Original article

Aerobic Aetiological Agents of Chronic Suppurative Otitis Media Among Children (1-16 years), Yemen: implications for treatment

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Abstract

Objective: Chronic Suppurative Otitis Media (CSOM) is a common cause of disabled hearing impairment in developing worlds. We aimed todetermine the aerobic aetiological agents of CSOM among children 1 to 16 years-old, studying the microbial susceptibility to antibiotics and its implications for treatment.

Methods: prospective case series study carried out in Khalifa Bin Zayed Hospital, Socotra Island in collaboration with Hadramouth Central Laboratories – Yemen, conducted during the period from June 2011 to June 2012.Study procedures involved completing the questionnaire, otoscopic ear examination and swab samples collected from one or both ears of children with CSOM for tests of microbial agents and sensitivity to antibiotics.

Results: among 76 children with CSOM studied, 42 [55%] were male. The mean age was 6.1 (range from 1 years to 16 years). A total of 86 swab samples were conducted from one or both ears. *Pseudomonas Aerogiunosa* 28/86 [33%] was the commonest microbial organism to cause CSOM, followed by *proteus spp* 20/86 [23%], *staphylococcus aureus* 18/86 [21%], *E. Coli* 14/86 [16%], *Klebsiella* 2/86 [2%], *Enterobacteria* 1/86 [1%] and three samples were sterile accounting for 4%.Of antimicrobials tested to four species, Ciporfloxacillin has the highest susceptibility rate.

Conclusion: The etiological agents of CSOM in the children studied demonstrates a commonest of *Pseudomonas aeroguinosa*, followed by *proteus spp* and *staphylococcus aureus*. All organisms were sensitive to ciprofloxacillin. Implications for treatment indicates quinolone as a good option in the treatment of CSOM. There is a need for better understanding of microbial and antimicrobial profiles of CSOM in the region.

Keywords: *CSOM, Yemen, Aetiology, treatment, aerobic patterns*.

Introduction

Chronic Suppurative Otitis Media (CSOM), is a common public health problem and an important cause of disabled hearing impairment in developing countries. The disease and its associations is a hidden disability and adversely affects cognition and school performance, delaying the development of speech, and increasing the risk of life threatening CSOM complications (1). it refers to an inflammation of the middle ear cleft, presents as persistent ear discharge through a perforated tympanic membrane for more than two weeks (2).

The disease is widely seen in children, usually follows either an infection with Acute Otitis Media (AOM), or through a direct passage of pathogens that are present in water, and enter the ear during bathing or swimming (3-5).The condition of tympanic membrane has a key role in possible pathogenesis of CSOM.In case of an intact tympanic membrane, AOM may be initiated by upper respiratory tract infections, viral and/or bacterial, resulting in the congestion of the nasophaynx and eusthacian tube, and may end in the blockage of the eusthacian tube causing negative pressure in the middle ear cleft, followed by the aspiration of respiratory secretion and associated pathogens into the middle ear cleft[1]. The eusthacian tube functions (clearance, protection and ventilation) are impaired due to congestion and the endogenous toxin of pathogens resulting in AOM(1,6-9). With the continuation of ear drainage for 2 weeks to 3 months or longer, the infection is CSOM (1). Perforation of the tympanic membrane and loss of the middle ear gas 'gas cushion', enhancing the reflux of nasopharyngeal secretion

and associated pathogens through the eusthacian tube into the middle ear, results in CSOM (8,10). However, the perforation of the tympanic membrane could result from other causes, including trauma.

The causative pathogens of CSOM have been isolated. A number of studies have been carried out in Africa(11-13), and in Asia(14,15), including the Singapore study(16) and a multicentre Korean study (17), revealed that the commonest isolated bacteria of CSOM are; *Pseudomonas Aerguinosa*, *Staphylococcus Aureus*, *Proteus spp*, *and Klebsielaa*. However, in some cases of acute otorrhea, the isolated pathogens could involve *s. pneumonia*, *Haemophilus influenza*, and *Moraxella catarrhalis*. The predominant isolated bacteria is varied, some studies revealed *pseudomonas spp*, as the predominant isolated pathogens (15,18-20),other investigators have reported *Staphylococcus Aureus* as the commonest isolates (21-23). A variety of factors are contributing in the evolving changes of bacterial patterns and antimicrobial susceptibility of CSOM, including geographical variations, antibiotics resistance, host and environmental factors. In Yemen, little is known about bacterial aetiologies and its sensitivity to antibiotics. Knowledge of both the aetiological agents and antimicrobial susceptibility are essential on developing proper management.

The aim of the study is to determine the pattern of aerobic bacterial isolates and associated antimicrobial susceptibility among children with CSOM.

Method

Study Design

The study was a prospective case series study. Seventy six children with CSOM were recruited over a period extending from June 2011 to June 2012.

Participants

Participants are children aged between 1 – 16 years with active purulent ear discharge for the preceding two weeks; pus in the external canal on otoscopy; and tympanic membrane perforation. The purpose of the study was explained to the parent or care taker and their consent was obtained for inclusion into the study. Information extracted included age, gender, duration of discharge and site of sampling. Exclusion criteria: children whose tympanic membrane was perforated but dry, children who had been recently treated for ear infection, children unable to participate due to illness, children with AOM and children with congenital anomalies (cleft palate).

Sample strategy and procedures

Pus sample were conducted from children with CSOM. Swab technique was used in collecting the sample from children as it has been found to be good as other techniques (24). A sterile swab was brought from the central lab and process started with inspecting the ear, cleaning the concha with spirit to remove contamination and then to introduce the stick onto the external auditory meatus, gently rotate and taken out[24]. The swab then was to be inoculated onto MacKonky and blood agar and aerobic incubated at 37° for 24 hours. Gram staining was to done and if there was bacterial growth, a discrete colony from the media was to be investigated by microscope in order to identifying the causative pathogen. Biochemical test for bacterial antibiotic profile were tested using standard disc diffusion technique of Bauer et al. (25). For quality assurance,10% of samples were analyzed by two external Bacteriologists. There were no facilities for isolation of anaerobic bacteria or fungi.

All participants were assigned a unique personal identification number (PIN), and used for data collection procedures. Data were analyzed and presented in tables and simple descriptive statistics.

Ethical approval

The study was approved by Liverpool School of Tropical Medicine Ethics Committee.

Results

Consent was received for a total of 87 school children aged 1 to 16 years, of whom 11 had to be excluded. A total of 76 children were thus enrolled into the study.

Over half of the children [42: 55%] were boys; Children with CSOM who came from urban settings were slightly higher than rural setting, 42/76, representing 55% of the total tested sample. The mean age of the children was 6.1 years [range 1 to16 years].

Ear swab sample from 76children with CSOM, either in one or both ears were tested for bacterial aetiologies and their sensitivity patterns. *Pseudomonas Aerogiunosa was found in* 28 [33%], followed by *Proteus Spp 20 [23%]*, *staphylococcus aureus* 18 [21%], *E. Coli* 14 [16%], *Klebsiella* 2 [2%] and the least was *Enterobacteria,* with one positive culture, accounting for only 1%. Sterile samples was found in three cases accounting for 4% (table 1).

Table 1: Patterns of bacterial isolates from children with CSOM

Pathogen	**Percentage [n=86]**
Pseudomonas Aerogiunosa	28 [33%]
PrteusSpp	20 [23%]
staphylococcus aureus	18 [21%]
E. Coli	14 [16%]
Klebsiella	2 [2%]
Enterobacteria	1 [1%]
Sterile	3 [4%]

The antibiotic disks used were; Ampicillin, Gentamicin, Chloramphenicol, Ciprofloxacillin, Neomycin, Cefuroxime, Augmentin, Cephaclor and Azithromycin. Four antibiotics are available in the form of ear drops and frequently used on management of CSOM, they are; Ciprofloxacillin, Gentamicin, Chloramphenicol and Nemycin. The antibiotic profile showed the majority of *Pseudomonas Aerogiunosa 26/28* [93%], *Proteus Spp* 20/20 [100%], *staphylococcus aureus* 17/18 [94%], and *E. Coli* 14/14 [100%] were sensitive to ciprofloxacillin (table 2).

Table 2: antimicrobial susceptibility to isolated pathogens from CSOM cases

Antibiotics profile	Antimicrobial susceptibility %			
	Pseudo. Aero[a] [n = 28]	*Proteus spp [n=20]*	*Staph. Aureus*[a] *[n=18]*	*E. Coli*[a] *[n=14]*
Ampicillin	[5: 18%]	[0: 0%]	[2: 11%]	[0: 0 %]
Gentamycin	[18: 64%]	[15: 75%]	[8: 47%]	[1: 7%]
Chloramphenicol	[22: 79%]	[16: 80%]	[16: 89%]	[13: 93%]
Ciprofloxacillin	[26: 93%]	[20: 100%]	[17: 94%]	[14: 100%]
Neomycin	[14: 50%]	[15: 75%]	[7: 38%]	[5: 36%]
Ceforuxim	[23: 82%]	[16: 80%]	[14: 78%]	[9: 64%]
Azithromycin	[12: 43%]	[12: 60%]	[9: 50%]	[8: 57%]
Augmentin	[8: 29%]	[10: 50%]	[9: 50%]	[12: 86%]
Cephaclor	[15: 54%]	[12: 60%]	[9: 50%]	[13: 93%]

[a]; *Pseudomonas Aerogiunosa, staphylococcus aureus, Escherichia Coli.*

Discussion

Chronic Suppurative Otitis Media is still widely seen in the world, especially in a number of low income countries and in some high risk group in the richest countries. The disease and its association of hearing impairment has been documented in Yemen (26), adversely affecting cognition and school performance. Bacterial infections and antimicrobial susceptibilities play an important roles in the pathogenesis and exacerbation of CSOM, intensifies persistency and recurrences, makes treatment are more challengeable (27-30). Knowledge of microbial patterns and antimicrobial sensitivity will assume proper intervention, lowering adverse complications and enhancing good cognition and school performance.

In the current study, 76 children aged 1-16 years with a diagnosis of CSOM were tested, boys were found to be slightly higher than girls. This is in corroborates with several studies have reported high prevalence of CSOM among children in developing countries (18-21). Factors including; recurrent upper respiratory tract infection, overcrowding, poor hygiene, swimming in local pools and parents with low education are known to lead to high CSOM in children.

The result of this study yield high culture positive cases of CSOM, with monomicrobial and polymicrobial isolates of 72/86 [84%] and 11/86 [13%] respectively. Few cases yield no growth [3%].The present findings is consistent with studies from Asia and Africa have reported bacterial isolates ranged from 50%-100% (15,27,30-32).This could be attributed to the geographical variations, nature of microorganisms and antimicrobial susceptibility, exposure to partial treatment and technical issues.

The predominant causative pathogens was *Pseudomonas Aerogiunosa* [28:33%] followed by *proteus spp* [20:23%] and *staphylococcus aureus* [18:21%]. In corresponding to the present findings, the study by Ba-Othman (33) from Yemen was aimed to determine the bacteriological findings and antibiotic susceptibility profile of CSOM in Mukalla city; investigated 218 reports of patients aged 3-52 [mean 13.1] and recovered *proteu spp* as the most predominant isolated microorganism [102: 46.7%] followed by *pseudomonas aeruginosa* [81: 37.2%] and *staphylococcus aureus* [24: 11%].However, findings in the current study are in consistent with several studies from Asia and Africa indicates *pseudomonas spp as* a predominant isolated organism (15,18-20).This could be explained by the condition of the tympanic membrane, through which, *pseudomonas spp* can invade the perforated membrane into the

middle ear cleft causing CSOM. Poor hygiene and swimming in local pools are known contributing factors for cases of CSOM with *pseudomonas spp* growth. In the region, the Jordanian study (31) indicates *staphylococcus aureus* with 59.9% as a predominant isolated microorganism but it was for OM. Meanwhile, *staphylococcus aureus* has reported as a commonest isolated pathogen by Rajat, et al. (21) from India 48.7%, Ettehad, et al. (22) from Iran 31.15%, Obi, et al. (23) from Nigeria 33.6% and Singh, et al. (32) from India with 36%. It is crucial that these organisms are considered in developing management options for CSOM in children. Other gram-negative rods including *Escherichia coli*, *Klebsiella* and *Enterobacteria* were isolated from 14[16%], 2[2%] and 1[1%] respectively. This is in agreement with previous reports from developing countries (30-32). In the current study, fewer cases yield no growth and there was no samples tested for anaerobic bacteria and fungal species. This is one limitation of this study; a complete test of both aerobic and anaerobic pathogens as well fungal species would be more likely to provide a true estimate of different organisms. All the species were sensitive to *ciprofloxacillin antibiotic*. The current findings are in agreement with many reports about the developing world (14,15,18,34,35). In Yemen, there are four topical antibiotics in wide use; *chloramphenicol, neomycin, gentamicin and ciprofloxacillin.* Although there is controversy about the efficacy of topical antibiotics versus its toxicity, the recent updates have indicated the superiority of topical antibiotics in the management of CSOM, and topical quinolon was found to be effective and superior to other topical antibiotics (36). In the current study, the antibiotic *ciprofloxacillin* was sensitive to all pathogens, making this antibiotic the proper choice for CSOM management. Implications for practice comes from the concern that CSOM is an important cause of preventable hearing impairment and early detection and management of CSOM is essential in controlling the disease, preventing hearing loss and adverse complications. A medical approach is the standard advice and is composed of two components; aural toilet and antimicrobial agents. In some severe cases, who fail to respond to the medical approach, a proper surgical intervention will be a next step. Aural toilet is advised as an initial step, and it should continue during the period of management. It involves suctioning the middle ear and canal, dry mopping with cotton-tipped applicators, or wicking the ear, with boiled normo-saline or plain water to body temperature and/or diluted hydrogen-peroxide (37), and to be accompanied by antimicrobial agents. A Cochrane systematic review of randomized controlled trials (36); analysed 9 trials, 833 randomised participants; 842 analysed participants or ears, have found topical quinolone antibiotics were better than systematic antibiotics at clearing discharge at 1 week, relative risk [RR] were, 3.21 [95% confidence interval CI 1.88 to 5.49]. Despite use and safety of quinolone in children remains the subject of discussion, Cochrane Review on safety of ciprofloxacin use in children indicates that the drug is safe and well tolerated (37,38).

The other concern is whether long term antibiotic use is effective in reducing the recurrent episodes of CSOM or not. A review of RCTs published in the Cochrane library by Leach and Morris (39) aimed to determine the effectiveness of long-term antibiotics [six weeks or longer] in preventing any AOM, AOM with perforation and CSOM. The participants in the review are children aged zero to 18 years at an increased risk of future episodes of AOM and the primary outcome is prevention any AOM/CSOM during intervention, and prevention episodes of AOM/CSOM during intervention. 17 studies including 1586 children were eligible for randomized controlled trials.16 studies were of high quality and reported data for the primary outcomes. All participants were children at high risk of AOM and seven studies reported data for children prone to CSOM.The primary outcome: the 14 studies with 1461 children found that long-term antibiotics reduced any episode of AOM/CSOM, RR O.65 95% CI 0.53-0.79; random-effects model.For the number of episodes of AOM/CSOM, the data from 13 studies [1327 children], found the Incidence Rate Ratio, IRR 0.51, 95% CI 0.39 - 0.66; random-effects model. This indicates that one in every five could avoid long-term treatment and 1.5 episodes of AOM could be prevented for every 12 months of treatment per child.The implications for practice is that, this review indicates that long-term antibiotics are effective in reducing the recurrent episodes of AOM/CSOM, but the recommendation cannot be generated as there is not enough evidence for the effectiveness beyond the treatment period and there is a need for research on the effectiveness of long-term antibiotic therapy of CSOM at completion of the intervention [6 to 12 months].

Conclusion

The aetiological agents of CSOM in the children studeid demonstrates a commonest of *Pseudomonas aeroguinosa* and *proteus spp* followed by *staphylococcus aureus.* All organisms were sensitive to ciprofloxacillin. Implications for treatment indicate quinolone as a good option in the treatment of CSOM. There is a need for better

understanding of microbial and antimicrobial profiles of CSOM in the region.

Conflict of Interest

The Authors declare that there is no conflict of interest.

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