Clinical aspects of chronic ENT inflammation in children


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Abstract. Clinical aspects of chronic ENT inflammation in children. In children, all ENT cavities are particularly prone to the development of chronic inflammation. This is due to many predisposing factors, of which the most common are unfavourable anatomy, absence of nasal blowing, day care attendance, allergy, immature immunity, gastro-oesophageal reflux and tobacco smoke exposure.

The aim of this paper is to outline the most specific paediatric clinical aspects of chronic pharyngo-tonsillitis, rhinosinusitis, otitis media, adenoiditis and laryngotracheitis and the important influence that some of these pathologies exert on the others.

Introduction

Chronic inflammatory conditions are extremely frequent in children. Viruses play an important role in acute situations, and bacterial complications, with the development of inflammation and biofilms, play a significant role in chronic pathologies, usually defined as an inflammation of the mucosa persisting for more than 12 weeks.

The aim of this chapter is to describe the clinical particularities of chronic ENT inflammatory pathologies in children by comparison with adults and to emphasise the importance of precise assessments and prolonged observations.

I. Pharyngo-tonsillitis

a) Acute pharyngo-tonsillitis

Acute throat infections are responsible for about 3% of GP consultations.1,2 Pharyngitis and tonsillitis are frequently used synonymously in the literature, often grouped as “acute sore throat” or “tonsillopharyngitis”. However, in clinical practice, one can frequently discriminate between these conditions. This differentiation is particularly important when considering a tonsillectomy.3

Clinical presentation

Sore throat and painful swallowing are the key symptoms in pharyngitis and tonsillitis, usually accompanied by fever and malaise. In younger children unable to express complaints, food refusal is common. Incidence is highest in winter and early spring. Other symptoms complete the clinical picture.1,4,5

Pharyngitis can be part of a “common cold” or rhinopharyngitis and is usually of viral origin. In this case, additional symptoms include nasal discharge, sneezing, cough and high fever. Headache or conjunctivitis are also possible. Clinical examination can reveal nasal congestion and secretions, postnasal drip and mild pharyngeal erythema.

Acute pharyngitis rarely occurs in isolation. In addition, there is usually inflammation of the mucosa in other subsites of the upper respiratory tract. In acute pharyngitis, throat complaints are more prominent than nasal complaints. Clinical examination shows generalised erythema of the pharynx. The tonsils can be erythematous and swollen. Anterior cervical lymphadenopathy can be present.

In acute tonsillitis, the throat complaints are more pronounced. Cough and rhinological complaints are usually absent and fever is more prominent (>38°C). The tonsils are erythematous and
swollen, often with a punctate or confluent gray-white tonsillar exudate, and anterior cervical nodes (frequently tender) are usually present. Snoring is possible due to the oedematous enlargement of the tonsils. Abdominal complaints (nausea, vomiting, and abdominal pain) are often present, especially in younger children.1,4,5

In reality, there is a clinical spectrum ranging from localised tonsil inflammation to an upper respiratory tract infection, with mucosal inflammation of most anatomical subsites of the upper respiratory tract.

Microbiology – laboratory tests

Most throat infections seem to be of viral origin. Streptococci (especially the group A β haemolytic streptococcus, GABHS) are responsible for 20-30% of throat infections. Other bacteria are rare pathogens. Streptococcal tonsillitis occurs most commonly in children between 5 and 15 years of age.4

Several attempts have been made to differentiate between viral and streptococcal infections, particularly to reduce unnecessary antibiotic treatment. Some propose clinical criteria to help with this differentiation. The Centor criteria (fever, tonsillar exudates, absence of cough, tender cervical lymphadenopathies) are the best known clinical scoring system.7 The chance of a positive throat swab for GABHS increases with a higher score.4 Other methods used to help in this differentiation include throat swab with culture, serology (antistreptolysine (ASLO) titre, for example) and rapid antigen detection. All these methods have shortcomings, limiting their use in clinical practice.

Problems with throat swabs using culture are the presence of GABHS carriers, resulting in a positive throat culture even in a viral throat infection. False negative results are also produced in 10%. Moreover, there is a delay between swab sampling and culture results, making it impossible to take the results into account in the initial therapy choice.6,8

In serology (ASLO), a titre rise in two consecutive blood samples is needed to confirm a GABHS infection. The influence on initial therapy is therefore limited here as well. A titre rise is not always present in a GABHS throat infection and antibiotic treatment can suppress this rise.6

Rapid antigen-detection testing (with a throat swab) is particularly popular in North America. It produces a result in a couple of minutes.6

The value of these detection methods in clinical practice is limited, especially since the results will not influence the choice of therapy. GABHS tonsillitis is usually self-limiting, even without antibiotic treatment. Complications of GABHS (peritonsillar abscess, scarlatinia, rheumatic fever, glomerulonephritis) are rare nowadays. On the other hand, antibiotic treatment can slightly shorten symptoms of a bacterial throat infection.6 The symptoms will be shortened by about 8-16 hours if the treatment begins within the first three days of sickness. The decision to start antibiotic treatment is a clinical decision that depends on the severity of symptoms and other risk factors. If a child is severely ill, it is impossible to withhold antibiotic therapy on the basis of the results of laboratory tests. If a patient with a throat infection is moderately ill, with symptoms that suggest viral disease, then antibiotic treatment is unnecessary, whatever the result of these tests.

b) Chronic and recurrent pharyngo-tonsillitis

In some patients, throat infections seem to be repetitive. Low-grade discomfort can persist between acute episodes. About 12% of the population experience recurrent tonsillitis episodes. A twin study has suggested a genetic predisposition to recurrent tonsillitis which may be related to tonsil anatomy and/or immunological defence mechanisms that make the subjects prone to tonsillar infections.9 Some patients who meet the criteria for tonsillectomy improve spontaneously with non-surgical treatment; in others, the condition persists.7 The exact aetio-pathogenesis of chronic tonsillitis is not known.

Some authors believe in the concept of biofilm formation, which makes the bacteria resistant to host defence mechanisms and allows them to survive even with adequate antibiotic therapy. Some S. pyogenes stains can produce biofilm. S. pyogenes can avoid eradication by internalisation in epithelial cells. The reaction of the host tonsil tissue to the bacteria may vary between individuals (for example, the level of production of peptides, which inhibit biofilm formation).10 This may explain the genetic predisposition. GABHS cannot manufacture β-lactamase themselves, so narrow-spectrum penicillin has been proposed as the first choice for antibiotic treatment (better tolerance, prevention of resistance development to broader spectrum antibiotics). A proposed explanation for penicillin
treatment failure is the presence of β-lactamase-producing bacteria alongside the pathological streptococcus. Broad-spectrum antibacterial treatment (amoxicillin, for example) is therefore recommended in recurrent tonsillitis. The role of other bacteria (Helicobacter pylori, Actinomyces species, Haemophilus influenzae, Staphylococcus aureus) in both chronic tonsillitis and tonsillar hypertrophy is also being investigated.

There are several other avenues of research that may yield explanations for the development of chronic/recurrent tonsillitis in some children. Despite the often beautiful theories, the exact pathogenesis of recurrent/chronic tonsillitis in children remains unclear, and current research looking at the pathogenesis of chronic tonsillitis has not led to any changes in current clinical practice.

Chronic pharyngitis can also be due to allergic rhinitis and chronic rhinosinusitis, with postnasal drip causing pharyngeal irritation. The rhinological complaints are usually more prominent. Smoke inhalation (passive smoking), air conditioning and gastro-oesophageal reflux disease (GORD) have been identified as non-infectious causes of chronic pharyngitis in children. The literature on this topic is sparse.

c) Specific tonsillar or pharyngeal infection

Infectious mononucleosis (IM) IM is a systemic infection caused by the Epstein-Barr virus (EBV). EBV tonsillopharyngitis is commonly seen in young adults, with transmission occurring predominantly through exposure to infected saliva. Typical clinical presentation includes sore throat, fever, enlarged and tender lymph nodes and tonsillar enlargement. The lymphadenopathies are not restricted to the anterior neck but generalised. Usually, the spleen is also enlarged. Inspection of the throat often reveals a pronounced yellow slough on the tonsils or pharynx. Palatal petechiae can be present. In addition to the generalised lymphadenopathies and the typical slough on the tonsils, nasopharyngeal endoscopy or posterior rhinoscopy usually reveals lymphatic tissue with the same fibrinous membranes in the nasopharyngeal cavity, allowing clinical differentiation from GABHS tonsillitis.

The throat complaints can be prolonged, although they usually disappear after one month. The tonsillitis is usually accompanied by fatigue, increased sleeping and sore joints. These complaints can persist for more than a month (in 15-30% of patients). Although IM is of viral origin, bacterial superinfection is present in a substantial proportion of patients. If antibiotic treatment is being considered, it is important to avoid ampicillin or amoxicillin since this may elicit a severe allergic rash. If clinical presentation suggests IM, a blood sample should be taken to produce a lymphocyte count and differentiation. An atypical lymphocytosis > 20% or lymphocytosis > 50% with > 10% atypical lymphocytes will provide strong support for the diagnosis. Serology (raised "viral capsid antigen" (VCA)-IgM in the absence of an EBV nuclear antigen (EBNA)-IgG) can confirm the diagnosis.

The mainstay of treatment is good supportive care, including adequate hydration, non-steroidal anti-inflammatory drugs or acetaminophen. Corticoids must be considered in severe cases where there is possible upper airway obstruction. Antiviral therapy (Acyclovir) is not recommended since there is no proven clinical benefit. Relative rest (not bed rest) is recommended. Contact sport should also be avoided for at least three weeks since there is a risk of splenic rupture. Re-activation is possible since the virus remains in the patient’s body but is generally considered to be of little clinical relevance in immunocompetent persons.

The presentation of cytomegalovirus infection (CMV) and toxoplasmosis can be similar to IM. Primary HIV infection should also be considered if tonsillopharyngitis is accompanied by fever, enlarged lymph nodes and fatigue, and if the course is protracted.

Take-home messages

Predisposition to recurrent tonsillitis may be related to tonsil anatomy and/or immunological defence mechanisms making children prone to tonsillar infection.

- Non-infectious causes of chronic pharyngitis in children are allergic rhinitis, chronic rhinosinusitis, smoke inhalation (passive smoking), air conditioning and gastro-oesophageal reflux disease (GORD).

- Systemic infection caused by viral pathogens can also present with sore throat and tonsillar enlargement.

II. Chronic rhinosinusitis

The pathophysiology, epidemiology and diagnosis of chronic
paediatric rhinosinusitis are debated\textsuperscript{17} and its poorly defined pathophysiology\textsuperscript{17} will be examined here. In particular, children outgrowing runny noses or the tendency to spontaneous resolution\textsuperscript{18}-\textsuperscript{20} will be considered since these outcomes represent a challenge to all proposed treatments. However, the management of chronic rhinosinusitis is beyond the scope of the present paper and will be dealt with in a separate chapter of this report.

\textit{a) Epidemiology}

One of the most recent reviews of rhinosinusitis\textsuperscript{21} confirmed that there is a paucity of accurate information in the current literature about the epidemiology of all types of rhinosinusitis in both adults and children. Specifically, in a CT scan study looking at children with chronic complaints, Van Der Veken et al.\textsuperscript{22} showed involvement of the sinuses in 64\% of children with a history of chronic purulent rhinorrhoea and nasal obstruction. The EPOS Position Paper\textsuperscript{21} mentioned above also quotes previously reported figures from the authors of the present paper: in an MRI study\textsuperscript{23} of non-ENT paediatric patients, the overall prevalence of sinusitis signs was 45\%. After a recent upper respiratory tract infection and in the presence of purulent nasal secretions, the prevalence figures increased to 81\% and 100\% respectively. Other authors\textsuperscript{26} have confirmed, on the one hand, a similar overall percentage of abnormalities on MRI among school children but, on the other hand, also demonstrated that half of these abnormalities resolved or improved without any intervention six to seven months later.

\textit{b) Definitions}

In 1993, the International Conference on Sinus Disease at Princeton University, with DW Kennedy as the conference chair, outlined the latest thinking on sinus disease and presented important advances in sinusitis care. Since it was felt that the Kennedy document\textsuperscript{24} did not cover in sufficient depth the paediatric aspects of sinusitis, several international experts in the field of paediatric rhinosinusitis gathered during a Consensus Meeting in Brussels in 1996. This consensus meeting gave rise to one of the first dedicated papers outlining the best knowledge of that era.\textsuperscript{25} While several other consensus reports have since addressed the subject, often as later and separate initiatives of one or more of the original co-authors, many of the original statements are still frequently used today.

The Brussels Consensus Meeting proposed discussing rhinosinusitis since rhinitis and sinusitis in children are often a continuum of disease, where it is not possible to differentiate rhinitis from sinusitis on clinical grounds alone.\textsuperscript{25} Chronic rhinosinusitis was defined as a sinus infection with low-grade symptoms and signs persisting for more than 12 weeks.\textsuperscript{25} Symptoms and signs of chronic rhinosinusitis were considered to be the same as those of non-severe acute rhinosinusitis (Table 1), often with fetor oris as an additional complaint.\textsuperscript{25}

\textit{c) Diagnosis}

According to the authors of the Brussels Consensus Meeting – and contrary to the Princeton Conference,\textsuperscript{24} which invariably required a CT scan for the diagnosis of chronic rhinosinusitis, even among children – the diagnosis of chronic rhinosinusitis should usually be made on clinical grounds alone.\textsuperscript{25} Table 2 lists the indications for imaging (preferably CT scan) and microbiological assessment (sinus puncture). However, no consensus was reached about whether middle meatal cultures could be used as a substitute for sinus punctures. A CT scan is also indicated if surgery is being considered. In the presence of recalcitrant cases of chronic rhinosinusitis, additional investigation is advised to assess underlying conditions such as allergy, immunodeficiency, cystic fibrosis, ciliary immotile disorders and gastro-oesophageal reflux.\textsuperscript{25}

Several years after the Brussels Consensus Meeting, the American Academy of Pediatrics endorsed most of the proposed definition and diagnosis of rhinosinusitis, at least as far as the chronic form of rhinosinusitis is concerned.\textsuperscript{26} More recent recommendations include the vast European Posi-

\begin{table}
\centering
\caption{Symptoms and signs of chronic rhinosinusitis}
\begin{tabular}{|c|}
\hline
- Rhinorrhoea (of any quality) \\
- Nasal congestion \\
- Cough \\
- Headache, facial pain, and irritability (variable) \\
- Low-grade or no fever \\
\hline
\end{tabular}
\end{table}
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Table 2
Indications for imaging and microbiological assessment in children with rhinosinusitis

- Severe illness or toxic condition
- Acute illness that does not improve with medical therapy in 48 to 72 hours
- Immunocompromised host
- Presence of suppurative (intra-orbital or intracranial) complications (orbital cellulitis excluded)

The diagnosis of chronic ENT inflammation in children is covered too. Evidenced-based schemes for the management of rhinosinusitis are being developed for all the different disciplines involved in the treatment of child rhinosinusitis (by contrast with those developed for adults, where a distinction is made between primary care/non-ENT specialists, ENT specialists and researchers). With respect to the diagnosis of chronic rhinosinusitis, the minimum duration of twelve weeks of symptoms and signs remains unchanged. However, the Position Paper requires two or more symptoms to be present, one of which should be either: nasal blockage/obstruction/congestion or nasal discharge (anterior/posterior nasal drip) +/- facial pain, +/- reduction or loss of smell. Moreover, the paper states that anterior rhinoscopy remains the first step in the clinical examination, but claims that it is inadequate if used alone. It therefore advises using a 2.7 mm rigid endoscope (a 4 mm endoscope for older children when possible), rather than a flexible nasal endoscope. Endoscopy is useful for diagnosis (it facilitates, for instance, the possible direct sampling of middle meatal flora) but also allows for the exclusion of several conditions such as polyps, foreign bodies, tumours and septal deviations. However, the use of a rigid endoscope limits its use to ENT specialists and this runs contrary to what the authors of the Position Paper claim themselves. One should routinely ask questions about allergy and, if positive, allergy testing should be performed. The Position Paper also states (by contrast with the Brussels Consensus Meeting, which failed to reach consensus on this specific topic) that studies from the past had shown that there is a good bacteriological correlation between the maxillary sinus and middle meatal specimens.

d) Microbiology

Other papers have addressed the microbiological differences between paediatric and adult chronic rhinosinusitis. The following micro-organisms are often retrieved in children with chronic rhinosinusitis: Streptococcus pneumoniae, Streptococcus viridans, alpha-hemolytic streptococci, Haemophilus influenzae, Moraxella catarrhalis, Staphylococcus aureus, coagulase negative staphylococci, Corynebacterium species and anaerobes. Some of these micro-organisms are identical to the flora of acute upper respiratory infections, while others should perhaps rather be seen as part of the commensal flora. The formation of biofilms, most commonly of a polymicrobial nature (including the micro-organisms mentioned above, together with Pseudomonas aeruginosa) could be of interest with respect to chronic rhinosinusitis.

e) More recent insights

The management of chronic paediatric rhinosinusitis is beyond the scope of this paper. To look specifically at clinical issues relating to chronic rhinosinusitis, and in order to appreciate new developments, a PubMed search limited to publications in the last five years was conducted using the keywords “pediatric chronic rhinosinusitis”. Two papers are worth discussing. In total opposition to the spirit of most of the previous consensus meetings and reports, Leo et al. try to resurrect plain radiography by Water’s projection for the routine diagnosis of chronic rhinosinusitis in children! The marginal benefits are, however, insufficient to justify the exposure to radiation. A very recent publication by Hsin et al. grants more credit to endoscopically directed middle meatal cultures (EDMMC), specifically in children: EDMMC with suction aspiration provided a much better correlation with maxillary sinus taps than EDMMC with swabs.

Take-home messages

- The diagnosis of chronic rhinosinusitis in children remains a clinical diagnosis.
- Chronic rhinosinusitis in young children does not have to be treated, as spontaneous resolution is the norm.
- In recalcitrant cases, a search for underlying conditions is mandatory.

III. Chronic otitis media

The term “chronic otitis media” describes an inflammation of the middle ear mucosa lasting more than 3 months, with or without perforation of the tympanic membrane (TM), with or without otorrhoea, which can be persistent or intermittent. Chronic otitis media must be seen as part of a continuum of inflammatory middle ear diseases which comprises chronic otitis media with effusion (COME), perforation of the TM, chronic suppurative otitis media (CSOM), tympanic membrane atrophy, retraction pockets and cholesteatoma (Figure 1).

a) Chronic Otitis Media with Effusion (COME)

COME is characterised by an inflammation of the middle ear mucosa, with proliferation of mucous glands and goblet cells, and by the presence of fluid in the middle ear for more than two months. The characteristics of this fluid vary from serous to thick mucoid. Signs of acute inflammation are typically absent, although emerging evidence supports a covered biofilm infection as a major contributing cause to the inflammatory changes in the middle ear cleft.32

Prevalence
COME is one of the most common diseases in childhood; up to 80% of children have been affected at 10 years of age, and most by the age of 3 years.33 Prevalence varies with age, with a median rate of approximately 13% between the ages of 1 and 6 years old. After the age of 6 years, there is a sharp drop to about 7% by the age of 7 years. This decline continues with increasing age.

Season is another important factor which has been shown to influence the occurrence of the disease, with prevalence being higher in winter than in summer.34,35

Risk factors and aetiology
Risk factors include factors contributing to a dysfunction of the Eustachian tube and factors causing an inflammation of the middle ear. Eustachian tube dysfunction may be due to intrinsic factors such as cleft palate, cranio-facial malformations, Down syndrome and ciliary dyskinesia or to extrinsic factors such as acute otitis media, daycare centre attendance, frequent upper respiratory tract infections, large number of siblings, low socio-economic status, bottle feeding, parental smoking and gastric acid reflux.32 The involvement of several risk factors doubles the risk of developing COME.36

Inflammation of the middle ear is generally infectious in origin. Acute otitis media significantly exacerbates the risk of COME; over half of cases follow an episode of acute otitis media.35 While the acute stage may respond to antibiotic treatment, the chronic stage of effusion is unlikely to do so.32 Infective pathogens stimulate an immune response, with a release of cytokins that upregulates the mucin genes expressed in the middle ear, leading to the secretion of a mucin-rich fluid that is recognised clinically as the middle ear effusion seen at myringotomy.38 In 2001, Gok et al.39 found a positive PCR for the bacterial DNA of *Haemophilus influenzae*, *Streptococcus pneumoniae* and *Moraxella catarrhalis* in 94% of 37 samples of COME, compared to only 24.3% tested with traditional bacterial aerobic cultures. The gaseous exchanges between the middle ear mucosa and the blood are altered by the inflammation and effusion in the middle ear. This situation, in conjunction with the prolonged obstruction of the Eustachian tube, is at the root of a vicious circle which maintains the middle ear effusion.40 Confocal laser scanning microscopy and vital dye examination of middle ear tissue biopsy samples, taken at the time of ventilation tube insertion, have identified biofilm colonies (population of bacterial cells growing on a surface
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enrolled in an exopolysaccharide matrix that is difficult to eradicate)\textsuperscript{41} in more than 80% of ears.\textsuperscript{42}

Symptoms and natural history
COME is often asymptomatic. In younger children, poor articulation, language delay, poor balance, irritability and head shaking may be observed. Older patients frequently complain of discomfort, hearing loss, fullness and possibly vertigo. At school, teachers often draw attention to the hearing loss when they observe inattention and poor social interaction. The hearing loss is frequently noted at a hearing screening assessment. There is often little parental concern prior to the results of the screening.

COME is self-limiting in most cases, with spontaneous resolution in over 90% of children in 2 to 4 months.\textsuperscript{43} For most children with COME, particularly younger children under the age of 3 years, watchful waiting and monitoring of hearing, usually over 3 months, is effective.\textsuperscript{33} Nevertheless, poor hearing can impede speech and language development. COME can also be recurrent throughout childhood, leading to some consequences for behaviour and cognition up to the age of 10 years and beyond.\textsuperscript{44}

About 10% of children, mostly those presenting with COME after 8 years of age, will develop complications such as tympanosclerosis, retraction pockets or cholesteatoma.\textsuperscript{3}

Diagnosis
Diagnosis is made by the clinical examination of the ears and age-appropriate audiological testing. Pneumatic otoscopy showing low or absent drum mobility when positive pressure is applied is recommended as the primary diagnostic method in the USA;\textsuperscript{44} it is the method with the best sensitivity and specificity for validated observers but it is less accurate in less experienced hands.\textsuperscript{46} Tympanometry is generally performed as a confirmatory test but it fails to detect the sensorineural hearing loss present in 0.1-1% of children.\textsuperscript{47} Audiometry is essential to assess the level of hearing loss and is recommended for a child presenting with bilateral COME for a total of 3 months Hearing losses fluctuate from less than 20 dB to 40 dB.\textsuperscript{44}

\textbf{b) TM atrophy and retraction pockets}

\textbf{Pathogenesis}
The factors promoting TM atrophy have not yet been elucidated. Some histological studies of human temporal bone clearly show an association between tympanic atrophy and chronic middle ear inflammatory changes. It is commonly believed that atrophy of the TM is related to negative pressure in the middle ear caused by Eustachian tube dysfunction. The inflammatory changes and/or the negative pressure generate circumscribed, either central or peripheral, retractions, retraction pockets (RP), or a generalised TM retraction. The chronic abnormal condition of the ear may result in tympanic areas that lose their middle collagenous fibrous layer and become atrophic: \textit{bimeric ear-drums}. This condition may also result from recurrent perforations in some areas during acute otitis media episodes and from the insertion of tympanostomy tubes.

The RPs may affect the pars tensa (they develop most commonly in the posterior and superior quadrants), or the pars flaccida, with the appearance of an attic retraction. These can be displaced towards the medial wall of the middle ear and become attached to the ossicular chain and promontory. In a small proportion of cases, this causes total or partial destruction of the ossicles, especially of the long process of the incus, leading to significant hearing loss.

An important aim in the management of TM atrophy is to distinguish RPs that will develop these complications from those that do not. This is often possible only by conducting repeated examinations over months or years, especially in children.\textsuperscript{39}

\textbf{Classification}
Many authors (Tos, Sade, Charachon, Gersdorff, Martin) have developed different classifications to facilitate the monitoring of the deterioration of retracted areas. The aim is to predict the progression of the disease. The best known of these classifications is Sade’s classification of pars tensa retraction\textsuperscript{40} (Table 3).

Tos et al.\textsuperscript{41} described four grades of retraction of the pars flaccida (Table 4).

\textbf{Surveillance of patients with TM retraction after a mean of 3 to 5 years has established that prognosis as a function of the different grades is usually as summarised in Table 5.}\textsuperscript{47}

\textbf{Symptoms}
Patients with TM atrophy and retraction may present symptoms but most children are asymptomatic, at least initially, and are only diagnosed at otomicroscopy. If there is an associated effusion or erosion of the incus or stapes,
A.-L. Mansbach et al.

Table 3
Pars tensa retraction or atelectasis

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Mild retraction</td>
</tr>
<tr>
<td>II</td>
<td>The drum is touching or adhering to the incus or stapes</td>
</tr>
<tr>
<td>III</td>
<td>The drum is touching the promontory</td>
</tr>
<tr>
<td>IV</td>
<td>The drum adheres to the promontory</td>
</tr>
</tbody>
</table>

b. Pars tensa localised retraction or RP

<table>
<thead>
<tr>
<th>Grade</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>Self-cleaning and controllable RP</td>
</tr>
<tr>
<td>II</td>
<td>Non-self-cleaning but controllable RP</td>
</tr>
<tr>
<td>III</td>
<td>Non-self-cleaning and non-controllable RP</td>
</tr>
<tr>
<td>IV</td>
<td>Deep retraction, non-self-cleaning and non-controllable RP with keratin debris</td>
</tr>
</tbody>
</table>

c. Perforation of TM and Chronic Suppurative Otitis Media (CSOM)

CSOM is defined by the following features: otorrhoea lasting at least 6 weeks in the presence of chronic TM perforation (WHO, 1996). Perforation of the TM is deemed to be chronic if present for three months. CSOM is preceded by acute otitis media that has been treated incompletely or unsuccessfully. Another cause of paediatric TM perforation is the surgical insertion of tympanostomy tubes, specifically long-term tubes that are associated with a relative risk of chronic perforation (3.5 times higher than with short-term tubes).33

Epidemiology

CSOM occurs most often in the first five years of life. The highest prevalences are found in specific social groups: Inuit and Australian aboriginal children (16%) and children with cranio-facial anomalies. The lowest prevalences are found in highly developed industrial countries such as the USA and the UK, where prevalence is less than 1%.54

Risk factors

CSOM is more common in lower socio-economic areas, where children lack access to health care and therefore timely diagnosis and treatment of acute and recurrent conductive hearing loss may be present. An underlying middle ear inflammation may cause pain and discharge if it is accompanied by acute perforation. Many children with pars tensa atrophy avoid performing Valsalva’s manoeuvre as this causes pain. Some patients may have distorted hearing if the atrophic area is distended by auto-inflation. Some children develop ways of reducing their middle ear pressure, for example sniffing or the Toynbee manoeuvre.47

<table>
<thead>
<tr>
<th>Table 4</th>
<th>Grades of retraction of the pars flaccida according to Tos</th>
</tr>
</thead>
<tbody>
<tr>
<td>Grade I</td>
<td>Mild retraction with air still present between pocket and malleus neck</td>
</tr>
<tr>
<td>Grade II</td>
<td>Deeper retraction; pocket touches malleus neck +/- erosion of neck</td>
</tr>
<tr>
<td>Grade III</td>
<td>Pocket begins to expand; limited erosion of outer attic wall</td>
</tr>
<tr>
<td>Grade IV</td>
<td>More severe erosion of outer attic wall; pocket attached to malleus head and incus</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 5</th>
<th>Prognosis as a function of TM Retraction</th>
</tr>
</thead>
<tbody>
<tr>
<td>Atelectasis</td>
<td>Grade I</td>
</tr>
<tr>
<td>Grade II-III</td>
<td>Dynamic condition: improves, remains the same or deteriorates (in about 16% of the cases)</td>
</tr>
<tr>
<td>Grade IV</td>
<td>About 16% will progress to perforation, does not revert back to earlier stages</td>
</tr>
<tr>
<td>RP</td>
<td>Grade I</td>
</tr>
<tr>
<td>Grade III</td>
<td>Might heighten an underlying cholesteatoma, in particular if lateral attic wall erosion is found with mucus, attic polyp or keratin debris</td>
</tr>
</tbody>
</table>

Grade III might heighten an underlying cholesteatoma, in particular if lateral attic wall erosion is found with mucus, attic polyp or keratin debris.
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otitis media. Fliss et al. have identified a parental history of chronic otitis media as a factor but could not establish an association between CSOM and allergy, recurrent upper respiratory tract infections, breast feeding, sex, parental age or passive smoking.

Microbiology
In CSOM, bacteria can reach the middle ear either from the nasopharynx through the Eustachian tube or from the external ear canal through a non-intact TM. The aerobic micro-organisms more frequently isolated in CSOM are *Pseudomonas aeruginosa*, *Staphylococcus aureus* and *Gram-negative* organisms such as *Proteus spp*, *Klebsiella spp*, *Escherichia coli spp* and *Haemophilus influenzae*. The most frequently isolated anaerobic organisms are *Bacteroides spp* and *Fusobacterium spp*. Fungi, especially *Aspergillus spp* and *Candida spp*, are also thought to play a role in CSOM. Recently, there has been concern about secondary fungal overgrowth as a complication of treatment with Quinolone ear drops.

Bacterial biofilms have gained attention; they may be a source of CSOM as they may attach to damaged tissue such as exposed osteitic bone and ulcerated middle ear mucosa.

Symptoms
The key symptoms of CSOM are otorrhea and hearing loss. Otorrhea may be serous, serosanguineous or muco-purulent, and transient or persistent. The level of conductive hearing loss is strongly related to the degree of erosion caused by past suppuration processes in the ossicular chain and to tympanic perforation size and location. Other otological symptoms are rare in children with CSOM.

Signs and assessment
The symptoms of CSOM are shared by cholesteatoma. The most important objective of the physical examination is therefore to determine the status of the TM. Secretions must be mopped or aspirated (this is usually well tolerated) and topical steroid/antibiotic ear drops are given to obtain a clear view of the tympanic perforation and exclude any other pathology. If it proves impossible to obtain a clear view of the affected TM, the child should be examined under Nitrogenous Protoxide or general anaesthesia.

Pure tone audiograms should be used to assess patient hearing disability. In general, a perforation alone causes little hearing loss (<20 dB HL). CT scan using axial and coronal sections will give valuable information, full attic status, mastoid pneumatisation and possible pathology, roof height, ossicular chain status…. However, CT scans are not essential. Biopsies and histological examination are essential in cases where CSOM is part of a systemic condition such as a Wegener granulomatosis or Histiocytosis X.

The factors influencing treatment are the patient’s symptoms and signs and, importantly, the patient’s age. Good control of ear discharge can result in almost complete loss of symptoms so that it is not always necessary to proceed to early closure of the TM, particularly in very young children.

Congenital cholesteatoma
Epidermal cysts are found medial to an intact TM, usually attached to the promontory, and anterior to the malleus handle, without any history of ear discharge, perforation or previous otological procedure. They result from embryonic epidermal inclusions in the middle ear. The reported incidence of congenital cholesteatoma in the literature has risen in recent decades; this increase is probably a result of better identification (at present, the incidence is 0.12/100 000 children).

Congenital cholesteatomas are usually slow-growing at first, behaving like pearls of keratin with intact matrices. Once the matrix has been breached, for example by infection, they behave in a more aggressive way typical of paediatric cholesteatomas.

Acquired cholesteatoma
Different theories have been provided to explain cholesteatoma aetiology.

- Immigration: there is an ingrowth of squamous epithelium into the middle ear through a defect in the TM. This mechanism is responsible for only a small proportion of cholesteatomas.
- Retraction: progressive retraction of the bilaminar TM, either in the pars flaccida or associated with atrophy of the pars tensa.
- Papillary proliferation: proliferation of the basal layers of
the keratinising epithelium of the TM. It is promoted by chronic middle ear inflammation.

- Metaplasia: transformation of the columnar endothelium of the middle ear cleft in response to chronic middle ear inflammation.

- Trauma: massive blunt trauma with a temporal bone fracture involving the external auditory canal and TM may implant squamous epithelium in the middle ear cleft.

- Iatrogenic: implantation of squamous epithelium during surgery on the TM.

A combination of retraction and proliferation is probably responsible for most acquired cholesteatomas.

Epidemiology
The incidence of cholesteatoma is 3–16/100 000 per year in Europe and North America. Congenital cholesteatomas may account for 9.2-28% of children’s cholesteatomas. Age at presentation is around 5 years for congenital cholesteatoma and around 10 years for acquired cholesteatoma.

Symptoms and diagnosis
In an actively infected ear, suppuration is usually fetid and purulent due to superinfection and debris detachment. Conductive hearing loss depends on the degree of middle ear damage. Ossicular chain impairment varies and, in some cases, defects may become visible. Pain is usually not present but it is a possibility when there are complications such as mastoiditis. Otomicroscopy is the examination of first choice. It requires the complete cleaning of the external ear canal. In small children, this sometimes requires general anaesthesia. The cholesteatoma may be encapsulated or diffused.

Particularities of paediatric cholesteatoma
It has been suggested that paediatric cholesteatomas are more aggressive than the adult disease. This can be explained in different ways.

- The child’s middle ear cleft is in a state of continuous development when compared to the adult. Persisting immaturity of the middle ear and Eustachian tube leads to continuing chronic otitis media and negative middle ear pressure, which can predispose to recurrent disease. The surgeon has to treat the disease, mindful that the underlying causes may only be rectified by growth.

- Some studies have suggested that there is an increase in the epithelial growth rate.

- Other studies implicate the higher level of pneumatisation in the child mastoid, which allows the easier spread of the squamous epithelium.

In children, there is a significantly higher rate of pars tensa cholesteatoma than in adults.

The reported rates of residual and recurrent cholesteatoma are higher than in adults, ranging from 18 to 44% after canal wall up surgery and after a mean post-operative follow-up of 4.5 years. Recently, some authors have obtained much more favourable outcomes - 1.9% residual or recurrent cholesteatoma – using canal wall up surgery associated with an obliteration technique.

Children with cholesteatoma are a more difficult group to treat than adults as it is more difficult for them to accept long follow-up and frequent microsuctions of the ear. This makes the management of a difficult disease even more challenging and should be kept in mind when considering the surgical options.

Take-home messages
- Chronic otitis media with effusion is one of the most common diseases in childhood and is self-limiting in most cases, with spontaneous resolution in over 90% of children within 2 to 4 months.
- The factors promoting atrophy of the tympanic membrane are not fully known yet but the induced inflammatory changes and/or the negative pressure can generate circumscribed, either central or peripheral, retractions, retraction pockets (RP), or a generalised TM retraction.
- Chronic Suppurative Otitis Media (CSOM) is defined by otorrhoea lasting at least 6 weeks in the presence of chronic TM perforation.
- Paediatric cholesteatomas are more aggressive than the adult disease and the reported rates of residual or recurrent cholesteatoma are higher than in adults.

IV. Chronic adenoiditis
The adenoids form the upper part of Waldeyer’s ring and are constantly exposed to bacterial and viral agents, allergens and environmental irritants.

In a healthy state, the lymphoid tissue of the adenoids plays an important role in innate and adaptive immune responses. The epithelial surface is a site for the attachment of antigens and contains locally produced immunoglobulins. From the surface, deep crypts, lined with specialised epithelium with dendritic cells, penetrate into the tissue. Here, the adenoid is organised into B- and T-
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cell areas and there is antigen uptake, processing, presentation, T/B-cell cooperation, maturation and differentiation.69

The size of the adenoid varies from child to child. The adenoid tissue is usually not apparent in early infancy, but it gradually grows, attaining its largest mass in relative terms between the ages of 2 and 5 years. At that time, the nasopharyngeal airway is not yet fully developed. Around the age of 10 years, the involution of the adenoid tissue begins and, by adulthood, very little lymphoid tissue remains.67

Due to the location in the nasopharyngeal airway, disorders of the adenoid not only lead to local disease; they can also spread to, or have an impact on, other regions of the respiratory tract (such as the Eustachian tube, the middle ear, the nasal cavity and paranasal sinuses and possibly also the lower respiratory tract).68,69

a) Pathophysiology and microbiology

Infection (adenoiditis) and adenoid hyperplasia are the principal adenoid disorders.70

Adenoid infection occurs in the presence of an increased load of micro-organisms and/or a breakdown of immunological defences.71 The adenoids serve as a natural reservoir for bacteria, especially Streptococcus pneumoniae, Haemophilus influenzae, Staphylococcus aureus and Moraxella Catarrhalis. Both in vitro and in vivo studies of adenoid tissue have demonstrated the ability of these bacteria to form biofilms.72 A biofilm is a colony of single or multiple bacteria embedded in a self-producing polymeric matrix composed of nucleic acids, proteins and polysaccharides. Bacteria in biofilms express a different set of genes than their planktonic counterparts and have markedly different phenotypes. Biofilms provide bacteria with antimicrobial resistance and protection from host defences.73

Furthermore, recent studies have found extensive biofilm formations containing pathogenic bacteria in the adenoid tissue of children with recurrent acute otitis media, chronic otitis media with effusion74,75 and chronic rhinosinusitis,76 suggesting that the adenoid acts as a bacterial biofilm reservoir for adjacent infections.

The recognition that chronic adenoiditis and its associated conditions are biofilm-related helps to explain the chronic or recurrent nature of these infections despite antibiotic treatment, and the clinically observed efficacy of adenoidectomy.77,78

Chronic infection of the adenoids, as well as the tonsils, induces a proliferation of lymphoid elements leading to adenotonsillar hyperplasia. Brodsky et al.79 found that, in children with clinical evidence of chronic tonsillitis and/or tonsillar hypertrophy, tonsil size was directly proportional to the mean bacterial load and the number of B en T cells. The same is probably true of adenoids.

These findings allow us to hypothesise that chronic infection and hyperplasia of the adenoids are part of the same disease spectrum, meeting as chronic adenoiditis, and are induced by multiple, often resistant, bacteria organised in a biofilm structure. However, it should be emphasised that, alongside infection, allergy, gastro-oesophageal reflux disease and tobacco exposure have also been found to induce inflammation and hyperplasia of the adenoid tissue80,81 and they merit attention in the assessment and treatment of children presenting with adenoid disease.

b) Clinical presentation of chronic adenoiditis

Chronic adenoiditis is a poorly defined clinical entity, but it can be described as a persistent inflammatory state of the adenoids leading to symptoms of otorhinolaryngological infection and upper airway obstruction, with both conditions often occurring together.

Fiber-optic nasendoscopy is the gold standard for the examination of the size and aspect of child adenoids, and it should of course always be interpreted in the context of clinical symptoms. In a cooperative child, evaluation of the nasopharynx can also be performed with a post-nasal mirror. Lateral radiography of the nasopharynx is no longer considered appropriate because of radiation exposure and insufficient accuracy.82

Enlarged adenoids can cause nasal airway obstruction with clinical symptoms of nasal congestion, stasis of sinonasal secretions, mouth breathing, dry mouth, halitosis, hyponasal speech, disturbed craniofacial growth, drooling and sleep-related breathing disorders (SRBD) ranging from primary snoring to true obstructive sleep apnoea syndrome. Night-time symptoms of SRBD include snoring, mouth breathing, restless sleep, sleep pauses, breath holding and gasping, but also enuresis. Daytime manifestations include hypersomnolence, behavioural disorders and headache. Children
with obstructive sleep apnoea syndrome are at risk of serious complications that include pulmonary oedema, rapidly progressive pulmonary hypertension, right-sided heart-failure (cor pulmonale) or failure to thrive. In children it is often difficult or even impossible to differentiate clinically between chronic or recurrent rhinitis/rhinossinusitis and adenoiditis. Supported by pathophysiological findings (see above), there is a growing consensus that the adenoid can harbour chronic infection that leads, or at least contributes, to chronic or recurrent infections of the nose, sinuses and tubotympanum, and that the symptoms of these infections are part of the clinical spectrum of children with chronic adenoiditis.

c) Epidemiology and indications for adenoidectomy

Exact data about the prevalence of chronic adenoiditis are not available. However, we do know that adenoidectomy is one of the most performed surgical procedures in Western countries in the paediatric age group for symptoms of chronic nasal discharge, upper airway obstruction and/or chronic or recurrent middle ear infections. Annual adenoidectomy rates differ from 127/10,000 children per year in Belgium and 101/10,000 in the Netherlands to 39/10,000 in England, 24/10,000 in the United States and 17/10,000 in Canada. Nevertheless, there is no single, all-encompassing indication for adenoidectomy and debate persists about the clinically observed benefits of adenoidectomy as compared to the evidence-based benefits. Overall, there is clinical and scientific consensus about the benefits of adenoidecotomy in children with enlarged adenoid tissue that is causing problems with obstructive daytime and/or nighttime breathing, children aged 3 years and older with persistent otitis media with effusion and children with recurrence of otitis media after previous tympanostomy tubes. There is no supporting evidence for the role of routine adenoidecotomy in children with recurrent acute otitis media. The efficacy of adenoidecotomy for the treatment of recurrent or chronic nasal discharge with or without nasal obstruction, orthodontic problems and disturbed craniofacial growth is not evidence-based either, but it may be considered depending on the specific clinical setting.

Take-home messages

- The adenoids form the upper part of Waldeyer’s ring, they are constantly exposed to bacterial and viral agents, allergens and environmental irritants, and they play an important role in innate and adaptive immune responses.
- Disorders of the adenoid such as infection (adenoiditis) and adenoid hyperplasia not only lead to local disease, they can also spread to or have an impact on other sections of the respiratory tract.
- There are no all-encompassing indications for adenoidecotomy and debate persists about the clinically observed benefits of adenoidecotomy and evidence-based benefits.

V. Laryngotracheitis in children

Laryngotracheitis (frequently called croup) in children can be acute or chronic, depending on the different origins and possible triggering factors of the disease. One important point is that severe inflammation is always present and can affect the treatment, the outcome and, finally, long-term prognosis. Viruses are the usual pathogens in frequent laryngitis, most commonly those viruses responsible for epidemic seasonal diseases (respiratory syncytial virus, adenovirus, influenza, para-influenza viruses). The infection leads to swelling inside the throat that can interfere with normal breathing, increasing the respiratory rhythm to maintain the ventilation per minute, while tidal volume is reduced. A “barking” cough is usually observed with stridor and hoarseness, and sometimes loss of voice. The symptoms are mostly present at night when the infection begins. Viral laryngotracheitis is diagnosed using clinical skills after more severe causes of symptoms have been excluded (in other words, epiglottitis or an airway foreign body). Classically, blood tests, cultures and/or X-rays are not needed. The disease affects about 15% of children, particularly between the ages of 6 months and 5-6 years. It is almost never seen in teenagers or adults.

In the majority of cases, laryngotracheitis evolves rapidly and patients recover completely. Evidence-based medicine strongly recommends the administration of dexamethasone (0.15 to 0.6 mg/kg/day) to children suffering from acute laryngitis to avoid severe complications, as secondary stenosis can be observed in about 4-10% of the cases where systemic corticosteroids are not administered to the patient and are practically never seen when dexamethasone is given. Occa-
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sionally, epinephrine is used in more severe cases; hospitalisation is increasingly rare. Bacterial tracheitis, laryngotracheobronchitis and laryngotracheobronchopneumonitis are secondary bacterial infections and are very severe. Experimental data suggest that even rhinovirus can significantly increase the ability of Staphylococcus aureus to internalise into pneumocytes via a mechanism that involves the virus-induced release of IL-6 and IL-8 and the overexpression of ICAM-1. Overall data disclose a possible mechanism through which rhinoviruses can promote bacterial infections in the lower respiratory tract. Anatomically, the larynx is at a crossroads where nasal infection, sinusal infection, gastroesophageal reflux, allergy or inhalation of irritants (such as passive tobacco smoking) can induce moderate to high levels of inflammation.

Innate humoural immunity must be intact to control viral and bacterial infections of the upper airways. Recurrent infections by the usual germs or by opportunistic pathogens should lead to the evaluation of immune responses.

Figure 2
Inflammation in allergic rhinitis and upper airways (Adapted from Pawankar et al.)

Laryngotracheitis refers to inflammation limited to the larynx and trachea in most cases. However, in some conditions, inflammation and infection can begin in the rhinopharyngeal and/or sinusal sphere. Finally, lower airways (bronchi and lung parenchyma) can also be contaminated by the progression of infection and inflammation. This leads to chronic bronchial infection as a secondary complication of acute ENT disease or the classic progression of chronic disease (as in cystic fibrosis). In some illnesses, inflammation precedes infection, encouraging swelling of the mucosa, increasing mucus production and reducing local air circulation. Dry nocturnal coughing,
followed by productive coughing mostly occurring at night, is commonly observed when children have fallen asleep. Gradually, the nocturnal symptoms also become manifest when the patient is awake. Coughing that is chronic (more than two weeks) and persistent should lead to the evaluation of trigger factors, as well as various complementary examinations.

Inflammation can be investigated via endoscopy (redness of tissues, swelling and mucosal secretions, sinusal drips), exhaled nitric oxide levels in airway physiopathology, and the analysis of lavages and biopsies (bioarkers such as TNF-alpha and IL-1beta, IFN-gamma and T-bet, TGF-beta). Understanding the underlying immune mechanisms of ENT inflammation (Figure 2) is central to developing better and more targeted therapies and also for a better understanding of the complex interactions between infection and inflammation.

b) Trigger factors of inflammation of the larynx, pharynx and trachea

Allergy, and allergic rhinitis in particular, are having an increasing impact on individuals' quality of life. Concurrent chronic obstructive pulmonary disorder and asthma are the strongest predictors of health care costs and respiratory infections in a patient's future. However, even if topical steroids have clearly improved patient health in terms of symptoms and respiratory function, it seems that intranasal antihistamine, intranasal steroids or the combination of both do not have a notable effect on either healthcare costs or on the occurrence of airway infections in this population. Recent studies in adults have suggested that rhinosinusitis and asthma may contribute to inflammation within a continuum rather than as fully separate diseases that only act separately. In fact, the presence of upper airway disease may influence lower airway disease. There are few paediatric studies looking at this area. However, the outcome of several paediatric studies looking at the medical or surgical management of sinusitis and asthma shows that aggressive treatment for sinusitis (when present) can significantly reduce asthma symptoms, the frequency of lower airway infections, and improve quality of life in children, indicating that sinusitis may play an important role in initiating or exacerbating asthma. Antibiotic administration, occasional surgical treatment, and specific topical drugs are the main procedures used.

The role of tobacco smoke as a trigger of recurrent respiratory infections and bronchial hyperreactivity is well established. Efforts must be made to convince parents to avoid this practice.

It is well known that, from the age of eighteen onwards, gastrooesophageal reflux exacerbates bronchial hyperreactivity, pharyngo-laryngeal inflammation, nose and ear obstructions, and lower airway infections such as acute and sudden pneumonia. Acid need not be introduced into the trachea to produce symptoms, as local inflammation of the lower oesophagus is sufficient to induce bronchial obstructive reflex. Evaluation of reflux with pH-metry, diagnosis and treatment (procinetics, omeprazole) is needed to obtain an improvement of laryngopharyngeal reflux when it plays a major role in the disease.

 Chronic inflammatory diseases such as cystic fibrosis and primary ciliary deficiency are classically associated with ENT complications and lower airway infections. ENT inflammation exacerbatrs symptoms, specifically due to gene abnormality at the level of the bronchial mucosa. Cystic fibrosis is currently considered to be one of the most inflammatory diseases. The prognosis for females suffering from multiple inflammatory conditions (including those caused by infections but also those resulting from surgical procedures) has been shown to be better throughout life, whereas the prognosis for females is poorer when they suffer from chronic inflammatory diseases such as cystic fibrosis, severe asthma or chronic pulmonary obstructive disease. This observation is probably associated with gene expression dependent on the X chromosome rather than hormonal influences: prepuberal children have the same dimorphism as adults.

Finally, in recurrent laryngitis and infection, it is always necessary to check for the possibility of a foreign body in the larynx and/or trachea.

Take-home messages

- Laryngotracheitis is extremely frequent in children, especially between the ages of six months and six years.
- Although viruses play the leading role in acute cases, bacterial complications are significant. Inflammation is always important.
- Many trigger factors, such as tobacco smoke, allergy, gastrooesophageal reflux, cystic fibrosis
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and primary ciliary insufficiency, can exacerbate symptoms.

- Diagnosis and treatment must be complete/thorough and efficient to reduce health costs, morbidity and mortality.

VI. Relationships between rhinosinusitis and the inflammation of lower airways

There is evidence of a link between the upper and lower respiratory tracts. Over the past fifty years, many clinical observations have led to a new pathogenic view of upper and lower respiratory tract inflammation, which is defined as Sinobronchial Syndrome: the association of chronic sinusitis and chronic non-specific inflammation in the lower airways, typically chronic bronchitis, bronchiectasis and diffuse panbronchiolitis. The aetiology is unknown, although it is not related to smoking. It is more common in Japan and other Asian countries than in Western countries. However, the relatively low incidence in Western countries could be due in part to insufficient awareness of the disease and therefore misdiagnosis.

Chronic inflammation of the upper and lower airways results in the impairment of mucociliary function due to the increased dynamic visco-elasticity of the airway fluid. The ciliary beat frequency remains unchanged. It is well known that mucociliary clearance is impaired in the noses of patients with chronic sinusitis and in the bronchi of patients with chronic bronchitis. However, it has been observed that the visco-elasticity of the tracheobronchial mucus also increases in patients with chronic sinusitis alone and that the visco-elasticity of the nasal mucus increases in patients with chronic bronchitis alone. This may be one of the causes of the interaction between the upper and lower respiratory tracts, leading to sinobronchitis.

Impaired mucociliary clearance provides an opportunity for organisms to colonise the airways. This mechanism is well known in mucoviscidosis (cystic fibrosis, CF), but it can also be found in all chronic bronchial inflammations and infections, such as primary ciliary dyskinesia, chronic bronchitis, non-CF bronchiectasis and diffuse panbronchiolitis. All these conditions are characterised by a chronic wet cough.

The treatment of choice is long-term therapy with low-dose Erythromycin or other 14- and 15-membered ring macrolide antibiotics. The beneficial effect is considered to be due to an anti-inflammatory rather than an anti-infective mechanism. It is associated with the downregulation of a non-specific host inflammatory response to injury, and the promotion of tissue repair. It includes the impairment of chemotaxis attracting neutrophils to the respiratory tract, inhibition of the expression of adhesion molecules, with a reduction of the infiltration of neutrophils into the respiratory epithelium. Macrolides also inhibit the expression of transcription factors and the formation of pro-inflammatory cytokines, and directly and indirectly block mucus secretion. Even with long-term use, macrolides are safe and well tolerated. Their prolonged use has not been associated with the emergence of clinically significant bacterial resistance or immunosuppression.

It has long been considered that surgery fails to improve sino-bronchial syndrome. However, this was at the time when transoral antrotomy (Caldwell-Luc operation) and ethmoidectomy (De Lima operation) were the standard procedures. Nowadays, with the generalised use of endoscopic sinus surgery (ESS) and the improved results in terms of decreased inflammation in the sinus, increased pulmonary function can be expected. Yanagi et al. reported a marked improvement in FEV, as well as an improvement in the subjective respiratory rating, one and six years after functional endoscopic sinus surgery.

GENERAL CONCLUSIONS

Chronic inflammation can affect all organs of the upper airways in children through many pathogenic pathways. Chronic dysfunction due to the underlying inflammation can not only generate direct symptoms but also interfere with the functions of distant loco-regional structures or with the neurocognitive development of the child. In general, a chronic inflammation limited to a single anatomic region is not usual.

The systematic screening of loco-regional comorbidity is the gold standard for children affected by chronic upper airway inflammation.

References

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