

Isolation and Characterization of Bacteria Causing Acute Suppurative Otitis Media in Egypt

Maryam Kotb^{1*}, Maged Bahgat², Shabaan Hashem³,
Hussein Sabit⁴, and Marwan ElBagoury⁵

¹Department of Microbiology and Immunology, Faculty of Pharmacy,
Modern University for Technology & Information, Cairo, Egypt.

²Department of Otolaryngology, Faculty of Medicine, Cairo University, Cairo, Egypt.

³Department of Microbiology and Immunology, Faculty of Medicine, Assuit University, Assuit, Egypt.

⁴Department of Microbial Genetics, Faculty of Biotechnology,
Misr University for Science and Technology, 6th of October, Egypt.

⁵Universität Ulm - Medizinische Fakultät, Ulm, Deutschland.

<http://dx.doi.org/10.22207/JPAM.11.4.22>

(Received: 01 November 2017; accepted: 10 December 2017)

Microbiology and susceptibility of middle ear (ME) pathogens are changing continuously. The aim of the present study was to report the isolation and characterization of causative bacteria involved in acute suppurative otitis media (ASOM) in Egypt. The study was conducted for a period of 6 months from February 2009 - August 2009. Seventy six patients with ASOM of all age groups and both sexes attending Kasr Al Aini Teaching Hospital outpatient clinic were randomly selected for the study. Seventy eight pus samples were obtained for the study. The results have shown that *Staphylococcus aureus* was the most common causative microorganism (78.37 %), followed by *Streptococcus pneumoniae* (13.79 %).

Keywords: Otitis media, acute suppurative otitis media,
Staphylococcus aureus, *Streptococcus pneumoniae*, Egypt.

Acute suppurative otitis media is inflammation of the mucous membrane lining of the middle ear cleft (consisting of the eustachian tube, tympanic cavity, mastoid antrum and mastoid air cells) produced by pus-forming organism¹. It is a disease of multiple etiologies and is well known for its recurrence. ASOM often starts in infancy, and is among the top common childhood illnesses. It mainly affects children². Infections usually results from bacterial and fungal causes, and in some cases secondary to other viral infections like upper respiratory tract infections (URTI)³. It may result

in serious complications as mastoiditis, meningitis or intracranial abscess⁴.

In the pre-antibiotic era of the early 1900s, β -haemolytic group A *Streptococcus pyogenes* (*S. pyogenes*, group A *Streptococcus*, GAS) was the most common frequently isolated pathogen from people with acute otitis media (AOM), especially when AOM was a complication of acute tonsillitis or scarlet fever^{5, 6}. However, since the 1950s, it has been rapidly replaced by *S. pneumoniae*, *H. influenzae*, and *M. catarrhalis*^{5, 7}, which are nowadays the main bacterial pathogens followed by other less frequent pathogens as *S. aureus*, and more rarely, anaerobic Gram negative bacilli such as *Escherichia coli* or *Pseudomonas aeruginosa*^{8, 9}. With the advent of antibiotics, the incidence of complications had decreased. However, due

* To whom all correspondence should be addressed.
Tel.: +201005141223;
E-mail: maryamkotb@hotmail.com

to unnecessary and improper use of antibiotics, resistance by bacteria, and increase in susceptibility of individuals, complications still occur. Prevention of the disease by risk factor modification is attractive because it diminishes the costs and the side-effects of antimicrobial therapy and surgery¹⁰. The study of the microorganisms commonly associated with ASOM is very pertinent for the clinician to plan a general outline of treatment. Despite the frequent diagnosis of ASOM in our hospitals, little information exists in the literature of this condition. Therefore, the present study was carried out to report the isolation and characterization of causative bacteria involved in ASOM.

MATERIALS AND METHODS

Subjects

The study population consisted of 76 outpatients who visited Kasr Al Aini Teaching Hospital, Cairo, Egypt outpatient clinic from February 2009 - August 2009, and were diagnosed with ASOM according to the results of their medical history and physical examinations. The population included 45 males, and 31 females.

Collection of Samples

Middle-ear aspirates for cultures were collected aseptically. The external auditory canal was thoroughly cleaned with 70% alcohol first and was allowed to act for 30-40 seconds to achieve sterile area. Then the contents of the ME were aspirated into the syringe. All clinical samples were transported to the Bacteriology laboratory at Faculty of Biotechnology, Misr University for Science and Technology, 6th of October City, Egypt.

Isolation and identification of bacteria

Collected samples were inoculated in blood agar, nutrient agar, chocolate agar, and

MacConkey agar plates. All plates were incubated aerobically at 37°C for 24 hours. Then all samples were subjected to Gram stain and biochemical reactions. Isolates were identified by colony morphology, gram staining reaction, catalase test, coagulase test, mannitol fermentation, blood hemolysis, and optochin sensitivity as per standard procedures¹¹.

RESULTS

Seventy six patients were examined by the attending otorhinolaryngologists during the period of the study. They were diagnosed as having ASOM based on the criteria employed (Table 1); 74 (97.36 per cent) of these presented with unilateral discharging ears, while only 2 (2.63 per cent) presented with bilateral discharging ears (Table 2). Of these patients, 54 (71.05 per cent) presented with infected left ear, while 20 (26.31 per cent) presented with infected right ear. Forty five patients (59.21 per cent) were males and 31 (40.78 per cent) were females. Their age ranged from 5 to 80 years old. The incidence in relation to their sex and age is shown in Table 3. Thirty patients (39.47 per cent) presented in winter, while 10 patients (13.15 per cent) presented in summer (Table 4).

Table 5 shows that the total number of cultures was 78, all of which were monomicrobial; no polymicrobial cultures. Out of the total 78 cultures, *S. aureus* accounted for 66 cultures (78.37 per cent), while *S. pneumoniae* accounted for 12 cultures (13.79 per cent) as shown in Table 6.

DISCUSSION

The study was carried out to determine the incidence of ASOM at Kasr Al Aini Teaching Hospital, Cairo, Egypt. The age ranged from 5 to 80 years. The criteria considered for diagnosing ASOM were those suggested in literature^{12, 13}.

Table 1. Clinical and diagnostic profile of ASOM subjects

Symptoms and signs	No. of Patients (%)
Otorrhea	76 (100)
Perforation of tympanic membrane	76 (100)
Nasal discharge	48 (63.15)
Otalgia	76 (100)
Ear itching	3 (3.94)
Hearing loss	4 (5.26)

Table 2. Distribution of ASOM subjects according to Laterality & the side of the ear affected

Laterality	Unilateral		Bilateral	Total
	Right	Left		
No. of Patients (%)	20 (26.31)	54 (71.05)	2 (2.63)	76

All the studied patients presented with perforated tympanic membrane, otalgia, and otorrhea. Forty eight patients (63.15 per cent) presented with nasal discharge, while 3 patients (3.94 per cent) presented with ear itching, and 4 patients (5.26 %) presented with hearing loss. These ratios are approximately similar to those obtained by Iseh and Adegbite [14] who have found otorrhea and tympanic membrane perforation in all their studied subjects, but the nasal discharge and otalgia were found in 47.7 per cent and 35 per cent of their studied population respectively. Ear itching was found in 3.4 per cent, and hearing loss was found in 2.5 per cent of the subjects.

In this study, unilateral infection was predominant (97.37 per cent), while bilateral infection was found in only 2.63 per cent, with a higher with left side incidence (71.05 per cent) compared to that of the right side (26.31 per cent). Olasunkanmi Oladapo¹⁵ also has found that unilateral infection accounted for 85.6 per

cent of his studied population while bilateral infection accounted for 14.4 per cent. On the contrary, Eugene Leibovitz *et al*¹⁶ have found a predominance of bilateral infection over unilateral infection.

Our study showed that the maximum number of cases was found in the age group 5-10 years suggesting that the disease is highly incident in children. In a similar study, Iseh and Adegbite¹⁴ reported that the majority of their studied subjects were within the age range 0-15 years, out of which 0-5 years accounted for 67.5 per cent. Children are more liable to ASOM because of being susceptible to upper respiratory tract infections, and having shorter, wider, more horizontal eustachian tube¹⁷⁻¹⁹.

The higher incidence of ASOM in males recorded in the study correlates with other incidences reported by various studies^{14, 20, 21}, whereas Olasunkanmi Oladapo has found a slight predominance in females¹⁵. No rationale has been given for the inequality^{1, 22}, while Rakesh Kumar *et al*²³ suggested that the male predominance may be due to their more exposed way of life.

Among the studied cases, ASOM was more prevalent during winter (39.47 per cent), than in summer (13.15 per cent). This was also found by Eliza Royan *et al.* in a prospective cohort study²⁴. Increased incidence of ASOM in winter is

Table 3. Incidence of ASOM among subjects in relation to their age and sex

Age (yrs)	Total number involved (%)	Sex	
		Male n (%)	Female n (%)
5-10	28 (36.8)	15 (19.73)	13 (17.10)
10-15	7 (9.21)	4 (5.26)	3 (3.94)
15-20	3 (3.94)	2 (2.63)	1 (1.31)
20-25	4 (5.26)	1 (1.31)	3 (3.94)
25-30	3 (3.94)	2 (2.63)	1 (1.31)
30-35	2 (2.63)	2 (2.63)	0 (0)
35-40	1 (1.31)	1 (1.31)	0 (0)
40-45	1 (1.31)	0 (0)	1 (1.31)
45-50	2 (2.63)	1 (1.31)	1 (1.31)
50-55	4 (5.26)	3 (3.94)	1 (1.31)
55-60	3 (3.94)	1 (1.31)	2 (2.63)
60-65	11 (14.47)	7 (9.21)	4 (5.26)
65-70	4 (5.26)	3 (3.94)	1 (1.31)
70-75	2 (2.63)	2 (2.63)	0 (0)
75-80	1 (1.31)	1 (1.31)	0 (0)
Total	76	45 (59.21)	31 (40.78)

Table 5. Incidence of Monomicrobial and polymicrobial cultures among ASOM subjects

Monomicrobial Cultures	Polymicrobial Cultures	Total
78 (100%)	0	78 (100%)

Table 4. Season wise distribution of ASOM subjects

Month	No. of Patients (%)
February	30 (39.47)
March	20 (26.31)
April	10 (13.15)
May	6 (7.89)
June	4 (5.26)
July	4 (5.26)
August	2 (2.63)
Total	76

Table 6. Distribution of Isolated Microorganisms among the cultures

Microorganism	No. of Isolates (%)
<i>S. aureus</i>	66 (78.37)
<i>S. pneumoniae</i>	12 (13.79)

mainly attributed to repeated upper respiratory tract infection²⁵.

In the present study, all cultures were monomicrobial indicating a 100 percent monomicrobial etiology and absence of polymicrobial etiology. On the contrary, chronic suppurative otitis media (CSOM) always show a considerable percentage of polymicrobial etiology. Upon isolating the organisms associated with CSOM in a tertiary care setup of Uttarakhand State, India, Rajat Prakash et al²⁶ have found that 57.84 per cent of samples showed monomicrobial growth whereas 33.33 per cent showed polymicrobial growth.

The organisms isolated were *S.aureus* and *S. pneumoniae*. *S.aureus* was frequently isolated (78.37 per cent) than *S. pneumoniae* (13.79 per cent). The predominance of *S.aureus* is similar to that found by Iseh and Adegbite who have found that *S. aureus* (46.2 per cent) was the commonest organism cultured in their study¹⁴. On the other hand, *S. pneumoniae* was the most cultured organism (82 per cent) by Katherine B Gibney et al²⁷. In another study carried out in So Paulo, Brazil²⁸, *S. pneumoniae* accounted for 16 per cent of the pathogens isolated from Brazilian children with acute otitis media, whereas *S. aureus* accounted for only 1 per cent. In Warsaw, Poland²⁹, *S. pneumoniae* was the most frequently isolated pathogen (39.69 per cent) from the middle ear in children with acute otitis media treatment failure, while *S.aureus* was isolated from 16.03 per cent of the subjects. The difference in the distribution of bacteria may be due to the geographical variability¹⁴.

REFERENCES

1. Ransome, J., Acute suppurative otitis media and acute mastoiditis. *Scott-Brown's Otolaryngology-Otology*, 1987. **3**: p. 203-214.
2. Kong, K. and H.L. Coates, Natural history, definitions, risk factors and burden of otitis media. *Medical Journal of Australia*, 2009. **191**(9): p. S39.
3. Gitiban, N., et al., Chinchilla and murine models of upper respiratory tract infections with respiratory syncytial virus. *Journal of virology*, 2005. **79**(10): p. 6035-6042.
4. Arvind, R., 100+ Clinical Cases In Paediatrics. 2008: Elsevier India Pvt. Limited.
5. Segal, N., et al., Acute otitis media caused by *Streptococcus pyogenes* in children. *Clinical infectious diseases*, 2005. **41**(1): p. 35-41.
6. Shulman, S.T. and R.R. Tanz, Streptococcal otitis media: from epidemiology to pathogenesis. *Clinical Infectious Diseases*, 2005. **41**(1): p. 42-44.
7. Bluestone, C.D., J.S. Stephenson, and L.M. Martin, Ten-year review of otitis media pathogens. *The Pediatric infectious disease journal*, 1992. **11**(8): p. S7-11.
8. del Castillo, F., et al. National consensus on acute otitis media (OMA). in *Anales de pediatria* (Barcelona, Spain: 2003). 2007.
9. Lopez, P., et al., Non-typeable *Haemophilus influenzae* and *Streptococcus pneumoniae*: Primary causes of acute otitis media in Colombian children. *International Journal of Infectious Diseases*, 2010. **14**: p. e416-e417.
10. Halter, R., G. Kelsberg, and J. Nashelsky, Is antibiotic prophylaxis effective for recurrent acute otitis media? *Clinical Inquiries*, 2004 (MU), 2004.
11. Cheesbrough, M., *District laboratory practice in tropical countries*. 2005, Cambridge: Cambridge University Press.
12. Block, S.L. and C.J. Harrison, *Diagnosis and Management of Acute Otitis Media*. 2005: Professional Communications, Incorporated.
13. Lieberthal, A.S., et al., The diagnosis and management of acute otitis media. *Pediatrics*, 2013. **131**(3): p. e964-e999.
14. Iseh, K. and T. Adegbite, Pattern and bacteriology of acute suppurative otitis media in Sokoto, Nigeria. *Annals of African Medicine*, 2004. **3**(4): p. 164-166.
15. Olubanjo, O., Epidemiology of Acute Suppurative Otitis Media in Nigerian Children. *Internet Journal of Pediatrics and Neonatology*, 2007. **8**.
16. Leibovitz, E., et al., Is bilateral acute otitis media clinically different than unilateral acute otitis media? *The Pediatric infectious disease journal*, 2007. **26**(7): p. 589-592.
17. Kemp, E.D., Otitis media. *Prim Care*, 1990. **17**(2): p. 267-87.
18. Mainous, A.G. and C. Pomeroy, *Management of Antimicrobials in Infectious Diseases: Impact of Antibiotic Resistance*. 2010: Humana Press.
19. Zielhuis, G.A., G.H. Rach, and P. van den Broek, Predisposing factors for otitis media with effusion in young children. *Adv Otorhinolaryngol*, 1988. **40**: p. 65-9.
20. Abubakar, K., et al., Pattern of Drug Utilization in the Treatment of Chronic Suppurative Otitis Media in a Tertiary Health Institution in Kaduna, Nigeria. *Journal of Health Science*, 2014. **4**(1): p. 7-10.

21. Kumar, R., et al., Isolation and antimicrobial sensitivity profile of bacterial agents in chronic suppurative otitis media patients at NIMS Hospital. Jaipur. *IJPBS*, 2013. **3**(4): p. 265-9.
22. Jonathan, M., et al., Antibacterial susceptibility spectrum of some gram negative bacteria from suspected Otitis media patients. *African Journal of Microbiology Research*, 2016. **10**(32): p. 1280-1285.
23. Kumar, R., R. Agarwal, and S. Gupta, A Microbiological Study Of Chronic Suppurative Otitis Media. *International Journal of Recent Scientific Research*, 2015. **6**(7): p. 5487-5490.
24. Roy, E., et al., Acute otitis media during the first two years of life in a rural community in Bangladesh: a prospective cohort study. *Journal of health, population, and nutrition*, 2007. **25**(4): p. 414-421.
25. Bluestone, C.D. and M.B. Bluestone, Eustachian Tube: Structure, Function, *Role in Otitis Media*. 2005: BC Decker.
26. Prakash, R., et al., Microbiology of chronic suppurative otitis media in a tertiary care setup of Uttarakhand state, India. *North American journal of medical Sciences*, 2013. **5**(4): p. 282-287.
27. Gibney, K.B., et al., The clinical course of acute otitis media in high-risk Australian Aboriginal children: a longitudinal study. *BMC pediatrics*, 2005. **5**(1): p. 16.
28. Sih, T.M., Acute Otitis Media in Brazilian Children: Analysis of Microbiology and Antimicrobial Susceptibility. *Annals of Otolaryngology & Laryngology*, 2001. **110**(7): p. 662-666.
29. Zielnik-Jurkiewicz, B. and A. Bielicka, Antibiotic resistance of *Streptococcus pneumoniae* in children with acute otitis media treatment failure. *International Journal of Pediatric Otorhinolaryngology*, 2015. **79**(12): p. 2129-2133.