**Original Research Article**

**ASSESSMENT OF THE PRESENT BACTERIOLOGICAL PROFILE AND ANTIBIOTIC SENSITIVITY PATTERN IN CHRONIC SUPPURATIVE OTITIS MEDIA IN SANA’A YEMEN**

**ABSTRACT**

**Background and objectives:** Chronic suppurative otitis media (CSOM) is the discharge of pus from the ear throughout a perforated tympanic membrane for a period of more than 12 weeks. The study objectives were to determine the microbiological profile of chronic inflammation for the middle ear (CSOM), and to determine the sensitivity of the isolates to locally available antimicrobials.

**Subjects and methods:** This cross-sectional study concerned 111 ear swab samples acquired from patients with clinically diagnosed active CSOM. Ear swabs were cultured to identify microbes according to a standard protocol, and susceptibility testing of antibiotics was performed using a modified Kirby-Bauer disk diffusion method, and the diameter of the zone of ​​inhibition was elucidated according to Clinical Laboratory Standards Institute guidelines.

**Results:** During two years, 111 patients of chronic suppurative otitis media were collected from January 2020 to the end of December 2022. Most of the patients were males (63.96%) while females were 36.04%. 36.04% of the total patients were in the ≤10-year group, and 29.7% were in the ≥46-year group while the other age groups were less frequent. Microbial growth was seen in 91.9% of samples, but 7.2% of samples did not. Among the samples with growth, 71.2% were monomicrobial, 12.6% were polymicrobial, and 9% had mixed growth with more than three microorganisms. The most frequently isolated bacteria were Pseudomonas aeruginosa (34.95%) followed by Staphylococcus aureus (14.6%) and Klebsiella spp. (9.8%). The antibiotics most sensitive against P aeruginosa were cefepime (97.7%), meropenem (95.3%), piperacillin-tazobactam (95.3%), and ciprofloxacin (93%). Staphylococcus aureus showed the highest sensitivity to rifampin (100%) and fusidic acid (88.9%).

**Conclusion:** High prevalence of P*. aeruginosa*, *S aureus*, *Klebsiella* spp, and *Acinetobacter* spp in the bacteriological profile of CSOM. CSOM has different distributions in different age groups. There was a decrease in the pattern of antibiotic susceptibility of bacterial isolates. It is important to be aware of the current trend of bacteriological profiles and to revise antibiotic prescribing according to susceptibility.

 **Key words**: bacteriological profile, antibiotic sensitivity, chronic suppurative otitis media, CSOM, Sana’a, Yemen

**INTRODUCTION**

Otitis media infections are inflammatory diseases of the middle ear. One of the main types is acute otitis media (AOM), which is a fast-onset infection that typically acquaints with ear pain. Otitis media with effusion (OME) is the second main type of otitis media that usually not associated with symptoms, even though a sensation of fullness in the infected ear is sometimes illustrated; it is described as the presence of non-infectious fluid in the middle ear that may persist for weeks or often months after an incident of AMO. The third type of otitis media is chronic suppurative otitis media (CSOM); it is an infection of the middle ear that results in perforation of the eardrum membrane with ear discharge for more than six weeks. All three types of otitis media may be associated with hearing impairment 1–4.CSOM takes place s after an upper respiratory infection that caused acute otitis media. This makes progress to an extended inflammatory reaction causing middle ear mucosal edema, perforation and ulceration. The middle ear makes an effort to solve this ulceration by producing granulation tissue and forming polyps. This can lead to over-exocytosis, failure to stop the inflammation, and the development of CSOM, which is frequently associated with cholesteatoma. Present of enough pus draining out of the ear (otorrhea) or the pus may be minimum to be seen just on otoscope or binocular microscope examination 5–8. Approximately 11% of the population worldwide is affected by AOM each year, or 709 million cases, from them about 4.4% might develop CSOM. According to the World Health Organization, CSOM is a major cause of hearing loss in children9] Recurrent episodes of CSOM among adults have a higher risk of developing permanent conductive and sensorineural hearing loss6, 8. The incidence of CSOM worldwide varies widely with the prevalence being relatively low in high-income countries while in low-income countries such as Yemen, the prevalence may be as high as three times4, 10. Every year 21,000 people die worldwide due to complications of CSOM9.

 The Yemen reviews showed that there were no studies discussing the microbiological features of CSOM, and the sensitivity of isolates to antibiotics. Therefore, the aim of this study was to determine the microbiological profile of CSOM, and to determine the sensitivity of isolates to locally available antimicrobials.

**SUBJECTS AND METHODS**

**Study population:** A cross-sectional study was conducted in the Department of Medical Microbiology and Department of ENT, Faculty of Medicine and Health Sciences, Sana'a University. Patients referred to the Department of Microbiology at the National Center for Public Health Laboratories (NCPHL) Sana'a, Yemen were selected from governmental and private hospitals in Sana'a city for a period of two years. During two years, 111 chronic suppurative otitis media patients were collected from January 2020 to the end of December 2022. Excluded criteria include: patients with, acute otitis externa, cholesteatoma, otomycosis, and tympanostomy tube, in addition to patients receiving treatment systemic or topical antibiotics or antifungal treatment in two weeks prior to sampling.

**Clinical data:** A detailed clinical history, including age, gender, duration of discharge and previous antibiotic treatment, was obtained. Data were collected during attendance at the NCPHL by a trained physician who performed an otoscopy examination followed by auditory toilet use. Characteristics of ear secretions, perforation of the tympanic membrane, including size and area of ​​perforation of the eardrum, and condition of the middle ear were recorded.

**Ear specimens**: A sample of ear secretions from the middle ear was collected under sterile precautions from the area of ​​the perforated tympanic membrane using a sterile aluminum stick with a diameter of 1.5 mm cotton wool-tipped applicator. The collected samples were cultured directly in the appropriate medium after collection.

 **Microbiological procedure:** One loop was inoculated on blood agar, one loop to MacConkey agar and one loop on chocolate agar. Blood agar, MacConkey agar was incubated aerobically at 37 °C for 24 hours. While the inoculated chocolate agar was incubated in a carbon dioxide-enriched atmosphere at 37 °C for 24 hours. Then the growth was identified by standard bacteriological methods 11.

**Antibiotic sensitivity:** Bacterial isolates antibiotic sensitivity was done using the modified Kirby-Bauer disc diffusion technique in Mueller-Hinton agar. The inhibition zone diameter was interpreted following the 2017 Clinical Laboratory Standards Institute guideline 12, 13.

**Ethical consideration:** Consent was taken from all the participants and the participants were informed that participation is voluntary and that they can refuse without giving any reason.

**Statistical analysis:** The data were analyses performing Epi Info statistical program version 6 (CDC, Atlanta, USA). Conveying the quantitative data like mean values, standard deviation (SD), as the data were normally distributed. The qualitative data were expressed as percentages;

**RESULTS**

Table 1 show the age and sex data for the 111 patients participating in this study. The patients' ages ranged from 1 to 77 years, with a mean of 23 years. The peak incidence of CSOM was observed in patients between the ages of ≤10 years (36.04%) and ≥46 years (29.7%). Male sex was predominant, with a male: female ratio of 1.8:1. Table 2 shows the duration, affected aspect, etiological factors, and symptoms associated with CSOM. Considering the duration of infection, most patients had it for more than 12 months (47.8%), followed by 6-12 months (27%), while less than 6 months was only 25.2%. Most infections were unilateral (95.5%), and only 4.5% had bilateral ear infections with approximately equal number of affected sides (48.6% vs. 51.4%). consideration of precipitating factors; 59.5% of patients suffer from upper respiratory tract infection, 26.1% suffer from allergic rhinitis, and 14.4% do not suffer from disorders. Consider the accompanying symptoms; 31.5% of the patients suffered from hearing impairment, 14.4% experienced ear pain and 21.6% experienced ear itching, while 32.4% did not experience any symptoms. Table 3 presents the discharge characteristics in CSOM patients. In 47.7% of patients, the ear secretions were mucopurulent, 41.4% were purulent, and 10.8% were mucopurulent only. Foul smelling discharge was 3.6% while 96.4% of the samples had no odor. Table 4 summarizes the microbiological profiles. A total of 111 ear swab samples were collected for microbial identification. Among them, microbial growth was observed in 103 (92.8%) samples, while 7.2% of the samples showed no growth, 71.2% showed mono-microbial growth, 12.6% poly-microbial growth and 9% mixed growth. Gram-negative microorganisms were more commonly identified than Gram-positive bacteria (69.1% vs. 21.1%). *Pseudomonas aeruginosa* was the most common microorganism isolated (34.95%), followed by *Staphylococcus aureus* (14.6%), *Klebsiella* spp. (9.8%), *Acinobacter* spp (7.3%) and *Proteus* spp (6.5%). Fungal organisms were isolated in 9.8% of the samples. Table 5 shows the patterns of sensitivity to Gram-positive bacteria towards antibiotics. The most sensitive antibiotics against *S. aureus* were rifampin (100%), fusidic acid (88.9%), gentamicin (77.8%), cefoxitin (72.2%) and clindamycin (72.2%), with the lowest sensitivity being for penicillin G (16.7%), erythromycin (55.6%), ciprofloxacin (61.1%), and trimethoprim/sulfamethoxazole (66.7%). Patterns of antibiotic sensitivity for Gram-negative bacteria are shown in Table 6. The most sensitive antibiotics against *P. aeruginosa* are Cefepime (97.7%), ceftazidime (95.3%), Meropenem (95.3%), piperacillin-tazobactam (95.3%), ciprofloxacin (93%) and amikacin (90.7%); with decreased sensitivity to gentamicin (74.4%) and imipenem (88.4%).

**DISCUSSION**

The age of the patients in the current study ranged from 1 to 77 years, with a mean of 23 years. The peak incidence of CSOM was observed in patients between the ages of ≤10 years (36.04%) and ≥46 years (29.7%). The current results are similar to those reported from Malaysia by Draman *et al*. 8, where the patients' age ranged from 1 to 90 years, with a mean of 24 years; also, the peak incidence of CSOM is observed in patients aged 1 to 10 years (33.0%) and over 40 years (35.1%) 8. However, the current findings contradict those of Chirwa *et al.* 14 and Bakari *et al.* 15 that showed that CSOM infection occurred predominantly during the first 5 years of life and there was no peak of infection in the adult age groups14, 15. The high prevalence of CSOM in children can be attributed to the fact that the Eustachian tubes are shorter, narrower, and more horizontal compared to the ears of adults16. This anatomical difference makes children more susceptible to the infections of the ear. This age group is also at a higher risk of developing upper respiratory tract infections (URTIs) than adults, which can progress to ear infections17. On the contrary, a study by Loy *et al.* in Singapore showed a different prevalent age group, with the disease most common among patients with age group 31 to 40 years18. In the current study, the male sex was dominant, with a male to female ratio of 1.8:1. This finding differs from studies conducted in Pakistan and Malaysia where the disease is more common in females 8, 19-21. Male predominance may be attributed to an increased vulnerability of males to the risk of developing CSOM and may also be due to an increase in health awareness among males, as they tend to seek early treatment. Also, several studies have shown a predominance of males, which can be attributed to their active lifestyles, such as swimming or diving activities 15, 17, 22. Infection of the middle ear from contaminated swimming water can lead to intermittent ear discharge and frequent infections4, 8.

 In this study, 59.5% of patients developed active CSOM after a URTIs. Draman *et al.* 8 and Koch *et al.*23; they also revealed that URTIs increase the risk of developing this disease. Respiratory pathogens, such as *Streptococcus pneumoniae*, *S. aureus*, and *Haemophilus influenza*, can be transmitted to the middle ear from the nasopharynx via the Eustachian tube during URTI episodes12, 24. In the current study, 26.1% of the patients had allergic rhinitis. Allergic rhinitis might cause inflammation of the nasal mucosa causing edema of the opening of Eustachian tube. Nasal blockage can raise the nasopharynx negative pressure, leading to further obstruction of the Eustachian tubes. Both effects lead to the progress of negative middle ear pressure1–4. The results of the current study are similar to a study by Md Daud *et al,* 25 where there is a significant association between CSOM and allergy. In this study, 47.7% of the patients, the ear secretions were mucopurulent, 41.4% were purulent, and 10.8% were mucoid only. The stench discharge was 3.6% while 96.4% of the samples had no odor. These results are almost identical to those reported in Malaysia by Draman *et al.* 8 in which 48.4% of patients had mucopurulent ear secretions, 41.8% had purulent discharge, 9.9% had mucoid discharge, and only 2.2% had foul-smelling discharge.

The most important sequelae of CSOM are mild to moderate conductive hearing loss, which was reported in 31.5% of cases in the current study. This result is lower than that reported by Draman *et al.* 8 As 45.5% of patients have symptoms associated with hearing loss. This complication can be explained by that; in prolonged and recurrent episodes of active CSOM, inflammatory mediators generated during CSOM can penetrate the inner ear through the round window. This can lead to loss of hair cells in the cochlea, resulting in mixed conductive and sensorineural hearing loss24, 26.

 In implementation, culturing of bacteria may not be obligate d to diagnose CSOM; comprehensive studies have determined that 90% to 100% of chronic discharge of infected ears produces two or more isolates contain both anaerobic and aerobic bacteria. Most recommended treatments might eradicate middle ear bacteria effectively, but this does not guarantee the non-recurrence of otorrhea or total solution of the CSOM. However, bacterial cultures are recommended, in particular in cases of intractable infections or when bacterial resistances to antibiotics are suspected. The microbiology profile in the current study population revealed that 71.2% of the isolated organisms were monomicrobial, 12.6% were polymicrobial, and only 9% were mixed growth of more than 2 microorganisms. These findings is roughly similar to that reported elsewhere 8, 12, 24. The most common microorganism isolated in the current study was *P. aeruginosa* (34.95%), followed by *S. aureus* (14.6%) (Table 4). This finding is similar to other bacteriological studies of CSOM conducted in countries such as Malaysia, Nepal, Greece, Ghana, and Singapore 8,18,22,27. The high incidence of *P. aeruginosa* is a concern. Although *P. aeruginosa* is a widespread colonizer of the auditory canal, this bacteria can produce nosocomial infections and has expanded resistance to numerous powerful anti-pseudomonal antibiotics 28, 29. *P. aeruginosa* can additionally cause progressive damage of the mastoid structure and middle ear by liberating *P. aeruginosa* toxins and enzymes. Nevertheless, further studies described that *S. aureus* was the most common pathogenic bacteria, followed by *P. aeruginosa* 30, 31. A study by Bakari *et al.* in Nigeria, the most common bacteria causing CSOM were found to be coliform comprising Klebsiellaspp. followed by *E. coli* 15. In addition, different results were obtained in studies conducted in Malawi, Kenya, and Ethiopia, where Proteus mirabilis was the most common bacteria isolated, ranging from 28.6% to 32.7% of the samples14,32. Finally, the current study revealed fungal growth in 9.8% of the cases of CSOM. The most common of these was *Candida* spp. 7.3%, followed by *Aspergillus* spp. 2.4%. This result is similar to other studies 8, 14, 33. The present study showed that the most sensitive antibiotics against *P. aeruginosa* were cefepime (97.7%), ceftazidime (95.3%), meropenem (95.3%), piperacillin-tazobactam (95.3%), ciprofloxacin (93%) and amikacin (90.7%) ; With reduced sensitivity to gentamicin (74.4%) and imipenem (88.4%). Previous studies conducted in Yemen showed that *P. aeruginosa* had an increased resistance rate towards aztroneome, ceftriaxone and ciprofloxacine that was 100%. Resistance rates ranged from 83.3-85.7% for amikacin, ampicillin sulbactam and levofloxacin. The rates were 71.4% for nitelmycin and 92.9% for chloramphenicol29. The results of the current study are less sensitive than those reported from Malaysia where *P. aeruginosa* showed 100% sensitivity to cefepime, ceftazidime, piperacillin-tazobactam, and meropenem8. A study conducted in Pakistan also showed that *P. aeruginosa* had an increased resistance rate towards fluoroquinolones (48.7%), followed by antipseudomonal penicillin (41.7%) and carbapenems (29.4%) 20. In the current study, the most sensitive antibiotics against *S. aureus* were rifampin (100%), fusidic acid (88.9%), gentamicin (77.8%), cefoxitin (72.2%), and clindamycin (72.2%), and were the least sensitive. for penicillin G (16.7%), erythromycin (55.6%), ciprofloxacin (61.1%), and trimethoprim/sulfamethoxazole (66.7%). Our results are consistent with previous studies conducted in Yemen, which revealed an increasing pattern of antibiotic resistance of *S. aureus* with an increase in the rate of MRSA 34–42. Our susceptibility rates differed from those reported in Malaysia where *S. aureus* showed the highest sensitivity to rifampin (100%), fusidic acid (93.3%), and cefoxitin (93.3%), with the lowest sensitivity to ciprofloxacin (66.7%), gentamicin (80%), chloramphenicol (80%), and Trimethoprim-sulfamethoxazole (80%). Also, our results are consistent with a study conducted in South Korea, which revealed an increased antibiotic resistance pattern of *S. aureus* with an increase in the rate of MRSA43.

**CONCLUSIONS**

The bacteriological profile of CSOM in the current study showed a high prevalence of Pseudomonas *aeruginosa* followed by *Staphylococcus aureus*, *Klebsiella* spp., Acinobacter spp and *Proteus* spp. There was declining pattern in their sensitivity toward commonly used antibiotics. It is important to be aware of the current trend of the bacteriological profiles and to revise the antibiotic regime according to the sensitivity. Also, this study suggested that continuous and periodic surveillance of antibiotic sensitivity of clinical isolates which is necessary to reduce the spread of antibiotic-resistant pathogens and to guide appropriate antibacterial therapy.

**RECOMMENDATIONS**

 Poor patient compliance and irrational use of antibiotics led to bacterial resistance to frequently used antibiotics, which led to treatment failure in many cases of CSOM infections. Also one of the reasons for raising the resistance is the prolonged use of otological drugs in persistent otorrhea. Therefore, there is a need to reassess the resistance and sensitivity of bacteria isolated from CSOM patients to antibiotics obtainable in different countries of the world. By quantifying the strength of different antibiotic susceptibility to the most common bacteria isolated, the antibiotic regimen for CSOM should be reviewed to ensure the most effective and efficient protocol of treatment. This review will prevent recurrent complications and additional complications of CSOM by initiating the most appropriate and effective antibiotic therapy.

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**CONFLICT OF INTEREST**

No conflict of interest associated with this work.

**AUTHOR CONTRIBUTIONS**

All authors contributed to data analysis, drafting and review of the paper, and gave final approval to the research.

**REFERENCES**

1.Lieberthal AS, Carroll AE, Chonmaitree T, Ganiats TG, Hoberman A, Jackson MA, *et al*.. ["The diagnosis and management of acute otitis media"](https://doi.org/10.1542/peds.2012-3488). Pediatrics 2013; **131** (3): e964-99.  [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.1542/peds.2012-3488](https://doi.org/10.1542/peds.2012-3488).

 2.Emmett SD, Kokesh J, Kaylie D. "Chronic Ear Disease". The Medical Clinics of North America 2018; **102** (6): 1063-1079. [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.1016/j.mcna.2018.06.008](https://doi.org/10.1016/j.mcna.2018.06.008).

3. Qureishi A, Lee Y, Belfield K, Birchall JP, Daniel M. ["Update on otitis media - prevention and treatment"](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3894142). Infection and Drug Resistance 2014; **7**: 15–24. [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.2147/IDR.S39637](https://doi.org/10.2147/IDR.S39637).

4**.** Al-Khamesy K S A, Al-Moyed K A, Al-Shamahy HA. “Colonization of pathogenic aerobic bacteria in the external ear and effects of cerumen types, age, and gender on colonization”. Universal J Pharm Res 2023; 7( 6):1-8. doi:10.22270/ujpr.v7i6.872.

5. Gleeson M, Clarke R. Scott-Brown's Otorhinolaryngology. Head and Neck Surgery. Vol 3. 7th ed. Boca Raton, FL: CRC Press; 2018: 115-131.

6. Monasta L, Ronfani L, Marchetti F, Montico M, Vecchi Brumatti L, Bavcar A, et al.. ["Burden of disease caused by otitis media: systematic review and global estimates"](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3340347). PLOS ONE 2012; **7** (4): e36226. [Bibcode](https://en.wikipedia.org/wiki/Bibcode_%28identifier%29):[2012PLoSO...736226M](https://ui.adsabs.harvard.edu/abs/2012PLoSO...736226M). [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.1371/journal.pone.0036226](https://doi.org/10.1371/journal.pone.0036226).

7. Vos T, Barber RM, Bell B, Bertozzi-Villa A, Biryukov S, Bolliger I, et al. ["Global, regional, and national incidence, prevalence, and years lived with disability for 301 acute and chronic diseases and injuries in 188 countries, 1990–2013: a systematic analysis for the Global Burden of Disease Study 2013"](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4561509). Lancet 2015;  **386** (9995): 743–800. [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.1016/s0140-6736(15)60692-4](https://doi.org/10.1016/s0140-6736%2815%2960692-4).

8. Wan Draman WNA, Md Daud MK, Mohamad H, Hassan SA, Abd Rahman N. Evaluation of the current bacteriological profile and antibiotic sensitivity pattern in chronic suppurative otitis media. Laryngoscope Investig Otolaryngol. 2021 Oct 18;6(6):1300-1306. doi: 10.1002/lio2.682. PMID: 34938866; PMCID: PMC8665472.

9.  Acuin J, WHO Dept. of Child and Adolescent Health and Development, WHO Programme for the Prevention of Blindness and Deafness. Chronic suppurative otitis media : burden of illness and management options. Geneve: World Health Organization 2004; [hdl](https://en.wikipedia.org/wiki/Hdl_%28identifier%29):[10665/42941](https://hdl.handle.net/10665/42941). [ISBN](https://en.wikipedia.org/wiki/ISBN_%28identifier%29) [978-92-4-159158-4](https://en.wikipedia.org/wiki/Special%3ABookSources/978-92-4-159158-4).

10.  Monasta L, Ronfani L, Marchetti F, Montico M, Vecchi Brumatti L, Bavcar A, et al. ["Burden of disease caused by otitis media: systematic review and global estimates"](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC3340347). PLOS ONE 2012; **7** (4): e36226.  [Bibcode](https://en.wikipedia.org/wiki/Bibcode_%28identifier%29):[2012PLoSO...736226M](https://ui.adsabs.harvard.edu/abs/2012PLoSO...736226M). [doi](https://en.wikipedia.org/wiki/Doi_%28identifier%29):[10.1371/journal.pone.0036226](https://doi.org/10.1371/journal.pone.0036226).

11. Cheesbrough M. District laboratory practice in tropical countries. Cambridge: Cambridge University Press; 2010. https://doi.org/10.1017/CBO9780511581304

12. Church DL. Biochemical tests for the identification of aerobic bacteria. Clinical Microbiology Procedures Handbook. 4th ed. Washington, DC: American Society of Microbiology; 2016:3-17.

13. Wayne PA. Performance Standards for Antimicrobial Disc SusceptibilityTesting. Vol 12. National Committee for Clinical Laboratory Standards; 2002:1-53.

14. Chirwa M, Mulwafu W, Aswani JM, Masinde PW, Mkakosya R, Soko D. Microbiology of chronic suppurative otitis media at Queen Elizabeth central hospital, Blantyre, Malawi: a cross-sectional descriptive study. Malawi Med J. 2015;27:120-124.

15. Bakari AA, Adoga AA, Afolabi OA, Kodiya AM, Ahmad BM. Pattern of chronic suppurative otitis media at the National Ear Care Centre Kaduna, Nigeria. J Med Trop 2010;12:22-25.

16. Gleeson M, Clarke R. Scott-Brown's Otorhinolaryngology. Head and Neck Surgery. Vol 3. 7th ed. Boca Raton, FL: CRC Press; 2018: 115-131.

17. Ayson PN, Lopez JEG, Llanes EGDV. Chronic suppurative otitis media: bacteriology and drug sensitivity patterns at the Quirino Memorial Medical Center (2004-2005): a preliminary study. Philipp J Otolaryngol Head Neck Surg. 2006;21:20-23.

18. Loy AHC, Tan AL, Lu PKS. Microbiology of chronic suppurative otitis media in Singapore. Singapore Med J. 2002;43:296-299.

19. Zahid T, Zeba A, Aqeel Z. Microbiology of chronic suppurative otitis media (CSOM) in tertiary care setup, Civil Hospital Karachi, Pakistan. Pak J Surg. 2016;32:176-180.

20. Mansoor T, Musani MA, Khalid G, Kamal M. *Pseudomonas aeruginosa* in chronic suppurative otitis media: sensitivity spectrum against various antibiotics in Karachi. J Ayub Med Coll Abbottabad. 2009;21: 120-123.

21. Mohamad H, Md Daud MK, Hasan H, Wong CY. Does fungal infection is the main cause for persistent middle ear otorrhea? Egypt J Ear Nose Throat Allied Sci. 2017;18:79-82.

22. Appiah-Korang L, Asare-Gyasi S, Yawson AE, Searyoh K. Aetiological agents of ear discharge: a two year review in a teaching hospital in Ghana. Ghana Med J. 2014;48:91-95.

23. Koch A, Homøe P, Pipper C, Hjuler T, Melbye M. Chronic suppurative otitis media in a birth cohort of children in Greenland: populationbased study of incidence and risk factors. Pediatr Infect Dis J. 2011; 30:25-29.

24. Acuin J. Global Burden of Disease Due to Chronic Suppurative Otitis Media: Disease, Deafness, Deaths and DALYs Chronic Suppurative Otitis Media-Burden of Illness and Management Options. Geneva: World Health Organisation; 2004:9-23.

25. Md Daud MK, Shahrjerdi B, Ramli RR, Abd RN. The association of allergy and chronic suppurative otitis media: a study in a tropical country. Med J Malaysia. 2019;74:205-208.

26. Verhoeff M, van der Veen EL, Rovers MM, Sanders EAM, Schilder AGM. Chronic suppurative otitis media: a review. Int J Pediatr Orl. 2006;70:1-12.

27. Bardanis J, Batzakakis D, Mamatas S. Types and causes of otorrhea. Auris Nasus Larynx. 2003;30:253-257.

28. Al-Safani AA, Al-Shamahy H, Al-Moyed K. Prevalence, antimicrobial susceptibility pattern and risk factors of MRSA isolated from clinical specimens among military patients at 48 medical compound in Sana’a city, Yemen. Universal J Pharm Res 2018; 3(3):40-44. <https://doi.org/10.22270/ujpr.v3i3.165>

29. AL-Magrami RTF, H. A. Al-Shamahy. Pseudomonas aeruginosa skin-nasopharyngeal colonization in the inpatients: prevalence, risk factors and antibiotic resistance in tertiary hospitals in Sana’a city-Yemen. Universal J Pharm Res 2019; 3(6). <https://doi.org/10.22270/ujpr.v3i6.219>

30. Penido Nde O, Chandrasekhar SS, Borin A, Maranh~ao AS, Gurgel Testa JR. Complications of otitis media–a potentially lethal problem still present. Braz J Orl. 2016;82:253-262.

31. Mozafari Nia K, Sepehri G, Khatmi H, Shakibaie MR. Isolation and antimicrobial susceptibility of bacteria from chronic suppurative otitis media patients in Kerman. Iran Iran Red Crescent Med J. 2011;13: 891-894.

32. Aduda DSO, Macharia IM, Mugwe P, et al. Bacteriology of chronic suppurative otitis media (CSOM) in children in Garissa District, Kenya: a point prevalence study. Int J Pediatr Orl. 2013;77:1107 - 1111.

33. Ibekwe AO, ZAS a S, Benayam A. Anaerobes and fungi in chronic suppurativeotitis media. Ann Otol Rhinol Laryngol. 1997;106:649-652.

34. Al-Shami A Z, Al-Haimi M, Al-dossary OA, Nasher A, Al-Najhi MM, Al-Shamahy HA, Al-Ankoshy AAM. “Patterns of antimicrobial resistance among major bacterial pathogens isolated from clinical samples in two tertiary’s hospitals, in Sana’a, Yemen”. U. Universal J Pharm Res 2021; 6(5):1-6. doi:10.22270/ujpr.v6i5.674.

35. Alyahawi A, Alkaf A, Alnamer R, Alnosary T. Study of resistance for recently marketed carbapenem drug among hospitalised patients in Sana’a, Yemen. Universal J Pharm Res 2018; 3(5).https://doi.org/10.22270/ujpr.v3i5.203

36. Saleh AAM, Al-Shamahy HA, Al-Hrazi RMA, *et al..* Biofilm formation and antibiotic susceptibility of uropathogens in patients with catheter associated urinary tract infections in Ibb city -Yemen. Universal J Pharm Res 2020; 4(6). <https://doi.org/10.22270/ujpr.v4i6.329>

37. Ishak AA, Alhadi AM, Al-Moyed KAA, Al-Shamahy HA. Childhood urinary tract infection: clinical signs, bacterial causes and antibiotic susceptibility. Universal J Pharm Res 2021; 6(4). [https://doi.org/10.22270/ujpr.v6i4.643 17](https://doi.org/10.22270/ujpr.v6i4.643%2017).

38. Al-Eryani SA, Alshamahi EYA, Al-Shamahy HA, Alfalahi GHA, Al-Rafiq AA. Bacterial conjunctivitis of adults: causes and ophthalmic antibiotic resistance patterns for the common bacterial isolates. Universal J Pharm Res 2021; 6, (1). <https://doi.org/10.22270/ujpr.v6i1.535>

39. Alshamahi EYA, Al-Shamahy HA, Musawa YA, Al-Shami HZ. Bacterial causes and antimicrobial sensitivity pattern of external ocular infections in selected ophthalmology clinics in Sana’a city. Universal J Pharm Res 2020; 5(3). <https://doi.org/10.22270/ujpr.v5i3.409>

40. Al-Haifi AY, Al Makdad ASM, Salah MK, Al-Shamahy HA, Al Shehari WAA. “Epidemiology, bacterial profile, and antibiotic sensitivity of lower respiratory tract infections in Sana’a and Dhamar city, Yemen”. Universal J Pharm Res 2020; 5(2):1-6. doi:10.22270/ujpr.v5i2.386.

41. Al-Akwa A AY, Zabara AQMQ, Al-Shamahy HA, Al-labani MA, Al-Ghaffari KM, Al-Mortada AM, Al-Haddad MA, Al-Sharani AA. “Prevalence of *staphylococcus aureus* in dental infections and the occurrence of MRSA in isolates”. Universal J Pharm Res 2020; 5(2):1-6. doi:10.22270/ujpr.v5i2.384.

42. Alhadi YAA, Al-Kibsi TAM, Al-Shamahy HA, Aldeen YASS. “Surgical site infections: prevalence, associated factors and antimicrobial susceptibility patterns of the bacterial isolates among postoperative patients in Sana’a, Yemen”. Universal J Pharm Res 2022; 7(3):1-6. doi:10.22270/ujpr.v7i3.777.

43. Choi HG, Park KH, Park SN, Jun BC, Lee DH, Yeo SW. The appropriate medical management of methicillin-resistant *Staphylococcus aureus* in chronic suppurative otitis media. Acta Otolaryngol. 2010;130:42-46.

Table 1: Age and sex distribution of patients with chronic suppurative otitis media who attended the National Center for Public Health Laboratories (NCPHL)

|  |  |  |
| --- | --- | --- |
| Characters | Number | Percentage |
| Sex |
| Male | 71 | 63.96 |
| Female | 40 | 36.04 |
| Age groups |
| ≤10 years | 40 | 36.04 |
| 11-20 years | 17 | 15.3 |
| 21 - 40 years | 21 | 18.9 |
| ≥46 years | 33 | 29.7 |
| Total | 111 | 100 |
| Median (IQR=39) | 23 years |
| Min | 1 years |
| Max | 77 years |

Table 2: Duration, affected side, precipitating factors, and symptoms associated with CSOM for patients Who attended the National Center for Public Health Laboratories (NCPHL) n = 111

|  |  |  |
| --- | --- | --- |
| Characters | Number | Percentage |
| Duration of CSOM, months |
| < 6 months | 28 | 25.2 |
| 6 – 12 months | 30 | 27 |
|  >12 months | 53 | 47.8 |
| Affected side |
| Unilateral | 106 | 95.5 |
| Right | 54 | 48.6 |
| Left | 57 | 51.4 |
| Bilateral | 5 | 4.5 |
| Precipitating factors |
| Upper respiratory tract infection | 66 | 59.5 |
| Allergic rhinitis | 29 | 26.1 |
| Nil | 16 | 14.4 |
| Associated symptoms |
| Hearing loss | 35 | 31.5 |
| Pain | 16 | 14.4 |
| Itchiness  | 24 | 21.6 |
| Nil | 36 | 32.4 |

Abbreviation: CSOM: chronic suppurative otitis media.

 Table 3: Characteristics of discharge from chronic suppurative otitis media patients who attended the National Center for Public Health Laboratories (NCPHL) n=111

|  |  |  |
| --- | --- | --- |
| Characters | Number | Percentage |
| Characteristic of discharge |
| Mucoid | 12 | 10.8 |
| Mucopurulent | 53 | 47.7 |
| Purulent  | 46 | 41.4 |
| Blood stained | 0 | Nil |
| Odor |
| Foul smelling | 4 | 3.6 |
| Non-foul smelling | 107 | 96.4 |

Table 4: Microbiological profiles of chronic suppurative otitis media patients n=111.

|  |  |  |
| --- | --- | --- |
| Characters | Number | Percentage |
| Type of isolated microorganisms |
| Mono-microbial | 79 | 71.2 |
| Poly-microbial | 14 | 12.6 |
| Mixed growth | 10 | 9 |
| No growth | 8 | 7.2 |
| Name of isolated microorganisms |
| **Gram-positive bacteria** | 26 | 21.1 |
| *Staphylococcus aureus* | 18 | 14.6 |
| *Streptococcus spp.* | 6 | 4.9 |
| *Enterococcus* spp | 2 | 1.6 |
| **Gram-negative bacteria** | 85 | 69.1 |
| *Pseudomonas aeruginosa* | 43 | 34.95 |
| *Klebsiella* spp. | 12 | 9.8 |
| *Acinetobacter* spp.  | 9 | 7.3 |
| *Proteus* spp.  | 8 | 6.5 |
| *Enterobacter* spp.  | 5 | 4.1 |
| *Escherichia coli*  | 6 | 4.9 |
| *Serratia marcescens*  | 2 | 1.6 |
| **Fungal organisms** | **12** | 9.8 |
| *Candida* spp. | 9 | 7.3 |
| *Aspergillus* spp | 3 | 2.4 |
| Total isolates | 123 | 100 |

Table 5: Antibiotic sensitivity pattern of gram-positive microorganisms isolated from CSOM (n = 26).

|  |  |  |  |
| --- | --- | --- | --- |
| Antibiotics | *S. aureus* n=18 | *Streptococcus* spp n=6 | *Enterococcus* spp n=2 |
| Trimethoprim/sulfamethoxazole | 12 (66.7) | 2 (33.3) | 1 (50) |
| Clindamycin  | 13 (72.2) | 5 (83.3) | 1 (50) |
| Erythromycin | 10 (55.6) | 6 (100) | 0 (0.0) |
| Fusidic acid  | 16 (88.9) | - | - |
| Penicillin G  | 3 (16.7) | 6 (100) | 1 (50) |
| Gentamicin  | 14 (77.8) | - | - |
| Rifampin  | 18 (100) | - | - |
| Cefoxitin  | 13 (72.2) | - | - |
| Ciprofloxacin  | 11 (61.1) | - | - |
| Cephalexin  | - | 6 (100) | 2 (100) |

Table 6: Antibiotic sensitivity pattern of gram-negative microorganisms isolated from CSOM patients.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Antibiotics | *Pseudomonas aeruginosa* n=43 | *Klebsiella* spp. n=12 | *Acinetobacter* spp. n=9 | *Proteus* spp. n=8 | *Escherichia coli* n=6 | *Enterobacter* spp.n=5 |
| Amikacin  | 39 (90.7) | 11(91.7) | 9 (100) | 8 (100) | 6 (100) | 4 (80) |
| Ceftriaxone  | - | 11(91.7) | - | 7 (87.5) | 5 (83.3) | 4 (80) |
| Cefuroxime  | - | 10 (83.3) | - | 7 (87.5) | 6 (100) | 1 (20) |
| Ceftazidime  | 41(95.3) | 10 (83.3) | 8 (88.9) | 8 (100) | 6 (100) | 4 (80) |
| Cefotaxime  | - | 9 (75) | 8 (88.9) | 8 (100) | 5 (83.3) | 3 (75) |
| Imipenem  | 38 (88.4) | 11(91.7) | 9 (100) | 8 (100) | 5 (83.3) | 4 (80) |
| Meropenem  | 41 (95.3) | - | 6 (66.7) | - | - | - |
| Ciprofloxacin  | 40 (93) | 9 ( (75) | 6 (66.7) | 6 (75) | 6 (100) | 5 (100) |
| Piperacillin-tazobactam  | 41 ( 95.3) | 12 (100) | 8 (88.9) | 8 (100) | 6 (100) | 3 (75) |
| Cefepime  | 42 (97.7) | 10 (83.3) | 8 (88.9) | 8 (100) | 5 (83.3) | 2 ( 40) |
| Gentamicin  | 32 (74.4) | 10 (83.3) | 7 (77.8) | 7 (87.5) | 4 ( 66.7)) | 1 (20) |
| Amoxillin clavulanate  | - | 8 (66.7) | - | 5( 62.5)) | 6 (100) | 2 ( 40) |
| Ampicillin  | - | 0 (0.0) | 1 (11.1) | 2 (25) | 2 (33.3) | 4 (80) |
| Trimethoprim/sulfamethazole | - | 8 (66.7) | - | 2 (25) | 3 (50) | 5 (100) |