ORIGINAL ARTICLE

Evaluation of Clinicopathological Profile of Deep Neck Space Infections in Western Part of Nepal; A Descriptive Study

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Article History

Received: 11th December, 2024
Acceptance: 4th June, 2025

Online Access

DOI: 10.70250/mjpahs202

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Abstract

Introduction: Deep neck space infections are the infections involving the deeper neck spaces compartmentalized by various layers of deep fascia of the neck. Patients with deep neck infections can easily land up in complication if prompt diagnosis and treatment is unavailable. This study aimed to assess the status of deep neck infections, the patient demography, their clinical presentations, bacteriology, mode of diagnosis, treatment and complications in a tertiary health centre of western region of Nepal.

Methods: This is a prospective study done in the department of ENT and head and neck surgery from July 2022 to June 2023 enrolling all the patients diagnosed with deep space neck infections. Data investigated age, sex, occupation and economic status, signs and symptoms, predisposing factors, spaces of neck involved, comorbidities, blood and radiological investigations, method of drainage of the abscess, pus culture and sensitivity, duration of hospital stay of the patients and complications if any.

Results: Out of total 53 patients, 34 were males and 19 females,age ranging from seven months to 64 years with the mean age of 32.38 years. The average duration of hospital stay was 6.8 days. Majority (39.62%) belonged to the lower middle-class status. Eighty-five percentof patients had history of prior use of medications before encountering the hospital. Submandibular space (32%) was the commonest space involved while peritonsillar space (30%) was the second. Sixteen patients had comorbidities including anemia, diabetes mellitus, HIV positive status, congenital fistula and malignancy. Thirty five patients underwent surgical incision and drainage for frank abscesses, four underwent needle aspiration, two underwent USG-guided needle aspiration and rest of them were medically managed. The microorganisms were isolated in only five cases with E.Coli, Citrobacter freundii, Kleibsella pneumoniae, Streptococcus pyogenes as isolates. Three cases suffered from complications such as upper airway obstruction, pharyngocutaneous fistula and death.

Conclusion: Increased self-administration of antibiotics have led to increase in absence of growth of microorganisms in culture media and increase in bacterial resistance of the common antibiotics. Deep neck infections if treated early can avoid undesirable complications.

Keywords: Deep neck space, infection, microorganisms

Introduction

Deep spaces in the neck are the potential spaces compartmentalized by various layers of deep fascia enclosing the muscles, nerves, vessels and other various important structures. They are broadly divided into three categories i.e spaces above the hyoid bone (include submental space, submandibular space, buccal space, parapharyngeal space, peritonsillar space, masticator space), spaces below the level

How to Cite this Article in Vancouver Style:

Shakya A, Acharya U, Bhandari AK, Sharma S, Gaudel B, Poudel R, Gurung B. Evaluation of Clinicopathological Profile of Deep Neck Space Infections in Western Part of Nepal, A Descriptive Study. Med. J. Pokhara A. Health Sci. 2025;8(1):12-17.

of the hyoid bone (include pretracheal, prelaryngeal or visceral space) and spaces of the entire neck (include retropharyngeal space, danger space, prevertebral space).These spaces easily communicate with each other when infections prevail thereby leading to faster spread and swift deterioration of the health condition of the patient.[1]

Previously tonsillar and pharyngeal infections were considered to be the most common cause of infections in the deep neck spaces.[2] However, with the introduction of various antibiotics, literatures suggest odontogenic infections to be the most common etiological factor making up to 70% of the cases.[3] Symptoms may vary from subtle sore throat to profound features like odynophagia, trismus, respiratory distress.[4,5] Delay in diagnosis and management of such infections may lead to certain fatal complications such as airway obstruction, mediastinitis, carotid blow out, jugular vein thrombosis, cavernous sinus thrombosis. Complications are imminent in patients with immunocompromised status, for example, diabetes mellitus, HIV infection, and anemia.[1] Globally the mortality rate of patients with deep neck space infections (DNSI) vary from 1 to 25%.[6] Limited studies from Nepal show no to negligible mortality in cases of DNSI.[7,8] Deep neck space infections (DNSI) are managed medically by broad spectrum antibiotics in cases of cellulitis and surgically by aspiration and or drainage of the abscess and broad spectrum antibiotics in cases of frank abscess.[9] Early diagnosis and treatment helps in curbing the spread of the disease and preventing fatal complications.

There are limited studies assessing the trends, microbiology and treatment outcomes of DNSI in our region. This study describes the medical and surgical experience of our institution in management of DNSI. The study aimed to assess the status of deep neck infections, the patient demography, their clinical presentations, bacteriology, mode of diagnosis, treatment and complications in a tertiary health centre of western region of Nepal.

Methods

A prospective and descriptive study of patients diagnosed with deep neck space infections admitted in the department of ENT and head and neck surgery was done from July 2022 to June 2023 after receiving ethical approval (Ref no.91/079). Total population sampling method was used i.e. all the patients admitted in the ENT ward during the study period of one year were taken as samples. Patients who received prior surgical treatment for deep neck space infections in other health centres were excluded. The age, sex, occupation and economic status, signs and symptoms, predisposing factors, spaces of neck involved, any comorbidities were noted. Following clinical assessment, blood investigations and radiological investigations (if required) were sent to consolidate the diagnosis and further aid in the management of the cases. Ultrasonography (USG) of the neck was sent in cases with localized infections whereas CT scan (Computerised Tomography) of neck was sent if the infection spread to multiple neck spaces. Clear cases of peritonsillar abscess were not sent any further radiological investigations. Empirically broad spectrum antibiotics were used, mainly ceftriaxone and metronidazole, in most of the cases. Aminoglycosides were added if the infection was widespread involving numerous deep spaces of neck. Patients diagnosed with salivary gland sialadenitis were given clindamycin as antimicrobials.[3,10] The antibiotics were then changed according to the report of pus culture and sensitivity obtained. Incision and drainage of abscesses were done either under general anesthesia or local anesthesia. USG guided aspiration of the pus were also done in some cases. Patients without evidence of abscess formation were treated medically. The pus after drainage was sent for culture and sensitivity. For pain management,non steroidal anti-inflammatory drugs were used, including acetaminophen or acetaminophen and ibuprofen in combination as first line medications. Injection Ketorolac was used as second line medication.None of the patients required opioid analgesics for pain management. Patients were discharged on oral medications after improvement in the symptoms and after no evidence of pus collection in the involved neck spaces. Note of complications if any and duration of hospital stay were also made.

Data were entered and descriptive analysis was done in MS-EXCEL (version 2013).

Results

During the study of one year, total of 53 samples were collected. There were 34 males and 19 females with age ranging from seven months to 64 years with the mean age of 32.38 years (SD±21.52) (Table 1). According to the modified Kupuswamy'ssocioeconomic status scale11, majority (39.62%) belonged to the lower middle class status.

Table 1: Socio-demographic characteristics of patients with deep space neck infections

Background characteristics	No. of patients (n=53)
Age	
0-10	11(20.75%)
11-20	6(11.32%)
21-30	10(18.86%)
31-40	7(13.02%)
41-50	5(9.43%)
51-60	6(11.32%)
61-70	7(13.2%)
71-80	1(1.8%)
Sex	
Male	34(64.15%)
Female	17(35.85%)
Socioeconomic status[11]	
Upper middle class	20(37.74%)
Lower middle class	21(39.62%)
Upper lower class	12(22.67%)
Antibiotics taken prior to hospital admission	
Yes	45(85%)
No	8(15%)

1. Etiology and symptomatology: Fourteen of the cases had tonsilopharyngeal infections as the cause for DNSI whereas other 14 of them had dental caries. Twelve patients had suppuration of cervical lymphnodes (excluding tubercular origin). Four patients had salivary gland infection, one patient each had an infected thyroglossal duct cyst, a fourth branchial cleft anomaly and a suppuration of necrotic malignant mass of parotid gland with local extension to the ipsilateral cheek area. Two cases had suppuration of cervical lymph node due to tubercular lymphadenitis. In rest of the cases, cause of infection could not be identified.

Patients with DNSI commonly presented with painful swelling in the neck, odynophagia, dysphagia andtrismus. One of the infant presented with fever and stridor.

2. Prior use of antibiotics: Out of 53 patients, 45 (85%) of them had history of prior use of antibiotics before encountering the hospital, most of which were undocumented.

3. Spaces of neck involved: Submandibular space was the commonest space involved in patients suffering from DNSI. Peritonsillar space was second to submandibular space (Table 2.)

Table 2: Involved spaces of neck in patients with deep space neck infection

Spaces of neck involved	No. of patients
Submandibular space	17(32%)
Peritonsillar space	16(30%)
Sublingual space	6(11%)
Parotid space	5(9.4%)
Parapharyngeal space	4(7.5%)
Masticator space	3(5.7%)
Carotid space	4(7.5%)
Visceral space	3(5.7%)
Submental space	2(3.7%)
Anterior cervical space	2(3.7%)
Retropharyngeal space	2(3.7%)
Buccal space	1(1.8%)

4. Comorbidities: Out of total 53 patients, 16 of them had comorbidities, anemia being the commonest. Three of them had more than one comorbidity (Table 3.).

Table 3: Comorbidities and types of intervention in patients with deep space neck infection

	No. of patients
Comorbidities	
Anemia	8
Diabetes Mellitus	6
Malignancy	1
HIV positive status	1
Hyperthyroidism	1
Chronic Obstructive Lung disease	1
Intervention	
Incision and drainage	35
Medical management	12
Needle aspiration	4
USG guided needle aspiration	2

5. Diagnosis and Intervention: The average collection of pus following radiographic evaluation was 23.62ml. This excludes the cases of peritonsillar abscesses where radiographic evaluation was not done.

Majority of the patients (35) underwent surgical incision and drainage for frank abscesses. One patient of Ludwig's Angina underwent surgical incision and drainage twice due to recollection of pus. Needle aspiration were done in four cases of deep neck abscess. USG guided aspiration was done in two cases.One was the case of parotid abscess with five millilitres of collection and the other was a case of abscess (27ml collection) in space of superficial layer of deep fascia with multiple comorbidities that underwent serial USG guided needle aspiration of abscess twice.Tracheostomy was performed in one of the case following incision and drainage to control airway. Non-surgical medical management was done in cases of DNSI without any evidence of abscess formation and in some cases with up to three millilitres of pus collection (Table 3).

All cases with diabetes mellitus had their abscess evacuated surgically, except for one that underwent serial USG guided aspiration of pus. All except two cases of DSNI with anemia underwent pus evacuation. The two cases of anemia were treated medically. A case with chronic obstructive pulmonary disease underwent aspiration for peritonsillar abscess.

6. Pus culture and sensitivity: Pus for culture and sensitivity were sent in almost all cases of frank abscess. However, the organisms were isolated in only five cases. The organisms isolated and antibiotic sensitivity of the most common organism isolated has been shown in the table 4 and 5.

Table 4: Microorganisms in pus culture

Microorganism	No. of patients (n=37)
E.Coli	2
Citrobacter freuindii	1
Kliebsella pnuemoniae	1
Streptococcus Pyogenes	1
No growth	32

Table 5: Drug sensitivity pattern of E.Coli

Drug	Sensitive	Resistant
Amikacin	1	0
Cefixime	1	0
Cotrimoxazole	2	0
Ciprofloxacin	1	1
Levofloxacin	1	0
Clindamycin	2	0
Gentamicin	2	0
Meropenam	1	0
Tegacycline	1	0
Imipenam	1	0
Piperacillin	1	0
Tazobactum	1	0
Ceftazidime	0	1
Clavulanic acid	0	1
Ceftriaxone	0	1

7. Complications: One of the patient with deep neck infection had pharyngocutaneous fistula, one of them developed stridor due to upper airway obstruction. One of the patient died during the course of the treatment as the patient also suffered from squamous cell carcinoma of the cheek in addition to the deep neck infection.

8. Duration of hospital stay: The average duration of hospital stay was 6.8 days. The longest length of stay was 21 days with the shortest being 3 days.

Discussion

All ages of patients could be affected by deep space neck infections, however, in our study majority of the patients belonged to the age group of zero to ten years (20.78%).Several other studies done by Martinez et al[10] and Maharjan et al[12] show majority of the patients belonging under adult age group. The preponderance of paediatric age group in our study could be because of limited time period of our study. The pediatric population accounted for 24.5% of total cases. Majority of the patients (39%) were of Lower Middle Class status (according to the modified Kupuswamy socioeconomic status in context

of Nepal[11]). A study done in India by Agarwal et al[13] showed majority of DNSI patients belonging to lower socioeconomic class. Several other studies also state the positive association of lower socioeconomic status with prevalence of DNSIs.[14]There was male preponderance in our study similar to studies done by Gujrathi et al[15], Das et al[16] and Martinez et al[10].

Most common cause behind DNSI in our study was tonsilopharyngeal infections and dental caries contributing equally, suppuration of cervical lymphnodes was the next common cause. The etiology was unknown in four of the patients. Amongst the four patients where the cause could not be identified, two of them were known cases of diabetes mellitus and henceforth minor trauma to the oral cavity/ oropharynx might have led to dissemination of infection to deep neck spaces. Kamath et al reported that majority of deep neck infections to be of odontogenic origin with tonsilopharyngeal infections being the second and 36% of cases the cause being unknown.[17] Gujrathi et al showed odontogenic origin (25%) to be the most common etiology followed by suppurative lymphadenitis (21%).[15] Several other studies show the leading cause of DNSI to be odontogenic infection followed by tonsilopharyngeal infection.[7,13,16] In our study, both odontogenic cause and tonsilopharyngeal infections had equal and major contribution as the cause for DNSI. One of the reason for this could be the prevalence of more number of pediatric patients than the adult ones in our study where the tonsilopharyngeal infections are very common. Boscolo-Rizzo et al in their study showed the upper respiratory tract infection to be the commonest etiological factor for DNSI.[18] Painful neck swelling and odynophagia were the most common clinical features of the patients with DNSI that were similar to studies done by Das et al[16] and Kharel et al[8].

The cases ranged from involvement of single deep neck space to multiple neck spaces (Figure 1). Submandibular space (32%) was the commonest space to be involved in the present study followed by peritonsillar space. Study done by Das et al[16], Jayagandhi et al[1] and Pokharel et al[7] showed similar findings. However, Almutairi et al showed peritonsillar space to be the commonest space involved in their study of 183 patients in Saudi Arabia.[4]Fifteen percent of cases in the present study had more than one space of neck involved.

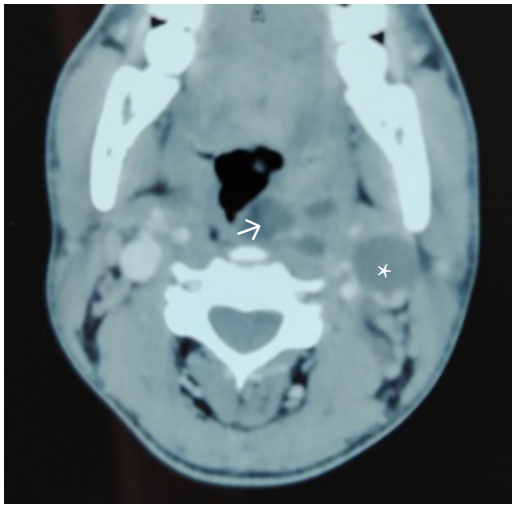

Fig 1: CT scan images showing abscess in A. Retropharyngeal (white arrow) and parapharyngeal space (denoted by star symbol).

Anemia was the most commonly associated disorder in our study followed by diabetes mellitus. In addition, HIV positive status, hyperthyroidism and chronic obstructive pulmonary disease were other added comorbidities. One of the patient with DNSI also suffered from concurrent squamous cell carcinoma of cheek. Other studies done by Pokharel et al[7], Das et al[16], Almutairi et al[4] show diabetes mellitus as the commonly associated comorbidity that support the finding of our study.

Antibiotics and drainage of the abscess is the main stay of treatment of patient presenting with DNSI. In our study, incision and drainage of the abscess was done in cases with frank abscesses. Ultrasonography guided aspiration of abscess was done in two cases. One was the case of parotid abscess with five millilitres of collection of pus. The other was the case of abscess in space of superficial layer of deep fascia with multiple comorbidities and about 27 ml of collection where USG guided aspiration was done two times. This case was fully cured of abscess following 15 days of hospital stay. Fan and Tao compared ultrasound guided puncture drainage and incision and drainage in deep neck abscess stating reduced duration of hospital in patients undergoing USG guided puncture drainage.[19] Aspiration of pus was done in four cases of deep neck abscess. Those were a case of peritonsillar abscess, a case of submental abscess, a case of cold abscess in lateral neck and a case of anterior neck abscess in thyroglossal duct cyst. There were no recurrence in any of the cases treated with either procedures. However, there have been no high quality evidence to determine whether needle aspiration is better than incision and drainage for treatment of deep neck abscess.[20] Medical management with antibiotics without surgical intervention was done in cases with no evidence of abscess formation to up to 3ml of collection. When considering comorbidities, all cases with diabetes mellitus had their abscess evacuated surgically, except for one that underwent serial USG guided aspiration of pus. All except two cases of DSNI with anemia underwent pus evacuation. The two cases of anemia without any evidence of abscess formation were treated medically. A case with chronic obstructive pulmonary disease underwent aspiration for peritonsillar abscess.

Pus for culture and sensitivity was sent after needle aspiration or incision and drainage of abscess, out of which only 15.62% resulted in positive culture. The low rate of positive culture in the present study could be because of high rate of self-administration of antibiotics prior to hospital visit (85%). Higher rates of self-administration of antibiotics in cases of DNSI has also been found in the study done in Nepalese population by Kharel et al which was about 51%.[8] A systematic review by Nepal et al highlights the high prevalence of self-administration of antibiotics in South-East Asian region with the prevalence in Nepal ranging from 25 to 50%.[21] As DNSIs are caused by mixed organisms, absence of provision for culture of anaerobic organism in our facility could also have been one of the reason for absence of bacterial growth.Out of total five isolates, E. coli was the commonest bacteria isolated in pus culture. The organism was found to be resistant to common antibiotics such as ciprofloxacin, ceftriaxone and clavulanic acid. Easy availability of antibiotics as the over the counter drugs and increased tendency of self-administration of antibiotics could be some of the reasons for increasing bacterial resistance to these common antimicrobials. Sethi and Stanley emphasized the changing bacterial pattern in the DNSI dominated by gram negative organisms.[22] In our case, although the rate of positive

bacterial culture were low, four out of five isolates were gram negative (E. coli, Citrobacter freuindii, Kleibsella pnuemoniae).

Deep neck infections can lead to serious life threatening complications, rate of which ranges from 9 - 20%.[23,24]In the present study, one case of DNSI suffered from death due to concurrent squamous cell carcinoma extending from parotid gland to the ipsilateral cheek. The case was not diagnosed for malignancy prior to the presentation to our hospital. One case of retropharyngeal abscess in an infant without known comorbidities landed up in stridor. Tracheostomy was performed on the same case to secure the airway. A case of multiple deep neck space abscess without any comorbidities suffered from pharyngocutaneous fistula which healed following conservative management for the fistula. The complication rate was around 5% probably because of less number of patients in the study.

Even though the average length of hospital stay was around 7 days, hospital stay above 1 week were mostly of the patients with multiple neck space infections. Out of total 16 patients with comorbidities, only three of them had duration of hospital stay of more than a week. One of the three had multiple comorbidities of diabetes mellitus, anemia and HIV positive status. Multiple comorbidities, elderly patients, multiple space infections are proven factors for increased duration of hospital stay in patients with DNSI.[14]

Conclusion

Deep neck space infections remain a significant health concern in Nepal with patterns similar to global trend. Odontogenic cause as well as tonsilopharyngeal infections were the commonest cause of deep neck infections. Majority of the patients of DNSI were from low middle class group. Increased self administration of antibiotics have led to increase in bacterial resistance of the common antibiotics. Deep neck infections if treated early can avoid undesirable consequences. Identification of predisposing factors and pathogens provide valuable insights for clinicians to develop targeted treatment strategies.

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