Deep neck space infections: An odontogenic parapharyngeal abscess reaching the base of the skull

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ABSTRACT

Introduction: Although the incidence of deep neck space infection (DNSI) has decreased due to the use of antibiotics, this infection continues to be quite frequent and can be associated with high morbidity and mortality. The odontogenic cause is the most frequent in adulthood and, usually, is a polymicrobial infection. It is important to be aware of the signs and symptoms of its severity and to start a treatment as quickly as possible. Airway protection, removal of the cause, surgical drainage if indicated, and antibiotic therapy, are the treatment steps. Case Report: A 23-year-old healthy woman with bad oral hygiene was admitted to the emergency department with trismus, unilateral swelling in the pre-auricular and retromandibular regions, fever, dysphagia and odynophagia. She had also a history of odontalgia few months before. Orthopantomography showed a carie of 28 tooth and neck CT revealed the presence of a left parapharyngeal space abscess, reaching the base of the skull, associated with deviation of the airway to the right. She was submitted to surgical drainage and started intravenous antibiotics. Streptococcus pasanguinis and Prevotella buccae were isolated from the culture. After clinical, analytical and imaging improvement, she was discharged with the indication to keep oral antibiotic and to perform oral opening exercise. Conclusion: Odontogenic infections can develop DNSI regardless of the presence of risk factors. Taking into account the etiology of these infections, would be important to improve oral health of population.

Keywords: Antibiotics, Deep neck space, Infection, Odontogenic, Surgical drainage

INTRODUCTION

Deep neck space infections are unique among infection diseases for their variability and potential for several complications [1]. DNSI are infections originated in the upper aerodigestive tract, whose common sources are dental infections, tonsilar and salivar gland infections, malignancies and foreign bodies [2]. Before antibiotic treatment was available, the mortality rate and incidence of these disorders were higher than now, and the tonsilar...
and peritonsillar infections were the source of 70% of cases of DNSI [2]. Currently, there is an increase in odontogenic situations, whose microbiological origin is essentially polymicrobial [3].

Deep fascial neck spaces are prevertebral, danger space, retropharyngeal, parapharyngeal, visceral vascular space and pretracheal spaces. In a healthy person, these are only potential spaces between the cervical fasciae that does not exist [4], and that can be affected by infections originating in other spaces that are in continuity with them.

DNSI can cause important emergencies, mainly due to the risk of airway compromise [5]. For this reason, it is important a rapid diagnosis and treatment, which usually involves the airway protection, removal of the source, surgical drainage if indicated, and antibiotic therapy, in order to avoid complications, such as airway obstruction, Lemierre syndrome, mediastinitis, pericarditis, pleural empyema, cavernous sinus thrombosis, sepsis and even death [1]. The estimated mortality rate due to DNSI is 0.3–1.6% [6].

We report a case of an odontogenic infection of the parapharyngeal space, with a considerable collection reaching the base of the skull.

**CASE REPORT**

A 23-year-old healthy woman was admitted to the emergency department with trismus, pain in the left side of the face, fever, odynophagia and dysphagia. She had a history of oral use of low dose of amoxicillin-clavulanic acid for eight days, because of a left odontogenic maxillary sinusitis. Patient remembered of having odontalgia of 28 a few months ago, but not currently. Her general status had gotten worse in the last two days, with increased symptoms.

On physical examination, there were no signs of respiratory distress. There were a painful swelling in the left pre-auricular and retromandibular regions, and a severe trismus (maximal interincisive opening of 8 mm), which made the oral examination difficult (Figure 1). Apparently, the floor of the mouth was not swollen and her tongue was mobile. She presented a bad oral hygiene.

Analytically, white blood cell score was 16.86x10^3/µL with 82.1% of neutrophils, and the C-reactive protein value was 209,2 mg/L. Orthopantomography showed a carie of the 3rd molar of the 2nd quadrant, the most likely source of infection, and two retained roots from the 2nd and 4th quadrants (Figure 2). Neck CT of the patient revealed densification of the left maxillary sinus and nasal fossa, and the presence of a left parapharyngeal space abscess with air bubbles, reaching the base of the skull (Figure 3). The collection had a transverse dimension of 4 cm and a longitudinal dimension of 5 cm and there was deviation of the airway to the right side. After fiber optic intubation we did the extraction of the 24,28,47 teeth and a left cervicotomy incision was performed and the parapharyngeal abscess was drained, with the release of fetid pus, which was sent to microbiological culture. We did an intense wash of the loca with saline, and placed 2 drains. We also did an extensive lavage of the nasal fossa. Intravenous amoxicillin-clavulanic acid 1000 mg + 200 mg 3id, with combination of metronidazole 500 mg 3id was advised.

On the first postoperative days the clinical and analytical improvement was slow. Streptococcus parasanguinis and Prevotella buccae which were sensitive to clindamycin were isolated from the culture, and on the 2nd postoperative day, the antibiotics were replaced by clindamycin 600 mg 4id, with clinical, analytical and imaging improvement. On her control neck CT, on the postoperative 3rd day, there was a residual collection in the left parapharyngeal space with presence of air (Figure 4).

Posteriorly, drains were removed. After nine days of intravenous treatment, she was discharged with the indication to continue the oral antibiotic for another five days, and to perform oral opening exercises. Patient is well after two years of follow-up.

**DISCUSSION**

Since Ludwig in 1836, extensive dispute has been fostered on appropriate evaluation and management of
deep neck infections [7], which are frequently observed in general maxillofacial practice, and primarily related to dental diseases [8].

DNSI are infections in the potential spaces and fascial planes of the neck, either with abscess formation or cellulitis [9]. The deep cervical fascia is the fibrous connective tissue that involves and divides structures of the neck, creating potential space, between its superficial, middle and deep layers. These fibrous boundaries determine the communicative pathways for infection spread in the neck [10], which happens through the pathway of least resistance. Deep neck spaces, which are the prevertebral space, danger space, retropharyngeal space, parapharyngeal space, visceral vascular space and pretraqueal space extend from the skull base to the mediastinum. DNSI can result from direct extensions from other spaces on the head and neck, or from primary sites.

The parapharyngeal space communicates inferiorly with the submandibular space and is limited by the masticator space anteriorly, the pharyngeal mucosal medially, the parotid space laterally and the vascular compartment posteriorly [10]. It contains fat, branches of the trigeminal nerve, pharyngeal vessels, internal maxillary artery and accessory salivary tissue [10]. As our case report, typically an infection in this space represents an extension of disease originating from one border spaces. The infection in the 28 tooth caused a maxillary and ethmoidal sinusitis, with extension to the homolateral parapharyngeal space.

The exact incidence of neck infections is not established [10]. The use of modern antibiotics, which has significantly reduced mortality rate [11], and improvement of oral hygiene, both have reduced the number of DNSI. However, these infections continue to be a source of severe morbidity [12], being more frequent in males [13].

The origin of DNSI is different in many publications, and typically it is a single one [10]. In the pre-antibiotic era, the most usual cause is tonsillitis or pharyngitis. Currently, odontogenic origin is much more frequent in older population groups, and tonsillar infection is the most common cause among children [9]. Our patient had a deep carie in the 28 tooth and presented bad oral hygiene. Other potential sources include the salivary glands, nasal sinuses, middle ear and mastoids, cervical lymph nodes, and trauma [10]. Besides these, intravenous drug abuse, foreign body or tuberculosis infection, can be a source of DNSI [9]. In some cases, however, the aetiology is uncertain.

Lower socioeconomic status has been associated with poor oral health [11], which is an important predisposing factor for DNSI. Contributing factors for severe progression of an odontogenic infection are deficiencies of immunological competence, such as immunodeficiency virus positivity, long-term diabetes mellitus, chronic alcohol abuse, hepatitis and liver cirrhosis, systemic lupus erythematosus, and history of immunosuppression after transplant surgery [14]. Between these, diabetes mellitus is the most common risk factor among the systemic diseases that has been associated with the development of DNSI [9]. It is known systemic hyperglycemia results in change of neutrophil function, cellular immunity and complement function [13], so it is important to get a glycemic control. However, even without any contributor factor, a DNSI from an odontogenic source could be a life threatening situation, as in our clinical report.

More than 700 bacterial species have been identified in the oral cavity, although less than 1% are cultured routinely in the laboratory. Most of them are nonpathogenic commensals and reside within biofilms [15]. The normal oral flora can be altered with tobacco use, pregnancy, diet, nutrition, age, oral hygiene, deciduous teeth eruption, dental caries, periodontal disease, antibiotics, hospitalization, and by genetic or racial factors [15].

DNSI are generally polymicrobial [9], and it has been observed that anaerobic bacteria tend to gain predominance over aerobic bacteria in later stages of the infection [14]. Commonly cultured organisms include Streptococcus viridans and Streptococcus milleri group species, Peptostreptococcus, Bacteroides, Prevotella, Porphyromonas species, Actinomyces species, Propionibacterium and Eikenella. In immunocompromised patients it should be considered the possible presence of Staphylococcus aureus [15].

According to the literature, in the samples collected from our patient, Streptococcus parasanguinis, which
belongs to the Viridian group and a Prevotella were isolated.

When evaluating a patient in whom a DNSI is suspected, a complete history and physical examination should be obtained, with focus on evaluation of the airway [16]. Firstly, we should look for any sign of airway obstruction and ask the patient when the symptoms started, potential initiating factors and comorbidities. Physical examination should include extraoral neck and face, intraoral and oropharyngeal evaluations [16]. Patients often present some, but not all, of the following signs and symptoms: dysphagia, odynophagia, odontalgia, dyspnea, dysphonia, painful face or neck swelling, fever, floor of mouth elevation, trismus, stridor, drooling and cervical lymphadenopathy.

It is usual that an infection in the parapharyngeal space does not change much the physical aspect of the patient, but trismus is a warning sign. Our patient had an intense trismus and a slight swelling in the left pre-auricular and retromandibular regions. Trismus does not often allow intraoral evaluation, and it is a sign that almost forces to admit the patient by the possibility of sudden obstruction of the airway, if it does not already exist, as happened with our patient. Dysphagia and odynophagia are symptoms that may point to the spread of infection to deep cervical spaces. In this patient, we think that pre-treatment with low-dose antibiotics and the failure to immediately remove the cause of the infection, contributed to the worsening of the situation.

Immunocompromised patients have a higher risk for atypical infections, and frequently do not present typical clinical signs and symptoms of infection, which can mask the severity of it [10]. Widespread diffusion of empirical broadspectrum antibiotic and anti-inflammatory treatments may cause masked presentations of DNSI [9].

In relation to analytical evaluation, it is normal to find rise of inflammatory markers, as our patient revealed. Imagologically, orthopantomography is commonly used to diagnose pathologic conditions of odontogenic origin. In this case was fundamental to determine the tooth causing the infection. Ultrasound is sometimes used in the evaluation of more superficial infections to exclude the possibility of the fluid collection [10]. However, contrast-enhanced CT is considered the most accurate and widely used imaging modality in cases of DNSI, allowing to distinguishing between cellulitis and abscess. In addition, it is possible to see the extent of the disease and to plane the surgical intervention [7]. In fact, the CT of our patient allowed us to see the permeability of the airway, the presence of a collection already formed and its extension, allowing to predict the seriousness of the situation.

It is important to note that a collection can be confused occasionally with necrotic lymph nodes when they are affected by metastatic disease [10], but in this case, nothing was suggestive of a neoplastic disease. Magnetic resonance imaging has no radiation and has similar prognostic value to CT scanning, but it is more expensive and requires longer exam time when compared with CT, that is why not commonly preferred in imaging DNSI [9].

In DNSI treatment, protection of the airway should be the first priority. To secure the airway, endotracheal intubation, tracheostomy, or in emergency, cricothyroidotomy may be required [17]. Our patient had no airway distress for the time, and was intubated orotracheally by optic fiber. However, on CT it was already visible a deviation of the airway to the right, that could suddenly be compromised. Because of this, is very important in this type of situation, to protect the airway.

Besides that, it is important to begin the empirical antibiotic treatment, which should be adjusted after the results of the microbiological cultures [16]. This must cover gram-positive and gram-negative aerobic and anaerobic pathogens. Usually, it is used an antibiotic derived from penicillin (amoxicillin with clavulanic acid) or third-generation cephalosporin, plus metronidazole or clindamycin combination, depending on the case severity, the most probable origin and the existence of previous treatment [8, 9]. Although our patient was already taking amoxicillin therapy, since the dose was sub-therapeutic, we decided to keep it. Therefore, we preferred the combination of amoxicillin with clavulanic acid associated with metronidazole. However, due to the results of the antibiogram, we had to replace them with clindamycin, with subsequent clinical improvement.

The prevalence of penicillin-resistant bacteria isolated from dental infections range from 5% to 20%. Clindamycin is recommended in these patients [11]. Moxifloxacin has previously been tested as alternative to clindamycin in purulent odontogenic infections, and was observed to be at least as effective as clindamycin in terms of pain reduction, clinical outcome and safety [14].

In addition, treatment includes the removal of the source of the infection and surgical drainage if indicated [11]. Samples to microbiological culture must be collected. The surgical approach is most often performed extraorally with drainage positioning, but can also be performed intraorally. Topazian and Goldberg [18], recommend as principles to drainage the following: incise in healthy skin and mucosa when possible, not at site of maximum fluctuance, because these wounds tend to heal with an unsightly scar; place the incision in a natural skin fold; place the incision in a dependent position; dissect bluntly; place a drain; and remove drains when drainage becomes minimal [18]. In this type of cases, we usually make a cervical incision 2 cm below the mandibular basilar border, on a skin fold.

Currently, there is no universal agreement on certain issues, such as optimal timing for surgical drainage and the duration of antibiotic therapy for the management of DNSI [7]. Some authors argue that the basis of treatment still remains the surgical drainage, even if a matured abscess is not already present and is more important than any antimicrobial therapy [8]. Others say that in the cellulitis stage, DNSI can be successfully treated with antibiotic therapy alone, and only if the presence
of purulence is suspected, should be done a surgical drainage [16]. In our case it was easy to decide to operate, once there was already a well-defined collection visible on the CT.

It is important to remember that patient comorbidities also have to be treated, for example, it is of special importance to obtain a good glycemic control and an adequate level of hydration.

Even in the advent of modern antibiotics, severe complications can occur in DNSI, such as airway compromise, jugular vein thrombosis, mediastinitis, pericarditis, pneumonia, empyema, hepatic failure, carotid artery erosion, meningites, respiratory distress syndrome, septic shock, disseminated intravascular coagulopathy [7, 9, 16]. Hematogenous spread may result in endocarditis [15]. When these serious complications occur, the mortality rate may reach 40% [9].

In this case, patient, fortunately, had no complications, most likely due to the fact that she started intravenous antibiotics very quickly and was operated a few hours after being seen in the emergency service by our team. However, by the size of the infection and its proximity to the base of the skull, could have existed an extension of the situation to the brain, significantly increasing the rate of morbidity and mortality.

CONCLUSION

DNSI can be life-threatening situation, especially in high-risk groups, and constitute a medical and surgical emergency. Early diagnosis and treatment are essential to prevent complications. The clinical features and severity of DNSI are variable, but the primary concern should be the protection of the airway. Contrast-enhanced CT is the most practical imaging modality for severe oral and maxillofacial infections, including DNSI. Treatment includes intravenous antibiotic therapy, the removal of the source of the infection and surgical drainage if indicated. Since the origin of these infections is essentially odontogenic and based on cost studies, strategies to improve oral health through a reduction in the incidence of untreated dental caries, would maximize the use of health care resources and likely decrease the incidence of severe odontogenic infections.

REFERENCES


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Conflict of Interest
Authors declare no conflict of interest.

Data Availability
All relevant data are within the paper and its Supporting Information files.

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