International Journal of Pediatric Otorhinolaryngology 83 (2016) 148–153

Contents lists available at ScienceDirect

International Journal of Pediatric Otorhinolaryngology

journal homepage: www.elsevier.com/locate/ijporl

Chronic suppurative otitis media, middle ear pathology and corresponding hearing loss in a cohort of Greenlandic children

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ARTICLE INFO

Article history:
Received 18 October 2015
Received in revised form 24 December 2015
Accepted 16 January 2016
Available online 25 January 2016

Keywords:
Inuit
Epidemiology
Tympanic membrane pathology
Hearing loss
Video otoscopy
Chronic suppurative otitis media

ABSTRACT

Background: Otitis media (OM) has been observed at elevated prevalence rates in Greenlandic children. OM associated hearing loss (HL) may compromise the children's linguistic skills, social development and educational achievements.
Objectives: We investigated the prevalence of chronic suppurative otitis media (CSOM), otitis media with effusion (OME) and tympanic membrane sequelae of OM, and compared the corresponding hearing thresholds.
Methods: In 2010 we examined a cohort of 223 Greenlandic children aged 4–10 years by video otoscopy, tympanometry and tested hearing thresholds for the low-frequencies: 500, 1000 and 2000 Hz and the high-frequencies: 4000 and 6000 Hz. HL was categorized according to the worst hearing ear and was compared within the groups: CSOM, OME, tympanic membrane sequelae of OM and normal.
Results: Of 207 children, 5.8% had CSOM, 13.9% had OME and 55.6% had tympanic membrane sequelae of OM. The median pure tone average in low-frequencies/high-frequencies were: CSOM: 34.2/31.3 dB, OME: 23.3/22.5 dB, Sequelae of OM: 13.3/15 dB and normal ears: 11.7/12.5 dB. We found a significant difference ($p < 0.05$) between the four groups. In 56.5% of all children a HL > 15 dB in any frequency was found, while 6.5% suffered from a bilateral low-frequency HL > 25 dB.
Conclusion: The severity of OM significantly corresponded to increased HL. The burden of CSOM and HL remains high in young Greenlandic children. Aggressive treatment with antibiotics, improved hearing rehabilitation, sound field amplification in classrooms and otosurgical capacity should be further promoted in Greenland.

1. Introduction

During the last decades persisting high prevalence rates of middle ear pathology, in particularly otitis media (OM), have been presented in Greenlandic Inuit children [1–3]. Especially the prevalence of the severe form chronic suppurative otitis media (CSOM) characterized by tympanic membrane perforation, otorrhea and hearing loss (HL) have been found at high levels (6–14%) compared to other western countries [1–3]. In Greenland several factors are associated with the high prevalence of OM such as passive smoking, crowding, parent's level of schooling, ethnicity, family history of OM and recent or frequent upper respiratory tract infections [4–6].

Middle ear disease is often initiated by an acute upper respiratory tract infection leading to acute OM (AOM) with ear pain, bulging of the tympanic membrane and potentially perforation. Edema of the Eustachian tube is a result of the infection, which closes the Eustachian tube, leading to a negative pressure in the middle ear inducing OM with effusion in the middle ear (OME). In some cases, AOM and OME lead to CSOM with perforation and otorrhea lasting >2 weeks as defined by WHO [7]. CSOM has a tendency to shift between an active form characterized by long lasting otorrhea and an inactive form with dry perforation lasting >3 months. OM and especially CSOM, leaves scars/pathology on

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http://dx.doi.org/10.1016/j.ijporl.2016.01.017
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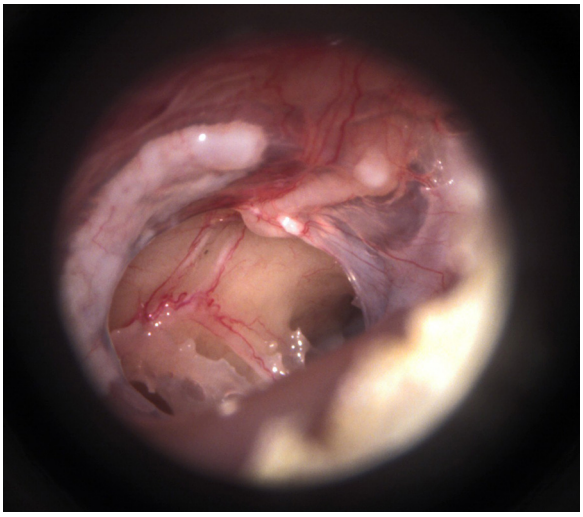

Fig. 1. Video otoscopy of a tympanic membrane in a child diagnosed with CSOM. Photo by Ramon G. Jensen.

the tympanic membrane such as fibrosis, myringosclerosis, atrophy, retraction, chronic perforation and damage to the middle ear ossicles leading to hearing loss (HL) (Fig. 1). OM develops mainly in early childhood and the HL may result in impairment of speech and language, compromising the children's social development and educational achievements [8–11]. The impact is significant on linguistic skills, reading capabilities, verbal comprehension, social behavior and IQ score and seem to last into the teenage years, diminishing around the age of 18 [12–15]. Only a few studies have investigated these outcomes in high-risk populations with CSOM [1,16]. The CSOM associated HL is often both more severe and persistent with educational difficulties and language impairment observed, in addition children with CSOM may have fatal complications such as meningitis and brain abscesses [7,17,18].

Living standards have increased during the last decades in Greenland, but it is unknown whether this has resulted in lower prevalence rates of middle ear pathology and HL in Greenlandic children. Recently a cohort study described a high occurrence of OM related HL among teenagers and adolescents in Greenland, but this association has never been investigated in younger Greenlandic children [19].

The purpose of this study was to estimate the prevalence rate of CSOM, OME and tympanic membrane sequelae of OM, and investigate their corresponding hearing thresholds in a cohort of Greenlandic children aged 4–10 years.

2. Methods

2.1. Study population

The study was performed in 2010 and included children from an existing population based birth cohort [20]. The cohort originally consisted of 400 children born on the West Coast of Greenland (in the capital Nuuk and the towns Ilulissat and Maniitsoq) in 1999–2007 [20]. By using the children's unique civil registration number we contacted 251 children still living in Nuuk and Ilulissat. Due to logistic reasons, children who had moved out of the research area were not invited to participate. The eligible children and their families were invited to an examination by a postal letter followed by up to three phone calls.

Due to the geography of Greenland, access to healthcare is limited and the children may travel far distances to reach a doctor. The country is the largest island in the world (2175,600 square kilometers), and is covered by an icecap except for the coastal areas [6]. The population consists of 56,000 people who are scattered in towns and settlements on the West and East coast. The larger referral hospital is placed in the capital Nuuk (population of approximately 16,100), while Ilulissat has four medical doctors taking care of the town's population of 4500 [6].

In Greenland all prescriptions and contacts to the healthcare system are kept in the patient's unique personal medical records. These medical records were reviewed for all included children and information regarding previous episodes of OM, perforations and the duration of otorrhea was recorded.

2.2. Ear and tympanic membrane examination

The ears and tympanic membranes of the 223 children were examined using a Digital MacroView (TM), Welch Allyn handheld video otoscope. Tympanometry was performed with a Madsen Otoflex 100, GN Otometrics, and OME was defined as a flat *B*-curve with a normal ear canal volume. All findings were reported in a modified version of the Ear and Hearing Disorders Examination Form from The World Health Organization [21].

Each of the children's ears were categorized by severity according to the pathology on the tympanic membrane in the following order: CSOM (active form with perforation and otorrhea >14 days or inactive form with dry perforation >3 months), sequelae of OM (myringosclerosis, circular and diffuse atrophy, retraction and fibrosis) and a normal tympanic membrane. Children with unremovable earwax occluding the external auditory meatus were categorized as unknown and excluded from the study. A normal tympanic membrane was defined as an intact tympanic membrane with no pathologic changes by video otoscopy and a normal pressure in the middle ear by tympanometry.

For comparison of hearing thresholds between OM subgroups, participants were categorized in the following order: CSOM, OME by tympanometry (regardless of tympanic membrane appearance), sequelae of OM (myringosclerosis, circular and diffuse atrophy, retraction and fibrosis) and normal.

To avoid inclusion of acute otitis media with perforation in the CSOM group we confirmed the chronic duration of the perforation and the otorrhea by medical records and by reports from the parents.

2.2.1. Hearing examination by audiometry

Following the examination of the tympanic membranes, the children were examined by audiometry by two Greenlandic and Danish speaking audiology assistants. The assistants were not blinded to the tympanic membrane findings by otoscopy, as the audiometric test was made in the same room as the otoscopic examination. The audiometry was conducted in a quiet room at the hospital selected to avoid background noise. We used a Madsen Xeta audiometer (GN Otometrics, Taastrup, Denmark) with THD39 earphones and MX41/AR circum-aural ear cushions placed in the Madsen Electronics ME70 noise-excluding headset. The audiometer was calibrated according to the American National Standard Institute (ANSI) s3.6-2004 and connected to a laptop for storage of the data in OTOsuite™ (GN Otometrics, Taastrup, Denmark) and NOAH-3™ (HIMSA, Copenhagen, Denmark) audiometric software. Performance checks were carried out every day. Air-conduction thresholds were obtained at five frequencies: 500, 1000, 2000, 4000, and 6000 Hz. If the air conduction thresholds at a certain frequency differed by 40 dB or more between the ears, masking was performed. When bone conduction thresholds were measured masking was applied to the contra lateral ear. Thresholds were determined manually according to the American Speech-Language-Hearing Association (ASHA) [22–24]. HL was defined by the