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CLINICO-MICROBIOLOGICAL PROFILE OF DEEP NECK SPACE INFECTIONS IN A TERTIARY CARE INSTITUTE: A PROSPECTIVE OBSERVATIONAL STUDY

ENT

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ABSTRACT

Introduction: Deep Neck Space Infections (DNSI) are potentially life-threatening infections and need vigorous management in patients with or without diabetes mellitus. Worldwide, treatment comprises of early initiation of effective empirical anti-microbial treatment with surgical drainage of abscess. Hence, for optimal management one must know the etiology, presentation, anatomical space involvement as well as common microorganisms encountered in DNSI in both diabetic and non-diabetic patients. **Aim:** To describe the prevailing clinical and microbiological profile of DNSI in diabetic and non-diabetic patients presenting to a tertiary care hospital in Goa, India. **Materials and Methods:** This is a prospective, observational, descriptive (hospital based) study conducted in Goa Medical College, Goa over a duration of 18 months. Forty-one cases of DNSI with abscess, consisting of 25 non-diabetic and 16 diabetic patients were included in the study. A comparative evaluation of the clinico-microbiological profile was performed. **Results:** Pain and swelling in the neck (78%) was the most common presenting symptom in both the groups. Most DNSI were of odontogenic origin (44%) and preceded by upper respiratory tract infections (22%). The peritonsillar space was most frequently involved (27%). The most frequently isolated microorganism in non-diabetic patients belonged to *Staphylococcus* (29%) and *Streptococcus spp*, (12.5%) while in diabetic patients they belonged to *Klebsiella* (35%) and *Pseudomonas spp* (23.5%). **Conclusion:** DNSI patients with concomitant diabetes mellitus are likely to present with severe disease, should be monitored closely for development of complications and administered empirical antibiotics providing coverage of *Klebsiella* and *Pseudomonas spp.*

KEYWORDS

Neck spaces, Diabetes, Odontogenic, Staphylococcus, Klebsiella

INTRODUCTION

Deep Neck Space Infection (DNSI) is an inflammation of the cervical fascia involving its different planes and intervening potential spaces[1]. These deep neck spaces are divided into three groups depending upon their anatomical location in relation to the hyoid. Superiorly are the peritonsillar, submandibular, parapharyngeal, masticator, buccal and parotid spaces. Inferiorly are the visceral and pretracheal spaces. The third group extending along the entire length of the neck are the prevertebral and carotid spaces[2]. Infection of these neck spaces can present as cellulitis, abscess, or necrotizing fasciitis[3]. Deep neck space infections can lead to life-threatening complications such as airway obstruction, mediastinitis, jugular venous thrombosis, carotid artery rupture, acute respiratory distress syndrome, septic shock, disseminated intravascular coagulation and hematogenous dissemination to distant organs [4-7].

Diabetes mellitus is the most common comorbidity associated with DNSI [8,9]. These patients differ in their clinical presentation from those without diabetes and their management is increasingly associated with prolonged hospital stay, higher rate of complications and increased need for invasive airway management. Septic shock in these patients is associated with 40-50% mortality rate; therefore, their treatment should be aggressive at the onset with appropriate antibiotics and surgical intervention if needed[10, 11].

Antibiotics are initiated on an empirical basis at presentation prior to availability of culture and sensitivity reports of pus, swab or tissue obtained via surgical drainage of abscesses. Hence there is a need to analyze the microbiological flora of deep neck space infections in both diabetic and non-diabetic patients. The results of this study will identify commonly implicated organisms in DNSI and thus guide the choice of agent to be administered initially as a part of empirical antimicrobial therapy. This will lead to improved outcomes in patients with DNSI, especially those with comorbid diabetes mellitus.

MATERIALS AND METHODS

This prospective, observational, descriptive(hospital based) study was conducted in a tertiary care hospital, Goa Medical College, Goa over a period of 18 months, in all inpatients(routine and emergency care setting) with a diagnosis of deep neck space infections with abscess formation. Comprehensive clinical evaluation of each patient was performed. Patients were subjected to appropriate radiological investigations e.g., ultrasound, CT scan and MRI as needed. Fasting Blood Sugar Level (FBSL), Post Prandial Blood Sugar Level (PPBSL) and HbA_{1C} were measured for each patient. In the absence of previous diagnosis, patients with deranged blood glucose were labelled diabetics as per institutional biochemistry lab diabetes criteria i.e., FBSL >=126mg/dl, PPBSL >=200mg/dl and HbA_1c of >=6.5% and were accordingly allocated to diabetic group. At presentation, all patients were administered empirical broad spectrum antibiotics followed by either needle aspiration or incision and drainage; cultures were taken and processed by the Department of Microbiology for culture on blood agar followed by identification, and sensitivity testing. In all patients, treatment was further tailored based on culture and or sensitivity reports. All patients diagnosed with diabetic mellitus also received treatment with appropriate diet, injectable insulin and appropriate glucose monitoring as per advice of the Department of Medicine.

Statistical Analysis:

Collected data was entered in excel sheet and descriptive analysis was done. Normality of the variables was checked with the use of Shapiro-Wilk test. If the variables were normally distributed then it was expressed as mean±SD otherwise as median & inter quartile range. Kruskall-Wallis tests was used for non-normal variables among the groups followed with multiple comparison via Dunn's test. To assess association between categorical data Chi-square test/Fishers exact test was used. All the statistical analysis was performed using STATA 16.0 version software. The results were considered statistically significant at a p-value less than 0.05.

RESULTS

The study enrolled 41 patients diagnosed with Deep Neck Space Abscess (DNSA), comprised of 30 males and 11 females, with mean age of 40 ± 16 years. Demographically, 25 patients were from urban and 16 patients were from rural background. Seventeen patients (41.46%) were current tobacco chewers.

17(41.46%) patients had comorbid diabetes mellitus. The presenting symptoms of the patients are shown in [Table 1].

Table 1: Symptoms of DNSI patients

Symptom	No. of patients(%)	
	Non-diabetic(%)	Diabetic(%)
Swelling and pain in neck	18 (75%)	14(82.35%)
Fever	9 (21.95%)	7(41.17%)
Toothache	7 (29.16%)	5(29.41%)
Odynophagia	2 (08.33%)	5 (29.41%)
Cheek swelling and buccal space infection	9(37.5%)	2 (11.76%)
Breathless with restricted mouth opening	Nil	2(11.76%)

Table 2: Etiological factors in patients with DNSA

Etiology	No. of patients(%)	
	Non-diabetic(%)	Diabetic(%)
Odontogenic	13(54.16%)	5(29.41%)
Acute Upper Respiratory infection	5 (20.83%)	4(23.52%)
Trauma	2(8.33%)	-
Foreign body (Fish bone)	-	1(5.88%)
Idiopathic	4(16.66%)	7(41.17%)

In majority of cases(54.16%) the infection was odontogenic in origin [Table 2]. There was history of preceding acute upper respiratory tract infection in around 20% of patients in both groups. In our study, no source of infection was found in 41.17% of diabetic DNSI patients.

Sub mandibular space was most frequently involved(41.66%) followed by the parotid space(24.39%) as shown in [Table 3]. There was greater presentation with Ludwig's angina and necrotizing fasciitis amongst diabetics compared to non-diabetics. This was statistically significant($p<0.05$).

Table 3: Deep neck space abscess involved in diabetic and non-diabetic

Deep neck space Abscess	Total n=41	Non Diabetic n=24	Diabetic n=17
Peritonsillar space	11(26.82%)	6(25%)	5(29.41%)
Submandibular	9(21.95%)	7(16.66%)	2(17.64%)
Parotid	7(17.07%)	4(16.66%)	3(17.64%)
Retropharyngeal	7(17.07%)	6(25%)	1(5.88%)
Ludwig angina	4(9.75%)	1(4.16%)	3(17.64%)
Necrotizing fasciitis	3(7.31%)	-	3(17.64%)

Microbiological Profile:
In non-diabetic patients(n=24) with DNSA, 8 (33.33 %) swabs did not yield any growth on incubation and were reported sterile. In remaining 16 (66.66%) swabs, 7(29.16%) yielded *Staphylococcus aureus* (all were reported methicillin resistant), 3 (12.5%) yielded *Streptococcus* species and 2 (8.33%) each grew *Klebsiella pneumoniae, Enterococcus* and *Pseudomonas*.

In diabetic patients(n=17) with DNSA, only 2 (11.76 %) swabs did not yield any growth on incubation and were reported sterile. In remaining 15 (88.23%) swabs, 6(35.29%) yielded *Klebsiella pneumoniae*, 4(23.52%) yielded *Pseudomonas aeruginosa* and1(5.88%) each grew *Proteus mirabilis*, coagulase negative *Staphylococcus*, *Acinetobacter*, Non-Group A beta hemolytic Streptococci, and *Burkholderia pseudomallei*.

Sterile cultures were reported more frequently amongst non-diabetics as compared to diabetics. Gram negative microorganisms were isolated more frequently from diabetics. These findings were statistically significant($p<0.05$).

During hospital stay, five diabetic patients developed complications: 3 had mediastinitis and 2 had pleural effusion. Of the 3 patients with mediastinitis, one suffered sudden cardiac arrest and expired. The non-diabetic patients did not report any complications till completion of study($p<0.05$). Hence mortality rate in the present study is 2.43%.

DISCUSSION

DNSI requires aggressive diagnostic evaluation and therapeutic management as it can lead to potentially fatal complications[12]. In this study, 41 patients diagnosed with DNSI and abscess in any of the deep neck spaces, with or without diabetes were included. There were 30 males and 11 females, with male-female ratio being 2.72 which is consistent with observations that DNSI is twice as common in males than in females [13-16]. This male preponderance can be attributed to high prevalence of substance use like tobacco chewing and smoking which is associated with poor oral hygiene and predisposes the patient to develop DNSI [17]. We reported tobacco chewing and smoking in 17(41.46%) and 10(24.39%) patients respectively. The mean age in our study was 40 ±12 years and is identical to other studies where mean age varied from 36 to 57 years [13].

Considering the prevalence of diabetes mellitus as 8.9% in the general population of India [18], a prevalence of 29.41% in this study highlights the significant association between diabetes mellitus and DNSI. Lower rate of sterile cultures in the diabetic group(11.76%) as compared to the non-diabetic group(33.33%) is possibly due to diabetes related immunosuppression [12].

Most patients in the non-diabetic(75%) as well as the diabetic group (82.35%) presented with pain and swelling in neck which corroborates with observations in other studies. Two patients with diabetes diagnosed with Ludwig's angina presented with mild breathlessness. In the pre-antibiotic era pharyngeal and tonsillar infections constituted 70% of DNSI [19-20]. Now with widespread use of antibiotics, odontogenic infections are a common route of infections in deep neck spaces as reported by Parhiscar et al[13], Bottin et al[21], Huang et al, Marioni et al and Eftekharian et al[8,22,23]. One diabetic patient with fish bone impaction in the posterior oropharyngeal wall presented with retropharyngeal abscess. 41% of diabetic DNSI did not have an identifiable source of infection.

In the present study, peritonsillar space was most frequently involved (26.82%), followed by submandibular space (21.95%) and parotid space (17.07%). Peritonsillar and submandibular abscesses are the second and third most frequent presentation in studies by Pariscar et al, Stalfor et al and Kataria G et al[13,26,27]. Majority of the severe infections in our study, i.e., Ludwig's angina (17.64%) and necrotizing fasciitis (17.64%) were reported in the diabetic patients. The results of the present study are consistent with observations of Parhiscar et al. and Khode et al[13,25].

Gram positive organisms *Staphylococcus aureus* and *Streptococcus viridans* species were most frequently isolated from non-diabetic patients. This is consistent with the observations of Parischar et al, Kataria et al, Ridder et al, Mumtaz et al and Gidley et al[13,27-30]. However, in patients of DNSI with diabetes, Gram negative micro-organisms were most frequently isolated, i.e., *Klebsiella pneumoniae*(35.29%) followed by *Pseudomonas aeruginosa* (23.52%). Similar results were reported by Luan et al. from Taiwan in a study comprising of 8237 patients with DNSI with diabetes [31]. Universally, the management of DNSI with abscess involves administration of empirical antibiotics followed by drainage via incision, till culture and sensitivity is reported. This usually takes reasonable time. Therefore, based on the implicated micro-organisms, severity of clinical presentation, presence of risk factors and possible source of DNSI an empirical broad spectrum antimicrobial is chosen and administered promptly. Our study describes the prevailing clinical and microbiological profile in DNSA patients to guide initial decision making and highlights the increased complication rates and differing causative microorganisms in diabetic patients, thereby necessitating closer monitoring, optimization of blood sugars and timely administration of antibiotics with appropriate coverage.

Limitation(s)
This study was conducted over a period of 18 months with 41 patients enrolled. A longer duration of study with more patients is worthy of further investigation.

CONCLUSION(S)

Odontogenic infections are the most frequent source of DNSI. Peritonsillar space is involved in most commonly, with severe presentations(i.e., Ludwig's angina and necrotizing fasciitis) and complications reported more frequently in diabetics. Patients with diabetes need to be given appropriate antimicrobial agents covering Gram negative micro-organisms like *Klebsiella* and *Pseudomonas* during initial empirical treatment, require close monitoring and optimization of blood glucose for improved outcome.

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