
Pathogenic Bacteria Associated with Tonsillitis

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ABSTRACT: Tonsillitis, is defined as an infection of the palatine tonsils with bacterial or viral agents. It is classified as acute or chronic tonsillitis. This disease has effects on high percentage of individuals worldwide, especially children. Complications of tonsillitis are uncommon, they may include: rheumatic fever, ear infections, sleep apnea, acute glomerulonephritis, peritonsillar abscesses and scarlet fever, and. For chronic, frequent, recurrent tonsillitis, tonsillectomy is the recommended treatment strategy. Literature have listed the bacterial causative agents for acute and chronic tonsillitis, including: *Streptococcus* spp., *Staphylococcus aureus*, and *Haemophilus influenza*. This review highlights the main bacterial causes of acute and chronic tonsillitis, their pathogenicity and treatment options.

1. INTRODUCTION

Tonsils that are located laterally in the oropharynx are referred to as palatine or faucial tonsils. Palatine arches, also known as palatine pillars, are structures that can be found between the palatoglossal arch in the front and the palatopharyngeal arch in the back of the mouth. The tonsils are elements of Waldeyer's ring, which also includes the adenoids (nasopharyngeal tonsil), tubal tonsil, and lingual tonsil. The tonsils are made up of lymphatic tissue and are a component of Waldeyer's ring. Tonsils are an essential component of the immune system of the body because they act as the first line of defense against infections that are inhaled or ingested. As a result, they play an important role in the immune system's ability to guard against infections (Anderson et al., 2024).

Tonsillitis, which refers to the inflammation of the tonsils, is a prevalent condition and constitutes around 1.3% of outpatient appointments. The condition is mainly caused by viral or bacterial infections and typically presents as a sore throat in its basic form. The diagnosis of acute tonsillitis is made through clinical assessment. Chronic tonsillitis (CT) is characterized by an individual experiencing seven or more episodes of tonsillitis annually. In Germany, over 120,000 individuals receive treatment each year to manage recurrent bouts of acute tonsillitis (Windfuhr et al., 2016).

Bacterial causes of tonsillitis are frequently occurs with: group A beta-hemolytic *Streptococcus* (GABHS), *Streptococcus pneumoniae*, *Staphylococcus aureus*, , and *Haemophilus influenza*. Tonsillitis can be resulted from both anaerobic and aerobic pathogens bacteria. Viral infections are more frequent in children under five (Wald et al., 1998).

Beta-hemolytic *Streptococcus* (GABHS)

Streptococci are Gram-positive bacteria that do not have the ability to move, do not create spores, and have a spherical shape. They arrange themselves in pairs or chains and do not produce the enzyme catalase. As cultures mature, they may gradually lose their Gram-positive characteristics. The majority of streptococci are capable of surviving in both aerobic and anaerobic conditions, while there are a few that can only survive in anaerobic conditions. In order to thrive, streptococci typically need specialized media such as blood agar that is rich in nutrients. Group A streptococci possess a hyaluronic acid capsule and are categorized according to their hemolysis on blood agar: β -hemolytic (resulting in clear and full lysis of red blood cells), α -hemolytic (causing partial and greenish hemolysis), and γ -hemolytic (no hemolysis observed). Group A β -hemolytic streptococci (GABHS) account for 5% to 15% of pharyngitis cases in adults and 15% to 30% in children aged five to fifteen, while they are rare in children under two years old (Wald et al., 1998).

Streptococci are parts of the opportunistic normal flora. Many virulence factors have been identified for group A streptococci include, and take part in their pathogenicity. These virulence factors include: M protein and lipoteichoic acid which are important for anchoring to host tissues; a hyaluronic acid capsule which prevent phagocytic activity of macrophages; other extracellular factors, like pyrogenic toxin, which result in the rash colors of scarlet fever; and many enzymes that include: streptolysins,

Pathogenic Bacteria Associated with Tonsillitis

streptodornase, and streptokinase. Few strains of Streptococci are may cause nephritogenicity (Roggiani et al., 2000; Alhamoud et al., 2021).

Group A β -hemolytic streptococcus (GABHS) is the main bacteria responsible for causing acute inflammatory problems in the pharynx. This is because GABHS has the ability to produce both local and systemic issues. It can also lead to meningitis, bacteremia, lymphatic infections, cardiovascular and musculoskeletal infections, skin and soft-tissue infections, pneumonia, and acute otitis media. Physicians frequently over-diagnose streptococcal tonsillopharyngitis, often resulting in the unwarranted use of antibiotics. (Pichichero, 1998; Evsikova et al., 2020).

Group A β -hemolytic streptococcal pharyngotonsillitis (GABHS) predominantly affects children and is typically spread through direct contact with nasal secretions or saliva. While rarer, outbreaks caused by contaminated food or water have also been reported. Most documented GABHS outbreaks involving person-to-person transmission occur in healthcare facilities for older adults (Culqui et al., 2014).

Most oral antibiotics are typically prescribed for a duration of 10 days to ensure optimal eradication rates of Group A β -hemolytic streptococcus (GABHS). Nevertheless, there have been reports suggesting that more recent drugs can achieve similar rates of eliminating bacteria and improving clinical symptoms for GABHS pharyngotonsillitis (PT) when given for a duration of fewer than five days. These medications include cefpodoxime, cefdinir, ceftibuten, cefixime, cefuroxime, clarithromycin, and azithromycin. Another option is amoxicillin, which exhibits similar efficacy against GABHS. Nevertheless, it presents theoretical benefits such as enhanced absorption reliability, elevated blood concentrations, extended plasma half-life, reduced protein binding, and greater compliance owing to its enhanced flavor. Trials have shown that a daily dose of amoxicillin, not exceeding 1000 mg, taken for a duration of 10 days, is helpful in treating GABHS infections. Pharyngitis (Brook, 2017).

STAPHYLOCOCCUS AUREUS

Spherical in shape, Staphylococcus aureus are Gram-positive bacteria that are positive for catalase reactions. They are facultative anaerobic, typically cluster together, and lack flagella, which prevents them from forming spores. Their diameter ranges from 0.5 to 1.5 μm . Uniquely, these bacteria are capable of withstanding osmotic stress and elevated salt concentrations. In both humans and animals, this species is frequently encountered as a component of the natural flora of the epidermis. It is widespread (Ahmad-Mansour et al., 2021).

Staphylococcus aureus ranks among the most common pathogens causing tonsillitis, primarily due to its antimicrobial resistance and ability to persist within the tonsil tissues. The throat and anterior nostril regions are recognized as the main sites for *S. aureus* colonization. Multiple studies have identified *S. aureus* as the predominant cause of tonsillitis or a likely co-pathogen, with reported prevalence rates reaching as high as 83.0%. (Cavalcanti et al., 2019).

The occurrence of *S. aureus* in tonsil infections, along with its endurance within tonsillar tissue post-inflammatory response, could be attributed to its capacity to develop biofilms. Biofilm presence might elucidate treatment ineffectiveness and consequent infection relapse, constituting a significant factor in chronicity, even in the absence of acute inflammation (Torretta et al., 2013).

The rate of resistance to penicillin was 83.6%, but the rate for the combination of amoxicillin and clavulanate was 13.1%. The data suggest that the increased resistance found is due to the synthesis of β -lactamase enzymes, which limits the effectiveness of this extensively used treatment in clinical settings. The inefficacy of penicillin treatments prompted a rise in the utilization of alternative antimicrobials, including combinations with β -lactamase inhibitors and cephalosporins (Drawz & Bonomo, 2010).

STREPTOCOCCUS PNEUMONIAE

Streptococcus pneumoniae, a gram-positive bacterium with a lancet-shaped appearance, is responsible for community-acquired pneumonia. Pneumococcal infections are global and tend to peak during the winter and early spring seasons. This resource details the assessment and management of Streptococcus pneumoniae infections, as well as emphasizes the collaborative efforts of interprofessional healthcare teams in enhancing patient care for this condition. Streptococcus pneumoniae is a prominent bacterial species found in the nasopharynx and frequently leads to upper respiratory tract infections in children (Dion and Ashurst, 2024).

The capsule of Streptococcus pneumoniae plays a crucial role in its pathogenesis. The polysaccharide composition of the envelope helps the cell wall from being engulfed by phagocytes by obstructing the access of granulocytes to the underlying cell wall. Furthermore, these polysaccharides play a crucial role in the process of bacterial identification and serotyping. The virulence of these strains can be determined on culture media based on their visual characteristics, which are classified as either opaque or transparent types. The transparent variant commonly inhabits the nasopharynx, but the opaque variant is linked to illnesses in the lungs, brain, and bloodstream. Another crucial element of Streptococcus pneumoniae's ability to cause disease is its capability to attach to respiratory epithelium and penetrate tissues. Pneumococcal illness is characterized by a significant inflammatory response, which is brought about by the activation of complement pathways and the production of cytokines. This response is responsible for increased severity of the disease. The proteins found in the cell wall, autolysin, capsular polysaccharides, and DNA that is produced by bacteria are the driving forces behind this reaction (Ghaffar et al., 1999).

Pathogenic Bacteria Associated with Tonsillitis

A previous study has found that when tested many strains of *Streptococcus pneumoniae*, 35.29% of them were sensitive to all investigated antibacterial agents. Low to moderate sensitivity to penicillin was reported in 45.11% of the strains. High percentage of antimicrobial resistance were observed: chloramphenicol - 43.11%, clindamycin - 51.01%, erythromycin - 52.89%, tetracycline - 43.11%, co-trimoxazole - 52.89%. All isolated strains were sensitive to norfloxacin (Niedzielski et al., 2013).

Haemophilus influenzae

Haemophilus influenzae is a gram-negative coccobacillus that is classified as a small, facultatively anaerobic, pleomorphic, and capnophilic bacteria. It cannot survive in the presence of oxygen. The Pasteurellaceae family is the one that it belongs to. A wide variety of bacterial infections, both invasive and non-invasive cases, can be traced back to this common component, which is responsible for their development. It is possible to divide the bacteria into two major categories: those that are encapsulated and those that are not encapsulated. At this time, non-encapsulated *H. influenzae*, which is also sometimes referred to as non-typeable *H. influenzae* (NTHi), is the causal agent responsible for the majority of instances of pneumonia, otitis media, and sinusitis, particularly in those who have been vaccinated against the influenza virus (Takeuchi et al., 2018).

While *H. influenzae* is known to cause various respiratory tract infections, it is also recognized as a common inhabitant of the nasopharynx, particularly in preschool-aged children. There is an observed correlation between the quantity of bacteria and tonsillar disease, with reports frequently noting a high prevalence of persistent *H. influenzae* infections. Research indicates that approximately 20% of cultures from recurrent tonsillitis cases reveal the presence of *H. influenzae* (Singh et al., 2014).

H. influenzae employs various mechanisms to adhere to host cells and demonstrate virulence. Encapsulated forms utilize proteins like protein H and *Haemophilus* surface fibrils (Hsf), although these attributes are absent in non-encapsulated *H. influenzae* (NTHi). The capsule provides the bacteria with antiphagocytic abilities, and the absence of anti-capsular antibodies leads to heightened bacterial proliferation. Following the introduction of vaccines targeting capsular *H. influenzae*, NTHi has become a predominant cause of infections (Khattak et al., 2024).

CONCLUSIONS

The condition known as tonsillitis is a cause for concern because it is a health condition that affects millions of individuals each year, particularly youngsters. Chronic tonsillitis is typically treated with surgical removal of the tonsils, which is the most common technique of treatment. According to the information presented in this article, the bacterial agents that have been investigated as possible causes of acute and chronic tonsillitis are as follows: *a beta-hemolytic Streptococcus (GABHS)*, as well as *Staphylococcus aureus*, *Streptococcus pneumoniae*, and *Haemophilus influenzae*.

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Pathogenic Bacteria Associated with Tonsillitis

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