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PREDISPOSING FACTORS AND ETIOLOGY OF SUBMANDIBULAR GLAND ABSCESS

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Abstract

Submandibular gland abscess is a severe infectious condition, characterized by the accumulation of pus in the submandibular space, having multiple causes and predisposing factors. Its etiology is mainly bacterial, involving aerobic and anaerobic pathogens, and obstruction of the Wharton duct by salivary stones is a major trigger. The diagnosis is based on clinical examination, imaging investigations, and laboratory tests, and the treatment combines antibiotic therapy with surgical drainage in advanced cases. Predisposing factors such as poor oral hygiene, diabetes, hyposalivation, and systemic conditions contribute to the development of the infection and its complications. Proper management involves early identification of symptoms and prevention of the spread of infection to adjacent structures. Future research aims to improve early diagnosis techniques and develop minimally invasive therapies to treat glandular infections. Through a multidisciplinary approach and effective preventive strategies, the incidence and severity of this condition can be reduced.

Keywords: Submandibular abscess, salivary lithiasis, bacterial infection, imaging diagnosis, surgical treatment.

Introduction

Submandibular gland abscess is a purulent collection formed in the submandibular space as a result of an acute or chronic infection, with significant implications for oral and general health. This condition can evolve rapidly, requiring prompt diagnosis and appropriate treatment to prevent severe complications, such as the spread of infection to the deep regions of the throat or mediastinum [1–4]. Due to the complex anatomy of the submandibular region and the close relationship with vital structures such as the airways and large blood vessels, this pathology requires special attention from both dentists and oro-maxillofacial surgeons [1,3].

Anatomically, the submandibular gland is located in the submandibular space, between the buccal floor and the lower edge of the mandible, and is responsible for a significant part of salivary secretion. Its drainage is done through the Wharton duct, which opens at the level of the sublingual caruncula, making it susceptible to obstruction and infections [5-10]. Salivary stones or stenosis of the duct can facilitate saliva stagnation, favoring bacterial proliferation and the appearance of an infection that can evolve into an abscess [2,3,10].

The clinical importance of this pathology derives from its potential to expand and affect essential functions such as swallowing, chewing, and breathing. For this reason, early recognition of symptoms is crucial. Initial manifestations include localized pain, progressive swelling, redness, difficulty swallowing, and fever. As the infection progresses, severe complications may

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occur, such as internal jugular vein phlebitis, cavernous sinus thrombosis, or descending mediastitis, which emphasizes the need for rapid therapeutic intervention [2,4,5].

The predisposing factors of this condition are multiple and can be local or systemic. Local ones include poor oral hygiene, untreated dental infections, post-traumatic ductal lesions, or dental procedures that can favor the penetration of bacteria into the ductal system of the gland [1,3,6]. Added to these are systemic factors such as immunosuppression, diabetes, dehydration, immunosuppressive treatments, and conditions that cause hyposalivation [2,5,6]. All these conditions create a favorable environment for the development of infection and the formation of an abscess [2,6,7].

As for the infectious etiology, the bacterial flora involved is mainly of the polymicrobial type, including both aerobic and anaerobic bacteria. The most commonly involved species are *Staphylococcus aureus*, *Streptococcus viridans*, and various species of *Fusobacterium* and *Prevotella* [8,9]. In some cases, infection may be secondary to systemic bacteremia, especially in immunocompromised patients [2,9]. Also, fungal infections, although rare, can occur in patients with low immunity [2,9,10].

Figure 1. Submandibular gland abscess (a) Intraoral image showing dental status and oral mucosa. It shows changes in oral hygiene and possible inflammation of the oral floor. (b) Extraoral image showing a drained submandibular abscess, characterized by swelling, erythema, and an open wound, indicating the evolution of the infection and the need for surgery.

The purpose of this review is to analyze in detail the predisposing factors and etiology of the submandibular gland abscess, providing a clear understanding of the mechanisms involved in the onset and evolution of this condition. Through a well-documented clinical and theoretical approach, the aim is to highlight the importance of early diagnosis and effective therapeutic options in order to prevent complications and improve the prognosis of affected patients.

Anatomy and physiology of the submandibular gland

The submandibular gland is one of the three major salivary glands, having an essential role in salivary secretion and in maintaining the balance of the oral cavity [10-13]. Located in the submandibular triangle, between the lower edge of the mandible and the digastric muscle, this gland is partially covered by the cervical fascia and is closely related to the neurovascular structures in the region. Although it is smaller in size than the parotid gland, it produces about 60–70% of the total volume of saliva at rest, thus having a major impact on oral functions [10,13,14].

Drainage of the gland is done through the Wharton duct, a narrow and relatively long canal that crosses the oral floor and opens at the level of the sublingual duct, near the lingual frenulum [10,13,14]. This anatomical peculiarity makes it vulnerable to obstruction, especially through the formation of salivary stones, which can cause inflammation and infection [1,2,10].

In addition, the trajectory of the duct inclined against gravity predisposes to saliva stagnation, especially in conditions of dehydration or glandular hypofunction [2,9,10].

The histological structure of the submandibular gland combines serous and mucous elements, the predominance of serous components being responsible for the secretion of a fluid saliva, rich in enzymes [10,13]. The main enzyme, salivary amylase, initiates the digestion of starch from the oral cavity, while mucins secreted by mucous cells contribute to lubricating the mucosa and protecting it from irritation. In addition to these digestive functions, the saliva secreted by the submandibular gland contains immunoglobulins, lysozyme, and lactoferrin, substances with an essential antimicrobial role in maintaining the balance of the oral microbiome and preventing infections [13,14,15].

The vascularization of the submandibular gland is provided by the branches of the facial artery and the lingual artery, which form a rich network that contributes to the proper functioning of the gland and its ability to fight infections. Venous drainage follows the path of the facial and lingual veins, indirectly connecting to the deep venous system, which explains the risk of rapid spread of infections in the event of an abscess. Innervation is provided by parasympathetic fibers from the facial nerve, through the lingual nerve and the submandibular ganglia, causing the stimulation of salivary secretion. On the other hand, sympathetic innervation, coming from the cervical chain, modulates the composition of saliva, reducing its volume and increasing viscosity [10,17].

The functions of the submandibular gland are essential for oral and digestive health. In addition to initiating digestion and protecting the mucosa, saliva plays an important role in neutralizing acidity in the oral cavity, thus preventing the appearance of cavities and gum inflammation [13-15]. In addition, continuous salivary flow contributes to the mechanical elimination of food debris and pathogenic bacteria, preventing the formation of plaque [10-15].

Given the anatomical and physiological complexity of this gland, any factor that interferes with salivary secretion or drainage of the Wharton duct can predispose to infections. Hyposalivation, ductal obstructions, and bacterial infections are the main causes of pathologies of the submandibular gland, including chronic sialoadenitis and abscess formation [2,5,10-15]. In this context, a detailed understanding of the anatomy and physiology of the submandibular gland is essential for the correct diagnosis and treatment of conditions that may affect it [10,17].

Etiology of submandibular gland abscess

The etiology of the submandibular gland abscess is multifactorial, involving infectious agents, mechanical factors, and systemic conditions that favor the development of infection. In most cases, the infection occurs as a consequence of obstruction of the Wharton duct, which causes salivary secretion to stagnate and bacterial proliferation. This obstruction can be caused by salivary lithiasis, which is one of the most important predisposing factors [1,2,10,20]. Salivary stones, formed by the precipitation of mineral salts in viscous saliva, block the drainage of the gland and create an environment conducive to the development of pathogenic microorganisms [1,20].

Bacterial infections are the main cause of submandibular abscess, involving a broad spectrum of pathogens. The microbial flora is predominantly polymicrobial, including both aerobic and anaerobic bacteria [13,18–20]. Among the most commonly involved microorganisms are *Staphylococcus aureus*, *Streptococcus viridans*, *Streptococcus pyogenes*, *Fusobacterium*, and *Prevotella* [18–20]. In certain cases, the infection can occur by hematogenous dissemination from other septic foci in the body, especially in immunocompromised patients. Viral or fungal infections are rarer, but can occur in patients with severely compromised immunity [9,10].

Mechanical factors play an essential role in the occurrence of infection [1,2]. In addition to lithiasis, post-traumatic ductal strictures or secondary to chronic inflammation can contribute to obstruction of salivary drainage and the development of an abscess. Local trauma, either as a

result of dental maneuvers or due to iatrogenic lesions, can favor the penetration of bacteria into the glandular tissue [13,18,20].

Systemic factors, such as diabetes, immunosuppressive treatments, and severe dehydration, directly influence susceptibility to infections [22]. Hyposalivation caused by the use of medications, such as antihistamines or antidepressants, contributes to the creation of an environment favorable to bacterial colonization. Patients with chronic conditions, such as Sjögren's syndrome, which cause a significant reduction in salivary secretion, are prone to recurrent infections of the submandibular gland [18-22].

The etiology of the submandibular abscess is complex, involving local and systemic factors that favor the obstruction of salivary drainage and bacterial proliferation. Salivary lithiasis, bacterial infections, and systemic conditions that affect salivary flow are the main causes of this condition. Early recognition of etiological factors is essential for preventing complications and applying effective treatment [13,18–22].

Table 1. The table presents the factors involved in the etiology of the submandibular gland abscess, highlighting the infectious, mechanical, and systemic causes. The bacteria commonly involved, the mechanisms of development, and the associated complications are described, such as the spread of the infection in the deep spaces of the throat. Additional predisposing factors influence the risk and severity of infection [2-7,10-15,18].

Category	**Details**
Infectious factors	Polymicrobial bacterial infections involve both aerobic and anaerobic bacteria.
Types of involved bacteria	Staphylococcus aureus, Streptococcus viridans, Streptococcus pyogenes, Fusobacterium, Prevotella, Peptostreptococcus.
Mechanical factors	Obstruction of Wharton's duct due to salivary stones, post-inflammatory or traumatic ductal strictures.
Systemic factors	Diabetes mellitus, immunosuppression, Sjögren's syndrome, dehydration, and medications that reduce salivary secretion.
Additional predisposing factors	Poor oral hygiene, smoking, recent dental procedures, and traumatic injuries to the oral floor.
Development mechanism	Salivary obstruction leads to stasis and bacterial proliferation, causing inflammation, edema, and pus accumulation.
Associated complications	Spread of infection to deep neck spaces (Ludwig's angina), internal jugular vein thrombosis, and descending mediastinitis.

Predisposing factors

The abscess of the submandibular gland occurs in the context of predisposing factors that favor the development of infection by obstructing salivary drainage and creating an environment conducive to bacterial proliferation. These factors can be local or systemic, each having a specific role in triggering the infectious process [13,18,20].

Local factors include poor oral hygiene, untreated dental infections, and the presence of salivary stones, which prevent the normal elimination of saliva through the Wharton duct. Bacteria present in the oral cavity can enter the ductal system of the gland, causing inflammation and pus to accumulate. In addition, dental interventions, such as tooth extractions or endodontic treatments, can favor the penetration of pathogens and the development of an infectious process [1,2,20].

Local trauma or lesions of the oral mucosa are also important factors. Accidental bites, poorly fitting dentures, and invasive procedures can cause micro-lesions that become gateways for bacteria. These lesions can affect the Wharton duct, causing inflammation and salivary stasis, which increases the risk of infection [1,20].

Among systemic factors, conditions that reduce salivary flow, such as diabetes, Sjögren's syndrome, and severe dehydration, play a key role. Hyposalivation creates a favorable environment for the development of pathogenic bacteria, reducing the ability of saliva to wash and protect the oral cavity. Immunocompromised patients, including those undergoing immunosuppressive treatments or chemotherapy, are at increased risk of severe glandular infections due to the body's reduced ability to fight pathogens [2,18-22].

Age is another predisposing factor, as both elderly patients and children are more vulnerable to salivary gland infections. In the elderly, decreased salivary flow and the presence of comorbidities contribute to an increased risk of sialadenitis and abscesses, while in children, the incompletely developed immune system can favor the spread of infections [19,21].

Unhealthy habits, such as smoking and excessive alcohol consumption, affect the function of the salivary glands and promote the appearance of chronic inflammation. Chronic stress can influence the immune response and cause changes in salivary secretion, indirectly contributing to infections [21].

In conclusion, the predisposing factors of submandibular gland abscess are diverse and interconnected, ranging from mechanical obstructions and poor oral hygiene to systemic conditions and unhealthy lifestyles. Identifying and managing these factors are essential for preventing infections and reducing the risk of complications associated with this pathology [20–22].

Diagnosis and clinical implications

The diagnosis of submandibular gland abscess is based on clinical evaluation and imaging, and laboratory investigations to quickly identify the infection and prevent severe complications. Clinical manifestations are characteristic and include intense pain, unilateral swelling in the submandibular area, local erythema, and difficulty chewing and swallowing. Patients may experience fever, altered general condition, and, in severe cases, trismus, breathing difficulties, or extension of the inflammatory process to the deep spaces of the neck [3,18,20].

The clinical examination highlights a swollen, firm, or fluctuating area with increased sensitivity to palpation. The overlying skin can be erythematous, and in some cases, the elimination of pus at the level of the sublingual caruncle can be observed. The differential diagnosis must exclude other conditions with similar symptoms, such as submandibular lymphadenitis, sialolithiasis without infection, or salivary gland tumors [18,20].

To confirm the diagnosis, imaging investigations play an essential role. Ultrasound is the first option, allowing the identification of the purulent collection and any salivary stones. In complicated cases or when ultrasound does not provide enough information, contrast-enhanced computed tomography (CT) is recommended to assess the extent of infection and involvement of adjacent structures [20]. Magnetic resonance imaging (MRI) can be used in situations where there is suspicion of deep soft tissue damage or spread of infection to the parapharyngeal and mediastinal spaces [3,20].

Laboratory tests help assess the severity of the infection and guide treatment [5,22]. Leukocytosis with neutrophilia, increased C-reactive protein, and erythrocyte sedimentation rate indicate an active infectious process. Blood cultures are recommended in severe cases or in immunocompromised patients to identify the bacteria responsible and adapt antibiotic therapy. Bacteriological examination of purulent secretion, obtained by aspiration or surgical drainage, allows accurate identification of the pathogen and testing of antibiotic sensitivity [2,21,22].

The clinical implications of submandibular abscess are significant, as the infection can quickly spread to the deep regions of the neck, causing serious complications, such as Ludwig's angina, internal jugular vein thrombosis, or descending mediastinum. These complications require intensive treatment, including broad-spectrum antibiotic therapy and, in advanced cases, extensive surgical drainage. Prompt diagnosis of a submandibular gland abscess is essential to prevent complications and institute appropriate treatment [18–20].

Conclusions

Submandibular gland abscess is a serious condition that requires rapid diagnosis and proper treatment to prevent severe complications. Early identification of predisposing factors, such as obstruction of the Wharton duct by salivary stones, poor oral hygiene, and systemic conditions, is essential for the prevention of this pathology. In addition, the polymicrobial infectious etiology and the involvement of aerobic and anaerobic bacteria emphasize the importance of using a well-targeted antibiotic based on the results of bacteriological tests.

Modern treatment of submandibular abscess combines drug management with surgery. Administration of broad-spectrum antibiotics is initial, but in severe cases, surgical drainage is necessary to remove the purulent collection and prevent the spread of infection to adjacent regions. The unfavorable course of the infection can lead to complications such as Ludwig's angina or mediastinitis, which requires complex surgery and intensive treatment. Therefore, the correct management of these cases must be multidisciplinary, involving specialists in oro-maxillofacial surgery, infectious diseases, and intensive care.

In terms of prevention, proper oral hygiene and regular monitoring of patients with high-risk factors, such as diabetics or people with Sjögren's syndrome, are essential to reduce the incidence of glandular infections. Dietary recommendations and proper hydration help maintain salivary flow and reduce the risk of salivary lithiasis, a major factor in the pathogenesis of this condition.

Future research directions include the development of advanced methods for early diagnosis, such as specific inflammatory biomarkers or high-resolution imaging techniques, which allow rapid identification of infection before complications occur. It is also necessary to explore new therapeutic options, including the use of antibiotics with innovative mechanisms of action and minimally invasive approaches for the drainage of purulent collections.

Submandibular abscess is a condition with a significant impact on oral and general health, and early diagnosis and effective treatment are essential to prevent complications. The continuous evolution of diagnostic and treatment methods can improve the prognosis of these patients, reducing the morbidity and mortality associated with severe salivary gland infections.

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