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CLINICAL CASES

Application of negative pressure therapy in patients with deep neck infections

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Abstract

Introduction: *This study outlines the clinical application of negative pressure therapy as an adjunctive treatment for deep neck infections, a condition with potential sepsis and airway obstruction risks.* **Case presentation:** *The experience encompasses 25 patients hospitalized at Hospital General de México Dr. Eduardo Liceaga.The study analyzes patient demographics, involved anatomical spaces, causes, and hospitalization duration.* **Results:** *Reveal that submandibular space was most commonly affected (68% due to odontogenic infection). Mean hospitalization was 18.48 days for 11 men and 14 women (mean age 49 ± 14.7 years).* **Conclusion:** *The study underscores the efficacy of negative pressure therapy.*

Keywords: *Infections. Drainage. Negative pressure wound therapy.*

Introduction

Deep neck infections affect potential spaces and actual structures of the neck and may lead to sepsis or airway obstruction. When the infection overcomes the resistance of the planes, it can spread through the different cervicofacial boundaries and may present as an abscess, cellulitis, or necrotizing fasciitis[1,2].

The primary causes of deep neck infections are dental caries, peritonsillar abscesses, head and neck trauma, cervical lymphadenitis, sialadenitis, and idiopathic factors. The most common cause is of odontogenic origin; the main associated bacteria represent flora normally found in the oral cavity, such as *Streptococcus*, *Neisseria*, *Peptostreptococcus*, *Staphylococcus*, and *Bacteroides*; others that are not very common are *Bartonella* and *Mycobacterium*. Also anaerobic bacterias, such as *Prevotella, Porphyromonas, Actinomyces, Propionibacterium,* and *Eikenella*, are involved. It occurs mainly in men, in an age range between 3 and 90 years, with a predominance in the third and fourth decades of life[3-5]. Signs and symptoms include fever, pain, odynophagia, cervical edema, trismus, and difficulty breathing[6,7].

Current treatment consists of empirical antibiotic therapy and surgical drainage; once a culture is obtained, generally by drag, a specific antibiotic is used[1]. Negative pressure therapy is a therapeutic alternative, it seems to be useful in eliminating pus and fluids rich in proteases; in addition to promoting granulation and neovascularization, increasing blood flow, reducing edema, and inhibiting metalloproteinases[8,9]. Those wounds with extensive tissue loss, exudate, and infection, which require subsequent wound cleaning, are indications for the use of the negative pressure system[10]. Negative pressure therapy was first reported by Kostiuchenok in Russia in 1986[11] and 1997. Argenta and Morykas introduce a Vacuum Assisted Closure® (VAC)® device that uses the negative pressure

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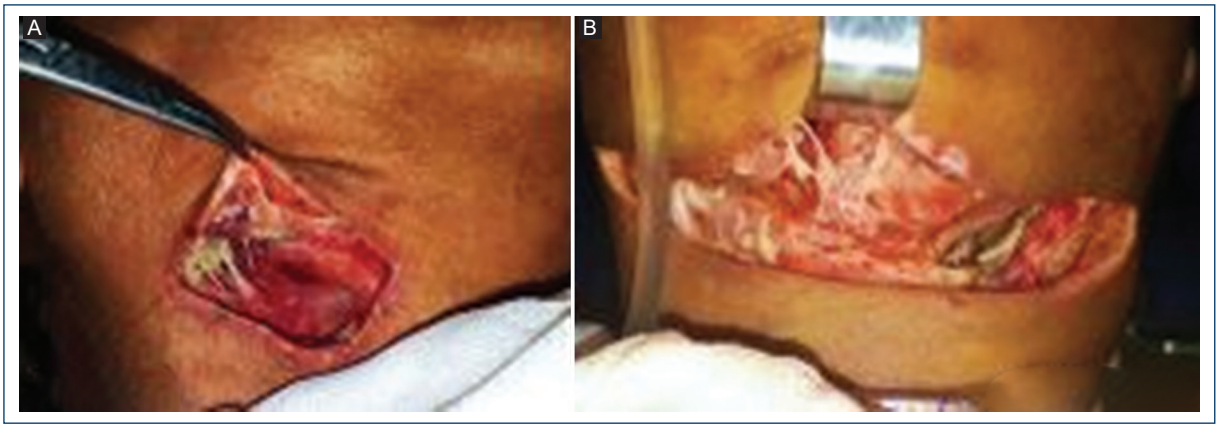

Figure 1. Dissection of anatomical spaces. Poorly vascularized tissue, with liquefactive necrosis is observed. **A:** submandibular space. **B:** bilateral submandibular and submental space.

system[12]. The technique focuses on the use of polyurethane foam (black) or polyvinyl (white) that is introduced into the permeabilized spaces, the sponge is connected to a vacuum device, the device has a pressure between –50 and 125 mmHg and can be applied constantly or intermittently[13,14].

Materials and methods

A retrospective descriptive study was carried out from March to May 2023, in the otorhinolaryngology and head-and-neck service of the Hospital General de México Dr. Eduardo Liceaga; 25 patients with deep neck infection were hospitalized and treated with surgical drainage and negative pressure therapy.

Patients with infection or abscesses in two or more spaces with airway compromise, patients with difficulty in manual healing, patients with necrotizing fasciitis, and patients with infection in spaces that compromise vital and difficult-to-access structures were included. Patients who only had infection or abscess in one space, patients who were treated only with surgical drainage and antibiotic therapy, and patients whose follow-up could not be completed were excluded. The diagnosis was based on a clinical inspection of the patient and was corroborated by contrasted and non-contrasted computed tomography of the neck and chest.

Surgical approach

Under general anesthesia, a planned incision was made (Fig. 1), followed by manual dissection of the tissues to open the infected spaces (Fig. 2). Samples were taken for culture, and necrotic tissue was removed. Negative pressure therapy was applied using polyurethane sponges and a negative pressure device (Smith & Nephew Renasys EZ Plus) (Fig. 3). Variables such as sex, age, affected spaces, cause, and length of hospitalization were evaluated. Data were collected in Microsoft Excel and analyzed in SPSS 28.0.1, and a T-test was performed to analyze sex and hospitalization time. Data accuracy was guaranteed by double-checking.

Figure 2. Blunt dissection with fingers, debrided plane, opening of submandibular, mental, parapharyngeal, and visceral space.

Results

Information was collected from 25 cases, of which 11 were men (44%) and 14 women (56%), with an average age of 49 ± 14.7 years (range 20-72 years). All patients presented perimandibular edema, dysphagia, and some degree of respiratory distress. The space most

Figure 3. Sponge placement, connected to the vacuum-assisted closure system using a Nelaton probe.

frequently affected was the submandibular space, as shown in table 1. In 48% of the cases, the spaces involved were bilateral, 40% were on the right side, and 12% were on the left side. One of the patients, a 72-year-old woman, died with symptoms of mediastinitis.

In this study, the main cause (68%) of cervicofacial infection was odontogenic, followed by submandibular gland infections (24%), and others due to trauma or idiopathic cases (Table 2). *Streptococcus* anginosus was found in 22% of the cases, and *Escherichia coli* in 16%; *Streptococcus agalactiae, Klebsiella pneumoniae* were also found. Individualized treatment with cephalosporins (ceftriaxone), metronidazole, and vancomycin was used in 48% of the patients (Table 3). Six patients presented a decrease in leukocytes in the 1st days of treatment, and subsequently a worsening, so new cultures and modifications in treatment were performed.

Twenty patients required tracheostomy due to breathing problems. The average hospital stay was 18.48 ± 8.073 days. After stabilization and relief of symptoms, the patients were discharged, with subsequent follow-up medical consultation. No statistical difference was found in hospitalization time by sex (p = 0.456).

Table 1. Percentage of infected spaces in patients

Space	Percentage
Submandibular	100
Oral	48
Sublingual	28
Pte masticator	76
Mas masticator	76
Parapharyngeal	80
Submentonian	68
Retropharyngeal	32
Parotid	8
Periamigdaline	0

Pte masticator: pterygoid masticator; Mas masticator: masseteric masticator.

Table 2. Frequency and percentage of causes of deep neck infections

Cause	Frequency	Percentage
Odontogenic	17	68
Sialoadenitis	6	24
Trauma	1	4
Idiopathic	1	4

Table 3. Frequency and percentage of medications used in patients with deep neck infections

Medicine	Patients	Percentage
Cefepime/Metro/Vanc	1	4
Ceftria/Metro	6	24
Ceftria/Metro/Clinda	1	4
Ceftria/Metro/Imipenem/Vanc	1	4
Ceftria/Metro/Vanc	12	48
Cefttia/Metro/Vanc/Colistina	1	4
Ceftria/Metro/Vanc/Ertapenem	1	4
Pipetazo/Vanc	2	8

Ceftria: ceftriaxone; Metro: metronidazole; Vanc: vancomizine; Pipetazo: piperacillin tazobactam.

Discussion

Deep neck infections continue to be a frequent emergency in the otorhinolaryngology and head-and-neck surgery service. Despite treatment with antibiotics, most cases require surgical drainage of the infected area and healing with daily irrigations. At present,

adjuvant devices such as the negative pressure therapy system are used to reduce manual healing that generates pain in the patient[15].

In this study, the importance of properly placing foam in spaces is highlighted to achieve effective suction and functionality of the negative pressure system. The foam was changed every 4-7 days depending on post-operative recovery. Socioeconomic deficiencies and neglect of oral health increase odontogenic infections. A predominance of adults with deep neck infections is observed. Tung-Tsun, in an analysis of 185 patients with deep neck infections, found that the average age was 49.5 years; whereas Jian Cao in a study of 12 patients determined that the average age is 62 years. The main causes are odontogenic (68%) and sialadenitis (24%). Odontogenic infections spread from the mandible or maxilla to other spaces, mainly to the submandibular space. Priyamvada also identified the submandibular space as the most common[16-18].

The hospitalization time is variable, in a study where deep neck infections were treated without a VAC system, the hospitalization time was from 2 to 78 days with an average of 31 days ± 19.6 in those patients who needed tracheostomy[16], a longer time compared to the use of VAC reported in our study. In a study carried out by Domínguez L of 10 patients, he reported an average hospitalization time of 8.8 ± 2.9 days, with the group that used the negative pressure system being smalle[19]. In our study, the average time was 18 days, associated with the patient's serious condition. The contrast-enhanced computed tomography (Gold Standard) allows us to corroborate our diagnosis and guides us to the treatment to follow[20]. In our study, contrasted and non-contrasted tomography was performed in 100% of the patients.

Conclusion

Negative pressure therapy acts as an adjuvant in deep neck infections, reduces exudate, and reduces painful daily healing. Odontogenic infections predominate as the main cause, linked to poor oral hygiene in adults. The tomography confirms the diagnosis showing frequent involvement of the submandibular space. Hospitalization time is similar for both sexes.

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Conflicts of interest

The authors declare no conflicts of interest.

Ethical disclosures

Protection of human and animal subjects. The authors declare that no experiments were performed on humans or animals for this study.

Confidentiality of data. The authors declare that no patient data appear in this article.

Right to privacy and informed consent. The authors declare that no patient data appear in this article.

Use of artificial intelligence for generating text. The authors declare that they have not used any type of generative artificial intelligence for the writing of this manuscript nor the creation of images, graphics, tables, or their corresponding captions.

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