BACTERIAL PATHOGENS AND THEIR DRUG SUSCEPTIBILITY PATTERN IN CHILDREN WITH AEROBIC CHRONIC SUPPURATIVE OTITIS MEDIA IN ADDIS ABABA

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ABSTRACT

In Ethiopia, as most developing countries there is little information on chronic suppurative otitis media. Thus, this study was conducted to establish the causative micro-organisms in chronic suppurative otitis media among children aged 0-12 years and to determine antibiotic treatment based on the information of antimicrobial sensitivity pattern of the isolates. A structured questionnaire designed for the purposes of this study was used to collect information from patients as well as parents. A total of 112 (63 males, 49 females) patients consisting 25% of those seen at the ear, nose and throat (ENT)clinic of the Ethio-Swedish Children's Hospital with problem of chronic suppurative otitis media were studied. Most of them (83%) were from Addis Ababa. Their age range was from 3 months to 12 years, 38.4% of them below 2 years of age. Bacterial pathogens were isolated from ear discharge of 120/132 (90.1%) swabs with chronic suppurative otitis media, while the remaining 12/132 (9.9%) were sterile. Of the 159 total isolates, 106 (66.7%) were identified as single pathogens, while 53 (33.3%) were mixed isolates. The main organisms isolated in the order of frequency were *Proteus* species, *Escherichia coli*, *Staphylococcus aureus*, *Klebsiella* species, *Pseudomonas aeruginosa*, and *Staphylococcus epidermidis*. Antibiotic sensitivity test results showed that the majority of the isolates were sensitive to Gentamicin, Kanamycin and Augmentin. Most of the isolates were resistant to commonly used antibiotics including, Tetracycline, Ampicillin and Penicillin. The result of this study showed that these three drugs should be considered in treating children with chronic suppurative otitis media in our setting. A randomised controlled clinical trial of these drugs is recommended to establish their in *vivo* efficacy and effectiveness studies need to be carried out in a community settings.

INTRODUCTION

Respiratory tract is a channel that leads air to the lungs. Its functions include the exchange and filtering of air, the intake of food and liquid and their separation from the air stream entering the trachoeobronchial tree. It is also responsible for the expression of speech, and consists of the senses of taste, smell and hearing. This tube is divided into two portions called the upper respiratory tract (URT) which consists of nasopharynx, tonsils, oropharynx, epiglottis, eustachian tubes, and the middle ear, and the lower respiratory tract (LRT), which consists of trachea, bronchi, bronchioles and the alveoli.

Respiratory infections are caused along any area of the whole respiratory tract. They are divided into the upper respiratory infections and lower respiratory infections which are caused by viruses, bacteria, fungi and parasites. There can be a wide variety of signs and symptoms of these infections, which include cough, difficult breathing, sore throat, running nose and ear problems.

Acquired respiratory infections are the most common illnesses for which people seek medical advice. Indeed in developing countries, every 7 seconds a child under five years of age dies of respiratory infections (WHO,1995). Most of the respiratory pathogens are able to cause diseases both in the upper and lower respiratory tract. They comprise 11-17 percent medical admissions to general hospitals in Ethiopia (Molineaux etal.,1965; Lester and Edemariam Tsega,1976). Diarrhoea, acute respiratory infections and protein energy malnutrition are considered to be the three leading killing diseases during early childhood (WHO, 1994).

Ear Nose and Throat problems (ENT) are highly prevalent in developing countries. Backwardness in socio-economic and technological development, plus, ethnic background and geographical environment of these communities are the main factors responsible for the epidemiology and presentation of ENT illnesses in the developing world (Editorial, 1990).

One of the (ENT) infections is a Chronic suppurative otitis media resulting from inadequate treatment and other additional factors carried over from acute otitis media. CSOM, a chronic inflammatory process, is slow and very often destructive with sometimes irreversible sequelae . It is a major health problem in the developing countries. As a result, considerable time and energy are expended in the management of these cases in many hospitals.

In Ethiopia, as most African countries, there is little information on otitis media. Thus, this present study was undertaken to assess the prevalence of the aerobic bacterial agents in chronic suppurative otitis media among children 3-144 months of age and to determine the status of suitable antibiotic treatment regimens based on the information of antimicrobial sensitivity pattern of the dominant bacterial isolates. In addition to the above major objectives, the specific objectives of this study have been designed to include such that, the data can be used

a. to help in drafting drug policy
- to produce systems for empcrical drug therapy, and thus,
- to help for the management of CSOM.

LITERATURE REVIEW

There is only scanty information on otitis media in the developing nations. In fact, chronic otitis media still poses a great problem in these countries. Thus, various complications such as facial disfigurement, loss of verbal intelligence, meningitis, brain abscess and even death still occur in spite of antibiotic therapy (Marchant, 1984).

Depending on symptoms, the character of middle ear fluid, the appearance of the typmpanic membrane, and the duration of the symptoms, otitis media is divided into acute otitis media, (AOM), secretory otitis media (SOM), and chronic otitis media (COM)(Lankinen, *etal.*,1994). Common cold or other viral respiratory tract infections often precede an acute middle ear infection (Fig 1). AOM can also be considered as a bacterial complication of viral disease

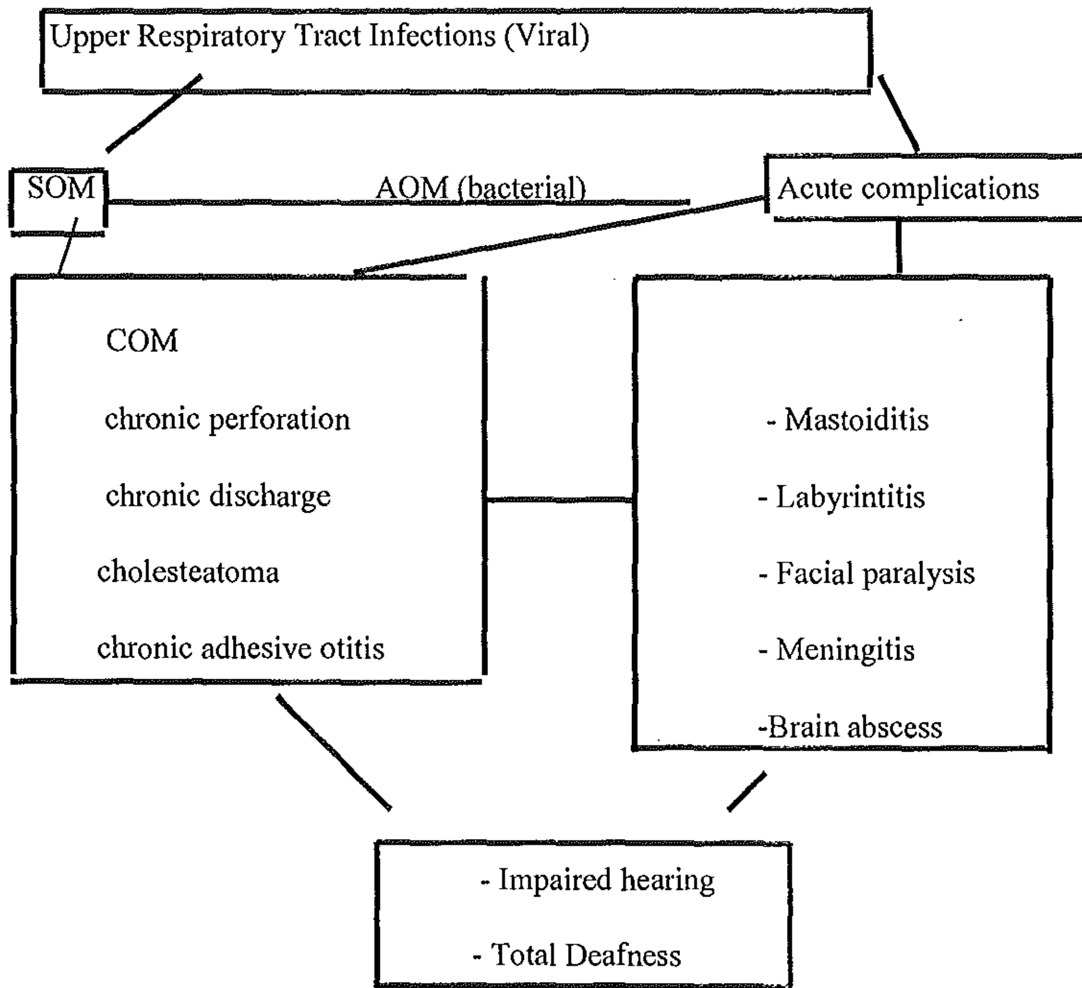

Figure 1. The relationship between upper respiratory infection (URI), AOM, SOM, and COM, and their complications.(Health and disease in developing countries by Lankinen,et.al,1994).

Acute Otitis Media (AOM)

Viral respiratory tract infections is the most common predisposing factor to AOM. The hallmark of middle ear infection are pains, purulent otorrhoea, hearing loss, vertigo, fever etc. Otoscopic examination will confirm the diagnosis of AOM, by demonstrating a red, dull and bulging or perforated tympanic membrane (Petersdorf et al.,1986). If the ear drum can not been seen, but the patient has purulent discharge from the ear, pain and fever, always AOM is considered. If there is only discharge for sometime but no pain chronic suppurative otitis media is a possible diagnosis. Acute otitis media is one of the common infections in children. It is also the common reasons for a pediatric sick visit and may take up to one third of the visits a pediatrician devotes to ill children (Howie, and Schwartz, 1983).

According to a study done in Colombia (Trujillo, etal.,1989), bacterial pathogens were isolated from ear swabs in 82 of 111 children. Among these isolates, *Haemophilus influenzae* accounted in 36% of the cases, and *Streptococcus pneumoniae* in 22%. Other isolates included *S. aureus* (3%), *Enterobacter* (1%), *Streptococcus* pyogens (1%), Gram negative enteric (3%). Bacteriological analyses of the middle ear effusion from children with AOM in the United States , European and Japan(Fugita,etal.,1983) have revealed *that Streptococcus pneumoniae*, *Haemophilus influenzae*, and Group A *Streptococcus* are the most commonly isolated organisms, this is also found true in some developing countries.

Streptococcus pneumoniae:- is aGam-positive ,non-motile lanceolate shaped diplococcus with a polysacharide capsule . It was first isolated in sputum by Louis

Pasteur in 1888 in france and G.M Sterbern in the U.S.A .It is a member of the normal or pharyngeal flora of most people , and an important human pathogen.

Pathogenesis: It has, for more than hundred years, been known as the most common cause of pneumonia. At the beginning of the twentieth century its fatality rate was approximately 30%.It also causes about 50% community acquired pneumonia admitted to hospitals and 20-40% of all pyogenic meningitis. It is second only to *Haemophillus influenzae* as a respiratory tract pathogen .It primarily cause diseases of the middle ear ,mastoid and the lungs.

Virulence factor: Approximately 90% of cases of bacteraemic pneumococcul pneumonia and meningitis are caused by some 23 serotypes. (Ostroft, 1999). The capsular polysaccharide is the major pneumococcal virulence factor ,which protects the pathogens from engulfement by alveolar macrophages. In addition to this ,the polysiccharide is, an antigenic allowing serotypes discrimination and the development of a plysacchride vaccine which is effective in the prevention of invasive pneumococcal diseases (Ortqvist *et al.*,1998). It produces an extra-cellular hamolysis called alpha-hemolysin which partially distructs blood cells.

Haemophilus influenzae: Haemophilus are obligate parasites which constitute part of the normal flora of the respiratory tract of humans and many animal species(Sleigh, 1990). The first recorded observation of *haemophilus* is thought to have been made by Robert Koch who described the microscopic appearance of a profusion of minute rods in pus from patients with conjuctivitis .

Haemophilus influenzae is the major pathogen in this group of organisms. It is associated with a variety of invasive infections such as meningitis ,epiglotitis ,pneumonia and localized disease of the respiratory tract such as bronchitis and otitis media(Brownn,1975).

Virulence factor: The capsule is polysaccharide in nature and represents six distinct antigenic types, designated a-f. It is an important virulence factor ,confering protection against immediate phagocytosis(Broughton,1984). The pile or fimbriae are thin hair-like substances which are used by the organism as means of attachment; and extra-cellular proteases which cleave immunoglobulin IgA, which helps *Haemophilus influenzae* strains to establish colonization.

In Sudan, from 86 ear swab cultures with acute suppurative otitis media, the following organisms were isolated in the following order of frequency. *Staphy. aureus, Klebsiella* species, and other coliforms, proteus species, *Pseudomonas aeruginosa, beta haemolytic streptococci, Streptococci pneumoniae* and *Escherichia coli.* By different methods of analysis, it has been clarified that AOM occurs when bacteria colonise the nasopharynx and gain entrance to the middle ear. Antecedence viral infections may be of importance in this process by damaging the respiratory epithelium in the eustachain tube (Ellis and Mccarthnr, 1998). AOM should be treated with antibiotics in order to get relief of the symptoms guickley and to prevent serious complications like mastoiditis or chronic otitis media. Mastoiditis is a serious complication of AOM, where the primary infection of the middle ear is spread to the surrounding bones in the mastoid process. The infection can also spread to the inner ear, meninges, and the brain. These complications are life threatening (Beharman, *et al.*, 1986).

Secretory otitis media (SOM)

Secretory otitis media (SOM) is one of the most common causes of slight hearing impairment in childhood (Lankinen *et al*., 1994). The diagnosis can only be made by otoscopy and assessment of the movement of the eardrum. Signs and symptoms of SOM are yellowish eardrum, mild conductive hearing impairment, inattentive child, but never discharge. Some of them heal spontaneously.

In the developed countries of the world from where most of the reports of the disease have come, SOM is one of the commonest causes of deafness in children of school age. As a study done in Nigeria showed, 4.9% of the total number of children in the urban areas, showed evidence of secretory otitis media, the percentage being higher in the younger age groups and decreasing to zero at the age of 11 (Okeowo,1985). In contrast, among the rural children the study reported an occurrence of SOM in 8.2% of them. There is a lack of unanimity about treatment of SOM, partly, due to lack of understanding about the etiology and pathogenesis of the disease.

Chronic Suppurtive Otitis Media

CSOM is the single most common ear disease and the most common cause of conductive deafness. It is one of the commonest conditions seen in pediatric out patient clinics in developing countries, particullarly among socio-economically disadvantaged and high risk populations (Maynard, *et al*., 1985). It is an important cause of hearing impairment in children with serious consequences for the development of language skills and school performance. CSOM continues for months or years with increasing hearing impairment, and finally can lead to life threatening infective complications.

It is one of the middle ear infections, which is defined as a chronic inflammation of the middle ear and the mastoid process with perforated tympanic membrane and otorrhoea persisting at least for two weeks (WHO,1995). The view that the nasopharynx is the source of bacterial infection to the middle ear through the eustachian tube was supported by studies in which the same bacteria have been cultured from the middle ear discharge and nasopharynx (Hasaballa *et al.*, 1986).

The most common bacterial species isolated are *Pseudomonas aeruginosa, Proteus* species, *Escherichia coli* and *Staphylococus aureus*, The relation between the type of organisms and the duration of the discharge in patients with CSOM has been described in Zaire (Mohoney and Oakland, 1980). They showed that *Proteus* species were the most common pathogens in patients presenting 2 months after the onset of ear discharge. From one week to 2 months *Pseudomonas aeruginosa* is prevalent where as *Staphylococcus aureus* is common in the first 7 days.

Short description of the major etiologic agents of CSOM

Escherichia coli: Strains of *Escherichia coli* and related Gram-negative coliform bacteria predominate among the aerobic commensal flora present in the gut of man and animals.

E.coli is the type species of the genus, but several other species have been described. Strains of E.coli are usually motile and some strains, especially those from extra-intestinal infections produce a polysaccharide capsule. They grew over a wide range of

temperature (15-40c). Some strains are more heat resistant than other members of Entrobacteriaceae and will servive 60c for 15 minutes or 55 °C for 60 minutes.

Pathogenesis: *E.coli* is one of the most frequent species isolate in bacteriology diagnostic laboratories as an etiologic agents of a variety of human infections. Such clinical isolates are also among those Gram-negative bacteria that are frequently resistant to a number of antimicrobal agents (Mesele Gedebou and Alebachew Tassew,1883). It is commonly implicated in infections of the urinary tract and is by far the most common cause of acute, uncomplicated urinary tract infections outside hospitals. It also causes neonatal meningitis and septicaemia as well as sepsis in operation wounds, diarrhoea and abscess in a variety of organs. It is also an indicator of faecal contamination.

Strains that cause diarrhoea fall into four groups with different pathogenic mechanisms. Enteropathogenic Esch. Coli (EPEC), Enterotoxigenic.E coli(ETEC), Enteroinvasive Esch. Coli(EIECl)and VERO cytotoxin producing Escherichia coli(VTEC).

Pseodomonas species:- The genus Pseudomonas comprises more than 200 species, mostly saprophytic, found widely in soil, water and other moist environment. *Pseudomonas aeruginosa* is the species most commonly associated with human diseases.

Pseudomonas aeruginosa is a Gram negative bacilli, strict aerobe , non lactose fermenter, non sporing, non capsulate and usually motile by virtue of one or two polar flagella, which is the major cause of nosocomial infections. A particular hazardous

hospital pathogen. Its strains are notorious for resistant to a wide variety of antibiotics and the number of antibiotics that can be used to treat *P. aeruginosa* infections is small. Resistance to these antibiotics is most likely to be encountered in hospital settings, the very setting in which *P.aeruginosa* infections are most likely to be encountered (Salyers and Whitt,1994).

Pathogenesis: *Pseudomonas aeruginosa* can infect almost any external site or organ. In hospitalised patients, Pseudomonas infections are more common, more severe and more varied. Infections are usually localised, as in catheter-related urinary tract infection, infected ulcers, bed sore or burn and in eye and ear infections.

Virulelnce factors: Most strains of *Psedomonas aeruginosa* produce two exotoxins, exotoxin A, and exo-enzyme S and a variety of cytotoxic substance including protease, phospholipase, pyocyanin etc. The importance of these virulence factors depend upon the site and nature of infections.

Genus *Staphylococcus*: The genus Staphylococcus consists of cluster forming Gran positive cocci. Sir Alexander Ogeston, a Scottish surgeon, first showed in 1880 that the organism cased a number of pyogenic diseases in human. He introduced the name Staphylococcus; which drives from the Greek staphyle (bunch of grapes) and kokks (grain or berry). The main pathogen within the genus, *Staphylococcus aureus,* is the cause of a wide range of major and minor infections in man and animals, such as boils, mastits, septicaemia, pneumonia and food poisoning.

Staphylococci, being resistant to dry conditions and high salt concentration, are well suited to their ecological niche, which is the skin surface of humans and animals. Approximately 30% of healthy people are carrier of *S. aureus* (Mimi *et al.*, 1993).

Staphylococcus aureus is a Gram positive coccus about 1 micrometer in diameter. The cocci are mainly arranged in grape like clusters; but some, especially when examined in pathological specimens , occurs as single cells or pairs of cells. The organism are non motile, non sporing,usually non capsulate and frequently pigmented(golden yellow).

The main diagnostic features *of Staph. aureus are*

1. production of an extra-celluar enzyme, coagulase, that converts fibrinogen into fibrin.
2. production of thermo-stable nuclease that break down DNA
3. production of a surface associated protein known as clumping factor or bound coagulase that react with fibrinogen.

Virulence factors: Despite the development and use of numerous antimicrobial agents Staphylococcal infection has remained an important cause of morbidity and mortality(Wesenet Teodeos and Messele Gdebou,1983) *Staphylococcus aureus* possess a large number of cell associated and extracellular factors, some of which contribute for the ability of the organisms to over come the body's defences and to invade, survive and colonize the tissues. Though the role of each individual factor is not fully understood, it is likely that they are responsible for the establishment of infection, enabling the organism to bind to connective tissue, to resist killing by the bactricidal activities of humoral factors such as complement and to over come phagocytosis. Some of the

virulence factors are:- Pepotidoglycan, Teichoic acid, clumping factors, alphalysin, betalysin, Entrotoxine, coagulase, Hyaluronidase, Staphylokinase, lipase etc.

Proteus species: Members of the genus proteus are Gram negative, are highly motile, urease positive and non-lactose fermenters. There are commonly recognized species, and all are implicated in human diseases (Lennette *et al.*, 1985). Proteus species are best known as urinary tract pathogens, but they are also well documented agents of various systemic and localized extraintestinal infections.

On the basis of their biochemical characteristics, the *Proteus* species can be divided into four , which can further be divided into two groups:

Group I. *P. mirabilis* and *P. vulgaris.* These group produces hydrogen sulphide rapidely, and swarm on blood agar media. *P. vulgaris* is indole positive while *P. mirabilis* is indole negative.

Group II. *P. morgani* and P. *rettgeri.* This group does share the general characteristics of group I. *P.morgani* is both citrate and mannitol positive.

Pathogenicity: *P. mirabilis.* This species causes urinary infections, especially following cathterization. Abdominal and wound infections. It is often a secondary invader of ulcers, burns, and damaged tissues, septicamiae and occasionally meningitis and chest infections.

P. vulgaris . This species is occasionally isolate from pus, urine and other specimens (Fineold and Martin, 1988)

The most common anaerobic species isolated from ear discharges of patients with CSOM are *Bacteriod* species, *Peptostreptococus, Peptcoccus, and Fusobacterium.* As a study done in Egypt (EL-Badry *et al.*, 1986) showed, anaerobes were isolated in 45% of the cases investigated, this was in line with the study conducted in Nigeria (Rotimi *et al.*, 1992), suggesting that anaerobic bacteria are important components of the bacterial flora in chronic suppurative otitis media. Studies mainly outside Africa have recorded a frequency of isolation of anaerobes from CSOM ranged between 1% and 45% (Berman, 1995). It is therefore evident that lack of detailed and careful laboratory methodology must have been responsible for the low or non-detection of anaerobes in the past particularly in studies from various centres of Africa.

The low oxygen concentration and the lack of ventilation in the middle ear cavities of patients with CSOM are most important factors in chronicity of otitis media. In addition to the above indicated bacteria, fungi such as *Aspergillus flavus, Aspergillus niger, Pencillum, Aspergillus fumigatus, Candida albicans*, and *Mycobacterium tuberculosis* are involved in chronic suppurtive otitis media infections. Some African countries report tuberclosis as a cause in small proportion of patients. For example, 1.2% of patients at a clinic in Uganda and 0.38% in Tanzania had CSOM associated with tuberclosis (Berman, 1995).

Bacteroides and other related non-sporing anaerobes

The significance of obligate anaerobes in general, and non-sporing anaerobes in particular, is increasingly recognized. This hightened awareness of the important role

that such organisms play, both as part of the normal microbial flora of the body and in a wide variety of infections.

A large number of anaerobes is found in the mouth and oropharynx, gastro-intestinal tract and female genital tract of healthy individuals as part of the commensal flora. These include gram-positive and Gram-negative cocci, rods and filaments, as well as a number of spiral forms. Examples of gram-positive bacilli are, *Bifidobacterium*, *Lactobacillus* and *Eubacteriun,* and exambles for Gram-positive cocci are,*Gaffkya, peptococcus peptostreptococcus, etc. Bacteroides and Fusobacterium* are examples of gram- negative bacilli(Greenwood *et al.*, 1992).

Fusobacteria: are Gram-negative bacilli which colonize the mucous memberans of humans and animals and are generally regarded as commensals of the upper respiratory and gastrintestinal tracts. The most studied species is *F. nucleatum*, which is frequently recovered from mixed infections of the head and neck region including the ear and dental abscesses.

Gram- positive anaerobic cocci: Strictly anaerobic Gram-positive cocci, as opposed to facultative, microaerophilic of carbondioxide dependent cocci, haveposed a number of difficulties for microbiologists over years, and their classification and nomenclature is still in need of further classification (Salyers and Whitt,1994).

Most species that are known to be clinically significant are now regarded as belonging to the genus *Peptostreptococcus.* Brain abscesses, head and neck infections, (including

ear), genito-urinary tract infections are some of the clinical specimens from which anaerobic Gram-positive cocci are isolated.

Bacteriodes. Bacteriod species are the commonest cause of non-clostridial anaerobic infections in man. The Bacteroids frgilis group are particularly significant since they are the most commonly isolated and tend to be more resistant to antimicrobial agents than many anaerobes.It is also the most common organism found in bacteremiae involving anaerobes and has even occasionally been reported from head and neck infections. Species of the B. fragilis group account for about a quarter of all anaerobes isolated from clinical specimens.

Despite advances in public health and medical care, CSOM is still, prevalent around the world. It is most common in developing countries and in certain high risk popultions in developed nations, as well as among children who have tympanostomy tube inserted. In Solomon islands (Eason, *et al*,.1996), SCOM affects 3.8% of 3500 studied children under 15 years and 6.1% under 5 years and was the major cause of conductive hearing loss in 265 children tested audiometrically. In the above study, measles, respiratory infections swimming and malnutrition were identified as etiological factors amenable to intervention. From these study, a total of 75 organisms were isolated from 58 ear swabs. Growth of a single organism was isolated in 19(33%) and of two or more in 39(67%) cases. *Proteus* species was most commonly recovered (41%) followed by *Pseudomonas aeruginosa* (26%), *Klebisilla* species (16%), *Escherichia coli*((%), *Staphylococcus aureus* (7%) and *Staphylococcus epidermidis*(9%).

In Nigeria (Rotimi *et al.*, 1992), specimens obtained directly from the middle ear of 40 patients with CSOM were investigated qualitatively for their aerobic and anaerobes bacterial agents. Twenty one of the 40 specimens yielded aerobic only, 17 yielded a mixed flora of aerobes and anaerobes, while only one specimen yielded anaerobe alone and the remaining one was sterile. The predominant species in anaerobic isolates were *Bacterides fragilis, B. Intermidus, B.melaninogenicus,* and anaerobic cocci. The least isolates were, *Bacteriodes distasoni,* and *Fusobacterium.* Among the aerobic bacteria, *Pseudomonas aeruginosa (17/40), Staphylococcus aureus(14/40), Escherichia coli*(8/40), *Klebsiella aerogens*(6/40), *Proteus* species(5/40). These were followed by least frequent isolates such as Beta hemolytic streptococci(1/40)and *Haemophilus influenzae*(1/40).

In Sudane, organisms which were isolated from CSOM were *Proteus* species, 46(28), *Klebsiella* and other coliforms 27(16.5%), *Staphylococcus aureus* 23(14%), *Pseudomonas aeruginosa* 16(9%) *and Escherichia coli 1*(0.6%) (Hussain et al.,1991).

In Nigeria (Coker *et al*,1983) bacterial isolates from chronic discharge ears in 260 cases of children, were. *Pseudomonas aeruginosa 90*(38%), *Proteus mirabilis* and *Klebsiella* species were each 23(9.8%),*Staphylococcus epedermidis* 22(9.4%), *Staphylococcus aureus* 19(8.1%0 and *Escherichia coli* 8(3.4%), *Streptococcus faecalllis* 5(2.1%), *Citrobacer* species 5(2.1%) Beta haemolytic *streptococci* 3(1.3%), and *Streptococcus pneumoniae* 1(0.4%) were the least common.

In Tanzania (Minija and Machemba, 1996), from 802 studied populations, 2.6 percent have chronic suppurative otitis media. The prevalence of CSOM was 9.4 percent among the rural school children and 1.3 percent among the urban school children, The low prevalence of CSOM among the urban school children is associated to better medical services which facilitate early diagnosis and treatment of AOM. This emphasises the need to improve the health service in the rural areas, so that AOM is diagnosed and treated at primary level of health care. This will in turn prevent bacterial infections, but, the bacteria that cause the initial episode of AOM with perforation are usually not those that are isolated from the chronic discharge.

In Ethipia, (Abebe Melaku and Sileshi Lulseged, 1999) from 97 patients with CSOM , the following major organisms were isolated, these are, *Proteus* species accounted for 40(37.7%), *Staphylococcus aureus* 34(32.1%), *Pseudomonas aeruginosa* 10(9.3%) *Klebsiella* species 8(7.6%),*Escherichia coli* 6(5.7%). The isolates were single pathogens in 56(70%) and mixed organisms in 24(30%)of the patients with pathogens isolated.

Management of CSOM: Since available data on otitis media in developing countries are not available for the populations living in these countries, there is an urgent need to conduct randomised clinical trails of antibiotic treatment of AOM in areas with high rates of mastoiditis and CSOM. Because the etiology of otitis is similar in developed and developing countries, the differing rates of CSOM and mastoiditis most probably reflect differences in population characteristics and environmental factors.

Therefore, an assessment of the value of case management of otitis media include:-

1. Reviewing antibiotic clinical trails for AOM carried out during the 1940s and 1950s in Europe and united States where the prevalence of CSOM and

mastoiditis were similar to that currently observed in many developing countries, and

2. Reviewing the effectiveness of providing enhanced primary care services to under served populations having a high prevalence of otitis media such as native American and Eskimo population.

The high rates of CSOM currently observed in many areas of the developing world are comparable to the rates reported in the pre-antibiotic era. It is estimated that, approximately 20% of untreated AOM cases progressed to CSOM and or mastoiditis. The complication rates for patients with CSOM described currently in many developing countries are also similar to those described in Europe in the pre-antibiotic ear. For example, complications occurred in 6.5% in patients with AOM and / or CSOM in the pre-antibiotic era compared with 10% complications rates in 1978 and 1980 in Nigeria (Berman, 1995).Various methods of management exist and ranged from conservative medical treatment to surgery. A conservative treatment, often aural toilet, will only render the infection inactive in 20% of the patients. This is generally unsatisfactory. The success of surgical management is generally enhanced by the degree of dryness of the ear, to reduce the number of types of micro-organisms infecting the ear pre-operatively.

It was thought that dry mopping alone of ears with CSOM was sufficient to bring about resolution of the disease and healing of the tympanic membrane. But studies conducted in Kenya and Nigeria have shown (Smith, et al., 1996; Rotimi , et al.,1990) that dry mopping alone did not bring the desired result. Instead, dry mopping, when supplemented with topical and systemic antibiotics, resulted in resolution that was more than twice than that of the dry mopping group.

A review of the available literature supports the belief that otitis media is responsible for a significant burden of disease in developing countries. Otitis media has a direct impact on mortality and severe morbidity because it is the major contributor to hearing impairment. Hearing impairment is a major public health problem compromising the quality of life in approximately one third of the population of developing countries. In addition the hospital based resources spent treating complications of CSOM and mastoiditis could be saved if primary care management can prevent the progression of AOM. Historical data support the effectiveness of antibiotic therapy in reducing the frequencies of mastoiditis and CSOM complicating AOM. The introduction of primary care and case management in selected high risk populations in developed countries have been associated with a reduction in the frequencies of CSOM and mastoiditis. Trained staff and resources for this disorder are so scarce in most developing countries that only appropriate primary-care interventions are likely to be effective on a wide scale.

MATERIALS AND METHODS

This study was conducted at the Department of Pediatrics and Child Health of the Tikur Anbessa Hospital, in Addis Ababa. The clinic, being the tertiary centre for referred children; where the ENT specialist and other experienced paediatricians are available, it is an appropriate hospital for collecting specimens for those age groups.

Patients

A total of 112 children suffering from chronic suppurative otitis media and seen over a period of 4 months (January - April 2000) were included in the study. During the study period, a total of 132 swabs (78% unilateral, 22% bilateral disease) were collected from subjects. All had copious, mucopurulent, often foul-smelling, discharge and with perforated tympanic membranes. All patients were enrolled after informed consent with their parents or guardian was secured. All patients were recruited from among those who came to the ENT clinic of the Department of Pediatrics and Child Health for treatment. Detailed records of the duration of ear disease, patients' ages and sex, previous medications, patients' weights, heights, ears involved, hearing status were taken. In addition to these, some background information about their parents and siblings, number of rooms and family size were obtained using a pre_structured questionnaire. Some of the patients, who were taking antibiotics, and previous ear drop medications, of some sort, were only enrolled after complying with the instructions to remain treatment free for 15 days and still had purulent discharge. Chronic Suppurative Otitis Media was considered in those patients as a chronic inflammation of the middle ear and the mastoid process with perforated tympanic membrane and ear discharge has persisted for at least two weeks (John, 1966).

Specimen

All specimens were collected by ENT specialist using a flexible sterile calcium alginate wool tipped based on the standard given on microbiology in clinical practice (Shanson,1995). The swabs were immediately immersed in to Amies transport media to be taken to the clinical microbiology laboratory at the Ethiopian Health and Nutrition Research Institute (EHNRI). Then, the specimens were inoculated and streaked with sterile bacteriological loop immediately on 5% defibrinated blood agar, Heated blood agar (chocolate agar), and MacConkey agar plates and incubated at 37c for 18-24 hours according to the procedures given on medical laboratory manual for tropical countries (Cheesbrough, 1984). The suspected pathogens were then identified according to conventional bacteriological methods namely:

- Morphological examination
- The growth character of colony appearance on the different inoculated culture media was carefully observed . Then colonies picked with a sterile straight wire or with a loop for different further tests, such as isolation, purification and identification. The picked colonies from the primary culture plates were used to be inoculated into appropriate broth media (such as nutrient broth and trypton soy broth)which were then sub cultured on solid general media in order to check for the presence of single or mixed isolates in a single specimen of a patient.

In addition to morphological examination the following tests were used for the identification of Gram negative bacteria.

Biochemical identification. This identification method is the most important test for the proper identification of bacteria. Two organisms may have similar morphological and cultural properties but these organisms exhibit very striking differences in their metabolic reactions. Some of the biochemical tests used were,

- Fermentation of carbohydrate on Kligler iron agar
- Indole test
- Urease test
- Citrate Utilisation test.
- Oxidase, was used as an additional test for Pseudomonas and Alcaligens species
- morphological examination, Coagulase, optochin bacitracin tests, and Gram staining technique were used to identify Gram positive bacteria .

Antimicrobial Susceptibility Testing: The bacteria that were grown in nutrient broth were rolled onto Mueller Hinton agar using sterile cotton swab. Then the antibiotics used for gram negative and Gram positive bacteria were placed using a dispenser and incubated at 37cfor 16-18 hours. If the bacteria were Streptococci and Diphthroid species instead of Mueller hinton agar, blood agar medium was used for sensitivity tests. All the procedures were done near a flame to avoid contamination. All isolates were tested for their susceptibility to different antimicrobial agents by the standard agar disk diffusion technique (Beaur et al., 1966).

The antimicrobial agents employed for Gram positives were Penicillin (100units), Tetracycline (30micrograms), Streptomycin (10 micrograms), Chloramphenicole (30 micrograms), Erytromycin (15 micrograms), Gentamicin (10 micrograms), Kanamycin (30micrograms), Cephalotin (30 micrograms), Clindamycin (2 micrograms) Ampicillin

(10 microgram), Cloxacillin (1) and Augmentin (30) were used and for Gram negative bacteria, all the above plus, (Trimethprim-Sulphametazole (25 micrograms)Polymixn B(300) and Cabencillin(100) except Erythromycin, clindamycin and cloxacillin were used. The diameter of zones of inhibition on Mueller Hinton agar and blood agar were measured and interpreted according to Bauer et al. as Sensitive, Intermidate and Resistant. Reading with intermidate sizes were relatively few, and were recorded as sensitive. The resistant patterns of the most prevalent organisms were analysed as indicated below.

RESULTS

A total of 112 infants and young children participated in this study and 132 ear swabs were collected from them for culture and sensitivity tests. The age-sex distribution of these subjects is shown in Table 1. A total of 159 different bacterial isolates were obtained from 120 of the ear swabs of patients with CSOM (Table 3). From these, 66.7% of the isolates were single (sole) cultures while the rest (33.3%) were of mixed cultures (Table 3). The distribution of these bacterial isolates in single and mixed cultures by age and sex of patients is shown in Table 4. Analysis of the isolates revealed that out of the total 159 micro organisms isolated, Gram negative bacteria accounted for 69.2% of the isolates, while Gram positive isolates accounted for 30.8% of the isolates (Tables 3).

The predominant species in these CSOM were *Proteus* mirabilis, isolated from 34 patients, *Staphylococcus aureus* in 28 patients, *Esherichia coli* in 26 patients , *Klebsiella* species 19 patients, *Pseudomonas aeruginosa* in 10 patients and *Staphylococcus epidermidis* in 10 patients. Other pathogens isolated were, *Streptoccus* pyogens from 7 patients, *Citrobacter* species in 4 patients, as well as *Streptococcs pneumoniae*, *Proteus rettigeri, Proteus morgani, Diphthroides* and *Alcaligens* species each isolated from two patients. From 159 bacterial isolates, *Proteus* species accounted for 49 (30.8%). Out of which *Proteus mirabilis* accounted for (69.4%) (34/49) and *Proteus vulgaris* (22.4%) (11/49). As shown in table 5 *Proteus mirabilis* strains were resistant to commonly used antibiotics showing that out of the total 34 isolates, 28(82.4%) were resistant to Polymixin B, 26 for tetracycline, 20 (44.1%) to Chroramphenicol. The majority of the Proteus species were ,however, highly sensitive to Gentamicin, Kanamycin and Augmentin.

The second most common isolates were *Staphylococcus aureus* accounted for 28 (17.6%) of the 159 isolates. They were highly resistant to tetracycline, ampicillin and penicillin, but `quite sensitive to kanamycin, Gentamicin, Augmentin and Erythromicin. These were followed by isolates of *Esherichia coli* which accounted for 26(16.3) of the total 159 isolates. Most of these strains were resistant to the commonly used antibiotics but sensitive to Gentamicin , Kanamycin and Augmentin. Table 6 describes the over view of the resistant pattern of all the predominantly isolated bacteria.

When we analysed the data on the basis of age distribution by sex of patients, the result in Table 1 indicated that there were more males 56.3 (63/112) than females 43.7% (49/112). More patients presented with CSOM of the left ear (44%), than either of the right ear (34%) or bilateral CSOM (22%) (Table 2). The age distribution, 38.4% of the patients studied were less than 2 years, and over 72.4% of the patients were less than 6 years. When the distribution of bacterial isolates is analysed based on age and sex of patients the results in Table 4 indicates that there were 70(44%) various bacterial isolates in the age group of 0.25_4 years. These were isolated from 63 (56%) infant and young children patients of the total studied populations. The male to female ratio was 1:0.8. From the 70 isolates 44 (42%) were sole(single) cultures while 26(38%) were mixed cultures when compared with the total isolated strains. *P.mirabilis* was the predominant species accounted for 25(15.8) in this age groups.

Table 1. Age and Sex distribution of 112 children with chronic suppurative otitis media

Age range (Year)	Male	Female	Total number of Patients	%
0.25-2	25	18	43	38.4
2---4	10	10	20	17.9
4---6	10	8	18	16.2
6---8	7	6	13	11.6
8--10	6	4	10	9.9
10---12	5	3	8	6.0
Total	63	49	112	100

Table 2. Ear involvement from 112 CSOM patients

Ear affected	Number	%
Right	50	44
Left	38	34
Both	24	22
Total	112	100

Table 3. Distribution of Isolates from the CSOM patients as sole or mixed organisms.

Orgamisms	Totally Isolated No %	Isolated from each specimen as: Single organism No	Mixed with others organism NO
Gram Negative	110	74	36
1. Proteus species	49 30.8	34	15
2. E.coli	26 16.3	17	9
3. Kelebsiella spp	19 11.9	11	9
4. P.aeronginosa	10 6.3	7	3
5. Citrobacter Spp	4 2.5	3	1
6. Alkaligens Spp.	2 1.3	2	0
Gram-positives	49	32	17
1. Staph.aureus	28 17.6	16	12
2. Staph. epidenm.	10 6.3	7	3
3. Strep.pyogenes	7 4.4	5	2
4. Diphtheroid spp	2 1.3	2	0
5. Strep. Pneumon.	2 1.3	2	0
Grand Total	159 100	106	53

Table 4. Distribution of bacterial isolates in (sole) and mixed cultures by age and sex of patients with CSOM.

Age (years)	Sex	Total Patients	No. of Isolates	Number of Organisms by Type									
				Proteus mirabilis		*S. aureus*		*E.coli*		*Klebsiella species*		Others	
				Pure	Mixed	Pure	Mixed	Pure	Mixed	Pure	Mixed	Pure	Mixed
0.25-4	M	35	48	7(6.6)	4(7.4)	6(5.7)	2(3.8)	5(4.7)	2(3.8)	3(2.8)	2(3.8)	9(8.5)	8(15.0
	F	28	21	5(4.7)	2(3.8)	2(1.9)	00	2(1.9)	2(3.8)	1(0.9)	2(3.8)	3(2.8)	2(3.8)
4 - 8	M	17	34	4(3.9)	2(3.8)	2(1.9)	3(5.6)	3(2.8)	2(3.8)	3(2.8)	2(3.8)	11(10.40	2(3.8)
	F	14	15	3(2.8)	00	3(2.8)	1(1.9)	00	2(3.8)	1(0.9)	1(1.9)	4(3.8)	00
8 - 12	M	11	27	3(2.8)	1(1.9)	2(1.9)	2(3.8)	4(3.9)	1(1.9)	2(1.9)	1(1.9	9(8.5)	2(3.8)
	F	7	14	2(1.9)	1(1.9)	1(0.9)	4(7.4)	3(2.8)	00	1(0.9)	00	2(1.9)	00
Total		112	159	24(22.7)	10(18.8)	16(15.1)	12(22.5)	17(16.1)	9(17.1)	11(10.2)	8(15.2)	38(36.0)	14(26.4)

Table 5. Antimicrobial resistance pattern of the most frequent bacterial isolates from ear discharges of patients with CSOM.

Organisms	No. of isolates (%)	Am	SXT	CF	C	GM	K	S	TE	AU	P	E
P. mirabilis	34(21.4)	16	8	10	20	5	5	16	26	2	-	-
S. aureus	28(17.6)	24	-	6	7	5	6	12	22	5	26	-
E. coli	26(16.4)	22	10	8	10	4	6	14	22	4	-	-
Klebsiella sp.	19(11.9)	13	8	8	10	0	8	6	13	8	-	-
P. aeruginosa	10(6.2)	10	10	8	8	0	8	9	10	0	-	-

Table 6. More frequent antibiogram of 107 CSOM isolates.

Resistance pattern	Strains(107)*					
	P.mib.	S.a.	E.coli.	Kleb.spec.	No.	%
Te**	-	-	-	2	2	1.9
Sm	-	-	1	1	2	1.9
AmTe	4	-	1	1	6	5.7
AmCp	1	-	-	1	2	1.9
SmTe	1	-	1	-	2	1.9
AmSmTe	6	4	4	2	16	14.9
AmSxTTe	2	-	2	1	5	4.7
AmCFTe	2	-	1	1	4	3.7
AmSmPn	-	4	-	-	4	3.7
AmTepn	-	4	3	-	7	6.5
AmCFPn	-	4	-	-	4	3.7
CpSmTe	-	1	1	1	3	2.8
AmCFCpTe	3	2	1	2	8	7.4
AmSxTCpTe	2	-	3	2	7	6.5
AmGmKmSm	2	-	1	1	4	3.7
AmCpTeSm	3	-	2	2	7	6.5
AmSmGmKmPn	-	4	-	-	4	3.7
AmSxtCFTeAu	-	4	-	-	4	3.7
AmCFSmTeAu	4	1	1	-	6	5.7
AmSxTCFSmTeAu	-	-	2	2	4	3.7
AmSxTCFCpTeAu	1	-	1	1	2	1.9
AmSxTCFCpSmTeAu	2	-	-	-	2	1.9
AmSxTCFGmSmTeAu	1		1	-	2	1.9
Total	34	28	26	19	107	100.0

* Figures in parentheses indicate the number CSOM isolates

** Abbreviations.Te=Tetracycline, Am=Ampicillin, Sm=Streptomycine, Pn= Penicillin, Gm= Gentamycine, Km=kanamycine, SxT=Trimethoprim/sulphamethoxazole Au= Augmentin, CF= Cephalotin, Cp= Chloramphenicol,

DISCUSSION

All specimens cultured in this study were obtained directly from the middle ear under direct vision with meticulous care to avoid contamination from the external ear. Laboratory processing was also prompt and particular attention was paid to aerobic cultures but not ignoring the presence of anaerobic bacteria.

In this study, there were more patients with CSOM of a single ear (78%) where as the bilateral CSOM accounted for 22% of cases (Table 2). This was in line with three studies done in Africa (Mohoney *et al.*,1980; Eason *et al.*,1986 and Minija and Machemba, 1996), which were reported as 66% to 34%, 68% to 32%, and 66% to 34% cases of the single ear to the bilateral ear infection respectively. In contrast, a recent study in one children's hospital (Abebe Melaku and Sileshi Lulseged) was reported to show more cases for bilateral ear infections(55%) compared to 45% of single ear infected cases. In our present hospital based study chronic suppurative otitis media was found in 112 patients, accounted for 25% from ear, nose and throat affecting problems. Most of the patients (83%) were from Addis Ababa. Their distribution by residential address was similar to that of the general patient population of the hospital as well as that of patients seen for otorhinolaryngological problems. Males were more than females. This is in line with other studies of some in developing countries (Mohoney et al,1980; Eson etal.,1986; Minija and Machemba, 1996).

In this study, as shown in Table 1, 38.4% children with CSOM are below 2 years of age, and over 72% of the total were less than 6 years. But a decreasing frequency of the CSOM cases were observed in the age range between 6 to 12 years. This is similar to the

findings in developing countries (Yagi, 1990), where 41.5% of the children with CSOM were reported to be below 2 years of age. It is, however, different from the result of an earlier hospital based study (Ramash, and Kacker, 1975) in which 65% of children with CSOM were of less than two years of age. The high prevalence in the younger age group is probably due to the anatomy of the eustachain tube and the frequent upper respiratory tract infections, that are among the predisposing factors for ear infections. The culture results from children with chronic suppuratire otitis media in this study showed that, a total of 159 organisms were isolated from 120 positive ear swabs (Table 3). Growth of only a single organism as sole isolates was detected in 67.3% and of two or more in 32.7%) cases. The detection of 67.3% single isolates in this study was slightly higher than a study earlier conducted elsewhere (Ramash and Kacker, 1975)which was reported as 56.8% but lower than another study (Trujillo et al.,1989) that reported as 79% single isolates. On the other hand this results was higher than a study conducted in Solomon islands (Eason et al.,1986), that was reported to have 33% and 67% of single and of two or more mixed organisms, respectively.

In the present study, the principal micro-organisms isolated from the discharges were *Proteus mirabilis* , *Staphylococcus aureus, Escherichia coli, Klebsiella* species *Staphylococcus epidermidis and Peudomonas aeruginosa.* Other isolates include *Streptococcus* pyogenes, *Streptococcus pneumoniae, Citrobacter* species, *Proteus rettigeri* and *Proteus morganii* were in small frequency. Although the results clearly reflect the Polymicrobial aetiology of chronic suppurative otitis media as described in many other studies. The frequency with which these organisms were isolated does not correspond the findings from other report. In Zaire (Mohoney *et al.*, 1980),and Nigeria (Rotimi etal, 1992), *Pseudomonas aeruginosa* was the commonest pathogen in children

with CSOM. This was followed *by S. aureus* and *Proteus* species, but in line with other studies (Eason *et al.*, 1986; Minija and Machemba, 1996; Abebe Melaku and Silesh Lulseged,1999) they reported that *Proteus* species was the predominant isolate accounting for 41% in the Solomon islands, 28% in Sudan and 37% in children's hospital of ,Addis Ababa. The predominance of *Proteus* species in the present study is probably associated with the late presentation of patients to the clinics long after ear discharge. The relationship between the type of organisms and the duration of discharge in patients with CSOM has been described in Zaire (Mohoney *et al.*, 1980). In this study it was shown that *Proteus* species were the most common pathogens in patients presenting 2 months after the on set of ear discharge. After one week to 2 months *Pseudomonas aeruginosa* is found to more prevalent, where as *Staphylococcus aureus* was predominant from the onset of discharge to 7 days. Mixed infections were present in many cases after otorrhea had been present for ten days. It was rare to find an organism other than pure Staphylococcus aureus immediately after the onset of the discharge. From this explanation, one can say that, almost 40% of our patients reported to hospitals two or more months after the onset of ear discharge. This could be due to long distance from tertiary health services for those who have come out side Addis Ababa (17%).It may also be due to parents attitude to bring their children to hospitals for ear discharge, thinking discharging ear is not a sign of sickness. Smears for acid fast bacilli were taken when Mycobacterium tuberculosis infection was suspected, but all smears were negative, even if does not exclude tuberculosis infections.

Antibiotic sensitivity test results of the present study show that,(Table 5) the majority of organisms isolated from children with discharging ears are sensitive to Gentamicin, followed by Augmentin and Kanamycin. This was in line with studies in Nigeria, the

Sudan and Addis Ababa. (Rotimi *et al.*, 1992; Minija and Machemba, 1996; Abebe Melaku and Sileshi Lulseged,1999). For the 70% Gram negative isolates Gentamicin appears the most effective antibiotic. From the 28 S.aureus isolates 22/28, 24/28,and 26/28 of them were resistant to Tetracycline, Ampicillin, and Penicillin respectively but highly sensitive to Erythromycin, Cloxacillin and Clindamycin.

Analysis of drug resistance of the most frequent isolates (Table 6) which consists 107 (67.3%) of the total isolates show, 23 different resistance patterns. The most frequent pattern was the triple drug resistance which accounted for 43(40%) of the total isolates and 40% of the total antibiogram. This was followed by quadriple resistance patterns. Resistance to the combination of 5 or more drugs was observed in 24(22.4) isolates. From all strains, only four strains show resistance to a single drug but others were resistance to multiple drugs. The drug resistance pattern of two drugs was 9.5% for triple drugs it was 40%, for quadriple, 24% for five drugs 13.3% for more than five it was 9.4%. This was greater than the study done in Addis Ababa (Abera Geyid and Yetnebersh Lemeneh,1991; Wesenet Tewodros and Mesele Gedebou,1983) where the most frequent pattern was the double drug resistance but in this study it was the triple drug resistance which is the most frequent pattern. There was no strain which was either sensitive or resistance to all drugs from these most frequent isolates.

SUMMARY AND RECOMMENDATIONS

In this study, a literature review was undertaken to determine the importance of aerobic and anaerobic etiologic agents of CSOM mainly in developing countries. The study results was compared with results of studies in developing countries. The comparsion was similar to other studies in developing countries in its polymicrobiality and drug sensitivity pattern, eventhough there is variation in rate of isolation.

As literatures indicate, anaerobes are also one of the major etiologic agents in CSOM patients. Therefore studies on this line may contribute a lot for the prevention and control strategies of CSOM.

In conclusion, the findings of high rates of multiple resistance and resistance to the many individual antimicrobials studied can cause alarm. They are the consequence of misuse of antibiotics caused by unrestrictive policy in sales. Therefore, a firm enforced national policy and a more discriminated use of antibiotics are strongly recommended, if this trend of resistance to be controlled.

As this study shows, the most commonly used antibiotics are the most resistant, therefore, strong follow ups of patients or and culture results are very necessary to reduce the side effects. Knowledge of the types of organisms, that are associated with chronic otitis media is of local clinical relevance especially as most of the patients would have self- treatment with various ear drop preparations before seeking medical attention. The result of this is chronicity and emergence of antibiotic-resistant strains. Since

anaerobes are generally resistant to aminoglycosides, attempts to eradicate the infection by antimicrobial therapy directed against both anaerobes and aerobes should therefore include drugs that are effective for both etiologic agents.

Based on the findings of the present study and the literature reviewed the following recommendations may be made:-

1. More elaborate epidemiological studies will be required to define the magnitude of the problem and identify optimal therapeutic of suppurative ear discharge in Ethiopia.
2. It is important to determine the role played by anaerobes and fungi in chronic otits media as it will detect management which has, as one of its aim, the prevention of potentially fatal intercranial complications.
3. Selective use of antibiotics and continuous aural cleaning need to be promoted.
4. Instructing care givers to encourage nose blowing, forbid swimming and insert cotton wool/ vaseline ear plugs before washing.
5. Instructions of health workers in remote situations and their provision with a functioning otoscope and effective antibiotics will help to reduce the transformation from acute to chronic otorrhoea, in developing countries where there is scarcy of ENT specialists.
6. The present study also suggests that there is a need for defining the magnitude, associated risk factors and consquence of CSOM in more comprehensive, community based studies.
7. In view of this finding, the majority of bacterial isolates from discharging ears were sensitive to Gentamicin, Kanamycin, and Augmentin, as a result of this, the above antibiotics are drug of choice for treating CSOM patients.

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Annex 1. Characteristics of the study population.

Sum total size of the househoold		107
Sum total size of the family		630
Mean size of the family		5.89
Address from Addis Ababa		93
Address out of Addis Ababa		19
Number of families shared only one room		138
Number of rooms shared by 138 families		29
Mean number of rooms /family		4.75
Number of families shared only two rooms		162
Number of rooms shared by 162 families		27
Mean number of rooms/ families		6
Education of mothers	illiterate	32
	elementaty	35
	high school	36
	college/university	3
Age of mothers	up to 30 years	52
	31_40 years	35
	>40 years	20
	youngest	16
	oldest	48
	mean age	30
age of children	0.25_4 years	52
	4-8 years	35
	8-12 years	20