

Deep Neck Space Infection: Clinical Outcomes of Patients Treated in a Tertiary Care Center

Derin Boyun Enfeksiyonları: Üçüncü Basamak Bir Hastanede Takip Edilen Hastaların Klinik Sonuçları

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ABSTRACT

Background: Deep neck space infection (DNSI) is a suppurative infection of the visceral cavities of the neck, which usually begins in the form of fasciitis and progresses to abscess formation. Immediate evaluation and management of deep neck space infections is imperative.

Materials and Methods: A total of 109 patients who were hospitalized and treated in our ear, nose and throat clinic with the diagnosis of DNSI were included in the study. No age or gender restrictions were made. Patient charts were analyzed retrospectively, and information about demographic characteristics of the patients, complaints at presentation and time of admission, location, antibiotics that were used in treatment, duration of hospitalization and complications were recorded.

Results: In our study, 60.6% of the patients were male and the mean age was 31 years (3.5 months-103 years). It was observed that the most frequent admissions to our clinic were in the months of April and January. The most common anatomical locations of infection and abscess were the submandibular region and level 2 in neck, respectively. The most common complaint at presentation was pain (92%), 47.7% of the patients (52) developed DNSI on the right side, and microorganism growth was reported in 52% of 48 patients whose culture results could be reached, and in 32% of these patients (8/25) *Staphylococcus spp.* and in 20% (5/25) *M. tuberculosis* growth was observed. The average age of the patients who required multiple antibiotics was found to be significantly higher.

Conclusion: Although *M. tuberculosis* is not frequently encountered as a causative microorganism in the literature, it was determined as the second most frequently encountered agent in our study and it is an important factor that should be considered. In addition, three important steps in the management of DNSI patients are; ensuring airway safety, appropriate antibiotherapy and surgical drainage. These crucial steps are very important in terms of protection from complications.

Keywords: Deep neck infection, neck abscess, tooth decay, *M. tuberculosis*

ÖZ

Amaç: Derin boyun enfeksiyonlarının (DBE) acil olarak değerlendirilmesi ve yönetimi zorunludur, çünkü tedavi edilmemesi durumunda yıkıcı sonuçlara neden olabilir. Kliniğimizde derin boyun enfeksiyonu nedeniyle tedavi edilen hastaların olası etiyolojik faktörlerinin, DBE boyun bölgelerinin, komorbid durumlarının, karşılaşılan komplikasyonlarının ve yapılan tetkik ve tedavilerinin kapsamlı bir şekilde incelenmesi amaçlandı.

Gereç ve Yöntemler: Çalışmaya derin boyun enfeksiyonu tanısı ile kulak burun boğaz servisimize yatışı yapılan ve tedavileri uygulanan 109 hasta dahil edildi. Yaş ve cinsiyet sınırlaması yapılmadı. Hasta dosyaları retrospektif olarak taranarak hastaların demografik özellikleri, başvuru şikayeti ve zamanı, sigara kullanım öyküsü, travma öyküsü, enfeksiyonun lokalizasyonu (seviye ve taraf), kullanılan antibiyotik özellikleri, hastanede yatış süresi ve gelişmişse komplikasyonlar ile ilgili bilgileri toplandı.

Bulgular: Çalışmamızda hastaların %60,6'sı erkek olup ortalama yaş 31 (3,5ay-103 yaş) olarak hesaplandı. Kliniğimize en sık başvuru yapılan ayların ise Nisan ve Ocak ayları olduğu gözlemlendi. Hastalarda enfeksiyonun ve apsenin en sık saptandığı anatomik



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lokalisasyonlar ise sırasıyla submandibuler bölge ve boyun seviye 2 idi. En sık başvuru şikayeti %92 ile ağrı olup hastaların %47,7'sinde (52) sağ tarafında derin boyun enfeksiyonu geliştiği ve kültür sonucuna erişilebilen 48 hastanın %52'sinde ise mikroorganizma üremesi raporlanmış olup bu hastaların %32'sinde (8/25) *Staphylococcus* %20'sinde (5/25) ise *M. tuberculosis* üremesi gözlemlendi. Çoklu antibiyotik kullanım gerekliliği olan hastaların yaş ortalamasının belirgin olarak yüksek olduğu saptandı.

Sonuç: Literatürde etken mikroorganizma olarak *M. tuberculosis* ile sık karşılaşılmasa da çalışmamızda en sık karşılaşılan ikinci etken olarak görülmüş olup dikkate alınması gereken önemli bir faktördür. Bunun yanında DBE hastalarının yönetiminde üç önemli adım; hava yolu güvenliği, uygun antibiyoterapi ve cerrahi drenajı sağlamaktır. Bu önemli adımlar komplikasyonlardan korunma açısından çok önemlidir.

Anahtar Kelimeler: Derin boyun enfeksiyonu, boyun apsesi, diş çürüğü, *M. tuberculosis*

Introduction

Deep neck space infection (DNSI) is a suppurative infection of the visceral cavities of the neck, which usually begins in the form of fasciitis and progresses to abscess formation (1). While the most common cause in adult patients is odontogenic origin, it often develops after tonsillopharyngitis in the pediatric age group (2,3). Less common causes are suppurative lymphadenitis, infection of congenital neck cysts and otologic infections (4).

There are 13 different compartments on the neck. If the primary infection originating in a region is not treated in time, the infection may spread to these compartments rapidly in accordance with the fascial plans (5). These infections, which initially start as cellulite and fasciitis, may progress to local organ damage with abscess formation and tissue necrosis in time (6). As a result, this complications such as airway obstruction, vascular pathologies (deep vein thrombosis), pleural or pericardial complications, empyema, mediastinitis, and vertebral osteomyelitis can be seen and these complications may result in serious morbidity or be fatal in patients due to sepsis or respiratory distress (7). Besides, death is often associated with mediastinal invasion or vascular complications in patients with DNSI (6,8). Therefore, a complete physical examination and appropriate treatment should be initiated promptly for the correct management of DNSI patients (2). Also, due to possible complications, comorbid conditions of patients may need to be handled in a multidisciplinary manner.

The aim of this study is to investigate the demographic characteristics of patients treated for DNSI in our clinic, to investigate the etiological causes of the disease and the anatomical spread regions, to evaluate the treatment applied and the approach to the complications encountered.

Material and Methods

Ethics committee approval for the study was obtained from the local ethics committee with the approval number of

2019/1994 and the study was conducted in accordance with the Helsinki Declaration-2008 principles. Informed consent was obtained from all patients included in the study.

This study was conducted from January 2013 to February 2020 in the otorhinolaryngology clinic of our tertiary hospital. One hundred nine patients who were hospitalized and treated with the diagnosis of DNSI were involved in the study.

No age or gender limitation was made for the patients that were included in the study. Patients who had a known malignancy in the head and neck region or who received treatment for this reason within the last 1 year, and outpatients were not included in the study. In addition, patients who were discharged due to treatment refusal were excluded from the study. All patients who met these criteria and were treated in our clinic with the diagnosis of DNSI were included in the study.

Patient data were scanned retrospectively, and information on demographic characteristics of the patients, complaints and time of admission, smoking history, trauma history, location of infection (level and side), antibiotic that were used in treatment, duration of hospitalization and complications (if developed) were collected.

In examination, patients with abscesses or those whose clinical findings were consistent with inflammation in deep tissue plans were visualized by ultrasonography (USG) and/or contrast-enhanced neck computed tomography. Also, superficial abscesses were aspirated with a needle in the clinic. Abscesses which were not superficial or could not be drained with a needle were drained under USG guidance with needle aspiration, and if the incoming material was purulent, it was sent to the microbiology laboratory for culture and antibiogram study.

All patients who were hospitalized and treated with the diagnosis of DNSI were treated with IV antibiotherapy. Empirical treatment was started with ampicillin-sulbactam at a dose of 150 mg/kg/day (maximum 4x1.5 gr), and according to the clinical response and antibiogram results of the patient, treatment was changed to multiple antibiotherapy or drug change was carried out.

Statistical Analysis

SPSS program was used for statistical analysis. Descriptive statistics were given as number and percentage for categorical variables, as mean and standard deviation for numerical variables with homogeneous distribution, and as median and minimum-maximum for numerical variables without homogeneous distribution. When numerical variables did not meet the normal distribution condition, comparisons of two independent groups were made using the Mann-Whitney U test. Statistical significance level was accepted as $p < 0.05$.

Results

In our study, there were 109 patients with DNSI, who were hospitalized and treated in our clinic, and the clinical characteristics of these patients were evaluated. The average age of the patient population was 31 years (3.5 months-103 years), 60.6% of the patients were male (M/F: 66/43) (Table 1).

It was observed that 47.7% (52) of the patients developed DNSI on the right side, 35.8% (39) on the left side and 16.5% (18) developed bilateral or midline deep neck infections (Table 1). In addition, in Table 1, patient characteristics such as the presence of dental caries, smoking history, trauma history, use of multiple

antibiotic treatments and whether surgical procedures were performed are also shown. The most common initial complaint of the patients was pain (92%), followed by fever and swelling in the neck (Table 2).

The most common anatomical locations for infection and abscess were the submandibular region and neck level 2, respectively (Table 3). 83% of the patients were punctured with a needle and a sample was sent for culture if there was an incoming purulent fluid. The results of 10 of the 58 patients whose samples were analyzed could not be reached through patient data forms and 23 (48%) of the 48 patients whose results were available did not have any from the samples taken. Microorganism growth was reported in 52% of 48 patients whose culture results could be reached, and *Staphylococcus* growth was observed in 32% (8/25) of these patients and *M. tuberculosis* was observed in 20% (5/25) (Table 4).

In 29 (26%) of 109 patients who received empiric treatment, multiantibiotic treatment was initiated according to clinical response and/or culture results. In addition to the empirical ampicillin-sulbactam treatment, Metronidazole (16/29) was more frequently added to the treatment, and different antibiotic preferences were made according to the culture-antibiogram results and clinical responses.

Table 1. Demographic and clinical characteristics of the patients

		n	Median	Minimum-maximum
Age		109	31	3.5 months-103 years
Hospital stay (days)		109	6	2-60
		n	%	
Gender	Male	66	60.6	
	Female	43	39.4	
Smoking	Yes	52	47.7	
	No	57	52.3	
Tooth decay	Yes	68	62.3	
	No	41	37.7	
Surgical intervention	Yes	22	20.2	
	No	87	79.8	
	Revision surgery	4	3.6	
Trauma history	Yes	5	4.6	
	No	104	95.4	
Use of antibiotics	Single	79	73.1	
	Multiple	29	26.9	
Tonsillectomy procedure	Yes	2	98.1	
	No	107	1.9	
Infection localization	Right	52	47.7	
	Left	39	35.8	
	Bilateral or median	18	16.5	

Four patients had to be followed up in the intensive care unit (ICU) due to their general conditions and respiratory symptoms. Tracheotomy was performed in 3 of these patients due to prolonged intubation caused by respiratory tract obstruction or general condition of the patient. In two patients, the infection advanced through the facial planes and mediastinitis developed. Surgical interventions for the neck and mediastinum were performed in both patients with the diagnosis of mediastinitis. While one patient completed his treatment and was discharged, the second patient, who was

tracheotomized, died due to the progression of mediastinitis and septic shock.

Multiple antibiotic treatment was required for all patients (4 patients) treated in the intensive care unit. In addition, when all patients were evaluated, patients who required multiple antibiotics were found to have a statistically significantly longer hospitalization period ($p < 0.001$) compared to other patients, and the mean age of the patients was higher ($p = 0.026$) compared to that of patients using single antibiotics. Although the use of multiple antibiotics was observed more frequently in patients with dental caries, it was not statistically significant ($p = 0.168$) (Table 5).

As abscess drainage under local anesthesia in clinic conditions was not thought to be sufficient, a total of 22 patients underwent abscess drainage under general anesthesia. Necrotic tissue debridement was also performed since 2 of these 22 patients also had skin necrosis. Also, surgical intervention was required for the second time after the first surgery in a total of 3 patients, one of whom underwent necrotic tissue debridement and two of whom underwent abscess drainage. Reconstruction of the open wound with free skin and drainage of regenerating abscesses were performed in these revision surgical interventions (Table 1).

When the time of admission to the hospital was evaluated monthly and seasonally, it was found that the patients were most frequently admitted to the hospital in the spring, then in the winter and autumn, respectively. It was observed that the months when admissions were mostly made were April and January (Figure 1).

Table 2. Symptom frequency

Symptom	%
Pain	92.66
Fever	74.31
Swelling	86.24
Dysphagia	40.37
Trismus	34.86

Table 3. Anatomical location where infection was detected

	N	%
Submandibular region	43	39.45
Neck level I-II	15	13.76
Buccal/premaxillary region	3	2.75
Neck level II	16	14.68
Neck level II-III-IV	9	8.26
Neck level IV	2	1.83
Neck level V	1	0.92
Retropharyngeal region	4	3.67
Parotids region	4	3.67
Parapharyngeal region	2	1.83
Undefined	10	9.17
Total	109	100.0

Table 4. Microorganisms detected in culture samples

Microorganism name	n
<i>Staf aureus</i> (3)	3
<i>Staf epidermidis</i> (3)	3
<i>MRSA</i> (2)	2
<i>M.tuberculosis</i> (5)	5
<i>Enterobacter</i> (2)	2
<i>Klebsiella</i> (2)	2
<i>Streptococcus viridans</i> (2)	2
<i>Streptococcus constellatus</i>	1
<i>pharyngis</i>	1
<i>Proteus mirabilis</i> (1)	1
<i>Streptococcus lugdunensis</i> (1)	1
<i>Finegoldia magna</i> (1)	1
<i>Prevotella denticola</i> (1)	1
<i>Candida albicans</i> (1)	-

Discussion

Dental problems, advanced age, comorbid diseases and smoking are important factors for the development of DNSI (2). In our study, 60.6% of our study consisted of men (M/F: 66/43), and the average age of the patient population was 31 years. The smoking rate of the patients in our study was

Table 5. Relationship of multiple antibiotic use with other clinical conditions

Demographic or clinical feature	p
Age of the patient	0.026*
Tooth decay	0.168
Hospital stay	0.001*
Gender	0.805
Smoking	0.943
Major surgical intervention	0.026*
Diabetes mellitus	0.490
*p<0.05	

47.7% and this rate was higher than the smoking rate (30.5%) in the Turkish population reported by Özer et al. (9) (Table 1). In addition, it is stated in the literature that the average length of stay in the hospital of the patients varies between 5 and 8 days (2,10). Also in our study, the average length of stay was 6 days.

In particular, factors that adversely affect the immune system, such as diabetes mellitus, human immunodeficiency virus (HIV), alcoholism, drug addiction and being elderly with comorbid diseases, cause higher risk for DNSI complications (11). Apart from the mentioned comorbid conditions, there are studies in the literature reporting that low socio-economic status and low educational status increase the susceptibility to the development of DNSI (12,13,14). In addition, infections caused by resistant microorganisms due to the widespread use of antibiotics also increase the risk in this population (6,15). Due to the widespread and timely use of antibiotics and the easy accessibility to broad-spectrum antibiotics, the incidence of deaths and complications due to DNSI has decreased (16). However, it is still possible to encounter with severe neck infections due to delayed diagnosis or the comorbid status of the patients (5). Although the incidence is not very high, diagnosis, treatment and management of DNSI are still an important issue.

Three important steps in the correct management of DNSI were defined as ensuring airway safety, antibiotherapy and surgical drainage (2,17).

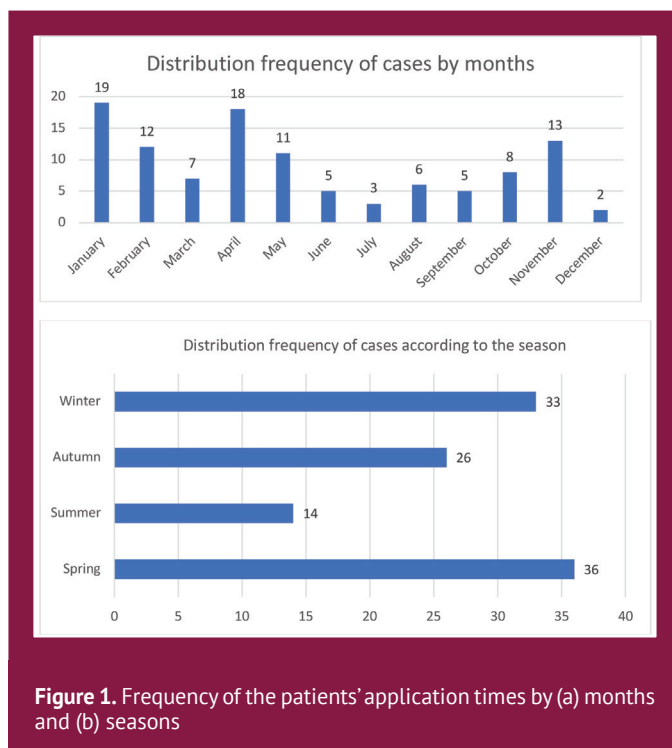


Figure 1. Frequency of the patients' application times by (a) months and (b) seasons

In the literature, it is recommended to use penicillin, gentamicin and combined antimicrobial therapies and, when necessary, metronidazole could be added to prevent anaerobic bacteria (2,4,15,17,18). In our clinic, metronidazole (16/29) was most frequently used additional treatment to ampicillin-Sulbactam treatment, and different antibiotics were added in the treatment according to the clinical response and culture-antibiogram results. However, it was determined that the hospitalization periods of the patients requiring multiple antibiotics were statistically longer ($p < 0.001$) and the mean age of the patients was higher ($p = 0.026$), and it was also found that no statistically significant difference was detected between dental caries and multiple antibiotic use ($p = 0.168$) (Table 5).

Moreover, abscess drainage was performed under general anesthesia in all patients who were found to have deep abscess that could not be drained under USG guidance. In addition, four patients whose general conditions and respiratory symptoms worsened despite medical treatment had to be followed up in ICU conditions. Tracheotomy was required for 3 of these patients.

In a retrospective analysis with 248 diabetic patients, they had longer hospital stay than non-diabetic patients (19). In our study, while no significant difference was detected between diabetic and non-diabetic patients in terms of length of stay and use of multiple antibiotics, a statistically significant difference was found in terms of the need for hospitalization in the ICU ($p = 0.048$) and the need for tracheotomy ($p = 0.052$).

Prabhu and Nirmalkumar (2) stated that according to the culture results of 1034 patients, *Streptococcus viridans* sp. (19.82%) and *S. aureus* (18.66%) were the most common pathogens. However, *M. tuberculosis* was not detected in their study. Also, Sittitrai et al. (20) found that, among 223 patients, *Streptococcus pneumoniae*, *Staphylococcus aureus* and *Streptococcus pyogenes* were the three most frequently isolated bacteria in 31 HIV patients, while *Streptococcus pyogenes*, *Streptococcus pneumoniae* and *Streptococcus viridans* were the most common pathogens in the non-HIV group (192), *M. tuberculosis* was not detected in this study, too. Besides, Martínez et al. (10) revealed that the most common isolated bacteria in 330 patients was *S. viridans* (32.1%), followed by *Streptococcus pyogenes* (22.6%). *Staphylococcus aureus* was found in 5.1% and *M. tuberculosis* was found in 0.7%. Agarwal et al. (16), Rana et al. (21) and Mungul and Maharaj (22) stated that *Staphylococcus aureus* was the most common pathogen detected in their studies. Also in our study, microorganism growth was reported in 52% of 48 patients whose culture results could be reached, and the most common microorganism was *Staphylococcus aureus* and it was detected in 32% (8/25) of the patients. However, unlike the literature, *M. tuberculosis* growth was observed in 20%

(5/25) of our patients (Table 4). However, it is an important limitation that 58 of the treated patients were taken for culture and only 25 of the patients had culture results.

DNSI often occurs in potential spaces of the neck such as the submandibular region, peritonsillar region, parapharyngeal or retropharyngeal space, and masticator space (6). Martínez et al. (10) reported that 65.2% of the patients had infection located in the peritonsillar region and 0.9% in the submandibular region. Buckley et al. (8) stated that infection was located in the parapharyngeal region at the rate of 60%. Moreover, Prabhu and Nirmalkumar (2) detected that, in 52% of the patients, infection was in the submandibular region, and Motahari et al. (18) revealed that infection was detected in the submandibular region in 45% of the 815 patients. Also in our study, the most common area of infection was the submandibular region with a rate of 39.45%.

Conclusion

Although *M. tuberculosis* is not frequently encountered as the causative microorganism in the literature, it was found to be the second most frequently encountered agent in our study and it is an important factor that should be considered. In addition, when the patient is admitted to the hospital, it is important to start treatment early against frequently encountered causative microorganisms and proper treatment plan management is very important in terms of protection from complications as delayed treatment of DNSI carries a serious risk of morbidity and mortality.

Ethics

Ethics Committee Approval: Ethics committee approval for the study was obtained from the local ethics committee with the approval number of 2019/1994 and the study was conducted in accordance with the Helsinki Declaration-2008 principles.

Informed Consent: Informed consent was obtained from all patients included in the study.

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Authorship Contributions

Surgical and Medical Practices: K.S.K., İ.Y., U.D., N.S., S.T., Concept: K.S.K., S.T., Design: K.S.K., İ.Y., Data Collection or Processing: İ.Y., U.D., N.S., Analysis or Interpretation: K.S.K., İ.Y., U.D., N.S., Literature Search: İ.Y., U.D., S.T., Writing: K.S.K., İ.Y., U.D., N.S., S.T.

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