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Deep Neck Space Infection in Diabetic and Non Diabetic Hospitalized Patients: A Comparative Retrospective Study

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Abstract

Background: Deep neck infection is an infection that occurs in the deep fascia and cervical spaces in the form of abscess or cellulitis. The impairment of the immune system due to the hyperglycemic state in patients with diabetes leads to different clinical presentations, prognosis, management and therapy in this group of patients and they can become life-threatening if they are not managed in the right time.

Aims: This study was undertaken to better define the clinical features and prognosis of deep neck infections in diabetic patients with special emphasis on the need for prompt surgical intervention and avoidance of life-threatening complications.

Patients and methods: In this study, we retrospectively reviewed the data of patients who were diagnosed with deep neck infection and who received treatment at the Department of Otorhinolaryngology at the ´Mother Teresa University Hospital Center´ during a two-year period between March 2023 and March 2025. 80 patients were included in our study. 15 patients with Diabetes Mellitus were compared with 65 other patients without Diabetes Mellitus in demographics, clinical features, involvement of several neck spaces, need for surgical intervention, possible complications, laboratory data and hospital stay.

Results: In the diabetic group compared to the non-diabetic group, older patient age was evidenced (mean age 56.2 vs. 37.8, $p<0.001$),

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a shorter duration of symptoms before hospitalization (4.6 days vs. 8.26 days, p=0.001), a wider involvement of neck spaces (≥3 spaces: 60% of patients in the diabetic group vs. 4.6% in the non-diabetic group, p=0.001), higher surgical intervention (80% of patients vs. 47.7%, p=0.024), higher number of complications (40% vs. 5%, p<0.001) and higher hospital stay (11.27 days vs. 4.25, p=0.002). No significant relationship was found between PCR values (14.11 ± 13.52 versus 10.44 ± 9.88 mg/dl, p=0.231) and WBC (13.27 ± 4.7 versus 14.39 ± 6.35× 109/L, p=0.447).

Conclusions: Diabetic patients tend to have deep neck infections with a more severe presentation and they have several typical characteristics compared to the non-diabetic hospitalized patients. They are older, have a tendency for infection to spread to multiple spaces, a more aggressive requirement for surgical intervention, a higher rate of complications, and a longer hospital stay. Thus, in their treatment, we must properly control diabetes, initiate antibiotic therapy as soon as possible, detect life-threatening complications early, and perform aggressive surgical treatment as soon as possible if complications occur.

Keywords: Deep neck infection, abscess, diabetes mellitus, surgical intervention, complication

INTRODUCTION

DM represents a group of physiological dysfunctions characterized by hyperglycemia due to insufficient insulin production, glucagon hypersecretion (type 1 DM), or directly from insulin resistance (type 2 DM) (1,2). DM has a significant impact on the course of infections. A deep neck infection (DNI) is a lethal emergent bacterial infection of the deep neck spaces that can lead to cellulitis or abscess formation (3). In diabetic patients, DNI is known to exhibit a unique clinical characteristic compared to the non-diabetic population. Multiple host factors in DM patients may increase the risk of skin and soft tissue infections, including uncontrolled hyperglycemia, disruption of the skin barrier, poor vascularization, and immune system dysfunction (4,5). Uncontrolled hyperglycemia is the main culprit behind infection (6,7). Furthermore, the clinical course of DNIs differs between patients with and without DM. It may result in life-threatening conditions from airway obstructions, mediastinitis, emboli, and septic shock (3,6). Due to rapid disease progression and life-threatening complications, the accurate surgical and medical treatment must be promptly applied (8).

This study aims to compare demographic, clinical, therapeutic data, and disease progression between hospitalized diabetic and non-diabetic patients with deep neck infection.

MATERIALS AND METHODS

In this study, we retrospectively reviewed the data of patients who were diagnosed with deep neck infections and who received treatment at the Department of Otolaryngology in the ´´Mother Teresa University Hospital Center´´ during a two-year period between March 2023 and March 2025. Eighty patients were included in our study. Fifteen patients with Diabetes Mellitus of this period (diabetic group) were evaluated and compared with sixty-five other patients without Diabetes Mellitus (non-diabetic group).

The inclusion criteria in the study are:

- Patients diagnosed by examinations (ultrasound, CT, MRI) with deep neck infection, involving one or more cervical spaces, with and without diabetes.

The exclusion criteria from the study are:

- Patients suspected of having deep neck infection whose diagnosis is not supported by imaging.
- Patients presenting to the emergency department with deep neck infection who were treated in the emergency department and did not have an urgent indication for hospitalization or who refused hospitalization.

Data Collection: Data extracted and analyzed include age, sex, duration of symptoms before hospitalization, the level of C-reactive protein (CRP), white blood cell (WBC) count, glycemia and glycosylated hemoglobin levels, abscess

location and the number of spaces included, the need of surgical intervention, complications and hospitalization time. For each variable, it was assessed whether there were differences between the group with diabetes and those without diabetes and conclusions were drawn.

Statistical Analysis: The programs used for the statistical analysis were SPSS statistical programs. Quantitative variables were expressed in frequency, percentage, mean value, minimum and maximum value. Categorical variables were expressed in frequency and percentage. Bivariate analysis was used to combine and facilitate the relationship between variables. The association between variables was tested using the χ^2 test and a p value ≤ 0.05 is considered statistically significant.

RESULTS

In the non-diabetic group 42 patients were male 42 (64%), and 23 were female (36%). Similarly, in the diabetic group, 10 patients were male (66.6%) and 5 were female (33.4%). A male-female ratio of 1.8:1 was observed in the non-diabetic group, and 2:1 in the diabetic group.

In the non-diabetic group, the average age is 37.78 years old and the most frequent age belongs to the group of patients younger than 40 years (55.3%). In the diabetic group, the average age is 56.2 and the most frequent age belongs to the group older than 60 years (53.4%) (Table 1). The age groups affected in both the groups were compared and the statistical difference was found to be significant: $t(33.92) = 4.77$, $p = <.001$, 95% confidence interval [10.56, 26.27].

Table 1. Distribution of diabetic and non-diabetic patients by age group

Age group (years)	Diabetic patients	Non-diabetic patients
<40	2 (13.30%)	36 (55.3%)
40-60	5 (33.30%)	20 (30.7%)
>60	8 (53.40%)	9 (14%)

In the group of non-diabetic patients, most patients were diagnosed with peritonsillar abscess (55.4%), laterocervical abscess (17%), parapharyngeal abscess (9.2%), retropharyngeal abscess (6.2%), anterocervical abscess (4.6%), abscess of epiglottis (3.1%), and the smallest group with pterygomandibular abscess, parotid abscess, Ludwig's angina (1.5%) (Table 2). In the group of the diabetic patiens most of them were diagnosed with submandibular, parapharyngeal, laterocervical abscess and Ludwig's angina (13.3% for each), while the rest with necrotizing fasciitis, submental, anterocervical, retrotonsillar, paraesophageal and retropharyngeal abscess. (6.6% for each group) (Figure 1).

Table 2. Abscess types in diabetic and non diabetic patients

Abscess type	Diabetic	Non-diabetic
Submandibular	2(13.3%)	0
Submental	1(6.6%)	0
Parapharyngeal	2(13.3%)	6 (9.2%)
Anterocervical	1(6.6%)	3 (4.6%)
Laterocervical	2(13.3%)	11 (17%)
Ludwig´s angina	2(13.3%)	1 (1.5%)
Laryngeal	1(6.6%)	2 (3.1%)
Necrotizing fasciitis	1(6.6%)	0
Peritonsillar	1(6.6%)	36(55.4%)
Paraesophageal	1(6.6%)	0
Retropharyngeal	1(6.6%)	4 (6.2%)
Pterygomandibular	0	1 (1.5%)
Parotid (with neck extension)	0	1 (1.5%)
All	15(100%)	65(100%)

The non-diabetic patients had 1-30 days of symptoms before hospitalization, with an average of 8.26 ± 5.74. While the diabetic patients had a shorter duration of the symptoms 1-7 days with an average of 4.6 ± 1.84. A two-tailed t-test showed that the difference between the diabetic and non diabetic group was statistically significant, t(45.89) = -3.39, p = .001, 95% confidence interval [-5.83, -1.48].

The majority of nondiabetic patients (95.4%) had fewer than three cervical spaces involved by infection, and a small number (4.6%) had three or more spaces involved. In the diabetic group 60% of patients had involvement of three or more spaces, while 40% had involvement of fewer than three spaces. A Fisher's exact test was performed between 'Diabetes' and 'Number of spaces involved' and there was a statistically highly significant association , p = <.001.

Of the 65 non-diabetic patients, 35 patients did not undergo surgical intervention in the operating room (54%), while 30 patients underwent surgical intervention (46%). Of the diabetic hospitalized patients, 12 patients (80%) underwent surgery, while 3 (20%) were followed only with therapy. A Chi2 test was performed. All expected cell frequencies were greater than 5, thus the assumptions for the Chi2 test were met. There was a statistically significant relationship, $\chi^2(1) = 5.12$, p = .024, Cramér's V = 0.25

Of the non diabetic patients 3 patients (4.6%) had complications: two underwent tracheotomy to preserve the airway, and one patient suffered mediastinitis. Of the diabetic group, 6 patients (40%) developed complications such as mediastinitis (2 patients) and airway obstruction (4 patients) that resulted in tracheotomy. There was a statistically significant difference between the two groups, $\chi^2(1) = 15.28$, p = <.001, Cramér's V = 0.44.

The nondiabetic patient had a hospitalization duration of 1-13 days, with an average of 4.25 days, while the diabetic group stay was of 5-34 days with an average of 11.47 days. A two-tailed t-test showed that the difference between two

Figure 1. Patient with necrotizing fasciitis before and after surgery (a,b); patient with Ludwig´s angina before and after surgery (c,d)

groups was statistically significant, t(15.18) = 3.67, p = .002, 95% confidence interval [3.03, 11.41].

The level of leukocytes (WBC) in the non diabetic patients was 14.39 ± 6.35 x 10^9/L, while of the diabetic patients was 13.27 ± 4.7 x 10^9/L . A two-tailed t-test for independent samples showed that the difference was not statistically significant, t(27.23) = -0.77, p = 0.447, 95% confidence interval [-4.08, 1.85].

The level of C Reactive Protein (CRP) in the non diabetic patients was 10.44 ± 9.88 mg/dl, while of the diabetic patients was 14.11 ± 13.52 mg/dl. A two-tailed t-test for independent samples showed that the difference between two gropus was not statistically significant, t(78) = 1.21, p = 0.231, 95% confidence interval [-2.39, 9.73] (Table 3).

Of the hospitalized diabetic patients, two patients had type 1 DM (13%), and 13 had type 2 DM (87%). Six of them were diagnosed with diabetes for the first time during their hospital stay (40%), while 9 of them had been previously diagnosed (60%). Known diabetics had been suffering from DM for 3-20 years, with an average of 11.4 years. Of the patients previously diagnosed with DM, 44.4% were on oral therapy, while 55.6% were on insulin therapy.

Another evidence of the study is that all diabetic patients present with dysregulated diabetes: with a blood glucose level higher than normal, ranging from 140-878 mg/dl (mean 382.8 ± 189.83 mg/dl) and with glycosylated hemoglobin above normal (93% of patients) ranging in values of 5.4-14%, with a mean of 9.75 ± 2.5% (Table 4).

Table 3. Classification of the charasteristics in the diabetic and non diabetic group

Characteristics	DM; N = 15 (%)	Non-DM; N = 65 (%)	*p*-Value
Gender	15 (100%)	65 (100%)	
Male	10 (66.6%)	42 (64%)	
Female	5 (33.4%)	23 (36%)	
Age, years ± SD (median; min, max)	56.2 ± 11.74 (61,36,70)	37.78 ± 19.26 (36,5,78)	**<0.001**
Chief complaint duration, days ± SD (median; min, max)	4.6 ± 1.84 (5,1,7)	8.26 ± 5.74 (7,1,30)	**0.001**
Multiple spaces involved, ≥3	9 (60%)	3 (4.6%)	**<0.001**
Surgery intervention	12 (80%)	31 (47.7%)	**0.024**
Complications	6 (40%)	3 (5%)	**<0.001**
WBC, /L ± SD (median, min, max)	13.27 ± 4.7 x 10^9 (12.6; 2.1; 22.2)	14.39 ± 6.35 x 10^9 (13; 4.4; 25.3)	0.447
CRP, mg/dL ± SD (median, min, max)	14.11 ± 13.52 (9.7; 1.48; 40.67)	10.44 ± 9.88 (7.73; 0.1; 40,7)	0.231
Hospitalization duration (median, min, max)	11.47 (10, 5, 34)	4.25 (3, 1, 13)	**0.002**
DM diagnosed for the first time	6 (40%)		
DM diagnosed before	9 (60%)		
Type 1 Diabetes	2 (13%)		
Type 2 Diabetes	13 (87%)		
On insuline control	5 (55.6%)		
On anti-diabetic drugs	4(44.4%)		

Table 4. Glycemia and glycosylated hemoglobin levels in diabetic patients

	Glycemia (mg/dl)	HbA1C (%)
Mean	382.8	9.75
Median	389	9.9
Mode	400	12.6
Std. Deviation	189.83	2.5
Minimum	140	5.4
Maximum	878	14
Mean ± Std.	382.8 ± 189.83	9.75 ± 2.5

DISCUSSION

In both groups, a male predominance is evident. In the diabetic group, a ratio of 2:1 is evident for males to females, while in the non-diabetic group a ratio of 1.8:1. Most studies, (9,10) although not all, demonstrate that males are affected more often than females with a ratio of approximately 1.6:1 (11,12).

In the diabetic group compared to the non-diabetic one, an older age of patients is evidenced (mean age 56.2, versus 37.8, $p<0.001$). In the diabetic group, most patients belong to the age group older than 60 years, while in the non-diabetic one, most patients belong to the age group younger than 40 years. This was similar to the study by Huang et al. at Taiwan of 185 patients (diabetic group: 57.2 years, non-diabetic group: 46.2 years, p-value: 0.0007) (3).

The diabetic patients had a shorter duration of symtoms before showing up in the hospital than the non diabetic one (4.6 ± 1.84 versus 8.26 ± 5.74 days: $p=0.001$). a wider involvement of the neck spaces (≥3 spaces (60% of patients in the diabetic group, versus 4.6% in the non-diabetic group, $p<0.001$), higher surgical intervention in the operating room (80% of patients versus 47.7%, $p=0.024$), higher number of complications (40% versus 5%, $p<0.001$) and higher hospital stay (11.27 versus 4.25 days, $p=0.002$). No significant relationship was found between PCR values between the diabetic and non diabetic patients (14.11 ± 13.52 versus 10.44 ± 9.88 mg/dl, $p=0.231$) and WBC (13.27 ± 4.7 versus 14.39 ± 6.35× 109/L, $p=0.447$). Similar results are found in a retrospective study conducted by Tung-Tsun Huang 1, Fen-Yu Tseng, Tien-Chen Liu, Chuan-Jen Hsu, Yuh-Shyang Chen comparing diabetic and non-diabetic patients at Taiwan University Hospital during the period 1997-2002 (3) and in another prospective cohort study at the Department of Otorhinolaryngology, Mysore Medical College and Research Institute, Mysuru, Karnataka, India from January 2022 to December 2022 (13).

An interesting evidence is that 6 (40%) of the diabetic patients with deep neck abscess were discovered for the first time that they had diabetes during their hospitalization. All diabetic patients present with dysregulated diabetes: with blood sugar level higher than normal (100% of patients), ranging from 140-878 mg/dl (mean 382.8 ± 189.83 mg/dl) and with glycosylated hemoglobin above normal (93% of patients) ranging from 5.4-14% (mean 9.75 ± 2.5%). There is good evidence that glycemic control is associated with infection. A study of 69,318 patients with type 2 DM in Denmark found an association between an increased risk of infection treated in the community and hospital in those with a higher HbA1c ≥10.5% compared with HbA1c 5.5-<6.4% (14). Similarly, in a large English cohort study there was an increased risk of infection in parallel with HbA1c level for patients with type 1 and type 2 (15). In a Taiwanese study looking at outcomes from a community-based health screening program, the authors found that glycemia >200 mg/dL and DM were associated with the highest risk of infection

and also a 3-fold higher risk of death than those without DM (15).

CONCLUSION

Diabetic patients, due to their compromised immune system, have several typical characteristics in the presentation of deep neck infections: older age, shorter chief complaint duration, tendency for unclear source of infection, tendency of infection to involve multiple spaces, more aggressive requirement for surgical intervention, higher rate of complications and prolonged hospitalization. Their clinical course is more severe and has a worse prognosis. Although conservative antibiotic therapy is appropriate in some cases, most diabetic patients need a more comprehensive and aggressive treatment that includes a multidisciplinary approach to avoid prolonged hospitalization, complications, and mortality.

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Conflict of Interest Statement: The authors declare that they have no conflict of interest.

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