

Clinical Spectrum and Microbial Patterns of Ludwig's Angina: A Cross-Sectional Study

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Abstract

Background: Ludwig's angina is a rapidly progressive cellulitis of the submandibular space that may lead to life-threatening airway compromise. Understanding its clinical presentation and microbial pattern is essential for early diagnosis and effective management.

Objective: To evaluate the clinical spectrum of Ludwig's angina and its association with microbial pattern, along with socio-demographic characteristics of affected patients.

Methods: A hospital-based cross-sectional study was conducted on 50 patients with Ludwig's angina admitted to three tertiary hospitals in Dhaka between January and June 2014. Patients with other causes of neck swelling, including lymphangioma, haemangioma, cystic hygroma, lymphoma, or submandibular gland neoplasm, were excluded. Data on socio-demographic characteristics, clinical features, and aerobic microbial culture results were collected using a structured data sheet and analyzed to evaluate the clinical profile and microbial pattern of Ludwig's angina.

Results: The mean age of patients was 34.8 ± 17.7 years, with the highest proportion (40%) in the 21-40 years age group. All patients (100%) presented with neck swelling, pain, and tenderness, while fever (90%) and dysphagia (72%) were common systemic and local symptoms. Respiratory distress was observed in only 6% of cases. Aerobic culture showed mixed bacterial growth in 76% and isolated Streptococcal growth in 24% of patients. A significant association was found between gender and microbial pattern ($\chi^2=4.20$, $p=0.041$), with mixed growth more common in males and Streptococcal growth more frequent in females. Mean age was significantly higher in patients with Streptococcal growth (42.5 ± 15.8 years) compared to mixed growth (33.4 ± 17.2 years) ($t=2.33$, $p=0.024$).

Conclusion: Ludwig's angina predominantly affected young adult males from lower socioeconomic, rural backgrounds. The infection was mostly polymicrobial, emphasizing the need for broad-spectrum empirical antibiotics, with age and gender significantly influencing microbial patterns.

Keywords: Ludwig's angina, clinical presentation, microbial pattern, Bangladesh.

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Introduction

Ludwig's angina is a rapidly progressive, potentially lifethreatening cellulitis involving the submandibular, sublingual, and submental fascial spaces, often resulting from bacterial invasion and oedema of the floor of the mouth that predisposes to airway obstruction if not promptly managed.^{1,2} It was first described in 1836 by Wilhelm Friedrich von Ludwig and historically carried a high mortality rate in the preantibiotic era, often due to asphyxiation and spread of infection into deeper neck spaces.³ Early recognition and intervention with appropriate airway management, broadspectrum antibiotics, and surgical drainage have considerably reduced mortality, but the condition still carries significant morbidity and risk of complications such as mediastinitis, thrombophlebitis, and sepsis.^{4,5}

The most common aetiology is odontogenic infection, especially of the lower second and third molars, accounting for up to 90% of cases worldwide.^{1,6} This is compounded in lowresource settings by poor dental hygiene, delayed presentation, limited access to dental care, and systemic diseases such as diabetes mellitus, which have been identified as important predisposing factors.^{7,8} The clinical features are typically characterised by neck swelling, pain, fever, dysphagia, trismus, and firm induration of the submandibular space.^{1,2} Early empirical antimicrobial therapy is crucial, as Ludwig's angina is often polymicrobial, frequently involving both aerobic and anaerobic oral flora including *Streptococcus*, *Staphylococcus*, and gramnegative organisms.^{9,10}

Despite its clinical importance, comprehensive data on sociodemographic characteristics, clinical presentations, and aerobic microbial patterns of Ludwig's angina remain limited in Bangladesh. Previous studies have reported male predominance, odontogenic aetiology, and a predominance of *Streptococcal* isolates, but broader analyses with associations to age and gender are sparse.^{7,11} Understanding these clinical and microbial patterns is essential for optimizing early empirical treatment and guiding antibiotic stewardship in resource-limited tertiary care settings.

Therefore, this study aimed to describe the sociodemographic characteristics and clinical presentation of patients with Ludwig's angina, determine the aerobic microbial pattern of isolates, and assess the association between microbial patterns and patient-related variables such as age and gender.

Material and Methods

This hospital-based cross-sectional observational study was carried out from January to June 2014 in the Departments of Otolaryngology and Head–Neck Surgery at Dhaka Medical College Hospital, Sir Salimullah Medical College & Mitford Hospital, and Shaheed Suhrawardy Medical College Hospital, Dhaka. The objective was to evaluate the clinical presentation of Ludwig's angina and its association with underlying pathology, as well as to describe the socio-demographic characteristics and microbial pattern of affected patients.

A purposive sampling method was used to recruit 50 consecutive patients who presented with clinical features consistent with Ludwig's angina and fulfilled the inclusion criteria. Patients who were clinically diagnosed and admitted to the selected hospitals were considered eligible. Individuals with other causes of neck swelling such as lymphangioma, haemangioma, cystic hygroma, lymphoma, or submandibular gland neoplasm those unwilling to provide informed consent, and cases with incomplete data were excluded.

Data were collected using a pre-designed structured data sheet based on detailed history taking, thorough clinical examination, and relevant investigations including X-ray, random blood sugar estimation, and culture and sensitivity testing.

Data entry, cleaning, and statistical analysis were performed using the Statistical Package for Social Sciences (SPSS) version 25 (IBM Corp., New York, USA). Categorical variables were summarized as frequencies and percentages, while continuous variables were expressed as mean and standard deviation (SD). The chi-square test was applied to determine associations between categorical variables and aetiological factors. An independent sample t-test was used to compare mean age between patients with dental and non-dental causes. A p-value of <0.05 at a 95% confidence interval was considered statistically significant.

Written informed consent was obtained from all participants prior to enrollment. Confidentiality was strictly maintained, and ethical standards were upheld throughout the study. The research was conducted in accordance with the principles of the Declaration of Helsinki (2013 revision) for medical research involving human subjects.

Results

Table 1 shows that the majority of patients with Ludwig's angina were young to middle-aged adults. The highest proportion (40%) belonged to the 21-40 years age group, followed by 41-60 years (24%), while only 8% were aged ≤ 10 years. The mean age of the patients was 34.8 ± 17.7 years. A marked male predominance was observed, with 72% of patients being male and 28% female. Regarding socioeconomic status, most patients (70%) came from the lower socioeconomic class, whereas 20% and 10% belonged to middle and upper classes, respectively. In terms of habitat, a large majority (82%) were from rural areas, compared to only 18% from urban settings.

Table 2 demonstrates that all patients (100%) presented with neck swelling accompanied by pain and tenderness. Fever was observed in 90% of cases, indicating a strong association with systemic infection. Dysphagia was present in 72% of patients, reflecting significant oropharyngeal involvement. Less frequent but clinically important symptoms included voice change (30%), dental complaints (28%), foul-smelling breath (24%), and trismus (10%). Only a small proportion (6%) developed respiratory distress, suggesting that airway compromise, although serious, was relatively uncommon at presentation. On local examination, 50% of patients had a firm submental and submaxillary area, while 28% exhibited a raised and firm floor of the mouth findings consistent with the typical spread of infection in the submandibular space.

Figure 1 shows that the majority of cases (76%) demonstrated mixed aerobic bacterial growth on culture, whereas 24% yielded isolated Streptococcal species.

Table 3 shows a statistically significant association between gender and microbial pattern ($\chi^2 = 4.20$, $p = 0.041$). Among male patients, the majority (88.9%) had mixed bacterial growth, while only 11.1% showed isolated Streptococcal growth. In contrast, more than half of the female patients (57.1%) demonstrated Streptococcal growth, compared to 42.9% with mixed growth.

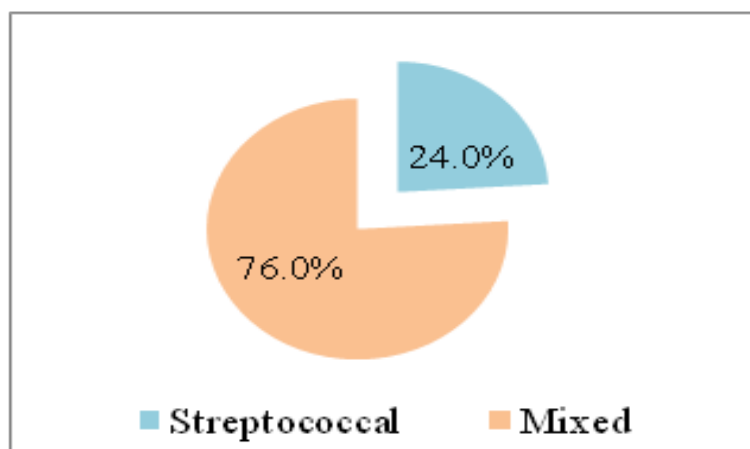
Table 4 demonstrates a statistically significant difference in mean age between patients with Streptococcal growth and those with mixed bacterial growth ($t = 2.33$, $p = 0.024$). Patients with Streptococcal growth had a higher mean age (42.5 ± 15.8 years) compared to those with mixed growth (33.4 ± 17.2 years).

Table 1: Patient-related information (n= 50)

Variables	Categories	Frequency (n)	Percent (%)
Age groups	≤ 10	4	8
	11-20	8	16
	21-40	20	40
	41-60	12	24
	> 60	6	12
	Mean $\pm$ SD		34.8 ± 17.7
Gender	Male	36	72
	Female	14	28
Socioeconomic status	Lower class	35	70
	Middle class	10	20
	Upper class	5	10
Habitat	Rural	41	82
	Urban	9	18

Table 2: Clinical spectrums of the patients (n= 50)

Clinical spectrums	Frequency (n)	Percent (%)
Neck swelling	50	100
Pain and tenderness	50	100
Fever	45	90
Dysphagia	36	72
Dental complaints	14	28
Voice change	15	30
Foul smelling breath	12	24
Trismus	5	10
Respiratory distress	3	6
Firm submental and submaxillary area	25	50
Raised and firm floor of mouth	14	28
*Multiple responses		

Figure 1: Pattern of microorganism in aerobic culture (n= 50)**Table 3: Association of microbial pattern with patient-related variables (n= 50)**

Variables	Category	Streptococcal growth	Mixed growth	Total	χ^2 value	p-value
		n (%)	n (%)	n (%)		
Gender	Male	4 (11.1)	32 (88.9)	36 (100)	4.20	0.041*
	Female	8 (57.1)	6 (42.9)	14 (100)		

Chi-square was done; A p-value <0.05 was considered significant value

Table 4: Association of microbial pattern with patient's age (n= 50)

Microbial pattern	n	Age (years)	t-value	p-value
		Mean $\pm$ SD		
Streptococcal growth	12	42.5 $\pm$ 15.8	2.33	0.024*
Mixed growth	38	33.4 $\pm$ 17.2		

Independent sample t-test was done; A p-value <0.05 was considered significant value

Discussion

This study evaluated the socio-demographic profile, clinical presentation, and aerobic microbial patterns of patients with Ludwig's angina in tertiary hospitals of Dhaka. The majority of patients were young to middle-aged adults, with the highest proportion (40%) aged 21-40 years and a mean age of 34.8 ± 17.7 years. This aligns with previous studies from both Bangladesh and other low-resource settings, which reported that Ludwig's angina predominantly affects adults in their productive age, likely due to the higher prevalence of dental infections in this population.^{11,12} The marked male predominance (72%) observed is consistent with global literature, which suggests males are more frequently affected, potentially related to differences in oral hygiene practices and healthcare-seeking behaviour. Most patients were from the lower socioeconomic class (70%) and rural areas (82%), reflecting limited access to dental care and delayed presentation, which are well-documented risk factors for severe odontogenic infections in resource-limited contexts.^{8,13}

Clinically, all patients presented with neck swelling and tenderness, and 90% had fever, confirming the classical presentation of Ludwig's angina described in prior studies.⁷ Dysphagia (72%), voice change (30%), and trismus (10%) were also observed, consistent with involvement of deep neck spaces and partial airway compromise. Respiratory distress was uncommon (6%), suggesting that most patients presented before critical airway obstruction developed. Local findings such as firm submandibular and submental regions (50%) and raised floor of the mouth (28%) corroborate the typical pathophysiology of submandibular space infection.^{7,14,15}

Microbiologically, 76% of patients exhibited mixed aerobic bacterial growth, while 24% showed isolated Streptococcal species. This predominance of polymicrobial infection is consistent with the literature, as Ludwig's angina typically arises from mixed oral flora including Streptococcus, Staphylococcus, and anaerobic organisms.^{9,10} The presence of isolated Streptococcal growth in older patients suggests that age may influence

the microbial profile, possibly due to age-related changes in oral microbiota or host immunity.^{16,17}

Gender was also significantly associated with microbial patterns. Mixed infections were more common in males (88.9%), whereas isolated Streptococcal growth predominated in females (57.1%). This finding may reflect differences in oral hygiene, dental care utilization, or immune response between genders, and it underscores the need to consider patient-specific factors when initiating empirical therapy.^{9,18}

These findings emphasize that Ludwig's angina in this cohort was primarily a polymicrobial disease affecting young adult males from rural, lower socioeconomic backgrounds. Recognition of the socio-demographic determinants, clinical features, and microbial patterns can guide timely airway management and empiric broad-spectrum antibiotic therapy, potentially reducing morbidity and mortality associated with this condition.

Conclusion

Ludwig's angina in this cohort predominantly affected young adult males from rural, lower socioeconomic backgrounds. Patients typically presented with classical signs of neck swelling, pain, and fever, while airway compromise was uncommon at presentation. The infection was mainly polymicrobial, highlighting the importance of early broad-spectrum empirical antibiotic therapy. Age and gender were significantly associated with microbial patterns, which may guide targeted management and improve patient outcomes in resource-limited settings.

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