Recurrent acute otitis media in infants: analysis of risk factors

Thesis Submitted for Partial Fulfillment of Master Degree in

Otorhinolaryngology

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2012

ACKNOWLEDGEMENTS

I would like to acknowledge and extend my heartfelt gratitude to the following persons who have made the completion of this work possible.

This work would not have been possible without the help, support and patience of my principal supervisor, **Prof.Mohamed Salah** Professor of Otorhinolaryngology, Faculty of Medicine, Cairo University, not to mention his advice, vital encouragement and support.

The good advice, support and friendship of my second supervisor, **Prof. Mosaad Abdel-Aziz** Professor of Otorhinolaryngology , Faculty of Medicine, Cairo University, has been invaluable on both an academic and a personal level, for which I am extremely grateful.

Many thanks for my third supervisor, **AssistantProf.Ahmed El Farouk** , assistant professor of Otorhinolaryngology, Faculty of Medicine, Cairo University, for his understanding, assistance and expert guidance.

Also **my parents** that have given me their obvious support and love throughout my life for which my mere expression of thanks does not suffice.

I also thank all the professors in the Otorhinolaryngology Department, Faculty of Medicine, Cairo University, for their support and assistance since the start of my residency in 2007**.**

Last, but by no means least, I would like to thank my colleagues and my friends for their kindness, friendship, encouragement and support.

My apologies if I have accidentally omitted anyone to whom acknowledgement is due.

Thank you

Abstract

Acute otitis media is one of the commonest diseases in infants and children. The objective of this study was to assess the commonest risk factors that influence the course of the disease and make it recurrent.

340 infants with recurrent episodes of acute otitis media were included in the study. The impact of some factors on the recurrence of acute otitis media was documented.

Short duration of breastfeeding, use of pacifiers, age, winter season, upper respiratory tract infection and presence of adenoid hypertrophy had significantly increased incidence of recurrent attacks of acute otitis media. Other risk factors had a positive relationship to recurrence in episodes of acute otitis media but statistically are not significant.

This finding indicates that particularly close-term follow-up is necessary for children aged under 2 years with recurrent acute otitis media for up to one month after treatment.

Keywords: Infants, recurrent acute otitis media, risk factors.

The aim of work is to study and analyse the impact of some risk factors on the recurrence of acute otitis media in infants under 2 years of age.

Contents

List of Abbreviations

AOM	Acute otitis media
AOMTF	Acute otitis media treatment failure
C.I.	Confidence interval
CDC	Centers for Disease Control
CT	Computed tomography
DRSP	Drug-resistant *Streptococcus pneumoniae*
ET	Eustachian tube
GERD	Gastroesophageal reflux disease
HMO	Health maintenance organization
HS	Highly significant
M E F	Middle ear fluid
MEE	Middle ear effusion
NHIS	National Health Interview Survey
NS	Non significant
OM	Otitis media
OME	Otits media with effusion
OR	Odds ratio
RAOM	Recurrent acute otitis media
RR	Relative risk
S	Significant
S.E.	Standard error
SD	Standard deviation
TM	Tympanic membrane
TT	Tympanostomy tube
TTs	Tympanostomy tubes
URTI	Upper respiratory tract infection
US	United States
$\mathbf{X^2}$	Chi-square

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Acute otitis media (AOM) is one of the most common bacterial diseases occurring in infants and children. Almost all children experience at least one episode and about one-third experience two or more episodes in their first 3 years of life ***(Pelton et al., 2005).***

AOM is considered to be the single most frequent diagnosis of febrile children occurring during the first years of life in approximately 20% to 30% of the pediatric population ***(Pichichero,2000).***

Infants and children with AOM typically present with otalgia or pulling of the ears, irritability, and fever. It is often associated with a viral upper respiratory tract infection (URTI) ***(Kontiokari et al., 1998).***

After an uncomplicated attack of AOM the child can face the problem of recurrent episodes of AOM. If at least 3 episodes occur in 6 months, then the patient is said to experience recurrent acute otitis media (RAOM) ***(Rovers et al., 2004, A).***

RAOM (three or more episodes) is common, affecting 10–20% of children by age of 1 year. Nearly 40% of older children may have experienced a total of six or more episodes of otitis media (OM) ***(Casselbrant and Mandel, 1999).***

Teele et al., (1989) found that 20% of children experienced 3 to 5 episodes of AOM in their first year of life. These children often proved to be prone to repeated episodes of AOM over the next several years.

Children who have had RAOM, of six or more episodes before age 2 years, are defined as otitis prone. Otitis-prone children often have a defective or immature antibody response specially a reduced level of immunoglobulin G2 (IgG2) ***(Veenhoven et al., 2003).***

Factors cited as responsible for such refractory OM include an increase in using of pacifiers, a decrease in duration of breastfeeding, URTI, winter seasons, presence of adenoid hypertrophy, age, gender prematurity, exposure to passive smoking, the presence of siblings (family size), allergy, craniofacial abnormalities as overt cleft palate, submucous cleft and occult submucous cleft, low socioeconomic level, gastroesophageal reflux disease(GERD), race and genetic predisposition **(Rovers et al., 2004)**.

These risk factors are not directly involved in the pathophysiology of OM, but when they are present, they result in increased risk of disease. Probably because they influence one or more causal mechanisms **(Rovers et al., 2004)**.

RAOM causes a considerable morbidity and great parental concern with each attack. The disease may also cause long-term middle ear damage, endangering the hearing. Furthermore, it can cause major complications such as mastoiditis and facial paralysis ***(Bluestone, 2000)***.

The middle ear cleft is a continuous space that begins at the nasopharyngeal orifice of the eustachian tube (ET) and extends to the farthest mastoid air cells. The three main segments are the ET; middle ear (tympanum); and the air cells of the mastoid, petrosa, and related areas. The middle ear cleft is normally aerated and is highly variable in dimensions ***(Gates, 1998).***

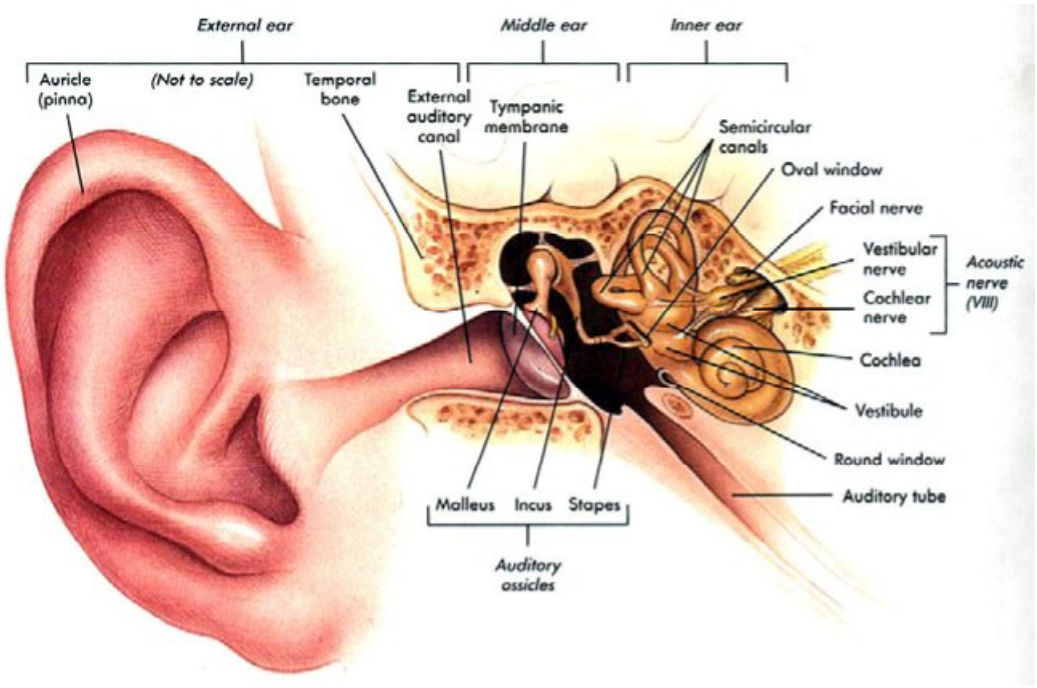


Figure 1: parts of the ear. ***(Sanna et al., 1980).***

The mucosal lining of middle ear cleft varies from the thick ciliated respiratory epithelium of the ET and the anterior tympanum to the thin nonglandular cuboidal epithelium in the mastoid cells ***(Ars, 1997).***

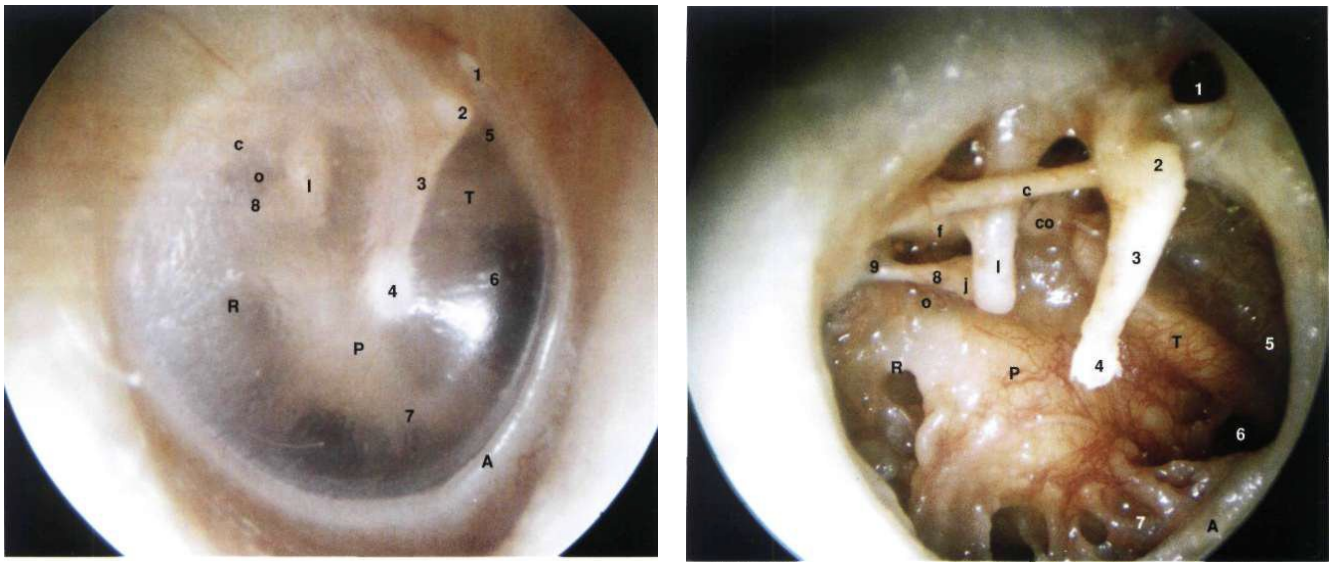
Hyperplasia and an increase in the number of goblet cells are common findings in the middle ears of patients with otitis media (OM).

The tympanic mucous blanket is swept toward the nasopharynx by the coordinated action of the ciliated epithelium. This process clears secretions and particulate matter from the middle ear into the nasopharynx via the ET ***(Gates, 1998).***

Tympanic membrane

The tympanic membrane(TM) forms the major part of the lateral wall of the middle ear. It is thin and semitransparent, has a pearly gray color and is cone-like. The apex of the membrane lies at the umbo, which corresponds to the lowest part of the handle of the malleus. Most of the membrane circumference is thickened to form a fibrocartilaginous ring, the tympanic annulus, which sits in a groove in the tympanic bone called the tympanic sulcus ***(Ars, 2003).***

The anterior and posterior malleolar folds extend from the short process of the malleus to the tympanic sulcus, thus forming the inferior limit of the pars flaccida of Sharpnell's membrane. The TM forms an obtuse angle with the posterior wall of the external auditory canal. It also forms an acute angle with the anterior wall of the canal ***(Sanna et al., 1980).***



(A) (B)

Figure 2:
A-Right ear normal tympanic membrane:1-pars flaccid. 2-short process of the malleus.3-handle of the malleus. 4-umbo. 5-supratubal recess; 6-tubal orifice. 7-hypotympanic air cells. 8-stapedius tendon; c-chorda tympani. I-incus. P-promontory; O-oval window. R-round indow. T-tensor tympani. A-annulus.
B-Middle ear after removal of the tympanic membrane. 9 -pyramidal eminence. co -cochleariform process. f -facial nerve. J- incudostapedial joint. ***(Sanna et al.,1980).***

The TM is irregularly round and slightly conical in shape; the apex of the cone is located at the umbo, which marks the tip of the manubrium. In the adult, it is angulated approximately 140° with respect to the superior wall of the external auditory canal. The vertical diameter of the TM as determined along the axis of the manubrium ranges from 8.5 to 10 mm, while the horizontal diameter varies from 8 to 9 mm. The malleal prominence, a projection formed by the lateral process of the malleus, is located at the superior end of the manubrium ***(Gulya and Schuknecht, 2007).***

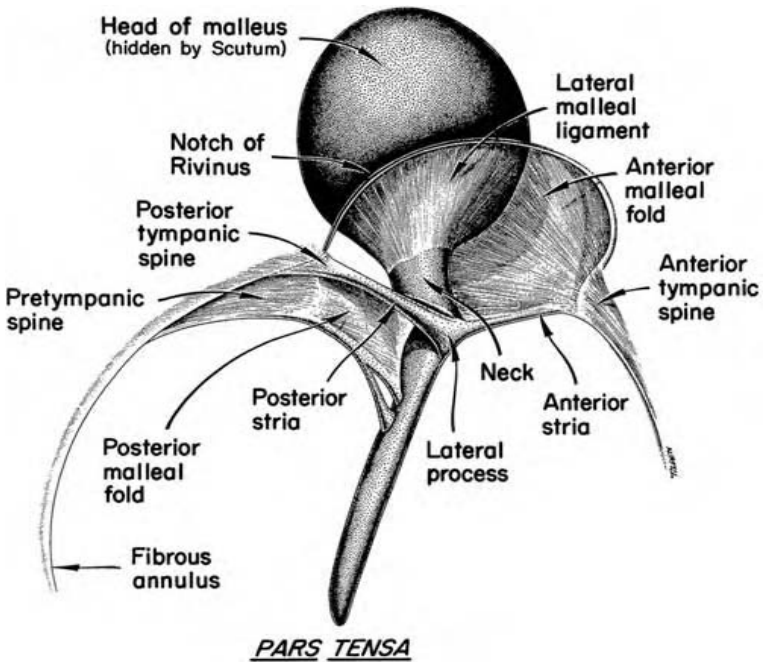


Figure 3: The tympanic membrane ***(Gulya and Schuknecht, 2007).***

The manubrium is firmly attached to the TM at the umbo and lateral process and is clearly visible throughout its length (the stria mallearis). The anterior and posterior tympanic striae extend from the lateral process of the malleus to the anterior and posterior tympanic spines, respectively. These striae divide the TM into larger pars tensa below, and smaller triangular pars flaccida (or Shrapnell's membrane) above ***(Gulya and Schuknecht, 2007).***

The superior recess of the TM is known as Prussak's space . The pars flaccida forms the lateral border of this space as it attaches superiorly to the bony margins of the notch of Rivinus or tympanic incisura. The lateral malleal ligament limits this space anterosuperiorly as it extends from the union of the head and neck of the malleus to the periphery of the notch of Rivinus. Posteriorly, Prussak's space opens into the epitympanum. The anterior and posterior malleal folds mark the inferior limit of Prussak's space The thickened periphery of the pars tensa, the tympanic annulus (limbus) , anchors the TM in a groove known as the tympanic sulcus. The tympanic annulus and sulcus are absent superiorly in the area of the notch of Rivinus ***(Ars, 1997).***

The TM consists of three layers: an outer epithelial layer continuous with the skin of the external auditory canal, a middle fibrous layer or lamina propria, and inner mucosal layer continuous with the lining of the tympanic cavity. The epidermis or outer layer is divided into the stratum corneum, the stratum granulosum, the stratum spinosum, and the stratum basale, which is the deepest layer that rests on the basement membrane ***(Lim, 1989)***.

The lamina propria is characterized by the presence of collagen fibers. In the pars tensa, these fibers are arranged in two basic layers: an outer radial layer that originates from the inferior part of the handle of the malleus and inserts in the annulus, and inner circular layer that originates primarily from the short process of the malleus. Such a distinct arrangement is absent in the pars flaccida. The mucosal layer is formed mainly of a simple cuboidal or columnar epithelium ***(Sanna et al.,1980).***

The pars tensa and pars flaccida differ in structure. The pars tensa consists of three layers: lateral epidermal layer, medial mucosal layer,

and intermediate fibrous layer, the pars propria. The epidermal layer is contiguous with the skin of the external auditory canal and the mucosal layer is contiguous with the mucous membrane of the middle ear. The intermediate layer consists of fibrous tissue arranged in inner circular and outer radial strata. Elastic fibers are rare in the pars tensa ***(Ars, 1997).***

The pars flaccida, although lax, is actually thicker than the pars tensa .It consist of epidermal, fibrous and mucosal layers. The epidermis is composed of 5 to 10 layers of epithelial cells, the fibrous layer consists of irregularly arranged collagen and elastic fibers, and the mucosal layer is composed of simple squamous cells, as in the pars tensa ***(Gulya and Schuknecht, 2007).***

With acute infections of the middle ear, the TM becomes acutely inflamed. It is not unusual for blebs or bullae to form at the interface between the pars propria and epidermal layers. The surgon performing therapeutic myringotomy (incision of the ear drum) must not be misled by such a bleb and fail to incise all three layers of the membrane ***(Ars, 1997).***

When the TM is perforated by either trauma or infection, the extent of fibrous tissue proliferation determines the thickness of the healing membrane. The replacement membrane may develop a dense intermediate fibrous layer or alternately may fail to develop a fibrous layer resulting in a thin membrane composed only of epidermal and mucosal layers. It may vary in thickness in different areas and may have areas of hyalinization .Thin replacement membranes are frequently seen during routine otoscopic examination and, unless very large, have no effect on hearing ***(Gulya and Schuknecht, 2007).***