Research

Correlation of bacterial patterns with length of stay in deep neck abscess in Denpasar

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ABSTRACT

Background: Deep neck abscess is a potentially life-threatening disorder, if not managed appropriately. Identification of the causative bacterial and factors influencing the length of hospital stay (LOS), essential for optimizing treatment strategies. **Purpose:** To evaluate the correlation between bacterial patterns and LOS in patients with deep neck space abscesses at Prof. Ngoerah General Hospital, Denpasar. **Method:** Observational analytic study with a retrospective cross-sectional design design. Data were obtained from medical records of patients diagnosed with deep neck abscess between January 2021 and December 2023, who met the inclusion criteria. Variables collected included patient characteristics, bacterial pattern based on culture results, and duration of hospitalization. The Mann-Whitney U test was used to analyze differences in LOS between bacterial groups, as the data were not normally distributed. **Result:** A total of 44 patients met the inclusion criteria, consisting of 27 males (61.4%) and 17 females (38.6%), with a mean age of 45.86±15.89 years. The most common diagnosis was submandibular abscess (52.3%). The distribution of bacterial pattern nearly equal between Gram-positive (47.7%) and Gram-negative (52.3%) organisms. The mean LOS in patients with Gram-negative infections was 8.70±4.92 days, compared with 6.48±4.17 days in those with Gram-positive infections. The Mann-Whitney U test demonstrated a statistically significant difference between the two groups ($p < 0.05$). **Conclusion:** There was a significant association between bacterial pattern and LOS in patients with deep neck abscess in this research. Gram-negative bacteria tend to result in longer hospitalization compared to those caused by Gram-positif bacteria.

Keywords: deep neck abscess, bacterial pattern, length of stay

ABSTRAK

Latar belakang: *Abses leher dalam merupakan kelainan serius, yang dapat mengancam jiwa apabila tidak ditangani secara adekuat. Identifikasi pola kuman penyebab dan faktor-faktor yang memengaruhi lama rawat inap* (length of stay/LOS) *penting dalam menentukan strategi tatalaksana yang tepat.* ***Tujuan:*** *Untuk mengevaluasi hubungan antara pola kuman dan lama rawat inap, pada pasien dengan abses leher dalam, di RSUP Prof. Ngoerah, Denpasar.* ***Metode:*** *Studi analitik observasional dengan desain desain potong-lintang retrospektif. Data diambil dari rekam medis pasien yang dirawat dengan diagnosis abses leher dalam, sejak Januari 2021 hingga Desember 2023, dan memenuhi kriteria inklusi. Data meliputi karakteristik pasien, jenis kuman penyebab berdasarkan hasil kultur, serta lama rawat inap. Analisis hubungan pola kuman dan* LOS *dilakukan menggunakan uji* Mann-Whitney U*, karena data tidak terdistribusi normal.* ***Hasil:*** *Terdapat 44 pasien yang memenuhi kriteria inklusi, terdiri dari 27 laki-laki (61,4%) dan 17 perempuan (38,6%), dengan rerata usia 45,86±15,89 tahun. Diagnosis terbanyak adalah abses submandibular (52,3%). Pola kuman menunjukkan distribusi yang hampir seimbang antara Gram-positif (47,7%) dan Gram-negatif (52,3%). Rata-rata* LOS *pada pasien dengan infeksi Gram-negatif adalah 8.70±4.92 hari, sedangkan pada Gram-positif 6.48±4.17hari. Uji* Mann-Whitney U *menunjukkan perbedaan bermakna secara statistik antara kedua kelompok ($p < 0,05$).* ***Kesimpulan:*** *Terdapat hubungan yang signifikan antara pola kuman penyebab dan lama rawat inap, pada pasien abses leher dalam. Dalam penelitian ini, bakteri Gram-negatif cenderung menyebabkan perpanjangan durasi rawat inap dibandingkan dengan infeksi bakteri Gram-positif.*

Temuan ini menekankan pentingnya identifikasi dini kuman penyebab dalam mendukung tatalaksana yang lebih efektif dan efisien.

Kata kunci: *abses leher dalam, pola kuman, durasi rawat inap*

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INTRODUCTION

Deep neck abscess is a kind of deep neck infection that is a potentially life-threatening emergency in otorhinolaryngology, caused by the accumulation of infection in the deep cervical fascial spaces. This disease remains associated with significant morbidity and mortality due to their potential to spread to adjacent structures such as the mediastinum, airway, and major vessels. Early diagnosis and appropriate management are therefore essential to prevent severe complications such as airway obstruction, septicemia, and descending necrotizing mediastinitis.[1]

Deep neck abcess commonly occurred from an infection of the oral cavity, pharynx, tonsils, odontogenic infections, or salivary gland infection, trauma and lymphadenitis. The polymicrobial nature of the oral cavity contributes to the complex microbiological profile of deep neck abcess, often involving both aerobic and anaerobic bacteria.[2,3]

Several studies have demonstrated that Gram-positive bacteria are the most commonly isolated pathogens. Streptococcus species, particularly the *Streptococcus viridans* group and *Streptococcus anginosus* group, are frequently reported due to their presence as normal flora in the oral cavity and oropharynx. *Staphylococcus aureus* has also been identified as an important pathogen in deep neck abcess. These bacteria play a significant role, particularly in infections originating from odontogenic or tonsillar sources. Even though Gram-positive organisms are often predominant, Gram-negative bacteria are also frequently identified in deep neck abcess. Pathogens such as *Klebsiella pneumoniae*, *Escherichia coli*, and *Pseudomonas aeruginosa* have been reported in several studies. In particular, *Klebsiella pneumoniae* has been found to be a common pathogen in certain populations, especially among patients with diabetes mellitus. The presence of Gram-negative bacteria has been associated with more severe infections, and may influence treatment outcomes.[2-4]

The clinical outcome of deep neck abcess can be influenced by several factors, including the type of infecting bacteria, the presence of comorbidities, and the severity of infection. Some studies have suggested that infections caused by certain pathogens or associated with systemic diseases, may lead to longer hospitalization and more complicated clinical courses.[4]

This study aimed to analyze the relationship between bacterial patterns—specifically Gram-positive versus Gram-negative organisms—and the length of hospital stay (LOS) in patients with deep neck abscesses, treated at Prof. Ngoerah General Hospital, Denpasar. Understanding this relationship is essential for improving clinical decision-making, optimizing empirical antibiotic protocols, and enhancing patient outcomes through more efficient and targeted management strategies.

METHOD

This study employed a retrospective cross-sectional analytic design, utilizing secondary data extracted from patient medical records. A retrospective cross-sectional design was selected because the data were collected at a single time point from existing medical records covering a defined study period, without prospective follow-up of an exposure-to-outcome timeline. This design is appropriate for describing the distribution of bacterial patterns and examining their association with length of hospital stay in a hospital-based setting, while acknowledging that causal inference cannot be established.

The research was conducted at Prof. Ngoerah General Hospital in Denpasar, Indonesia, between January and April 2025. The target population comprised all patients diagnosed with deep neck abscesses, while the accessible population included those who received treatment at the hospital between January 2022 and December 2023. A total sampling technique was used, in which all eligible patient records that met the inclusion and exclusion criteria were analyzed.

Inclusion criteria required patients to have received standard antibiotic therapy consisting of cefoperazone-sulbactam and metronidazole, and to have undergone microbiological culture and antibiotic susceptibility testing. Patients with incomplete medical records, lacking microbiological data, or with comorbidities and complications, were excluded. A minimum of 12 samples per group was calculated as sufficient, based on statistical power analysis.

The study aimed to analyze the relationship between bacterial patterns (Gram-positive vs. Gram-negative) and the length of hospital stay (LOS), among deep neck abscess patients. The independent variable was the bacterial pattern identified through culture, and the dependent variable was the LOS. Confounding variables such as age, sex, and comorbidities were also considered. Data collection and analysis were systematically performed based on operational definitions to ensure accuracy and consistency.

RESULT

In this study, a total of 44 patients who met the inclusion and exclusion criteria were included as samples. The sample consisted of 27 (61.4%) male patients and 17 (38.6%) female patients, with a mean age of 45.86±15.89 years. The diagnosis of deep neck space abscess was most commonly found in the form of submandibular abscesses, observed in 23 (52.3%) patients; followed by pseudoangina Ludovici in 7 (15.9%) patients, parotid abscess in 6 (13.6%), peritonsillar abscess in 5 (11.4%), Ludwig's angina in 2 (4.5%), and parapharyngeal abscess in 1 (2.3%) patient. Based on the bacterial pattern, infections caused by Gram-negative bacteria were found in 23 (52.3%) patients, while Gram-positive bacteria were identified in 21 (47.7%) patients, indicating a nearly balanced distribution between the two groups. The overall average length of stay (LOS) for both bacterial groups was 7.64±4.66 days. (Table 1).

The mean LOS in the Gram-negative and Gram-positive bacterial groups was 8.70±4.92 days and 6.48±4.17 days, respectively. According to the Shapiro-Wilk normality test, data from both groups were not normally distributed ($p < 0.001$). Therefore, the comparison of LOS between the two groups was analyzed using the Mann-Whitney U test. The comparison revealed a statistically significant difference in LOS, between infections caused by Gram-negative and Gram-positive bacteria. (Table 2).

Table 1. The distribution of research sample

Characteristic	N
Age	45.86±15.89 y.o
Sex	
Male	27 (61.4%)
Female	17 (38.6%)
Diagnosis	
Submandibular abscess	14 (31.8%)
Coli abscess	9 (20.5%)
Pseudoangina Ludovici	7 (15.9%)
Parotid abscess	6 (13.6%)
Peritonsillar abscess	5 (11.4%)
Ludwig angina	2 (4.5%)
Parapharyngeal abscess	1 (2.3%)
Bacterial Pattern	
Gram-negative	23 (52.3%)
Gram-positive	21 (47.7%)
LOS (Mean±SD)	7.64±4.66 days
Median (Min-max)	7 (3-28) days

Table 2. Comparison of Length-of-Stay (LOS between Gram-negative and Gram-positive bacteria

	Gram-negative	Gram-positive	*p* value
Length of stay (LOS)			
Mean±SD	8,70±4,92	6,48±4,17	0.009*
Median (range)	8 (4–28)	5 (3–22)	

SD = standard deviation, **p* value from Mann–Whitney U test

DISCUSSION

This study aimed to evaluate the relationship between bacterial patterns and length of stay (LOS), in patients diagnosed with deep neck space abscesses, treated at Prof. Ngoerah General Hospital, Denpasar. The findings revealed a significant difference in the mean duration of hospitalization, between patients with Gram-positive and Gram-negative bacterial infections.

The study included 44 patients who met the inclusion and exclusion criteria, with a male predominance (61.4%). The mean age of patients was 45.86±15.89 years, indicating that deep neck space abscesses tended to occur in middle-aged to elderly adults. The most common diagnosis was submandibular abscess (52.3%), followed by pseudoangina Ludovici, parotid abscess, peritonsillar abscess, Ludwig's angina, and parapharyngeal abscess.

In this study, deep neck space abscesses were more common in male patients (61.4%), with a mean age of 45.86±15.89 years. These findings indicated that the disease predominantly affected middle-aged adults. There was similar demographic patterns have

been reported in previous studies. Almutairi et al.[5] reported that deep neck infections were more frequently observed in male patients and commonly affected adults in the middle-aged group. Likewise, Bal et al.[2] found that the majority of patients with deep neck infections were adults, reflecting the higher prevalence of predisposing factors such as odontogenic infections, tonsillitis, and systemic diseases in this age group. According to the description in *Cummings Otolaryngology*, deep neck infections commonly occur in adults due to infections originating from the upper aerodigestive tract, particularly dental and tonsillar infections.[3]

The distribution of bacterial patterns showed that 52.3% of infections were caused by Gram-negative bacteria and 47.7% by Gram-positive bacteria. Although the distribution was relatively balanced, there was a significant difference in the mean LOS between the two groups. Patients with Gram-negative infections had a longer LOS (8.65±4.87 days) compared to those with Gram-positive infections (5.38±4.08 days), with the Mann-Whitney U test demonstrating a statistically significant difference ($p < 0.05$).

This study evaluated the correlation between bacterial patterns and length of stay, focusing on Gram-positive and Gram-negative bacterial infections. Deep neck infections were typically polymicrobial and involve both aerobic and anaerobic bacteria, originated from oral cavity and upper respiratory tract.[3] Several studies had reported that Gram-positive bacteria, particularly *Streptococcus* species, were among the most common pathogens isolated in deep neck infections. Bandol et al.[1] identified *Streptococcus* species as one of the most frequently isolated organisms in patients with deep neck infections. Similarly, Yankov[6] reported that Gram-positive bacteria were predominant in many cases of neck abscesses, particularly those originating from lymph node infections. Severe infections caused by Group A *Streptococcus* might even lead to invasive disease requiring intensive care management, as described in the multicenter study by Orieux et al.[7]

Gram-negative bacteria also had an important role in the microbiological profile of deep neck abcess. Gao et al.[8] reported that *Klebsiella pneumoniae* was one of the most commonly isolated Gram-negative pathogens and was associated with more severe clinical presentations. Likewise, Luan et al.[9] found that *Klebsiella pneumoniae* was particularly prevalent in patients with diabetes mellitus, indicating the influence of systemic comorbidities on bacterial patterns. Our study found a near-equal distribution between Gram-negative (52.3%) and Gram-positive (47.7%) organisms. Overall, the findings of this study were consistent with previous literatures demonstrating that deep neck infections were complex infections involving a wide spectrum of microorganisms. While Gram-positive bacteria remained common pathogens, Gram-negative bacteria also played an important role in certain patient populations and might be associated with more severe clinical outcomes.[1,6,8,9]

Understanding the bacterial profile of deep neck abcess is important for selecting appropriate empirical antibiotic therapy and optimizing patient management. Since deep neck infections are often polymicrobial, broad-spectrum antibiotics targeting both Gram-positive and Gram-negative bacteria are generally recommended during the initial treatment.[2,3] Early identification of the causative organisms through culture and sensitivity testing is important to guide targeted antimicrobial therapy. Appropriate treatment is essential to prevent severe complications such as airway obstruction, sepsis, or descending necrotizing mediastinitis.[10,11]

A notable finding of this study was the significant difference in the mean length of hospitalization between patients with Gram-positive and Gram-negative bacterial

infections. Previous studies had shown that infections caused by certain bacterial pathogens might lead to more severe clinical presentations and prolonged hospitalization. Gao et al.[8] reported that infections caused by *Klebsiella pneumoniae* were associated with increased disease severity and more complicated clinical courses. Ho et al.[12] explained that several factors, including infection severity, comorbidities, and microbiological characteristics, were associated with prolonged hospitalization in patients with deep neck infections.

The observed difference in hospitalization duration between Gram-positive and Gram-negative, highlighted the importance of understanding bacteriological patterns in deep neck abcess. These findings supported previous studies suggesting that microbial characteristics could influence disease severity, treatment strategies, and clinical outcomes.[8,12]

Our study provided important epidemiological insight. There was limited published data from Indonesia, and this research hopefully could fill the gap. The nearly even bacterial distribution, predominance of submandibular involvement, and notable LOS difference between bacterial groups, should prompt regional considerations for empiric therapy guidelines and public health strategies.

These findings had important implications for the initial management of patients with deep neck space abscesses. Early identification of the causative organism, particularly if Gram-positive infection is suspected, may help clinicians select appropriate antibiotic strategies, and anticipate the likely duration of hospitalization. This approach is crucial for optimizing hospital resource utilization, and planning more effective and efficient clinical management.

Furthermore, since the overall mean LOS in this study was 7.64±4.66 days, identifying factors that contribute to prolonged hospitalization, including the type of causative bacteria, is essential to prevent delays through targeted and aggressive treatment strategies.

In conclusion, this study proved that the majority of deep neck abscess patients were male (61.4%) with a mean age of 45.86±15.89 years. The most common type was submandibular abscess (52.3%), followed by pseudoangina Ludovici (15.9%). Culture results showed a nearly equal distribution of causative pathogens: Gram-negative bacteria (52.3%) and Gram-positive bacteria (47.7%). The overall mean length of stay (LOS) was 7.64±4.66 days. Patients with Gram-negative infections had a significantly longer LOS (8.70±4.92 days) compared to those with Gram-positive infections (6.48±4.17 days), with statistical significance confirmed by the Mann-Whitney U test ($p < 0.05$). Therefore, Gram-negative bacterial infections were significantly associated with prolonged hospitalization in deep neck abscess cases.

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