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ACUTE KIDNEY INJURY IN THE INTENSIVE CARE UNIT: A CASE STUDY AT RSUD DR. CHASAN BOESOIRIE TERNATE

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ABSTRACT

This study aimed to analyze the factors influencing the incidence of Acute Kidney Injury (AKI) in the ICU of Dr. H. Chasan Boesoirie Hospital, Ternate, North Maluku. The research utilized a cross-sectional design involving 53 ICU patients diagnosed with AKI, examining the relationship between risk factors such as diabetes mellitus, hypertension, and the severity of AKI. Data was collected through medical record reviews. The results revealed that most AKI patients were over 60 years old, with a high mortality rate. Diabetes mellitus was found to be less common among AKI patients in this study, contrary to findings from other regions in Indonesia. This research emphasizes the importance of early detection and addressing comorbidities in preventing and managing AKI. The findings suggest a need for improved healthcare systems and early interventions, especially in underserved areas.

KEYWORDS *Acute Kidney Injury, Kidney, ICU, Characteristics, LFG*

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INTRODUCTION

Acute Kidney Injury (AKI) is the occurrence of a rapid decrease (within hours to weeks) of Glomerular Filtration Rate (GFR), which is generally reversible, followed by renal failure to excrete the rest of nitrogen metabolism, without disturbances in fluid and electrolyte balance and acid-base homeostasis (KDIGO, 2012). One of the common complications in patients with critical illnesses in the Intensive Care Unit (ICU) is acute kidney failure or Acute Kidney Injury (AKI). The incidence of Acute Kidney Injury (AKI) can be predicted using the RIFLE

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(Risk-Injury-Failure-Loss-End stage renal failure) criteria. AKI is a new terminology for acute kidney injury. A term that can provide an overview of the gradual phase of damage from the beginning to the occurrence of kidney failure (Bu, 2019). Acute Kidney Injury (AKI) can be interpreted as a rapid and sudden or severe decrease in kidney filtration function. This event is generally characterized by increased serum creatinine concentration or azotemia (increased BUN concentration). Melyda (2020). However, as soon as a kidney injury occurs, the concentration level of BUN returns to normal, so the benchmark for kidney damage is a decrease in urine production.

Epidemiology of AKI is generally most common in patients aged >65 years and have comorbidities such as cardiovascular disease and/or diabetes mellitus, but in some cases, AKI can also occur in children, such as the case that occurred in Indonesia in 2022 due to ethylene glycol poisoning in children's syrup drugs (Hoste, 2015). The prevalence of AKI incidence in developing countries is different from that of developed countries. Old age or post-cardiac operation is a common factor in developed countries, in contrast to what is often found in cases in developing countries, which mostly occur at a young age or in children, with the source of the cause usually infection, toxicity, dehydration, or obstetric cases (Musda et al., 2023). Several world reports show that the incidence varies between 0.5-0.9% in the community, 7% in hospitalized patients, up to 36-67% in intensive care unit (ICU) patients, and 5-6% of ICU patients with AKI require renal replacement therapy (TPG). The meta-analysis included 154 studies in more than 3,000,000 individuals, resulting in 1 in 5 adults and 1 in 3 children worldwide experiencing AKI during hospital treatment. Around 20-50% of the incidence of AKI patients who are treated in the intensive care unit (ICU) (Doi, 2016).

Establishing the diagnosis of acute kidney injury (AKI) through anamnesis, physical examination, and history is critical to evaluate. Anamnesis, information about the causes or risk factors of prerenal AKI include decreased circulation volume (gastroenteritis and bleeding), redistribution of circulation volume (edematose state, nephrotic syndrome, and sepsis), decreased cardiac output (heart disease), or increased resistance to blood flow (abdominal complement syndrome and renal artery stenosis). It is also important to remember that creatinine usually increases up to 48 hours after a kidney injury. Therefore, it is important to review episodes of hypotension, hypoxia, sepsis, surgery, contrast exposure, and drug exposure that occur 48 to 72 hours before the episode of acute kidney injury (AKI) becomes apparent (Melyda, 2020).

Classification based on the etiology of AKI is classically divided into 3 divisions based on the location of pathophysiological events, namely before the kidney (55%), then in the renal parenchyma (40%), and after the kidney (5%). Almost 50% of AKI is reported to be caused by sepsis. This varied classification requires that, in therapy, it needs to be considered precisely and strictly. The main goal of AKI management is to prevent further kidney damage and pay attention until the kidneys return to normal function. There are two types of treatment in the management of AKI, namely supportive therapy and renal replacement therapy (RRT). Conservative therapy is carried out with drugs or fluids to prevent or reduce

the progression of decreased kidney function, morbidity, and mortality due to AKI complications; it is necessary to consider PRC (dialysis) (Alscher et al., 2019).

AKI is a life-threatening disease, so the cooperation of the medical team, patients, family, and the environment is needed in the management of this disease. Educating patients and their families about possible diseases and complications will significantly help improve treatment outcomes and is expected to help improve the patient's quality of life. Early diagnosis, lifestyle modification, and treatment of underlying diseases are therefore important in patients with AKI. However, research related to the incidence of AKI has never been conducted in Ternate City or North Maluku Province. Therefore, researchers need to search for information about the incidence of AKI in Ternate City by taking the location of the research population of patients hospitalized at Dr. H. Chasan Boesoirie Hospital, especially in the Intensive Care Unit.

Acute Kidney Injury (AKI) in Indonesia poses a significant public health concern due to its high mortality rates and complex risk factors. AKI is associated with various comorbidities, such as hypertension, diabetes mellitus, and cardiovascular diseases, which contribute to increased complications and mortality. The mortality rate in AKI patients, particularly in critical care settings like the ICU, is notably high. In Indonesia, limited access to early detection, inadequate healthcare resources, and delays in receiving medical attention exacerbate the situation, leading to worsened outcomes. Furthermore, environmental factors such as the prevalence of infectious diseases and poor sanitation in rural areas increase the risk of AKI, especially in children. These factors, coupled with lifestyle habits such as smoking and alcohol consumption, further elevate the burden of AKI in the country. It is crucial to address these risk factors through public health interventions, timely diagnosis, and improved healthcare infrastructure to reduce the mortality and long-term complications of AKI in Indonesia. Understanding these factors and improving early interventions could help mitigate the widespread impact of AKI, especially in underserved regions.

The objective of this study is to analyze the factors influencing the incidence of Acute Kidney Injury (AKI) in Indonesia, specifically in Ternate, North Maluku Province, and to evaluate the impact of risk factors such as hypertension, diabetes mellitus, and cardiovascular diseases on the severity of AKI. This research also aims to explore the relationship between comorbidities, length of treatment, and patient outcomes with AKI in the ICU. Additionally, the study seeks to provide a clearer understanding of the distribution patterns of AKI based on age, gender, and environmental factors that may influence the occurrence of AKI in the region. Therefore, this study will provide valuable insights for developing strategies for preventing and managing AKI in Indonesia.

The benefit of this study is that it will provide a deeper understanding of the prevalence and risk factors of AKI in Indonesia, particularly in the Ternate area. The findings of this research are expected to serve as a reference for healthcare professionals and stakeholders in improving their knowledge and preparedness in managing AKI patients, as well as minimizing the mortality rate from AKI in the ICU. This study can also contribute to developing health policies in Indonesia related to the prevention and treatment of AKI and strengthening policies to

improve the healthcare system, including early detection and timely interventions. Furthermore, the results of this study may serve as a foundation for further research on AKI and help improve healthcare infrastructure in regions with high AKI prevalence.

RESEARCH METHODS

Design, Place, and Time

This study uses an observational descriptive design with a cross-sectional approach. It was carried out at Dr. H. Chasan Boesoirie Hospital, Ternate, North Maluku. The study lasted 6 months and included collecting and analyzing data on patients treated in the hospital's ICU.

Amount and Method of Intake

The study involved 53 ICU patients diagnosed with Acute Kidney Injury (AKI) at Dr. H. Chasan Boesoirie Hospital. The sampling technique used was total sampling, where all ICU patients diagnosed with AKI who met the inclusion criteria during the 6-month study period were included. The inclusion criteria required that patients be treated for AKI in the ICU and have relevant data, including creatinine levels, comorbid conditions (such as hypertension and diabetes), and treatment duration. Patients with incomplete data or those not meeting the AKI diagnosis criteria were excluded from the study.

The sample size of 53 patients was selected based on the anticipated number of AKI cases treated in the ICU during the research period. This sample size is considered adequate for observational descriptive studies, providing sufficient power to analyze the distribution of AKI cases by age, gender, comorbidities, and outcomes. It also ensures that the results can be generalized with statistical confidence for the larger population of AKI patients in the region. Data was collected by reviewing patient medical records and ICU patient management books to extract clinical variables such as creatinine levels, gender, age, comorbidities, treatment duration, and patient outcomes. Data was then systematically documented and analyzed using descriptive statistical methods to summarize the frequency distribution of these clinical characteristics.

Types and Methods of Data Collection

The research data was sourced from the patient's medical records at Dr. H. Chasan Boesoirie Hospital and the patient management form/book at the ICU Installation. Data collection was carried out by means of documentation, including clinical variables of patients such as age, gender, creatinine levels, hypertension, diabetes, length of treatment, and AKI diagnosis.

Data Processing and Analysis

The collected data were analyzed using univariate statistical methods. Univariate analysis was used to describe the frequency distribution of each variable studied, such as age distribution, sex, and clinical outcomes. Data processing is

carried out using SPSS version 24 software, and the analysis results are presented in tables for easy interpretation.

Validity and Reliability

Cross-checks are carried out between medical record data and ICU records to ensure the data's validity. Data reliability is obtained through a double-entry process in data processing to avoid input errors.

Research Ethics

This research has received approval from the Ethics Committee of dr. H. Chasan Boesoirie Hospital, by maintaining the confidentiality of patient data and complying with the principles of health research ethics. The research recommendation letter from PTSP Sofifi and Dr. H. Chasan Boesoirie Ternate Hospital, with letter number: 070/229/VII/2023. The researcher guarantees the confidentiality of all identities and data related to the patient

RESULT AND DISCUSSION

Table 1. Sample Characteristics

Variable	Number (n=53)	Presented (%)
Age		
10-19 years	1	1.9
19-59 years old	24	45.3
> 60 years	28	53.8
Gender		
Man	30	56.6
Woman	23	43.4
Creatinine		
Low	11	20.8
Tall	42	79.2
Primary Diagnosis		
No	51	96.2
Already	2	3.8
Laju Filtrasi Glomerulus (LFG)		
Stage 1: ≥ 90 ml/min/1.73m2	2	3.8
Stage 2: 60-89 ml/min/1.73m2	5	9.4
Stage 3a: 45-59 ml/min/1.73m2	11	20.8
Stage 3b: 30-44 ml/min/1.73m2	10	18.9
Stage 4: 15-29 ml/min/1.73m2	14	26.3
Stage 5:<15 ml/min/1.73m2	11	20.8
Payment methods		
BPJS	49	92.5
Common	4	7.5
Long Treatment		
≤ 3 days	44	83.0
< 3 days	9	17.0

Outcome		
Die	46	86.8
Live	7	13.2

Based on table 1, of the 53 samples studied, the most were obtained at the age of 60 years and above as many as 28 patients (53.8%), for the second place, namely at the age of 19-59 years as many as 24 patients (45.3%), while the lowest percentage was 10-19 years old as many as 1 patient (1.2%). Based on gender, the number of samples was 30 male patients (56.6%) and 23 female patients (43.4%). Based on creatinine levels, most patients had high creatinine levels, 42 patients (79.2%), while 11 patients (20.8%) had low creatinine levels. Based on the establishment of the diagnosis, 51 patients (96.2%) did not have the primary diagnosis of AKI. Based on the characteristics of glomerular filtration rate (LFG), the highest data was obtained in patients who had LFG of 15-29 ml/min/1.73m2 as many as 14 patients (26.3%), patients who had LFG of 45-59 ml/min/1.73m2 and <15 ml/min/1.73m2 were obtained as many as 11 patients (20.8%), patients who had LFG of 30-44 ml/min/1.73m2 were 10 (18.9%), patients who had LFG of 60-89 ml/min/1.73m2 were 5 patients (9.4%), and those who had an LFG ≥ 90 ml/min/1.73m2 as many as 2 patients (3.8%). Based on the payment method, 49 patients (92.5%) were paid using the BPJS method, while 4 patients (7.5%) were paid without health insurance. Based on the characteristics of the length of time, most patients were hospitalized for less than 3 days, namely 44 patients (83%), and for patients who were hospitalized for >3 days, there were 9 patients with a percentage of 17.0%. Based on the characteristics of patient outcomes, it was found that the number of patients who died was as high as 46 patients (86.8%), and patients who survived or returned home after treatment were 7 patients (13.2%).

Table 2. Conditions or comorbid diseases of AKI events

Variable	Number (n=53)	Presented (%)
Hypertension		
Already	9	17.0
No	44	83.0
Diabetes Mellitus		
Already	10	18.9
No	43	81.1
Heart failure		
Yes	3	5.7
Not	50	94.3
Accident		
Yes	1	1.9
Not	52	98.1

Based on the characteristics of the condition or comorbidities presented in Table 2, namely hypertension, patients who did not have hypertension were found to be higher, as many as 44 patients (83%), and those who had hypertension were 9 patients (17.0%). Based on the characteristics of comorbidities with diabetes mellitus, there were 43 patients (81.1%) who did not suffer from diabetes, while

10 patients (18.9%) had diabetes. Based on comorbidities with heart failure, patients who did not suffer from heart failure were 50 patients (94.3% while there were 3 patients (5.7%) who suffered from heart failure. Based on the characteristics of accidents, most were obtained in patients who did not have an accident, namely 52 patients (98.1%), and patients who had an accident, namely 1 patient (1.9%).

Distribution of AKI Patients by Age

Based on the research conducted, most AKI sufferers are found to be over 60 years old. This study is in line with research conducted by Magboul et al. in Sudan; most people who experience AKI in the age group of >60 years are 61 patients (58.1%) (Magboul et al., 2020). In contrast to old age, in a study conducted by Fuhrman et al., it was found that AKI developed in the young adult age group (16-25 years), or by 39.8%, this can occur due to the use of drugs such as vancomycin and calcineurin inhibitors, which were found to be significantly related to AKI (Fominskiy et al., 2021).

Cases of AKI in developed countries mostly occur in patients who are elderly and have chronic diseases such as diabetes mellitus, malignancy, and cardiovascular disease. AKI that occurs in old age is mainly caused by ischemia and is often related to the failure of other organs. The life expectancy of AKI patients decreases with age. One study found that the mortality of patients aged >50 years had a twice greater risk (Hidayat et al., 2020). It was also found in a study conducted by Moore et al. that the elderly contribute to the number of patients treated for acute kidney failure per 100,000 population, but at the age of 18-44 years, there is also a rapid increase in the rate (Moore & Torio, 2017).

Distribution of AKI Patients by Gender

Based on gender in this study, it is known that most are male. The results of this study are in line with the research conducted by Saeed in Iran, for 770 AKI patients, it is known that 455 samples (59.1%) are male patients 59.1% while female patients are 315 samples (40.9%) (Safari et al., 2018), and in line with the research conducted by Hidayat et al at Bandung Hospital, it was found that the most AKI samples were found in men, amounting to 33 samples (54%), and for women, amounting to 28 samples (46%) (Hidayat et al., 2020). However, there are different results from the research conducted by Utami et al at dr. Soedarso Pontianak, the most AKI samples were obtained for women, amounting to 35 samples (51%), and for men, amounting to 34 samples (49%) (Utami et al., 2016).

Men have higher risk factors for AKI compared to women due to the role of estrogen hormones, which can be protective for the kidneys. Meanwhile, men have more testosterone (Franco-Acevedo et al., 2021), and the incidence of AKI is greatly influenced by unhealthy lifestyles such as smoking and alcohol consumption, which are more often carried out by men compared to women, so this causes the incidence of AKI to occur more in men (Loutradis et al., 2021).

Distribution of AKI Patients Based on Creatinine Results

Based on the results, creatinine was obtained most in the category of high creatinine. This study is in line with a study conducted by Ramires et al. in Brazil,

294 AKI patients experienced increased serum creatinine levels (Ramires et al., 2022). In contrast to the research conducted by Jaelani et al., with results based on the number of 40 samples obtained with an average value divided into several days of collection, namely for the first day of 3.83 and a decrease on the next day, namely 3.23 (Jaelani et al., 2023).

Creatine is a non-nitrogenous protein that is the result of creatine phosphate metabolism. Creatinine in the muscles and brain will undergo phosphorylation into creatine phosphate. If energy is needed, creatine phosphate is broken down into ATP. The creatinine in the kidneys will be filtered and secreted by the tubules. Increased creatinine levels indicate a disturbance in kidney function or a decrease in kidney function; this is due to the disruption of the excretory process from the serum creatinine itself, so that the level of creatinine increases (Radišić Biljak et al., 2017).

Distribution of AKI Patients Based on Primary Diagnosis

It was found that in the enforcement of the diagnosis, the majority of AKI was not the primary diagnosis. This result is in line with a study conducted by Jurawan et al. in the United Kingdom on 73,016 patients, most of whom were AKI patients who were not the primary diagnosis, with 71,381 patients, while those who were mainly diagnosed as AKI were 1,635 patients (Jurawan et al., 2017).

There are various symptoms with cases of AKI, which are indeed quite complex, as well as the primary diagnosis, which varies, including patients who experience stroke, septic shock, hypovolemic shock, and respiratory disorders. The etiology of AKI is very complex, but is generally divided into pre-renal, renal, and post-renal (Fatoni & Kestriani, 2020). Several diseases may be the primary diagnosis that have an impact on the occurrence of AKI, such as sepsis and heart failure, which are the causes of pre-renal AKI. Renal battery occurs due to abnormalities in the vascular or tubular components of the kidney, due to malignant hypertension, vasculitis, interstitial nephritis, and acute glomerular nephritis glomerulus, while post-renal AKI can occur due to intrarenal or extrarenal obstruction that causes blood flow disruption in the kidneys (Maskoen & Akbar, 2023).

Distribution of AKI Patients Based on Glomerular Filtration Rate

Based on the characteristics of glomerular filtration rate (LFG), the highest LFG data was obtained, which was 15-29 ml/min/1.73 m2. The presence of patients who recovered or improved from a sudden decline in kidney function showed a degree of mild to severe AKI. A slightly elevated change in serum creatinine values may indicate a more severe condition. The RIFLE (Risk, Injury, Failure, Loss, ESRD) classification can help to know the stages of AKI. This is in line with the research of Hidayat et al. at Dr. Hasan Sadikin Bandung Hospital in 2018, which showed that the AKI stage experienced a decrease in LFG, with stage 3 dominated by 32 samples (53%) (Hidayat et al., 2020), as well as the results of a study by Marzuki et al at Dr. Saiful Anwar Malang Hospital on 135 AKI patients, most of whom were found with 3rd degree AKI, as many as 54 samples (40%) (Marzuki et al., 2022).

This study showed that the average AKI patient had an increased serum creatinine level, which affected the decrease in glomerular filtration rate. Normal creatinine levels can be caused because creatinine has an alternative elimination pathway; creatinine will compensate for the decrease in LFG and cause the level to remain unchanged until there is a decrease of ±50% of the LFG. Creatinine levels will increase when the capacity of this alternative tubule secretion pathway has been fully utilized. This causes a creatinine blind range, which makes sensitivity and stabilizes creatinine levels in the decrease in LFG (Hartati et al., 2015).

Distribution of AKI Patients Based on Payment Method

Based on the payment method in this study, it is known that most AKI patients use BPJS as their payment method. According to research by the Health Care Research and Quality Agency in the United States, the number of hospitalizations with acute kidney failure registered as a secondary diagnosis increased 3.1 times, from 1.0 million to 3.2 million hospitalizations and in 2014 acute kidney failure was included in the top 20 most common causes of hospitalization as well as one of the 20 most expensive conditions billed to Medicare. In 2014, hospitalizations primarily due to acute kidney failure accounted for 1.4 percent of all hospital patient admissions and 1.2 percent of total hospital costs or reached $4.6 billion and primary Medicare covered more than two-thirds of hospitalizations due to acute kidney failure (69.4%) and more than two-thirds of costs (68.6%) in 2014 (Moore & Torio, 2017). Therefore, the choice of payment method also eases the financial burden owned by patients suffering from acute kidney failure.

Distribution of Patients with Chronic AKI

Based on research conducted, for the duration of treatment of AKI patients, the most common treatment duration is less than or equal to 3 days. Another study conducted by Hidayat et al at Dr. Hasan Sadikin Hospital, Malang, showed that the results of hospitalization of AKI patients in the ICU were, on average, for approximately 7.2-9.4 days, with a mortality rate of 77% (Hidayat et al., 2020).

This is possible due to limited resources for early detection of AKI in primary health centers and hospitals, which leads to delays in referral and admission of patients with AKI who are already in a severe stage, usually accompanied by complications, and die early on admission to the hospital (Abebe, 2021a). The association between the short duration of hospital stay and increased mortality can represent a delay in going to the hospital, and because it is usually when their illness is severe enough, the option of going to the hospital is made (Bello, 2017).

Distribution of AKI Patients Based on Outcomes

Based on the results of the AKI output, there were more patients with death outcomes. The results of this study are in line with those carried out at Dr. Soedarso Pontianak Hospital, with a total of 69 samples; it was found that the most AKI patients were discharged from the death category, with 51 samples (73.91%)

(Utami et al., 2016). This result is also in line with the research conducted by Hidayat et al at Bandung Hospital, for 61 samples of AKI patients, most of whom were found to be 47 patients (77%), while 14 patients (23%) were alive (Hidayat et al., 2020).

A study entitled "Acute Kidney Injury and Mortality in Hospitalized Patients" explained that patients who were treated longer in the hospital had a higher mortality rate compared to AKI patients who were discharged from the hospital in good health, this was possible due to the influence of increased creatinine levels so that the risk factor for mortality in AKI patients increased. An increase in serum creatinine can cause excessive accumulation of urea toxins, which can cause uremic encephalopathy syndrome, which can manifest as a risk factor for morbidity and mortality (Marzuki et al., 2022). The study also said that patients who are susceptible to AKI disease are patients who have cardiovascular disease, infections, and sepsis; in addition, complications from medical treatment, neoplasms, and trauma can also occur. In AKI disease, it can be associated with patients who are associated with rhabdomyolysis, pancreatitis, and respiratory failure disease (Utami et al., 2016).

Distribution of AKI Patients Based on Diabetes Mellitus

Based on risk factors or comorbid diseases of diabetes mellitus, most AKI patients are found in those who do not have diabetes mellitus. This research is in line with the research conducted in Ethiopia, with a total sample of 203 AKI patients who have diabetes mellitus, 14 samples (6.9%), and those who do not have diabetes mellitus, as many as 189 samples (93.1%) (Abebe, 2021b). However, this study is not in line with the research conducted at Dr. Saiful Anwar Hospital Malang, where it was found that the most AKI patients experienced diabetes mellitus, amounting to 48 patients (Marzuki et al., 2022).

In this study, the majority of AKI patients did not have diabetes mellitus (DM), with only 18.9% of the patients diagnosed with DM. These findings are consistent with a study conducted in Ethiopia, where a sample of 203 AKI patients showed that 93.1% did not have diabetes mellitus (Abebe, 2021b). This is in contrast to research from Dr. Saiful Anwar Hospital in Malang, Indonesia, where the incidence of AKI among diabetic patients was higher, with 48 out of 135 patients (35.5%) diagnosed with DM (Marzuki et al., 2022).

Diabetes mellitus (DM) is widely recognized as a risk factor for acute kidney injury (AKI) due to its effects on kidney function. The pathophysiological mechanisms by which DM contributes to AKI include the overproduction of reactive oxygen species (ROS), renal medulla hypoxia due to increased oxygen consumption, and a disrupted oxygen supply. These factors, along with osmotic diuresis and changes in renal blood flow due to hyperglycemia, contribute to kidney injury. Moreover, DM leads to structural changes in the renal vasculature, such as endothelial damage, which hampers oxygen delivery to tissues and exacerbates kidney dysfunction.

The findings of this study also align with research in other developing countries, where the incidence of AKI in DM patients has been more pronounced. In some regions, however, non-diabetic patients still make up the majority of AKI

cases. This discrepancy may reflect differences in healthcare access, management of underlying comorbidities, and lifestyle factors such as diet and physical activity, which are key contributors to both AKI and DM (Abebe, 2021b; Marzuki et al., 2022). Further comparative studies between regions and countries could provide deeper insights into the relationship between DM and AKI and help optimize prevention and treatment strategies specific to local health challenges.

In Indonesia, the growing prevalence of DM, combined with its link to kidney damage, presents a significant public health challenge, particularly as the country faces an increasing burden of non-communicable diseases. Therefore, a more integrated approach to managing DM alongside other risk factors, such as hypertension and cardiovascular diseases, could play a critical role in reducing the incidence of AKI in the population.

Distribution of AKI Patients Based on Hypertension Incidence

The distribution of AKI patients based on hypertension comorbidities was highest in those who did not experience or had no history of hypertension. This result is in line with the research conducted at the Gatot Soebroto Army Central Hospital, namely from 373 samples of AKI patients who experienced hypertension, as many as 147 samples, and those who did not have hypertension, as many as 226 samples (Jonny et al., 2020), but this study is not in line with the research conducted in Malaysia, where it was found that the most AKI patients with hypertension amounted to 52 patients (36.4%) (Md Ralib and Mat Nor, 2015), and is not in line with the research conducted in Ethiopia, where there were 131 patients (64.5%) who had the most hypertension while 72 patients (35.5%) did not have hypertension (Abebe, 2021a).

Hypertension is a disease that can damage blood vessels. If the blood vessels are in the kidneys, then, of course, the kidneys are damaged. A person who does not have kidney disorders but has hypertension and is not treated, will cause complications in kidney damage, and the kidney damage that occurs will aggravate the hypertension. Hypertension causes stimulation of barotrauma in the glomerular capillaries and increases the pressure of the glomerular capillaries, which will lead to glomerulosclerosis over time. Glomerulosclerosis can stimulate the occurrence of chronic hypoxia, which causes kidney damage (Kadir, 2018).

Distribution of AKI Patients Based on Heart Failure

Based on the research conducted, there are characteristics of heart failure in a total of 53 samples that have been experienced. This result is in line with the research conducted, the most patients were found not to have heart failure, as many as 144 patients (71%), while those who experienced heart failure were 59 patients (29%) (Abebe, 2021a), but this result is not in line with the research conducted by Marzuki et al at dr. Saiful Anwar Hospital Malang, for 135 patients, the most AKI patients were found to have heart failure, as many as 73 patients (54%), while 62 patients did not have heart failure (46%) (Marzuki et al., 2022).

Cardiovascular syndrome always involves heart failure and kidney failure together. Heart failure is a complex syndrome resulting from impaired heart function and structure that inhibits the heart's ability to function as a pump to

support physiological circulation (Holgado et al., 2020). Complex hemodynamic, neurohumoral, inflammatory, and oxidative mechanisms support cardiorenal syndrome (CRS) development and progression. Decreased cardiac output and arterial filling pressure, as well as increased central venous pressure (CVP) due to systemic venous congestion and decreased renal perfusion, trigger various maladaptive neurohumoral mechanisms such as activation of the renin-angiotensin-aldosterone system (RAAS), sympathetic nervous system (SNS), and secretion of antidiuretic hormone (arginine vasopressin). Furthermore, the increased regulation of RAAS itself triggers a pro-inflammatory state with associated adverse oxidative stress. This neurohumoral response, aimed at restoring perfusion to vital organs in the impaired circulatory system, has the potential to create a constantly recurring vicious cycle of fluid retention, venous congestion, tissue hypoperfusion, inflammation, and oxidative stress, which can result in further declines in heart and kidney function (Chahal, 2020).

Distribution of AKI Patients Based on Accidents

Based on the characteristics of the accident, the most AKI patients were found in those who did not have an accident. Looking at the literature in terms of accident characteristics in this study, there is only one patient, this is different from the study conducted by De Abreu in Brazil which also focused on collecting data on ICU patients, namely from 129 patients who experienced trauma and 52 patients diagnosed with AKI, there were 38 (73.%) with brain trauma and 11 (21.2%) with abdominal trauma from the cases studied, it was found that abdominal trauma is an independent risk factor for AKI.

Trauma due to increased intra-abdominal pressure is also a significant factor in determining kidney dysfunction, but this decrease in kidney function is caused by increased intra-abdominal pressure, which is a local effect caused by direct kidney compression and not related to cardiac output.

CONCLUSION

In conclusion, the study highlights the significant role of age, comorbid conditions like diabetes mellitus and hypertension, and treatment duration in determining the severity and outcomes of Acute Kidney Injury (AKI) in ICU patients at Dr. H. Chasan Boesoirie Hospital, Ternate. The findings underscore that while diabetes mellitus was not a predominant risk factor in this study, it remains a notable contributor to kidney dysfunction globally. Mortality rates were high among AKI patients, emphasizing the need for early diagnosis and management to reduce complications. Implementing preventive strategies targeting high-risk populations, improving early detection, and enhancing the healthcare infrastructure is crucial, particularly in underserved areas like North Maluku. Further studies with larger sample sizes and in other regions of Indonesia are recommended to validate these findings and improve AKI management.

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