

Bacteriological profile and antibiotic sensitivity in Chronic Suppurative Otitis Media

Mary Nirmala S^{1,*}, Kumaresan S²

¹Senior Assistant Professor, Govt. Thoothukudi Medical College & Hospital, Tamil Nadu, ²Associate Professor, Dept. of ENT, Govt. Theni Medical College & Hospital, Tamil Nadu

***Corresponding Author:**

Email: nirmalasuganth@yahoo.com

Abstract

Chronic Suppurative Otitis Media is a chronic inflammation of middle ear presents with recurrent otorrhoea through a tympanic perforation, usually occurs after upper respiratory viral infections followed by invasion of pyogenic organisms. Our prospective study, conducted over a period of 10 months, includes ear discharge from 100 patients with chronic suppurative otitis media. Discharge collected in sterile swabs were sent immediately to microbiology laboratory and processed. Bacterial isolates were identified by standard methods and antibiotic susceptibility testing was done. *Staphylococcus* was the predominant organism followed by *Pseudomonas* spp., and *Escherichia Coli*. Most of the organisms were sensitive to Cefotaxime followed by Amikacin. The aim of the study on aerobic microbes and their anti-biogram pattern was to prepare a protocol for empirical antibiotic therapy based on the study to shorten the period of infection.

Keywords: Chronic suppurative otitis media, Bacterial isolates, Anti-boigram, Anti-biotic resistance.

Introduction

The diagnosis of chronic otitis media implies a permanent abnormality of pars tensa or flaccida most likely as a result of earlier acute otitis media, negative middle ear pressure or otitis media with effusion.⁽¹⁾ It is common in children from poor economic status^(2,3,4) due to malnutrition, poor hygiene and overcrowding and in developing countries.⁽⁵⁾ The complications of chronic suppurative otitis media have been reduced to a greater extent because of the invention of antibiotics. But irrational use of antibiotics has lead to the emergence of resistant organisms to the commonly used drugs. Most of the studies have showed that the common organism isolated from cases of Chronic suppurative otitis media are *Pseudomonas* spp., *Staphylococcus aureus* and *Proteus* spp.^(6,7) Chronic suppurative otitis media has received considerable attention not only because of its high incidence, chronicity and complication, but also drug resistance⁽⁸⁾ and ototoxicity⁽⁹⁾ with both topical and systemic antibiotics.

Aim

- To isolate and identify the bacteria causing Chronic Suppurative Otitis Media in patients attending the ENT outpatient department.
- To determine the antibiotic sensitivity of the bacterial isolates.
- To correlate the results in relation to age and sex of the patients.

Inclusion criteria:

- Ear discharge taken only from those patients who had clinical diagnosis of Chronic Suppurative Otitis Media both tubo-tympanic and attico-antral type of disease.

- Only patients who had not received parenteral or topical antibiotics 6 weeks previously were taken in the study.
- All age groups of patients were included in the study.

Exclusion criteria:

- Patients who had mastoiditis.
- Patients who had treatment with antibiotics within 6 weeks
- Patients having intra or extra cranial complications
- Patients who had external otitis
- Patients with bilateral ear discharge.
- Pregnant and lactating women.

Materials and Methods

The selected patients were subjected to detailed history taking and clinical examination. Informed written consent was taken. Ear discharge were collected from the selected patients under strict aseptic precautions using two sterile cotton swabs with the assistance of aural speculum and processed immediately in the microbiology laboratory. The first swab was used for direct Gram stain and the second swab was cultured in nutrient agar, blood agar and Mac conkey agar plates and incubated at 37°C for 24–48 hrs. The isolates grown were identified by their cultural characteristics, morphology and biochemical reactions. Antibiotic susceptibility testing of the organisms diagnosed was done by Kirby Bauer method in Muller Hinton agar. The plates were read after overnight incubation at 37°C by measuring the zone of inhibition around the antibiotic discs as per CLSI (Clinical Laboratory Standards Institute) guidelines.

Results

In our study out of 100 patients 63 were male and 37 were female. They are in an age group varying from 2-70 years with the maximum patients in the age group of 41-50 years (27%) (Table 1). In our study 85% were suffering from tubo-tympanic type of chronic suppurative otitis media and 15% from attico-antral type. Right ear was affected in 54% patients and left ear in 46% in our study. Regarding symptoms, 100% of patients had discharge, 53% had impaired hearing, 4% had tinnitus and 12% had pain. On culture of the ear swab, infection with single organism was seen in 85% patients, with two organisms in 10% and no growth in 5% of the patients. Among the bacterial isolates *Staphylococcus* was 95% the commonest, followed by *Pseudomonas* 25%, *Escherichia coli* 6%, *Enterococci* 4%, *Proteus* 4%, *Klebsiella* 3% Non-fermenting gram negative bacilli 1% and *Citrobacter* 1%. On observing the bacterial sensitivity pattern of *Staphylococcus*, we found that Vancomycin was 100% sensitive. Ceftriaxone 85%, Cefotaxime 85%, Netilmycin 82.5%, Amikacin 80%, Ofloxacin 67.5%, Cephalexin 60%, Erythromycin 57.5%, Ciprofloxacin 52.5%, Tetracycline 42.5%, Norfloxacin 40%, Gentamycin 37.5%, Amoxicillin 30%, Cotrimoxazole 27.5%, Ceftazidime 22.5%. *Pseudomonas aeruginosa* was most sensitive to Ciprofloxacin 68% followed by Amikacin 64%, Cefotaxime 64%, Ofloxacin 60%, Ceftriaxone 60%, Gentamycin 52%, Netilmycin 48%, Ceftazidime 48%, Norfloxacin 32%, Cephalexin 4%, Cotrimoxazole 4%. It was observed that most of the isolates were sensitive to Cefotaxime followed by Amikacin and Ceftriaxone and least sensitive to Amoxicillin and Cotrimoxazole. Cefotaxime is 100% effective in *Proteus*, *Enterococci* and *Klebsiella* infection, 85% in *Staphylococcus* and 64% in *pseudomonas aeruginosa* and 80% in *Staphylococcus aureus* infection.

Table 1: Age Distribution

Age Group (Range in Years)	Number	Percentage
0-10	9	9%
11-20	25	25%
21-30	7	7%
31-40	17	17%
41-50	27	27%
51-60	10	10%
61-70	5	5%

Discussion

Bansal *et al*⁽¹⁰⁾ and Micheal *et al*⁽¹¹⁾ have found that Chronic suppurative otitis media is common in pediatric age group. In the study we observed maximum prevalence of Chronic Suppurative Otitis Media in 41-50 years. This was consistent with other regional and international studies.^(3,12) While some other

studies reported that Chronic Suppurative Otitis Media was seen in second decades of life.^(13,14)

P. Talwar *et al* showed increased prevalence of Chronic suppurative otitis media below 20-27 years,⁽¹⁵⁾ while Loy *et al*⁽¹⁶⁾ showed increased prevalence in 30-40 years. It was observed that males were affected more in our study. High incidence in males were also reported in Iqbal *et al*,⁽¹⁷⁾ Nwabwisi *et al*,⁽⁷⁾ Kumar *et al*,⁽⁵⁾ Shim *et al*,⁽¹⁸⁾ Wari so *et al*,⁽¹⁹⁾ Lodhi *et al*⁽²⁰⁾ and Yosuf *et al*.⁽²¹⁾ But this is in contrast to study done by Loy *et al*⁽¹⁶⁾ and Mansoor *et al*,⁽³⁾ where female predominance was reported. Male predominance may be due to their more exposed way of life.

Main symptoms for which the patient returned to the hospital were discharge (100%), followed by impaired hearing (53%), tinnitus (4%) and pain (12%) (Table 2). In Rao study,⁽²²⁾ the symptoms leading to the return of the patients were discharge in 100% followed by pain in 15% and tinnitus in 0.83%. In the present study, unilateral infection was predominant, in which right ear was more commonly affected (54%). This is similar to the study conducted by Shrestha *et al*⁽²³⁾ and Shymala *et al*.⁽¹³⁾ In our study 85% of patients were affected by tubo-tympanic types of Chronic Suppurative Otitis Media and 15% by attico-antral type. Gulati *et al* showed that 96.3% had central perforation and rest of the patients had unsafe variety.⁽²⁴⁾

Table 2: Symptoms

Symptoms	No	Percentage
Discharge	100	100%
Impaired Hearing	53	53%
Tinnitus	4	4%
Pain	12	12%

In our study culture positive was 95% and 5% showed no growth. This is in accordance with Vijaya *et al* in which 5.28% was sterile. Similar findings were observed with an incidence of 11-15% in Chaturvedi *et al*⁽²⁵⁾ and Siraj *et al* studies.⁽²⁶⁾ In Kenne *et al* study,⁽²⁷⁾ it was 2.1% and in Taneja *et al* study⁽²⁸⁾ it was 16% and 12.5% in Mohammed S Attatah *et al*.⁽²⁸⁾ Chakraborty *et al*⁽²⁹⁾ found 12.6%, Fathima *et al*⁽³⁰⁾ found 16.9% of culture negative samples. Culture positive was 95% in our study. Tanmoy Dev *et al*⁽³¹⁾ studies showed 52%, Nikakhlagh *et al*⁽³²⁾ showed 82%, Vikas Khanna *et al*⁽³³⁾ showed 84% and V.K. Poorey *et al* showed 92%.⁽¹²⁾ In our study 85% was pure culture, 10% was mixed culture.

In Vikas Khanna *et al*⁽¹¹⁾ and V.K. Poorey *et al*,⁽¹²⁾ polymicrobial culture were 39% and 10% respectively. Mono bacterial growth was 85% in Agarwal *et al*⁽³⁴⁾ study which was similar to our study. High rate of pus cells in a study may be due to anaerobic culture not done and also possibility of viral agents.^(35,36)

Among the organisms *Staphylococcus aureus* formed the predominant isolates (40%) (Table 3). Many workers^(10,20,22,23,37,38,39,40,41,42,43,44,45,46,47) have also

reported the same. The frequency of *Staphylococcus aureus* in middle ear can be attributed to the ubiquitous nature and high carriage of resistant strain in the external auditory canal and upper respiratory tract.⁽⁴⁸⁾ *Pseudomonas aeruginosa* is the second predominant organism (25%) followed by *Escherichia Coli* 6%, *Proteus* 4% in the present study. On the contrary *Pseudomonas* was isolated as predominant agent by Gulati et al,⁽¹⁴⁾ Kulkarni et al,⁽⁴⁶⁾ Gupta et al,⁽⁴³⁾ Fliss et al,⁽⁴⁹⁾ Kenne et al,⁽²⁷⁾ Taneja et al,⁽²⁸⁾ and Brooke et al.⁽⁵⁰⁾ *Pseudomonas aeruginosa* and *Proteus* infection were considered mostly as secondary infection from the external canal entering the middle ear via perforated tympanic membrane.^(51,52)

Escherichia coli, *Proteus*, *Enterococcus*, and *Klebsiella* were the next commonly isolated organism in our study. Tulsidas showed *Proteus* as common isolate.⁽⁵³⁾ *Diphtheroids* was isolated from 1% of the patients in our study. It has also been isolated from the middle ear by other workers.^(44,54) *Staphylococcus aureus*, an opportunistic pathogen and a normal flora of skin, but when it gains entry to the middle ear it results in infection of the middle ear cleft.⁽⁵⁵⁾ In contrast predominant gram negative bacilli is consistent with many previous investigators, Gulati et al,⁽¹⁴⁾ Goya et al,⁽⁵⁶⁾ Rajendra kumar et al,⁽⁵⁷⁾ Nene et al,⁽⁵⁸⁾ Fule et al⁽⁵⁹⁾ and Mishra et al.⁽⁶⁰⁾

Table 3: Organisms Isolated

Organisms Isolated	No	Percentage
Staphylococcus Aureus	40	40
Pseudomonas Aeruginosa	25	25
E.Coli	6	6
Proteus	4	4
Enterobacter	4	4
Klebsiella	3	3
Non-Fermenting Neg-Ve Bacilli	1	1
Citrobacter	1	1
Corynebacterium	1	1
Staph.Aureus + Candida	6	6
Staph.Aureus +Aspergillus	1	1
E.Coli +Klebsiella	1	1
E.Coli +Proteus	1	1
Klebsiella +Pseudomonas	1	1
No Growth	5	5

It was observed that most of the organisms were sensitive to Cefotaxime, the same results as Gulati *et al.*,⁽⁶¹⁾ Varshney *et al.*⁽⁶²⁾ and Sinha *et al.*⁽⁶³⁾ Cephalosporin and Quinolones are more effective than previously used penicillin and aminoglycosides.⁽⁶²⁾

Pseudomonas aeruginosa sensitivity to Ceftriaxone and Ciprofloxacin in our study was 64% and 68% respectively, in contrast to 78% and 100% in Fliss and Dagon study.⁽⁴⁹⁾ In our study, Amikacin sensitivity to *Pseudomonas aeruginosa* is only 64% in contrast to earlier reports which showed 100% sensitivity.^(64,65) For

Proteus infection Gentamycin is only 50% effective in our study whereas previous studies showed Gentamycin being the drug of choice in *Proteus* infection.^(66,67) The effectiveness of Gentamycin on different bacteria has been reported by various written.^(45,66,68,69) Zaida *et al.*⁽⁴⁵⁾ and Rao *et al.*⁽²²⁾ were found to be very effective. In our study Gentamycin sensitivity to *Pseudomonas aeruginosa* is 52% and to *Staphylococcus aureus* is 37.5%, (Table 4) in contrast to Rao study where it was 84.6% and 92.15% respectively. Tetracycline showed poor results for organisms in the present study like the results of other workers.⁽⁶⁷⁾

Table 4: Antibiogram

Organisms	No of Patients	Amikacin	Amoxicillin	Cephalexin	Cefotaxime	Ceftazidime	Ceftriaxone	Chloramphenicol	Ciproflox	Co-Trimoxazole	Erythromycin	Gentamycin	Lincomycin	Netilmycin	Norflox	Ofloxacin	Tetracycline	Vancomycin
Staphylococcus Aureus	40	32	12	24	34	9	34	30	21	11	23	15	38	33	16	27	17	40
Pseudomonas Auruginosa	25	16	-	1	16	15	12	7	17	1	-	13	-	12	8	15	2	-
E.Coli	6	5	-	2	3	3	4	4	4	-	-	3	-	4	-	3	1	-
Enterococcus	4	4	-	2	4	3	3	1	4	1	-	2	-	3	3	3	-	-
Proteus	4	4	-	-	4	4	4	2	4	4	-	3	-	4	-	4	1	-
Klebsiella	3	3	-	2	3	2	3	2	3	2	-	3	-	3	3	3	2	-
NFGNB	1	-	-	-	1	-	-	1	-	-	-	-	-	-	-	-	-	-
Citrobacter	1	-	-	-	-	-	-	1	1	1	-	-	-	-	-	1	-	-
Cornye Bacterium	1	-	-	-	1	1	-	-	-	-	-	-	-	-	-	-	-	-
Total	85	64	12	31	66	27	60	48	54	20	-	39	38	59	30	56	23	40

Conclusion

Staphylococcus aureus was the most common isolates and it being most sensitive to Vancomycin, followed by Lincomycin and Cefotaxime. For overall bacterial isolates Cefotaxime was found to be the most effective drug. To conclude, it is imperative to have the knowledge of causative organisms in Chronic suppurative otitis media and their sensitivity pattern for appropriate management to prevent morbidity and mortality.

References

- George G Browning, Saamil N Merchant, Gerard Kelly, Chronic otitis media, Scott Brown's Otorhinolaryngology, 7th edition, 2008;3:3396.
- Kumar H, Seth S, Bacterial and Fungal study of 100 cases of chronic suppurative otitis media. J. Clinical and Diagnostic Research. 2011(N.V) (Suppl-1); ICOL 5(6):1224-7.
- Anifasi WB, Tumushime-Buturo CG. Bacteriology and drug sensitivity of chronic suppurative otitis media in central hospital Zimbabwe, Cent Afr J Med 1989;35:481-3.
- Fairbanks D. Pocket Guide to antimicrobial therapy otolaryngology –Head and Neck surgery. In: Alexandria VA, editor. 8th ed. The American academy of otolaryngology –Head and Neck Surgery Foundation.1996.p.1-91.
- J Acuin, “Chronic suppurative otitis media, Burden of illness and management options” WHO Publications, 2004.
- Sattar A, Lamgir A, Hussain Z, Sarfraz S, Nasir J, Alan B, Bacterial spectrum and their sensitivity pattern in the patients of chronic suppurative otitis media. Journal of the college of physicians and surgeons Pakistan. 2012;22(2):128-129.
- Nwabuisi C, Ologe FE. Pathogenic agent of chronic suppurative otitis media in Ilorin, Nigeria, East African Medical Journal. 2002;79(4):202-205.
- Rupa V, Raman R, Chronic suppurative otitis media complicated versus uncomplicated disease. Acta otolaryngology. 1991;111:530-535.
- Malkappa KS, Kandapaneni S, Supam BR, Chakraverti KT, Study of bacterial isolates and their antibiotic susceptibility pattern in Chronic Suppurative Otitis Media, Indian Journal of otology. 2012;18(3):136-139.
- Bansal S, Ohja T, Kumar S, Singhal A, Vyas P. Changing microbiological trends in cases of Chronic suppurative otitis media patients. International journal of current research and review.2013;5(15):76-80
- Micheal G Li, Peter J H, Jeffery T V, Donald T D. Is chronic suppurative otitis media a neglected tropical disease? PLOS neglected tropical diseases. 2015;9(3):1-6.
- VK Poovey, Arati Iyer, study of Bacterial Flora in Chronic suppurative otitis media and its clinical significance. Indian J. otolaryngol. Head and Neck surg. 2002;54(2):91-5.
- Shyamala R, Reddy PS, The study of Bacteriological agent of Chronic suppurative otitis media: Aerobic culture and evaluation.J. Microbial Biotech Res.2012; 2:152-62.
- Gulati.J, Tanden PL Singh, Bias AS, Study of bacterial flora in chronic suppurative otitis media .Indices J Otolaryngol, Head and Neck surg. 1969;2:198-202.
- Talwar P, Chakrabartha A, Pooriamjit Kaur, Pahawa RK, Ashok Mittal and Mehra YN. Fungal infection with special references to chronic suppurative otitis media. Mycopathologica. 1988;104:47-50.
- Loy Att, Tan AL, Lee PK, Microbiology of Chronic suppurative otitis media in Singapore, Singapore Med J. 2002;43:296-9.
- Iqbal K, Khan M, Sulti L, Microbiology of Chronic suppurative otitis media; experience at Dera Ismaili Khan. Journal of medical sciences. 2011;9(2):189-193.
- Shim HJ, Park CH, Kim Mg, Lee SK, Yeo SG, A pre and post operative Bacteriological study of Chronic suppurative otitis media. 2010;38(6):447-52.
- Wariso BA, Ibe SN, Bacteriology of chronic discharging ears in Port Harcourt, Nigeria, West Africa. J.Med. 2006;25(3):219-22.
- Lodhi M, Munir T, Azis K and Lodhi H. Chronic suppurative otitis media; Empirical Quinolones in children, Preferential Med J .2010;17(3):420-4.
- Yousuf M, Majumder KA, Kamal A, Shumon AM and Zaman Y. Clinical study on Chronic suppurative otitis media with Cholesteatoma. Bangladesh J otorhinolaryngology. 2011;17(1):42-7.
- Rao BN, Reddy M.S. Chronic supportive otitis media, A prospective study Indian Journal of otolaryngology and Head and neck surgery. 1994; vol 3: no2, 72-77.
- Shrestha BL, Amatya RCM, Shroshtha I, Ghosh I, Microbiological Profile of Chronic suppurative otitis media , Nepalere Journal of Ent, Head and neck surgery. 2011;2(2):6-7.
- VJjaya D, Nagarathinam, Microbiological study of Chronic suppurative otitis media. Indian J Otol. 1998;4:1723-4.
- Chaturvedi VM, Grewel BS and Cad MS. Bacterial study of chronic suppurative otitis media in Benghazi Garga. Medical Journal. 1980;6(2):161.
- Siraj HEL, Shaik Mahgoub. Otitis media in Saudi Arabia Bacteriological and clinical study; Saudi medical journal. 1980; 6:317.
- Kenna MA, Blue Stone CD. Medical Management of Chronic suppurative otitis media and Cholesteatoma in children, Laryngoscope. 1986;96920:146-151.
- Taneja MK, chronic suppurative otitis media. A Bacteriological Study, Indian journal of otology,Dec. 1995;1(2):24-27.
- Chakraborty A, Bhattacharjee A, Purkaystha P, Microbiological Profile of chronic suppurative otitis media .Its significance in North east India. Indian J otol.2005;11:39-44.
- Fatma AA, Assiry S, Siraj MJ, Microbiological evaluation and aspects on Management of Chronic suppurative otitis media in Riyadh. Indian J otol. 1998;4:115-20.
- T.Deb and D Ray. “A study of bacteriological profile chronic suppurative otitis media in Agartala”. Indian journal of otolaryngology and Head and neck surgery, Vol64, No4. 2012: P326-329.
- S. Nkakhalth, AD, Khosravi, A Fazlipur, M Safar Zadeh and N Rashidi, “Microbiological findings in patients over Chronic suppurative otitis media “, Journal of medical science, Vol8. 2008; Pg: 503-500.
- V khanna, J Chender, NM Nagarkar and A Dass, Clinico Microbiologic Evaluation of Active Tubo-tympanic type Chronis suppurative otitis Media, Journal of otolaryngology, Vol29, No.3. 2000; PP: 148-153.
- Agarwal A, Kumar D, Goyal A, Goyal S, Singh N, Khandelwal G, Microbiological Profile and antimicrobial sensitivity pattern in patients of otitis media with ear discharge. Indian J otol. 2013;19:5-8.

35. Handeson FW, Collier AM, Abd Sanyal M et al 1982. A Longitudinal study of respiratory virus and bacteria in etiology of acute otitis media with effusion, *New England Journal of Medicine*;306:1377.
36. Riding, K.H, blue stone CD, Micheles RH, Cantekin EL, Doyle NJ and Poziviak CS 1978. Microbiology of chronic and recurrent otitis media with effusion in young infants. *Journal of Pediatrics* 193;139.
37. Gaur. RS, Mathew J, Varghese AM, Mathew GA, Chandrasekar R, Anandan S, Microbiological pattern of ear swabs in chronically discharging ear in the tertiary care hospital in India. *Indian J otol.* 2013;19:51-4.
38. Haider A, Chronic suppurative otitis media; Bacteriological study, *Orion Med J* 2002;13:13-4.
39. Aysur PN, Lopez JEG and Iianeg. EGDV, Chronic suppurative otitis media; bacteriology and drug sensitivity pattern at the Quirino Memorial Medical centre. (2004-2005); A preliminary study, *Philip J otolaryngology head and neck surg.* 2006;21(1,2);20-3.
40. Nia K.M, Sepehri G, Khatmi H and Slakibaie MR, Isolation and Antimicrobial susceptibility of bacteria from chronic suppurative otitis media patients in Kerman, Iran, *Iranian Red Crescent Med J.* 2011;13(12):891-4.
41. Karma P, Jokip, Ojala K and Jopik AMM. Bacteriology of chronically discharging ear. *Acta otolaryngology.*86:110-114.
42. Constable L and Buttler I, 1982 microbiological flora in chronic otitis media: *journal of infection*;5:57-60.
43. Gupta Vineeta; Gupta Abhay; Sivarajan K, Chronic suppurative otitis Media Aerobic Microbiological Study *Indian Journal Vol 4;No2;* June 98-79-82.
44. Milten DV and Edson (1989). Bacteriological study of chronic otitis media affecting children living in Rio de Janeiro. *Ear Nose and throat journal* 68;448.
45. Zaida H, Abdulla EN, 1979 Incidence of potential pathogen in microbial infection in Benghazi and an antibiotic policy. *Garyounis Medical Journal* 2(2);27.
46. Kulkurani RD, Dharmadhikani CA, Kulkarini VA, Udaganokar US, Pavar G Gu, Bacteriological study of Chronic otitis media. *Indian Journal of otolaryngology and Head and neck surgery.* June 1993;4(2):110-112.
47. Papastavros T, Giamavdlaon Lt, Varlejides S. Role of aerobic and anaerobic mixture of organism in Chronic suppurative otitis media *Layyorpe Apis.* 1988;96:438-42.
48. Michales Glonscock III George Shamburgh JR. *Surgery of ear, fourth edition, 1990 W.B saunelevs company PP: 107-168.*
49. Fliss DM, Dagan R, Medan N, Lietierman A, Aerobic Bacteriology of chronic suppurative otitis media with cholesteatoma in children anoles of otorhinolaryngology. 1992;101:866-809.
50. Book I Prevalence of beta lactamase producing bacteria in chronic suppurative otitis media, *American journal of disease of children* 139;280-283.
51. Herold Ludman Mawson's diseases of ear, fifth edition, 1988 Edward Arnold publications PP: 426-440.
52. Tulsidas singh M, Taneja GH, Khanna S and Chadda MR, 1954. *Archives of otolaryngology and head neck surgery.* 1954;60:58.
53. Sweeney G, Piccozzi GZ and Brunning CG, 1982. A Quantitative Study of aerobic and anaerobic bacteria in chronic suppurative otitis media. *Journal of infection*; 5:47.
54. RamaRao MV, and Jataker PA, 1980. Bacteriological study of chronic suppurative otitis media. *Journal of Indian Medical association* 75;30.
55. Alo MN, Anyim C, Okonkwo FC and Orgi JO. Prevalence, Antibiogram of bacterial pathogen associated with otitis media among primary school children in Ebony state. *J pharm Bio science.* 2012;(7-8):17-20.
56. Gorjal R, Alar A, Des, Kumar A, Chronic suppurative otitis media _A clinico- microbiological study. *Indian J. otol.* 2009;15:18-22.
57. Rajendra Kumar PV. *Indian J Otolaryngology.* 1974;26(3):153.
58. Nene SS, Joshi BN, Patil SR. *Indian Medical Gazette* 1986.CXXX iii (3):95.
59. Flue RP, Damale AS, Mohan C, Chandra R. *Indian Medical Gazette, 1986. CXXX no. 2;* 49.
60. Mishra Anupam, Shukla Girish, Nag Devika. Mishra Subhash Chandra; Bacteriological Study Of chronic suppurative otitis media .VOL5, No 2(June 99);87-91.
61. Gulati sudesh kumar. Investigative profile in patients of chronic suppurative otitis media. *Indian Journal of otology Vol-3 No.2.* 1997;(6):59-62.
62. Varshey Saubh, Gupta Pratima. Bacteriology study of chronic suppurative otitis media. *Indian journal of Otolology.* 1999;(6):87-91.
63. Sinha A, Kapil A, Gupta V. Aerobic microbiological study of Chronic suppurative otitis media. *Indian journal of otology Vol5; No4.* 1999;(12):203-206.
64. Hussain MT, Karim DN, Zaida H and Abdulla EM, 1980. An evaluation of *pseudomonas* infection in a Burns unit. *Caryonus Medical Journal* 3:115.
65. Karim DN, Hassea DN, Abdulla 1981. Ear infection among children in Benghazi, An Analysis of 177 cases. *Garyounis Medical Journal* 4(1):85.
66. Urmil Mohan Jindal Fungal and bacterial Flora of Chronic suppurative otitis media in Amritsar *Indian Journal of otolaryngology and Head and neck surgery, Vol 50;No.2, April –June.* 1998: 175-177.
67. Narashingha Rao B and Jeyakar PA. 1985. Incidence of *Proteus* infection in Visakhapatnam and their antibiotic sensitivity pattern. *The Indian Practitioner* 38:461.
68. Malik AK, Nagia IP, Saudharwal V, Saini S and Chugh TD. Microbial flare in chronic suppurative otitis media. *Indian medical gazette.* 1982;116(10): 305-307.
69. Singh MP, prabhakar H, Arora S. Anaerobes and fungi in chronic suppurative otitis media. *Indian journal of microbiology.* 1985;3(7):177-182.

