA	1 (100)	0	0	1 (100)	0.189
No growth	10 (50)	4 (20)	6 (30)	20 (100)	0.0314
<b>Total</b>	<b>20 (29.8)</b>	<b>10 (14.9)</b>	<b>37 (55.2)</b>	<b>67 (100)</b>	

**Table 6: Distribution of the study subjects based on the various micro-organisms detected and severity of hearing loss.**

Micro-organisms	Hearing loss (based on the results of pure tone audiometry)			Total (%)	P value
	Mild (%)	Moderate (%)	Severe (%)		
<i>P. aeruginosa</i>	10 (45.4)	7 (31.8)	5 (22.7)	22 (100)	0.319
<i>S. aureus</i>	3 (33.3)	4 (44.4)	2 (22.2)	9 (100)	0.284
<i>S. pneumoniae</i>	1 (50)	1 (50)	0	2 (100)	0.719
CONS	5 (55.5)	3 (33.3)	1 (11.1)	9 (100)	0.139
<i>Citrobacter</i>	0	1 (100)	0	1 (100)	0.812
<i>Klebsiella spp</i>	0	2 (100)	0	2 (100)	0.671
<i>Enterococcus spp</i>	0	0	1 (100)	1 (100)	0.831
MRSA	1 (100)	0	0	1 (100)	0.828
No growth	5 (25)	13 (65)	2 (10)	20 (100)	0.0318
<b>Total</b>	<b>25 (37.3)</b>	<b>31 (46.2)</b>	<b>11 (16.4)</b>	<b>67 (100)</b>	

## DISCUSSION

In developing countries like India CSOM is one of the predominant cause of preventable hearing loss and which on long term would have an adverse effect on language development, auditory processing, educational process and cognitive development. So early identification and

effective treatment of CSOM would help in preventing the complications due to CSOM.<sup>10</sup> Studies done earlier on CSOM were all mainly pertaining to the clinical profile and few studies have been done on microbiological aspect with regard to CSOM and not much were done on patients of CSOM with complications and so the present study was conducted on 67 patients with CSOM who

were requiring surgical interventions. Microbiological culture was performed on all patients with the ear swabs and the overall culture positivity rate was found to be 70% in the present study. In our study we found CSOM was more prevalent in the 2nd and 3rd decade of life which accounts for 65% and it was almost in par with the studies done by the earlier researchers.<sup>11-13</sup> Frequent upper respiratory tract infection, poor hygiene and usage of unconventional ear drops for ear infections would initiate the proliferation of opportunistic pathogens. The male:female ratio of the present study is 1:2.1 with females being more commonly affected than the males and the findings is similar to the study done by Mansoor et al and Loy et al and it was contrast to the study done by Kumar et al and Poorey et al, where they have quoted males were more commonly affected with CSOM than the females.<sup>1,8,14,15</sup> This difference could be only an incidental finding as no knowledge of anatomical differences in the ear structures of male and female has been reported. The ear swab culture done on our patients showed positivity in 47 patients out of 67 with an overall incidence rate of 70%, the results of the studies done by other authors also showed more or less a similar finding.<sup>16,17</sup> A study done in Pakistan by Aslam et al showed 76% of the swab samples showed growth in the culture report, another study in India done by Poorey et al showed growth in 82% of the samples and in most of the studies majority of the subjects showed mono-microbial growth and mixed growth was seen in less than 10% of the patients with CSOM.<sup>15,18</sup> A study done in Iran had showed 100% mono-microbial etiology in CSOM patients.<sup>19</sup> Difference in results of various authors could have been due to the difference in the patient population studied and geographical variations. The predominant microbe detected in our study was *Pseudomonas* followed by *S. aureus* and CONS and it was almost in par with the previous studies reported from India, Nigeria and Pakistan, whereas few studies done in colder regions of Iran and in certain parts of India, *S. aureus* was found to be the most common microbe among the 67 patients with CSOM requiring surgical intervention.<sup>8,11,13,19,20</sup> *Pseudomonas* was the predominant cause of CSOM in tropical regions but it was not a usual habitat of upper respiratory tract and so it could be considered as a secondary invader to the middle ear cavity due to a defect in the tympanic membrane. In the present study most of the patients with atico-antral type of CSOM their ear swab results showed growth of either *pseudomonas* or *staphylococcus* organism compared to tubotympanic type of CSOM and it was in par with the previous study done by Mahajan et al in 2019.<sup>21</sup> Study done by Deb et al showed that *Staphylococcus* and *Pseudomonas* were the two most common organism isolated in the culture of the ear swab among patients with tubotympanic type of CSOM. So it can be quoted that type of microbe in the ear swab do not influence the type of CSOM.<sup>22</sup> In our study majority of the patients whose culture report was negative had tubotympanic type of CSOM. Further our study also showed that majority of the patients who had acquired *Pseudomonas* or *Staphylococcus* had complete

absence of ET function whereas patients with culture showing no growth their ET function was found to be normal and majority of them had mild hearing loss whereas patients with culture showing microbes had moderate to severe hearing loss. No studies done so far had mentioned about the association between the presence of microbe and ET function or hearing loss and so we can't totally infer that the presence of microbes have an influence in ET function and hearing loss and so more studies has to be conducted to proof the association between the presence of microorganism and ET function and hearing loss.

The only limitation of the present study was the sample size and the sampling technique, which was because of time and logistic constraint.

## CONCLUSION

*Pseudomonas* and *Staphylococcus* were found to be the most common microorganism reported among the patients with CSOM requiring surgical intervention. Further our study found an association between the presence of microorganism and absence of ET function with moderate to severe hearing loss and patients with no microbes detected in swab culture had a better hearing and ET function. So it can be recommended that swab culture for CSOM patients to be done at the early stage and treating them appropriately would prevent further complications due to the disease.

*Funding: No funding sources*

*Conflict of interest: None declared*

*Ethical approval: The study was approved by the Institutional Ethics Committee*

## REFERENCES

1. Kumar H, Seth S. Bacterial and fungal study of 100 cases of chronic suppurative otitis media. J Clin Diagn Res. 2011;5(6):1224-7.
2. Acuin J. Chronic suppurative otitis media, burden of illness and management options. Geneva: WHO Publications; 2004.
3. Ologe FE, Nwawolo CC. Chronic suppurative otitis media in school pupils in Nigeria. East Afr Med J. 2003;80(3):130-4.
4. Rout MR, Mohanty D, Vijaylaxmi Y, Kamalesh B, Chakradhar M. Prevalence of cholesteatoma in chronic suppurative otitis media with central perforation. Indian J Otol. 2012;18(1):7-10.
5. Morris PS, Leach AJ. Prevention and management of chronic suppurative otitis media in aboriginal children: A practical approach. Comm Ear Hearing. 2007;4:22-5.
6. Roland PS. Chronic otitis media: a clinical overview. Ear Nose Throat J. 2002;81(1):8-10.
7. Vartiainen E, Vartiainen J. Effect of aerobic bacteriology on the clinical presentation and

- treatment results of CSOM. *J Laryngol Otol.* 1996;110(4):315-8.
8. Mansoor T, Mussani MA, Khalid G, Kumal M. *Pseudomonas aeruginosa* in chronic otitis media: sensitivity spectrum against various antibiotics in Karachi. *J Ayub Med Coll Abbottabad.* 2009;21(2):120-3.
  9. Chowdhury MA, Alauddin M. Comparative study between tubotympanic and atticofurrow types of chronic suppurative otitis media. *Bangladesh Med Res Counc Bull.* 2002;28(1):36-44.
  10. Berman S. Otitis media in developing countries. *Pediatrics.* 1995;96:126-31.
  11. Osazuwa F, Osazuwa E, Osime C, Igharo EA, Imade PE, Lofor P, et al. Etiologic agents of otitis media in Benin city, Nigeria. *N Am J Med Sci.* 2011;3(2):95-8.
  12. Wariso BA, Ibe SN. Bacteriology of chronic discharging ears in Port Harcourt, Nigeria. *West Afr J Med.* 2006;25(3):219-22.
  13. Shyamla R, Reddy SP. The study of bacteriological agents of chronic suppurative otitis media— aerobic culture and evaluation. *J Microbiol Biotechnol Res.* 2012;2(4):152-62.
  14. Loy AH, Tan AL, Lu PK. Microbiology of chronic suppurative otitis media in Singapore. *Singapore Med J.* 2002;43(6):296-9.
  15. Poorey VK, Lyer A. Study of bacterial flora in csom and its clinical significance. *Indian J Otolaryngol Head Neck Surg.* 2002;54(2):91-5.
  16. Prakash R, Juyal D, Negi V, Pal S, Adekhandi S, Sharma M, et al. Microbiology of chronic suppurative otitis media in a tertiary care setup of Uttarakhand State, India. *N Am J Med Sci.* 2013;5(4):282-7.
  17. Chirwa M, Mulwafu W, Aswani JM, Masinde PW. Microbiology of chronic suppurative otitis media at Queen Elizabeth central hospital, Blantyre, Malawi: A CROSS-SECTIONAL descriptive study. *Malawi Med J.* 2015;27(4): 120-4.
  18. Aslam MA, Ahmed Z, Azim R. Microbiology and drug sensitivity patterns of chronic suppurative otitis media. *J Coll Physicians Surg Pak.* 2004;14(8):459-61.
  19. Ettehad GH, Refahi S, Nemmati A, Pirzadeh A, Daryani A. Microbial and antimicrobial susceptibility patterns from patients with chronic otitis media in Ardebil. *Int J Trop Med.* 2006;1:62-5.
  20. Singh AH, Basu R, Venkatesh A. Aerobic bacteriology of chronic suppurative otitis media in Rajahmundry. *Biol Med.* 2012;4(2):73-9.
  21. Mahajan T, Dass A, Gupta N, Chander J, Saini V, Pol SA. Bacteriological profile in atticofurrow type of chronic suppurative otitis media. *Indian J Otolaryngol Head Neck Surg.* 2019;71(2):1412-21.
  22. Deb T, Ray D. A Study of the Bacteriological Profile of Chronic Suppurative Otitis Media in Agartala. *Indian J Otolaryngol Head Neck Surg.* 2012;64(4):326-9.

**Cite this article as:** Hemalatha P, Shankar R. Microbiological pattern in patients with complicated chronic suppurative otitis media requiring surgical intervention. *Int J Otorhinolaryngol Head Neck Surg* 2021;7:1337-42.