Original Article

Risk Factors Associated with Intradialytic Hypotension among Patients with Stage 5 Chronic Kidney Disease on Hemodialysis at a Tertiary Referral Hospital in Banjarmasin Indonesia: A Retrospective Cross-sectional Study

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ABSTRACT

Background: Intradialytic hypotension (IDH) remains one of the most frequent acute complications of maintenance hemodialysis. Local data from Indonesian hemodialysis units remain limited, although patient characteristics, dialysis practices, comorbidity burden, and nutritional status may influence IDH risk.

Objective: This study aimed to identify patient-related and dialysis-related factors associated with IDH among CKD-5HD patients at Ulin General Hospital, Banjarmasin, Indonesia.

Methods: This retrospective cross-sectional study used secondary medical record data from adult patients with stage 5 chronic kidney disease undergoing maintenance hemodialysis at Ulin General Hospital, Banjarmasin, Indonesia. Patient-related and dialysis-related factors were evaluated. Variables with $p<0.25$ in bivariate analysis entered a multivariable binary logistic regression model.

Results: A total of 145 patients were included. IDH occurred in 72 patients (49.66%). In multivariable analysis, age >=60 years was associated with higher odds of IDH compared with age <60 years (adjusted prevalence odds ratio [aPOR] 3.537, 95% confidence interval [CI] 1.185-10.562, p=0.024). Compared with body mass index (BMI) >=30 kg/m2, BMI 23.0-24.9 kg/m2 was associated with lower odds of IDH (aPOR 0.101, 95% CI 0.015-0.677, p=0.018).

Conclusion: Nearly half of CKD-5HD patients experienced IDH. Older age, BMI category, antihypertensive medication burden, and pre-hemodialysis blood pressure category were associated with IDH. These findings support structured IDH risk assessment in routine hemodialysis care, especially among older patients and patients with severe pre-hemodialysis hypertension.

Keywords: chronic kidney disease; hemodialysis; intradialytic hypotension; body mass index; antihypertensive agents; blood pressure.

Introduction

Chronic kidney disease (CKD) is a major global health problem and contributes substantially to morbidity, health-care utilization, and mortality. The increasing number of patients with advanced CKD has expanded the need for kidney replacement therapy, including maintenance hemodialysis. In Indonesia, registry data show a growing burden of patients receiving dialysis, which makes dialysis safety a relevant clinical and public health issue.[1,2]

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Intradialytic hypotension (IDH) is among the most common acute complications during hemodialysis. Its reported frequency varies because studies use different definitions, blood pressure thresholds, symptom requirements, and session-based or patient-based measurements.[3–5] IDH may impair dialysis tolerance, reduce delivered dialysis dose, precipitate myocardial and cerebral hypoperfusion, increase vascular access complications, and contribute to adverse cardiovascular outcomes and mortality.[5–8]

The pathophysiology of IDH is multifactorial. Ultrafiltration reduces intravascular volume. A stable blood pressure response depends on adequate plasma refilling, vascular tone, baroreflex function, cardiac reserve, and neurohormonal compensation. Older age, diabetes, cardiovascular disease, nutritional status, excessive ultrafiltration, interdialytic weight gain, dialysate factors, and antihypertensive therapy have all been linked to IDH, although findings vary across populations.[7–13]

Evidence from Indonesian hemodialysis populations remains limited. Local patient profiles may differ from those in large international cohorts because of differences in comorbidity pattern, nutritional status, dialysis frequency, access type, and blood pressure management. This study aimed to identify patient-related and dialysis-related factors associated with IDH among CKD-5HD patients at Ulin General Hospital, Banjarmasin, Indonesia.

Methods

Study design and setting

This retrospective cross-sectional study used secondary medical record data from patients with stage 5 CKD undergoing maintenance hemodialysis (CKD-5HD). The study was conducted at the Hemodialysis Unit of Ulin General Hospital, Banjarmasin, Indonesia. Data extraction and analysis were performed after ethical and institutional approvals were obtained.

Study population

The target population consisted of all CKD-5HD patients. Total sampling was used. All patients who fulfilled the eligibility criteria during the observation period from January to December 2025 were included. Inclusion criteria were age >=18 years, CKD-5HD for at least 3 months, hemodialysis one to three times per week with 4-5 hours per session, and complete medical records for hemodialysis blood pressure monitoring, ultrafiltration volume, intradialytic events, comorbidities, and relevant laboratory data. Exclusion criteria were acute or non-regular hemodialysis, dialysis at more than one facility during the observation period, hypotension from non-intradialytic causes such as acute bleeding, septic shock, or severe arrhythmia, incomplete key medical record data, intermittent dialysis after kidney transplantation, and inpatient status for any indication during the study period.

Outcome definition

The dependent variable was IDH. IDH was defined as a decrease in systolic blood pressure of at least 20 mmHg or a decrease in mean arterial pressure of at least 10 mmHg from pre-dialysis measurement to the intradialytic nadir, accompanied by symptoms such as dizziness, weakness, nausea, or cramps, or requiring clinical intervention such as saline administration or interruption of ultrafiltration.

Variables

Independent variables included patient-related factors and dialysis-related factors. Patient-related factors were age, sex, body mass index (BMI), dialysis vintage, hypertension category based on pre-hemodialysis blood pressure, diabetes mellitus, heart disease, antihypertensive medication use, hemoglobin concentration, and albumin concentration. Dialysis-related factors were interdialytic weight gain (IDWG), ultrafiltration volume, ultrafiltration rate (UFR), and vascular access type.

Age was categorized as <60 years and >=60 years. BMI was categorized using Asian cutoffs: <18.5, 18.5-22.9, 23.0-24.9, 25.0-29.9, and >=30.0 kg/m2. Pre-hemodialysis blood

pressure was categorized as non-hypertensive (<140/90 mmHg), grade I hypertension (140-159/90-99 mmHg), grade II hypertension (160-179/100-109 mmHg), and grade III hypertension (>=180/>=110 mmHg). IDWG was categorized as <3%, 3-5%, and >5%. Antihypertensive medication use was categorized as no medication, 1-2 agents, 3-4 agents, and >4 agents.

Statistical analysis

Data were analyzed using IBM SPSS Statistics version 26. Categorical variables are presented as frequencies and percentages. Numerical variables are presented as mean +/- standard deviation or median with minimum and maximum values, according to distribution. Bivariate associations were tested using the chi-square test for categorical variables. The independent t test was used for normally distributed numerical variables, and the Mann-Whitney U test or nonparametric testing was used for non-normal numerical variables. A two-sided p value <0.05 was considered statistically significant.

Variables with p<0.25 in bivariate analysis were entered into a multivariable binary logistic regression model using the enter method. Results are reported as adjusted prevalence odds ratios (aPORs) with 95% confidence intervals (CIs). Because the outcome was common, odds ratios were interpreted as measures of association rather than direct estimates of relative risk.

Results

Baseline characteristics

A total of 145 CKD-5HD patients met the eligibility criteria. IDH occurred in 72 patients (49.66%), while 73 patients (50.34%) did not experience IDH. The mean age was 50.21 +/- 11.41 years. Most patients were aged <60 years (77.24%) and male (53.10%). Heart disease and hypertension were common, affecting 88.97% and 93.10% of the cohort, respectively. Grade III pre-hemodialysis hypertension was the most frequent blood pressure category (31.72%). The median dialysis vintage was 12 months (range 3-168), and the mean UFR was 7.81 +/- 3.73 mL/kg/hour. Detailed baseline characteristics are shown in Table 1.

Bivariate analysis

In bivariate analysis, heart disease (p=0.032), pre-hemodialysis blood pressure category (p=0.009), and hemoglobin level (p=0.031) were significantly associated with IDH. Age >=60 years showed a clinically relevant but statistically borderline association with IDH (POR 2.093, 95% CI 0.940-4.662, p=0.068). BMI category (p=0.088), diabetes mellitus (p=0.186), dialysis vintage (p=0.208), and antihypertensive medication category (p=0.244) met the pre-specified p<0.25 threshold for multivariable modeling. Sex, UF, UFR, albumin level, IDWG, and vascular access type did not meet this threshold. Bivariate findings are summarized in Table 2.

Multivariable analysis

In the multivariable logistic regression model, age >=60 years was independently associated with increased odds of IDH compared with age <60 years (aPOR 3.537, 95% CI 1.185-10.562, p=0.024). BMI 23.0-24.9 kg/m2 was associated with lower odds of IDH compared with BMI >=30.0 kg/m2 (aPOR 0.101, 95% CI 0.015-0.677, p=0.018). BMI 18.5-22.9 kg/m2 showed a protective trend that did not reach statistical significance (aPOR 0.188, 95% CI 0.034-1.028, p=0.054).

Compared with no antihypertensive medication use, the use of 1-2 agents (aPOR 0.049, 95% CI 0.003-0.849, p=0.038), 3-4 agents (aPOR 0.025, 95% CI 0.002-0.420, p=0.010), and >4 agents (aPOR 0.006, 95% CI 0.000-0.134, p=0.001) was associated with lower odds of IDH. Compared with grade III hypertension, grade II hypertension (aPOR 0.309, 95% CI 0.103-0.923, p=0.036), grade I hypertension (aPOR 0.166, 95% CI 0.052-0.530, p=0.002), and non-hypertensive pre-hemodialysis blood pressure (aPOR 0.029, 95% CI 0.006-0.132, p<0.001) were associated with lower odds of IDH. The final model is shown in Table 3.

Discussion

This study found a high patient-level occurrence of IDH among CKD-5HD patients at a tertiary referral hospital in Indonesia. IDH affected 49.66% of included patients. The main independent factors associated with IDH were older age, BMI category, antihypertensive medication category, and pre-hemodialysis blood pressure category. These findings strengthen the need for individualized IDH risk assessment rather than reliance on a single dialysis-related variable.

Older age showed the most consistent risk-increasing association. Patients aged >=60 years had more than threefold higher odds of IDH after adjustment for other variables. This finding agrees with the biological model of IDH in which adequate blood pressure during ultrafiltration depends on plasma refilling, baroreflex sensitivity, arterial compliance, peripheral vasoconstriction, and cardiac reserve. Aging reduces baroreflex responsiveness and increases arterial stiffness, which limits compensatory vasoconstriction during intravascular volume reduction.[4,5,14] Older patients may also have a higher burden of diastolic dysfunction, ischemic heart disease, autonomic dysfunction, and frailty, all of which can reduce hemodynamic reserve during dialysis.

BMI showed a non-linear association with IDH. A BMI of 23.0-24.9 kg/m2 was associated with substantially lower odds of IDH compared with BMI >=30.0 kg/m2. In hemodialysis patients, BMI does not reliably distinguish muscle mass, adiposity, edema, and fluid overload. Patients with high BMI may have higher adipose tissue burden, endothelial dysfunction, inflammation, arterial stiffness, and absolute ultrafiltration requirements. Conversely, patients with very low BMI may have protein-energy wasting or sarcopenia. Recent studies suggest that body composition, rather than BMI alone, may better predict IDH risk.[15–17] The present finding supports the use of BMI as an initial screening measure, but it also highlights the need for body composition assessment, nutritional evaluation, and dry-weight reassessment in future studies.

Pre-hemodialysis blood pressure category was strongly associated with IDH. Patients with grade III hypertension before dialysis had the highest odds of IDH, while lower blood pressure categories showed lower odds. This finding may appear counterintuitive because hypotension is often expected in patients with low baseline pressure. However, severe pre-dialysis hypertension can indicate chronic volume overload, arterial stiffness, sympathetic activation, or cardiovascular disease. These conditions may require more aggressive fluid removal and may reduce the ability to tolerate rapid intravascular volume changes. Previous work has shown that predialysis blood pressure and IDH have complex, non-linear relationships, and that both very low and very high predialysis pressure profiles may reflect unstable hemodynamics.[7,8]

The inverse association between the number of antihypertensive agents and IDH requires cautious interpretation. This finding should not be interpreted as evidence that increasing antihypertensive medication prevents IDH. Medication number is a proxy for multiple clinical factors, including treatment indication, blood pressure severity, residual kidney function, cardiovascular disease, timing of administration, drug dialyzability, and physician selection. The predominant use of calcium channel blockers and angiotensin receptor blockers in the cohort may have influenced this association. Prior studies suggest that IDH risk differs more clearly by drug class, timing, and pharmacokinetic profile than by medication count alone.[10,18–20] Future research should evaluate antihypertensive class, dose, timing before dialysis, interdialytic blood pressure, and adherence.

Several variables that are commonly associated with IDH in the literature did not remain independently associated in this study. Diabetes mellitus, heart disease, dialysis vintage, hemoglobin, IDWG, UF, UFR, albumin, and vascular access type were not independent predictors in the final model. These results do not

exclude their biological relevance. Diabetes may affect IDH through autonomic neuropathy and cardiovascular disease. Heart disease risk may depend on ejection fraction, diastolic function, valvular disease, arrhythmia burden, and ischemia rather than a broad binary diagnosis. UFR and UF may require session-level analyses because patient-level summary measures can obscure intradialytic hemodynamic patterns. Albumin analysis was limited by incomplete data.[21–25]

This study has practical implications. Hemodialysis units should consider structured IDH risk screening using age, pre-hemodialysis blood pressure, nutritional or anthropometric profile, and medication review. Older patients and patients with grade III pre-dialysis hypertension may need closer blood pressure monitoring, careful reassessment of dry weight, review of ultrafiltration goals, consideration of longer or more frequent dialysis when fluid removal targets are high, and individualized antihypertensive timing. Routine clinical protocols should identify early symptoms of hypoperfusion, such as nausea, weakness, yawning, cramps, dizziness, and altered consciousness, before severe blood pressure decline occurs. This study adds local evidence from an Indonesian tertiary referral hemodialysis unit and evaluates multiple patient-related and dialysis-related variables in one model. The use of total sampling reduced selection bias within the defined clinical setting.

Conclusion

IDH occurred in 49.66% of CKD-5HD patients at Ulin General Hospital, Banjarmasin. Age >=60 years increased the odds of IDH, while BMI 23.0-24.9 kg/m2 was associated with lower odds compared with BMI >=30.0 kg/m2. Antihypertensive medication category and pre-hemodialysis blood pressure category were also associated with IDH. These findings support individualized IDH prevention strategies that combine age-based risk assessment, nutritional and body composition evaluation, medication review, and careful pre-dialysis blood pressure management.

Limitations of the Study

However, several limitations should be noted. First, the retrospective cross-sectional design limits causal inference. Second, the sample size was modest for a multivariable model with several predictors, which may produce wide confidence intervals and unstable estimates. Third, the study used medical record data, so measurement and documentation quality may vary. Fourth, heart disease was analyzed as a broad categorical variable without detailed echocardiographic or biomarker data. Fifth, antihypertensive analysis used medication count rather than drug class, dose, timing, dialyzability, or adherence. Sixth, albumin data were incomplete. Finally, the study did not use session-level repeated measures, which may better capture dynamic changes in ultrafiltration, blood pressure, and symptoms during dialysis.

Declarations

Ethics approval and consent to participate

The study protocol received ethical approval from the Health Research Ethics Committee, Faculty of Medicine and Health Sciences, Universitas Lambung Mangkurat (No. 047/KEPK-FKIK ULM/EC/VI/2026), and research permission from the Director of Ulin General Hospital (No. 63/PPDS IPD/Litbang/RSUDU/V/2026). The study used anonymized secondary medical record data, and all identifiable patient information was removed from the analytic dataset.

Competing interests

The authors declare no competing interests.

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Author's Contribution

Idea/concept: ABC. Design: ABC. Control/supervision: ERK, NMF. Data collection/ processing: ABC. Analysis/interpretation: ABC, ERK, NMF. Literature review: -. Writing the article: ABC. Critical review: MDP, MB. All authors have critically reviewed and approved the final draft and are responsible for the content and similarity index of the manuscript.

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