Research

Factors associated with the length of stay of deep neck abscess patients

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ABSTRACT

Background: Deep neck abscess is an accumulation of pus in one or more potential spaces of the deep neck fascia. Complications of deep neck abscesses are considered as an emergency in the Ear Nose Throat–Head and Neck field. One determining factor of prognosis in deep neck abscess patients is the length of stay in the hospital. **Objective:** To find out the factors associated with the hospital length of stay of deep neck abscess patients. **Method:** Observational research using a cross sectional design. Data collection was carried out using medical record data on 91 subjects diagnosed with deep neck abscess at Dr. Mohammad Hoesin Hospital Palembang from July 2018 to May 2021. **Result:** From the 91 samples studied, the average hospital length of stay for deep neck abscess patients was 11.26 days. The study found factors related to the length of stay in the hospital, namely comorbidities (p=0.005), location of the abscess (p=0.004), pus culture (p=0.003), and the number of deep-neck spaces involved (p=0.005). Linear regression found that the most significant factors on the hospital length of stay were the involvement of abscess in 2 or more deep neck spaces (p = 0.002) and the presence of comorbidities (p = 0.005). **Conclusion:** Abscess involvement in 2 deep neck spaces or more and the presence of comorbidities were the most influential factors associated with the hospital length of stay in deep-neck abscess patients..

Keywords: deep neck abscess, length of stay in hospital, factors, influence

ABSTRAK

Latar belakang: Abses leher dalam adalah akumulasi pus pada satu atau lebih ruang potensial fasia leher dalam sebagai akibat penjalaran infeksi. Komplikasi abses leher dalam masih merupakan keadaan darurat di bidang THT-KL. Salah satu faktor penentu prognosis adalah lama rawat di rumah sakit. Banyak faktor yang dapat mempengaruhi lama rawat pasien abses leher dalam di rumah sakit. Tujuan: Untuk mengetahui faktor-faktor yang berhubungan dengan lama rawat pasien abses leher dalam di RSUP Dr. Mohammad Hoesin Palembang. Metode: Penelitian observasional yang menggunakan rancangan potong lintang. Pengumpulan data dilakukan dengan menggunakan data rekam medis pada 91 subjek dengan diagnosis abses leher dalam di RSUP Dr. Mohammad Hoesin Palembang periode Juli 2018 sampai dengan Mei 2021. Hasil: Dari 91 sampel yang dilakukan penelitian, rerata lama rawat di rumah sakit pada pasien abses leher dalam adalah 11,26 hari. Penelitian mendapatkan faktor yang berhubungan dengan lama rawat di rumah sakit yaitu komorbid (p=0,005), lokasi abses (p=0,004), kultur pus (p=0,003), dan jumlah ruang leher dalam yang terlibat (p=0,005). Dari uji regresi linier didapatkan faktor yang paling memengaruhi lama rawat di rumah sakit adalah keterlibatan abses ≥ 2 ruang leher dalam (p=0,002) dan terdapat komorbid (p=0,005). Kesimpulan: Keterlibatan abses pada 2 ruang leher dalam atau lebih, dan terdapatnya komorbid adalah faktor yang paling berpengaruh terhadap lama rawat pasien abses leher dalam.

Kata kunci: abses leher dalam, lama rawat di rumah sakit, faktor, pengaruh

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INTRODUCTION

Deep neck abscess is an accumulation of pus in one or more potential spaces between the neck fascia caused by the spread of infection from various sources such as teeth, mouth, throat, paranasal sinuses, middle ear and neck.[1] The parapharyngeal space is a potential space that includes the deep neck space, in the form of an inverted pyramid with its base at the base of the skull, namely the pars petrosa os temporale and the tip or apex of the major horn of the hyoid bone.[2] In the United States, the incidence of retropharyngeal and parapharyngeal abscesses among < 20 years old deep neck abscess patients in 2003-2012 increased from 2.98 per 100,000 population per year to 4.10 per 100,000 population per year.[3] Another study in Brazil, in 2016, the incidence ranged around 10 per 100,000 people per year with a tendency to increase every year, especially in children under 5 years with an incidence of 2 per 100,000 people per year.[4]

Although it has been commonly reported that the incidence of neck abscesses has decreased with the extensive use of antibiotics, the complication of neck abscess is an emergency in the Ear Nose Throat-Head and Neck (ENT-HN) field. Complications of deep neck abscess include airway obstruction, sepsis, endocarditis, pericarditis, necrotizing fasciitis, mediastinitis, spondylitis, brain abscess, cavernous sinus thrombosis, thoracic empyema, pleuropulmonary suppuration, aspiration pneumonia, pneumothorax, carotid abscess, jugular thrombophlebitis, hematogenous spread to organs, and coagulation abnormalities ranging from thrombocytopenia to fulminant states of disseminated intravascular coagulation (DIC) that will lead to increased length of hospital stay.[5-7]

Many factors that could affect the length of stay of patients with neck abscess in the hospital include those related to the patient such as age, gender, comorbidities, symptom onset before hospital admission, and risk factors which include smoking, oral hygiene, and alcohol consumption. Factors related to deep neck abscess itself are the location of the abscess, the causative bacteria, abscess involving more than one deep neck space, and previous management with intravenous antibiotics. From several studies, it was found that patients with deep abscesses with old age and the presence of systemic disease were the most common. Diabetes mellitus was the factor most associated with an increase in hospitalizations. A study at The Royal Gwent Hospital Newport England for 10 years between 2006 to 2016 found that active smoking and comorbid diabetes mellitus were risk factors which often found in this disease and most influenced the hospital length of stay.[8] In a study in India, it was found that a history of smoking or alcohol consumption were influential risk factors, with the average hospital length of stay being 17.13 days, while those with diabetes mellitus were 24 days longer.[9] In Indonesia, research in Bali in 2016 found the average hospital length of stay for deep neck abscess was 8 days.[10]

Based on the description above, the researchers would like to determine the factors that have a role in the hospital length of stay for deep neck abscess patients. There was no such research in Indonesia yet. This study was expected to find out what factors could affect the hospital length of stay for deep neck abscesses patients, and determine the appropriate management and prevention of complication occurrence. With the hope it could improve the outcome and prognosis of

deep neck abscess patients, thereby reducing the mortality and morbidity, and minimize the treatment cost.

METHOD

An observational study using a cross sectional design. Data collection was carried out using medical record data on 91 subjects diagnosed with deep neck abscess at Dr. Mohammad Hoesin Hospital Palembang, from July 2018 to May 2021.

The inclusion criteria were complete medical record data of patients with proper treatment until fully cured. Data was described and presented as the characteristic of subjects and data was analyzed univariately. The researchers also analyzed and compared the length of stay between categories in each variable. Multivariate analysis was used to compare variable's contribution towards each other to define the length of stay.

RESULT

The number of subjects of this research were 91 patients diagnosed with deep neck abscess at Dr. Mohammad Hoesin Hospital Palembang, from July 2018 to May 2021.

The demographic factors of the research subjects were presented in Table 1. The presentation also included symptom onset before hospital admission, location of the abscess, pus culture, amount of deep neck space involved, and previous management using intravenous antibiotics.

Based on the age category, the majority of the research subjects were in the 26–35-year age group, as many as 22 patients (24.2%). In this study, there were more male (63.7%) than females (36.3%). Subjects who had comorbidities were 36 subjects (37.4%), with the most frequent comorbid was diabetes mellitus, as many as 23 subjects (25.3%), while without comorbidities as

many as 55 people (62.6%). Based on the onset of symptoms before admission to the hospital, the most subjects were in the 0–1-week onset group, as many as 57 subjects (62.6%), while the least was the onset > 1 month, which was only 2 patients (2.2%). The majority of subjects had risk factors, as many as 60 subjects (65.9%) with the most risk factors being dental infections in 54 subjects (59.3%), and the remaining 31 subjects did not have risk factors. Based on the location of the abscess, 59 subjects (64.8%) occurred in the non-parapharynx and 32 subjects occurred in the parapharynx (35.2%). The most often found location of the abscesses outside the parapharynx was submandibular, which affected 54 subjects (59.3%). Based on pus culture examination, 52 subjects found with bacterial growth (57.1%), and the most common bacterial species found was Klebsiella pneumoniae in 21.9% of all examinations, and 38.5% of all positive culture results, and in 39 other subjects no bacterial growth was found. (42.9%). Based on the number of deep neck spaces involved, there were 41 subjects who had 1 deep neck chamber space (45.1%), while the other 50 subjects had 2 or more spaces (54.9%). Based on previous administration of intravenous antibiotics, there were 70 subjects who had not been treated with previous intravenous antibiotics (76.9%), and 21 subjects who had received previous intravenous antibiotics treatment (23.1%). The distribution of the characteristics of the research subjects could be seen in Table 1.

The average length of stay for deep neck abscess patients in this study was 11.26 days with a standard deviation of 7.65 days. The shortest length of stay for deep neck abscess patients in this study was 2 days and the longest was 41 days.

The researchers found a significant difference between the mean length of stay in each age group in deep neck abscess patients (p=0.024). In male subjects, the average

length of stay was 12.15 days, and in females, the average length of stay was 10.75 days.

However, there was no relationship between gender and length of stay in hospital in deep neck abscess patients (p=0.29, r=-0.112).

Table 1. Distribution of characteristics of subjects

Variable(s)	N	%
Age		
0 – 5 y.o.	4	4.4
6 – 11 y.o.	1	1.1
12 – 16 y.o.	4	4.4
17 – 25 y.o.	8	8.8
26 – 35 y.o.	22	24.2
36 – 45 y.o.	15	16.5
46 – 55 y.o.	16	17.6
56 – 65 y.o.	14	15.4
>65 y.o.	7	7.7
Sex		
Male	58	63.7
Female	33	36.3
Onset of symptoms before admission		
0 – 1 week	57	62.6
2 weeks	20	22
3 weeks	4	4.4
4 weeks	8	8.8
>4 weeks	2	2.2
Comorbid present*		
Hypertension	36	37.4
Diabetes melitus	12	13.2
Kidney disorder	23	25.3
Thyroid disorder	4	4.4
Lung disorder	2	2.2
Anemia	2	2.2
Absent	1	1.1
	55	62.6
Risk factors present*		
History of dental infection	60	65.9
History of smoking	54	59.3
History of alcohol consumption	6	6.6
Absent	1	1.1
	31	34.1
Abscess location*		
Parapharynx	32	35.2
Not parapharynx	59	64.8
Peritonsil	17	18.7
Buccal	9	9.9
Submandibular	54	59.3
Masetter	2	2.2
Sublingual	3	3.3
Submental	23	25.3
Ludwig's angina	1	1.1
Parotid	7	7.7
Pretracheal	5	5.5
Retropharynx	16	17,6
Danger space	2	2.2
Visceral vascular	2	2.2

Pus culture		
Presence of pathogen	52	57.1
Klebsiella pneumoniae	20	21.9
Streptococcus sanguinis	5	4.4
Unidentified	5	5.5
Acinetobacter baumannii	4	4.4
Streptococcus gordonii	3	2.2
Burkholderia pseudomallei	2	2.2
Escherichia coli	2	2.2
Pseudomonas aeruginosa	2	2.2
Staphylococcus aureus	2	2.2
Streptococcus anginosus	2	2.2
Lactococcus garvieae	1	1.1
Proteus mirabilis	1	1.1
Salmonella spp	1	1.1
Sphingomonas paucimobilis	1	1.1
Staphylococcus capitis	1	1.1
Staphylococcus haemolyticus	1	1.1
Staphylococcus hominis	1	1.1
Absent	39	42.9
Number of deep neck space involved		
1 space	41	45.1
2 spaces	50	54.9
Previous intravenous antibiotic use		
Yes	21	23.1
No	70	76.9
Total	**91**	**100.0**

Table 2. Mean of length of stay of all subjects

	N	Min	Max	Mean ± S.D.
Length of stay	91	2.00	41.00	11.26 ± 7.65

The researchers found a significant difference between the mean length of stay in each age group in deep neck abscess patients (p=0.024). The longest average length of stay among age groups was the group of 0-5 years of age, which was 18.75 days. There was no relationship between age and length of stay in hospital in patients with deep neck abscess (p=0.09, r=0.17).

There was no significant difference between the mean length of stay for neck abscess patients in male and female (p=0.407). In male subjects, the average length of stay was 12.15 days and in women the average length of stay was 10.75 days. There was no relationship between gender and length of stay in hospital in deep neck abscess patients (p=0.29, r=-0.112).

There was no significant difference between the mean length of stay in each symptom onset group in deep neck abscess patients (p=0.092). The longest average length of stay was for patients with symptom onset of 2 weeks, namely 14.85 days, while the shortest was symptom onset of 0–1 week (9.68 days). There was a significant relationship between symptom onset before hospital admission and length of stay in deep neck abscess patients with a weak positive correlation strength (p=0.007, r=0.282).

The researchers found a significant difference between the mean length of stay for deep neck abscess patients with and without comorbidities (p=0.005). In patients with deep neck abscess with comorbidities,

the average length of stay was 16.08 days, while in patients without comorbidities, the average length of stay was 8.1 days. There is a significant relationship between patient comorbidities and length of stay for deep neck abscess patients with a strong positive correlation strength (p=0.005, r=0.517).

There was no significant difference between the mean length of stay in deep neck abscess patients with no risk factors and no risk factors (p=0.435). In the group with risk factors, the average length of stay was 11.71 days, while in the group without risk factors it was 10.38 days. There was no significant relationship between the risk factors for deep neck abscess and the length of stay of deep neck abscess patients (p=0.272, r=0.116).

The researchers found a significant difference between the mean length of stay in patients with abscess location in the parapharynx and non-parapharynx (p=0.004). In patients with abscesses located in the parapharynx, the average length of stay was 14.37 days, while in patients with non-parapharyngeal abscesses the mean was 9.57 days. There was a significant relationship between the location of the abscess and the length of stay for deep neck abscess patients with a weak positive correlation strength (p=0.001, r=0.355).

The researchers found a significant difference between the mean length of stay of patients with bacteria found in culture and no bacteria found in culture (p=0.019). In patients with bacteria found in culture, the average length of stay was 12.88 days, while in patients without bacteria the average length of stay was 9.1 days. There was a relationship between culture results and length of stay of patients with a low positive correlation strength (p=0.03, r=0.228).

The researchers found a significant difference between the mean length of stay for patients with 1 neck space involvement and 2 or more deep neck spaces (p=0.005). In patients with involvement of 1 deep neck chamber, the average length of stay was 7.7 days, while with involvement of 2 or more deep neck chambers, the length of stay was 14.18. There was a significant relationship between the space involved and the length of stay for deep neck abscess patients with a moderate positive correlation strength (p=0.005, r=0.51).

There was no significant difference between the mean length of stay of patients with a history of previous intravenous antibiotic treatment and those without a history of previous intravenous antibiotic treatment (p=0.664). Patients with a history of previous intravenous antibiotic treatment had a mean length of stay of 11.9 days while patients who did not have a history of previous intravenous antibiotic treatment had a mean of 11.07 days. There was no relationship between the history of previous intravenous antibiotic treatment and the length of stay for deep neck abscess patients (p=0.298, r=0.11).

Table 3. Mean of length of stay of each category in their respective variables

Variable(s)	Mean ± S.D.	P value
Age		
0 – 5 y.o.	18.75 ± 9.71	
6 – 11 y.o.	6	
12 – 16 y.o.	16.25 ± 16.56	
17 – 25 y.o.	9.37 ± 5.97	
26 – 35 y.o.	7.45 ± 4.85	0.024*
36 – 45 y.o.	11.67 ± 6.31	
46 – 55 y.o.	10.31 ± 6.46	
56 – 65 y.o.	14.57 ± 7.68	
>65 y.o.	13.71 ± 9.69	

Sex		0.407**
Male	12.15 ± 7.91	
Female	10.75 ± 7.52	
Onset of symptoms before admission		0.092*
0 – 1 week	9.68 ± 6.5	
2 weeks	14.85 ± 10.42	
3 weeks	13.25 ± 6.8	
4 weeks	13.25 ± 5.31	
>4 weeks	8.5 ± 6.36	
Comorbid		0.005**
Present	16.08 ± 8.78	
Absent	8.1 ± 4.69	
Risk factors		0.435**
Present	11.71 ± 7.64	
Absent	10.38 ± 7.72	
Abscess location		0.004**
Parapharynx	14.37 ± 7.98	
Not parapharynx	9.57 ± 6.97	
Pus culture		0.019**
Presence of pathogen	12.88 ± 8.71	
Absent	9.1 ± 5.33	
Number of deep neck space involved		0.005**
1 space	7.7 ± 5.71	
2 spaces	14.18 ± 7.85	
Previous intravenous antibiotic use		0.664**
Yes	11.9 ± 7.48	
No	11.07 ± 7.74	

*One-way ANOVA
**Independent T-test

Table 4. Bivariate correlation between variables and length of stay

Variable(s)	Length of stay	
	P-value*	**Coefficent R**
Age	0.090	0.179
Sex	0.29	-0.112
Onset of symptoms before admission	0.007	0.282
Comorbid	0.005	0.517
Risk factors	0.272	0.116
Abscess location*	0.001	0.355
Pus culture	0.03	0.228
Number of deep neck space involved	<0.005	0.515
Previous intravenous antibiotic use	0.298	0.11

*Spearman correlation

Table 5. Multivariate analysis of all variables using backward

Step*	Variable(s)	Coeff. (B)	Standard Error	*Partial correlation*	*P-value*
1st	Age	-0.236	0.381	-0.095	0.395
	Sex	-0.301	1.433	-0.023	0.834
	Number of neck abscess space involved	2.918	1.817	0.176	0.112
	Abscess location	2.727	1.759	0.170	0.125
	Onset of symptoms	0.413	0.668	0.069	0.538
	Risk factors	-0.862	1.530	-0.063	0.574
	Comorbidities	6.828	1.597	0.429	0.005
	Pus culture	1.434	1.450	0.109	0.326
	Previous intravenous antibiotics	-0.835	1.895	-0.049	0.661
	Constant	7.411	2.263		0.002
Final (7th)	Number of neck abscess space involved	4.383	1.817	0.315	0.002
	Comorbidities	6.520	1.597	0.437	0.005
	Constant	6.276	1.180		0.005

*Backward RL

The results of the multivariate linear regression analysis using the Backward LR method as many as 7 eliminations of 9 variables are shown in table 4.4.2, where the amount of deep neck space involved and comorbidities significantly affects the length of stay in the hospital in deep neck abscess patients. If there are 2 or more deep neck spaces involved with abscesses, it will increase the duration of hospital stay in patients with deep neck abscesses by 4.38 days with a p value of 0.002 and in subjects with comorbidities such as diabetes mellitus, hypertension, kidney disease, kidney disease, lung, or thyroid disease will increase the patient's length of stay by 6.52 days with a p value of 0.005.

The equations obtained were:

$$Y = 6,52 (X1) + 4,38 (X2) + K$$

Legends:

Y = Length of stay for deep neck abscess patient (in days)

X1 = Comorbidity (1 = Present, 0 = absent)

X2 = Number of neck space affected by abscess (1 = 2 spaces or more, 0 = 1 spaces)

K = Constant = 6.276

DISCUSSION

In this study, the average length of stay in the hospital was 11.26 days, ranging between 2 to 41 days. This result was in accordance with research by Putra et al.[10] in 2017 that the average length of stay for deep neck abscess patients in Bali was 8 days, with a range of 3 to 33 days. Velhonoja et al.[11] in 2020 found results with a longer hospital length of stay, namely 2 to 114 days and at an average of 8.5 days.

Metin et al.[12] study revealed that the age group with the longest hospitalization was children under 12 years old, with the average length of stay in the <10-year age

group was 15.1 days with a duration of 5-35 days. Meanwhile, in this study, the majority were in the 26-35 years age group (24.2%). This was similar with the study by Brito et al.[4] where patients with deep neck abscesses were most often in the age group of 31-40 years. Meanwhile, in the study of O'Brien et al.[13], they found that the age group which often experienced deep-neck abscesses was 30-55 years. It could be due to delays in diagnosis and management of deep neck abscesses in infants and children.

Diagnosis of deep neck abscesses is usually very challenging to establish in infants and children and could cause delays in management, because clinical symptoms in children <3 years old are difficult to observe where they cannot express the location and severity of the pain they feel. Thus, delay in diagnosis can lead to an increase in complications and may eventually require surgical management. Consequently, this will prolong the length of stay of infants and children patients. Meanwhile, in research by Chi et al.[14] they found elderly group with deep neck infection had more underlying systemic diseases, multiple space involvement, more complications, and longer hospital stay than the adult group, and elderly group also had a higher ratio of surgical interventions.

This study found more male than female patients had deep neck abscesses. The result was similar to the research by Velhonoja et al.[11] in 2020 which found that there were more males (64.6%) than females (35.4%). Ko et al.[15] discovered that the female patients had a longer length of hospitalization when accompanied by diabetes mellitus due to difficulties in controlling hormones. The majority of patients with deep neck abscesses were male because many of them smoked or chewed tobacco, causing poor oral and dental hygiene. This study found no significant difference between the mean length of stay between patients with neck abscess in males and females, and no significant relationship

was found between gender and length of stay. Velhonoja et al.[11] also found that deep neck abscesses have no predisposition for age or gender.

Brito et al.[4] found that the average symptom onset was 8 days, and according to the study of Yanti et al.[16] that the onset of symptoms until the patient was diagnosed with a deep-neck abscess was mostly 0-1 week (52.7%). Chuan et al.[17] reported that symptom onset was found in a group of patients from local regions with a duration of 1-12 days with a mean of 5.3 days, while in the group living in urban areas, a duration of 1-10 days with an average of 5.3 days. In this study, we found that symptom onset > 4 weeks had a mean length of stay of 8.5. This was probably because the symptoms felt by the patient were not too bothersome, so that the patient did not immediately seek treatment or might have been doing self-medication. The onset of symptoms may also be influenced by lack of education and low economic level which compel patients to consult a dentist only if there are complaints of infection in the teeth.

Based on the category of risk factors, this study was dominated by patients who had a risk factor for deep neck abscess (65.9%). The risk factors found in this study were infections in the teeth and mouth, smoking habits, and alcohol habits. Sharma et al.[18] reported that all of their subjects were tobacco chewer and 40% were tobacco smokers, that resulted in poor oral hygiene and affect the host's vulnerability to systemic diseases by the formation of subgingival biofilms acting as reservoirs of Gram negative bacteria, and through the periodontium acting as a reservoir of inflammatory mediators that could increase the incidence of deep neck abscesses. Yang et al.[19] reported that patients could identify the source of infection as the cause, most often from oropharyngeal and odontogenic infections. Oromaxillofacial infection spreads in several ways, such as

the spread of the infection directly from the tissue to the surrounding tissue, through the lymph vessels to the regional lymph nodes, and hematogenous which was relatively rare. The effects of tobacco in cigarettes play an important role in decreasing local immunity in the oropharynx. Nicotine is known to be immunosuppressive, which can cause a decrease in neutrophil phagocytic activity and affect chemotaxis and cell signaling so that it interferes with the ability of neutrophils to fight pathogens. In the respiratory tract, tar in cigarettes triggers a cascade of inflammatory agents in which macrophages cause tissue damage and further release of inflammatory agents.[20]

Based on the comorbid categories in this study, the majority of subjects consisted of groups without comorbidities. The study by Sharma et al,[18] and Velhonoja et al,[11] found that patients with deep neck abscess who had an underlying systemic disease, particularly diabetes mellitus, tended to have longer treatment. O'Brien et al,[13] found that deep neck abscess patients with a high Charlson Comorbidity Index led to an increase in the hospital length of stay of deep neck abscess patients and an increase for repeated drainage. In patients with diabetes mellitus, there is a decreased immune response and an increased risk of vascular complications and episodes of infection. Increased sensitivity to infection in patients with diabetes mellitus can be caused by hyperglycemia or impaired immunity. Polymorphonuclear leukocyte function and cytokine production are impaired in patients with diabetes mellitus. Complement dysfunction is also found in some patients with diabetes mellitus. Diabetes mellitus can also suppress T cell function and antibody production, these abnormalities are associated with uncontrolled blood glucose levels which are also associated with microvascular angiopathy and neuropathy. Diabetes mellitus can also trigger periodontitis through an exaggerated inflammatory response to the periodontal microflora. Diabetes mellitus is susceptible to more severe infections so it must be alert to the emergence of sepsis.[15,18]

Based on the category of the amount of deep neck space involved, most of the subjects in this study had deep neck abscesses in 2 or more neck spaces. The amount of space involved is one of the determinants strongly related to the length of stay of deep neck abscess patients. This was in line with the research by Brito et al.[4] which stated that patients with neck abscess had involvement of more than 1 deep neck spaces and found a significant difference between the mean length of stay of patients with deep neck space involvement where involvement of 2 or more spaces added 5 days longer length of stay. This was also in line with the research of Chi et al.[14] that the occurrence of deep neck abscess in more than 2 deep neck spaces was significantly higher. Yang et al.[19] found that patients with deep neck abscesses in 2 or more spaces could increase the hospital length of stay (19.4 days vs. 13.8 days). The more neck space involved in the abscess, the more likely the infection will spread and the clinical deterioration in the patient getting worse, so surgical intervention that requires an intensive care unit after that will increase the patient's length of stay. X-ray imaging, ultrasonography, computed tomography (CT) and magnetic resonance imaging (MRI) might be needed in the management of infection.

This study found that the most common location for deep neck abscess was adjacent to the parapharynx. Sebastian et al.[21] found that the majority of deep neck abscess locations were the peritonsillar space (58%), parapharyngeal space (16%), where there was an increase in the average length of stay to 21 days in patients with parapharyngeal abscess while in non-parapharyngeal abscess the average length of stay was 18 days. Research by Brito et al.[4] also found that the most common locations for deep neck abscesses were the peritonsillar space

(26.7%), submandibular space (22.7%), and parapharyngeal space (18.8%). Velhonoja et al.[11] reported a different finding where the most common location for deep neck abscess was the parapharynx. The study by Sharma et al.[18] also found that the most common location for deep neck abscesses is the parapharynx. The parapharyngeal space is a potential space that includes the deep neck space, in the form of an inverted pyramid with its base at the base of the skull, namely the pars petrosa os temporalis and the tip or apex of the major horn of the hyoid bone. Because it is located in the middle of the deep neck spaces and has multiple connections with all the neck spaces as well as the carotid sheath, the parapharyngeal space is not only the space most commonly involve neck spaces as well as the carotid sheath, the parapharyngeal space is not just the space most commonly involved in serious deep neck abscesses but also allows spread to other areas, usually to the carotid sheath and retropharyngeal space. The carotid sheath through the posterior part of the parapharyngeal space acts as a potential carrier for infection spreading to the mediastinum.[2]

Based on the category of pus culture, the abscess culture with positive results in this research subject was only about 57.1% of all samples, and mostly were *Klebsiella pneumoniae*. The research of Velhonoja et al.[11] found that 85.4% of deep neck abscess patients had positive bacterial pus culture results, with the majority of bacteria being *Streptococcus sp*, followed by *Provotella sp*. This study found a significant difference between the average length of stay of patients with positive culture, and there was a positive significant relationship with the length of stay and also found that there was a relationship between dental infection by *Streptococcus-sp* and other bacteria on the length of stay of deep neck abscess patients. Tiwana et al.[22] reported a bacteriological growth pattern in patients with necrotizing fasciitis compared to deep neck abscesses. In the pre-antibiotic

era, the most frequently isolated organism from deep neck space abscess aspiration was *Staphylococcus aureus*. Since the introduction of antibiotics, Streptococcal aerobic species and non-Streptococcal anaerobes have become the main causative agents in deep neck abscesses. The most common organisms are *S. viridans aerobic*, *H-hemolytic Streptococcus*, *Staphylococcus*, *Klebsiella pneumoniae*, anaerobic bacteriodes, and peptostreptococcus. Infections originating from the oropharynx are mostly caused by normal flora in the upper respiratory tract, such as gram-positive aerobic cocci (Streptococcus sp.). In dental infections, anaerobic bacteria are more abundant than aerobic and facultative bacteria.[23,24]

Most of the study subjects had not received intravenous antibiotic treatment before recruitment, so it was reasonable to expect a high rate of positive culture results. The bacterial culture did not grow in about 42.9% of subjects. The result is similar with the study by Tiwana et al.[22] that reported 42.6% of cultured specimens were found to be sterile; this could be due to the use of high-dose intravenous antibiotics or empiric antibiotics before abscess drainage. As for the examination of anaerobic bacteria, there are limitations in the examination at this research institution due to limited reagents so that they were often declared as sterile or not growing.

The limitations of this study were that we could only analyze a few among so many factors related to the hospital length of stay of deep neck abscess patients, due to the limited number of research samples and data in medical records. There were several factors not included in this study such as educational status, employment status, economic status, nutritional status of the subject, Oral Hygiene Index status, and bacterial culture data. The authors suggested further research with larger samples to obtain better results.

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