

Characteristics of Intradialytic Hypertension in Hemodialysis Patients at the Prof. Dr. W. Z. Johannes General hospital, East Nusa Tenggara

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ABSTRACT:

One of the most common complication of hemodialysis patients in Indonesia is intradialytic hypertension. Intradialytic hypertension, defined as an increase in blood pressure during or immediately after hemodialysis which results in postdialysis hypertension, has long been recognized to complicate the hemodialysis procedure, yet it is often largely ignored. A large observational study recently showed that intradialytic hypertension of any magnitude increased mortality risk. The aim of this study was to identify the incidence of intradialysis hypertension in hospitalized patients undergoing hemodialysis at Prof. Dr. W. Z. Johannes General Hospital, Kupang, East Nusa Tenggara, Indonesia. The research method used is descriptive with an observational approach. Data collection was carried out by taking a total sampling using secondary data by medical records in the 3 months period of 2023 with 60 respondents who met the inclusion criteria. The results of research on respondents showed that 83,3% had intradialysis hypertension, dominated by men, age over 45 years who had a history of comorbid hypertension and type 2 diabetes mellitus, had anemia, potassium within normal limits, and more than 4 hours hemodialysis duration. The conclusion is that patients with intradialytic hypertension must be identified as high risk patients and the incidence can be said to be relatively high. Intradialysis hypertension in this study was determined based on the threshold criteria for systolic blood pressure with an increase of 10 mmHg from pre- to post-dialysis. This must be controlled for the patient's quality of life and to prevent worsening of the condition.

Keyword: Intradialytic hypertension; hypertension; type 2 diabetes mellitus; anemia; demodialysis duration.

INTRODUCTION

Chronic kidney disease (CKD) is a major global health issue. Obviously, the incidence and prevalence vary substantially between countries due to differences in underlying diseases rates

and availability of medical treatment options. The incidence of CKD reached 200 cases per million per year in many countries, although prevalence varies between countries: eg, US, Taiwan and certain regions in Mexico are approaching almost 400 cases per million. In 2017 the global prevalence of CKD was 9.1%, ranging from 8.5% to 9.8%, while a third of CKD patients lived in China and India. 1 Like other parts of the world, Indonesia equally suffers from a high burden of CKD. 1 The prevalence number of Chronic Kidney Disease (CKD) in Indonesia around 90% to 3.8 cases in 1000 population increased significantly past decades, and 19.3% of them require hemodialysis treatment. Chronic kidney disease patients at the end stage of the kidney disease stage require renal replacement therapy to maintain body functions. Hemodialysis is the main choice of the kidney replacement therapy which is performed routinely to replace part of kidney function in patients with end-stage kidney disease. Data from the Indonesian Renal Registry (IRR) shows an increasing new patients undergoing haemodialysis in Indonesia from 2017 to 2018 as much as 53.7%. 2

Complications can occur either during or after hemodialysis. The most common complications during the hemodialysis process are intradialytic hypotension, intradialytic hypertension, cramps, nausea and vomiting, headaches, chest pain, back pain, and itching. Among the complications frequently observed in terminal renal failure patients undergoing hemodialysis, hemodynamic disturbances, particularly changes in blood pressure, are always a major concern. In some cohort studies, approximately 5% to 15% of patients who undergo regular hemodialysis experience an increase in blood pressure during or immediately after the dialysis. One of the important complications is the increased of intradialytic blood pressure or the occurrence of intradialytic hypertension. 1,2

The phenomenon of intradialytic hypertension (IDH), where blood pressure increases throughout dialysis, has intrigued nephrologists for years due to its deviation from the expected response to dialysis and the evidence that patients with recurrent IH have higher risk for long term complications. Most smaller case-control studies focusing on mechanistic associations used definitions including an increase in systolic (>10 mmHg) or mean arterial pressure (>15 mmHg) from pre- to post-dialysis occurring in the majority of treatments during periods ranging from 2–12 weeks.3

The prevalence incidence of IDH is quite varied across the globe. It can be determined by many factors, including differences in the definition of the IDH terminology. A retrospective cohort study of 22,955 hemodialysis treatments showed that the prevalence of IDH was 21.3 per 100 procedures. Study in Korea showed that 19.2% of patients on routine hemodialysis had IDH. A study in India concluded that IDH was experienced by 81.8% of hemodialysis . Several studies in Indonesia showed that IDH is often experienced by hemodialysis patients. The 2018 annual report of the Indonesian Nephrology Association stated that the prevalence of IDH in Indonesia was 38%. Research at one dialysis center in Semarang showed the prevalence of IDH was

25.9%.¹¹ Another study in Bali showed that IDH was the most common complication experienced by hemodialysis patients with 52.4%. The increasing blood pressure can be severe even to the point of a hypertensive crisis that endangers the patients. Various factors contribute to IDH including predialysis fluid overload. Predialysis fluid overload can be identified by an Interdialytic Weight Gain (IDWG) assessment. The increase in fluid volume between two dialysis times, manifested by interdialytic weight gain, is the most common cause of changes in blood pressure. IDH can occur because of the activation of the renin angiotensin aldosterone system (RAAS) due to hypovolemia when fluid withdrawal is carried out through ultrafiltration. A Study showed that blood pressure increases during IDH due to increased cardiac output, mediated by volume overload. A decrease in relative blood volume and total blood volume due to a large ultrafiltration goal decreases blood flow to the kidneys, stimulates the release of renin and causes hypertension. ⁵

Other factors related to patient characteristics can also influence the occurrence of intradialytic hypertension. These factors include age, gender, duration of hemodialysis. This study was purposed to analyze the various factors that contribute to the incidence of IDH such as sex, age, length of undergoing hemodialysis, IDWG, compliance with fluid regulations and ultrafiltration during hemodialysis. This research is useful to anticipate and prevent IDH by controlling these factors.⁶

RESEARCH METHODS

This research design uses a retrospective descriptive study where secondary data from the patient's medical records is used. The population in this study were patients in the inpatient ward who were diagnosed with stage V chronic kidney failure who underwent hemodialysis at the Prof. W. December 2023. Total sampling collected from 3 month visits was 60 subjects with inclusion criteria: age > 18 years, chronic kidney failure undergoing hemodialysis, patients who agreed to undergo hemodialysis twice a week and respondents with complete medical records.

RESULTS AND DISCUSSION

Data was collected from medical records taken in 2023, specifically during ward patient visits in inpatient rooms for 3 months, including in October 2023 – December. The total sampling consisted of 60 respondents. medical record data was taken in the inpatient room at the regional general hospital, Prof. W.Z. Johannes, Kupang city, East Nusa Tenggara, Indonesia.

Table 1

Distribution of Respondents Based on Age, Gender, History of Hypertension, History of Diabetes Mellitus, Potassium Levels, Hemoglobin Levels, and Duration of Hemodialysis

Variable	n	%
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Gender		
Woman	27	45 %
Man	33	55 %
Age		
<45 years	22	36,7 %
>45 years	38	63,3 %
History of hypertention		
Yes	44	26,7 %
Not	16	73,3 %
History of Diabetes Melitus		
tidak	24	40 %
ya	36	60 %
Pottasium level		
<3,5	25	41,67 %
>3,5	35	58,33 %
Haemoglobin level		
<10	42	70 %
>10	18	30 %
Duration of hemodialysis		
<4 hours	20	33,33 %
≥4 hours	40	66,67 %

Bases on table 1, there are 60 respondents who show an age range from 21 to 71 years old, described that most of participants' age in this study are ranged from 45-71 years old as much as 63.3%. The majority of gender is male, 33 respondents (55%), the majority of respondents have a history of hypertension, 44 respondents (73.3%). The majority of respondents also had a history of Diabetes Mellitus, 36 respondents (60%), the value of potassium levels in the blood of most respondents was more than 3.5 mmol, 35 respondents (58.3%), the value of HB levels in the blood predominantly showed <10, 42 respondents (70%), and based on the duration the majority of respondents experienced hemodialysis for > 4 hours.

Table 2 Distribution of Respondents According to the Occurrence of Intradialytic Hypertension

Variable	n	%
Intradialysis hypertention		
Yes	50	83,3 %
Not	10	16,7 %

Based on data analysis in table 2, it is known that of the 60 respondents, the majority experienced intradialysis hypertension namely 50 respondents (83.3%) and 10 respondents (16,7%) did not experience hypertension during dialysis.

Table 3. Distribution of Intradialytic Hypertension

Intradialytic Hypertention	Case	Control
Gender		
Woman	24	48 %
Man	26	52 %
Age		
<45 years	20	40 %
>45 years	30	60 %
History of hypertention		
tidak	15	30 %
ya	35	70 %

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History of Diabetes Melitus		
tidak	19	38 %
ya	31	62%
Pottasium level		
<3,5	22	44%
>3,5	28	56 %
Haemoglobin level		
<10	14	28 %
>10	36	72 %
Duration of hemodialysis		
<4 hours	15	30 %
≥4 hours	35	70 %

As mentioned in table 2 above, It was found that the number of incidents of intradialysis hypertension was 50 respondents (83.3%). So the distribution of respondents who experienced this incident is presented in table 2 which shows that 26 respondents (52%) were men who experienced intradialysis hypertension, and 24 (48%) women experienced intradialysis hypertension. Based on age group, 20 respondents aged under <45 years experienced hypertension during dialysis, and 30 respondents aged >45 years experienced intradialysis hypertension. Based on the history of comorbidities, there were 35 (70%) respondents with intradialysis hypertension who had a history of hypertension, while there were 15 (30%) respondents who had no previous history of hypertension. The dominant intradialysis hypertension respondents had a history of comorbid type 2 diabetes mellitus, 31 respondents (62%), and 19 respondents (38%) who did not have a history of type 2 diabetes mellitus.

Based on laboratory tests, the incidence of intradialysis hypertension which had hypokalemic levels was 22 respondents (44%), and 28 respondents (56%) who were not hypokalemic. Based on hemoglobin results, the majority of intradialysis hypertension incidents had hemoglobin levels <10, 36 respondents (72%), and those with hemoglobin levels >10 were 14 respondents (28%).

Discussion

In patients with end-stage renal disease (ESRD) undergoing hemodialysis (HD) or peritoneal dialysis (PD), hypertension is common and often inadequately controlled. Hypertension affects nearly 50–60% of HD patients. The prevalence of hypertension in the general Korean adult population aged ≥20 years is approximately 30%. It is well known that dialysis patients have an association between Blood pressure and risk of death, as opposed to a linear association in the general population.^{3,9}

However, when explaining this reverse epidemiology, it is first questioned whether it reflects the accuracy and adequacy of Blood pressure measurement in dialysis patients. Persistent intradialytic hypertension is reported to occur in 15% to 30% of patients treated with HD and is associated with twofold to fourfold increased risks of hospitalization, all-cause mortality, and cardiovascular mortality.¹³ One recent cohort study defined intradialytic hypertension as an increase in systolic BP ≥10 mmHg from pre to post dialysis to identify the prevalence of this phenomenon over long term follow up. Over the course of 6 months, intradialytic hypertension occurred in over 90% of the patients at least once.^{4,11} Intradialytic hypertension, defined as an increase in blood pressure during or immediately after hemodialysis which results in postdialysis hypertension, has long been recognized to complicate the hemodialysis procedure, yet it is often largely ignored. There are no accepted criteria that define intradialytic hypertension, but several definitions exist:¹³

- An increase in systolic blood pressure >10 mm Hg during HD (most common definition)
- Rise in the mean arterial pressure >15 mmHg during or immediately post-HD
- Any BP rise during HD

Age can influence the distribution of fluids in the body, and when a person experiences an illness, they may be unable to adapt to these changes. Theoretically, as age increases, the number of body cells decreases. A reduction in the number of body cells results in a decreased body water capacity, as most of the water is intracellular. This condition is exacerbated by the decreasing blood volume due to ultrafiltration at the start of hemodialysis. Aggressive ultrafiltration at the beginning of hemodialysis often triggers an overactive response of the renin-angiotensin-aldosterone system and the sympathetic nervous system, which leads to increased blood pressure to maintain adequate perfusion. Research indicates that the majority of respondents are aged 45-71 years, which is consistent with data from Pernefri, showing that in Indonesia, most hemodialysis patients are in the 45-64 age group (50.27%), while patients over 65 years old make up about 24.11%. Additionally, a study at Mackay Memorial Hospital involving 225 hemodialysis patients found an average age of 62.47 years, with the youngest being 16 years and the oldest 93 years. In this study, the youngest patient was 21 years old and the oldest was 71 years old.^{5,6}

The majority of respondents in the study are male. This finding is consistent with IRR data, which indicates that the proportion of male patients undergoing hemodialysis is higher than that of female patients, with males constituting 55.77% of 3,907 patients. The impact of gender on the occurrence of intradialytic hypertension shows that, in general, there is no significant difference in the prevalence of hypertension between males and females. However, some studies suggest that females tend to have a higher prevalence of chronic kidney disease (CKD) in certain countries, which may increase their risk of intradialytic hypertension. Biological factors, such as a higher survival rate in females with CKD and specific complications like pregnancy-induced hypertension, may contribute to this difference. Additionally, social factors such as access to care and adherence to treatment may also influence the occurrence of intradialytic hypertension in females. Therefore, further research is needed to gain a deeper understanding of the specific factors affecting this condition in females and to ensure that health policies can be tailored to the needs of each gender.

In Indonesia, the leading causes of chronic kidney failure are hypertension and diabetes mellitus. In this study, medical records reveal that a significant number of respondents have a history of hypertension. Cardiovascular diseases are the leading causes of morbidity and mortality in terminal kidney failure patients. Various heart abnormalities can lead to decreased myocardial contractility, resulting in weakness and failure to pump blood adequately. In this study, respondents who experienced intradialytic hypertension had a history of hypertension. According to data from the Health Research and Development Agency (2013), the most common heart diseases among Indonesians are conditions such as heart failure, coronary artery disease, cardiomegaly, cardiomyopathy, rheumatic heart disease, and acute myocardial infarction. A history of heart disease and hypertension in respondents can impair heart contractility, reduce vascular viability, and decrease the heart's ability to adapt to changes in blood circulation during hemodialysis.^{7,9}

The results of this study show that the majority of respondents with a history of diabetes mellitus experienced intradialytic hypertension during hemodialysis. Similar results have been observed in previous studies, where diabetes mellitus was found to be a risk factor for intradialytic hypertension, with an odds ratio of 8.18 and a p-value of 0.016. Further analysis in this study revealed that 62% of respondents with a history of diabetes mellitus experienced intradialytic hypertension. Most respondents in this study underwent hemodialysis for more than 4 hours. This finding is consistent with research which reported that 72.4% of patients undergoing hemodialysis at RS M. Djamil Padang had a dialysis duration of 4.5 hours with a frequency of twice per week. The Indonesian Renal Registry (2015) indicates that most hemodialysis patients in Indonesia undergo dialysis for ≥ 4 hours. However, some studies suggest that adequacy of hemodialysis can be achieved with a duration of 4.5 hours for patients undergoing dialysis twice a week.⁸

Based on Table 3, patients with potassium levels >3.5 experienced lower rates of intradialytic hypertension (44%) compared to patients with potassium levels <3.5 (56%). Sodium, potassium, and calcium play complex roles in affecting intradialytic blood pressure in hemodialysis patients. Excess sodium is associated with endothelial dysfunction, but its effect on blood pressure is not always consistent. Low potassium levels can cause vasoconstriction and rebound hypertension, while increased calcium ion levels can enhance myocardial

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contractility. However, the role of each electrolyte in intradialytic hypertension still requires further research due to varying results.

Potassium levels play a crucial role in the occurrence of intradialytic hypertension (IDH). Hyperkalemia can cause vasoconstriction, which directly affects blood pressure, while hypokalemia due to low-potassium dialysate can trigger rebound hypertension after hemodialysis. In hemodialysis patients, low potassium levels before dialysis are associated with an increased risk of IDH. Studies show that patients with lower potassium levels experience a more significant increase in blood pressure during hemodialysis sessions compared to those with higher potassium levels. This suggests that maintaining potassium levels within normal limits during hemodialysis is important to reduce the risk of IDH. Some studies also identify that low serum potassium levels are associated with smaller decreases in blood pressure after hemodialysis, which may indicate hemodynamic instability and an increased risk of IDH.¹⁵

Patients with hemoglobin levels <10 have a higher incidence of intradialytic hypertension (72%) compared to patients with hemoglobin levels >10 (28%). Anemia can influence the occurrence of intradialytic hypertension (IDH) through several mechanisms. In hemodialysis patients, anemia leads to decreased tissue oxygenation and reduced blood viscosity, triggering compensatory responses such as increased heart rate and vasoconstriction. This results in elevated blood pressure, particularly during dialysis sessions when circulating blood volume is reduced. Anemia can also cause imbalances in blood volume and pressure regulation, exacerbating the risk of IDH. Monitoring and managing hemoglobin levels are crucial for reducing this risk.¹⁰

Anemia affects intradialytic hypertension through multiple mechanisms. Firstly, anemia decreases hemoglobin levels, which reduces tissue oxygenation and leads to tissue hypoxia. This hypoxia triggers the release of hormones such as renin, angiotensin II, and aldosterone, all of which contribute to increased blood pressure. Additionally, anemia enhances sympathetic nervous system activity, causing vasoconstriction and increased peripheral vascular resistance, which can provoke hypertension during dialysis sessions. During hemodialysis, a sudden reduction in blood volume can further worsen blood pressure in patients with anemia. As the body attempts to re-balance blood pressure after fluid removal, this compensatory response may become exaggerated, particularly in anemic patients, eventually leading to hypertension.¹¹

Patients with hemodialysis durations >4 hours (70%) experience a higher incidence of hypertension compared to those with durations <4 hours (30%). The duration of hemodialysis can affect the occurrence of intradialytic hypertension because longer dialysis sessions may result in greater fluid removal. Rapid and significant fluid removal can lead to a decrease in blood pressure; however, in some cases, it may trigger compensatory responses such as vasoconstriction or increased vascular resistance, which can actually elevate blood pressure during dialysis. Therefore, shorter durations with proper management are often recommended to reduce the risk of IDH.¹² The duration of hemodialysis impacts the occurrence of intradialytic hypertension because longer sessions can cause an accumulation of hemodynamic stress on patients. During extended hemodialysis sessions, the volume of fluid removed from the body can be larger, potentially causing electrolyte imbalances, including sodium and potassium. These imbalances can trigger vasoconstriction as a compensatory mechanism, ultimately increasing blood pressure during or after dialysis sessions.^{13,15} Longer hemodialysis sessions can also affect blood pressure regulation through mechanisms such as increased sympathetic nervous system activity and unbalanced hormonal responses, including elevated renin-angiotensin levels. Additionally, a longer duration increases the risk of more drastic changes in blood pressure, either during or after dialysis, as the body needs more time to adjust to the changes. Studies show that patients undergoing longer hemodialysis sessions often experience higher blood pressure at the end of the dialysis session compared to those with shorter sessions. This highlights the importance of adjusting dialysis duration appropriately for each patient to minimize the risk of IDH.¹⁴

Take home message :

Five Things to Know About Intradialytic Hypertension:¹³

1. Intradialytic hypertension is a paradoxical rise in blood pressure (BP) that occurs specifically during the hemodialysis procedure.

2. Persistent intradialytic hypertension is common and is associated with poor prognostic factors and increased mortality.
 3. Patients with intradialytic hypertension often have high ambulatory BP between dialysis sessions, but this is not universal.
 4. The causes of intradialytic hypertension are complex and not yet fully elucidated.
- Several strategies have been proposed.

CONCLUSION

The incidence of hypertension during hemodialysis at the Professor Johannes General Hospital in Kupang, East Nusa Tenggara, can be said to be relatively high. The definition of intradialysis hypertension in this study was determined based on a single criterion, namely the systolic blood pressure threshold with an increase of at least 10 mmHg from predialysis to postdialysis. In summary, while intradialytic hypertension is often underappreciated, recent studies suggest it should not be ignored. However, Further work is necessary to elucidate the pathophysiology of intradialytic hypertension and its appropriate management, and to determine whether treatment of intradialytic hypertension can improve clinical outcomes.the goal is not only to reduce the number of hospitalizations or reduce deaths due to hemodialysis but to improve the patient's quality of life.

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