

Original Research Article

Microbiology and antibiotic sensitivity of uncomplicated chronic suppurative otitis media at Dr. George Mukhari Academic Hospital, South Africa

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ABSTRACT

Background: The study was conducted to assess the type and frequency of isolation of different microorganisms in uncomplicated chronic suppurative otitis media (CSOM) and their antibiotic sensitivity in our institution.

Methods: A total of 88 consecutive patients with unilateral or bilateral active, chronic suppurative otitis media attending outpatient department at DGMAMH were included in the study after obtaining an informed consent. There were 55 males (62.5%) and 33 females (37.9%) with age range between 6 months and 76 years. Pus swabs were taken through the perforation site and from the promontory after ear mopping under direct vision.

Results: Children less than 5 years were more affected (23.9%) than older children 5-10 years (13.6%) and 11-15 years (11.45%). One hundred and six microorganisms were isolated from analysis of cultures obtained from 72 patients. Seven cultures were negative (5.9%), 8 specimens were contaminated (6.7%) and 1 specimen was lost (1.1%). *Pseudomonas aeruginosa* (24.0%) was the most common isolate, followed by *Staphylococcus aureus* (17%) and *Proteus mirabilis* (10%). Drug sensitivity pattern showed that Piperacillin-tazobactam was effective against the majority of *Pseudomonas aeruginosa* isolates at 72%, followed by both Gentamicin and Ceftazidime at 64% and Ciprofloxacin at 48%. *Staphylococcus aureus* isolates were sensitive to Erythromycin (77%), Cloxacillin and Clindamycin at 72%. *Proteus mirabilis* was sensitive to Cefuroxime (91%), Co-amoxiclav (72.8%).

Conclusions: Isolation rate and susceptibility patterns in CSOM, suggest a need for regular surveillance to monitor antimicrobial resistance and to guide antibacterial therapy.

Keywords: Chronic suppurative otitis media, Microbiological profile, Sensitivity profile

INTRODUCTION

Chronic suppurative otitis media (CSOM) is a disease frequently encountered by the Otorhinolaryngologist. The World Health Organization defines CSOM as chronic inflammation of the middle ear and mastoid air cells characterized by a perforated tympanic membrane and otorrhea for a period of more than two weeks.¹ It is a disease of multiple aetiologies and known for its recurrence and persistence despite adequate treatment at

the primary healthcare level. Its importance lies in its consequences on hearing impairment, chronicity, local and central sequelae. It affects different cultural and racial groups in both developing and industrialized countries.² Epidemiological studies have reported a high incidence of the disease in children belonging to lower socioeconomic groups.³ The active form of the disease persists into adulthood in a very small percentage of the affected population.⁴

The aetiology of CSOM is multifactorial and a number of risk factors are known to predispose children to the disease. In any patient, more than one risk factor may be involved; these include:

Anatomical factors²

Congenital cranio-facial abnormalities. Developmental abnormalities.

Physiological factors^{6,7}

Congenital or functional ciliary dyskinesia, immune dysfunctions and male gender.

Poor socio-economic circumstances

Overcrowding, poor hygiene, allergy, poor nutrition.² Lack of breastfeeding.⁶ Exposure to smoke from parental smoking and indoor cooking using wood and coal.⁸

Pathological factors

Recurrent viral upper respiratory tract infection, chronic adenoidal hypertrophy and chronic laryngo-pharyngeal reflux.

Early age of the first episode of CSOM, before six months of age, is associated with an increased rate of recurrence.⁶ Children are at risk of developing CSOM due to the anatomical nature of their Eustachian tubes which are short and horizontal. In addition, children have an immature immune system which renders them vulnerable to infection.² In some communities there is a significant increase in adults presenting with CSOM. Factors that contribute towards the occurrence of CSOM in adulthood include.³

Some individuals tend to live with the disease and tolerate its discomfort, immunosuppression, extreme poverty with poor hygiene and nutritional challenges and in geographic areas with inaccessible, insufficient and poorly equipped health care facilities.

The aerobic pathogens frequently isolated in CSOM are *Pseudomonas aeruginosa* and *Staphylococcus aureus*, which are normal commensals of the external ear canal.^{2,9} They colonize the middle ear through a perforated tympanic membrane and participate in middle ear infection as opportunists. Anaerobes are involved to a lesser extent; often isolated anaerobes are *Peptostreptococcus* and *Bacteroides* species.⁹ These are normal commensals of the nasopharynx, which colonize the middle ear through a dysfunctional Eustachian tube and participate in a symbiotic relationship with the aerobes in causing middle ear infection and CSOM.^{2,9}

Once the disease is established, it is difficult to eradicate. It is characterized by recurrence and persistence with occasional progression into adulthood. The presence of

persistent disease may lead to the development of complications which range from minor problems, such as a persistent otorrhoea, to potentially life-threatening complications. Major complications of CSOM are grouped into extra-temporal intracranial and intra-temporal extracranial.¹⁰ The intra-temporal extracranial complications are those that are localized in the ear and include hearing loss, mastoiditis and facial nerve paralysis.¹¹ The extra-temporal intracranial complications include, meningitis, brain abscess and lateral sinus thrombosis.¹² There is an increased risk of morbidity and mortality associated with major complications, therefore, the prevention and early effective treatment of CSOM has great relevance.

There are a high number of patients with chronic discharging ears who present at the Otorhinolaryngology out-patient department at Dr George Mukhari Academic Hospital (DGMAH). DGMAH is a large tertiary care Centre in the Gauteng Province of South Africa servicing largely the low socio-economic populations of Gauteng and North West Provinces of South Africa. Data obtained from the Otorhinolaryngology outpatient register showed that an estimated number of eight thousand patients, with a variety of different ailments, visited our outpatient department in 2011. The population demographic in Otorhinolaryngology department was estimated to be 99% Africans with the other racial groups contributing 1%.

The preferred choice of topical antibiotic treatment for CSOM varies between centers due to regional differences in the bacteriology and antimicrobial sensitivity profiles. At DGMAH, CSOM is treated by aural toilet in the form of ear mopping, topical acetic acid 2% ear drops and topical administration of broad-spectrum antibiotic, namely Ciprofloxacin. The treatment is given empirically while waiting for a laboratory bacteriology report on an ear swab specimen. Treatment is then adjusted or maintained according to the culture and sensitivity outcome. There is no previous study on the microbiological profile and antimicrobial sensitivity patterns in patients presenting with CSOM at DGMAH. Therefore, the decision to embark on this study was to determine the bacteriological findings and the antimicrobial sensitivity at this institution and to suggest appropriate antibiotics for initial empirical treatment.

Aim

The aim of this study was to determine the microbiological profile of chronic suppurative otitis media and antimicrobial sensitivity patterns at DGMAH.

Objectives

The objective of the study was to document the antibiotic susceptibility profile of the isolated microorganisms, determine the prevalence of CSOM between the

adult and pediatric population at DGMAH, compare microorganisms isolated from adult and pediatric patients and compare the gender distribution of patients with respect to the incidence of CSOM.

METHODS

Ethics

The study was approved by SMU Research and Ethics Committee (SMUREC), and the DGMAH senior management team.

Study design

A prospectively guided and descriptive study was carried out at DGMAH Otorhinolaryngology out-patients department from November 2011 through to September 2012. Consecutive patients from all age groups and all genders with either unilateral or bilateral CSOM were identified after history taking and examination. In this study patients between the ages of 6 months to 13 years were classified as children and those 14 years and older, as adults.¹ The purpose of the study was explained to the patients.

Eighty-eight patients agreed to participate in the study and were asked to sign an informed consent form. Parents or guardians signed on behalf of minors (17 years and below). Under direct vision with a head lamp, ear canals were thoroughly cleaned by ear mopping until the perforation was visualized. Ear swabs were carefully collected using sterile swab sticks which were transported in a Stuart transport media to the National Health Laboratory Service (NHLS) which is 5 minutes' walk from the hospital building, within 4 hours of collection. The specimens were taken to the NHLS by the researcher. The specimens were received and registered at the central receiving area. After registration, the specimens and the request forms were sent to the Microbiology division by a messenger.

In the Microbiology laboratory, samples of ear discharge were plated for bacterial and fungal microorganisms in accordance with the NHLS standard operating procedures. Gram stains were done on all the slides using the following crystal violet, Lugol's iodine, iodine-acetone and dilute carbol fuchsin.

After staining, the slides were examined under light microscopy, for the presence of pus cells and bacteria. The process takes thirty minutes. Specimens are then incubated and cultured aerobically and for fungal infections at 37°C for 18-24 hours on the following culture media:

Blood agar (gram positive and gram-negative aerobes), chocolate agar (gram-positive and negative aerobes), colistin sulphate-nalidixic agar (gram-positive aerobes only), MacConkey agar (gram-positive aerobes only) and sabouraud dextrose agar (for fungal infection).

Isolates were purified and identified using standard microbiology methods. Antibiotic susceptibility tests were carried out using disc diffusion methods.

Inclusion criteria

The inclusion criteria were all patients with otorrhea for more than two weeks through a perforated tympanic membrane. Children whose parents (or legal guardians) have accepted and signed an informed consent. Adults who have signed an informed consent.

Exclusion criteria

The exclusion criteria included the following patients with cholesteatoma. Facial nerve palsy. Tumours of the ears. Patients who declined to participate in the study.

Data analysis

Data generated from the study was analyzed by descriptive statistics to determine rates, means and standard deviation, as well as appropriations. Standard statistical methods were used. Statistical significance of a two-tailed significance test was established if p-value was <0.05. The following software applications were used for data manipulations and statistical analysis:

Microsoft office excel 2007 spreadsheet for data analysis, summary of statistics and comparison of sample mean. Chi Square test to compare the results of microbiological culture and susceptibility testing. Microsoft Word 2007 for final documentation.

Study bias

No form of bias was evident in the study. The areas that could have introduced bias, such as patient selection and adherence to the methodology were closely guarded. All the participants who signed the informed consent form were included in the study irrespective of the severity of the ear discharge.

RESULTS

Population demographics

During the review period, a total of 88 patients with CSOM were identified. The ages of the patients ranged from 6 months to 76 years with a median age of 15 years. Table 1 illustrate the age and gender distributions of the patients. More than a third (40.9%) of the patients were aged 30 years and above, this was followed by infants of less than 5 years old who made up 23.9% of the population. The rest of the patients in the series were distributed between the ages of 5 and 30 years (Table 1).

Table 1: Age distribution of patients with chronic suppurative otitis media.

Variables	Number	Percentage
Age distribution (in years)		
<5	21	23.9
5-10	12	13.6
11-15	10	11.4
16-20	3	3.4
21-25	2	2.3
26-30	4	4.5
≥30	36	40.9
Age range: 0-76 years		
Median age: 15 years		
Paediatric patients	41	46.6
Adult patients	47	53.4

Table 2: Summary of cultured pus swabs.

Organisms	Total cases	Percentage
Pure culture	77	64.7
Mixed culture	27	22.7
No growth	7	5.9
Contaminated specimen	8	6.7
Total	119	100

Pediatric cases (i.e., from 6 months to 13 years of age) contributed 41 out of the 88 cases (46.6%) and the rest were made up of 47 adults (53.4%).

Table 3: Incidence of isolated microorganisms.

Micro-organisms	Primary isolates	Secondary isolates	Tertiary isolates	No. of isolates	Incidence (%)
<i>P. aeruginosa</i>	23	2	-	25	24
<i>S. aureus</i>	16	1	1	18	17
<i>P. mirabilis</i>	10	-	1	11	10
<i>H. influenzae</i>	6	3	-	9	8.5
CONS	3	4	-	7	7
<i>E. faecalis</i>	4	2	-	6	6
<i>S. anginosus</i>	2	-	-	2	1.9
<i>S. pneumoniae</i>	2	-	-	2	1.9
<i>Micrococcus spp</i>	1	-	-	1	0.9
<i>A. baumannii</i>	1	1	-	2	1.9
<i>E. cloacae</i>	1	-	-	1	0.9
<i>E. raffinosus</i>	1	-	-	1	0.9
<i>K. pneumoniae</i>	1	-	-	1	0.9
MRSA	1	-	-	1	0.9
<i>M. morgani</i>	1	1	-	2	1.9
Group C β-haemolytic Streptococcus	1	-	-	1	0.9
Group D β-haemolytic Streptococcus	1	-	-	1	0.9
<i>S. pyogenes</i>	1	1	-	2	1.9
<i>H. parainfluenzae</i>	-	1	-	1	0.9
<i>K. oxytoca</i>	-	1	-	1	0.9
<i>S. agalactae</i>	-	1	-	1	0.9
Group A β-haemolytic Streptococcus	-	1	-	1	0.9
<i>C. freundii</i>	-	1	-	1	0.9
<i>E. faecium</i>	-	1	-	1	0.9
<i>E. coli</i>	-	1	-	1	0.9
<i>Streptococcus spp</i>	-	1	-	1	0.9
<i>P. stutzeri</i>	-	1	-	1	0.9
Yeast isolate	1	-	-	1	0.9
<i>A. niger</i>	-	1	-	1	0.9
Total number of isolates	77	27	2	106	100

CoNS = Coagulase negative staphylococcus, *S. pyogenes* = *Streptococcus pyogenes*, *Morganella morgani* = *M. Morgani*, *Acinetobacter baumannii* = *A. Baumannii*, *Streptococcus anginosus* = *S.anginosus*, *P. stutzeri* = *Pseudomonas stutzeri*, *A. niger* = *Aspergillus niger*, *K. Oxytoca* = *klebsiella oxytoca*, *C. freundii* = *Citrobacter freundii*, **MRSA** = **Methicillin-resistant Staphylococcus aureus**.

The microbiological profile

The microbiological results showed that seven samples yielded no growth (5.9%), one sample was lost (1,1%) and eight samples were regarded as contaminated because the pus cells were not identified (6,7%) and were excluded from the study. A total of seventy-two patients were included in the analysis. Table 2 summarizes cultured pus swabs.

Table 4: Comparison of microbiological isolates common to both pediatric and adult patients.

Microorganisms	Adults N (%)	Paediatrics N (%)	P value
<i>P. aeruginosa</i>	17 (36.0)	8 (19.5)	0.26*
<i>S. aureus</i>	9 (19.1)	9 (21.9)	0.81*
<i>P. mirabilis</i>	8 (17)	3 (7.3)	0.46
CONS	5 (10.6)	2 (4.8)	0.43*
<i>E. faecalis</i>	4 (8.5)	2 (4.8)	0.59*
<i>S. anginosus</i>	1(2.1)	1 (2.4)	0.51*
<i>S. pneumoniae</i>	1 (2.1)	1 (2.4)	0.51*

* = Not statistically significant.

Table 5: Microorganisms isolated in pediatric patients only.

Microorganism isolated	No. of patients (%)
<i>H. influenzae</i>	9 (21.9)
<i>E. cloacae</i>	1 (2.7)
<i>Micrococcus spp</i>	1 (2.7)
<i>M. morgani</i>	1 (2.7)
<i>H. parainfluenzae</i>	1 (2.7)

Table 6: Microorganisms isolated in adults' patients only.

Microorganism isolated	No. of patients (%)
MRSA	1 (2.4)
<i>E. raffinosus</i>	1 (2.4)
Group C β-haemolytic Streptococcus	1 (2.4)
Group D β-haemolytic Streptococcus	1 (2.4)
<i>A. baumannii</i>	1 (2.4)
<i>S. pyogenes</i>	1 (2.4)
<i>K. pneumoniae</i>	1 (2.4)
<i>S. anginosus</i>	1 (2.4)

Sensitivity profile

For the variety of organisms isolated from the samples of these patients, a total of seventeen different antibiotics were used for the sensitivity tests. Sensitivity profile of the eight common microorganisms isolated demonstrated that *P. aeruginosa* was sensitive to Piperacillin-tazobactam (72%), followed by Gentamicin and Ceftazidime at 64% and Ciprofloxacin at 48%. *S. aureus* was sensitive to Erythromycin (77%), Cloxacillin and Clindamycin at 72%, followed by Gentamicin and Penicillin at 64%. *P. mirabilis* was sensitive to Cefuroxime (91%), Co-amoxiclav (72.8%), and Gentamicin and Penicillin at 64%. *H. influenzae*, *E. faecalis*, *S. anginosus* and *S. pneumoniae* were all 100% sensitive to Penicillin and Ampicillin. Table 7 illustrates the sensitivity profile of isolated microorganisms.

Table 7: Microbiological profile and antibiotic sensitivity.

Drugs	<i>P. aeruginosa</i> n=25 (%)	<i>S. aureus</i> n= 18(%)	<i>P. mirabilis</i> n= 10(%)	<i>H. influenzae</i> n= 9 (%)	CONS n=7(%)	<i>E. faecalis</i> n=6 (%)	<i>S. anginosus</i> n=2 (%)	<i>S. pneumoniae</i> n=2 (%)
Gentamicin	16 (64)	-	7 (64)	-	-	-	-	-
Ciprofloxacin	12 (48)	-	1 (9.1)	-	3 (43)	-	-	-
Amikacin	5 (20)	-	1 (9.1)	-	-	-	-	-
Ceftazidime	16 (64)	-	-	-	-	-	-	-
Piperacillin-tazobactam	18 (72)	-	1 (9.1)	-	-	-	-	-
Cloxacillin	-	13 (72)	-	-	5 (71)	-	-	-
Erythromycin	-	14 (77)	-	-	-	-	1 (50)	-
Clindamycin	-	13 (72)	-	-	-	-	1 (50)	-
Vancomycin	-	3 (16)	-	-	-	-	-	-
Trimethoprim-sulfamethoxazole	-	2 (11)	1 (9.1)	2 (22.2)	1 (14.2)	-	-	-
Penicillin/Ampicillin	-	2 (11)	7 (64)	9 (100)	3 (43)	6 (100)	2 (100)	2 (100)
Azithromycin	-	2 (11)	-	-	-	-	-	-

Continued.

Drugs	<i>P. aeruginosa</i> n=25 (%)	<i>S. aureus</i> n=18 (%)	<i>P. mirabilis</i> n=10 (%)	<i>H. influenzae</i> n=9 (%)	CONS n=7 (%)	<i>E. faecalis</i> n=6 (%)	<i>S. anginosus</i> n=2 (%)	<i>S. pneumoniae</i> n=2 (%)
Cefuroxime	-	-	10 (91)	7 (78)	-	-	-	-
Co-amoxiclav	-	-	8 (72.8)	-	-	-	-	-
Cefazolin	-	-	1 (9.1)	-	-	-	-	-
Chloramphenicol	-	-	-	2 (22.2)	-	-	-	-
Tetracycline	-	-	-	1 (11)	1 (14)	-	-	-

(-) = no sensitivity.

DISCUSSION

CSOM is a common ear disease characterized by chronic inflammation of the middle ear, mastoid cavity and persistent otorrhea through a perforated tympanic membrane for a period of two weeks or more.¹ The absence of a tympanic membrane facilitates entry of bacteria into the middle ear and subsequently results in ear discharge. It is prevalent in lower socio-economic groups, and is encountered frequently in patients who present at the Otorhinolaryngology out-patient department at DGMAH. Once the disease is established, it is difficult to treat. Medical treatment needs to be continued for months, and even when the perforation is dry, patients are at risk of further episodes of otorrhea until the tympanic membrane perforation has healed.³

The reasons for the difficulty in treating the disease are multifactorial, and include inadequate treatment, poor patient compliance, bacterial resistance to antimicrobials and invasion by secondary pathogens.³ Untreated CSOM result in a wide range of complications ranging from extracranial, such as hearing loss and mastoid abscess to intracranial extension such as meningitis, epidural, subdural and intracerebral abscess.⁵

Treatment should be instituted early and effectively to avoid complications, that should be kept in mind when dealing with a patient with active disease. There is no consensus about the treatment of CSOM, however, there is a common understanding that aural toilet (ear mopping or suctioning) combined with instillation of topical antibiotics and antiseptics gives a satisfactory clinical outcome in terms of achieving a dry ear.^{20,21,35}

The therapeutic use of antibiotics is usually started empirically prior to obtaining results of microbiological culture. Selection of any antibiotic is influenced by its sensitivity to common organisms in a particular population, resistance of bacteria, efficacy, safety, risk of toxicity and cost. At DGMAH, CSOM is empirically treated with aural toilet combined with administration of topical ciprofloxacin and 2% acetic acid drops. At present there is no departmental protocol at DGMAH on the treatment of CSOM; hence the decision was taken to embark on this study.

In the DGMAH study, CSOM was found to be more prevalent in children and young adults (49.4%), and a second peak was found in patients aged 30 years and above (40.9%). Children less than 5 years were more affected (23.9%) than older children 5-10 years (13.6%) and 11-15 years (11.4%).

These findings are similar to the studies performed in Nigeria and Nepal which also found a high prevalence in children and young adults as compared to patients over the age of 30 years.^{3,6} In addition, two of the studies done in Nigeria, by Adoga et al, Lasisi et al, demonstrated similar age range and socio-economic demographics as the population seen at DGMAH.^{3,38} Whereas the Nepalese study was only similar to DGMAH study in terms of age range but no mention was made of the socioeconomic status of the sample population in the Nepalese study.⁷ There are several possible reasons that could explain the high incidence of CSOM in children and young adults, such as the short and floppy anatomical nature of the children's Eustachian tubes as well as their immature immune system and environmental factors such as overcrowding and passive smoking.² However, the findings at DGMAH differ from those in a Singapore study, on a predominantly adult population, which found a low prevalence in children and young adult groups, and high prevalence in the age groups above 30 years.⁸

More males (62.5%) than females (37.5%) were affected at DGMAH. The findings are similar to studies done by Iqbal et al who found more males (62%) affected than females (37.9%) and Lasisi et al had more males (59%) than females (41%) in their study.^{9,38} The findings at DGMAH differ from studies done by Shrestha et al who found that females out-numbered the males.⁷ The reason for this difference may be influenced by sample sizes. All these three studies had larger sample sizes of more than 150 patients as opposed to a sample of 88 patients in the DGMAH study. There are no studies which suggested gender as a risk factor to CSOM and therefore the differences in sex distribution could have resulted from a random event.

The proportion and frequency of micro-organisms isolated differs from one study to another. In the DGMAH study, 77 primary (pure culture), 27 secondary and 2 tertiary isolates were identified (Table 3). The most

common isolated micro-organisms in the DGMAH study were *P. aeruginosa* (24%), *S. aureus* (17%), *P. mirabilis* (10%) and *H. influenzae* (8.5%). Table 9 illustrates and compares findings from other studies with the DGMAH study. It can be concluded from the tabulation that the most commonly isolated microorganisms in CSOM are *P. aeruginosa*, *S. aureus* and *P. mirabilis*.

Seven specimens (5.9%) in the DGMAH study failed to show bacterial growth after 48 hours of incubation. The incidence of no bacterial growth in the DGMAH study was higher than in the Singapore study (2.2%) but lower

than in the Nigerian study (17%).^{8,18} The 3 studies however fall within the acceptable value of less than 30% of uncultured bacteria. In 2 of these 7 specimens, inflammatory cells were identified. The possibilities of unculturable bacteria in the presence of inflammatory cells are multifactorial. These factors include the insufficient quantity of the specimen to be analyzed. The duration taken between collection time and the actual specimen processing time (the longer this duration, the higher the chances of bacterial death). Technical errors during handling and processing. The role of bacterial biofilms.

Table 8: Comparison of the microbiological isolates from different studies in percentages.

Micro-organisms	DGMAH (RSA)	Mansoor et al ⁴⁰ (Pakistan)	Loy et al ⁸ (Singapore)	Wariso et al ⁶ (Nigeria)	Shrestha et al ⁷ (Nepal)	Lodhi et al ³⁹ (Pakistan)	Stolp et al ³⁴ (RSA)	Constable and Butler ³¹ (England)
<i>P. aeruginosa</i>	24	40	33.3	40.9	26.9	28.8	100	10.2
<i>S. aureus</i>	17	30.9	33.3	21.7	32.2	50	6.6	19.9
<i>P. mirabilis</i>	10	11.6	2.2	21.7	6.9	10	6.6	17.8
<i>H. influenzae</i>	8.5	-	-	-	-	-	6.6	2.0
CONS	7	-	21.1	-	-	-	-	-
<i>E. faecalis</i>	6	-	-	-	-	-	6.6	-
<i>S. anginosus</i>	1.9	1.8	3.3	0.9	-	-	-	-
<i>S. pneumoniae</i>	1.9	-	-	-	6.1	-	6.6	-

(-) = not cultured.

Table 9: Comparison of the microbiological findings in children’s studies in percentages.

Micro-organisms	DGMAH (RSA)	Van Hasselt et al ³⁵ (Malawi)	Ferede et al ²⁷ (Ethiopia)	Bello et al ¹⁸ (Nigeria)
<i>P. aeruginosa</i>	19.5	44	6	4.1
<i>S. aureus</i>	21.9	7	17.6	28.7
<i>P. mirabilis</i>	7.3	74	30.8	22.1
<i>H. influenzae</i>	21.9	0.8	-	-
CoNS	4.8	-	-	-
<i>E. faecalis</i>	4.8	-	-	-
<i>S. anginosus</i>	2.4	-	-	-
<i>S. pneumoniae</i>	2.4	3	1.3	6.9

(-) = not cultured.

Table 10: Comparisons of microbiological isolates in the adult studies in percentages.

Micro-organisms	DGMAH (RSA)	Gul et al ¹⁶ (Pakistan)	Loy et al ⁸ (Singapore)
<i>P. aeruginosa</i>	36.0	62	33.3
<i>S. aureus</i>	19.1	18.7	33.3
<i>P. mirabilis</i>	17	9.0	2.2
CONS	10.6	-	21.1
<i>E. faecalis</i>	8.5	-	-
<i>S. anginosus</i>	2.1	-	-
<i>S. pneumoniae</i>	2.1	-	-

(-) = not culture.

Different studies demonstrated different variations of sensitivity profile to the three most commonly isolated CSOM microorganisms, *P. aeruginosa*, *S. aureus* and *P. mirabilis*. The microbiological cultures often show many and mixed cultures and these vary according to climate, patient population and improper use of antibiotics⁷. The DGMAH study is in agreement with the study done by Lee *et al*¹³ on sensitivity profile of *P. aeruginosa* to Piperacillin-tazobactam (82%), Ceftazidime (90.8%) and Ciprofloxacin (41.5%). Otopical Ciprofloxacin has been utilized as first-line therapy at DGMAH for many years. The prolonged exposure to this drug may have contributed to substantially low susceptibility against *P. aeruginosa*.

This may explain the low sensitivity of *P. aeruginosa* to Ciprofloxacin (48%) in this study. Since Piperacillin-tazobactam and Ceftazidime are less frequently prescribed to our patients and only prescribed for hospitalized patients with complicated CSOM, their susceptibility is high in this study because of low patients' exposure to these drugs. The general conclusions in most studies agree with the DGMAH study that most *P. aeruginosa* isolates are still sensitive to Gentamicin.^{6,8} Gentamicin eardrops thus appear to be an effective first-line topical antibiotic in the treatment of active CSOM. There remains, however, a controversy over the question of ototoxicity with the topical usage of Aminoglycosides, such as Gentamicin. This sentiment was also shared by Bluestone, who discouraged the use of Aminoglycosides in non-intact tympanic membranes.¹¹ While the systemic usage of Aminoglycosides has been known to have a serious effect on the inner ear, the effect of topical Aminoglycosides is however less clear.^{8,34} In contrast some studies showed that *P. aeruginosa* is progressively acquiring resistance against both Gentamicin and Ciprofloxacin.^{18,24} In the DGMAH study, only one *P. aeruginosa* which was isolated as a mixed culture, was resistant to Ciprofloxacin. Out of the four drugs that were effective against *P. aeruginosa* in this study, only Gentamicin and Ciprofloxacin are available in otopical forms. The controversial effect of Gentamicin makes it less favorable in our setting and most studies^{8,34}. The other two drugs, Piperacillin-tazobactam and Ceftazidime are available in intravenous preparations only. The use of these drugs therefore implies prolonged hospitalization. Though Ciprofloxacin is less sensitive to *P. aeruginosa* as compared to Gentamicin in this study, its proven lack of ototoxicity and its high anti-pseudomonas activity, makes it a drug of choice in our setting.²⁴⁻²⁶

In the DGMAH study, *S. aureus* was sensitive to Erythromycin (77%) followed by Clindamycin and Cloxacillin at 72% and resistant to penicillin (98%). A study done in Iraq, agrees with the DGMAH study in terms of incidence of *S. aureus* sensitivity to Erythromycin (80%) but differs in Clindamycin (22.8%) incidence.²⁹ This Iraqi study did not feature Cloxacillin in their antibiotic profile against *S. aureus*. The findings of

Penicillin resistance against *S. aureus* were both more than 60% in the Iraqi (66%) and DGMAH (98%) studies.

The finding of *P. mirabilis* in the DGMAH study demonstrated its sensitivity to Cefuroxime (91%), Co-amoxiclav (72.8%) and to both Gentamicin (64%) and Penicillin (64%). Wariso *et al* agrees with the DGMAH study in terms of sensitivity to Gentamicin (65%) and Cefuroxime (91%) but differs in terms of Penicillin for which he found very low sensitivity of 20%.⁶ Lodhi *et al* found sensitivity to Gentamicin to be low at 7.6%.³⁹ None of the two studies demonstrated Co-amoxiclav sensitivity or resistance. In Iraq, it was found that Co-amoxiclav and Gentamicin had equal sensitivity (60%) against *P. mirabilis* and 75% resistance was demonstrated by Penicillin against the same organism.²⁹

The presence of *CoNS* may represent skin flora contamination and not a true pathogen. This was supported by isolation of this organism by limited studies and failure of others to culture it^{6,8,34,40}. In this study *CoNS* demonstrated sensitivity to Cloxacillin (71%) and to both Ciprofloxacin and Penicillin (43%). This DGMAH study agrees with Loy *et al*⁸, who found sensitivity of *CoNS* to Cloxacillin to be 72%.

Nine isolates of *H. influenzae* (all of which were 100% sensitive to Penicillin) were found in children, 6 of them as pure while 3 as mixed cultures in the DGMAH study. Since *H. influenzae* is an Acute Otitis Media (AOM) pathogen, this finding suggests that these children were probably experiencing bouts of Recurrent AOM with perforation, which is defined as 3 episodes of AOM in 6 months or 4 to 5 attacks in twelve months.¹⁴ This support the suggestion by Gul *et al* that, it is difficult sometimes in children to differentiate between Recurrent AOM from CSOM.¹⁶ The low incidence of *Streptococcus spp* (3.8%) in the DGMAH study support the findings that these pathogens are not as important in CSOM as in AOM.^{6,34}

CONCLUSION

P. aeruginosa, *S. aureus* and *P. mirabilis* were the potentially important causative pathogens found in patients presenting with CSOM at DGMAH.

Ciprofloxacin was found to be less effective against *P. aeruginosa* as compared to Gentamicin. However, due to the potential ototoxic effect of Gentamicin it is not recommended either in systemic or topical form.

The choice of drug is often influenced by its availability, safety and efficacy. Ciprofloxacin is still recommended in our setting since it is readily available and its safety has been proven by several studies. Sensitivity rate of forty eight percent at DGMAH suggest that the drug is still effective against *P. aeruginosa* to some extent. In the event of persistent otorrhoea despite topical use of Ciprofloxacin drops in patients in whom *P. aeruginosa* was cultured, it is therefore justified to give intravenous

anti-pseudomonas antibiotic for 7-14 days depending on the clinical response.

Since cloxacillin and penicillin/ampicillin are effective against *S. aureus* and *P. mirabilis* respectively in our setting, the use of a combination drug Ampiclox (ampicillin-cloxacillin) is justified to cover the two organisms. Ampiclox comes in both oral (tablets and suspension) and intravenous forms. It exhibits bactericidal activity against Gram-positive and Gram-negative organisms and is well absorbed orally. Ampiclox is much cheaper and accessible in our setting. The ampicillin in this combination drug will also cover for insignificant isolates most of which were sensitive to it.

Recommendations

Initial antibiotic therapy, prior to obtaining culture and sensitivity results, should include antibiotics that will cover the three most commonly cultured microorganism's topical ciprofloxacin drops for *P. aeruginosa*. Oral combination of ampicillin and cloxacillin (Ampiclox) for *S. aureus* and *P. mirabilis*. In addition to these antibiotics, combined frequent ear mopping and the use of topical antiseptics 2% acetic acid ear drops) are recommended.

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