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Research Article

Clinical Characteristics of Acute Kidney Injury in COVID-19 Patients

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ABSTRACT

Background: Coronavirus Disease 2019 (COVID-19) is one of the infectious diseases that exist in Indonesia. Not only infects the lungs, but this virus can also infect other organs such as the kidneys. In addition, the process of viral infection causes cell hypermetabolism, which can increase the workload of the kidneys in excreting metabolic waste. In the end, the damage caused by the virus can cause Acute Kidney Injury (AKI). It is necessary to know the prevalence and characteristics of this event. **Purposes**: This study aims to provide an overview of AKI's prevalence and clinical features in COVID-19 patients. **Methods**: This was a descriptive study that used patient medical records for the period April-September 2021. The univariate analysis data showed a characteristic frequency distribution of age, gender, comorbidity, hospitalization duration, and urea creatinine rate. **Results**: The incoming samples based on the inclusion and exclusion criteria were 44 samples. In COVID-19 patients, complications of AKI were found in adults, as much as 68.2% of both men and women had a percentage of 50%, the most common comorbid was hypertension 30.8% with a hospitalization duration of 1-10 days 43.2% and an average increase in urea 79.68 mg/dL and creatinine average 2,859 mg/dL. **Conclusion**: Based on patient characteristics, the results showed that more COVID-19 patients with acute kidney injury complications occurred in adult patients, with no difference in prevalence between males and females, with comorbid hypertension and length of hospitalization less than ten days.

Keywords: acute kidney injury, clinical characteristics, COVID-19, prevalences

INTRODUCTION

Indonesia has various kinds of infectious diseases, one of which is Coronavirus Disease 2019 (COVID-19) (1). This case was first reported in Wuhan, China, on December 31, 2019, due to infection with the SARS-CoV-2 virus As of August 8, 2022, there were 581,686,197 cases in Indonesia, with a total death of 6,410,961 (2).

This infection starts with a virus that enters via the Angiotensin Converting Enzyme-2 or ACE2 receptor (1,3). These receptors are not only owned by the lungs but also by other organs such as the kidneys, bladder, ileum, and heart (4) The blockage of these receptors by the Coronavirus means that angiotensin II cannot be converted to angiotensin 1-7, increasing the amount of angiotensin II. Angiotensin II affects the vasoconstriction of blood vessels. This causes disruption of blood flow to supply sufficient oxygen and a source of nutrition for organ cells (5–7). In addition, the entry of this virus will activate inflammatory mediators, which can cause cell damage and lead to necrosis or cell death (8). If this process occurs, complications

from COVID-19 will arise. In the kidneys, viruses can damage nephron cells so that they can cause acute kidney failure (AKI) (4,9).

The causes of AKI are divided into 3 locations, namely pre-renal, renal, and post-renal—generally, the cause of pre-renal damage results from tissue hypoperfusion conditions. AKI can also occur due to problems with the kidneys themselves, such as an infection or abnormality in the kidneys' structure. In addition, post-renal obstruction to urine flow can also be a cause of AKI (10,11). AKI can be diagnosed if there is a condition of decreased kidney function where there is an increase in serum creatinine by 0.3 mg/dL or 1.5 times greater in 7 days or urine volume is less than 0.5 ml/kg/hour in 6 hours (9,12).

The kidneys regulate the process of filtration and secretion so that creatinine can be excreted at a constant concentration in plasma every day. Protein metabolized by the body will produce a waste product in the form of urea. This urea will be excreted by the kidneys in the form of urea so that if there is a malfunction, urea will accumulate in the blood. Like urea, creatinine is also a product of protein metabolism that occurs in muscles. The rate of muscle metabolism is equal to the rate of creatinine excretion in the kidneys. If there is an increase in creatinine, this indicates impaired kidney function (13). The incidence of AKI can increase in elderly COVID-19 patients. It can also increase in patients who have comorbidities such as diabetes mellitus, peripheral vascular disease, hypertension, congestive heart failure, and chronic liver disease (10,11,14). The aim of study will present information in the form of prevalence and clinical characteristics including age, gender, comorbid factors, length of hospitalization and increased urea and creatinine in COVID-19 patients who experience AKI at RSU Bunda Margonda.

METHODS

This research is a descriptive observational study conducted at Bunda Margonda General Hospital using secondary data from patients' medical records confirmed positive for COVID-19 from April to September 2021. The research sample used total sampling calculated by the Lemeshow formula. The minimum number of samples needed in this study was 39, with inclusion criteria being complete medical records of COVID-19 patients accompanied by AKI treated at Bunda Margonda General Hospital. While the exclusion criteria were COVID-19 patients without hemodialysis, COVID-19 patients with chronic kidney failure, and COVID-19 patients accompanied by secondary infection with complications of acute kidney failure. Medical records were collected, including medical record number, age, gender, comorbid factors, hospitalization length, and patient urea and creatinine levels.

After all the data needed in the research has been collected, it will be processed using SPSS (Statistical Package for Social Science) computerized statistics so that the results of univariate analysis of the frequency distribution of the prevalence and clinical characteristics of COVID-19 patients with AKI based on age, gender, comorbidities, length of hospitalization, levels of urea and creatinine will be obtained. The research has passed an ethical review based on letter number: 280/PE/KE/FKK-UMJ/X/2022 issued by the Health Research Ethics Commission, Faculty of Medicine and Health, the University of Muhammadiyah Jakarta.

RESULTS

After searching for medical record data for April to September 2021, there were 1,211 patients diagnosed with COVID-19. However, only 44 patients were included in the study sample based on inclusion and exclusion criteria. The following are the results of research that has been done.

Table 1. Prevalences and characteristics of Acute Kidney Injury in COVID-19 patients

Characteristics	Frequency (n)	Percentage (%)
Age		
18 - 65	30	68.2
>65	14	31.8
Gender		
Male	22	50
Female	22	50
Hospitalization		
1 - 10	19	43.2
11 - 14	14	31.8
>14	11	25.0
Comorbid		
None	13	16.7
Hypertension	24	30.8
SNH (stroke non hemorrhage)	3	3.8
Obesity	3	3.8
DM (diabetes mellitus)	20	25.6
CHF (chronic heart failure)	2	2.6
CAD (coronary artery disease)	2	2.6
Osteoarthritis	2	2.6
Neuro disease	2	2.6
Other cardiovascular disease	7	9.0

COVID-19 patients with AKI were more experienced by patients aged between 18-65 years in 30 of 44 patients (68.2%) and patients over 65 years of age in 14 of 44 patients (31.8%). The sexes were balanced, namely 22 patients (50%) each. The most comorbidities, in this case, were hypertension (30.8%), followed by diabetes mellitus (DM) (25.6%), no comorbidities (16.7%), other cardiovascular diseases (9%), non-hemorrhagic stroke (SNH) and obesity each 3.8%, as well as chronic heart failure (CHF), coronary artery disease (CAD), osteoarthritis and neurological disease each 2.6%. COVID-19 patients with AKI underwent treatment for less than 11 days in 19 patients (43.2%), 11 – 14 days in 14 patients (31.8%), and more than 14 days in 11 patients (25.0%).

Table 2. The increase of urea and creatinine

Characteristics	Increase
Urea	
Minimum	23
Maximum	210
Average	79.68
Kreatinin	
Minimum	1.2
Maximum	9.0
Average	2.859
Total	44

Based on table 2, COVID-19 patients with AKI experienced an average increase in the urea of 79.68 mg/dL, with the lowest value found in patients, namely 23 mg/dL, and the highest value, namely 210 mg/dL. In comparison, the increase in creatinine that occurred on average was 2.859 mg/dL with the lowest value found in patients, namely 1.2 mg/dL and the highest value, 9.0 mg/dL.

DISCUSSION

From the data obtained, the prevalence of AKI in COVID-19 patients starts from 30 to 78 years, with the highest number of cases at the age of 68, namely five people. Previous research supported this result, which found that the average patient age was 69 years from the 26 samples studied (15). However, the overall results showed that the prevalence of AKI in COVID-19 patients at Bunda Margonda General Hospital was dominated by adults (18-65 years old) in 30 of 44 patients with an average age of 59 years. These results align with research conducted by Cheng et al. (2020), which found an average patient age of 63 years from the 701 samples studied (16). This research variable can prove that with age, a degenerative process can affect a person's health through a decrease in the quantity and quality of the immune system (17).

The results of this study are different from previous studies, which found that the occurrence of AKI in COVID-19 patients was dominated by men (15,16,18) Based on table 1, the prevalence found in both male and female sexes has the same percentage of results, namely 50%. Differences in conditions in sex occur due to several factors, such as differences in reproductive hormones and lifestyles, such as protein, salt, cigarettes, and alcohol consumption (19). The most common comorbid was hypertension in 24 of 44 samples (30.8%) (Table 1). The same results were found in the study by Cheng et al. (2020), with the most cases being hypertension (33.4%) (16). A survey by Diao et al. (2021) also found the most cases being hypertension (39.13%), followed by coronary heart disease 21.74% and another heart disease 17.39% (18). Also, in the study of Su et al. (2020), as many as 11 out of 26 samples had comorbid hypertension (15). Patients infected with SARS-COV-2 have a greater risk of experiencing hypertension due to disorders caused by the virus on the ACE2 receptor. The results of this study support the theory that one of the risk factors for AKI is impaired blood circulation to the kidneys. In people with a history of hypertension, inflammatory cells

accumulate in the blood vessels and kidneys, which in the process cause kidney cell damage which can trigger AKI (10).

The duration of treatment received by patients varies greatly depending on the severity of the disease experienced. Factors that can affect the severity of the disease are age and comorbidities (20). Research conducted by Putri (2022) explains that the average recovery for COVID-19 patients is seven days (21). The patient's recovery time affects the treatment length and complications that can occur in patients. Based on table 1, it was found that 19 of 44 samples (43.2%) underwent treatment for 1-10 days. 6 of 19 patients underwent treatment for nine days. These results are supported by the research of Cheng et al. (2020), namely with an average treatment of 10 days (15).

SARS-COV-2 virus infection enters through ACE2 receptors which are owned by tissues in the respiratory tract and other tissues/organs such as the kidneys. Damage to the kidney will give a sign, one of which is an increase in urea and creatinine. Increased urea and creatinine can also be found in several circumstances besides kidney damage. Increased urea can be found in severe dehydration, bleeding, drug side effects, burns, and excess protein intake. Meanwhile, an increase in creatinine can be found in a state of dehydration, rhabdomyolysis, hypertension, diabetes, drug side effects, and excess protein intake (13). In a study conducted by Volunteers et al. (2020), urea increased by 27% of the total sample of COVID-19 patients who had impaired kidney function and increased creatinine by as much as 19% of the total sample (22). Based on table 2 of the research that has been done, the average increase in urea in patients was 79.68 mg/dL, and the average increase in patient creatinine was 2.859 mg/dL.

CONCLUSION

This study shows that COVID-19 patients with complications of acute kidney injury are more experienced by adult patients, with no difference in prevalence between males and females. The most common comorbid was hypertension, length of hospitalization less than ten days. All the patients experienced an increase of urea and creatinine with the results that had been explained before.

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CONFLICT OF INTEREST

This research was purely carried out by the researchers themselves without any interference from other parties.

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