

Otitis Media in Children: A Review

A.Ashik Ahamed

Student -BDS, Saveetha Dental College, Chennai

Karpagam Krishnamoorthy

Saveetha Dental College, Chennai

INTRODUCTION

Otitis media (OM) is one of the severe healthcare problems in the world because of the suffering it poses upon the patient and the family and also because of the economic burden it forces the health care system. Otitis media is defined as an inflammation of the middle ear, without having any specific aetiology or pathogenesis. Because, all sinuses of the temporal bone are contiguous, infection of the middle ear may also cause inflammation and infection in the other three regions of sinuses^[1].

Otitis media is the inflammation of the mucous membrane of the middle ear which includes the middle ear cavity, mastoid air cells, mastoid antrum and the Eustachian tube^[11]. If the inflammation is associated with a discharge from a perforation in the tympanic membrane, suppurative Otitis media results. It can be acute or chronic^[12]. It is one of the most common infectious diseases of the childhood in the world^[13]. 2 out of 3 children will have at least one episode of Otitis media before the third birthday^[11]. Many prevalence rates of O. media have been documented in the world^[14, 16]. Infants and young children are at a higher risk of developing Otitis media^{[13][15]}. OM is prevalent among children with cleft lip and palate and other craniofacial defects, and those from lower socio-economic status^[13, 17]. Bacteria are the most important etiological agents in suppurative or discharging Otitis media^{[18][19][20]}. The resistance to antibiotics is common, predisposing children to complications^[21, 22].

The acute, sub acute, and chronic terms are used. Acute Otitis media (AOM) is an inflammation of the middle ear that presents with a rapid onset of symptoms and signs of up to three weeks duration. Chronic disease has many synonyms, including serous OM, glue ear, secretory OM, and implies middle ear fluid that has been present for three months or longer. The sub-acute term is in between. Recurring AOM is defined as three episodes within six months or four episodes within one year^[1].

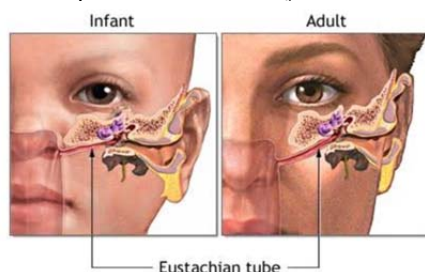


Figure.1: Comparison of Eustachian tubes of adult and child. The Eustachian tube of the human child is shorter, narrower, and more horizontal than that of the adult human. Neil K. Kaneshiro, MD, MHA, Clinical Assistant Professor of Paediatrics, University of Washington School of Medicine. Last reviewed on 5/16/2012

The Eustachian tube goes from the middle of ear in both sides to the back of the throat. The Eustachian tube drains fluid normally made in the middle part of the ear. If it becomes blocked, the fluid cannot be drained and would build up. This can lead to ear or even throat infection. Ear infections are common in infants and young children, because the Eustachian tubes become easily clogged. Ear infections may also occur in adults, although they are less common than in children. The difference in the shape of the Eustachian tube in the children and adult is shown in figure.1.

Otitis media (OM) is a collective term for a group of inflammatory and infective conditions affecting the middle ear. Otitis media involves pathology of the middle ear and middle ear mucosa. Otitis media is one of the leading causes of healthcare visits and the complications of OM are important causes of preventable hearing loss^{[23][24]}.

There are various types. These include AOM, OME, chronic suppurative Otitis media (CSOM). These are described as a distinct diseases but there is some degree of relation between the types. The OM may be a combination of diseases:

Acute Otitis media (AOM) is acute inflammation of the middle ear which may be caused by various types of infectious microorganisms such as bacteria, viruses, etc. A subtype of AOM is acute suppurative OM, characterised by the presence of pus in the middle ear.

Otitis media with effusion (OME) is a chronic condition without acute incidence, which follows a slowly resolving AOM. There is an effusion of glue like fluid in the absence of signs and symptoms of acute inflammation.

Chronic suppurative Otitis media (CSOM) is a chronic suppurative middle ear inflammation, usually with a perforated tympanic membrane.

Most children with acute condition experience a self-limiting episode. A few will have problems and may require referral.

This review suggests the clinical features, sequelae and the management of childhood Otitis media.

METHODS AND MATERIALS

Google and Pub Med and certain journals were searched for articles on Otitis media and children. Search was restricted to English language, and used the following searches in Google:

Otitis media in children and Otitis media in paediatrics and Otitis media and clinical features, Otitis media and epidemiology or complications or sequelae, determinants and causative organisms or causes, Otitis media at very young age, incidence and prevalence, challenges or management and treatment. Overall, from various articles, only 15 were selected and researched. The references were

inspected and included for related relevant articles. These were selected, analysed and reviewed.

Clinical Features

Predisposing factors:

- Smoking and wood smoke [12] [31] [32] [33]
- Upper respiratory tract infections [29] [34]
- Day care attendance [29] [31] [32] [35] [36]
- Familial conditions [37]-[40]
- Overcrowding [41]
- Short duration of breast-feeding and bottle feeding [12]
- Use of pacifiers and presence of digit sucking [33]
- Cleft palate, Down syndrome and other similar defects [13]
- Measles, pertussis, tuberculosis and immunosuppression [42] [43]

Symptoms: Acute Otitis Media usually presents with sudden onset of symptoms such as Malaise, pain, irritability, crying, restlessness, rhinorrhoea, fever, vomiting.

Signs: OME on examination may reveal high temperature, a reddish yellow or cloudy tympanic membrane, air-fluid level behind the tympanic membrane, bulging of the tympanic membrane, discharge in the ear canal after the perforation of the tympanic membrane and the pinna may be red.

Children below 6 months may display non-specific symptoms. Perforation of the eardrum relieves pain.

Otitis media with effusion generally follows AOM. OME in patient includes any of the following symptoms: Hearing loss, tinnitus, vertigo, and otalgia.

Sequelae

Otitis media is a general term for all types of inflammation of the middle ear [24] [25]. Acute Otitis media (AOM) is characterised by the sudden onset of symptoms or signs of acute inflammation. It is frequently preceded by an upper respiratory symptoms [24] [25]. The Chronic suppurative Otitis media (CSOM) is defined as a persistent inflammatory condition associated with a perforated tympanic membrane, discharging pus for more than 6 weeks [26]. Hearing impairment is the partial or total inability to hear sound in one or both ears [27]. Conductive hearing loss (CHL) is the partial or total inability to hear sound in one or both ears because of some mechanical problem in the external or middle ear. The fluid accumulated due to the obstruction in the middle ear can cause CHL [27]. Sensorineural hearing loss (SNHL) is the partial or total inability to hear sound in one or both ears resulting from a damage to the inner ear. It occurs when the cilia that transmit sound through the ear are injured. This sensorineural type of hearing loss is sometimes called to be nerve damage, but this is not accurate [27]. WHO defines disabling hearing impairment as having permanent unaided hearing threshold in the better ear of more than 30 dB in children aged up to 15 years, or more than 40 dB in adults at frequencies of 0.5, 1, 2, and 4 kHz [28].

Complications of CSOM occur if infection spreads from the middle ear to other regions. The complications are generally classified into 2 types:

1. Intratemporal (within the temporal bone):

- Hearing impairment is more prolonged and

pronounced in chronic than acute Otitis media with suppuration.

- Petrositis occurs when the infection spreads from the middle ear and mastoid to the petrous part of temporal bone. The diagnosis can be done by x-rays (Towne's and Stenver's method) and CAT of temporal bone [29] [30].
 - Acute mastoiditis may result which is the inflammation of the mucosal lining of the mastoid air cell system. AM usually follows acute suppurative Otitis media.
 - Labyrinthitis occurs if the infection spreads to the labyrinth [29].
 - Facial paralysis results as a complication of acute and chronic Otitis media. Facial nerve function completely convalesces if acute Otitis media is controlled with systemic antibiotics. Survival interventions like Myringotomy or cortical mastoidectomy may be needed.
- #### 2. Intracranial complications of Otitis media:
- Collection of pus between the bone and dura mater may occur which would result in extradural abscesses. Pus can also get collected between the Dura and arachnoid mater leading to subdural abscess.
 - Inflammation of the space between pia and arachnoid and of the cerebrospinal fluid can result in meningitis [22]. Cerebral abscess is another complication associated with extradural abscess. The Cerebellar abscess is another complication. Generally, brain abscess is associated with other complications, such as extradural abscess, meningitis, peri-sinus abscess, labyrinthitis, sinus thrombosis.
 - Lateral sinus (sigmoid sinus) thrombophlebitis is the inflammation of the inner wall of the lateral venous sinus along with the formation of thrombus. Hydrocephalus due to Otitis is characterised by increased intracranial pressure with normal cerebrospinal fluid findings [29] [30]. Its origin may be from thrombosis from the lateral sinus leading to the superior sagittal sinus.

DIAGNOSIS

Auroscopy/otoscopy:

An otoscope with a good bulb and a good power source, and the tympanic membrane which is not occluded by cerumen, are necessary to make the correct diagnosis of Otitis media [29] [41]. The discharge may be serous, serosanguineous or mucopurulent [52]. Removing cerumen and crying can cause erythema of the eardrum; therefore solely erythema of the tympanic membrane should not be the basis for the diagnosis of AOM [53]. In OME, Otoscopic findings include air-fluid levels and clear or tawny ear fluid and can be associated with negative ear pressure [12]. In CSOM, visualisation of the tympanic membrane would reveal perforation. If the perforation is wide, the condition of the middle ear mucosa can be assessed easily. Also polyps, crusts, discharge may be seen and identified [52].

Pneumatic otoscopy/auroscopy:

A pneumatic otoscope has a rubber suction bulb and tube which is used to examine mobility of the tympanic membrane. Pneumatic Otoscopy is helpful in correct

diagnosis of AOM from “red ears”^[12]. If the fluid accumulates in the middle ear, there will be decreased mobility of the tympanic membrane and bulging of the TM can be seen^[13].

Tympanometry:

Tympanometry can identify an effusion but not inflammation^[12]. As there is compliance in the cartilaginous canal of the infants, tympanometry is mostly used for children over the age of 6 months [12].

MANAGEMENT AND TREATMENT

Prevention:

Medical strategies to prevent OM include immunological interventions, the elimination of risk factors for AOM, and antibiotic prophylaxis i.e., vaccinations. The surgical strategies to prevent recurrent OM include prophylactic myringotomy and Tympanostomy tube insertion.

Elimination of risk factors:

The risk factors include daycare attendance, secondary exposure to tobacco smoke, pacifier use, and breastfeeding for less than 3 months. Exposure to the passive smoke is a major risk factor for respiratory tract infections, including Otitis media, due to the pathological and physiological changes in the respiratory tract. As a result, there is an increased incidence of placement of tympanostomy tubes (TT), incidence of chronic and recurrent OM, and otorrhea in children whose mothers smoked^[23].

In February 2013, the American Academy of Paediatrics (AAP) and the American Academy of Family Practice (AAFP) published updated guidelines for the medical management of AOM^[23]^[59]. Their recommendations are summarised as follows:

AOM management should include pain assessment and treatment. Antibiotics should be prescribed for severe AOM in children aged at least 6 months and for nonsevere, bilateral AOM in children aged 6-23 months. The decision should be jointly made with the parents for unilateral, nonsevere AOM in children aged 6-23 months or nonsevere AOM in older children which may be managed either with antibiotics or with close follow-up and withholding antibiotics unless the child worsens or does not improve within 48-72 hours of onset of the symptoms. Amoxicillin is the antibiotic of choice, but it should not be administered if the child received it within 30 days, and if the child has concurrent purulent conjunctivitis, or is allergic to penicillin; therefore, in such cases, clinicians should prescribe an antibiotic with additional beta-lactamase coverage.

Clinicians should reevaluate a child whose symptoms have gone worse or not responded to the initial antibiotic treatment within 48-72 hours and change treatment if indicated. If the children have recurrent AOM, tympanostomy tubes (TTs), but not prophylactic antibiotics, may be indicated to reduce the frequency of AOM episodes. They should recommend pneumococcal conjugate vaccine and influenza vaccine yearly to all children according to updated schedules. They should encourage exclusive breastfeeding for 6 months or longer.

In February 2016, the American Academy of Otolaryngology–Head and Neck Surgery Foundation, the

AAP, and the AAFP issued the following updated guidelines for OME^[29]^[60].

The clinician should perform pneumatic Otoscopy to evaluate for OME in a child with otalgia, hearing loss, or both. If the diagnosis is uncertain after performing pneumatic Otoscopy clinicians should get tympanometry in children with suspected OME. For OME, the clinicians should evaluate at-risk children at the time of diagnosis of an at-risk condition and also at 12 to 18 months of age if diagnosed as the children are at risk prior to this time. The children should not be routinely screened for OME, as they are not at risk and do not have symptoms that may be attributable to OME. The clinicians should manage the child with OME who is not at risk with watchful waiting for 3 months from the date of effusion onset if known or 3 months from the date of diagnosis if onset is unknown. They should recommend against using intranasal steroids or systemic steroids and systemic antibiotics for treating OME. They should recommend against using antihistamines, decongestants, or both for treating OME. They should get an appropriate hearing test if OME persists for 3 months or longer or for OME of any duration in an at-risk child. Clinicians should reevaluate, at 3- to 6-month intervals, the children with chronic OME until the effusion is no longer present. If significant hearing loss is identified, structural abnormalities of the eardrum or middle ear are suspects. They should recommend tympanostomy tubes when surgery is performed for OME in a child younger than 4 years. But the adenoidectomy should not be performed unless a distinct indication such as nasal obstruction, chronic adenoiditis exist other than OME. The physicians should recommend tympanostomy tubes, adenoidectomy, or both when surgery is performed for OME in a child aged 4 years or older.

Surgical care:

It is needed to assess surgical management for AOM and OME with medical treatment. Early surgical interventions may be performed by primary care providers, but more invasive procedures (e.g., myringotomy, TT insertion, and adenoidectomy) require an otolaryngologist. If the patients have the Intratemporal or intracranial complications of OM, surgery is crucial. Some patient populations, such as those with cleft palate, Down syndrome, or other craniofacial abnormalities, may require early surgical intervention to prevent OM.

Tympanocentesis:

The indications for tympanocentesis are OM in patients who have severe otalgia, who are seriously ill, or who appear toxic, who shows no response or reduced response to antimicrobial therapy, who has onset of AOM even after receiving antimicrobial therapy, who has OM associated with a confirmed or potential suppurative complication, and also OM in a newborn, sick neonate, or patient who is immunologically deficient.

Tympanostomy tubes:

In July 2013, the American Academy of Otolaryngology–Head and Neck Surgery Foundation (AAO-HNSF) issued the first evidence-based, multidisciplinary clinical practice

guideline on the use of TTs in children aged 6 months to 12 years who have OM.^{[61][62]} Guideline recommendations include the following:

Many children with OME get better, especially when effusion is present for less than 3 months. Age-appropriate hearing evaluation is needed to be done before surgery and for all children with persistent OME lasting 3 or more months. Clinicians should offer TTs to children with impaired hearing and bilateral OME for 3 or more months. They may perform TT placement in children with unilateral or bilateral OME lasting 3 or more months and associated symptoms, such as vestibular symptoms, school or behavioural problems, ear discomfort, or lowered quality of life. Children with recurrent acute OM without MEE (middle ear effusion) should not undergo TT placement. TT placement could be done for children with MEE to prevent probable future AOM episodes and to facilitate treatment of AOM with ear drops instead of oral antibiotics. If the unilateral or bilateral OME is not likely resolving quickly, children at risk for developmental difficulties (including those with permanent hearing loss; speech, language, or developmental delay or disorder; autism spectrum disorder; Down syndrome; craniofacial disorders; or cleft palate) may benefit from TTs. Children with TTs who develop ear infections, including uncomplicated acute TT otorrhea, should be treated with topical antibiotic ear drops^[63] rather than systemic antibiotics. Children with TTs can usually swim or bath without specific precautions such as earplugs or headbands.

The advantage of adenoidectomy, tonsillectomy, to treat patients with OM has produced wide discussion and research, though the benefits are controversial. Current literature supports the following recommendations from Bluestone^[64]:

Myringotomy and TT placement are the initial surgical techniques (withhold adenoidectomy unless the patient has a nasal obstruction); some experts' advice simultaneous adenoidectomy in patients older than 3 years because this has improved Eustachian tube (ET) function. The repeat surgery includes Myringotomy, with or without TT placement, and adenoidectomy.

If indications such as recurrent tonsillitis, pharyngeal obstruction are present, tonsillectomy could be performed concurrently with surgery for OM.

Myringotomy and TT placement are necessary in most children with cleft palate because of inborn ET dysfunction (ETD) and increased risk of OM. In patients who also have a cleft lip, the TT may be placed at the time of lip repair prior to palate repair. TT placement or replacement at the time of palate repair is needed to be considered.

CONCLUSION

As we see that many studies and researches have shown that the Otitis media is the leading cause of the preventable hearing impairment, we are in greater need to find a way to prevent such causes.

Infants are at higher risk of sequelae from suppurative AOM. Middle ear pathogens include group B streptococcus, enteric bacteria, and *C. trachomatis*^[65]. Febrile neonates with AOM should have a sepsis investigation^[65].

Amoxicillin is acceptable for infants older than two weeks with upper respiratory tract infection and AOM^[66].

Adults with new unilateral, chronic AOM or OME should receive investigation to rule out a serious underlying condition, such as mechanical obstruction, which may be caused by nasopharyngeal carcinoma. They may be caused by Eustachian tube dysfunction from an upper respiratory tract infection. Adults with chronic AOM or OME should be referred to an otolaryngologist.

Acute Otitis media (AOM) is a common condition and a leading cause of health care visits and antibiotic prescription^[2]. Studies in developed countries show that by the third year 80% of children would have experienced at least one episode of AOM^[3,4] and 40% would have six or more recurrences by seventh year^[5]. The burden of AOM varies substantially, the main differences residing in the frequency of suppurative complications such as meningitis and mastoiditis and of sequelae such as hearing loss due to chronic suppurative Otitis media (CSOM)^[2,4]. CSOM is an important cause of preventable hearing loss, particularly in the developing world^[6], and a reason of serious concern in children because it may have effects on early communication, language development, psychosocial and cognitive development, auditory processing and educational progress and achievement^[7].

In developed countries, hearing loss is the third most prevalent chronic condition in older adults after hypertension and arthropathy^[8,9]. There is less information on the adult population of less industrialised countries^[6].

The members of the Expert Group of the Global Burden of Diseases and Injuries and Infections and Risk Factors and certain specialists from various universities in the USA estimated the global burden of Otitis media for all ages for all of the 21 WHO regional areas^[10].

In a survey, 354 children who visited a physician for acute respiratory illness, fever, ear ache, and crying were present frequently (90%) with AOM^{[44][45]}. These symptoms were prominent among children without AOM (72%). Other symptoms of upper respiratory infection, such as cough and nasal discharge accompany AOM and are nonspecific. Clinical history alone is poor predictor of the presence of AOM^[44]. The presence of MEE is commonly confirmed with the use of pneumatic Otoscopy^[46] but can be supplemented by tympanometry^[47] and acoustic reflectometry^{[48][49][50][51]}. The tympanic membrane with inflammatory changes and with the identification of an MEE is the diagnostic criteria with certainty.

The FDA has approved many antibiotics to treat Otitis media. Other clinicians suggest administering corticosteroids combining with a beta-lactam stabilising antibiotic.

Hence, the clinician should confirm the diagnosis by history of acute onset, signs of MEE, and evaluate and arrive at the correct diagnosis. The management should include the assessment of pain. Observation should be done if the antibiotics are not used in uncomplicated cases. If needed, Amoxicillin may be used for children. Clinicians should encourage the reduction of risk factors. Clinicians should consider referral if the OM persists for 3 or more months.

REFERENCES

- Kenna MA. Otitis media with effusion, In: Bailey BJ, editor. *Head & Neck Surgery – Otolaryngology*. 2nd Ed. Philadelphia/New York: J.B. Lippincott Company; 1998: p.1297-310.
- Klein JO (2000) the burden of Otitis media. *Vaccine* 19 Suppl 1: S2–S8
- TeeleDW, Klein JO, Rosner B (1989) Epidemiology of Otitis media during the first seven years of life in children in greater Boston: a prospective, cohort study. *J Infect Dis* 160: 83–94.
- Vergison A, Dagan R, Arguedas A, Bonhoeffer J, Cohen R, et al. (2010) Otitis media and its consequences: beyond the earache. *Lancet Infect Dis* 10: 195–203.
- Casselbrant ML, Mandel EM (2003) Epidemiology. In: Rosenfeld RM, Bluestone CD, eds. *Evidence-based Otitis media*. Hamilton, (ON): BC Decker. pp 147–162.
- Berman S (1995) Otitis media in developing countries. *Paediatrics* 96: 126–131.
- Acuin J (2004) *Chronic suppurative Otitis media –Burden of Illness and Management Options*. Geneva: World Health Organization.
- Cruikshanks KJ, Wiley TL, Tweed TS, Klein BE, Klein R, et al. (1998) Prevalence of hearing loss in older adults in Beaver Dam, Wisconsin. The Epidemiology of Hearing Loss Study. *Am J Epidemiol* 148: 879–886.
- Yueh B, Shapiro N, MacLean CH, Shekelle PG (2003) Screening and management of adult hearing loss in primary care: scientific review. *JAMA* 289: 1976–1985.
- Harvard University, Institute for Health Metrics and Evaluation at the University of Washington, Johns Hopkins University, University of Queensland, World Health Organization (2009) *GBD Study Operations Manual –Final Draft Jan. 2009*.
- Ibekwe, A.O. (1999) Common Ear, Nose and Throat disorders. In: Azubuike, J.C. and Nkanginieme, K.E.O., Eds., *Paediatrics and Child Health in a Tropical Region, African Educational Services, Owerri*, 546-545.
- Berman, S., Johnson, C., Chan, K., Kelley, P. (2001) Ear, Nose and Throat. In: Hay, W.W., Hayward, A.R., Levin, M.J., Sondheimer, J.M., Eds., *Current Pediatric Diagnosis and Treatment*, McGraw-Hill Companies Inc., New York, 400-410.
- Kline, M.W. (1999) Otitis Media. In: McMillan, J.A., DeAngelis, C.D., Feigin, R.D., Warshaw, J.B., Eds. *Oski's Pediatrics. Principles and Practice*. Lippincott Williams & Wilkins, Philadelphia, 1302-1304.
- Chayapham, S., Stuart, J., Chongsuvivatwong, V., Chinpairoj, S. and Lim, A. (1996) A Study of the Prevalence of and Risk Factors for Ear Diseases and Hearing Loss in Primary School Children in Hat Yai, Thailand. *Journal of the Medical Association of Thailand*, 79, 468-472.
- Ibekwe, A.O. and Okafor, J.I. (1983) Pathogenic Organisms in Chronic Suppurative Otitis Media in Enugu, Nigeria. *Tropical and Geographical Medicine*, 35, 389-391.
- Adeleke, S.I. (2003) Bacteriology of Ear Discharges in Children Attending Paediatric Out-Patient Department of Ahmadu Bello University Teaching Hospital, Zaria. A Dissertation in Part Fulfilment of the Part II Finals of the West African Postgraduate Medical College.
- Amusa, Y.B., Ijadunola, I.K.T. and Onayade, O.O. (2005) Epidemiology of Otitis Media in a Local Tropical African Population. *West African Journal of Medicine*, 24, 227-230.
- Bluestone, C.D. and Klein, J.O. (1990) Otitis Media, Atelectasis, and Eustachian tube Dysfunction. In: Bluestone, C.D., Stool, and S.E. and Scheetz, M.D., Eds., *Pediatric Otolaryngology*, W.B. Saunders Company, Philadelphia, 320-486.
- Oni, A.A., Bakare, R.A., Nwaorgu, O.G.B., Ogunkunle, M.O. and Toki, R.A. (2001) Bacterial Agents of Discharging Ears and Antimicrobial Sensitivity Patterns in Children in Ibadan, Nigeria. *West African Journal of Medicine*, 20, 131- 135.
- Coker, O.A., Ijaduola, G.T. and Odugbemi, T.O. (1982) Bacterial Isolates from Chronic Discharging Ears in Nigerian Children. *Nigerian Medical Practitioner*, 4, 170-174.
- Ako-Nai, A.K., Oluga, F.A., Onipede, A.O., Adejuyigbe, E.A. and Amusa, Y.B. (2003) The Characterization of Bacterial Isolates from Acute Otitis Media in Ile-Ife, Southwestern Nigeria. *Journal of Tropical Paediatrics*, 48, 15-23. <http://dx.doi.org/10.1093/tropej/48.1.15>
- Koufman, J.A. (1990) *Core Otolaryngology*. J.B. Lippincott Company, Philadelphia, 69-84.
- Lim DJ, Bluestone CD, Casselbrant ML. Recent advances in Otitis media: epidemiology and natural history. Report of the Sixth Research Conference. *Ann OtolRhinolLaryngol* 1998;107 (10 Suppl): 1.
- SIGN (2003) *Diagnosis and management of childhood Otitis media in primary care –A national clinical guideline*.
- Gates GA, Klein JO, Lim DJ, Mogi G, Ogra PL, et al. (2002) Recent advances in Otitis media. 1. Definitions, terminology, and classification of Otitis media. *Ann OtolRhinolLaryngolSuppl* 188: 8–18.
- Alberta Clinical Practice Guidelines Working Group (2000) *Diagnosis and Treatment of Acute Otitis Media in Children -2008 Update*.
- Medline plus encyclopaedia (2011) *Hearing loss*. National Library of Medicine National Institutes of Health. Available: <http://www.nlm.nih.gov/medlineplus/ency/article/003044.htm>. Accessed 2012 March 19.
- World Health Organization (2001) *International classification of functioning, disability and health: ICF*.
- Paradise, J.L. (2004) Otitis Media. In: Behrman, R.E., Kliegman, R.M., Jenson, H.B., Eds., *Nelson Textbook of Paediatrics*, 17th Edition, Saunders, Philadelphia, 2138-2149.
- Dhingra, P.L. (2004) Disorders of Middle Ear. In: Dhingra, P.L., Ed., *Diseases of Ear, Nose and Throat*, 3rd Edition, Elsevier, New Delhi, 80-112.
- Daly, K.A., Rich, S.S., Levine, S., Margolis, R.H., Le, C.T., Lindgren, B and Giebink, G.S. (1996) The Family Study of Otitis Media: Design and Disease and Risk Factor Profiles. *Genetic Epidemiology*, 13, 451-468. [http://dx.doi.org/10.1002/\(SICI\)1098-2272\(1996\)13:5<451::AID-GEPI2>3.0.CO;2-5](http://dx.doi.org/10.1002/(SICI)1098-2272(1996)13:5<451::AID-GEPI2>3.0.CO;2-5)
- Collet, J.P., Larson, C.P., Boivin, J.F., Suissa, S. and Pless, I.B. (1995) Parental Smoking and Risk of Otitis Media in Pre-School Children. *Canadian Journal of Public Health*, 86, 269-273.
- Uhari, M., Mantysaari, K. and Niemela, M. (1996) A Meta-Analytic Review of the Risk Factors for Acute Otitis Media. *Clinical Infectious Diseases*, 22, 1079-1083. <http://dx.doi.org/10.1093/clinids/22.6.1079>
- Sassen, M.L., Brand, H. and Grote, J.J. (1997) Risk Factors for Otitis Media with Effusion in Children 0 to 2 Years of Age. *American Journal of Otolaryngology*, 18, 324-330. [http://dx.doi.org/10.1016/S0196-0709\(97\)90027-2](http://dx.doi.org/10.1016/S0196-0709(97)90027-2)
- Uhari, M., Hietala, J. and Tuokko, H. (1995) Risk of Acute Otitis Media in Relation to the Viral Biology of Infections in Children. *Clinical Infectious Diseases*, 20, 521-524. <http://dx.doi.org/10.1093/clinids/20.3.521>
- Kvaerner, K.J., Nafstad, P., Hagen, J.A., Mair, I.W. and Jaakkola, J.J. (1996) Early Acute Otitis Media and Siblings' Attendance at Nursery. *Archives of Disease in Childhood*, 75, 338-341. <http://dx.doi.org/10.1136/adc.75.4.338>
- Stenstrom, C. and Ingvarsson, L. (1997) Otitis-Prone Children and Controls: A Study of Possible Predisposing Factors. 1. Heredity, Family Background and Perinatal Period. *ActaOto-Laryngologica*, 117, 87-93. <http://dx.doi.org/10.3109/00016489709117997>
- Bernstein JM. (1996) Role of Allergy in Eustachian Tube Blockage and Otitis Media with Effusion: A Review. *Otolaryngology—Head and Neck Surgery*, 114, 562-568. [http://dx.doi.org/10.1016/S0194-5998\(96\)70247-4](http://dx.doi.org/10.1016/S0194-5998(96)70247-4)
- Juntti, H., Tikkanen, S., Kokkonen, J., Alho, O.P. and Niinimäki, A. (1999) Cow's Milk Allergy Is Associated with Recurrent Otitis Media during Childhood. *ActaOto-laryngologica*, 119, 867-873. <http://dx.doi.org/10.1080/00016489950180199>
- Kvaerner, K.J., Nafstad, P., Hagen, J.A., Mair, I.W. and Jaakkola, J.J. (1997) Recurrent Acute Otitis Media: The Significance of Age of Onset. *ActaOto-laryngologica*, 117, 578-585.

- <http://dx.doi.org/10.3109/00016489709113441>
41. Bluestone, C.D. and Klein, J.O. (1990) Otitis Media, Atelectasis, and Eustachian tube Dysfunction. In: Bluestone, C.D., Stool, and S.E. and Scheetz, M.D., Eds., *Pediatric Otolaryngology*, W.B. Saunders Company, Philadelphia, 320-486.
 42. Ibeziako, N.S. (1999) Common Bacterial Infections. In: Azubuike, J.C. and Nkanginieme, K.E.O., Eds., *Paediatrics and Child health in a Tropical Region*. African Educational Services, Owerri, 410-425.
 43. Obiakor, M.N. (2002) *Diseases of The Ear, Nose and Throat*. Ochumba Press Ltd., Enugu, 55-86.
 44. Niemela M, Uhari M, Jounio-Ervasti K, Luotonen J, Alho OP, Vierimaa E. Lack of specific symptomatology in children with acute Otitis media. *Pediatr Infect Dis J*. 1994;13:765-768
 45. Kontiokari T, Koivunen P, Niemela M, Pokka T, Uhari M. Symptoms of acute Otitis media. *Pediatr Infect Dis J*. 1998;17:676-679
 46. Pelton SI. Otoscopy for the diagnosis of Otitis media. *Pediatr Infect Dis J*. 1998;17:540-543
 47. Brookhouser PE. Use of tympanometry in office practice for diagnosis of Otitis media. *Pediatr Infect Dis J*. 1998;17:544-551
 48. Kimball S. Acoustic reflectometry: spectral gradient analysis for improved detection of middle ear effusion in children. *Pediatr Infect Dis J*. 1998;17:552-555
 49. Barnett ED, Klein JO, Hawkins KA, Cabral HJ, Kenna M, Healy G. Comparison of spectral gradient acoustic reflectometry and other diagnostic techniques for detection of middle ear effusion in children with middle ear disease. *Pediatr Infect Dis J*. 1998;17:556-559
 50. Block SL, Mandel E, McLinn S, et al. Spectral gradient acoustic reflectometry for detection of middle ear effusion by paediatricians and parents. *Pediatr Infect Dis J*. 1998;17:560-564
 51. Block SL, Pichichero ME, McLinn S, Aronovitz G, Kimball S. Spectral gradient acoustic reflectometry: detection of middle ear effusion in suppurative acute Otitis media. *Pediatr Infect Dis J*. 1999;18:741-744
 52. Mills, R.P. (1997) Management of Chronic Suppurative Otitis Media. In: Kerr, G.A. and Booth, J.B., Eds., *Scott- Brown's Otolaryngology*, 3rd Edition, Butterworth-Heinemann, Oxford, 1-11.
 53. Weiss, J.C., Yates, G.R. and Quinn, L.D. (1996) Acute Otitis Media: Making an Accurate Diagnosis. *American Family Physician*, 54, 1212-1216.
 54. Qureishi A, Lee Y, Belfield K, Birchall JP, Daniel M. Update on Otitis media – prevention and treatment. *Infection and Drug Resistance*. 2014;7:15-24. doi:10.2147/IDR.S39637.
 55. Monasta L, Ronfani L, Marchetti F, et al; Burden of disease caused by Otitis media: systematic review and global estimates. *PLoS One*. 2012;7(4):e36226. Epub 2012 Apr 30.
 56. Mathers CD, Lopez AD, and Murray CJL (2006) The burden of disease and mortality by condition: data, methods and results for 2001. In: Lopez AD, Mathers CD, Ezzati M, Jamison DT, Murray CJL, eds. *Global Burden of Disease and Risk Factors*. Washington, (DC): World Bank. pp 45-240.
 57. Little P, Gould C, Williamson I, Moore M, Warner G, Dunleavy J (2001) Pragmatic randomised controlled trial of two prescribing strategies for childhood acute Otitis media. *BMJ* 322: 336-342.
 58. NICE Short Clinical Guidelines Technical Team (2008) Respiratory tract infections –antibiotic prescribing. Prescribing of antibiotics for self-limiting respiratory tract infections in adults and children in primary care. London: National Institute for Health and Clinical Excellence.
 59. [Guideline] Lieberthal AS, Carroll AE, Chonmaitree T, Ganiats TG, Hoberman A, Jackson MA, et al. The diagnosis and management of acute Otitis media. *Paediatrics*. 2013 Mar. 131 (3):e964-99. [Medline].
 60. [Guideline] Rosenfeld RM, Shin JJ, Schwartz SR, Coggins R, Gagnon L, Hackell JM, et al. Clinical Practice Guideline: Otitis Media with Effusion (Update). *Otolaryngol Head Neck Surg*. 2016 Feb. 154 (1 Suppl):S1-S41. [Medline]. [Full Text].
 61. Barclay L. Tympanostomy Tube Guideline Issued by Multidisciplinary Team. Available at <http://www.medscape.com/viewarticle/807157>. Accessed: July 9, 2013.
 62. Rosenfeld RM, Schwartz SR, Pynnonen MA, Tunkel DE, Hussey HM, Fichera JS, and et al. Clinical practice guideline: tympanostomy tubes in children--executive summary. *Otolaryngol Head Neck Surg*. 2013 Jul. 149(1):8-16. [Medline].
 63. van Dongen TM, van der Heijden GJ, Venekamp RP, Rovers MM, Schilder AG. A trial of treatment for acute otorrhea in children with tympanostomy tubes. *N Engl J Med*. 2014 Feb 20. 370(8):723-33. [Medline].
 64. Bluestone CD. Role of surgery for Otitis media in the era of resistant bacteria. *Pediatr Infect Dis J*. 1998 Nov. 17(11):1090-8; discussion 1099-100. [Medline].
 65. Nozicka CA, Hanly JG, Beste DJ, et al. Otitis media in infants aged 0-8 weeks: frequency of associated serious bacterial disease. *Pediatr Emerg Care*. 1999;15(4):252-254.
 66. Turner D, Leibovitz E, Aran A, et al. Acute Otitis media in infants younger than two months of age: microbiology, clinical presentation and therapeutic approach. *Pediatr Infect Dis J*. 2002;21(7):669-674.