



Research Paper

Deep neck space infection – A retrospective study of 270 cases at tertiary care center



Atishkumar B. Gujrathi*, Vijayalaxmi Ambulgekar,
Pallavi Kathait

Department of Ear, Nose and Throat, Dr. S. C. Government Medical College, Nanded, Maharashtra
431601, India

Received 19 April 2016; received in revised form 28 July 2016; accepted 1 November 2016
Available online 22 December 2016

KEYWORDS

Deep neck space
infection;
Incision and drainage;
Odontogenic
infections;
Tracheotomy

Abstract Objective: To review the clinical findings in deep neck infections and identification predisposing factors of these complications.

Methods: In this study, 270 patients with deep neck infections were studied retrospectively, study conducted in the Department of Ear, Nose and Throat, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, India, from March 2013 to March 2016.

Results: Analysis showed that males are most likely to have deep neck space infections (DNSI). Odontogenic and tonsillar causes were the more frequent ones. *Staphylococcus aureus* and *Streptococcus* species were the microorganisms more commonly isolated.

Conclusion: DNSI remains a common and challenging disease for otorhinolaryngologists, and should be treated on emergency basis. In developing countries, lack of adequate nutrition, poor oral hygiene, tobacco chewing, smoking and beetle nut chewing has led to an increased prevalence of dental and periodontal diseases. In present study, Odontogenic infections were the most common etiological factor for DNSI.

Copyright © 2016 Chinese Medical Association. Production and hosting by Elsevier B.V. on behalf of KeAi Communications Co., Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

* Corresponding author.

E-mail address: dr_atish2012@yahoo.co.in (A.B. Gujrathi).

Peer review under responsibility of Chinese Medical Association.



Production and Hosting by Elsevier on behalf of KeAi

<http://dx.doi.org/10.1016/j.wjorl.2016.11.003>

2095-8811/Copyright © 2016 Chinese Medical Association. Production and hosting by Elsevier B.V. on behalf of KeAi Communications Co., Ltd. This is an open access article under the CC BY-NC-ND license (<http://creativecommons.org/licenses/by-nc-nd/4.0/>).

Introduction

Infections of the deep spaces of the neck often present a true clinical challenge. Although antibiotics have reduced their incidence, deep neck space infections (DNSI) remain a relevant health problem. The complex anatomic organization of the neck makes diagnosis and precise localization of deep neck infections difficult. Clinical suspicion remains critical in that many deep neck infections are not evident on palpation or visual inspection.

The deep neck spaces that run the entire length of the neck include the retropharyngeal space, the danger space, the prevertebral space and the visceral vascular space. The spaces limited to above the hyoid include the submandibular space, the parapharyngeal space, the peritonsillar space, the masticator space, the temporal space and the parotid space. The only potential space limited to below the hyoid is the anterior visceral space. This area is enclosed by the middle layer of the deep cervical fascia and contains the thyroid gland, esophagus and trachea.^{1–4}

DNSI refers to an infection in the potential spaces and fascial planes of the neck, either with abscess formation or cellulitis.⁵ DNSI are bacterial infections originating from the upper aero-digestive tract and involving the deep neck spaces.⁶ The most common primary sources of DNSI are the dentition, tonsils, salivary glands and retained foreign bodies. DNSI often occur following preceding infections such as dental caries, tonsillitis, pharyngitis, trauma to the head and neck, or among intravenous drug abusers. Infections originating from teeth or their supporting structures, known as odontogenic infections, are among the most common diseases in the oral and maxillofacial region, especially in developing countries. Previously, before the advent of antibiotics, tonsillar and peritonsillar infections were the source of infection in 70% cases of DNSI⁷; but now the most common cause is considered to be dental in origin.⁸ DNSI are usually polymicrobial in nature. *Streptococci*, *Peptostreptococcus* species, *Staphylococcus aureus*, and anaerobes are the most commonly cultured organisms from DNSI.^{9,10} Clinical manifestations of DNSI depend on the spaces involved, and include pain, fever, malaise, fatigue, swelling, odynophagia, dysphagia, trismus, dysphonia, otalgia, and dyspnea.¹¹

Potentially life-threatening complications have been reported to occur at a rate of 10%–20%, even in recent literature on DNSI cases.^{12,13} Common and potentially life-threatening complications include airway obstruction, jugular vein thrombosis, descending mediastinitis, pericarditis, pleural empyema, cavernous sinus thrombosis, sepsis, respiratory distress, disseminated intra-vascular coagulation,⁴ pleuropulmonary suppuration, and hematogenous dissemination to distant organs.¹⁴ Treatment of DNSI includes antibiotic therapy, airway management and surgical intervention. Management of DNSI is traditionally based on prompt surgical drainage of the abscess followed by antibiotics or nonsurgical treatment using appropriate antibiotics in the case of cellulitis.¹⁵ Proper diagnosis and prompt management can effectively overcome the disease and provide a cure without complications. However, for this, otorhinolaryngologists must have detailed knowledge of the presentation, etiology, investigations and access to

appropriate medical and surgical interventions. The main aim of our study was to share our experience in terms of presentation, clinical trends, common sites involved, bacteriology, management, complications, and outcomes.

Material and methods

Trial design

This is a retrospective study conducted in the Department of Ear, Nose and Throat, Dr. Shankarrao Chavan Government Medical College, Nanded, Maharashtra, India. After taking approval from local ethical committee, study was conducted and patients from March 2013 to March 2016, last three years studied retrospectively.

Participants

The study population comprised of patients with DNSI reporting to the facility and satisfying the following inclusion criteria: symptomatology of DNSI and all age groups. Those patients with post traumatic infected wound and wound secondary to malignancy were excluded from the study.

A total of 270 cases of DNSI met our inclusion criteria. Patients of all age groups and both genders were included. All parameters including age, gender, co-morbidities, symptoms, site involved, bacteriology, culture growth, type of intervention required, complications, and outcome were studied. All patients were initiated on treatment with amoxicillin, clavulanate, and metronidazole; the treatment regimen was later modified based on a culture and sensitivity report. After routine hematological investigations like CBC, RBS, Serum Creatinine were done, in few cases specific investigations like montoux test or histopathological testing of granulations or fine needle aspiration cytology, ultrasonography and X-rays were done as a imaging studies were done wherever necessary. Patients were subjected to incision and drainage under local anesthesia except in infants and children below 6 yrs of age require sedation.

Results

In our study, male preponderance was seen which was about 57.04% (154/270) and females were 42.96% (116/270).

Patients from births to age 70 yrs and above were included in the study. Majority of patients were seen in third decade of life (21.85%) which is followed by fourth decade (18.15%). While we found that there were slight increase in occurrence was seen in seventh decade of life i.e. 16.30% (Table 1).

Most common presenting complaints were throbbing type of pain and is seen in 81.48% of patients, followed by neck swelling (77.78%), difficulty in swallowing (39.26%), ear ache and restricted mouth opening of about 31.11% and 30.37% respectively (Table 2).

Regarding etiology of DNSI, odontogenic infections in the form of carious teeth were the most common etiological

Table 1 Distribution of age in patients with DNSI ($n = 270$).

Age (yrs)	Number of patients	Percentage
0–10	41	15.19%
11–20	35	12.96%
21–30	59	21.85%
31–40	49	18.15%
41–50	7	2.59%
51–60	26	9.63%
61–70	44	16.30%
70 above	9	3.33%
Total	270	100%

DNSI: deep neck space infection.

Table 2 Symptomatology in patients with DNSI ($n = 270$).

Symptoms	Number of patients	Percentage
Pain	220	81.48%
Neck swelling	210	77.78%
Difficulty in swallowing	106	39.26%
Pain while swallowing	78	28.89%
Restricted neck movements	32	11.85%
Toothache	65	24.07%
Airway difficulty	5	1.85%
Ear ache	84	31.11%
Restricted mouth opening	82	30.37%

factor and found in about 24.07% of patients which is followed by Suppurative lymphadenopathy (21.49%), salivary gland infections and tonsillopharyngitis both of about 13.33%. Deep neck infections due to foreign body impaction is seen in only one case of retropharyngeal abscess, where a fish bone was impacted in posterior pharyngeal wall. 10.37% of patients were of tuberculous lymphadenopathy and all patients were presented with either matted lymphnode in neck or asymptomatic cold abscess (Table 3).

Table 3 Etiological factors in patients with DNSI ($n = 270$).

Etiology	Number of patients	Percentage
Odontogenic	65	24.07%
Tonsillopharyngitis	36	13.33%
Furunculosis	4	1.48%
Suppurative lymphadenopathy	58	21.49%
Tuberculous lymphadenopathy	28	10.37%
Salivary gland infections	36	13.33%
Infected cysts	16	5.93%
Complicated otitis media	20	7.41%
Foreign body	1	0.37%
Unknown	6	2.22%
Total	270	100%

Ludwig's angina is the most common presentations amongst all DNSI and is seen in 17.78% of patients. This is followed by submandibular abscess (13.33%) and peritonsillar abscess (12.59%). These three conditions were mostly due to odontogenic in origin. Cold abscess were seen in 9.26% of the patients and they were found in anterior and posterior triangles of the neck. Mastoid abscess were seen in about 7.41% of patients and were mostly subperiosteal at post aural region and were due to complications of attic-antral type of unsafe chronic suppurative otitis media (Table 4).

In our study, *Streptococcus pyogenes* and viridance were found to be major causative organism and was seen in 30.37% and 12.96% of patients accounting for 43.33% of patients followed by *S. aureus* (22.97%). Negative cultures were also seen in 10.74% of patients (Table 5).

Table 6 shows that majority of patients were smoker (39.63%), drinkers (24.81%) and tobacco chewer (24.44%). Amongst major associated illnesses diabetes mellitus was the most common and is found in 36.30% of patients and hypertension in 24.44% of patients. This is might be the cause for second height in occurrence in seventh decade of life.

Incision and drainage is the modality of treatment in DNSI and was done in 94.81% of patients along with treatment of etiological factors like tooth extraction (24.07%), mastoidectomy (7.41%), debridement were done in cases of necrotizing fasciitis and diabetic post intervention wounds (7.78%) and tracheostomy was needed in only two cases of DNSI (Table 7).

Conservative line of management in the form of broad spectrum antibiotics for a period of atleast one week, analgesics, anti inflammatory drugs and hydration were given in 5.19% of patients of suppurative lymphadenitis not forming abscess and cellulitis. In cold abscess and tuberculous lymphadenitis, antitubercular treatment (category I) was started for six month along with small incision and drainage or wide bore needle aspiration were done wherever required (Table 7).

Table 4 Locations of abscesses in patients with DNSI ($n = 270$).

Site of presentations	Number of patients	Percentage
Ludwig's angina	48	17.78%
Peritonsillar abscess	34	12.59%
Periapical abscess	15	5.56%
Submandibular abscess	36	13.33%
Parapharyngeal abscess	7	2.59%
Retropharyngeal abscess	5	1.85%
Parotid abscess	26	9.63%
Masticator space abscess	2	0.74%
Anterior triangle neck abscess	34	12.59%
Posterior triangle neck abscess	18	6.67%
Cold abscess	25	9.26%
Mastoid abscess	20	7.41%
Total	270	100%

Table 5 Bacteriology in patients with DNSI ($n = 270$).

Micro-organisms	Number of patients	Percentage
<i>Staphylococcus aureus</i>	62	22.97%
<i>Streptococcus pyogenes</i>	82	30.37%
<i>Streptococcus viridance</i>	35	12.96%
<i>Pseudomonas aeruginosa</i>	11	4.07%
<i>Bacteroides</i>	23	8.52%
<i>Klebsiella pneumonia</i>	4	1.48%
<i>Peptostreptococcus</i>	21	7.78%
<i>Escherichia coli</i>	3	1.11%
Negative cultures	29	10.74%
Total	270	100%

Table 6 Addictions and associated disorders in patients with DNSI ($n = 270$).

Addictions/Disorders	Number of patients	Percentage
Chronic smoker	107	39.63%
Chronic drinker	67	24.81%
Chronic tobacco chewer	89	32.96%
Hypertension	66	24.44%
Diabetes	98	36.30%
HIV	10	3.70%
Heart disease	12	4.44%
Pneumopathy	37	13.70%
Pregnancy	4	1.48%

Table 7 Treatment in patients with DNSI ($n = 270$).

Treatment	Number of patients	Percentage
Incision and drainage	148	54.81%
Incision, drainage and debridement	21	7.78%
Incision, drainage and mastoidectomy	20	7.41%
Incision, drainage and teeth extraction	65	24.07%
Incision, drainage and tracheostomy	2	0.74%
Conservative	14	5.19%
Total	270	100%

Discussion

The widespread use of antibiotics has decreased the incidence of DNSI, but it remains a fairly common problem. In our study, 270 DNSI patients were included and all were admitted to the hospital for treatment. The management and diagnosis of DNSI is still a challenge for otorhinolaryngologists. In our study, the majority of patients were seen in their third and

fourth decade of life. This correlates with the studies by Parischar and Harel⁸ and Meher et al¹⁶ in which 50% and 60% patients were in the third and fourth decade of life, respectively. In our study, a male predominance was seen i.e. 57.04%, which is consistent with studies by Sethi and Stanley,¹⁷ Meher et al¹⁶ and Parischar and Harel⁸ all of which showed male preponderance. Our study is consistent with those of Bakir et al,¹² Meher et al,¹⁶ Sethi and Stanley¹⁷ and Marioni et al¹⁸ with pain as the most common symptom followed by swelling, dysphagia/dynophagia, and trismus. In a study by Tschiasny¹⁹ 70% of cases of DNSI were odontogenic in origin. In a retrospective study by Parischar and Harel⁸ odontogenic infections were declared as the most common cause of DNSI (43%). Bottin et al²⁰ also reported similar results to Parischar and Harel⁸ with 42% of DNSI due to odontogenic origin. Huang et al,¹⁰ Marioni et al¹⁸ and Eftekharian et al²¹ reported that odontogenic problems were the most common causative factor for DNSI, in 42%, 38.8% and 49% cases, respectively. Studies by Sethi and Stanley¹⁷ and Har-El et al²² also showed the major cause of DNSI to be dental in origin. Thus, our study results i.e. 24.07%, are consistent with those of these previous studies. The most common presentation of DNSI in our study was Ludwig's angina (17.78%), followed by submandibular abscess (13.33%), peritonsillar abscess (12.59%), anterior neck abscess (12.59%), cold abscess (9.26%). Ludwig's angina, peritonsillar abscess, and anterior neck abscess accounted for approximately 42.96% of our cases, which is consistent with the study by Khode et al²³ with about 60% cases with a similar presentation. Peritonsillar abscess and submandibular abscess were the second and third most common presentation in our study, which correlates with study results from Parischar et al⁹ and Stalfor et al²⁴ with peritonsillar and submandibular as the second and third most common presentation. Further, in our study, diabetes was associated with 36.30% patients, which is same as compared with the study of Huang et al¹⁰ which reported 30.3% patients of diabetes mellitus. Eighty nine (32.96%) of our patients were tobacco chewers. This results in poor oral hygiene and is reported to affect the host's vulnerability to systemic diseases by the formation of subgingival biofilms acting as reservoirs of Gramnegative bacteria, and through the periodontium acting as a reservoir of inflammatory mediators.²⁵ *Streptococcus* species were the most common cultured organism in our study, which is consistent with the studies of Ridder et al,²⁶ Parischar and Harel,⁸ Mumtaz et al²⁷ and Gidley et al.²⁸ In 29 patients (10.74%), no organism was cultured, which was probably due to use of antibiotics at the time the cultures were sent. In our study, all patients were initiated on intravenous antibiotic therapy with amoxicillin, clavulanic acid, and metronidazole, which was later modified or change over to another antibiotic according to the culture and sensitivity report. In our study, surgical intervention was carried out in 94.81% of patients, which is consistent with the studies by Mumtaz et al,²⁷ Eftekharian et al,²¹ Parischar and Harel⁸ and Har-El et al²² with surgical intervention required in approximately 78%, 79%, 100% and 90% of cases, respectively. Airway management is challenging in patients with DNSI. Usual causes of airway compromise are laryngeal edema and pushing of the tongue upwards and backwards, especially in Ludwig's angina. In our study, tracheotomy was performed in 0.74% of cases, which is not matching with the study by Eftekharian et al,²¹ in which tracheotomy was required in 8.8% cases. This

might be due to the difference in selection of cases. A tracheal intubation with rigid laryngoscopy may be difficult in these patients due to the possibility of distortion in the airway anatomy, tissue rigidity, and a limited access to the mouth. Thus, the tracheotomy must always be considered whenever there is respiratory difficulty. Sometimes attempting intubations can worsen an already damaged airway.²⁹

The three keys to successful management of deep neck infections are protection and control of the airway, antibiotic therapy and surgical drainage. The age-old dictum that all abscesses must be surgically drained has recently been tested in studies looking at the medical management of neck abscesses and the use of image guided aspiration of abscesses. However, many still practices by Levitt's thinking that "antibiotics are not a substitute for surgery, they should be used in conjunction with proper surgical drainage".³⁰

The decision on which antibiotic therapy to empirically start for patients with DNSI should be directed by the fact that the most commonly isolated organisms are Streptococcal species and anaerobes. The majority of infections are polymicrobial so broad spectrum antibiotic coverage is desirable. Improved gram-negative coverage should be considered in debilitated patients or immunocompromised patients. Of course, antibiotic therapy should always be adjusted as directed by culture and sensitivity findings in those cases in which a specimen is obtained.²⁸ The duration of antibiotic coverage were decided on the basis of patients general condition and wound status like presence of slough, healthy granulation tissue or presence of induration.

DNSI remains a common and challenging disease for otorhinolaryngologists, and should be treated on emergency basis. In developing countries, lack of adequate nutrition, poor oral hygiene, tobacco chewing, smoking and beetle nut chewing has led to an increased prevalence of dental and periodontal diseases. In present study, Odonogenic infections were the most common etiological factor for DNSI. Therefore, prevention of DNSI can be achieved by making the population aware of dental and oral hygiene and encouraging regular checkups for dental infections. It is also very important to give special attention to high-risk groups such as diabetics, the elderly, and patients with underlying systemic diseases as the condition may progress to life-threatening complications. Early diagnosis and treatment is essential, thus, all patients should be initiated on treatment with empirical intravenous antibiotic therapy, which should be change over later according to the culture and sensitivity report. Tracheotomy should be considered if airway protection is needed and surgical drainage is the standard treatment of DNSI.

References

1. Levitt GW. Cervical fascia and deep neck infections. *Laryngoscope*. 1970;80:40935.
2. Panoessa DF, Goldstein JC. Anatomy and physiology of head and neck infections (with emphasis on the fascia of the head and neck). *Otolaryngol Clin N Am*. 1976;9:561–580.
3. Gidley PW, Stiernberg CM. Deep neck space infections. In: Johnson JT, Yu VL, eds. *Infectious Diseases and Antimicrobial Therapy of the Ears, Nose and Throat*. Philadelphia, WB: Saunders Company; 1997:500–509.
4. Vieira F, Allen SM, Stocks RSM, Thompson JW. Deep neck infections. *Otolaryngol Clin N Am*. 2008;12:459–483.
5. Wang LF, Kuo WR, Tsai SM, Huang KJ. Characterizations of life threatening deep cervical space infections: a review of one hundred ninety six cases. *Am J Otolaryngol*. 2003;24:111–117.
6. Durazzo M, Pinto F, Loures M, et al. Deep neck space infections. *Rev Ass Med Brasil*. 1997;43:119–126.
7. Weed H, Forest L. Deep neck infection. *J Otolaryngol Head Neck Surg*. 1998;3:2515–2524.
8. Parhiscar A, Harel G. Deep neck abscess: a retrospective review of 210 cases. *Ann Otol Rhinol Laryngol*. 2001;110:1051–1054.
9. Ungkanont K, Yellon RF, Weissman JL, Casselbrant ML, Gonzalez VH, Bluestone CD. Head and neck space infections in infant and children. *Otolaryngol Head Neck Surg*. 1995;112:375–382.
10. Huang TT, Liu TC, Chen PR, Tseng FY, Yeh TH, Chen YS. Deep neck infection: analysis of 185 cases. *J Otolaryngol Head Neck Surg*. 2004;26:854–860.
11. Hasegawa J, Hidaka H, Tateda M, et al. An analysis of clinical risk factors of deep neck infection. *Auris Nasus Larynx*. 2011;38:101–107.
12. Bakir S, Tanriverdi MH, Gun R, et al. Deep neck space infections: a retrospective review of 173 cases. *Am J Otolaryngol*. 2012;33:56–63.
13. Boscolo RP, Stellin M, Muzzi E, et al. Deep neck space infections: a study of 365 cases highlighting recommendations for management and treatment. *Eur Arch Otorhinolaryngol*. 2012;269:1241–1249.
14. Wills PI, Vernon RP. Complications of space infections of the head and neck. *Laryngoscope*. 1981;91:1129–1136.
15. Mayor GP, Millan JMS, Martinez VA. Is conservative treatment of deep neck space infections appropriate? *Head Neck*. 2001;23:126–133.
16. Meher R, Jain A, Sabharwal A, Gupta B, Singh I, Agarwal I. Deep neck abscess: a prospective study of 54 cases. *J Laryngol Otol*. 2005;119:299–302.
17. Sethi DS, Stanley RE. Deep neck abscesses: challenging trends. *J Laryngol Otol*. 1994;108:138–143.
18. Marioni G, Staffieri A, Parisi S, Marchese RR, Zuccon A. Rational diagnostic and therapeutic management of deep neck infections: analysis of 233 consecutive cases. *Ann Otol Rhinol Laryngol*. 2010;119:181–187.
19. Tschiasny K. Ludwig's angina: an anatomic study of the role of the lower molar teeth in its pathogenesis. *Arch Otolaryngol*. 1943;38:485–496.
20. Bottin R, Marioni G, Rinaldi R, Boninsegna M, Salvadoni L, Staffieri A. Deep neck infection: a present day complication. A retrospective review of 83 cases (1998–2001). *Ear Arch Otolaryngol*. 2003;260:576–579.
21. Eftekharian A, Roozbahany NA, Vaezeafshar R, Narimani N. Deep neck infections: a retrospective review of 112 cases. *Eur Arch Otorhinolaryngol*. 2009;266:273–277.
22. Har-El G, Aroesty JH, Shaha A, Lucente FE. Changing trends in deep neck abscess: a retrospective study of 110 patients. *Oral Surg Med*. 1994;77:446–450.
23. Khode SR, Bhat P, Rane S, Dasguota KS. Retrospective analysis of 298 cases of deep neck infections: its diagnosis and management. *Sci J Med Clin Trials*. 2013;103:1–3.
24. Stalfor J, Adielsson A, Ebenfelt A, Nethander G, Westin T. Deep neck space infections remain a surgical challenge: a study of 72 patients. *Acta Otolaryngologica*. 2004;124:1191–1196.
25. Anil S, Al-Ghamdi HS. The impact of periodontal infections on systemic diseases. An update for medical practitioners. *Saudi Med J*. 2006;27:767–776.
26. Ridder GJ, Technau IK, Sander A, Boedeker CC. Spectrum and management of deep neck space infections: 8 year experience of 234 cases. *J Otolaryngol Head Neck Surg*. 2005;133:709–714.

27. Mumtaz RM, Arain AA, Suhail A, Rajput SA, Mohammad A, Nabeel H. Deep neck space infections: retrospective review of 46 patients. *J Cranio Max Dis.* 2014;3:21–25.
28. Gidley PW, Ghorayed BY, Stiernberg CW. Contemporary management of deep neck space infections. *Otolaryngol Head Neck Surg.* 1997;116:16–22.
29. Osborn TM, Assael LA, Bell RB. Deep space neck infection: principles of surgical management. *Oral Maxillofacial Surg Clin N Am.* 2008;20:353–365.
30. Levitt GW. The surgical treatment of deep neck infections. *Laryngoscope.* 1971;81:403–411.

Edited by Jie Gao