

Clinico Microbiological Profile of Deep Neck Space Infections in Patients Presenting to Department of Otorhinolaryngology

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Abstract: ***Objectives:** Deep Neck Space's complicated anatomical arrangement, defined by a series of interconnected fascial planes, gives rise to potential spaces. While typically collapsed, these spaces can become susceptible to infectious processes. To study clinical and microbiological profile of patients with deep neck space infections. **Materials and Methods:** A prospective observational study was conducted on 100 patients with deep neck space infections at a tertiary care hospital, Bhopal from April 2024 to October 2025. Initially broad spectrum antibiotics were administered which is followed by incision and drainage and antibiotics according to culture and sensitivity report. **Results:** The most common clinical presentation was neck swelling or lump (85%). The peritonsillar space was the most commonly affected anatomical area (35%), most frequent source of infection was odontogenic origin (40%). Out of 100 isolates, the most prevalent organism was *Staphylococcus aureus*, including methicillin-resistant strains (23.8%) and methicillin-sensitive strains (19.0%). For *Staphylococcus aureus* species, amongst all the antibiotics Linezolid, Teicoplanin and Vancomycin found to be most effective.*

Keywords: DNSI, Culture and Sensitivity, Incision and Drainage.

1. Introduction

A deep neck space infection (DNSI) is defined as an infectious process anatomically contained within the potential spaces delineated by the layers of the deep cervical fascia. These deep spaces, though normally collapsed and sterile, become actual pathological compartments when distended by inflammatory exudate or pus.

The presence of underlying comorbidities, particularly those that compromise immune function, is a well-established risk factor for more aggressive disease progression and a greater likelihood of complications. Among these, Diabetes Mellitus is consistently identified as the most critical predisposing condition. Consequently, diabetic patients frequently present with more extensive tissue necrosis and a higher incidence of severe complications, highlighting the pivotal role of host factors in the pathogenesis of this disease^{2,3}.

The microbiology of deep neck space infections is characteristically complex and polymicrobial, reflecting the synergistic flora of the infection's originating site within the upper aerodigestive tract¹⁴. Cultures obtained from abscess drainage typically yield a mixture of both aerobic and anaerobic bacteria. The most frequently isolated aerobic pathogens include species of *Streptococcus* and *Staphylococcus aureus*, often in combination with anaerobic organisms such as *Prevotella*, *Porphyromonas*, and *Peptostreptococcus* species^{5,6}. This diverse and often unpredictable bacteriology presents a considerable challenge for initial treatment, necessitating the selection of broad-spectrum empirical antibiotic regimens that can provide adequate coverage pending definitive culture and sensitivity results. However, pharmacotherapy alone is frequently insufficient for resolving a formed abscess; therefore, timely surgical intervention for source control, most commonly via incision and drainage, remains an indispensable component of successful management⁷.

2. Materials and Methods

The study was conducted as a prospective observational on patients with deep neck space infections presenting to the Department of Otorhinolaryngology, Gandhi Medical College and Hamidia Hospital, Bhopal, Madhya Pradesh, India during the study period of 18 months (April 2024 to October 2025).

Patients of all age groups and both sexes with deep neck space infections and who were willing to participate in the study and provided consent were included, whereas patients with only superficial neck space infections, lymph node abscess, other head and neck infections not involving deep neck spaces who did not give consent or unwilling to participate in the study were excluded.

A total of 100 patients were enrolled using convenient sampling. Approval from the Institutional Ethics Committee (IEC) of Gandhi Medical College, Bhopal, was obtained prior to the commencement of the study to ensure methodological transparency and quality.

All the patients satisfying the inclusion criteria were enrolled and written consent was obtained from all of them. Using the proforma, detailed history was obtained and documented. All the patients were then subjected to local, general and systemic examinations, and findings were noted. Routine preoperative investigations were done along with USG neck CT and MRI wherever necessary and findings were documented.

All patients presenting with deep neck space infections were initially administered empirical broad-spectrum antibiotics. This was followed by either needle aspiration or incision and drainage, as deemed appropriate.

Pus samples for culture and sensitivity testing were collected and sent to the Department of Microbiology. After the report obtained antibiotics were administered according to them. As

Anaerobic cultures are not available at our institute, we did not include anaerobic organisms in our study.

Statistical Analysis:

Data were entered into Microsoft Excel and analysed using SPSS software version 23.0. The results were analysed using descriptive statistics only. Continuous variables were expressed as mean $\pm$ standard deviation (SD), while categorical variables were presented as frequency (n) and percentage (%). The findings were summarized in tabular form to describe the demographic, clinical, microbiological, treatment, and outcome characteristics of the study population.

3. Observations and Results

The study included 100 patients diagnosed with deep neck space infections. The mean age of presentation was 38.2 ± 14.9 years, indicating that the condition predominantly affects

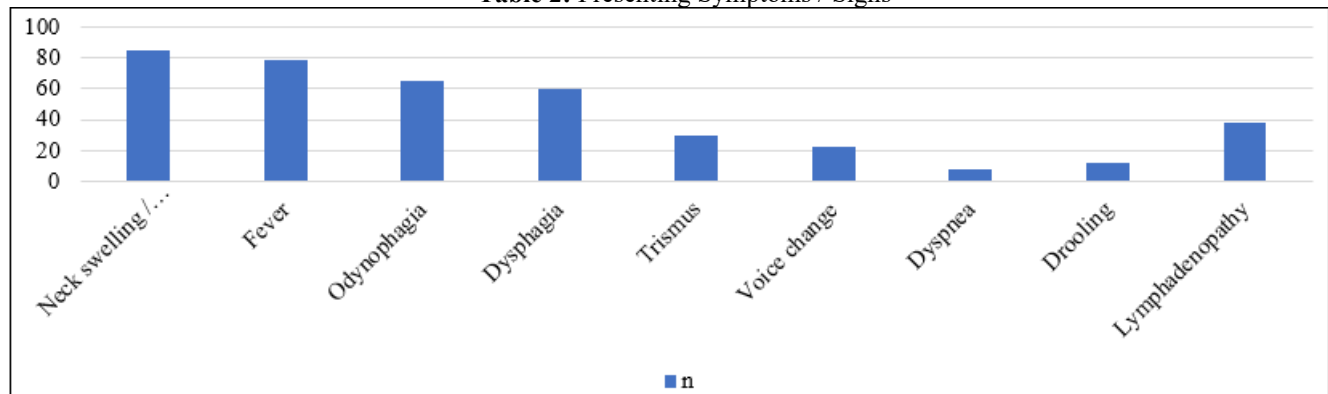
young to middle-aged adults. The gender distribution revealed a male predominance (60%) compared to females (40%), suggesting that males are slightly more prone to developing such infections, possibly due to higher rates of risk factors such as smoking and poor oral hygiene.

Table 1: Age Distribution of Patients (n = 100)

Age Group (years)	Frequency (n)	Percentage (%)
< 20	8	8.0
20–39	46	46.0
40–59	34	34.0
≥ 60	12	12.0
Total	100	100.0

When the age distribution was analysed, the majority of patients were in the 20–39-year age group (46%), followed by the 40–59-year age group (34%).

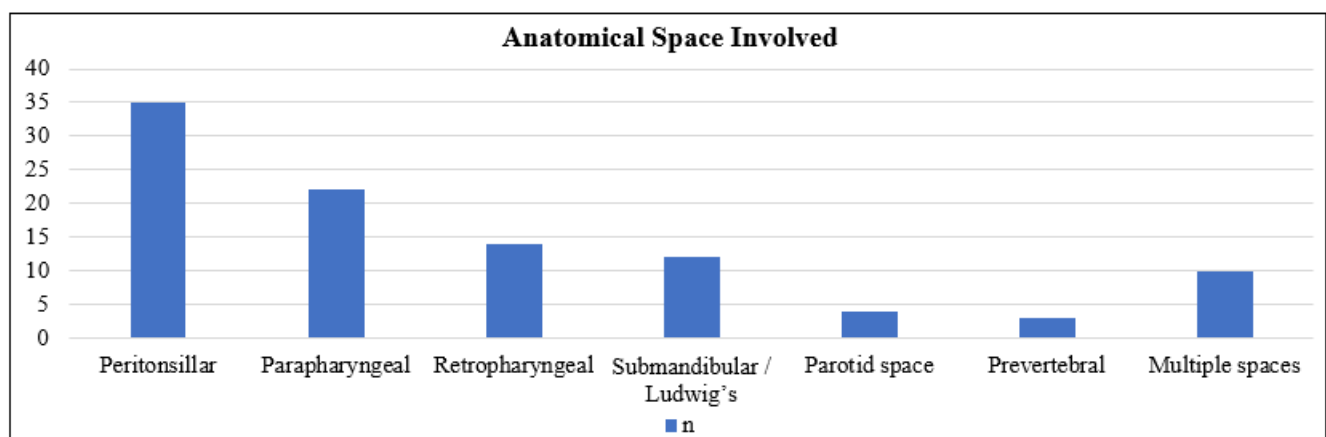
Table 2: Presenting Symptoms / Signs



The most common clinical presentation was neck swelling or lump (85%), followed by fever (78%), odynophagia (65%), and dysphagia (60%). Less frequent symptoms

included trismus (30%), voice change (22%), and dyspnea (8%).

Table 3



The peritonsillar space was the most commonly affected anatomical area (35%), followed by the parapharyngeal (22%), retropharyngeal (14%), and submandibular/Ludwig's spaces (12%). In 10% of cases, multiple spaces were involved, indicating the potential for infection to spread along fascial planes. Less commonly involved regions included the parotid (4%) and prevertebral (3%) spaces.

The most frequent source of infection was odontogenic origin (40%), emphasizing the importance of dental hygiene in preventing such infections. Other causes included tonsillopharyngitis (25%), trauma or foreign body (5%), salivary gland infection (3%), and post-operative infections (2%).

Table 4: Microbiological culture results.

Culture result category	n	%
Culture positive (any growth)	75	75.0%
— of these: Monomicrobial growth	45	45.0% (of total)
— of these: Polymicrobial growth	30	30.0% (of total)
No growth (sterile)	25	25.0%

Cultures were positive in 75% of cases, indicating a high microbiological yield. Among these, monomicrobial infections were more common (45%) than polymicrobial (30%). Sterile cultures (no growth) were found in 25%, possibly due to prior antibiotic use or anaerobic organisms not isolated by standard culture methods.

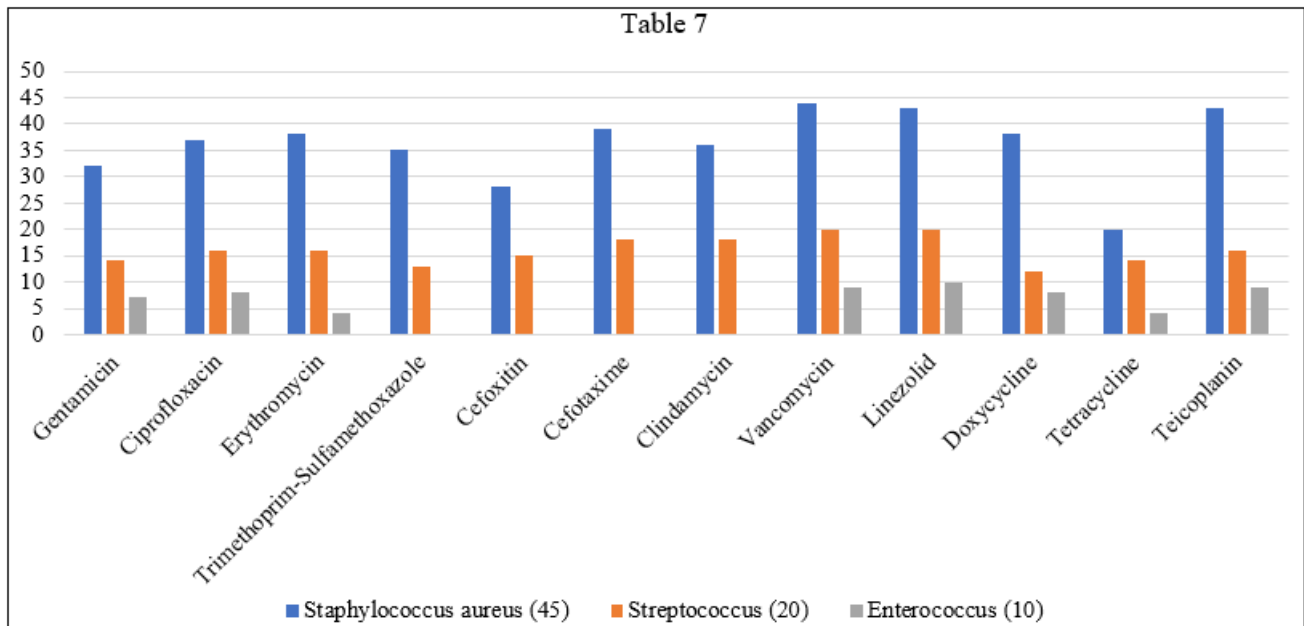
Table 5: Complications (occurrence; patients may have >1)

Complication	n	%
Airway compromise requiring airway support/tracheostomy	10	10.0%
Septic shock	5	5.0%
Descending necrotizing mediastinitis	2	2.0%
Internal jugular vein thrombosis (Lemierre-like)	1	1.0%
Carotid sheath involvement / vascular complication	1	1.0%
No major complication	82	82.0%

Table 6: Organisms isolated (breakdown of total isolates, n = 105)

Organism group / species	No. of isolates	% of isolates (n=105)
<i>Staphylococcus aureus</i>		
MRSA	25	23.8%
MSSA	20	19.0%
<i>Streptococcus</i> spp. (e.g., <i>S. pyogenes</i> , viridans group)	20	19.0%
<i>Enterococcus</i>	10	9.5%
Gram-negative bacilli (e.g., <i>Klebsiella</i> , <i>E. coli</i> , <i>Pseudomonas</i>)	20	19.0%
<i>Candida</i> spp.	10	9.5%
Total isolates	105	100%

Out of 105 isolates, the most prevalent organism was *Staphylococcus aureus*, including methicillin-resistant strains (23.8%) and methicillin-sensitive strains (19.0%). *Streptococcus* species (19%) and *Enterococcus* (9.5%). Gram-negative bacilli including *Klebsiella*, *E. coli*, *Pseudomonas* (19%) and *Candida* (9.5%).

Table 7

For *Staphylococcus aureus* species, amongst all the antibiotics Linezolid, Teicoplanin and Vancomycin found to be most effective. For *Streptococcus* species, amongst all the antibiotics Penicillin, Teicoplanin, Vancomycin found to be most effective. For *Enterococcus* species, Teicoplanin, Vancomycin and Linezolid found to be most effective amongst all the antibiotics. For Gram Negative bacilli (*E. coli*, *Klebsiella* spp., *Pseudomonas* spp.), Colistin, Trimethoprim-Sulfamethoxazole and Cefotaxime found to be most effective amongst all the antibiotics.

4. Discussion

Deep neck space infections (DNSIs) are severe infections that affect the potential fascial spaces of the neck. They progress quickly and can lead to life-threatening complications. Even with improvements in antimicrobial treatments and imaging

techniques, these infections remain challenging due to their complex anatomy and proximity to critical structures like the airway, major blood vessels, and mediastinum. DNSIs can manifest as cellulitis or abscesses and spread along fascial planes, causing risks such as airway blockage, mediastinitis, septic shock, and vascular damage^{8,9,10}.

The clinical presentation and microbiological profile of DNSIs vary with demographic factors, underlying health conditions, and regional infection patterns. The most common sources are odontogenic infections and infections of the upper aerodigestive tract, with organisms frequently implicated including *Streptococcus*, *Staphylococcus*, anaerobes, and Gram-negative bacilli^{11,12}. Recently, more attention has been given to identifying factors that affect disease severity, including diabetes mellitus, multi space involvement, and delayed presentation^{13,14}.

Previous studies have reported similar findings. **Das et al.** reported a mean age of 34.4 years and 69% male patients, highlighting the higher incidence of DNSIs among young adult males (8). Similarly, **Treviño-Gonzalez et al.** reported a mean age of 41.79 years with 66.6% male patients, which aligns with the current study (10).

Furthermore, **Singhal et al.** noted that deep neck space infections can affect people of all ages but are more prevalent among adults, which aligns with the age distribution found in this study (4).

Furthermore, **Singhal et al.** highlighted that deep neck space infections often exhibit both local and systemic symptoms. Despite improvements in antibiotic treatment, these infections still carry a risk of quick worsening and airway obstruction. (4)

This study evaluated 100 patients, with an **average age of 38.2 ± 14.9 years**, showing that deep neck space infections mainly affect young to middle-aged individuals. Most patients were aged **20–39 years (46%)**, followed by **40–59 years (34%)**.

Similar findings have been documented in earlier research. Huang et al. identified the parapharyngeal space as the most commonly affected area in both diabetic and non-diabetic patients (1). Conversely, **Das et al.** and **Treviño-Gonzalez et al.** reported the submandibular space as the most frequently involved site, illustrating differences in anatomical involvement among populations (8,10).

In the present study, the **peritonsillar space was the most commonly involved (35%)**, followed by the **parapharyngeal space (22%)**, **retropharyngeal space (14%)**, and **submandibular/Ludwig's space (12%)**.

Moreover, **Chen et al.** showed that involvement of multiple deep neck spaces is strongly associated with more severe disease and a greater need for airway intervention, particularly tracheostomy (5). Similarly, **Ho et al.** and **Hung et al.** also found that multispace involvement is a key predictor of severe illness, longer hospital stays, and ICU admission (6,7).

Das et al. found odontogenic infections in 64.1% of cases, identifying it as the primary cause (8). **Loperfido et al.** observed an odontogenic origin in 70% of patients, reinforcing its dominant role (9). Similarly, **Treviño-Gonzalez et al.** reported odontogenic infections in 65.3% of cases (10).

In the present study, the most common source of infection was **odontogenic origin (40%)**, followed by **tonsillopharyngitis (25%)**.

Lee et al. showed that odontogenic infections often involve polymicrobial flora, especially *Streptococcus milleri* group and anaerobes, consistent with microbiological observations in deep neck infections (2). Furthermore, **Huang et al.** noted that both odontogenic and upper airway infections are the

primary causes of deep neck infections in various patient groups (1).

Lee et al. found *Klebsiella pneumoniae* (27.1%), *Streptococcus milleri* group (21.9%), and anaerobes (20.8%) to be the most common organisms, with frequent polymicrobial infections (2). **Huang et al.** noted that *Streptococcus* species were most common in non-diabetic patients, whereas *Klebsiella pneumoniae* was predominant in diabetic patients, highlighting variations in microbiological patterns depending on patient factors (1).

In the present study, **culture positivity was observed in 75% of cases**, while **25% showed no growth**. Among the culture-positive cases, **monomicrobial infections accounted for 45%**, whereas **polymicrobial infections accounted for 30%**.

Das et al. observed that 77.7% of patients needed both medical and surgical treatment, consistent with this study (8). **Loperfido et al.** also reported that approximately 80% of patients underwent surgical intervention, emphasising that surgery remains the primary treatment for deep neck infections (9).

In the present study, most **patients (70%) required surgical drainage along with intravenous antibiotics**, while **20% were treated conservatively with antibiotics alone**. **Additional interventions included tooth extraction in 6%, tracheostomy in 4%, and mediastinal drainage in 2% of cases**.

Treviño-Gonzalez et al. found mediastinitis in 10.67% of cases, with a notably high mortality rate, underscoring its serious prognosis (10). **Huang et al.** further showed that complications are more common among patients with comorbidities such as diabetes, highlighting the importance of systemic factors in disease development (1).

Chen et al. and **Ho et al.** identified mediastinitis and multispace involvement as important indicators of severe disease, greater need for airway intervention, and longer hospital stays (5,6). Similarly, **Hung et al.** found that patients with severe infections requiring ICU admission experienced more complications, especially airway compromise and systemic dissemination (7).

In this study, some patients experienced complications. The most frequent was airway compromise needing support or **tracheostomy (10%)**, then **septic shock (5%)**, and **descending necrotizing mediastinitis (2%)**.

5. Conclusion

Deep neck space infections mainly occur in young to middle-aged people, with a higher prevalence in males. The most common cause is odontogenic infections, followed by tonsillopharyngeal infections. These infections are usually polymicrobial, involving organisms such as *Staphylococcus aureus*, *Streptococcus* species, anaerobes, and Gram-negative bacteria. Most patients need surgical drainage along with broad-spectrum antibiotics, due to the abscess-forming nature of the disease. Conditions like diabetes mellitus and delayed

medical presentation can worsen the severity and increase the risk of complications. Although complications like airway obstruction and mediastinitis are less common, they can greatly affect patient outcomes when they occur. Prompt diagnosis, early surgical intervention, and appropriate antimicrobial treatment are vital for positive outcomes, and a multidisciplinary approach is essential for effective management.

There are no conflicts of interest.

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