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Natural History and Spontaneous Healing in Chronic Suppurative Otitis Media – The Greenlandic Experience

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Otitis media (OM) is one of the most common childhood infections and is associated with a significant economic burden in the developed part of the world¹. Here the illness is often mild and can resolve without any treatment or further complications. However, in the developing part of the world and among certain indigenous populations a more severe form of OM is found. Chronic suppurative otitis media (CSOM) develops predominantly in the first years of childhood when the middle ear infection leads to a chronic tympanic membrane perforation with repeated periods of drainage that can last throughout life. This disease is rarely seen in the developed part of the world but among the Inuit population in Greenland it has been highly prevalent for decades and is one of the most frequent chronic childhood diseases^{2,3}. CSOM can lead to fatal complications but in most cases the problem is a chronic hearing loss established at the critical time of language acquisition and the development of social behavior.

Very little is known about the determinants for CSOM, the natural history or the long-term consequences on the hearing in Greenland – or in any other population in the world. These basic epidemiological facts are needed in order to estimate the burden of otitis media and to help inform health policy makers if this primarily non-fatal but disabling disorder is to be prioritized to a larger extent. Among primary healthcare providers increased knowledge of risk factors for CSOM is important to identify children in need of special interventions and to enable preventive measures.

A little on Greenland

Greenland or *Kalaallit Nunaat* (Land of the Greenlanders) (**Figure 1**) is a former Danish colony but now an autonomous country within the Kingdom of Denmark. Greenlandic (*Kalaallisut*) has been the official language since 2009 but Danish is widely used in the major towns, government and higher education.

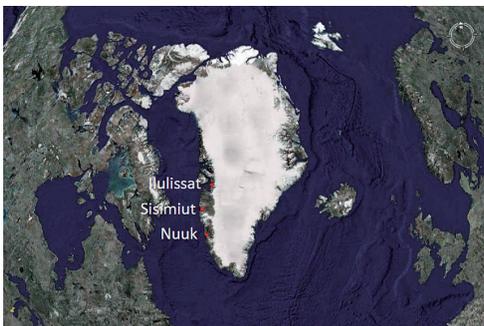


Figure 1. Greenland

The first descriptions of ear disease in Greenland resembling CSOM date back to 1889 when the Danish physician Kiær reports from northwest Greenland that an almost constant symptom apart from upper respiratory tract infections was otitis media with a prolonged course extending over the acute stadium⁴. Since the 1950s otologists have reported high frequencies of OM, and the first epidemiological studies

confirming high prevalences of CSOM are from the 1980s³. Since a series of epidemiological studies have been conducted and the latest from 2010-2011 has provided the first data on the long-term outcome of CSOM^{5,6}.

Population, economy and health services

The total population of individuals in Greenland is 56,749 with 16,000 living in the capital Nuuk. Approximately 90% are Inuit (**Figure 2**) or of mixed descent and the rest are predominantly Danes. The lifestyle is largely western in the major towns while smaller towns and settlement, are more traditional, mainly depending on commercial fishing⁷. The gross domestic product (GDP) in Greenland is high and was in 2003 \$ 24,356 comparable with \$ 31,465 in Denmark⁸. However, the GDP does not state anything about how the wealth is distributed in a population.

Figure 2. Greenland Inuit child



Earlier there was quite a large difference between high and low-income families in Greenland. In 1993 the economic inequality was larger than in the USA, while figures from 2009 show that the income dispersion has been reduced considerably and is now below that of the USA, but still higher than in e.g. Denmark^{7,9,10}. The health care system in Greenland is obliged to deliver equal and free health care to all citizens regardless of geographical remoteness. Therefore expenditure on transport of patients and staff is high.

The only ear nose and throat specialist is based in Nuuk. The position was established in 2005. The remaining part of the population is visited once per year by Danish otologists and every third year by an audiologist.

CSOM the definition

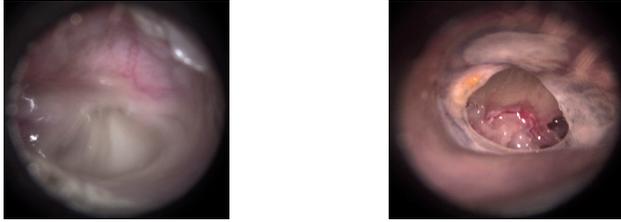
CSOM is defined by the World Health Organization (WHO) as a chronic inflammation of the middle ear and mastoid mucosa, with discharge through a chronic perforation of the tympanic membrane. The duration of otorrhea has been set to a minimum of 14 days while the duration or the size of the chronic perforation has not been defined. A chronic perforation without evident discharge has been included under this definition as it is considered to be a different stage of the same disease, where the tympanic membrane fails to heal, leaving it vulnerable to recurrent infections and causing conductive hearing loss¹¹. The experience among clinicians working in high risk areas is, however, that children often develop recurrent bouts of otorrhea between periods with dry perforations¹². These periods with drainage may vary from weeks to several years. In Greenland we define CSOM as a perforation lasting for more than 3 months and/or otorrhea lasting more than 14 days (**Figures 3 A and B**).

In Greenlandic studies we have demonstrated that genetic factors such as family history and Indigenous heritage as well as environmental factors such as socioeconomic conditions, passive smoking, and the use of childcare centers are risk factors for the development of CSOM^{2,5}.

Figure 3 A (left). Chronic suppurative OM active with otorrhea

Figure 3 B (right). Chronic suppurative OM active dry perforation

As these risk factors are similar to the ones found for AOM, actions tak-



en to prevent AOM in a population will most likely also reduce the prevalence of CSOM.

In one of the studies we have found that the mother's level of schooling and her history of CSOM were risk factors for the development of CSOM among their children⁵. The absolute risk of development of CSOM in a child with a mother who had both a history of CSOM and low schooling was 45% for boys and 41% for girls. The mother's level of schooling and history of CSOM are indicators of mother's with low health literacy and poor health seeking behavior when the child has otorrhea. **In some Greenlandic families otorrhea is so common that it is seen as a "normal" part of childhood, and the mothers do not contact the healthcare system if the child is otherwise unaffected.**

Factors that can identify children at special high risk such as mother's level of schooling and CSOM history are valuable in the creation of a risk profile to identify CSOM-prone children (**Figure 4**). A risk profile may not only assist the health care provider in treatment of disease but also facilitate preventive strategies on the individual level. Parents who are informed that their child has a particular high risk of developing CSOM might be more motivated to take responsibility of management and preventive measures. This could for instance be instructions on correct use of topical antibiotics and ear syringing at home combined with counseling of smoking cessation among the parents. However, the use of preventive measures on individuals will not address the underlying cause of disease which might need an approach on a population level. Here, risk factors such as housing standards, socioeconomics and educational level in the population are important. For policy makers the importance of improvement of these areas is not limited to public health alone but also to the general development of society, and changes of these factors take time. But the identification of e.g. child-care centers as a risk factor for the development of CSOM could be a target for specific public health interventions that might influence CSOM prevalence more rapidly. **Regulations on number of children per square meter, courses in hygiene and guidelines for management of draining ears in child-care centers could be part of such intervention.**

Natural history and dynamics of CSOM.

Despite being the most severe form of OM and affecting a large number of children in the developing world basic epidemiological facts such as the natural history of CSOM and the long-term outcome are virtually unknown. As stated in a WHO report on CSOM in 2004: "The ultimate fate of the tympanic perforation is still

Figure 4. Health care providers in Greenland

largely undocumented”¹². It is known that CSOM can heal spontaneously while some cases continue to have almost constant ear discharge from early childhood into adult life. However, CSOM has generally been considered to persist into adulthood^{12,15}.

A long-term follow-up study in Greenland have found that more than 1/3 of all children with

CSOM healed spontaneously without surgical intervention⁶. Cross-sectional studies showed that every 10th child had CSOM but when follow-up was done it was seen that almost ever 5th child had been affected with CSOM at some point in childhood. As illustrated in **Figure 5**, the nature of CSOM is dynamic and cross-sectional studies need follow-up, in order to estimate the number of children affected by the disease through childhood (the cumulative risk). Without follow-up the burden of CSOM in a population will be underestimated.

The age at which CSOM was diagnosed did not have any influence on the healing rate, and children as old as 8 years healed spontaneously. The most common types of scarring in ears that healed spontaneously were circular atrophy and myringosclerosis.

Course A & B: The tympanic membrane perforates before the initial study. In Course A the perforation persists to follow-up while in Course B it spontaneously heals after the initial study. Based on the number of children in Course A or B the spontaneous healing rate within a cohort can be estimated.

Course C: The tympanic membrane perforates after the initial study and persists to follow-up. This course adds “new” CSOM cases in a cohort study with an initial study conducted among children of young age where there is a greater possibility that some will develop CSOM subsequently.

Course D: The tympanic membrane both perforates and heals prior to the initial study and is here registered as an intact tympanic membrane. Subsequently it re-perforates before the follow-up where it erroneously appears as a late CSOM debut.

Course E: Both perforation and healing occurs before the initial study but here there is no re-perforation prior to follow-up.

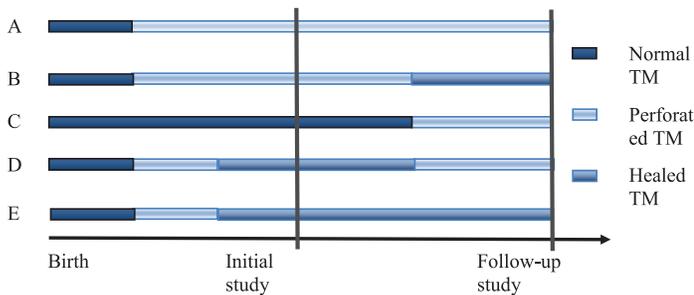
Perspectives and concluding remarks

- The finding of a high rate of spontaneous healing in CSOM should be considered when selecting children of young age for surgery in developing countries with limited surgical capacity. It should also encourage the effort of managing CSOM with medical treatment and ear toilette.
- The finding of the mother’s history of CSOM and her level of schooling as important risk factors for CSOM could be used in a primary health care setting to select high-risk children for antibiotic treatment and follow-up. This should be integrated in the development of national guidelines for treatment of CSOM in Greenland.
- Studies estimating the occurrence of CSOM in a population should seek to

conduct follow-up studies to estimate the total number of individuals affected during childhood. If follow-up is too costly the tympanic membrane changes should be recorded, especially the occurrence of circular atrophy as this may give an estimate of the number of children affected by long-lasting perforations.

- The population estimates used to assess the global burden of CSOM are based on the premise that CSOM is a static disease. This underestimates the number of individuals who have been affected by CSOM and the associated hearing loss in childhood.

Figure 5. Five possible courses, A-E, of chronic perforations (> 3 months duration) from birth to follow-up. TM: Tympanic membrane



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