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General review

Update on childhood and adult infectious tracheitis

Mise au point sur les trachéites infectieuses de l'enfant et de l'adulte

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Abstract

The trachea is a pivotal organ of the respiratory tract. Rather than a genuine anatomic border, it acts as a crossroad in all respiratory infectious processes. Even though not strictly limited to the trachea, infections such as laryngotracheitis and tracheobronchitis are frequently diagnosed in children, in particular during the winter season. Infectious tracheitis etiologies are diverse and the distinction between viral and bacterial origins, albeit difficult, remains relevant considering the substantial differences in terms of gravity and therapeutic management. This literature review summarizes the microbiological and clinical aspects of community-acquired and nosocomial tracheitis in adults and children, as well as the adequate diagnostic and therapeutic approaches. It also highlights the emergence of fungal tracheitis in immunocompromised patients, of ventilator-associated tracheitis in intensive care medicine, and beyond all that the potential short and long-term consequences of tracheitis.

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Keywords: Tracheitis; Croup; Ventilator-associated tracheitis

Résumé

Considérée comme le plus long organe des voies respiratoires, la trachée joue plus un rôle de carrefour au cours des processus infectieux, qu'une véritable frontière anatomique. Alors que la trachéite pure est rare, les laryngo-trachéites et les trachéo-bronchites sont fréquemment diagnostiquées chez l'enfant en période hivernale. Le spectre étiologique des trachéites infectieuses est vaste et la distinction entre origine virale et bactérienne reste un véritable challenge tant la gravité et la gestion thérapeutique varie entre ces deux origines. Cette revue souligne les particularités microbiologiques et cliniques de l'enfant et de l'adulte au cours des trachéites communautaires et nosocomiales, et décrit les approches diagnostique et thérapeutique. Elle met en exergue l'émergence des trachéites fongiques chez le patient immunodéprimé comme la trachéo-bronchite aspergillaire, et les trachéites acquises sous ventilation chez le patient en réanimation, et au-delà de ces situations spécifiques, les conséquences à court et long terme des trachéites.

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Mots clés : Trachéite ; Croup ; Trachéite acquise sous ventilation

1. Introduction

Infectious tracheitis is always neglected because of the concomitant and frequent involvement of adjacent airways,

the associated non-specific clinical signs, and the endoscopy required to confirm the diagnosis.

However, several factors urge a particular attention to the tracheal infection. Distinguishing a viral infection from a bacterial one in pediatric patients, and a colonization from a tracheal infection in patients admitted to the Intensive Care Unit (ICU) is a real challenge. Short-term consequences of tracheitis may be fatal and must be well-known. The same goes for longer term consequences of post-infectious stenosis. Infectious tracheitis

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should be viewed as an entity in its own right considering the specificities of its management.

2. The trachea: an organ at the crossroad of infectious processes

The trachea is the longest part of the airways. It prolongs the larynx and separates to form the main bronchial tubes. The trachea is made of fibers, muscles, and cartilages and can thus resist to the various pressures applied by the breathing mechanism and depress itself during the inspiratory collapse. Its mucous membrane is made of a pseudo-stratified ciliated respiratory epithelium with goblet cells that are responsible for mucociliary activity and for drainage of glandular secretions towards the pharynx. The presence of bronchial-associated lymphoid tissue (BALT) ensures cellular or humoral mucosal immunity [1].

Tracheitis is an inflammation of the trachea, which may be infectious. “Isolated” tracheitis is rare. The inflammation usually affects surrounding organs such as the larynx (laryngotracheitis) and/or the bronchial tubes (tracheobronchitis, laryngotracheobronchitis [LTB]), depending on the infectious agent involved and on the pathophysiology of the infection (direct, toxic, etc.) (Table 1). Acute LTB or “croup” is considered when signs and symptoms of viral laryngotracheitis or spasmodic croup of viral and/or atopic origin are observed in children aged below 6 years [2]. Inflammation of the tracheal and/or laryngeal wall(s) leads to a narrower lumen and to an increased airflow in this area (Venturi effect). This constriction triggers a negative pressure responsible for the airway collapse, which in turn triggers turbulent airflow, known as stridor. Stridor can be inspiratory when the obstruction originates in the larynx or cervical trachea, or expiratory when the obstruction originates in the intrathoracic trachea or in the bronchial tubes. It can even be biphasic when the inflammatory obstruction is diffuse [3].

Anatomical differences between children and adults make children at higher risk of severe signs and symptoms during upper respiratory tract infection. The subglottic region is the narrower portion of the airways in children, while it is the glottis in adults. This subglottic region is surrounded by cricoid cartilage, which is itself covered by a loose mucous membrane prone to edema during the infection.

Children presenting with tracheitis often have symptoms of airway obstruction that may include respiratory distress syndrome. These symptoms include tachypnea, stridor, and hoarse voice. Patients usually present with an initially dry, hoarse, painful, and spasmodic cough (coughing fit) that may evolve into a productive cough. Cough usually occurs at night, and its deterioration may be due to the lying position or to the circadian rhythm of cortisol and epinephrine levels with low levels between 11pm and 4am, just like asthma peaks that are more often observed at night [4]. Stridor is indicative of the narrowing of the upper airways, that most often originates in the larynx and sometimes in the trachea. Inspiratory and/or expiratory dyspnea, symptoms of respiratory distress syndrome with labored breathing, cyanosis, consciousness disorders, and agitation may occur depending on the extent of the tracheal obstruction. Fever is not always observed in patients presenting

with viral tracheitis; it is however more frequent and severe with a bacterial origin. Severity is determined depending on the degree of stenosis (marked/persisting at rest/persisting despite ongoing treatment stridor, sub-clavicle labored respiration) and on the consequences of the lack of oxygen (cyanosis, desaturation, agitation, consciousness disorders) [4]. Pediatric scores may be used to assess croup severity [4].

The main differential diagnoses are epiglottitis (high fever, toxic shock syndrome, absence of hoarse cough, dysphonia, refusal to lie down), tracheal obstacle, angioneurotic edema (sudden without infectious signs), retropharyngeal abscess, laryngeal diphtheria, or allergic reaction.

Signs of airway obstruction in adults are usually less severe. A biphasic stridor must lead physicians to suspect tracheitis, although not always present. Patients most frequently present with a cough, that may sometimes be productive, and dyspnea that may be as severe as respiratory distress syndrome. Unlike children in whom toxic signs and severe respiratory distress syndromes are observed during bacterial LTB, these symptoms are rarely observed in adults [5].

Frontal and lateral (left) chest and cervical region x-ray is the first-line examination for patients presenting with a suspicion of tracheal infection. X-ray results of patients presenting with croup usually reveal an excessive distension of the lower pharyngeal region and a narrowing of subglottic airways; steeple sign may even be observed. For bacterial tracheitis – mainly suspected in patients presenting with toxic clinical signs – the x-ray may reveal a narrowing of subglottic airways and even the presence of intraluminal tracheal membranes or irregularities of the tracheal wall. These signs support the bacterial origin of the infection [6]. The x-ray also reveals pulmonary infiltrates during tracheobronchopneumonia. CT scan is, however, the reference examination to detect the presence of stenosis, of a thickening of the tracheal wall, and of a tracheal obstruction by pseudomembranes. Its main limitation is radiation exposure, especially for young children. Radiation exposure may, however, be reduced with low-dose CT imaging [7]. CT scans are more sensitive and more specific than x-rays for detecting an associated pulmonary infection. Flexible endoscopes help in visualizing supraglottic structures. Subglottic mucosal edema and purulent secretions are often observed with a bacterial infection [8]. Flexible endoscopes help in performing tracheal aspirations to unblock airways and ensure non-contaminated samples for microbiological documentation. The diagnosis may sometimes be confirmed during the autopsy for patients who presented with severe manifestations, most often of bacterial origin [9].

3. Epidemiology and etiologies of infectious tracheitis

3.1. Pediatric community-acquired tracheitis

Viral tracheitis is probably not the adequate term as the larynx, trachea, and bronchial tubes are affected during viral infection. This laryngotracheobronchitis (LTB), or croup [3], mainly affects children from 6 months to 3 years of age, with an incidence peak at the age of 2. LTB may also occur in infants

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