

# Clinical and epidemiological profile of deep neck space infections: A retrospective study in Hamadan, Western Iran, during 2008-2013

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## Abstract

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**Background:** The diagnosis of deep neck space infection (DNSI) is difficult due to lack of common clinical symptoms and signs and covering of deep seated infections by regular tissues of neck. There is no evidence of clinical and epidemiological profile of deep neck space infections in western Iran. This study was designed to analyze demographic features, clinical presentations, and outcomes of DNSIs in order to promote diagnosis, management and treatment of the disease.

**Materials and Methods:** This retrospective study was carried out on 202 patients with the diagnosis of DNSI hospitalized in Hamadan hospitals, Iran, during 2008-2013. All parameters including demographic characteristics, geographical location, symptoms, site of infection, required interventions and treatments, and complications and outcomes were studied. Finally, the data were reported by descriptive statistics like mean  $\pm$  standard deviation (SD), median for quantitative parameters, and frequency tables and percentages for qualitative parameters.

**Results:** Among 202 patients, 58.9% (119 patients) were men. The mean age  $\pm$  SD was  $28.4 \pm 14.7$  years and ranged from 4 months to 82 years. Most admissions were in winter with 25.7% (52 patients), the majority of which came from urban background (60%). The most common site of infection was submandibular abscess (50%). Airway obstruction occurred in 11.8% of the patients as the most common complication. Two top antibiotics were metronidazole (80.8%) and penicillin G (79.8%). Surgical intervention was carried out in 82.7% of the cases. One patient died of Ludwig's angina.

**Conclusions:** The results of this study showed that although DNSIs have proven to be life-threatening diseases, proper diagnosis and management can effectively defeat them and provide cure without complications.

**Keywords:** Ludwig's Angina, Airway Obstruction, Antibiotics

## Introduction

Deep neck spaces are potential spaces of loose connective tissue filling the areas between the three layers of deep cervical fascia. Fascial planes divide the neck into true and potential spaces. Deep neck space infections (DNSIs) are suppurative infections that develop within deep neck spaces. Infections and inflammatory conditions of the upper aerodigestive tract are the primary cause of DNSIs. If left untreated and depending on the virulence of the causative pathogen, the infection might

eventually lead to an abscess and spread along cervical paths into to the mediastinum (1, 2).

The three layers of the deep cervical fascia encase the structures of the neck and form the deep neck spaces. The parotid, masticator, infratemporal, submandibular, parapharyngeal, buccal and peritonsillar spaces are exclusively suprahyoid in location. The anterior visceral

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space is exclusively infrahyoid in location. The prevertebral, retropharyngeal, danger and carotid spaces traverse the neck from the skull base down to the mediastinum (2, 3).

Prior to the advent of antibiotics, tonsillar and peritonsillar infections were the sources of infection in 70% of DNSIs (2). However, recently odontogenic infections have been one of the most common diseases in the oral and maxillofacial region, especially in developing countries (4). Other causes include intravenous drug abuse and foreign bodies (5). The predominant bacteria of odontogenic DNSI are viridans group streptococci (VGS), *Staphylococci*, *Prevotella*, *Peptostreptococcus*, and *Bacteroides* species (6).

Clinical manifestations of DNSI depend on the infected spaces and include pain, fever, swelling, dysphagia, trismus, dysphonia, otalgia and dyspnea. Common and potentially life-threatening complications include airway obstruction, jugular vein thrombosis, descending mediastinitis, sepsis, acute respiratory distress syndrome, disseminated intravascular coagulation, jugular venous thrombosis, septic pulmonary emboli, empyema, and septic arthritis (7, 8).

Although the incidence of severe DNSI requiring hospitalization and extraoral incision and drainage has decreased, the clinical challenge of their proper treatment remains the same. Even stable-appearing patients are at grave risk for sudden clinical decompensation. Also accurate diagnosis is difficult due to lack of common clinical symptoms and signs, as well as the covering of deep seated infections by neck tissues. Furthermore, there is no evidence of clinical and epidemiological profile of DNSI in western Iran which could have an important role in the clinical course.

This retrospective study was designed to review the clinical features of cases with DNSI in order to identify the presentations, etiologies and investigations to promote diagnosis, management and treatment of the disease particularly in this region.

## Material and Methods

This retrospective cross-sectional study was carried out on 202 patients diagnosed with DNSI hospitalized in Hamadan hospitals, Iran, from March 2008 to March 2013.

Geopolitically, Hamadan is one of the most important provinces in western Iran. Easy access to Hamadan is one of the reasons of patient referrals from not only other provinces within the country, but also from neighboring countries. To provide a better view of the disease we reviewed hospital files of the patients treated for DNSI in Besat Hospital. We used any special reports such as upper air way endoscopy, computed tomography (CT) or magnetic resonance imaging (MRI) of the neck and thorax if available, and surgical reports for establishing which of the neck spaces were involved with the infection. Superficial cellulitis or abscesses, limited intraoral abscesses, cervical necrotizing fasciitis, infections secondary to penetrating or surgical neck trauma, infections related to salivary glands and tumors were all excluded from this study. We also excluded uncompleted charts. All parameters including demography, geographical location, etiology, site of infection, required interventions, complications, and outcomes were identified from the patients' medical records. Outcomes were reviewed and analyzed.

The involved spaces were divided according to the paper of Hegde and included the following spaces: submandibular space, parapharyngeal space and peritonsillar space, Ludwig's angina, masticator space, retropharyngeal space, and parotid space (2).

Finally, for data analysis we used SPSS for Windows (version 16.0, SPSS Inc., Chicago, IL, USA) and descriptive statistics like mean  $\pm$  standard deviation (SD) and median were used for quantitative, and frequency tables and percentages for qualitative data analysis.

## Results

A total of 202 patients with DNSI were identified for this evaluation. Among 202

patients, 58.9% (n = 119) were men and 41.1% (n = 83) were women. The mean age  $\pm$  SD of the patients was  $28.4 \pm 14.7$  years and ranged from 4 months to 82 years. About 83.2% (n = 168) were younger than 40 years old, and 61.9% (n = 125) were younger than 30 years

old. According to demographic distribution, 60% (n = 121) of cases were settled in urban areas of Hamadan and 40% (n = 81) of total patients habited in rural areas of Hamadan (Table 1).

**Table 1:** Baseline characteristics of patients with deep neck space infections, Hamadan, Iran, 2008-2013

Variable	Category variable	N (%)
Sex	Men	119 (58.9)
	Women	83 (41.1)
Age (year)	0-10	24 (11.8)
	11-20	32 (15.8)
	21-30	69 (34.1)
	31-40	43 (21.2)
	41-50	19 (9.4)
	51-60	7 (3.4)
	61-70	5 (2.4)
	71-80	2 (1.0)
	81-90	1 (0.5)
Residency	Urban	121 (60.0)
	Rural	81 (40.0)
Season of administration	Spring	68 (33.6)
	Summer	38 (18.8)
	Fall	51 (25.2)
	Winter	52 (25.7)

Neck pain was the most common symptom, found in 64.9% (n = 131), followed by neck swelling in 51.5% (n = 104),odynophagia in 46% (n = 93), toothache in 44.1% (n = 89), dysphagia in 38.6% (n = 78), trismus in 36.6% (n = 74), fever in 24.8% (n = 50), airway difficulty in 24.3% (n = 49), otalgia and hot potato voice each one in 6.4% (n = 13), lymphadenopathy in 5.4% (n = 11), and torticollis in 1.5% of the patients (n = 3).

The cause of DNSI was identified in 192 patients (95% of all patients). Odontogenic infections were the most common cause (89 patients), tonsillopharyngitis was the second most common cause (49 patients) followed by upper airway infection (23 patients), complicated otitis media (13 patients), infected lymphadenopathy (11 patients), foreign body (3 patients), parotitis (2 patients) and thyroglossal cyst infection (2 patients).

According to the registered files and reported cases, the prevalence of involved spaces in descending order of frequency were

submandibular (50%), parapharyngeal (25.2%), peritonsillar (12.3%), Ludwig's angina (5.4%), masticator (4.4%), retropharyngeal (2%) and parotid space (0.5%). In 45 cases (22.3%), multiple space involvement was observed. The majority of patients (93%) underwent a CT scan, nine patients (4.5%) had a neck ultrasound, and no imaging was performed in the remaining five patients (2.5%). Complications were encountered in 28 patients. Twenty-four patients had upper airway obstruction and among them, 20 patients were managed by tracheostomy. Three patients had septic shock and among them was a 28-year-old woman that suffered from Ludwig's angina and died (fatality rate 33.3%). In this study one patient expired out of 202 patients (mortality rate 0.49%). Mediastinitis was noted in one Ludwig's angina case in which surgical drainage was performed. Patients with mediastinitis and septic shock showed poor prognosis of the infection.

**Table 2:** Clinical characteristics of patients with deep neck space infections, Hamadan, Iran, 2008-2013

Variable	Category variable	N (%)
<b>Symptom</b>	Neck pain	131 (64.9)
	Neck swelling	104 (51.5)
	Odynophagia	93 (46.0)
	Toothache	89 (44.1)
	Dysphagia	78 (38.6)
	Trismus	74 (36.6)
	Fever	50 (24.8)
	Airway difficulty	49 (24.3)
	Earache	13 (6.4)
	Hot potato	13 (6.4)
	Lymphadenopathy	11 (5.4)
	Torticollis	3 (1.5)
<b>Etiology</b>	Odontogenic	89 (44.1)
	Tonsillopharyngitis	49 (24.3)
	Upper airway infection	23 (11.4)
	Complicated otitis media	13 (6.4)
	Infected lymphadenopathy	11 (5.4)
	Foreign body (digestive tract)	3 (1.4)
	Parotitis	2 (1.0)
	Thyroglossal cyst	2 (1.0)
	Unknown	10 (4.9)
<b>Site of involvement</b>	Submandibular space	101 (50.0)
	Parapharyngeal space	51 (25.2)
	Peritonsillar space	25 (12.3)
	Ludwig's angina	11 (5.4)
	Masticator space	9 (4.4)
	Retropharyngeal space	4 (2.0)
	Parotid space	1 (0.5)
<b>Complications</b>	Airway obstruction	24 (11.8)
	Septic shock	3 (1.4)
	Mediastinitis	1 (0.5)
<b>Paraclinical assessment</b>	Computed tomography	188 (93.0)
	Ultrasound	9 (4.5)
<b>Treatment</b>	Surgery	167 (82.7)
	Antibiotic	35 (17.3)

All patients received empirical broad-spectrum intravenous antimicrobial therapies on admission in order to eradicate both aerobic and anaerobic microorganisms which were later updated based on culture and sensitivity report. Thirty-five patients (17.3%) were cured with antibiotic regimen and 167 patients (82.6%) underwent surgical drainage (Table 2).

The most frequent choices of antibiotics alone or in combination were metronidazole (80.8%), penicillin G (79.8%), clindamycin (12.8%), second- and third-generation

cephalosporins (11.3%), moxycillin/clavulanic acid (9.9%), gentamicin (4.9%) and vancomycin (3.9%).

### Discussion

Extensive use of antibiotics has reduced the incidence of DNSI. In spite of that, it is still a fairly common entity. The number of our cases was 202 and all these patients were admitted in the hospital for treatment. According to age distribution, most of the patients were in the third and fourth decades of their lives which correlates with the studies by Parhiscar (5) and

Meher (9) in which 50% and 60% of the patients, respectively were in the third and fourth decades of life and differed from one recent report from Huang (10) in which 52.4% of the patients were in fifth and eighth decades. This can be attributed to the increasing population of the young group in our country. Another factor may be the intravenous drug abuse or external blunt trauma in our series, which usually occurs in the young or middle aged persons (5).

The majority of the patients were men, which is consistent with studies by Meher (9) and Kataria (11) that showed predominance of men. This may result from women's delicate attention to their general health condition specifically their oral hygiene. In contrast with our study, in Yeganeh-Moghadam (12) and Bakir (13) study there was a slight predominance of women (60% and 53.8%, respectively).

DNSI may cause life-threatening complications, such as upper airway obstruction, descending mediastinitis, septic shock, jugular vein thrombosis, venous septic emboli, carotid artery rupture, adult respiratory distress syndrome, and disseminated intravascular coagulopathy (8, 14). In our cases, upper airway obstruction was the most common complication followed by septic shock and mediastinitis. In this study three patients had septic shock and one of them died, for a fatality rate of 33.3% which was obviously higher than what Boscolo-Rizzo had reported with fatality rate of 4.5% for septic shock (15). Overall mortality rate in our study was 0.49% which is acceptable and reflects rapid diagnosis, efficient medical treatment and appropriate surgical interventions.

Our study is consistent with those of Meher (9), Bakir (13) and Marioni (16) with pain as the most common symptom followed by neck swelling and odynophagia. In contrast with above studies, in our study dysphagia was ranked fifth after toothache. Differences in the expression and understanding of health definitions due to cultural diversities, difference in treatments received before

admission to hospital and the time passed to visit specialties could be other reasons of symptoms differences.

Odontogenic infection was the most common cause of DNSI in our study. In a study by Bottin 42% of DNSI cases were odontogenic in origin (17). In a retrospective study by Zamiri, odontogenic infection was declared as the most common cause of DNSI (34.3%) (18). Kataria also reported similar results to Zamiri with 34.21% of DNSI due to odontogenic origin (11). Huang (10), Marioni (16) and Eftekharian (19) reported that odontogenic problems were the most common causative factor for DNSI, in 43.7%, 38.8% and 49% cases, respectively. Therefore, our results are consistent with these studies. Unlike our study, Yeganeh-Moghadam reported tonsillar abscess as the main reason of DNSI (12). The second most common cause of DNSI in Parhiscar (5) and Zamiri (18) reports was intravenous drug abuse and trauma which differs from the tonsillopharyngitis and upper airway infection in our study.

The results showed 121 (60%) cases were settled in urban areas of Hamadan and 81 (40%) cases of total patients habited in rural areas of Hamadan. The same was observed in the study of Zamiri which reported 61.8% and 38.2% patients were from urban and rural areas, respectively. These results show a higher percentage of hospital admissions for the urban citizens despite fewer admissions of rural patients which is probably due to difficulties of access to care or transportation issues, and lower settlements in rural areas (18).

The most frequent site of DNSI in our study was submandibular space (50%), followed by parapharyngeal space (25%), peritonsillar (12.3%) and Ludwig's angina (5.4%). Infections of masticator space, retropharyngeal space and parotid space were approximately 7% of our study. Our results were consistent with Meher (9) and Rega (20) with submandibular space as the most common location of DNSI in 37% and 30% of the patients. Our results were not consistent with

following studies: Parhiscar study in which parapharyngeal space had the most involvement (43%), followed by submandibular space (27%) and Ludwig's angina (17%) (5), Kataria study that showed Ludwig's angina (28.9%) as the most common infected site, followed by peritonsillar abscess and submandibular abscess (10), Mumtaz study in which parapharyngeal space was seen in 20 patients (43.4%) and was at top of the list (21), and the study by Yeganeh-Moghadam that reported peritonsillar (28.7%) and submandibular (21.2%) as the most common sites of infection (12).

Neck pain was the most common symptom, found in 95% of the patients in Zamiri study (18) and 82.6% in Mumtaz study (21). The other signs and symptoms in order of prevalence were: pain, fever and chills, trismus, dysphagia and breathing difficulties in Zamiri study (18) and odynophagia and fever in 28 patients in Mumtaz study (21).

CT and MRI are excellent diagnostic tools for deep neck infections as was also represented in our study (8). Decision on treating the patient only with antibiotics or adopting a surgical intervention depends on the patient's sign and symptoms, appropriate response to medical treatments and CT scan findings. In our study the most frequent antibiotic choices, alone or in combination, were metronidazole (80.8%), penicillin G (79.8%), clindamycin (12.8%), second- and third-generation cephalosporins (11.3%), amoxicillin/clavulanic acid (9.9%), gentamicin (4.9%) and vancomycin (3.9%). Penicillin G (67.7%) was the most prescribed antibiotic in Zamiri study followed by metronidazole (65.2%) and clindamycin (37.7%) (18). Poeschl reported resistance in aerobes against clindamycin in 18%, against macrolides in 14%, and against penicillin G in 7%. In this study anaerobes were resistant to clindamycin in 11%, to metronidazole in 6%, and to penicillin G in 8% (6). It seems that antibiotic resistance is one of the reasons of failure of medical therapy and a new generation of antibiotic is required.

Clinically unstable patients (sepsis accompanied by collection, airway difficulty), patients with descending infection and confirmed abscess formation, those with multi-space abscess, and patients with abscess larger than 3.0 cm underwent immediate surgical drainage. Surgical drainage was also performed if the patient's symptoms and signs worsened or if there was no sign of improvement after two days. In our study, surgical intervention was carried out in 82.7% of patients, which is consistent with the studies by Kataria (11), Mumtaz (21), Eftekharian (19), Parhiscar (5) and Har-El (22) in which surgical intervention was required in approximately 89.5%, 78%, 79%, 100% and 90% of cases, respectively.

Consequently, in our society more attention needs to be paid to physical health and oral hygiene specially in middle and low socioeconomic groups of rural areas. Further investigations are necessary to clarify factors and variables related to deep seated and potentially fatal head and neck infections. An important limitation in this research was the study method and retrospective design which caused ignoring those cases that had not completed files in the hospital.

### Conclusions

Although today, the availability of advanced diagnostic methods and improved oral hygiene has dramatically modified the epidemiology of DNSIs and reduced them, DNSIs are still life-threatening diseases with serious complications. The results of this study showed that although DNSIs are still life-threatening diseases but proper diagnosis and management can effectively defeat the disease and provide a cure without complications. Further investigations are necessary to clarify factors and variables related to deep and potentially fatal head and neck infections.

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