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RESEARCH

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Comparison of Severity in Diabetic Ulcer Patients with and Without Sepsis

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Abstract

Diabetes mellitus patients in Central Java grow yearly. According to data provided by the Central Java Health Department in 2019, Diabetes mellitus ranks second as the largest non-communicable disease (NCD), covering 13,4% of the total NCD patients. The prevalence of diabetic ulcers is 15-25% of all diabetes mellitus patients in Indonesia, which concerns the author regarding the possible increase of the diabetic ulcer population in Central Java. The severity of diabetic ulcers depends on various factors, including infection and complications. The most common complication is sepsis, a systemic infection often arising from local infections that are not appropriately treated, causing progressive damage and increasing mortality rates. This study aims to examine the comparison of ulcer severity in diabetic ulcer patients with sepsis and non-sepsis complications using Meggitt Wagner's criteria. This study utilizes an analytic observational study using a cross-sectional approach. The author sampled 126 patients diagnosed with Diabetic Ulcers in 2022 at Dr. Moewardi General Hospital for this study, using a purposive sampling method. The research was conducted by looking at the patient's medical record data, and data analysis using SPSS software. The test used in this research includes a Parametric T-independent test and a Pearson bivariate relationship test. This study shows that the comparison of ulcer severity in diabetic ulcer patients with sepsis and without sepsis was statistically significant (p -value = 0.000002). The mean of the group with sepsis (3.4127) was greater than the group without sepsis (2.5238). In conclusion, the comparison of ulcer severity in diabetic ulcer patients with sepsis and without sepsis is significant. We recommend future researchers include patients' comorbidities, total hospitalization time, and detailed information on drug use and patient adherence to treatment in their research for more nuanced findings.

Keywords: Diabetes Mellitus, Diabetic Ulcer Severity, Sepsis, Wagner's Criteria.

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1. INTRODUCTION

Diabetes Mellitus (DM) is a chronic metabolic disease characterized by persistent hyperglycemia. It is caused by insulin secretion damage or peripheral insulin resistance (Goyal, Jialal, & Delhi, 2023). In 2019, Indonesia was ranked 7th as the country with the most diabetic patients in the world (Kementerian Kesehatan, 2020). Meanwhile, in Central Java itself, diabetes is the second largest non-communicable disease (NCD) after hypertension with 618,546 patients, covering 10.7% of the total number of patients with NCD (Dinas Kesehatan Provinsi Jawa Tengah, 2019). Therefore, it is vital for the medical institution to pay additional attention in order to reduce the prevalence and complications of Diabetes Mellitus in Central Java.

Common Diabetes Mellitus complications that often emerge are diabetic ulcers (Wang et al., 2021). The term diabetic ulcer is used to describe a wound on the skin of a person with diabetes, which does not heal properly (Monteiro-Soares et al., 2019; Syafril, 2018). Wounds with longer periods of healing increase its risk of infection, and if not treated accordingly, it may cause sepsis (Perez-Favila et al., 2019). Patients with sepsis experience systemic inflammation and immune disorders that involve altering multiple organs in the body, thus increasing the risk for amputation, disability, and death (Huang, Cai, & Su, 2019)

Diabetic ulcer is a potentially fatal complication that can cause mortality and morbidity in patients. Previous studies suggest that 19-34% of diabetic patients are likely to develop diabetic ulcers in their lifetime (Everett & Mathioudakis, 2018). In Indonesia, the probability of developing diabetic ulcer reaches 15% of the total diagnosed DM patients with a prevalence rate of diabetic ulcers occurring in 15-25% of patients (Sukartini, Theresia Dee, Probawati, & Arifin, 2020).

During the course of the disease, diabetic ulcer is so susceptible to infection that it commonly caused septic foot or infected diabetic wound (Lin, Hung, Huang, & Yeh, 2019). Previous study showed that 98.8% of diabetic ulcer patients in Indonesia suffer from infection, which requires patients to be assessed for possible infection during admission (Najihah, 2020). In 2021, it is stated that sepsis is the most common complication for diabetic ulcer patients, which is evident in 68.26% of the total patients (Hariftyani, Novida, & Edward, 2021).

Previous research regarding the profile of diabetic ulcer patients proves that sepsis is the most common complication in DM, and ulcer severity determined with Meggitt-Wagner criteria grade 4 and 5 have manifested in 41,31% of patients (Hariftyani et al., 2021). However, it has not been clarified whether there is a difference in the severity of ulcers in patients with sepsis and without sepsis. Based on this information, this study aims to contribute novelty by analyzing the comparison of ulcer severity in patients with sepsis and without sepsis using Meggitt-Wagner's criteria. The increasing number of diabetic ulcer patients and the lack of knowledge regarding these complications indicates the urgency to research this matter.

2. RESEARCH METHOD

This is analytic observational research utilizing a cross sectional method as its research design, conducted at the Internal Medicine Department of Dr. Moewardi General Hospital Surakarta. The population of this research are type 2 DM patients diagnosed with diabetic ulcers in the year of 2022 at Dr. Moewardi General Hospital Surakarta with inclusion of patients with pneumonia excluding patients with a history of malignancy and autoimmune; patients undergoing immunosuppression therapy; patients with other infection such as UTI and gastrointestinal infection; and patients with insufficient medical records.

The independent variable is the presence or absence of sepsis in patients measured using Sequential Organ Failure Assessment (SOFA) criteria (Cecconi, Evans, Levy, & Rhodes, 2018). The dependent variable is severity of diabetic ulcer measured with Megitt-Wagner's

criteria (Utami, Marselin, & Hartanto, 2021). Confounding variables include age, gender, length of stay, types of pathogens in the ulcer, and patients' mortality. Samples were taken using a purposive sampling method, with 63 patients in each category with and without sepsis, making the total sample of 126 patients. Data analysis was performed using SPSS software. The population was first subjected to normality and homogeneity tests using Kolmogorov-Smirnov test and Levene's test (Conover, Guerrero-serrano, & Gustavo, 2018; Orcan, 2020). Furthermore, data on ulcer severity and the presence or absence of sepsis was analyzed using a parametric comparison test to determine the difference between the severity in both categories (Kim, 2015). A significant difference is obtained if the p-value is <0.05. Ethical approval for this study was obtained in Dr. Moewardi General Hospital Surakarta with ethical number: 364/III/HREC/2023.

3. RESULTS AND DISCUSSION

Table 1. Subject Characteristics (age, gender, comorbidities)

Subject	Characteristic	Frequency (n)	Percentage (%)
Age	15-44 years old	7	6%
	45-59 years old	61	48%
	≥60 years old	58	46%
Gender	Female	67	53%
	Male	59	47%
Comorbidities	Yes	64	51%
	No	62	49%

Table 1 shows that the population of this study consists of 67 female patients and 59 male patients, with the age ranging from 33-83 years old. The data indicates that the most common age group of this study population is between 45-59 years old. The percentage of patients with comorbidities prior to admission is slightly higher than that of patients without comorbidities

Table 2. Ulcer Severity on Patients with and Without Sepsis

Sepsis	Wagner's Criteria Grade					Total	Mean	p-value
	1	2	3	4	5			
Yes	2	7	22	26	6	63	2.5238	0.000002
No	11	23	16	12	1	63	3.4127	

Table 2 shows that this study obtained medical records from 126 diabetic ulcer patients at Dr. Moewardi General Hospital Surakarta in the year 2022. The data was later examined for ulcer severity using Meggitt-wagner's criteria, and the presence or absence of sepsis. The outcome shows that the average Wagner's Criteria grade for ulcer patients with sepsis is 3.4127, with grade 4 being the frequent Wagner's grade. For patients without sepsis, the average Wagner's Criteria grade is 2.5238 with grade 2 contributing to a third of the total patient's severity grade.

Data acquired in this study suggest that diabetic ulcer patients with sepsis had a higher Wagner grade (3.4127) compared to its counterparts without sepsis (25238). Further analyzing the data using T-Independent test resulted in p-value <0.001 (p<0.05), meaning that the comparison between two groups is significantly different.

Ulcer Severity is influenced by many factors, such as infection. Infection in diabetic ulcers varies in type, ranging from uncomplicated cellulitis to systemic inflammation or sepsis (Goh et al., 2020). The presence of infection is one of the bases for assessing the severity of ulcers. Likewise, in Wagner's criteria used in this study, the presence of infection is specified in grade 3 (Stang & Young, 2018). Infection in diabetic ulcers is progressive, and ulcer patients

with infections are 10 times more probable of hospitalization and have an increased amputation risk up to 155 times compared to individuals without infections (Najihah, 2020; Primadina, Basori, & Perdanakusuma, 2019). In a previous study, it is mentioned that 59% of diabetic ulcer patients were the result of sepsis (Matta-guti, Garc, Garc, Á, & Luis, 2021). Moreover, the Department of Orthopedic Surgery in Korea university found a positive and linear correlation between patients diagnosed with sepsis and the severity of diabetic ulcers (Park, 2017).

Table 3. Samples Distributions Based on Age and Mortality

Subject		Wagner's Criteria Grade					Mean	p-value	
		1	2	3	4	5			Total
Pathogens	MDR	2	5	11	17	1	36	3.2778	0.029
	Non-MDR	11	25	27	21	6	90	2.8286	
Age	≤60 years old	9	14	25	17	3	68	2.8678	0.263
	>60 years old	4	16	13	21	4	58	3.0862	

Table 3 shows that the patients with multi-drug resistant (MDR) pathogens experience higher severity grade albeit a lower population count. Based on the information acquired in this research it is stated that 36 out of 126 patients are infected with MDR pathogens, and the average Wagner's Criteria Grade on those patients are 3.2778. Whilst, Wagner's Criteria grade for patients infected with non-MDR pathogens averaged at 2.8286.

Furthermore, it appears that patients over 60 years old had a higher Wagner's Criteria Grade during admission over patients aged 60 years and younger. With the average Wagner Grade for patients over 60 are 3.0862.

In patients infected with MDR pathogens, the Wagner grade averaged higher than patients infected with non-MDR pathogens. This analysis also bears significant results with a p-value of 0.29 ($p < 0.05$). A previous study supported this result by stating that patients infected with MDR pathogens require longer healing periods, resulting in an increase in the Wagner grade due to bacterial reproduction which exacerbates tissue damage and increases the risk of infection (Liu, 2022; Yan, Song, Zhang, & Li, 2022)

Patients over 60 years old are found to have higher Wagner grade over patients age 60 years and younger. Despite this, after analyzing the comparison between both groups using the T-Independent test, the resulting p-value is proven to be insignificant. Meaning the difference between the two groups mean are indistinguishable in comparison. The Previous study in 2021 and 2022 affirms this result in that they found no correlation between age and diabetic ulcer severity (Dörr et al., 2020; Syauta, Hendarto, Mariana, Kusumanegara, & Faruk, 2021). In 2018, a study by Jeffcoate found that older patients had a longer recovery period, which is believed to have contributed to ulcer severity (Jeffcoate, Vileikyte, Boyko, Armstrong, & Boulton, 2018).

Table 4. Sepsis Distribution on Hospital Length of Stay

Sepsis	Length of Stay			Mean	p-value
	0-5 days	6-10 days	>10 days		
Yes	22	26	15	7.6984	0.372
No	22	33	8	7.0635	

Table 4 shows that Patients with and without sepsis are further examined on their hospital length of stay, comparing the time spent for treating both groups. The results are longer periods of hospital stay for patients with sepsis. Patients with sepsis had an average length of stay of 7.7 days, and patients without sepsis spent an average 7 days at the hospital.

In comparing the length of stay of patients with and without sepsis, the results for patients with sepsis appear to be longer in duration. However, after analyzing the comparison between the two groups, the result does not hold significance as the p-value equals to 0.372. In the T-independent test, the p-value needs to be <0.05 for the comparison to have any significant difference. In contrast with previous study, it is said that diabetic ulcer patients with sepsis experience 1.6 times longer hospital stays than patients without sepsis (Gunawan, Pangalila, & Ludong, 2019). This contrasting outcome is likely due to study limitations; however, the author believes that said contrast warrants further study to determine such findings.

Table 5. Sepsis Distribution on Patients Mortality

Sepsis	Mortality (n)		Pearson Correlation	p-value
	Yes	No		
Yes	27	36	0.496	<0.0001
No	1	62		

Table 5 shows Out of 126 medical records from patients that had been acquired, this study found that 28 patients died in total. 27 of them were patients with sepsis, and only one patient died without sepsis. A significant correlation between sepsis patients and mortality is characterized by the p-value result at <0.0001 ($p<0.05$). It is discovered that out of 28 patients in the sample population who died, 27 of them are patients with sepsis. Moreover, after further examining the data, the Pearson Correlation is valued at 0.496 which indicates a moderate correlation. These findings are in accordance with the previous study by Schofield, 2021 claiming that sepsis is the leading cause of death in ulcer patients, and another study by Chen, 2023 affirms this result by mentioning that systemic and local infection was the second leading cause of death after cardiovascular disease in patients with diabetic ulcer (Chen, Sun, Gao, & Ran, 2023; Schofield, Haycocks, Anderson, Heald, & Robinson, 2021).

4. CONCLUSION

In accordance with this research, which utilizes a cross-sectional approach on 126 diabetic ulcer patients' medical records at Dr. Moewardi General Hospital during the year 2022, it is evident that the comparison of ulcer severity in diabetic ulcer patients with and without sepsis is statistically significant. It is also concluded that the severity of ulcer on patients infected with MDR pathogens are more severe than patients who are infected with non-MDR pathogens. Lastly, this study also noted the moderate correlation between the presence of sepsis and patient mortality.

For future researchers, it is advised to classify comorbidities according to organ system and analyze the severity for each group to see if there are significant results, also to consider the total time of hospitalization for patients with multiple admissions in order to extensively comprehend the patient's condition, lastly, future studies should provide a detailed picture of drug use and patients treatment adherence.

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