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The effect of appropriate antibiotic use on the length of hospital stay in deep neck abscess (DNA) patients

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ABSTRACT

Deep neck abscess (DNA) is an emergency in the otorhinolaryngology head and neck surgery field due to the formation of abscesses in the potential space between the deep neck fasciae. It is typically caused by the expansion of infection from various sources, including the teeth, mouth, throat, paranasal sinuses, middle ear, and neck. The increase of DNA cases needs for improvement of patient management especially when the patients have comorbidities which lead to an extended length of treatment. The study aimed to evaluate the appropriateness of empirical antibiotics given according to culture results and any comorbid factors that affect the length of hospital stay (LOHS). It was case-control observational study involving 44 cases of DNA patients who treated at Dr. Sardjito General Hospital Yogyakarta in the period of January 2018 to December 2020. The patients were divided into two groups with 22 patients in each group. The first group was the DNA patients with > 7 d LOHS and the second one was those with ≤ 7 d. No significantly relationship was observed between variables evaluated included the appropriate antibiotic use (p=0.546). However, dental caries (DC) was significantly related with the LOHS (p=0.015). In conclusion, there is no relationship between the appropriate antibiotic use and the LOHS. However, the DC is risk factor that influence the LOHS in patients with DNA.

ABSTRAK

Abses leher dalam (ALD) merupakan kegawatan di Bidang THT-KL akibat terbentuknya abses di dalam ruang potensial di antara fasia leher. Hal ini umumnya disebabkan adanya perluasan infeksi dari berbagai sumber, seperti dari gigi, mulut, tenggorok, sinus paranasal, telinga tengah dan leher. Meningkatnya kasus ALD memerlukan perbaikan dalam penanganan pasien khususnya jika pasien mempunyai factor penyerta yang menyebabkan perpanjangan masa perawatan. Penelitian ini bertujuan untuk mengkaji kesesuaian pemberian antibiotik secara empiris berdasarkan hasil kultur dan faktor penyerta terhadap lama perawatan di rumah sakit (LPRS). Penelitian observasional dengana rancangan kasus kontrol ini melibatkan 44 kasus ALD yang menjalani perawatan di RSUP Dr. Sardjito, Yogyakarta periode Januari 2018 sampai Desember 2020. Pasien dibagi dalam dua kelompok dengan masing-masing kelompok terdiri dari 22 pasien. Kelompok pertama adalah pasien ALD dengan LPRS >7 hari dan kelompok kedua dengan LPRS ≤7 hari. Tidak terdapat hubungan nyata yang teramati antara variabel yang dievaluasi termasuk penggunaan antibiotik yang tepat (p=0,546). Namun demikian, karies gigi berkaitan nyata dengan LPRS (p=0,015). Dapat disimpulkan tidak ada hubungan antara penggunaan antibiotik yang tepat dan LPRS. Namun demikian karies gigi merupakan faktor risiko yang mempengaruhi LPRS pasien ALD.

Keywords:
deep neck abscess;
length of hospital stay;
appropriate antibiotic use;
empirical antibiotic;
dental caries

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INTRODUCTION

Deep neck abscess (DNA) is an emergency condition in the otorhinolaryngology head and neck surgery field. The formation of an abscess in the potential space of the deep neck fascia is typically due to the expansion of infection from various sources, such as teeth, mouth, throat, paranasal sinuses, middle ear, and neck. The DNA may lead to sepsis, which is a condition that triggers the patient's condition in multi-organ failure. These conditions are dreadful, so the management needs to be more comprehensive, and it must be taking more time than usual.[1-5]

The diagnosis and management of DNA is a difficult challenge in otolaryngology because of its complexity and depth of involvement of the abscess site, the incidence of multibacterial infection, and the compatibility of antibiotics given with the results of bacterial cultures in DNA. Changes in the pattern of bacteria and resistance to antibiotics have contributed to an increase in the incidence of DNA. Antibiotics play an important role in the hospital environment, especially inpatient rooms, and intensive care units where many patients are administered antibiotics as prophylaxis. Successful treatment and prevention of resistance depends on using antibiotics wisely. Inappropriate antibiotic use can have a negative impact on patients' outcomes.[6] In severe cases, incision and drainage procedure can be performed if the airway is stable by transcervical and transoral approach and the pus can be obtained by needle aspiration.[7] In Dr. Sardjito General Hospital, Yogyakarta the antibiotic for standard therapy derived from an empirical study was firstly stipulated since around end of 2018. It came up with combination of ceftriaxone and metronidazole based on the previous study.[8]

Study concerning evaluating the appropriateness of the use of antibiotics and risk factors related to length of hospital stay (LOHS) in patients with DNA at Dr. Sardjito General Hospital has never been conducted. Brito *et al.*[8] reported morbidity factors that can increase the LOHS of the inpatient with DNA such as diabetes mellitus (DM), and obesity, and identified that those comorbidities with the extending abscess, and the location of the potential space of the abscess. Other studies conducted by Kauffman *et al.*,[9] and O'Brien *et al.*,[10] also reported that there are some factors affecting the rise of LOHS stay, such as age, ASA class, repeat procedure, Charlson comorbidity index, cardiopulmonary diseases, patients with multiple space infections, and DM.

This study aimed to investigate the appropriate antibiotic use and the risk factors that may contribute to the LOHS. The results can provide the latest information on empirical antibiotics with the latest bacterial culture and inform about the risk factors related to the LOHS, therefore they can be used as a future guideline.

MATERIALS AND METHODS

Design

The study used a case control design to investigate the relationship between appropriate antibiotic use with LOHS in patients with DNA. The study was conducted by collecting data from the medical records of patients with DNA at Dr. Sardjito General Hospital, Yogyakarta in the period of January 2018 to December 2020.

Procedure

Patients with DNA who meet the inclusion and exclusion criteria were involved in this study. The inclusion

criteria were the patients with DNA who had received intravenous antibiotics in their first admission at once, had been performed culture and sensitivity test of bacteria from pus sample with detected bacteria growth and sensitivity of antibiotic to the bacteria, and had finished the treatment until patients leaving the hospital. Complete data of medical records must be complied with to meet the inclusion criteria. The exclusion criteria were patients with DNA without complete treatment, such as patients who had passed away before treatment finished or patients discharged.

In this study, the appropriate antibiotic use was when a sensitive value to bacterial culture and sensitivity test results were suitable to the regimen administered beforehand. The LOHS was described as the duration of a single episode of hospitalization. It was measured from the patient's admission to the patients discharge.

According to the calculation of the research sample obtained with minimal sample was 22 samples in each group. The case group was the group of patients who were diagnosed with DNA with LOHS for > 7 d and the control group was the group of patients with DNA who stayed for ≤ 7 d.

The protocol of study was approved by the Medical and Health Research Ethics Committee, Faculty of Medicine, Public Health and Nursing, Universitas Gadjah Mada/Dr. Sardjito General Hospital, Yogyakarta, Indonesia with the reference number KE/FK/0152/EC/2021.

Statistical analysis

After the data from the medical records were collected, then the results were tabulated with percentages and means with 95% confidence interval (CI), then analyzed by using Chi-square tests and logistic regression analysis for multivariate analysis with significance set as $p<0.05$.

RESULTS

The presentation of the results of the data analysis used descriptive and statistical analysis, which was divided into two main parts. The first part was the characteristics of the research subjects, and the second part was the main results which contained the analysis of the relationship of appropriate antibiotics to the LOHS in patients with DNA.

A total of 44 patients with DNA who met the inclusion and exclusion criteria were involved in this study. For the case and control groups, 22 patients were diagnosed as DNA with hospitalization of > 7 d, and 22 patients were diagnosed with DNA with hospitalization of ≤ 7 d. From the 44 patients diagnosed with abscess, the age range was between 6 to 79 y.o., and 5 of them experienced complications of upper airway obstruction so that a tracheostomy was needed (TABLE 1). Moreover, it was found that only dental caries (DC) was significantly correlated with the LOHS ($p = 0.015$), whereas other variables were not correlated with the LOHS ($p> 0.05$). This finding shows that the presence of DC in DNA patients is the only variable that significantly affected the LOHS (TABLE 1).

The location of the extension of DNA involved the submandibular space, parotid parapharynx, pretrachea, masticator, buccal, retropharynx, and peritonsillar. Bacterial culture results in DNA patients mainly found *Streptococcus* spp., *Staphylococcus* spp., and *Acinetobacter* spp. Bacteria (TABLE 2).

TABLE 1. Characteristics based on LOHS

Variable	LOHS >7 d	LOHS ≤ 7 d	Total	p
	n_1	n_2	n	
Gender				
• Male	11	18	29	0.056
• Female	11	4	15	
Age				
• Geriatric	9	6	15	0.525
• Non-geriatric	13	16	29	
DM				
• Yes	13	7	20	0.130
• No	9	15	24	
Hypertension				
• Yes	7	3	10	0.280
• No	15	19	34	
GIT bleeding				
• Yes	4	2	6	0.664
• No	18	20	38	
IDP				
• Yes	20	17	37	0.412
• No	2	5	7	
DC				
• Yes	17	8	25	0.015
• No	5	14	19	
IRF				
• Yes	6	4	10	0.719
• No	16	18	34	
Mediastinitis				
• Yes	1	2	3	1.000
• No	21	20	41	
Sepsis				
• Yes	2	2	4	1.000
• No	20	20	40	

DM: diabetes mellitus; IDP: incision and drainage procedure; CD: caries dentis; IRF: impaired renal function

TABLE 2. Culture and antibiotic sensitivity test results

Patient	Bacteria	Antibiotic	
		Sensitive	Resistence
53/M	*Klebsiella pneumoniae*	Gentamicin, amikacin, ceftriaxone, ciprofloxacin, trimethoprim/sulfamethoxazole, aztreonam	Ampicillin
36/F	*Streptococcus viridans*	Gentamicin, ampicillin/sulbactam, cefuroxime, ceftriaxone, ciprofloxacin, levofloxacin	None
53/F	*Prevotella oralis*	Penicillin, erythromycin, ampicillin/sulbactam, cefuroxime, ceftriaxone, tetracycline, chloramphenicol, metronidazole, colistin	Cefazolin
72/F	*Acinetobacter baumannii*	Amikacin, trimethoprim/sulfamethoxazole	Gentamicin, Tigecycline
55/M	*Staphylococcus gallinarum*	Azithromycin, amikacin, ampicillin/sulbactam, cefuroxime, cefoxitin, ertapenem, imipenem, meropenem, tetracycline, trimethoprim/sulfamethoxazole	Clindamycin, Ciprofloxacin
43/M	*S. aureus*	Gentamicin, cefepime, trimethoprim/sulfamethoxazole, aztreonam	None
36/M	*Corynebacterium sp*	Imipenem, linezolid	Cefotaxime
21/M	*Micrococcus sp.*	Ampicillin, penicillin, clindamycin, oxacillin, ampicillin/sulbactam, cefuroxime, cefoxitin, ciprofloxacin, vancomycin, ceftazidime	Tetracycline
62/F	*A. baumannii*	Gentamicin, cefepime, ciprofloxacin, trimethoprim/sulfamethoxazole, aztreonam, ceftazidime	None
38/M	*S. viridans*	Ampicillin, erythromycin, clindamycin, ampicillin/sulbactam, cefuroxime, ciprofloxacin, imipenem, doxycycline, chloramphenicol	Cefoxitin, Ceftriaxone, Tetracycline
60/F	*A. baumannii*	Gentamicin, ampicillin/sulbactam, ciprofloxacin, meropenem, trimethoprim/ sulfamethoxazole, ceftazidime	Ceftriaxone
24/M	*S. anginosus*	Ampicillin, penicillin, azithromycin, erythromycin, clindamycin, oxacillin, cefuroxime, cefepime, ciprofloxacin, levofloxacin, imipenem, linezolid, trimethoprim/ sulfamethoxazole, chloramphenicol, moxifloxacin, trimethoprim/sulfamethoxazole, ceftazidime	Amikacin, Cefoxitin, Ceftriaxone, Tetracycline
17/F	*S. anginosus*	Ampicillin, penicillin g, azithromycin, erythromycin, clindamycin, oxacillin, cefuroxime, cefepime, ciprofloxacin, levofloxacin, imipenem, linezolid, trimethoprim/ sulfamethoxazole, chloramphenicol, moxifloxacin, trimethoprim/sulfamethoxazole, ceftazidime	Amikacin, Cefoxitin, Ceftriaxone, Tetracycline,
30/M	*S. viridans*	Flucytosine	None
65/M	*A. baumannii*	Oxacillin, ampicillin/sulbactam, cefoxitin, levofloxacin, linezolid, tetracycline, ofloxacin	Azithromycin, Erythromycin, Amikacin, Chloramphenicol
34/M	*A. baumannii*	Gentamicin, ampicillin/sulbactam, ciprofloxacin, trimethoprim/sulfamethoxazole, ceftazidime, tigecycline	Ceftriaxone
65/M	*S. viridans*	Ciprofloxacin, aztreonam, ceftazidime	None
29/M	*S. epidermidis*	Azithromycin, erythromycin, clindamycin, gentamicin, linezolid, vanco, tigecycline	Moxifloxacin
45/M	*Enterobacter cloacae ssp cloacae*	Gentamicin, ciprofloxacin, meropenem, aztreonam, ceftazidime	None
30/M	*Cryptococcus laurentii*	Ketoconazole, nystatin, fluconazole, voriconazole	Clotrimazole, Econazole
20/M	*Coagulase negative Staphylococcus*	Azithromycin, erythromycin, ciprofloxacin, levofloxacin, trimethoprim/ sulfamethoxazole, ofloxacin, moxifloxacin, rifampicin	None
6/M	*S. aureus*	Azithromycin, erythromycin, clindamycin, oxacillin, cefazolin, gentamicin, ampicillin/sulbactam, cefuroxime, ceftriaxone, ciprofloxacin, levofloxacin, linezolid, tetracycline, vancomycin, trimethoprim/sulfamethoxazole, cefotaxime, ceftazidime, amoxicillin/clavulanic acid, cephalothin, methicillin, quinupristin/dalfopristin, ticarcillin/clavulanic acid, piperacillin/tazobactam, ceftizoxime,	None
51/F	*A. baumannii*	Amikacin, ampicillin/sulbactam, meropenem, trimethoprim/sulfamethoxazole, tigecycline	None

TABLE 2. Culture and antibiotic sensitivity test results (cont.)

Patient	Bacteria	Antibiotic	
		Sensitive	Resistence
79/M	*Prevotella oralis*	Ampicillin, penicillin, azithromycin, erythromycin, clindamycin, oxacillin, ampicillin/sulbactam, cefuroxime, ceftriaxone, ciprofloxacin, levofloxacin, doxycycline, tetracycline, trimethoprim/sulfamethoxazole, chloramphenicol, ofloxacin, cefotaxime, ceftazidime, metronidazole, colistin	None
60/M	*Pseudomonas aeruginosa*	Gentamicin, ceftriaxone, trimethoprim/sulfamethoxazole, aztreonam, ceftazidime	Cefotaxime
53/M	*K. pneumoniae*	Gentamicin, ampicillin/sulbactam, cefepime, ceftriaxone, ciprofloxacin, trimethoprim/sulfamethoxazole	None
35/F	*S. epidermidis*	Ampicillin, penicillin, oxacillin, ampicillin/sulbactam, cefuroxime, cefoxitin, ceftriaxone, ciprofloxacin, levofloxacin, imipenem, vancomycin, chloramphenicol, ofloxacin, cefotaxime, ceftazidime	None
47/F	*Escherichia coli*	Ampicillin, penicillin g, azithromycin, amikacin, cefuroxime, cefoxitin, ceftriaxone, ciprofloxacin, levofloxacin, tetracycline, chloramphenicol, trimethoprim/sulfamethoxazole, cefotaxime	None
32/M	*K. pneumoniae*	Gentamicin, ampicillin/sulbactam, ceftriaxone, ciprofloxacin, ertapenem, meropenem, trimethoprim/sulfamethoxazole, aztreonam	None
76/M	*A. junii*	Gentamicin, ampicillin/sulbactam, ceftriaxone, ciprofloxacin, trimethoprim/sulfamethoxazole, ceftazidime	None
49/M	*K. pneumoniae*	Gentamicin, ampicillin/sulbactam, ceftriaxone, ciprofloxacin, trimethoprim/sulfamethoxazole, ceftazidime	Cefotaxime
53/F	*S. hominis*	Gentamicin, ampicillin/sulbactam, cefuroxime, ceftriaxone, ciprofloxacin, levofloxacin, cefotaxime	None
32/M	*S. epidermidis*	Azithromycin, clindamycin, cefazolin, gentamicin, ampicillin/sulbactam, ciprofloxacin, meropenem, linezolid, tetracycline	None
42/F	*Salmonella sp*	Ampicillin, ampicillin/sulbactam, cefepime, ceftriaxone, ciprofloxacin, ertapenem, meropenem, trimethoprim/sulfamethoxazole, aztreonam, ceftazidime	None
49/M	*S. constellatus*	Ampicillin, penicillin g, azithromycin, ampicillin/sulbactam, cefoxitin, levofloxacin, ertapenem, meropenem, vancomycin, trimethoprim/sulfamethoxazole, ofloxacin, cefotaxime	None
68/M	*Enterococcus faecalis*	Ampicillin, penicillin g, ampicillin/sulbactam, cefuroxime, cefoxitin, ceftriaxone, levofloxacin	Doxycycline
31/F	*P. aeruginosa*	Gentamicin, cefepime, ciprofloxacin, meropenem, aztreonam, ceftazidime	Ceftriaxone
46/M	*S. viridans*	Ampicillin, penicillin g, azithromycin, clindamycin, erythromycin, clindamycin, oxacillin, ampicillin/sulbactam, cefuroxime, cefepime, cefoxitin, ceftriaxone, ciprofloxacin, imipenem, meropenem, trimethoprim/sulfamethoxazole, chloramphenicol, ofloxacin, moxifloxacin, trimethoprim/sulfamethoxazole, cefotaxime, ceftazidime	Amikacin, Levofloxacin
65/M	*Salmonella sp*	Ampicillin/sulbactam, ceftriaxone, trimethoprim/sulfamethoxazole, ampicillin	Ciprofloxacin
64/M	*S. hominis*	Vancomycin, moxifloxacin, rifampicin,	Clindamycin, Gentamicin, Ciprofloxacin
62/F	*S. epidermidis*	Ampicillin, penicillin g, erythromycin, azithromycin, clindamycin, ampicillin/sulbactam, ertapenem, meropenem, tetracycline	Gentamicin, Chloramphenicol
35/F	*S. agalactiae*	Ampicillin, azithromycin, erythromycin, clindamycin, ampicillin/sulbactam, ceftriaxone, levofloxacin, imipenem, linezolid, tetracycline, vancomycin, trimethoprim/sulfamethoxazole, chloramphenicol, cefotaxime	Penicillin G
68/M	*S. viridans*	Gentamicin, cefepime, ciprofloxacin	None
40/F	*S. anginosus*	Ampicillin, azithromycin, clindamycin, ampicillin/sulbactam, cefuroxime, ciprofloxacin, trimethoprim/sulfamethoxazole	None

FIGURE 1 shows the sum of each type of potential space involved in the form of a bar chart. From the data, there were 29 cases with submandibular abscess, followed by parapharyngeal, pretracheal, parotid, masticator, buccal, retropharyngeal, and peritonsillar abscess cases.

A multivariate analysis of the variables with p< 0.200 on the main dependent variables to the LOHS was performed. Gender, DM, and dental caries were included (TABLE 3). After the logistic regression analysis conducted, it was found that only DC had a significant effect on the LOHS (p=0.029).

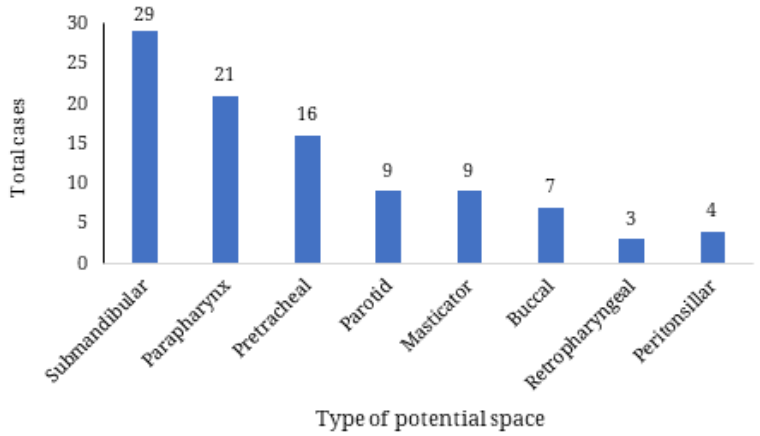

FIGURE 1. Type of potential neck space involved

TABLE 3. Multivariate analysis

Variable	Total	Univariate analysis		Multivariate analysis	
		OR (95% CI)	p	OR (95% CI)	p
Gender					
• Male	29	1	0.056	0.285 (0.064- 1.274)	0.100
• Female	15	0.222 (0.057-0.873)			
DM					
• Yes	20	1	0.130	2.782 (0.692- 11.180)	0.149
• No	24	3.095 (0.899-10.651)			
DC					
• Yes	25	1	0.015*	4.838 (1.180- 19.843)	0.029
• No	19	5.950 (1.586-22.328)			

DC: dental caries; DM: diabetes mellitus; CI: confidence interval; OR: odds ratio; *significant (p<0.05)

The main outcome of the study was the effect of the appropriate antibiotic use on the LOHS by comparing the sample LOHS > 7 d and ≤ 7 d in DNA patients with the appropriateness of the antibiotic given to the patients based on the culture and antibiotic sensitivity's results (TABLE 4). No significant relationship between the appropriate use of antibiotic on the DNA patients and the LOHS (p=0.546).

TABLE 4. Relationship of the appropriate use of antibiotic to LOHS

Antibiotic use	LOHS		Total (%)	OR (95% CI)	p
	> 7 d	≤7 d			
• Inappropriate	13	10	23	1	0.546
• Appropriate	9	12	21	0.577(0.175-1.905)	

CI: confidence interval; LOHS: length of hospital stay; OR: odds ratio.

DISCUSSION

This study showed that DC prolongs the LOHS of the patients with DNA (TABLE 1 and 3). Dental caries was the most common predisposing factor that caused the formation of odontogenic infections.[11] Poor oral hygiene and odontogenic infections could lead to lethal conditions such as descending necrotizing mediastinitis which required surgery. The cases of this condition had a mortality rate up to 40% although treatment had been conducted.[12] It was reported that the presence of DC in patients with DNA could deteriorate the condition requiring surgical treatment and prolong the treatment time. This condition was consistent with our study that found the DC was associated with an increase in the LOHS > 7 d. Bakir *et al.*,[13] also found that the DNA originating from odontogenic infection influenced a longer LOHS than non-odontogenic origin. Septic progressions in patient with dental infection can be aggravated by several predisposing factors such as DM, obesity, poor oral hygiene, and long-term nicotine or alcohol abuse so that these conditions can appear inclined inpatient stay.[14]

This study showed that no significantly relationship between the appropriate antibiotic use and the LOHS (TABLE 4). Marioni *et al.*,[15] reported that empirical antibiotic administration prior to culture and antibiotic sensitivity test obtained must cover Gram-positive, Gram-negative, and anaerobic bacteria. In addition, culture-appropriate antibiotic replacement could reduce the LOHS stay from 8.3 ± 6.2 d in 2000-2002 to 7.1 ± 5.3 d in 2003-2008. However, Nuryah *et al.*[16] reported that there was no correlation between the appropriate antibiotic use to clinical outcome in patients with MRSA infection. In this study, there was no significant correlation between the appropriate antibiotic use and LOHS. It was possible because the Department of Otolaryngology, Dr. Sardjito General Hospital, Yogyakarta had implemented an immediate antibiotic change according to culture.

In this study, each patient could contribute to more than one potential type (FIGURE 1). The number of submandibular abscesses was the highest number of abscess cases. This finding was similar to the results in the literature that the pre-antibiotic era of DNA came from pharyngeal or tonsil infections, but after the antibiotic era, DNA cases were caused by dental infections even in the antibiotic era. The number of cure rates also increased than the previous era.[17]

CONCLUSION

In conclusion, there is no relationship between the appropriate antibiotic use and the LOHS. However, the DC is risk factor the influence the LOHS in patients with DNA.

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