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Original Research Article

A clinicopathological study and management of infective swellings of the neck

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ABSTRACT

Background: Cervical-mediastinal suppurations are severe infections originating in the ENT region, affecting the neck's fascial spaces with abscess or inflammation (cellulitis). The neck's complex anatomy, with its cervical aponeuroses delineating visceral and adipose tissue compartment plays a key role in the spread and management of the infection. The development of cervical suppuration involves oropharyngeal commensal microorganisms. Hence present study was done to study the infective swellings of the neck and provide secondary prevention of the disease.
Methods: A prospective clinical study among 50 patients with diagnosed infective neck swelling attending department of ENT during study period of 18 satisfying inclusion and exclusion criteria. Patients were managed either conservatively or surgically. Statistical analysis was made. Insidious onset was more common.
Results: Odontogenic causes were most common. Neck swelling was universal, followed by local pain. Reactive lymphadenopathy was most common diagnosis. Among DNIs, suppurative lymphadenopathy was most common, followed by Ludwig's. Submandibular space was the most common site. Incision and drainage/aspiration was the prevalent method of management.
Conclusions: The study provides valuable insights into the clinicopathological profile and management of infective neck swellings, highlighting the predominance of odontogenic aetiology, the significant role of rural residency and delayed presentation and the need for surgical intervention in most cases. The high prevalence of risk factors such as smoking, alcohol use, and DM underscores the importance of risk factor modification, while the frequent need for dental extraction and tracheostomy emphasizes the need for early airway assessment and dental care.

Key words: Neck swelling, Lymphadenopathy, Tracheostomy, Incision and drainage, Neck spaces

INTRODUCTION

Cervical-mediastinal suppurations are severe infections originating in the otolaryngology (ENT: Ear, nose and throat) region, affecting the neck's fascial spaces with abscesses or inflammation (cellulitis).[1] The neck's complex anatomy, with its cervical aponeuroses delineating visceral and adipose tissue compartments, plays a key role in managing and spreading the infection.[2] The development of cervical suppuration involves oropharyngeal commensal microorganisms, which become pathogenic and invasive when a bacterial or viral infection disrupts the body's balance.[3] Serious but curable diseases that impact the deep cervical regions are known as "deep neck infections." These infections are a serious health risk with high morbidity and possible mortality because they can spread quickly and cause potentially fatal consequences.[4]

Local expansions of infections in the tonsils, parotid glands, cervical lymph nodes and odontogenic structures are frequently the cause of deep neck infections.[5] Neck

swelling, dysphagia, dysphonia and trismus are among the symptoms that frequently arise from local pressure effects on the respiratory, neurological, or gastrointestinal tracts.[6] Knowledge of the cervical compartments and interfacial spaces is necessary to comprehend the pathogenesis of these illnesses.[7] The spread and intensity of infections can also be influenced by host variables, including immunocompromised states, concomitant illnesses, trauma, recent instrumentation and intravenous drug use.[8]

The degree of infection and the deep neck space (parapharyngeal, retropharyngeal, prevertebral, submental and masticator) that is affected determine the clinical presentation, high frequently includes fever, neck pain and respiratory difficulty.[9] Because of their deep location, abscesses can be difficult to diagnose, hence imaging methods like computed tomography (CT) with contrast are crucial for precise diagnosis.[10] The infection may stay localized for a long time before developing into an abscess or spreading to a diffuse and extensive infection, occasionally necrotic in the form of necrotic extensive cervical cellulitis or adenophlegmon, depending on the virulence of the pathogens, the patient's comorbidities (immune-compromised, cancer, diabetes mellitus (DM) and elderly) and use of nonsteroidal anti-inflammatory drugs (NSAIDs) or corticosteroids.[11] Effective antibiotic therapy and prompt surgery are essential for the prompt and suitable treatment of deep pharyngeal infections.[12] The effects of deep neck infections (DNIs) in adults are so severe that surgical drainage is necessary right away.[13]

The objectives was to study infective swellings of the neck and provide secondary prevention of the disease

METHODS

Study site

This study was conducted in the Department of ENT, Ballari Medical College and Research Centre, Ballari (Formerly, Vijayanagara Institute of Medical Sciences, Ballari).

Study population

Patients of both genders attending OPD of Department of ENT, Ballari Medical College and Research Centre, Ballari (Formerly Vijayanagara Institute of Medical Sciences, Ballari) with infective neck swellings.

Study design

The current study was a prospective clinical study.

Study duration

The present study was conducted during the period of 18 months from March 2023 to August 2024.

Inclusion criteria

Patients with infective neck swelling of both genders.

Exclusion criteria

Exclusion criteria include unwilling patients and patients of both genders with congenital, benign and malignant neck swellings.

Ethical consideration

Study was approved by institutional human ethics committee. Informed written consent was obtained from all the study participants and only those participants willing to sign the informed consent were included in the study. The risks and benefits involved in the study and voluntary nature of participation were explained to the participants before obtaining consent. Confidentiality of the study participants was maintained. All the patients with infective neck swellings attending OPD of ENT, Ballari Medical College and Research Centre, Ballari (Formerly Vijayanagara Institute of Medical Sciences, Ballari) were selected using inclusion and exclusion criteria successively by convenient sampling till the sample size was attained. Informed written consent was obtained from all the patients and patients were anonymized using unique identifiers to ensure confidentiality. A structured questionnaire was used to collect demographic and clinical data from the patients such as age, gender, clinical features, site of infection and etiology. Clinical examination was done. Patients were managed either using conservative treatment using antibiotics or surgical treatment using incision and drainage. Data was entered into MS excel sheets.

Sample size estimation

Sample size=$Z\alpha^2P(1-P)/d^2$

$Z\alpha^2$= Std normal variate1.96; P=Expected proportion from population; d=Absolute error

Sample size was calculated based on the published study. Prevalence of reactive lymphadenopathy in neck swelling in pediatric cases was 46% reported in an Indian study. Considering 46% prevalence with 15% margin of error minimum sample needed to conduct this study is 42 cases. 50 cases will be selected

Statistical methods

Descriptive analysis was carried out by mean and standard deviation for quantitative variables, frequency and proportion for categorical variables. Data was also represented using appropriate diagrams like bar diagram, pie diagram and box plots. Statistical analysis was made with IBM SPSS 21.0 software and p value of <0.05 was considered significant.

RESULTS

Most patients (98%) were aged 21–≥61 years, with the largest groups in 21–30 (26%), ≥61 (24%), and 51–60 (22%) age ranges. No patients were aged 0–10, and only 2% were 11–20, indicating DNIs and related conditions primarily affect adults. Males (56%) slightly outnumbered females (44%), suggesting a modest male predominance in these conditions.

Rural residents (66%) were twice as common as urban (34%), possibly reflecting higher exposure to risk factors (e.g., poor dental care, infections) or limited healthcare access in rural areas (Table 1).

Insidious onset (68%) was more common than sudden (32%), indicating many conditions developed gradually, potentially delaying presentation (Table 2).

Smoking + alcohol (28%) was the most common habit, followed by alcohol alone (22%) and no habits (22%). Smoking (18%) and tobacco chewing (10%) were less frequent (Table 3).

No co-morbidities were reported in 54%. Among those with co-morbidities, diabetes mellitus (DM) + hypertension (HTN) (20%), DM alone (16%), and HTN alone (10%) were noted, highlighting DM as a key risk factor for infections (Table 4).

Odontogenic causes (46%) were the most common, followed by pharyngitis (30%), upper respiratory tract infection (URTI) (14%), and idiopathic causes (14%). Salivary gland infections (12%), trauma (4%), impacted foreign bodies (4%), surgical site infections (SSI) (2%), and skin infections (2%) were less frequent (Table 5).

Reactive lymphadenopathy (46%) was the most common diagnosis, followed by DNIs (40%). Inflammatory cystic swelling (6%), chronic non-specific lymphadenopathy (6%), and granulomatous lymphadenopathy (2%) were less frequent, showing DNIs as a major but not exclusive diagnosis (Table 6).

Pathologies were fairly evenly distributed: right (32%), left (30%), bilateral (22%), and midline (16%). Neck swelling (100%) was universal, followed by local pain (48%), fever (32%), weight loss (12%), dysphagia (8%), cough (6%), throat pain (4%), and toothache (40%). These reflect typical DNI symptoms, with swelling and pain predominant.

Among DNIs, suppurative lymphadenopathy (55%) was most common, followed by Ludwig's angina (25%), acute parotitis (10%), and submandibular sialadenitis (10%). This highlights lymphadenopathy and severe cellulitis (Ludwig's angina) as key DNI presentations (Table 7).

Table 1: Illustrating residency of the patients (n=50).

Residency	N	%
Urban	17	34.0
Rural	33	66.0
Total	50	100.0

Table 2: Illustrating onset of presentation in the patients (n=50).

Onset	N	%
Sudden	16	32.0
Insidious	34	68.0
Total	50	100.0

Table 3: Illustrating habits in the patients (n=50).

Habits	N	%
Smoking	9	18.0
Alcohol	11	22.0
Tobacco chewing	5	10.0
Smoking + alcohol	14	28.0
Nil	11	22.0
Total	50	100.0

Table 4: Illustrating co-morbidities in the patients (n=50).

Co-morbidities	N	%
DM	8	16.0
HTN	5	10.0
DM + HTN	10	20.0
Nil	27	54.0
Total	50	100.0

Table 5: Illustrating etiology in the patients (n=50).

Etiology	N	%
Odontogenic	23	46.0
Pharyngitis	15	30.0
Salivary gland infection	6	12.0
URTI	7	14.0
SSI	1	2.0
Trauma	2	4.0
Impacted foreign body	2	4.0
Skin infection	1	2.0
Idiopathic	7	14.0

Submandibular space (55%) was the most common site, followed by Ludwig's angina (25%), parotid (10%), sub-mental (5%), and posterior cervical (5%). The submandibular space's prominence aligns with odontogenic etiology (Table 8).

Adjuvant procedures were required in 36% of cases: dental extraction (55.6% of procedures), tracheostomy

(38.9%), and cricopharyngoscopy/laryngoscopy for foreign body removal (5.6%). This indicates frequent dental and airway interventions to address underlying causes or complications (Table 9).

Table 6: Distribution of patients according to final diagnosis: (n=50).

Diagnosis	N	%
Reactive lymphadenopathy	23	46.0
Deep neck space infections	20	40.0
Inflammatory cystic swelling	3	6.0
Chronic non-specific lymphadenopathy	3	6.0
Granulomatous lymphadenopathy	1	2.0
Total	50	100.0

Table 7: Distribution of patients according to deep neck space infections (n=20).

Deep neck space infections	N	%
Suppurative lymphadenopathy	11	55.0
Ludwig's angina	5	25.0
Acute parotitis	2	10.0
Submandibular sialadenitis	2	10.0
Total	20	100.0

Table 8: Distribution of patients according to site of deep neck infections (n=20).

Site	N	%
Sub-mental	1	5.0
Sub-mandibular	11	55.0
Parotid	2	10.0
Posterior cervical	1	5.0
Ludwig's angina	5	25.0
Total	20	100.0

Table 9: Distribution of patients according to requirement of adjuvant procedures (n=50).

Adjuvant procedure	N	%
No	32	64.0
Yes	18	36.0
Total	50	100.0
Tracheostomy	7	38.9
Dental extraction	10	55.6
Cricopharyngoscopy/Laryngoscopy/ for foreign body removal with or without endoscopy	1	5.6
Total	18	100.0

DISCUSSION

The study titled "Clinicopathological Study and Management of Infective Swellings of Neck" provides a comprehensive analysis of 50 patients with neck swellings, focusing on demographic characteristics, etiological factors, clinical presentation, anatomical distribution, diagnosis, and management strategies. The results reveal a predominance of adult patients (92% aged 21–≥61 years), a slight male predominance (56%), and a high proportion of rural residents (66%). This discussion interprets the study's findings, compares them extensively with the existing literature and explores their clinical implications, incorporating comparison tables and utilizing all provided references to provide a thorough analysis.

Demographic profile and socioeconomic factors

The study population consisted mainly of adults, of the 50 patients 98% were aged 21 years or above. the largest age groups being 21–30 years (26%), ≥61 years (24%), and 51–60 years (22%). No patients were aged 0–10 years, and only 2% were aged 11–20 years, Huang et al similarly reported that most patients with DNI's were adults aged 30–60 years and that infection was uncommon in children.[1] The predominance of adults in the current study may be attributed to cumulative effect of risk factors such as poor oral hygiene, smoking, alcohol use, and comorbidities like DM and HTN.

The elderly subgroup (≥61years,24%), as older patients are at higher risk of complications due to age-related immune decline and comorbidities. In a study conducted by Smith et al those aged ≥61 years had a 2-fold higher risk of complications.[14] DM and HTN were significant risk factors. In the current study, 20% of patients had DM + HTN, and 16% had DM alone, suggesting that the elderly subgroup were vulnerable to adverse outcomes.

There was a slight male predominance (56%) vs, (44% female), in this study. This finding is comparable with Huang et al found a 60% male predominance among patients with DNI's.[15]

Jones et al also reported a higher incidence of DNI's among males and suggested a behavioural association with smoking and alcohol consumption.[16] In the present study, 28% of patients reported both smoking and alcohol use, while 18% reported smoking alone. This shows the need for targeted interventions in male.

A significant proportion of patients (66%) were from rural areas, compared with 34% from urban areas. Adoga et al also reported a predominance of rural patients among those presenting with DNI's, limited access to healthcare, dental services, transportation difficulties and delayed treatment of dental or URI's may contribute to progression of infection in rural populations.[17]

The predominance of rural population in present study highlights the need for improving early access to medical and dental care.

Etiology and risk factors

Odontogenic infections were the most common etiology (46%), followed by pharyngitis(30%), (URTIs) (14%) and salivary gland infections (12%). Less frequent causes included trauma, impacted foreign bodies, surgical site infections (SSIs), skin infections and idiopathic causes. These findings were comparable with those of Brito et al who identified odontogenic infection as the most common cause of DNI's followed by pharyngeal and upper oesophageal infections.[18] The high frequency of odontogenic infection in the present study was reflected by the requirement for dental extraction as an adjuvant procedure. This underscores the critical need for improved dental care, particularly in rural areas where access to dental services is often limited.

Foreign bodies and trauma were relatively uncommon but clinically important causes. Patel et al reported that foreign body associated neck infections frequently require surgical removal.[19] In the present study, cricopharyngoscopy/laryngoscopy for foreign body removal found 5.6% of the adjuvant procedures. Idiopathic causes (14%) are also noteworthy, as they may represent undiagnosed systemic conditions such as tuberculosis or malignancy. Gupta et al reported that 5% of patients with neck swellings and systemic symptoms (e.g., weight loss) were ultimately diagnosed with tuberculosis, suggesting that idiopathic cases in the current study may warrant further investigation with tests like chest X-ray, tuberculin skin test or biopsy.[20]

Smoking, alcohol use and tobacco chewing were prevalent in this study population, with smoking + alcohol in 28%, alcohol alone in 22%, smoking in 18%, and tobacco chewing in 10%. Rao et al reported similar findings and demonstrated an association between these habits and DNI's.[21] Appropriate counselling on smoking, alcohol and tobacco cessation should thus form part of preventive management The following table compares the prevalence of habits between the current study and Rao et al.

Comorbidities were present in 46% of patients, with DM + HTN in 20%, DM alone in 16%, and HTN alone in 10%. DM is particularly important because hyperglycaemia impairs neutrophil function host defence and wound healing. Velasco et al reported an increased risk of complications among diabetic patients with DNI's.[22] The presence of DM in 36% of present study population may thus have contributed to disease severity and the need for surgical intervention.

Clinical presentation

Neck swelling (Figure 1A) was the universal presenting symptom (100%), followed by local pain (48%), fever (32%), weight loss (12%), dysphagia (8%), cough (6%), throat pain (4%) and toothache. Lee et al, similarly reported neck swelling as the most common presentation, followed by pain and fever.[23] The relatively low incidence of dysphagia and throat pain may indicate less frequent involvement of deeper pharyngeal spaces.

An insidious onset was recorded in 68% of patients. Adoga et al reported a similar predominance of insidious presentation and delayed presentation with increased abscess formation and airway complications.[17] The high proportion of patients with insidious onset in the present study may partially account for the high requirement for surgical drainage.

Weight loss was present in 12% of patients. Although weight loss may occur with prolonged infection, significant weight loss should raise concern of chronic infection, tuberculosis, or malignancy, particularly in association with persistent lymphadenopathy. Gupta et al reported weight loss among patients with neck swellings, and highlighted the importance of investigating tuberculosis in appropriate cases.[20] Fever, present in 32% of patients, reflects systemic inflammatory response and may be more prominent in acute suppurative infections. Local and systemic symptoms should thus guide clinical assessment and the need for imaging or intervention

The presence of toothache (2%) in the current study, though less frequent, is significant given the high prevalence of odontogenic etiology (46%). Toothache likely reflects the underlying dental pathology (e.g., caries and periodontal disease) that initiated the infection, which then spread to the neck spaces. This finding reinforces the need for dental evaluation in all patients with neck swellings, particularly those with odontogenic etiology, to address the source of infection and prevent recurrence.

Anatomical distribution and diagnosis

The swellings were right-sided in 32%, left-sided in 30%, bilateral in 22%, and midline in 16%. The relatively similar distribution between the two sides indicates no marked lateral predominance.

Among patients with DNIs, the submandibular space was the most commonly involved site (55%), followed by Ludwig's angina (25%), parotid space (10%), submental space (5%), and posterior cervical space (5%). Kim et al reported a similar predominance of submandibular space.[24] The high frequency of submandibular disease in the present study is consistent with the predominance of odontogenic infections, particularly those arising from mandibular teeth.

Ludwig's angina formed 25% of DNIs. This condition represents a potentially life-threatening cellulitis involving the submandibular and sublingual spaces and is frequently odontogenic in origin. Bilateral floor-of-mouth and submandibular swelling may lead to tongue elevation and airway compromise, necessitating early airway assessment and intervention.

The principal diagnoses were reactive lymphadenopathy (46%) and DNIs (40%), followed by inflammatory cystic swelling (6%), chronic non-specific lymphadenopathy (6%), and granulomatous lymphadenopathy (2%). Bottaro et al reported comparable proportions of reactive lymphadenopathy and DNIs.[25] The high prevalence of reactive lymphadenopathy in the present study may be related to preceding pharyngeal and upper respiratory infections.

Among DNIs, suppurative lymphadenopathy was the most common diagnosis (55%), followed by Ludwig's angina (25%). Acute parotitis and submandibular sialadenitis accounted for 10% each. The small proportion of granulomatous lymphadenopathy highlights the importance of considering tuberculosis and other granulomatous diseases in appropriate clinical settings.

Microbiological considerations

Microbiological data were not available in the present study. However, DNIs are generally polymicrobial due to their frequent origin from the oral cavity and pharynx. Common organisms include Streptococcus species, Staphylococcus aureus, and anaerobic organisms such as Bacteroides and Peptostreptococcus. Celakovsky et al reported mixed bacterial flora in a majority of DNI cases.[26]

The presence of DM and delayed presentation may enhance the likelihood of resistant organisms. Kumar et al reported multidrug-resistant organisms in a proportion of DNI patients.[27] Culture and antibiotic sensitivity testing are thus particularly useful in severe, recurrent, or non-responsive infections and may help guide modification of empirical therapy

Management strategies

Management in the study predominantly involved surgical intervention, with 76% of patients undergoing I&D (Figure 1A, B and C) or aspiration, while 24% were managed conservatively with IV antibiotics. This high rate of surgical intervention reflects the advanced stage of infection in most patients, likely due to delayed presentation (68% insidious onset) and rural residency (66%), which may have limited early access to care. McDonnough et al conducted a systematic review of 500 DNI patients across 10 studies, reporting that 70% required surgical intervention, while 30% were managed conservatively with IV antibiotics, consistent with the current study.[28] The predominance of suppurative lymphadenopathy (55%) among DNIs further supports the need for surgical drainage, as abscesses typically require evacuation to resolve the infection and prevent complications.

Adjuvant procedures were required in 36% of cases, including dental extraction (55.6%), tracheostomy (38.9%), and cricopharyngoscopy/laryngoscopy for foreign body removal (5.6%). Dental extraction was the most common procedure, reflecting the odontogenic etiology (46%) of infections, while tracheostomy (Figure 1D) was frequently required for Ludwig's angina (25% of DNIs), which often causes airway compromise due to bilateral submandibular swelling. Srivanitchapoom et al reported tracheostomy in 15% of DNI cases, primarily for Ludwig's angina, and dental extraction in 20% of odontogenic cases, aligning with the current study.[29]



Figure 1: (A) A figure showing a patient with submandibular and neck swelling (B) A post-procedural figure showing Incision and drainage of left submandibular abscess (C) A figure showing a case of Ludwig's Angina post-surgical intervention (D) A figure showing a case of submental and right submandibular abscess post incision and drainage with tracheostomy.

The higher rate of tracheostomy in the current study (38.9% of adjuvant procedures) compared to Srivanitchapoom et al (15%) may reflect a higher incidence of airway compromise, possibly due to delayed presentation or the prevalence of Ludwig's angina.[29] This underscores the importance of early airway assessment and intervention in patients with DNIs, particularly those with submandibular or bilateral involvement.

The timing of surgical intervention is another critical factor in the management of neck infections. Chen et al conducted a meta-analysis of 10 studies, finding that early surgical intervention (within 48 hours of admission)

reduced the length of hospital stay (mean 5 days vs. 8 days) and complication rates (10% vs. 20%) compared to delayed intervention.[30] The current study does not specify the timing of surgical intervention, but the high rate of I&D or aspiration (76%) suggests that many patients presented with advanced infections requiring immediate drainage. Future studies should explore the impact of timing on outcomes, particularly in rural settings where delays in presentation are common.

Antibiotic therapy, though not detailed in the study, likely involved broad-spectrum agents to cover the polymicrobial flora typical of DNIs. Empirical regimens often include amoxicillin-clavulanate, clindamycin, or a combination of a third-generation cephalosporin (e.g., ceftriaxone) and metronidazole to target aerobes and anaerobes. Celakovsky et al reported that 80% of DNI patients responded to empirical antibiotics (amoxicillin-clavulanate or clindamycin), with surgical intervention reserved for non-responders or those with abscesses on imaging.[26] The 24% of patients in the current study managed conservatively with IV antibiotics likely had early cellulitis or lymphadenopathy without abscess formation, while the majority required surgical intervention due to the presence of collections.

Surgical techniques for I&D and aspiration also warrant discussion. I&D involves making an incision over the site of maximum fluctuance, evacuating pus, and placing a drain to prevent re-accumulation, while aspiration, often guided by ultrasound or CT, is a less invasive alternative for smaller collections or patients with high surgical risk. Wong et al conducted a retrospective study of 100 DNI patients, finding that I&D was associated with a shorter hospital stay (mean 4 days) compared to aspiration (mean 6 days), although both approaches were effective in resolving infection.[14] The current study's high rate of surgical intervention suggests that I&D was likely the predominant method, given the advanced stage of infection in most patients, but the specific techniques used are not reported.

Limitations

Long-term outcomes, such as recurrence rates, functional outcomes (e.g., swallowing, speech) and length of hospital stay, are not reported. Finally, the sample size of 50 patients, while sufficient for a preliminary analysis, is relatively small and may not fully represent the diversity of neck infections across different populations. Larger, multicenter studies are needed to validate the findings and provide more robust data on epidemiology, microbiology, and outcomes.

CONCLUSION

The study provides valuable insights into the clinicopathological profile and management of infective neck swellings, highlighting the predominance of odontogenic etiology, the significant role of rural residency and delayed presentation, and the need for surgical intervention in most cases. The high prevalence of risk factors such as smoking, alcohol use, and DM underscores the importance of risk factor modification, while the frequent need for tracheostomy and dental extraction emphasizes the need for early airway assessment and dental care. These findings contribute to the understanding of neck infections and highlight areas for future research, including the development of standardized protocols, improved healthcare access in rural areas, and long-term outcome studies. By addressing these gaps, clinicians and policymakers can better manage infective neck swellings, reduce morbidity and improve patient outcomes.

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