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Surgical Intervention for Deep Neck Infections: An Analysis on Prognostic Factors and Acute Airway Management

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Abstract

Objective: *Authors propose a retrospective chart review of 124 patients who have undergone surgical intervention for deep neck infection over a period of time between 2008 and 2020. From this study, patients whose abscess was located only in peritonsillar space were excluded.*

Data Sources: *Acquired data included: demographic characteristics, symptoms, localization of the abscess, etiology, result of microbiological culture, complications, comorbidities, mortality, length of hospitalization, need of reintervention, tracheostomy or early intubation,*

Results: *It was possible to identify pathogenic noxa in 47% of cases. Airway management was necessary for 22 (17%) patients. Authors have also looked for any relation between the symptoms and the site of the abscess: odynophagia was the most common symptom in patients with masticatory space involvement (92%), parapharyngeal space involvement was associated with dyspnea (48%) whereas dysphonia was referred by patients with prevertebral space involvement (56%). Focusing on complications, 106 of our patients (86%) had a regular recovery, without any problem. A small group of 18 (14%) patients has developed complication, including: mediastinitis, internal jugular vein thrombosis, pulmonary embolism, transverse sinus thrombosis, and facial nerve paralysis. The overall mortality rate was 0,8%.*

Conclusions: *We identified a cause in 48% of patients who underwent surgical intervention for deep neck infection and culture were positive in only for 45% of cases. Deep neck infections of elderly males patients with a multifascial impairment were associated with an increased duration of hospitalization. Acute airway management was required in 26% of patients.*

Keywords: *deep neck infections, abscess, surgical management, otolaryngology.*

Introduction

Infections of the deep neck spaces are among the most common emergencies in ENT surgery. This is a group of diseases in which a bacterial infection localizes to the neck spaces between the various cervical bands (superficial, middle and deep). The use of broad-spectrum antibiotics, coupled with improved sanitation, has helped to decrease the incidence of this disease compared with the past, although some recent studies are showing a gradual increase in the incidence of this disease [29-30]. Currently, the estimated incidence for this disease is between 9-15/100,0000 cases per year (from Boscolo-Rizzo et al. [24]). Thanks to improved diagnostic techniques (especially CT) and immediate treatment, both surgical and pharmacological, it has been possible to drastically reduce the complication rate related to deep neck space infections, positively affecting the prognosis of these patients. Complications secondary to neck abscesses include: mediastinitis, laryngeal edema, pericarditis, sepsis, jugular vein tromobosis and arterial compromise. The treatment of deep neck infections is still debated today. Undoubtedly, broad-spectrum antibiotic therapy plays a key role in the management of this type of pathology, however, the use of surgical techniques to ensure adequate discharge of purulent material plays a crucial role in many cases, both in the treatment and prevention of complications associated with deep neck infections [30]. However, although there are several studies in the literature that address the management and causes of deep neck infections (DNI) [9], there are no reports that focus on follow-up and long-term complications associated with this condition or surgical treatment. The aim of this study was to review our experience in the surgical management of DNI, to evaluate possible features that may lead to a more severe presentation or prognosis, and to assess the incidence and impact of long-term sequelae.

Materials and Methods

We reviewed the records of 124 patients operated on a tertiary center (San Giovanni Bosco Hospital, Turin, Italy) between 2008 and 2020, assessing demographics, site of infection, initial presentation, aetiology, comorbidities and length of stay.

Patients with localized peritonsillar abscess and those who had been treated conservatively were excluded.

Data analysis

Acquired data included: demographic characteristics, symptoms, localization of the abscess, etiology, result of microbiological culture, surgical approach and need for surgical revision, need for tracheostomy or early intubation, complications, comorbidities, mortality and duration of hospitalization. Data were entered in Excel and analyzed using STATA version 16

Results

Retrospective review

There were 40 females (34%) and 84 males (67%). Patients ranged in age from 17 to 89 years, with an average of 49 years (Table I). The mean in-hospital length of stay was 11.3 days (SD 5.7; range 3-27). Of the 124 patients, 52 (42 %) were current smokers, 9 (8 %) were intravenous drug users and 19 (15 %) were diabetic (Table 1)

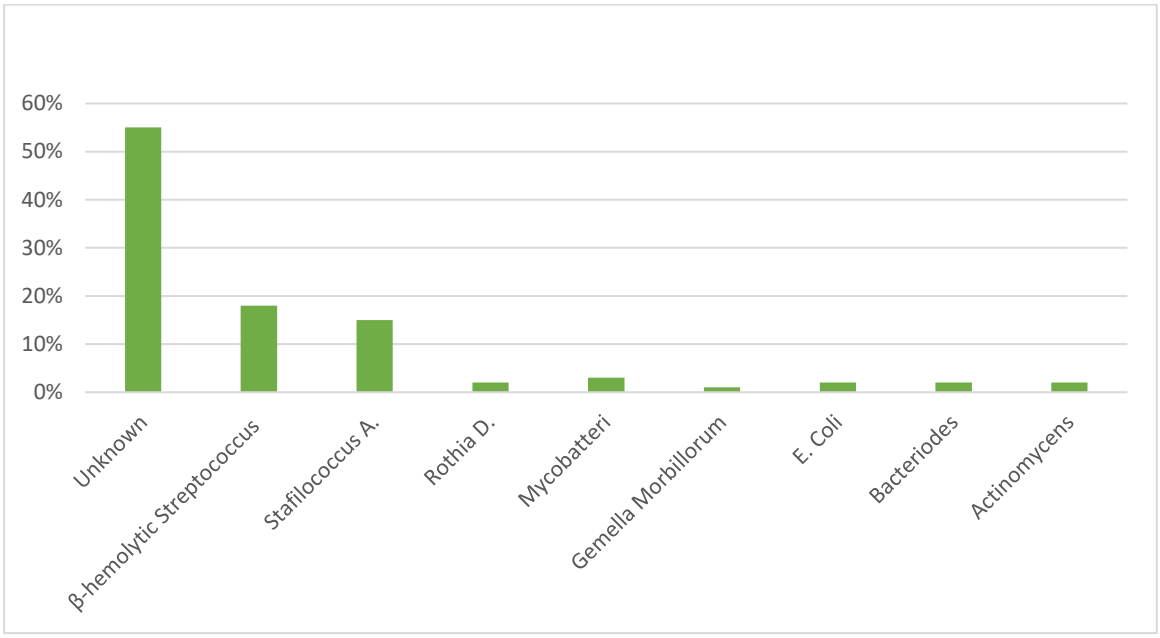
Patients demographics (%)	Patients
Total	124
Female	40 (34)
Male	84 (67)
Smoker	52(42)
Diabetic	19(15)
Intravenous drug use	9 (8)
Age (range, years)	17--89
Length of hospital stay (range, days)	3--27

Table 1: Demographics of patients presenting with a deep neck space infection.

Aetiology

In 68 cases (55%), it was not possible to identify a pathogen responsible for the pathology. Nevertheless, there were 8 different microorganisms isolated and identified on culture, the most common were β-hemolytic Streptococcus (18%) and Staphylococcus A. (15%). (Figure. 1)

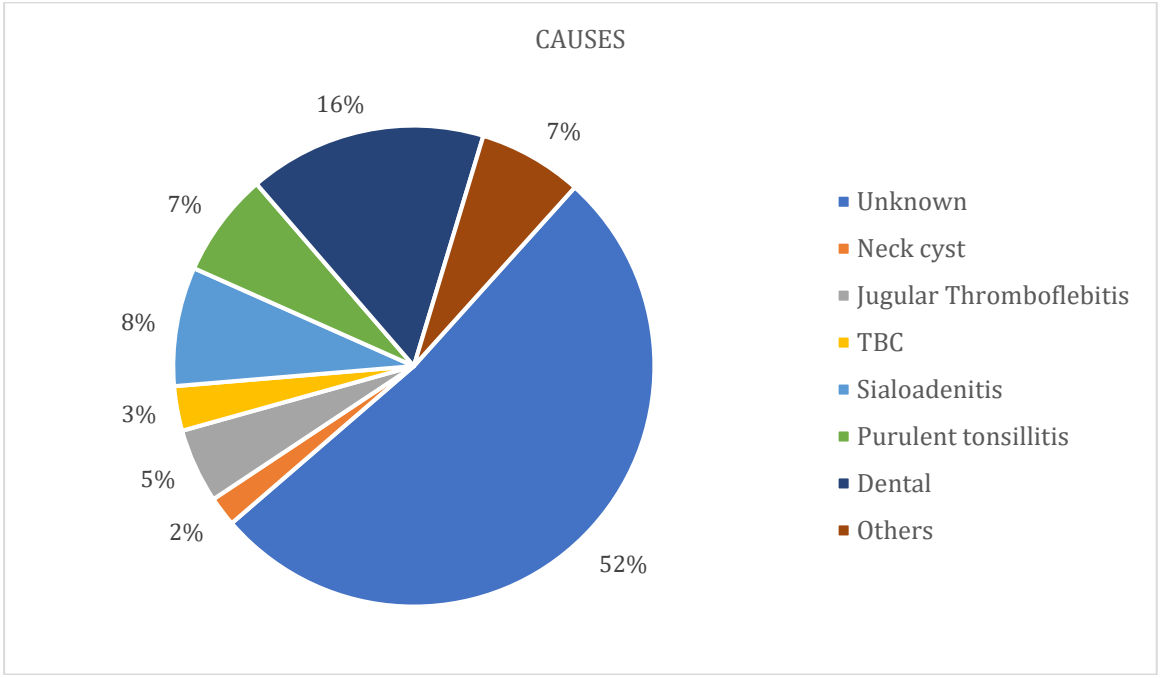
Figure 1: Aetiology



Cause

In 65 (52%) of cases we were unable to identify a cause of deep neck infection. It was possible to identify a cause in 48% of cases. The most common cause in our study was dental infection which was present in 20 (16%), followed by sialoadenitis that involved around 10 patients (8%) Under the voice "others" we included: thyroiditis (2 cases), actynomicosis (1 case) epiglottitis (2 cases), bacterial pneumoniae (1 case), metal plate infection (1 case), sphenoid infection (1 case). (Figure. 2)

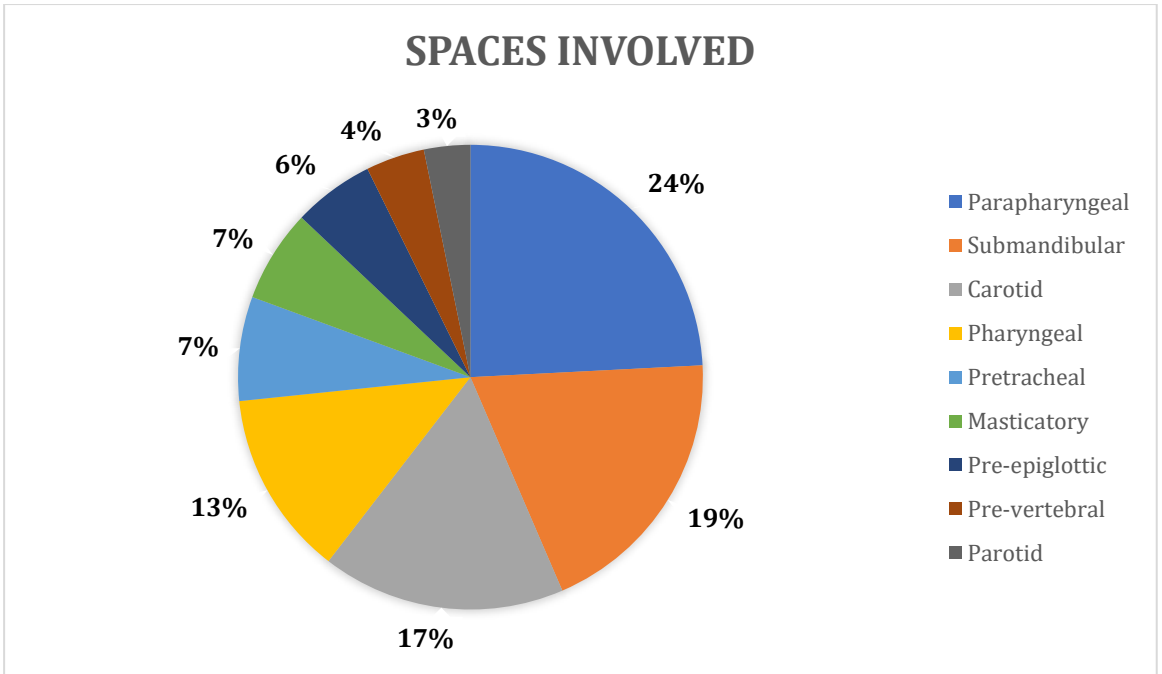
Figure 2: Causes of deep neck infections.



Spaces involved

From our study it emerged that the Abscess locations mainly involved parapharingeal and submandibular spaces (24% and 19% respectively). Parotid and prevertebral spaces were less intrested by abscesses (around 3%). Moreover 36 patients (30%) had one single fascial space affected, whereas 86 patients (70%) had multiple space infection. (Figure. 3).

Figure 3: Spaces involved.



Symptoms

Odinophagia was the most common symptom, it was referred by in 70 (56%) patients.

Airways edema, evaluated through fiber optic endoscopy, was reported by 48 (39%) patients, while dyspnea and dysphonia were present in approximately 36 (29%) and 28 (23%) of patients, respectively.

We also evaluated the relationship between the location of the abscess and the symptoms reported by the patient. Thus, odinophagia was the most common symptom in patients with masticatory space involvement (92%), dyspnea was more reported by patients with parapharyngeal space involvement (48%), whereas dysphonia was common in patients with prevertebral space involvement (56%) (Table 2).

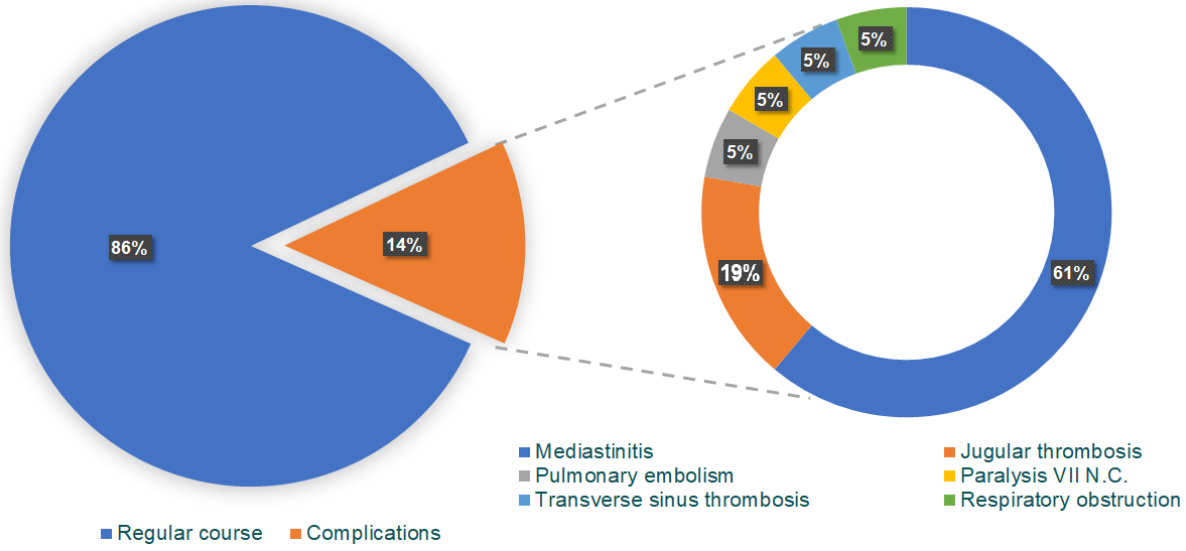
Space involved	N°	Dyspnea	Odynophagia	Dysphonia	Airway Edema
Preepiglottic	20	20%	30%	20%	25%
Submandibular	48	33%	79%	25%	21%
Parapharyngeal	62	48%	71%	39%	32%
Prevertebral	18	22%	78%	56%	28%
Parotid	14	29%	71%	14%	14%
Masticatory	24	42%	92%	33%	25%
Carotid	46	39%	74%	39%	26%
Pretracheal	28	36%	50%	14%	18%
Visceral	34	26%	59%	35%	38%

Table 2: Correlation between symphtoms and abscess localization.

Complications

In our study 106 (86%) patients had a regular course, while 18 (14%) developed complications. In this small group of patients: 11 (61%) had mediastinitis, 3 (19%) patients had internal jugular vein thrombosis, 1 (5%) patient had a pulmonary embolism, 1 (5%) patient had transverse sinus thrombosis, and 1 (5%) had facial nerve paralysis. The overall mortality rate was around 0,8% due to a patient with an extended parapharyngeal abscess who died as a conseguence of an airway obstruction which lead to an ischemic brain damage. (Figure 4).

Figure 4: Complication.



In hospital stay.

Mean hospital stay was 11,31 days (ST Dev 5,770173151); Eldery patients and males had a significant increased length of hospital stay ($p<0.05$) (Figure 3 and 4). From our analysis, it emerged that the involvement of more facias of the neck, as well as the interest of the parapharyngeal space (both pre- and retrostyloid) is associated with an increase in the average duration of hospitalization. (Table. 3)

Variables	Hazard Ratio	95% Confidence Interval	P-Value
Age (younger)	0.9869406	0.975- 0 .998	0.021
Sex (male)	1.856	1.099- 3.134	0.021
Unifascial	1.096	0.719 - 1.672	0.669
Multifascial	2.243	1.147 - 4.386	0.018
Pre-epiglottic	0.911	0.597 - 1.390	0.669
Parapharyngeal retrostyloid	1.582	1.029 - 2.434	0.037
Parapharyngeal prestyloid	1.610	0.392 - 1.949	0.029
Prevertebral	1.723	0.918 - 3.233	0.090
Parotid	1.384	0.777 - 2.464	0.269
Masticatory	1.105	0.683 - 1.787	0.683
Submandibular	0.788	0.520 - 1.194	0.5203
Pretracheal	0.716	0.427 - 1.200	0.205
Visceral (retropharyngeal)	1.000	0.621	0.997

Table 3: Hospital length of stay: odds ratio calculated by logistic regression model.

Reintervention

Revision surgery was required in 32 % of cases (40 patients). As summarized in Table 4, the involvement of visceral space or parapharyngeal space (both pre- and retrostyloid) was significantly correlated with a revision surgery. The risk of reintervention was also significantly correlated with age increase and diabetes ($p<0.05$). (Table. 4).

Variables	Odds Ratio	95% Confidence Interval	P-Value
Unifascial	1.171	0.511 - 2.661	0.6805
Multifascial	0.853	0.375 - 1.953	0.6805
Age	1.027	1.004 - 1.050	0.018
Diabetes	2.8	0.979- 8.045	0.0283
Sex (m)	0.484	0.1926-1.237	0.0890
Preepiglottic	1.352	0.434- 3.993	0.5463
Submandibular	0.613	0.268- 1.391	0.2024
Parapharyngeal prestyloid	0.361	0.140- 0.883	0.0148
Prevertebral	1.694	0.527-5.240	0.3053
Parotid	1.541	0.406-5.489	0.4507
Masticatory	1.066	0.456- 2.452	0.8692
Parapharyngeal retrostyloid	1,024	0.075-1.086	0.0474
Pretracheal	1.913	0.770- 4.691	0.1185
Visceral (retropharyngeal)	3.589	1.369 - 9.458	0.0031

Acute airway management

Acute airway management was required in 32 (26%) patients. In particular, tracheostomy was required for 12 patients (10%) and early orotracheal intubation was required in 20 patients (16%). As summarized in Table 5, the involvement of visceral space or parapharyngeal space (both pre- and retrostyloid) spaces was significantly correlated with airway obstruction and the need of tracheostomy or early intubation. (Table. 5)

Variables	Odds Ratio	95% Confidence Interval	P-Value
Diabetes	0.257	0.0276 - 1.185	0.0622
Pre-epiglottic	0	0 - 0.478	0.0055
Submandibular	1.544	0.613-3.839	0.3041
Parapharyngeal Prestyloid	0.214	0-3,49	0.0011
Prevertebral	0.879	0.193 - 3.143	0.832
Parotid	0.488	0.050-2.415	0.358
Masticatory	1.055	0.307 -3.193	0.9182
Parapharyngeal Retrostyloid	5.230	1.994-14.123	0.0001
Pretracheal	1.345	0.447- 3.746	0.5387
Visceral (retropharyngeal)	7.7	2.802-21.299	0.0001

Table 5: Acute airway management: odds ratio calculated by logistic regression model.

Discussion

Our population consisted of patients who did not respond to antibiotic therapy or had a clinical presentation that required immediate surgery.

Agarwal et al. [2] showed that socio-economic inequalities lead to an increasingly severe presentation of DNI. Delayed access to health care due to the geographical location of our hospital may have led to a worse presentation, resulting in a greater degree of airway compromise and failure to respond to antibiotic therapy, requiring critical interventions. In addition, it is postulated that limited access to tertiary care may have prevented appropriate abortive treatment at primary care level.

Deep neck infections have a variety of aetiologies, including salivary gland infections, upper respiratory tract infections, trauma and foreign bodies. Studies by Sethi and Stanley et al. [17], and Har-El et al. [14-18] also showed that the most common cause of DNI was dental.

The incidence of DNI was higher in patients with mandibular odontogenic infections and patients with dental abscesses compared to patients with maxillary odontogenic infections and patients without dental abscesses. [7]

The study by Boscolo-Rizzo [24] et al and Cheng et al [23] showed that tonsillitis was the most common cause of cervical abscess, followed by odontogenic infection. Tonsillar hypertrophy with increased bacterial load in the tonsillar crypts is associated with severe DNI [5].

Other rare causes include branchiogenic cysts, instrumentation, spread of superficial infection, intravenous drug abuse and hypopharyngeal malignancy.
In a few cases in the literature no specific cause can be found [15-19].

Instead, we could not find a specific cause in 52% of cases, and previous studies also found that the aetiology was unknown in most patients [16].

In our study it was possible to identify a cause in 48% of cases. The most common cause in our study was dental infection, which was present in 20 (16%) cases, followed by sialoadenitis, which affected about 10 patients (8%). Under "other" we included: thyroiditis (2 cases), actinomicosis (1 case), epiglottitis (2 cases), bacterial pneumoniae (1 case), metal plate infection (1 case), sphenoid sinus infection (1 case).

According to Honnegowda et al [6], Parhiscar et al [14] and Boscolo-Rizzo et al [24], diabetes is the most common underlying disease (14%), followed by HIV infection (2%) and tuberculosis. Elderly diabetic patients are susceptible to DNI, have more frequent complications and longer hospital stays, and surgical drainage remains the mainstay of treatment. [8]

Co-morbidities such as liver cirrhosis, hypertension, diabetes mellitus and chronic renal disease requiring regular dialysis have been described as the most common risk factors for extension of DNI into the mediastinal space. [20].

The common causative microorganisms involved in the development of DNI may vary considerably between different countries or even between different regions of the same country. Differences in aetiology may be a contributing factor.

In our study, the most common bacteria isolated were β-hemolytic Streptococcus (18%), Staphylococcus aureus (15%), Mycobacterium (3%), Actinomyces (3%), Rothia dentocariosa (2%), Gemella morbillorum (2%), Escherichia coli (2%), Bacteroides (2%), and a negative culture was seen in 55% of cases. This finding differs from some previous studies [10-21-22-23]. There was a significant rate of negative cultures in the current study. The reason for this could be that many of our patients received antibiotic therapy before admission. Antibiotic therapy should always be adjusted according to culture and sensitivity results in cases where a sample is obtained.

O'Brien et al [28] examined the effect of individual risk factors and type of service on LOS and found that patients with higher comorbidity indices had longer hospital stays and were more likely to be treated in a medical service. In addition, as expected, older age, diabetes and repeat procedures were associated with longer LOS. We also found that older patients and men had significantly longer hospital stays. We also evaluated the association of LOS with involvement of the fascial spaces and found that multifascial involvement, as well as involvement of the parapharyngeal space (both anterior and retrostyloid), was associated with an increase in the average length of hospital stay.

Tracheal intubation with rigid laryngoscopy may be difficult in these patients due to the possibility of distortion of the airway anatomy, so tracheotomy must always be considered in the setting of respiratory compromise. Presentation with airway compromise, tobacco use and diabetes are associated with prolonged hospital course. [3-21]

In our report, the most common site of involvement was the parapharyngeal space in 30 (24.19%) patients, followed by the submandibular space in 24 (19.35%), the carotid space in 21 (16. 93%), visceral space in 16 (12.90%), pretracheal space in 9 (7.25%), masticatory space in 8 (6.45%), preepiglottic space in 7 (5.64%), prevertebral space in 5 (4.09%) and parotid space involvement in 4 (3.22%) patients.

These findings are similar to a study by Kataria [10] who also reported most abscesses in the parapharyngeal space (48%), followed by the submandibular space (31%) and the retropharyngeal space (24%). Our findings are in contrast to those of Rega et al [11] and Pokharel et al [12], who found that the submandibular space was the most common site for a single space abscess (30%), followed by the buccal space (27.5%) and the lateral pharyngeal space (12.5%). The most dangerous sites appear to be the retropharyngeal space (for severe infection) and the parapharyngeal (for complicated course). This is probably related to the spread of infection from these spaces through the fascia to the mediastinum. Similar to other authors such as Honnegowda at al [6], we found that odynophagia was the most common symptom, present in a total of 70 (56%) patients. Thirty-six patients (29%) reported dyspnoea and 28 (23%) reported dysphonia. Our findings differ from previous published literature where neck swelling was reported as the main sign, followed by fever and trismus. [13-14]

Reintervention is required in some patients during the hospital stay as demonstrated by Obregon-Guerrero [26] and Chia-Ying Ho. [25]

In our study, reoperation was required in 32% of cases, and involvement of the visceral or parapharyngeal space (both anterior and posterior) was significantly correlated with reoperation, whereas involvement of the submandibular or masticatory space was significantly less associated with the need for reoperation. Our rate of reoperation was higher than in previous studies [25-26], probably because our population consisted exclusively of patients who did not respond to antibiotic therapy or had a worsening presentation. Multiple site involvement was previously identified as a risk factor for reintervention [25], but was not a risk factor in our study. As previously reported [27], the risk of reintervention was also significantly correlated with increasing age and diabetes. Complications of deep neck infection can be life-threatening and include upper airway obstruction, jugular venous thrombosis, descending mediastinitis, pleural effusion, pneumonia, pericarditis, septic venous embolism, carotid artery rupture, liver failure, adult respiratory distress syndrome, septic shock and disseminated intravascular coagulopathy, septic shock and death [8-24]. The mortality rate can be as high as 40% with these complications, like demonstrated by Rega et al [11].

In our study, 11 patients had mediastinitis, 3 patients had internal jugular vein thrombosis, one patient had a pulmonary embolism, one patient had transverse sinus thrombosis, and one patient had facial nerve paralysis. The

overall mortality rate was 0,8% due to a patient with an extended Parapharyngeal abscess who died because of ischemic brain damage due to airway obstruction before the urgent tracheostomy.

Ethical Considerations

Both components of this study were approved by the Institutional Review Board.

Limitations

Limitations of this study include its retrospective nature and location at a single institution the number of patients is limited and is affected by local characteristics, such as selected demographic characteristics and the fact that patient assessment, the need for surgical intervention, intubation, tracheostomy, and the duration of the length of stay was determined by the single physician, as we don't have an internal guideline. A multi-institutional study would increase the sample size by incorporating more patients reducing the selection bias made by the single clinician

Conclusion

We identified a cause in 48% of patients who underwent surgical intervention for deep neck infection and culture were positive in only for 45% of cases. From our analysis emerged that eldery, males, patients with involvement of more facias of the neck, as well as the interest of the parapharyngeal space (both pre- and retrostyloid) is associated with an increase in the average duration of hospitalization. Acute airway management was required in 26% of patients and it was more common when involvement of visceral space or parapharyngeal space (both pre- and retrostyloid) occurred. Revision surgery was required in 32% of cases (40 patients), especially in those with involvement of visceral space or parapharyngeal space (both pre- and retrostyloid), eldery and diabetics.

This study showed how some socio-demographic factors (such as sex, age, smoking) act as risk factors in the development of infectious pathologies in the head and neck area, and how they can influence both the development of the disease and its course. In fact, the greatest hospital stay was found in male patients with a history of diabetes and smoking abuse. From our experience it has also emerged that the location of the disease can impact both the average duration of hospitalization and the rate of reoperation and complications. In particular, our study has shown that parapharyngeal localizations of disease are associated with a slightly more complicated clinical course than other localizations of disease.

This study has been presented at the SIO conference of Milano – Italy (IT) from 24 to 27 May in 2023.

Conflicts of interest or sponsors: Authors do not have any.

Authors Contribution

Pezzoli M: Study designer, Presentator of research, Article writer
Bucolo S.: Study designer
Pagliassotto A.: Study designer
Del Corso C.: Data analysis
Pezzoli L.: Study designer, Data analysis
Succo G.: Study designer

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