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Original Research Article

Deep neck space infections: comparison of outcomes between diabetic and non-diabetic patients

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ABSTRACT

Background: The objective of the study was to study the clinical presentation, microbiological profile, treatment protocol of deep neck space infections in diabetics and non diabetics.
Methods: This was a prospective study conducted on 76 patients (diabetics and non diabetics) admitted in the Department of Otorhinolaryngology, TD Medical college, Alappuzha over a period of 18 months from January 2012 to June 2013.
Results: The age distribution was 15-75 years. Male to female ratio was 2:1. Fever, pain, neck swelling and odynophagia were the common symptoms with dyspnoea and chest pain indicative of complications. The most common etiology was odontogenic (68.4%) followed by tonsillopharyngeal infection and foreign bodies. No etiological factor was found in 34.2%. The commonest site was submandibular space (64.2%) followed by parapharyngeal space (26.6%). Abscess was present in majority needing surgical drainage. The most common organism isolated was *streptococcus viridans* (37.5%). Preponderance of *klebsiella* species was noted in diabetics. *Streptococcus* showed susceptibility to pencillin (83.33%), ampicillin (92%), cefotaxime (60.526%). *Klebsiella* showed susceptibility to gentamicin (42.3%) and ciprofloxacin (28.57%). The complication rate was more in diabetics (34.21%). Contrast enhanced CT was done in cases suspected to have complication. The mean hospital stay was longer in diabetics (19.6 days) than non diabetics (6.4 days).
Conclusions: Deep neck space infection still remains life threatening if not heeded promptly. Senescence and diabetes demand surgical intervention and meticulous glycemic control to prevent complications. Judicious use of antimicrobials and timely radiological and surgical interventions have come a long way in the management and in providing a cure to this dreaded condition.

Keywords: Deep neck space infection, Diabetes abscess, Complications, Microbiological profile, Antibiotics

INTRODUCTION

The quote by Mosher “Pus in the neck calls for the surgeon's best judgment, his best skill and often for all his courage” still remains as significant as in 1929 as infections of the neck spaces can be of a life threatening nature.[1]

Deep neck space infection (DNI) has been mentioned under the names “morbus strangulatorius” “cynanche”, Greek for suffocation and as “angina maligna” during the times of Hippocrates and in the time of Galen in the second century A.D.[2,3]

The neck is lined by the superficial and deep layers of the cervical fascia. Anatomically the hyoid bone divides the neck spaces into suprahyoid and infrahyoid spaces with inter communication between these spaces.[4-6] The peritonsillar, sublingual, submandibular, parotid, buccal and parapharyngeal spaces come under suprahyoid space.

Visceral spaces including the thyroid gland, larynx, trachea, hypopharynx and oesophagus are included under infrahyoid space, while the entire neck is involved in carotid space, prevertebral space, and retropharyngeal space.[6]

(DNI) is an infection of the facial planes and potential spaces of the neck forming cellulitis, abscess and necrotizing fasciitis. Infection is treated by antibiotics and surgical drainage of these potential spaces with utmost respect to the closely lying neurovascular structures with a guarded awareness of spread of infection to the mediastinum.[5] Yet it still a matter of grave concern among patients with diabetes mellitus.[5] Airway obstruction, mediastinitis, jugular vein thrombosis, carotid artery rupture, pericarditis, disseminated intravascular coagulopathy etc. are some of the life threatening complications, and diabetes mellitus is commonly associated with DNI.[7]

The diabetic population in India (known as the world's capital of diabetes) is predicted to be around 69 million by 2025 about 80 million by 2030.[8] The prevalence of diabetes is at a higher rate in South India and among the urban population than the Northern states and rural population.[9,10] Genetic factors, obesity, life style changes and urbanisation are some of them.[11]

Although tonsillitis remains the most common cause in children, odontogenic infection and intravenous drug abuse are the most common causes of DNSI in adults, followed by foreign body ingestion and infections of unknown origin.[3] Polymicrobial organisms are involved in DNI, the common ones being *Streptococcus viridans, beta hemolytic streptococcus, Klebsiella pneumoniae, Staphylococcus aureus* and anaerobes like *Peptostreptococcus and Bacteroides*.[2] *Klebsiella pneumoniae* has been the predominant organism isolated in diabetic patients.[12]

The aim of the study is to define the clinical features and prognosis of deep neck space infections in both the diabetic and non-diabetic patients, to emphasize on the use of proper antibiotics, and the timing of surgical management.

METHODS

Main objectives of the study

To compare the clinical presentations of DNI in diabetics and non-diabetics. To compare the microbiological profile of DNI in diabetics and non-diabetics and their antibiotic sensitivities. To compare the clinical outcomes of this condition in the diabetics and non-diabetics. To prepare a treatment protocol for DNI. To assess the role diabetes plays in the clinicopathogenesis of deep neck space infections.

Study design

This study was a prospective comparative study.

Study setting and duration

The study was conducted at Government T.D. Medical College, Alappuzha, Kerala in the ENT department for a period of 18 months from January 2012 to June 2013.

Inclusion criteria

The following criteria were included in the study.

All patients above 15 years of age with clinically diagnosed DNI.

Exclusion criteria

The following criteria were excluded from the study.

Immunocompromised conditions other than diabetes mellitus like – diagnosed cases of HIV, hepatitis B or C, chronic liver disease, known cases of malignancy on chemotherapy or radiotherapy. Superficial neck space infections – carbuncle, furuncle, folliculosis, submandibular sialadenitis, cervical lymphadenitis. Patient not willing to participate in the study.

Method of data collection

Informed consent was taken. Biodata was collected. Relevant history was taken and clinically examined according to the prepared proforma. Infection was categorised into cellulitis and abscess confirmed by aspiration. Aspirated pus was sent for culture and sensitivity. Clinical follow up and details of patient condition were maintained in the case sheets.

Study variables

Age, sex, symptoms developed, neck spaces involved, etiological factor, abscess developed, management-surgical or conservative, organism isolated, antibiotic sensitivity, complication if any, tracheostomy if required and duration of hospital stay

Study procedure

Patients above 15 years with DNI (Ludwig's angina, submandibular, parapharyngeal/ retropharyngeal/ masticator/ peritonsillar infections) were individually evaluated by clinical examination, admitted and treated as inpatients. Clinically assessed cases of abscess were confirmed by aspiration using 18 G needle and syringe. Gram sensitivity and pus culture and sensitivity were done. At the site of aspiration, incision with drainage of pus were done. Routine blood and urine investigations were carried out. Diabetic patients were started on insulin therapy to

control blood sugar levels to less than 200 mg/dl. They were put on empirical antibiotics – intravenous penicillin, metronidazole and gentamicin and changed according to culture sensitivity reports. Patients worsening clinically with temperature >38˚C with elevated complete blood count of more than 10,000 cells/cu mm) after 48 hours of treatment were evaluated for any complications like dyspnoea or stridor, odynophagia, swelling in the neck, signs of inflammation on the skin of the neck, tachypnoea, raised pulse rate etc.

If complications are suspected, emergency CT scan of the neck (from base of skull to level of upper mediastinum) was taken and managed accordingly. Radiological characteristics of abscess include low attenuation, contrast enhancement of the abscess wall, tissue edema surrounding the abscess and a cystic or multiloculated appearance.[36] In case of airway compromise, emergency tracheostomy was done. Patients were discharged on oral antibiotics on recovery with controlled blood sugar levels.

Statistical analysis

Data obtained were analysed with statistical package for social sciences (SPSS) 16.0.

Ethical considerations

The permission to conduct the study was obtained from the Institutional Ethical Committee and Institutional Research Committee.

RESULTS

The study involved a total of 76 patients consisting of diabetics and non-diabetics with 38 in each group. The study was carried out from January 2012 to June 2013 in the Department of Otorhinolaryngology, Government TD Medical college, Alappuzha.

The study involved patients above 15 years of age. The age distribution was from 15 to 75 years (Table 1).

The average age was 45.4 years in the non-diabetic and 50.4 years in the diabetic group (Table 2). The age groups affected in both the groups were compared and the statistical difference was found to be significant. (p value:0.004; Chi square value:15.569).

The study included 50 males and 26 females (Table 3). The comparison was found to be statistically insignificant (p-value: 0.333; Chi square value: 0.935).

Table 1: Age group distribution.

Age group (years)	Study group				Total
	Non-diabetic		Diabetic		
26-35	2	5.26%	0	0%	2
36-45	19	50%	8	21.05%	27
46-55	12	31%	13	34.21%	25
56-65	4	10.52%	17	44.73%	21
66-75	1	2.6%	0	0%	1
Total	38	100	38	100	76

Table 2: Mean age comparison.

Variables	Mean age	Std. deviation	Std. error mean
Diabetic	50.47368	8.278062	1.342879
Non-diabetic	45.47368	9.117067	1.478984

Table 3: Sex distribution of the study groups.

Gender	Study group				Total
Sex	Non-diabetic		Diabetic		
Male	27	71.05%	23	60.52%	50
Female	11	28.94%	15	39.47%	26

The symptoms at the time of presentation were compared in both the groups (Table 4). The symptoms indicating multiple space involvement were seen in 73.684% of diabetic patients and 52.631% of non-diabetics at the time of presentation. The comparison of difference in presentation in both the groups was found to be statistically significant (p-value:0.025, Chi square value: 14.4).

The involvement of various neck spaces in both the groups was compared (Table 5). The difference in space

involvement was found to be statistically insignificant (p-value:0.308; Chi square:11.667).

The etiological factors were compared in each group. Definite etiological factors resulted in neck space infections in 94.736% of diabetics and 65.789% of non-diabetics (Figure 1). No specific etiological factor was identified in 34.21% of cases. The comparison in two groups was found to be statistically significant (p-value: 0.037; Chi square value: 11.823).

Abscess developed in 89.473% of diabetics and 81.578% of non-diabetics (Table 8). The statistical significance could not be established with p-value: 0.328; Chi square value: 0.957, Odds ratio: 0.521; 95% confidence interval: 0.139-1.953. Abscess was drained and pus sent for culture sensitivity studies.

Table 4: Clinical presentation in deep neck space infection.

Symptom	Study group				Total
	Diabetic		Non-diabetic		
Fever, neck swelling	7	18.42%	16	42.10%	23
Fever, odynophagia, trismus	11	28.94%	12	31.57%	23
Fever, odynophagia, trismus, otalgia	4	10.52%	3	7.89%	7
Fever, odynophagia, trismus, neck swelling, otalgia	8	21.05%	5	13.15%	13
Fever, otalgia, neck swelling	3	7.89%	0	0	3
Fever, neck swelling, chest pain, dyspnoea	5	13.15%	0	0	5
Trismus	0	0%	2	5.26%	2
Total	38		38		76

Table 5: Neck spaces involved in diabetic and non-diabetic groups.

Neck spaces involved	Study group				Total	
	Diabetic		Non-diabetic			
Submandibular	13	34.21%	17	44.73%	30	39.4%
Submandibular, sublingual	6	15.78%	6	15.78%	121	15.7%
Submandibular, sublingual, masticator	1	2.63%	4	10.52%	5	6.5%
Submandibular, sublingual, masticator, parapharyngeal	1	2.63%	0	0%	1	1.3%
Parapharyngeal	10	26.30%	6	15.78%	16	21%
Retropharyngeal	1	2.63%	2	5.26%	3	3.9%
Parapharyngeal, retropharyngeal	1	2.63%	1	2.63%	2	2.6%
Anterior visceral	3	7.89%	0	0%	3	3.9%
Anterior visceral, parapharyngeal	1	2.63%	0	0%	1	1.3%
Masticator	0	0%	2	5.26%	2	2.6%
Submandibular, sublingual, anterior visceral space	1	2.63%	0	0%	1	1.3%
Total	38		38		76	

The complications, which developed among the patients at time of presentation and during hospital stay, were compared and were seen only in diabetic patients (34.210%). The difference between the two groups was found to be statistically significant (p-value: 0.028; Chi square value: 15.683) as shown in Table 7.

The most common organism isolated from neck abscesses was *Streptococcus viridians* (34.21%) among the non-diabetic patients. Commonest organisms in diabetics were *Klebsiella pneumoniae* (31.57%), *Streptococcus viridans* (28.94%). *Klebsiella* was isolated only in one patient among the non-diabetics (Table 8). The difference in the two groups was statistically significant (Chi-square test: 7.7433, p-value:0.005391).

The most common isolates were *Streptococcus viridans* and *Klebsiella pneumonia* (Table 8). *Streptococcus viridians* showed susceptibility to penicillin (83.333%), ampicillin (92%), cefotaxim (60.526%), ciprofloxacin (54.761%) and gentamicin (46.153%). Klebsiella showed susceptibility to gentamicin (42.307%), ciprofloxacin (28.571%) and cefotaxim (26.315%) and resistance to ampicillin (Figure 2).

Table 6: Comparison of presence of abscess in the study group.

Presence of abscess	Study group				Total	
	Diabetic		Non-diabetic			
Abscess	34	89.47%	31	81.57%	65	85.5%
Total	38		38		76	

Table 7: Comparison of complications of deep neck space infections.

Complications in deep neck space infection	Study group				Total
	Diabetic		Non-diabetic		
None	25	65.78%	38	100%	63
Airway obstruction	1	2.63%	0	0	1
Necrotizing fasciitis	1	2.63%	0	0	1
Sepsis, necrotizing fascia	1	2.63%	0	0	1
Spread to other space during hospital stay	1	2.63%	0	0	1
Supraglottitis	6	15.78%	0	0	6
Mediastinitis	2	5.26%	0	0	2
Mediastinal abscess, Death	1	2.63%	0	0	1
Total	38		38		76

Only one of the patients required tracheostomy for airway obstruction and he was a diabetic. The difference between the two groups could not be established statistically. Fisher extract test value=1, not significant at $p<0.05$ (Table 9).

The mean hospital stay duration was 19.6 days in diabetics (SD. 16.6) and 6.4 days (S.D. 1.86) in non-diabetics. 86.8% diabetics had hospital stay for more than 7 days. Only 28.9% non-diabetes needed hospital stay for more than a week (Table 10). The difference between the groups was statistically significant (Chi square: 26.125; 95% Confidence interval: 0.019- 0.200).

DISCUSSION

Although antibiotics are extensively used in this era, DNI are still of interest because of their grave complications and difficulty in making an accurate diagnosis.[13] Here we included patients with age more than 15 years as this study aims at studying the difference in the outcomes of DNI in diabetics and non-diabetics. The mean age in the diabetic group was 50.47 years and in non- diabetic was 45.47 years. Majority of diabetics were in the 56-65 years of age group and non- diabetics in 36-45 years of age group which was statistically significant (p-value: 0.004). This was similar to the study by Huang et al. at Taiwan of 185 patients (diabetic group: 57.2 21.2 years, non-diabetic group: 46.2 16.5 years, p-value: 0.0007). [12]

65.78% were males and 34.21% females which were similar to the study by Huang et al (109 males, 76 females among 185 patients), Kataria et al (42 males, 34 females among 76 patients), Sethi et al, Meher et al and Parischar et al.[12,14]

The most common symptoms were neck pain, neck swelling and odynophagia which were similar to other studies by Kataria et al and Motahari et al[14,15] Neck swelling was the most common presenting feature (88.4%) in the study by Boscolo-Rizzo while fever (98%), was reported in all patients in the study by Mohatari et al.[16,15] Dyspnea and chest discomfort may indicate mediastinitis.[17] Life threatening complications include airway obstructions, internal jugular vein thrombosis, mediastinitis, pericarditis, pleural empyema, cavernous sinus thrombosis, respiratory distress, disseminated intravascular coagulation, lung abscess and hematogenous spread to all organs.[7]

Our study identifies etiologies as 68.4% odontogenic, 31.57% peritonsillar abscesses, 26.3% foreign body of upper aerodigestive tract, 2.63% infected neck cyst and 34.2% unknown cases. The most common etiology was dental infection (68.4%). Huang et al found in 42%, Marioni et al (38.8%) and Eftikharian et al (49%) and Khataria et al (34.21%) that the commonest cause of DNI was odontogenic.[14]

The next most common cause was tonsillopharyngeal infections (31.57%). In the pre antibiotic era, several studies showed that most DNI cases (70-80%) resulted from complicated tonsillopharyngeal infections, whereas

nowadays, the incidence has reduced (8-16%) though in children acute upper respiratory tract infection is the commonest cause, and odontogenic infection the next common cause.[18,19]

The usual presentation in infants is various types of neck abscesses as it is difficult to make out the early clinical features.[20]

Table 8: Comparison of microbiological profile.

Organisms	Study group				Total
	Diabetic		Non-diabetic		
Cellulitis.	4	10.52%	8	21.05%	12
Klebsiella	12	31.57%	1	2.63%	13
Streptococcus viridans.	11	28.94%	13	34.21%	24
Staphylococcus aureus	1	2.63%	2	5.26%	3
Anaerobes	2	5.26%	4	10.52%	6
Beta- hemolytic streptococcus	0	0%	1	2.63%	1
CONS	1	2.63%	2	5.26%	3
Escherichia coli	1	2.63%	0	0%	1
Sterile	3	7.89%	4	10.52%	7
Mixed bacterial growth	3	7.89%	3	7.89%	6
Total	38		38		76

Table 9: Comparison of tracheostomy done.

Surgical procedure	Study group				Total
Tracheostomy	**Diabetic**		**Non-diabetic**		
Not required	37	97.36%	38	100%	75
Required	1	2.63%	0	0%	1
Total	38		38		76

Table 10: Duration of hospital stay.

Duration of hospital stay	Study group				Total
	Non-Diabetic		Diabetic		
More than 7 days	11	28.94%	33	86.84%	44
7 days or less	27	71.05%	5	13.15%	32
Total	38		38		76

The next common cause in our study was foreign body especially fish bone of the upper aero digestive tract (26.32%). The reason may be attributed to the fact that Alappuzha is a coastal area with fish being part of the staple diet. Some studies have shown that intravenous drug abuse and trauma were frequent etiologies.[15]

The cause of DNI infection was unknown in 34.2% in our study. Unknown etiology was also noted in the studies by Kataria et al (9.21%), Motahari et al (24.1%) and Sharma et al (22.2%).[14,15,21]

Cellulitis was present in 21.05% and 10.52% of cases in the non-diabetics and diabetics. The difference between the groups was not statistically significant (Chi-square test: 1.5833 p value: 0.208).

According to the source of infection, in this study the most common primary site of DNI was the submandibular space (64.2%) followed by the parapharyngeal space (26.6%) anterior space (5.2%), retrophayngeal space (3.9%) and masticator space (1.3%). The findings were similar to the study by Kataria et al, Pariscar et al and Stalfor et al.[14]

The cause may be that poor dental hygiene, use of cigarette smoking resulting in odontogenic infections which can contiguously spread to submandibular, sublingual and masticator spaces.[14]

Poor hygiene among tobacco chewers leads to the formation of biofilms harbouring gram negative bacteria, predisposing to inflammation of the periodontium.[7] Poor glycemic control also predisposes to severe periodontitis.[14,22]

Parapharyngeal space is commonly involved as the peritonsillar space, submandibular space, the masticator space and the parotid space communicate with it. Infection

can also spread to the mediastinum through the parapahryngeal space to the retropharyngeal space.[23]

In our study abscess drainage was done in 89.473% of diabetics and 81.578% of non- diabetics. Statistically there was no significant difference between the two groups (p-value 0.32). Similarly, surgical drainage was reported in the studies conducted by Mumtaz et al. (78%), Eftekharian et al. (79%), Parhiscar et al (100%) and Har-EI et al (90%) and Khataria (89.47%).[14]

The common organisms isolated in diabetes were *Klebsiella* (31.57%) and *Streptococcus* (28.94%). In non-diabetics, *Streptococcus viridans* (34.21%) was the most common isolate. The difference in the two groups for *Klebsiella* was statistically significant (Chi-square test=11.5467 p-value=0.000679). Similarly studies in Taiwan have also shown high rates of positive culture for *Klebsiella pneumonia* in diabetics (56.1%).[12]

Possible contributing factors of the preponderance of *Klebsiella pneumonia* in DNI patients with diabetes include increased oropharyngeal colonization by gram negative bacilli and the defects of the host defenses, especially in phagocytosis among diabetic patients. Higher incidence of *Klebsiella* infection has been noted in southeast Asian countries.[12,24] Susceptibility of *Streptococcus viridans* to penicillin was 83.333%, ampicillin (92%), cefotaxim (60.526%), ciprofloxacin (54.761%) and gentamicin (46.153%) as concluded from the culture sensitivity report, while *Klebsiella* showed susceptibility to gentamicin (42.307%), ciprofloxacin (28.571%) and cefotaxim (26.315%) and resistance to ampicillin.

In this study 34.21% of diabetics developed complications. No complication was noted in the non- diabetic group. The difference between the two groups was found to be statistically significant (p-value: 0.028). One patient underwent tracheostomy for airway obstruction. One case developed necrotizing fasciitis and was managed with surgical debridement and antibiotics. Among the 3 cases of mediastinitis, one succumbed to death while the other two survived.

In this study CT was taken for patients with suspected complications. Contrast enhanced computed tomography (CECT) is highly sensitive (positive predictive value of 82%), and very useful to identify the extent of the DNI and distinguish cellulitis from abscesses.[25] Magnetic resonance imaging (MRI) has similar prognostic value when compared to CECT. MRI is superior to CT in complications like internal jugular vein thrombosis, rupture of abscess into carotid sheath, but as it is expensive and requires longer time it is not the commonly preferred.[26]

CT and MRI are quick and accurate methods for the evaluation of head and neck infections. MRI is superior to CT in regard to lesion pathology and determining the number of anatomic spaces involved and the degree of extension and the source. MRI displays the lower neck clearly without any shoulder artifact which is commonly seen on CT. Gas containing lesions are better demonstrated by CT. MRI is a very useful tool in case of acute infection of neck.[26]

CONCLUSION

Deep neck space infection can be life threatening especially when associated with diabetes. This is of utmost importance in India with the number of diabetic cases on the rise. Yet proper clinical and radiological assessment, with appropriate management can go a long way in bringing down the morbidity and mortality of this once dreaded condition and its complications.

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