



RESEARCH ARTICLE

Intense relationship of blood pressure and stadium of chronic kidney disease at early diagnosis

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ABSTRACT

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Chronic kidney disease (CKD) is a pathological stage with multiple causes that is characterised by a very high level of urea in the body because the kidneys are unable to balance the metabolism of fluids and electrolytes. Previous research has demonstrated that high blood pressure is one of the causes of chronic kidney disease. This study was conducted to determine the relationship between blood pressure and the initial stage of chronic kidney disease. observational study of Ninety patients with chronic kidney disease (CKD) at the RSUD Dr. Soeroto, Ngawi participated in this cross-sectional. Subjects were required to have CKD stages I-IV, high blood pressure, to be hospitalised for the first time at RSUD dr Soeroto, Ngawi, and to have never been treated for hypertension. This study employed the Spearman rank test, which was analysed by SPSS ($p < 0.05$). 64.5% of patients with chronic kidney disease have reached stage V. In contrast, 47.8% of patients with chronic kidney disease have stage 2 hypertension. The Spearman Rank test revealed a p-value of 0.000 (< 0.05) between blood pressure and the stage of chronic kidney disease at the time of initial diagnosis in patients with chronic kidney disease. The correlation coefficient has a value of 0.638, making it a strong correlation. There is a strong correlation between blood pressure and the stage of chronic kidney disease at the initial diagnosis of chronic kidney disease patients at the RSUD Dr. Soeroto, Ngawi.

1. Introduction

Chronic kidney disease (CKD) is a pathophysiological stage resulting in a progressive decline in kidney function and performance. It is characterised by a very high level of urea in the body due to an inability to regulate fluid and electrolyte metabolism (Rizki and Andina, 2017). According to the Global Burden of Disease, CKD is the 18th leading cause of death, and in Indonesia, according to the Badan Penyelenggara Jaminan Sosial Kesehatan (BPJS), CKD is the second leading cause of health expenditures, consuming a substantial budget (Gliselda, 2021).

The prevalence of chronic kidney disease in Indonesia is 0.38%, while the prevalence in East Java is 0.2%. This information indicates that the incidence of chronic kidney disease is quite prevalent in the province of East Java (Laporan Nasional Riset Kesehatan, 2018). According to information obtained from the medical records at RSUD Dr. Soeroto Ngawi 267 patients had chronic kidney disease in 2020-2021. Recent Indonesian Renal Registry (IRR) research indicates that high blood pressure is one of the most significant risk factors for the development of chronic kidney disease.

Blood pressure measurements determine the diagnosis and treatment of hypertension. The systolic

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and diastolic blood pressure readings are frequently reported, and they may indicate risk factors for certain diseases in addition to cardiovascular disease. Masked hypertension is more common in populations with chronic kidney disease, diabetes, and obstructive sleep apnea (Muntner *et al.*, 2019). Schneider *et al* (2018) defined hypertensive patients as having three times measurements of systolic blood pressure > 140 mmHg and diastolic blood pressure > 90 mmHg, or having taken an antihypertensive medication in the past.

Untreated hypertension can exacerbate progressive kidney function decline. Eighty to eighty-five percent of CKD patients have a history of hypertension. Greater than 130 mmHg systolic blood pressure was associated with an increased risk of renal outcome, with 60% of patients at an increased risk of CKD (Tsuchida-Nishiwaki *et al.*, 2021).

Currently, it is estimated that 22% of the world's population has hypertension, but only about 20% of patients attempt to control their blood pressure (Kemenkes RI, 2019). In 2018, the Basic Health Research (Riskesdas) revealed that the prevalence of hypertension in Indonesian adults aged 18 and older was 34.%, while the prevalence in the province of East Java was 36.3%, indicating that the incidence of hypertension in East Java is higher than the national average. Organ damage results from untreated or uncontrolled hypertension. Chronic kidney disease is an associated complication of hypertension (Prasetyo and Wijayanti, 2015).

According to Andrea's (2013) research, the degree of hypertension correlates significantly with the stage of chronic kidney disease. Because the blood vessels in the kidneys are deficient, chronic elevations in blood pressure will cause damage to the kidneys. Chronic kidney disease is caused by progressive damage from chronically elevated blood pressure in the renal capillaries and glomeruli, which destroys the nephrons and leads to hypoxia and kidney death (Kadir, 2016). This study was conducted to determine the relationship between blood pressure and the stage of chronic kidney disease at the initial diagnosis of chronic kidney disease; as a result, the findings will contribute to the improvement of public health and reduce the risk of hypertension and chronic kidney disease complications.

2. Materials and Methods

The method of research employed was a cross-sectional observational study. This study was conducted in January 2022 at the RSUD dr. Soeroto Ngawi conference. The study collected secondary data from the medical records of patients with chronic kidney disease stages I, II, III, IV, and V from 2020 to 2021.

The ethical committee of the Faculty of Medicine at Wijaya Kusuma Surabaya University approved this study (approval number 1/SLE/FK.UWKS/2022).

In this study, 90 hospitalised patients with chronic kidney disease stages I, II, III, IV, and V were examined between 2020 and 2021 at the RSUD Dr. Soeroto Ngawi. Patients with CKD grades I-V, high blood pressure, being hospitalised for the first time in the RSUD Dr. Soeroto, Ngawi, and being untreated hypertensives met the inclusion criteria for this study, which employed total sampling methods to collect data. The medical record, including each sample's blood pressure, serum creatinine, age, and gender, was utilised for instrument development. On the first day of hospitalisation, blood pressure and serum creatinine levels were measured. The stages of hypertension and chronic kidney disease were classified. According to JNC VII, blood pressure were categorised in 4 stage i.e normal tension (Systolic Blood Pressure/ SBP < 120 mmHg; Diastolic Blood Pressure/ DBP < 80 mmHg), prehypertension (SBP 120-139 mmHg; DBP 80-89 mmHg), hypertension stage 1 (SBP 140-159 mmHg; DBP 90-99 mmHg), and Hypertension stage 2 (SBP≥160; DBP ≥ 100) (Chobanian *et al.*, 2003). Glomerular Filtration Rate was used to classify Chronic Kidney Disease into five stages (eGFR). eGFR estimated using age and gender in samples and calculated by application (National Kidney Foundation, 2022). For data processing and analysis, SPSS software was utilised. Using the Spearman Rank correlation test, we analysed the relationship between blood pressure and all stages of chronic kidney disease.

3. Results

This study uses secondary data from a population of patients with chronic kidney disease (CKD) for the period 2020–2021. The characteristics of the age distribution among patients are displayed in Table 1. Most of the patients were women (53.3%) with aged below than 60 years (72.2%), categorized in hypertension stage 2 (n=43) and stage V of CKD (n=58).

The relationship between blood pressure and chronic kidney disease in patients can be tested using the Spearman correlation test ($\alpha=0.05$). The results of Spearman Rank test (Table 2) obtained a *p-value* of 0.000 (<0.05) so there was a relationship between blood pressure and the stage of chronic kidney disease at the initial diagnosis at RSUD dr. Soeroto Ngawi. The correlation coefficient between blood pressure and chronic kidney disease were 0.638 which included in the strong correlation, so that there is a strong relationship between blood pressure and the stage of chronic kidney disease at the initial diagnosis of chronic kidney disease patients at the RSUD dr. Soeroto Ngawi. Increasing in blood pressure lead to elevate stage of chronic kidney

Table 1. Clinical characteristics of this study population

| Variabel | Total Population | | | | | | | | | |
|----------------------|------------------|-----------------------|-------------------------|-----------------------------|------------------------------|---------------|----------------|------------------|-----------------|--------------|
| | (n=90) | Blood Pressure (n=90) | | | | CKD (n=90) | | | | |
| | | Normal (n=0) | Pre Hypertension (n=10) | Hypertension stage I (n=37) | Hypertension stage II (n=43) | Stage I (n=0) | Stage II (n=0) | Stage III (n=11) | Stage IV (n=21) | Stage V (58) |
| Age | | | | | | | | | | |
| ≤ 60 yo | 65 (72.2%) | - | 5 | 29 | 31 | - | - | 7 | 15 | 43 |
| > 60 yo | 25 (27.8%) | - | 5 | 8 | 12 | - | - | 4 | 6 | 15 |
| Gender | | | | | | | | | | |
| Men | 42 (46.7%) | - | 8 | 20 | 14 | - | - | 8 | 8 | 26 |
| Women | 48 (53.3%) | - | 2 | 17 | 29 | - | - | 3 | 13 | 32 |
| Mean Level of | | | | | | | | | | |
| Blood pressure | 98/254 | | | | | | | | | |
| Serum Creatinin | 5.11 ± 1.06 | | | | | | | | | |
| eGFR | 15.6 ± 12 | | | | | | | | | |

Table 2. Cross Tabulation and Statistical Test Results

| Blood Pressure | Stage (%) | | | | | Rank Spearman |
|----------------------|-----------|----------|-----------|------------|------------|---|
| | Stage I | Stage II | Stage III | Stage IV | Stage V | |
| Prehypertension | 0 | 0 | 8 (8.9%) | 2 (2.2%) | 0 | <i>p value</i> = 0.000 coefficient correlation = 0.638 |
| Hypertension stage 1 | 0 | 0 | 3(3.3%) | 15 (16.7%) | 19 (21.1%) | |
| Hypertension stage 2 | 0 | 0 | 0 | 4 (4.4%) | 39 (43.4%) | |

disease, vice versa.

4. Discussions

Chronic kidney disease is a progressive condition characterised by the gradual loss of function of the kidneys' nephrons. Chronic kidney disease is characterised by a decline in kidney function as measured by a GFR of <60 ml/min/1.73 m² and the presence of kidney disorders lasting at least three months. According to the National Kidney Foundation (NKF), there are many other causes of chronic kidney disease besides hypertension, such as diabetes mellitus, glomerulonephritis, interstitial nephritis, and many others; however, hypertension is the most common cause of chronic kidney disease (Lederer and Ouseph, 2007).

CKD is more prevalent in the elderly than in the young. The kidneys cannot regenerate new nephrons, so the number of nephrons decreases when the kidneys are damaged or as a result of the ageing process. At age 40, the number of functioning nephrons decreases by approximately 10% every decade; by age 80, only 40% of nephrons are functional. In this study, 72.2% of patients with chronic kidney disease at the RSUD under the care of Dr. Soeroto Ngawi are younger than 60. Hypertension is the leading cause of CKD in individuals under 60 years old. Age, gender, and a history of diseases such as hypertension that cause a decrease in kidney function can be risk factors for chronic kidney disease (CKD) (Tjekyan, 2014).

The majority of patients with chronic kidney disease at the RSUD Dr. Soeroto Ngawi have hypertension stage 2 (up to 47.8%) and CKD stage V (64.5%), indicating that the majority of patients with high blood pressure have the severe stage of CKD. Numerous research studies (Vaaraniemi *et al.*, 2014) have demonstrated a correlation between diminished renal function and increased arterial stiffness. Increasing arterial rigidity reduces the amplitude of the pulse pressure. Pulse wave velocity (PWV) measures arterial rigidity. Increasing carotid radial-PWV and decreasing eGFR are indicators of CKD's primary characteristic, which is a stiffening of the muscular arteries due to medial sclerosis. Controlling hypertensive patients' blood pressure is essential for reducing the risk of kidney function loss and the incidence of chronic kidney disease (CKD). In addition to an increase in albuminuria, a decrease in GFR is an unmistakable sign of declining kidney function (Carlsen *et al.*, 2016). A person with untreated hypertension but no kidney disease may develop complications related to kidney damage that exacerbate the hypertension. This event contributes to the disease's relatively high mortality rate by increasing the frequency of hemodialysis (Kadir, 2016). In Table 2, there was a strong correlation between blood pressure and CKD stage, with a correlation coefficient of 0.638.

This study's findings are also consistent with previous research (Kim, Lim, and Park, 2012) on the association between prehypertension and chronic kidney disease. The study included 6,039 participants, who were

divided into groups with normal blood pressure (3,133 individuals) and groups with abnormal blood pressure, including prehypertension and hypertension (as many as 2,906 individuals). After two years of reevaluation, the results indicated that 52.5% of the group with normal blood pressure and 62.9% of the group with abnormal blood pressure experienced a decrease in GFR. Then, after two years, a re-evaluation was conducted, and it was discovered that prehypertensive patients with uncontrolled blood pressure had a greater incidence of decreased GFR than patients with controlled blood pressure. According to the findings of this study, it takes time for a patient with controlled hypertension to develop chronic kidney failure.

Several factors, including stress, physical activity, and dietary pattern, have a significant impact on uncontrolled blood pressure. According to a study conducted in Bali, Indonesia, 64.8% of patients with CKD caused by predialysis had uncontrolled blood pressure. Regularly taking medication, eating a healthy diet that avoids excessive sodium intake, and engaging in daily exercise and physical activity are the most effective ways to control blood pressure (Dharmapatni, Sriyuktasuth, and Pongthavornkamol, 2020). High blood pressure impairs kidney function and alters the amount of creatinine transported to the kidneys via the bloodstream. The kidneys filter and excrete the majority of creatinine via urine. When kidney function is compromised, creatinine levels will rise. Creatinine levels that are abnormal decrease the glomerular filtration rate (GFR), which is a major risk factor for kidney failure and damage (Apriani, 2016). In this study, the mean serum creatinine concentration was 5.11 mg/dL, which is more than 5 times the normal level and is associated with kidney function. Chronic kidney disease is both a consequence and a cause of hypertension, and it contributes to its progression. It was difficult to examine each individual factor contributing to the occurrence of both high blood pressure and CKD, which was one of the study's limitations. Moreover, hypertension and CKD were the chronic diseases that required retrospective investigation to determine disease onset. Therefore, we utilised the medical record of Dr. Soeroto and Ms. Ngawi, the first patients diagnosed with RSUD.

5. Conclusions

The Spearman Rank test *p-value* for the relationship between blood pressure and chronic kidney disease stage at the time of initial diagnosis is 0.000. In addition, there is a strong correlation between blood pressure and chronic kidney disease stage. At the time of the initial diagnosis of patients with chronic kidney disease at the RSUD Dr. Soeroto Ngawi correlation

coefficient was 0.638, which is included in the strong correlation between hypertension and chronic kidney disease.

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