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Correlation between SOFA Score with Mortality and Length of Stay for Deep Neck Abscess Patients in Intensive Observation Room (IOR) at Dr. Soetomo General Academic Hospital Surabaya

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ABSTRACT

Background: Deep neck abscess has a high mortality if accompanied by complications. Sepsis and septic shock are complications that often occur in patients with deep neck abscess. Sepsis is a life-threatening organ dysfunction caused by dysregulation of the host's response to infection. The SOFA score is a score that is often used by clinicians to monitor a patient's condition during intensive care. Previous studies have shown that SOFA scores and changes in SOFA scores are associated with patient mortality in the Intensive Care Unit.

Aim: This study aimed to analyze the correlation between the SOFA score and mortality and length of stay (LOS) for deep neck abscess patients in the Intensive Observation Room (IOR).

Material and Methods: This research is an observational analytical study with a retrospective design in patients with deep neck abscess complicated by sepsis and septic shock who were treated at IOR Dr. Soetomo General Academic Hospital Surabaya during 1 January – 31 December 2023. Samples were taken using a total sampling technique involving 50 patients. Data on patient characteristics, SOFA score, mortality and LOS were obtained from patient medical records. Data were processed statistically using SPSS version 26 software with a significance value of $p < 0.05$.

Results: Of the 50 patients, the majority were male, 32 patients (64.0%) with an age range of 21-82 years. The mean SOFA score showed 5.10 ± 3.01 and the LOS was 5.08 ± 3.65 . The mortality rate shows 42.0% of all patients. There is a significant relationship between SOFA score and LOS with a positive correlation ($p = <0.001$; $r = 0.477$). The SOFA score in deceased patients was higher than the SOFA score in living outcome patients ($p = <0.001$). The cut off of SOFA score based on mortality was >5 ($p = <0.001$) with a sensitivity value of 85.7%, specificity of 96.6% and accuracy value of 92.0%.

Conclusion: There is a correlation between SOFA score with mortality and LOS for deep neck abscess patients that were treated in IOR at Dr. Soetomo General Academic Hospital Surabaya.

Keywords: SOFA score, Deep neck abscess, Sepsis, Mortality of deep neck abscess, Length of stay of deep neck abscess

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1. Introduction

Deep neck abscess (DNA) is defined as a localized collection of pus formed in the potential space between the deep cervical fasciae, resulting from tissue damage caused by the spread of infection from various sources, such as teeth, mouth, throat, paranasal sinuses, middle ear, and neck (Rosen et al., 2002). The incidence of DNA is estimated to have decreased with the use of antibiotics; however, it still has a high mortality rate when mediastinitis occurs, with a mortality rate of 10-40% (Gehrke et al., 2022).

A study in 2019 in England showed a mortality rate of 2.7% related to deep neck abscess (DNA) (Hurley et al., 2018). Research by Arianto & Romdhoni (2019) in the Teratai ENT-HN Surgery Inpatient Room at Dr. Soetomo General Hospital during the period from January to December 2019 found 41 patients with deep neck abscess, with sepsis being the most common complication (29.26%), followed by upper airway obstruction requiring tracheotomy (14.63%), mediastinitis (9.75%), and 4.87% mortality (Arianto & Romdhoni, 2019). Septic shock is the most frequent complication with a mortality rate of 40-50% (Gujrathi et al., 2016; Kataria et al., 2015).

Another complication is airway obstruction, requiring patients to undergo tracheostomy or have an endotracheal tube inserted post-surgery (Suminar, 2022). These complications necessitate patients to be treated in intensive care units and result in prolonged hospital stays (Thimmappa et al., 2015). Factors influencing DNA complications include old age, high white blood cell count, accompanying systemic diseases, diabetes mellitus, multiple deep neck space involvement, and involvement of the anterior visceral space (Boscolo-Rizzo et al., 2006).

Sepsis is a life-threatening organ dysfunction caused by a dysregulated host response to infection (Utariani et al., 2023). Septic shock is a more severe condition of sepsis where circulatory and cellular metabolic abnormalities occur, which can increase mortality. Patients with septic shock can be identified by establishing a diagnosis of sepsis accompanied by persistent hypotension requiring vasopressors to maintain MAP \geq 65 mmHg and serum lactate levels $>$ 2 mmol/L (18mg/dL) despite adequate fluid resuscitation. When these criteria are met, the in-hospital mortality rate increases to over 40% (Singer et al., 2016).

Sepsis and septic shock are among the leading causes of morbidity and mortality in the Intensive Care Unit (ICU). The incidence of sepsis in the United States is about 450,000 cases per year. The mortality rate depends on the severity of sepsis, varying from 20-30% in sepsis patients to up to 80% in patients with septic shock (Martin et al., 2003). Organ failure is strongly associated with high morbidity and mortality rates in ICU patients. The Sequential Organ Failure Assessment (SOFA) score allows clinicians to monitor the overall disease process compared to other scores. However, previous studies have shown that the SOFA score calculated when patients are first admitted to the intensive care unit, and changes in SOFA scores calculated on days 1-7, are associated with patient mortality both in the intensive care unit and in the hospital (in-hospital mortality) (Karakike et al., 2019; Soo et al., 2019).

Other studies state that patients with an initial SOFA score $<$ 7 have a mortality rate of 56%, which increases to 70% in patients with scores of 8-15. The score is reassessed after 48 hours, resulting in patients with a SOFA score $<$ 7 having a mortality rate of 52%, which increases to 88% for scores of 8-15. Although the SOFA score is used to describe and measure body organ function, and is not intended to predict outcomes, previous studies have shown a relationship between the occurrence of organ dysfunction and patient mortality (Bale et al., 2013).

The length of hospital stay for DNA (Deep Neck Abscess) patients varies greatly, ranging from 2 to 45 days (with an average of 9.7 days), and the presence of DNA complications increases the length of hospital stay by 5 days (Brito et al., 2017). Intensive care for patients with deep neck infections requires specialized resources (internal medicine, oral surgery, cardiovascular thoracic surgery, anesthesiology), as well as special facilities and infrastructure that not all hospitals possess (Maharaj et al., 2019).

This research seeks to analyze the correlation between SOFA scores and outcomes of deep neck abscess patients in the Intensive Observation Room (*Ruang Observasi Intensif/ROI*) and can strengthen efforts to improve quality of care, reduce morbidity, and increase patient recovery rates.

On those grounds, the study has the objectives to analyze the correlation of the SOFA score in relation to the mortality of patients with deep neck abscess treated at ROI Dr. Soetomo General Hospital Surabaya, analyze the correlation of the SOFA score in relation to the length of stay of patients with deep neck abscess treated at ROI Dr. Soetomo General Hospital Surabaya, and analyze the cut-off value of the SOFA score according to the mortality of patients with deep neck abscess treated at ROI Dr. Soetomo General Hospital Surabaya.

2. Methodology

Research Type and Design

This research was an observational analytic study with a retrospective design. The materials and data sources for this research were obtained from the medical records of deep neck abscess patients treated in the ROI of Dr. Soetomo General Hospital Surabaya.

Research Location

The research location was the Intensive Observation Room (ROI) of Dr. Soetomo General Hospital Surabaya for the period of January 1 - December 31, 2023.

Research Timeline

The research was conducted from the proposal writing (January 2024) until the research results (May 2024).

Population

The population consisted of deep neck abscess patients with complications of sepsis and septic shock who underwent treatment in the Intensive Observation Room (ROI) of Dr. Soetomo General Hospital Surabaya during the period of January 1 - December 31, 2023.

Sample Size and Sampling Technique

In this study, the author used a total sampling technique, where total sampling took a sample that was the same as the total existing population.

Sample Inclusion and Exclusion Criteria

The inclusion criteria for this study included: all deep neck abscess patients with complications of sepsis or septic shock, aged over 18 years, and deep neck abscess patients who met the criteria for sepsis based on a SOFA score ≥ 2 upon admission and discharge from the Intensive Observation Room (ROI) of Dr. Soetomo Hospital. Meanwhile, the exclusion criteria encompassed patients who were discharged at their own or family's request, as well as incomplete medical record data.

Research Variables

The variables examined in this study were SOFA score, mortality, and length of stay.

Data Collection Procedure

The tools and materials used in this study consisted of medical records of deep neck abscess patients treated in the ROI of Dr. Soetomo General Hospital Surabaya during the research period, as well as patient data tables, patient characteristics, and research variables.

The research procedure included three main stages. First, the assessment of patients with suspected sepsis and septic shock based on a SOFA score ≥ 2 who were admitted to the Intensive Observation Room of Dr. Soetomo Surabaya and met the inclusion and exclusion criteria. Second, the assessment of organ dysfunction with SOFA score on day 1. Lastly, the

assessment of mortality and length of stay based on SOFA scores.

Operational Framework

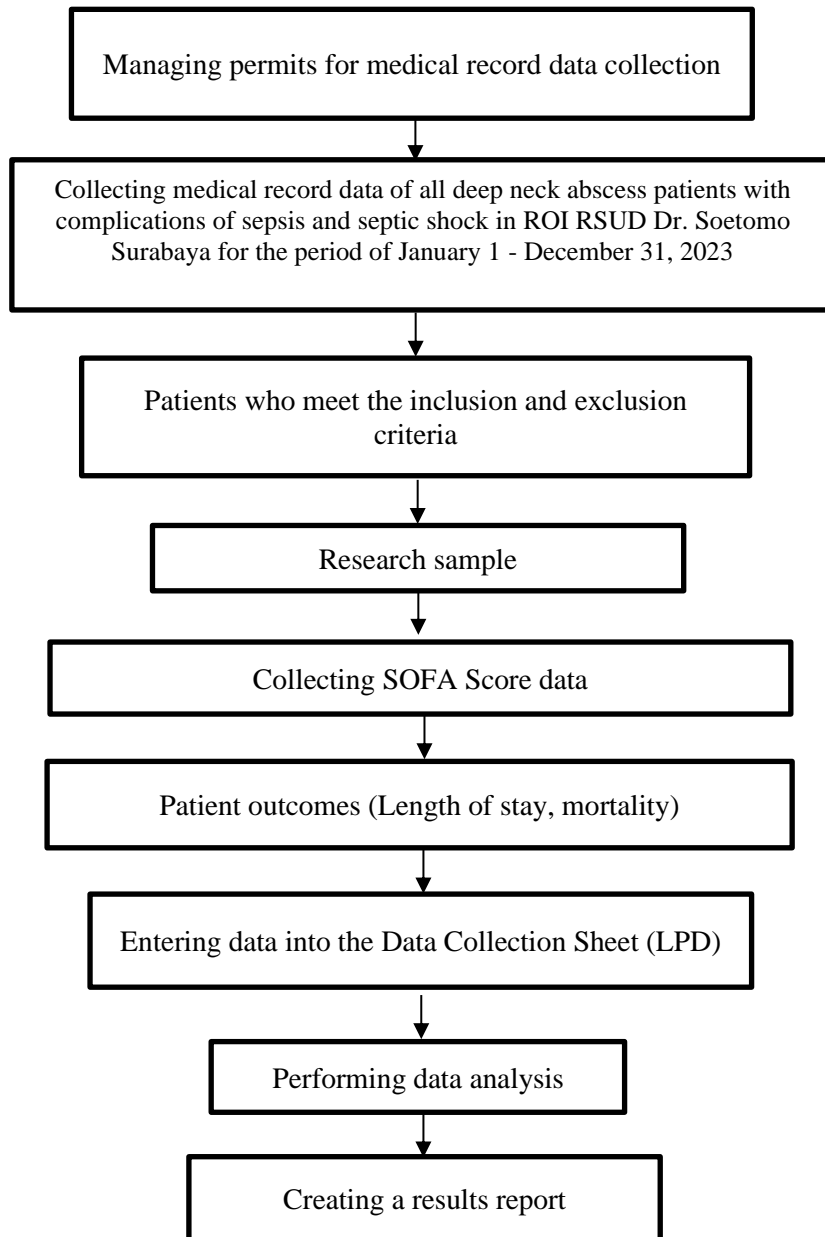


Figure 1. Research Flow Chart

Data Collection and Presentation

Data collection was conducted through medical records and patient status. For data presentation, the research results were presented in two main forms. First, data was presented in tabular form. Second, data was presented in the form of text or writing that served to clarify graphs or diagrams used in the research.

Data Analysis

The collected data was analyzed using the Kolmogorov-Smirnov test and Spearman correlation test. Data was processed using the SPSS 21.0 program.

3. Results and Discussion

Research Results

Descriptive Data of the Research

This study was an observational analytic study with a retrospective design. The materials and data sources for this research were obtained from the medical records of patients with deep neck abscesses treated at the Intensive Observation Room (ROI) of Dr. Soetomo General Hospital in Surabaya. The sample for this study consisted of patients with deep neck abscesses who received treatment in the Intensive Observation Room (ROI) of Dr. Soetomo General Hospital in Surabaya during the period from January 1 to December 31, 2023. Based on the inclusion and exclusion criteria, the sample size for this study was 50.

The characteristics of the subjects in this study include gender, age, Mean Arterial Pressure (MAP), Respiration Rate (RR), Pulse, and Blood Pressure (BP). The descriptive characteristics of the subjects in this study are presented in the form of frequencies and percentages for categorical data, and range, median, and mean values for numerical data. The following is a descriptive overview of the characteristics of the study subjects:

Table 1. Distribution of study subjects' characteristics

Subject Characteristics	Frequency c (%)	Range (Median)	Mean ± Sd	p Value Normality
Gender				
Male	32 (64,0%)	-	-	-
Female	18 (36,0%)	-	-	-
Age	-	21 - 82 (49,50)	48,74 ± 12,27	0,200
MAP	-	60 - 105 (89,00)	85,59 ± 11,83	0,001
RR	-	16 - 32 (20,00)	20,90 ± 2,58	< 0,001
Pulse	-	60 - 125 (95,00)	96,06 ± 15,58	0,200
Systolic BP	-	102 - 144 (124,50)	124,58 ± 10,16	0,200
Diastolic BP	-	45 - 90 (72,00)	72,92 ± 10,28	0,036

Based on the results in Table 1, the descriptive characteristics of 50 samples show that for gender, male subjects accounted for 32 (64.0%), meaning the sample tended to have more males. For age, the range was from 21 to 82 years with a mean age of 48.74, indicating that the average age of the sample falls into the late adult category. For MAP (Mean Arterial Pressure), the range was from 60 to 105 with an average MAP of 85.59. For RR (Respiratory Rate), the range was from 16 to 32 with a median of 20.00. For Pulse, the range was from 60 to 125 with an average pulse of 96.06. For systolic blood pressure, the range was from 102 to 144 with a median of 124.50, while for diastolic blood pressure, the range was from 45 to 90 with a median of 72.00.

Based on the results in Table 1, for the normality test of demographic data using the Kolmogorov-Smirnov test (due to the sample size of 50), it was found that the data for age, pulse, and systolic BP were normally distributed, while the data for MAP, RR, and diastolic BP were not normally distributed.

Descriptive of SOFA Score

The SOFA score is one of the scoring systems used to define the severity of illness in intensive care and to estimate mortality risk in critically ill patients. The SOFA score is obtained on the first day the patient is admitted to the ROI, and it consists of the following systems: Respiratory System: PaO₂/FiO₂ (mmHg); Cardiovascular System: Hypotension (mmHg); Central Nervous System: GCS; Urogenital System: Creatinine (mg/dL) and urine output (ml/day); Liver: Bilirubin (mg/dl); Coagulation: Platelets 103/μL. As noted earlier, a descriptive overview of SOFA scores was conducted, followed by a normality test of the SOFA score data given below:

Table 2. Descriptive SOFA score

SOFA	Range (Median)	Mean ± Sd	p Value Normality
SOFA score	2 - 12 (4,00)	5,10 ± 3,01	< 0,001

From Table 2, the description of the SOFA scores among 50 subjects showed that the minimum value was 2, whereas the maximum value was 12, with a median score of 4. Also, the average SOFA score was 5.10 ± 3.01. The frequency distribution of the SOFA scores taken from 50 samples is as follows: 14 samples with a SOFA score of 2, which accounts for 28.0 percent; 8 samples with a score of 3, accounting for 16.0 percent; and 6 samples with a score of 4, accounting for 12.0 percent. The p-value result of the Kolmogorov-Smirnov test for normality conducted on the data for the SOFA score was less than 0.001, thus indicating non-normality in the distribution of the SOFA score data.

Descriptive of Mortality

The outcome of this study is mortality, specifically the death of a patient who had deep neck abscess and was then diagnosed with sepsis and septic shock according to the ROI Intensive Observation Room, Dr. Soetomo General Hospital, Surabaya, during the study period. A descriptive overview of the mortality is presented below:

Table 3. Descriptive mortality

Outcome	Frequency	Percentage
Mortality		
Alive	28	58,0%
Deceased	21	42,0%

Descriptive mortality outcomes from the results in Table 3 among the 50 samples showed that 28 subjects survived, accounting for 58.0 %. The given frequency indicates that there are more subjects with the outcome of survival compared to those who died.

Descriptive of Length of Stay (LOS)

Length of stay (LOS) is the duration/number of days counted, starting from when a patient was admitted to the Intensive Observation Room of Dr. Soetomo General Hospital until they were transferred to another room or died at ROI. The descriptive overview of the length of stay is as follows, along with the normality test:

Table 4. Descriptive Length of Stay (LOS)

Length of Stay	Range (Median)	Mean ± Sd	p Value Normality
LOS	1 - 20 (4,50)	5,08 ± 3,65	< 0,001

From the results in Table 4, the descriptive Length of Stay (LOS) for the 50 subjects was a shortest LOS of 1 day, longest of 20 days, and a median of 4.50 days. The frequency distribution of the LOS among the 50 samples showed that 10 of the subjects resulted in 20.0% having an LOS of 3 and 5 days, 6 subjects resulted in 12.0% who had an LOS of 1 and 4 days, and 5 subjects resulted in 10.0% with an LOS of 7 days. Using the Kolmogorov-Smirnov test, the results for normality testing of LOS data gave a p-value less than 0.001, hence less than 0.05, indicating LOS data is not normally distributed.

Analysis of SOFA Score with Mortality

1) Analysis of SOFA Score Comparison with Mortality

This analysis compares the SOFA scores with regard to mortality to determine if the SOFA score is different based on survival versus death. The comparison of SOFA scores versus mortality is done with a Mann-Whitney test, a test used for comparing two groups (in this case, survived vs. deceased) with data (in this case, the SOFA score) that is not normally distributed. The results of the comparison test between the SOFA scores and mortality are

shown below:

Table 5. Comparison test of SOFA score with mortality

Mortality	SOFA score		p value
	Range (Median)		
Alive	2 – 7 (3,00)		< 0,001
Deceased	4 – 12 (9,00)		

*considered significantly different if the p-value < 0.05

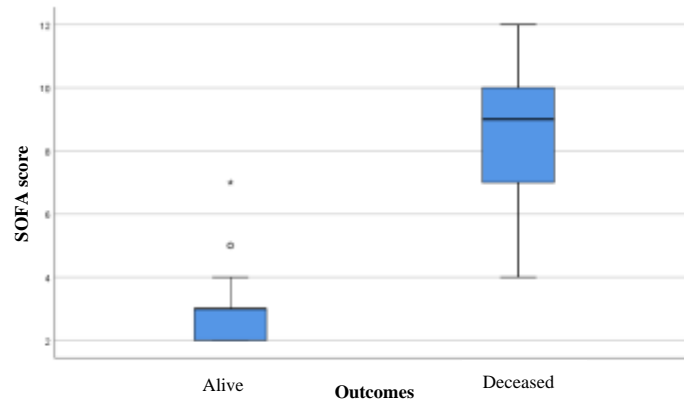


Figure 2. Box plot of SOFA scores with mortality

Using the results in Table 5, carrying out the Mann-Whitney test for the difference of SOFA scores with respect to mortality yielded a p-value of < 0.05; therefore, there exists a meaningful or significant difference in the SOFA scores based on mortality. The median value of SOFA score for the deceased is 9.00, while that for survival is 3.00. This means that the mean SOFA score in the dead outcome is higher than in the survival outcomes, and this difference is statistically significant since the p-value is less than 0.05.

2) Analysis of SOFA Score Cutoff (ROC Curve) Based on Mortality

The ROC curve analysis aimed at determining the cut-off SOFA score using the mortality events. The ROC test also evaluates the diagnostic performance of the SOFA score based on the cutoff with respect to mortality, assessing sensitivity, specificity, Positive Predictive Value (PPV), Negative Predictive Value (NPV), and accuracy. The following is the ROC curve test of SOFA scores based on mortality:

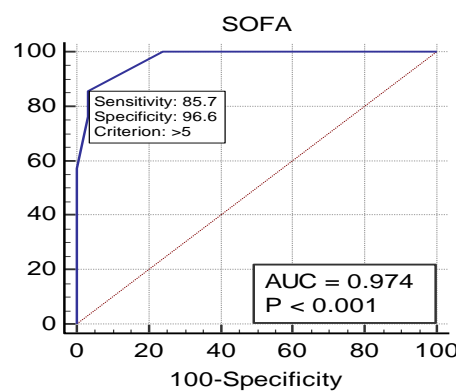


Figure 3. ROC curve of SOFA scores based on mortality

Table 6. Diagnostic Test of SOFA Score Cutoff with Mortality

SOFA	Mortality		p value	AUC	Sensitivity	Specificity	PP V	NP V	Accuracy
	Deceased	Alive							
> 5	18	1	< 0,001	0,974	85,7	96,6	94,7	90,3	92,0
≤ 5	3	28							

Based on the results of the ROC test, a p-value of <0.001 was obtained, which is less than 0.05. This indicates that the SOFA Score in this study can determine a cutoff based on mortality, as it is deemed significant in the ROC test. From the test results, the cutoff value for the SOFA Score based on mortality was found to be >5. According to Table 5.7, the results of the diagnostic test for the SOFA cutoff with mortality showed that the sensitivity was 85.7%, specificity was 96.6%, and the accuracy was 92.0%.

3) Interpretation of SOFA score with mortality

Table 7. Interpretation of SOFA score with mortality

SOFA score	Alive (n=29)	Deceased (n=21)	Mortality rates in ROI	Interpretation of mortality rates according to Fauziyah (2020)
0-6	28	5	17,85%	27,27%
7-9	1	10	90,9%	37,5%
10-12	0	6	100%	42,86%

From the interpretation of SOFA scores with mortality, a mortality rate of 17.85% was obtained for SOFA scores 0-6 with 5 patients dying. The mortality rate for SOFA scores 7-9 and 10-12 was 90.9% and 100%.

4) Test Analysis of the Relationship between SOFA Score and LOS

Test the relationship between SOFA scores and length of stay (LOS) to see if there is a relationship or correlation between the high and low SOFA scores and the length of stay (LOS), the correlation test uses the Spearman test because during the normality test both SOFA score data and LOS data are not normally distributed. The following is a test of the relationship between SOFA scores and length of stay (LOS):

Table 8. Test of the Relationship between SOFA Score and Length of Stay (LOS)

	N	r _s	p value	description
SOFA with LOS	50	0,477	< 0,001	related

* declared related if p value < 0.05

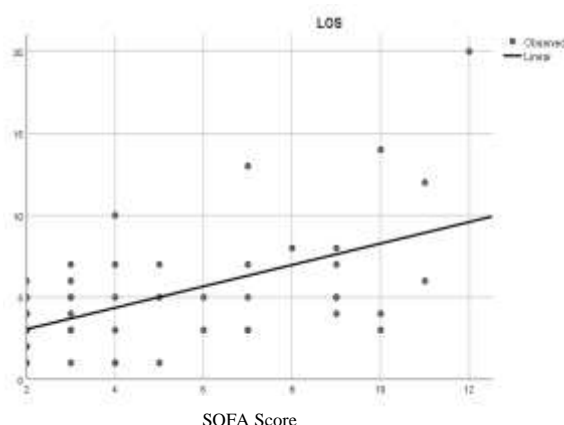


Figure 4. Scatterplot of with Length of Stay (LOS)

According to the presentation of data in Table 8, using Spearman’s test to determine the connection between SOFA Score and Length of Stay (LOS) gave a p-value of 0.000. This value is lower than 0.05 thus revealing a significant or meaningful relationship existing between SOFA score and length of stay (LOS). The test results displayed an r value that correlated positively or in other words, showing a correlation of 0.477. This means that there is a direct correlation between SOFA score and length of stay (LOS); when SOFA score rises, then length of stay (LOS) will also rise and vice versa. The correlation coefficient (r value) is

what shows how strong the relationship between the SOFA score and length of stay (LOS) really is. The result shows that its strength is at 0.477 or 47.7% thus making it moderate or sufficient in terms of SOFA Score and Lengths of Stay (LOS).

Demographic Data

This research was conducted on patients with deep neck abscesses complicated by sepsis and septic shock treated in the ROI of Dr. Soetomo General Hospital, Surabaya, from January 1 to December 31, 2023. Using the inclusion and exclusion criteria, the required sample size is 50, with more male subjects than female subjects. The age of the subjects ranged from 21 to 82 years, with a mean of 48.74 ± 12.27 , thereby indicating that the average age of the sample falls under late adulthood.

This is backed by research into the characteristics of abscess patients conducted in hospitals in Bali, where it was found that the highest proportion of abscess patients falls within the age group 31-40 years at 30.55 percent, while the least characteristics were found in the age group over 60 years at 5.58%.

In terms of gender, it was 61.11% male and 38.89% female. Epidemiologically, this pathologic process prevails in the age group from 20 to 60 years with a male-to-female ratio of 3:1 (M. F. A. Putra & Anggraini, 2022). This is corroborated by findings reported in Álvaro-Meca et al. (2018), where the male group accounted for 64.1 percent versus a female group that had less. Deep neck abscess conditions are more incident in males as compared to females. This could be because males pay less attention to oral hygiene, particularly dental hygiene, compared to females. It is also due to the fact that in males with sepsis, the plasma IL-6 levels are higher compared to those in females, while females have better immune and cardiovascular responses compared to males (Nasir et al., 2015).

Discussion

Descriptive Data of SOFA Score

According to the data, all subjects of the research in this study showed an infection with organ dysfunction (sepsis) indicated by a SOFA score of ≥ 2 . Among the 50 patients, the minimum value for the SOFA score was 2 and the maximum value was 12, with a median of 4. This theory supports the identification of organ failure in sepsis patients as an acute change in the SOFA (Sequential Organ Failure Assessment) score of ≥ 2 points due to infection. In contrast to other scores, the SOFA score allows for an assessment of the general process of the disease (Vincent et al., 1998).

In this study, the lowest SOFA score was 2 and the highest was 12, indicating that nearly all patients with deep neck abscesses experienced sepsis complications with a SOFA score of ≥ 2 . This is consistent with the study by Arianto & Romdhoni (2019) conducted in the Teratai ENT-HN Surgery Inpatient Room at Dr. Soetomo General Hospital from January to December 2019, which found 41 patients with deep neck abscesses, with the most common complication being sepsis (29.26%), followed by upper airway obstruction requiring tracheotomy (14.63%), mediastinitis (9.75%), and a mortality rate of 4.87%. The most frequently found bacteria from pus cultures were *Staphylococcus aureus* and *Streptococcus viridans*. Sepsis is involved in about 2% of all hospital admissions, with an estimated more than 1 million sepsis cases per year in the United States by 2020. Hospital mortality for sepsis patients ranges from 18% to 30% (O'Brien et al., 2020). Sepsis was initially introduced as a systemic inflammatory response syndrome (SIRS) of the body to infection.

Abscesses in the deep neck spaces are relatively more common in elderly patients with systemic diseases, such as diabetes mellitus, and lead to high morbidity and mortality in cases of inappropriate or delayed treatment. The cumulative effect, besides age, is organ dysfunction, which can directly affect an increased mortality rate in sepsis patients. The mortality rate in patients with sepsis in the absence of organ dysfunction is 15%, with organ failure 70%, and septic shock 45-60%. According to some sources, hypoalbuminemia reaches 60-70% of all cases of sepsis. Also, hypoalbuminemia has been associated with an increased risk of morbidity and mortality in patients with sepsis (Takegawa et al., 2019).

Relationship between SOFA Score and Mortality

In this study, it was found that the death outcome was smaller than the life outcome, out of 50 patients for living subjects as many as 28 (58.0%) and died as many as 21 (42.0%). However, based on the analysis of the results obtained the value of the SOFA score on the death outcome for the median of 9.00, the value of the SOFA score on the life outcome for the median of 3.000, which is based on the median value, it can be interpreted that the value of the SOFA score on the death outcome will be higher than the value of the SOFA score on the life outcome.

In this study, the cut off value of SOFA score based on mortality was >5 , with a sensitivity value of 85.7%, specificity of 96.6% and accuracy value of 92.0%. This is in line with several previous studies, where in research by Poutsiaka et al. (2019) obtained a Hazard Ratio SOFA score associated with mortality in sepsis patients of 5.38. Rahmatinejad et al. (2019) also obtained an AUC SOFA score of 0.751 with a cut off SOFA score of 4 in predicting sepsis-related mortality.

This is in accordance with Iskandar & Siska (2020), which states that patients with SOFA scores ≥ 7 have a 3.8-fold greater chance of dying compared to patients who have SOFA scores <7 . Research by Bale et al. (2013) also stated that patients with an initial SOFA score <7 had a mortality rate of 56%, and increased to 70% in patients with a score of 8-15.

The scores were reviewed after 48 hours, with patients with SOFA scores <7 having a mortality rate of 52% and increasing to 88% for scores 8-15. Although SOFA scores are used to describe and measure organ function, and are not intended to predict outcome, previous studies have shown an association between the occurrence of organ dysfunction and patient mortality, that SOFA scores can be used as a predictor of patient outcome (Bale et al., 2013).

The difference in cut off point values in this study is possible because the patients in this study were specialized for patients with sepsis or septic shock due to complications from ALD while other studies used all patients with sepsis and septic shock regardless of their etiology.

Organ failure is strongly associated with high morbidity and mortality rates in ICU patients. Organ failure in sepsis patients can be identified as an acute change in SOFA score of ≥ 2 points as a result of infection. The SOFA score allows clinicians to monitor the overall disease process compared to other score (Vincent et al., 1998). However, previous studies have shown that SOFA scores calculated on admission to the intensive care unit, and changes in SOFA scores calculated on days 1-7 are associated with both intensive care unit and in-hospital mortality (Karakike et al., 2019; Soo et al., 2019).

Fauziyah et al. (2020) in the ICU of Dr. Soetomo Hospital showed that the interpretation of the first day SOFA score 0-6 had a mortality rate of 27.27%, score 7-9 of 37.50%, score 10-12 of 42.86%. In this study, the first day SOFA score mortality rate in the 0-6 range had a smaller percentage than the SOFA mortality according to Fauziyah (2020). However, in the SOFA score range 7-9 and 10-12, a greater percentage was obtained, namely 90.9% and 100%.

The mean SOFA score of deceased patients was higher than that of living patients, and statistical tests showed that the difference was significant. A higher SOFA score indicates an increase in the number and severity of organ dysfunctions in patients. These results are consistent with previous studies that showed that patients with high SOFA scores have a higher risk of mortality (Karakike et al., 2019; Soo et al., 2019).

In the study by Lopes Ferreira et al. (2001) on the same issue, the results showed that the SOFA score was an independent predictor of mortality in patients with sepsis. Both the mean and highest SOFA scores were excellent predictors of outcome and an increased SOFA score in the first 48 hours in the ICU predicted mortality of 50%. A study conducted in an emergency department in Turkey on sepsis, however, yielded different results; the AUC for the SOFA score was 0.63, with a sensitivity of 71% and a specificity of 57% and 95% CI; 0.55-0.70 as a predictor of mortality. Further, a study conducted by Putra (2020) at Soetomo Surabaya Hospital revealed that the results obtained from the SOFA score were significantly related to mortality, with a cut-off point of 8.5 for the SOFA score. Therefore, it can be observed that based on the results of this analysis, the SOFA score is significantly associated

when assessing the mortality of patients with sepsis and septic shock.

Relationship between SOFA Score and Length of Stay (LOS)

The results of this study obtained the length of treatment (LOS) of 50 subjects obtained the lowest LOS value of 1 day and the highest of 20 days with a median value of 4.50 days and a mean LOS of 5.08 ± 3.65 with a relationship when the greater the SOFA score, the longer the length of treatment (LOS) will be and vice versa. This is in accordance with research on the length of stay of ALD patients, which varies greatly between 2 to 45 days (average 9.7 days). The presence of ALD complications increased the length of hospital stay by 5 days. (Brito et al., 2017). According to Reuter et al. (2023) ALD patients with complications are admitted to the intensive care unit, with an average length of stay of 7 days (Reuter et al., 2023).

Almost all patients in this study experienced sepsis complications with a SOFA score of ≥ 2 . Complications in deep neck abscess (DNA) patients caused them to be treated in the ICU for an average of 13.3 days (Reuter et al., 2023). Palupi et al. found that patients with dental caries had a significant correlation with prolonged hospitalization (Palupi et al., 2023). Older age and the presence of diabetes significantly increased the length of stay. The higher the Charlson Comorbidity Index (CCI) and ASA (American Society of Anesthesiologists) scores, the longer the length of stay (O'Brien et al., 2020). Patients undergoing surgical intervention had shorter treatment durations compared to those receiving only medication (O'Brien et al., 2020).

The results of this study are consistent with the study by Karnina et al. (2024), which evaluated 180 samples and found that 96 sepsis patients (53.3%) had a SOFA score > 11 . The highest length of stay was in the 3 to 7-day group, with a total of 108 patients (60.0%). The analysis of the relationship between SOFA scores and the length of stay for sepsis patients in the ICU showed a positive correlation. An organ failure assessed by the score can help estimate how long head injury patients will stay in the ICU. Vincent et al. (1998) study on 181 injury patients showed that patients with an average SOFA score of 8 ± 4 had a length of stay of 10 days, with $p < 0.05$. This means there is a significant relationship between the SOFA score and the length of stay.

The study conducted by Reuter et al. (2023) noted that the average duration of hospitalization for patients with deep neck abscesses was 25.5 days, with 74 (84.1%) patients being treated in the Intensive Care Unit (ICU). The average duration of ICU stay was 13.3 days (median 7 days, maximum 110 days) (Reuter et al., 2023). Severe complications with high mortality rates involved multiple organ dysfunction syndrome, sepsis, or septic shock (Reuter et al., 2023). In the study by Angus & Van der Poll (2013), the length of stay for sepsis patients in intensive care was 13.8 ± 20 days in teaching hospitals and 10.0 ± 13.8 days in non-teaching hospitals. Sepsis is one of the main risk factors leading to in-hospital mortality. Deaths related to sepsis are 140% higher compared to the estimated annual deaths from other causes. The average length of stay for septic patients is 75% longer compared to those hospitalized for other conditions, and the mortality rate for sepsis patients is 8 times higher during hospitalization (Hajj et al., 2018).

4. Conclusion

The SOFA score has been proven to have a relationship with the mortality of deep neck abscess patients treated in the IOR of Dr. Soetomo General Hospital, Surabaya. Furthermore, the SOFA score has also been proven to have a relationship with the length of stay of deep neck abscess patients treated in the IOR of Dr. Soetomo General Hospital, Surabaya.

Based on the results, several suggestions are proposed. The SOFA score can also become a predictor tool in mortality, indicating organ failure available to all hospitals for patients with deep neck abscesses. The serial calculation of the SOFA score could be done in the future, providing a better landscape of changes in the patient's SOFA score related to the mortality and length of stay of the patients with deep neck abscesses. The SOFA score can also be used as a reference in planning the length of stay, complications, and as a guideline

for health workers regarding the management and prognosis of deep neck abscesses. The need for education of the community to understand deep neck abscess will encourage them to seek early hospital treatment, hence improving the prognosis of patients with deep neck abscesses.

The limitations of this study include: This study only assessed the SOFA score at the time of the patient's initial admission to the Intensive Observation Room (IOR). Additionally, this study did not include comorbid factors as variables that could influence mortality and length of stay.

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