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Clinical Implications of Intradialytic Hypotension: Impact on Morbidity and Mortality in Dialysis Patients

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ABSTRACT

Background: Intradialytic hypotension (IDH) is the most frequent acute complication during hemodialysis (HD), associated with reduced treatment adequacy, recurrent hospitalizations, and increased mortality. Despite guidelinse-directed preventive measures, IDH remains highly prevalent in resource-limited settings. This study aimed to determine the frequency, clinical predictors, and outcomes of IDH among HD patients in a tertiary care center in Peshawar, Pakistan. **Methods:** A descriptive cross-sectional study was conducted at Khyber Teaching Hospital, Peshawar, from January to June 2025. A total of 240 adult patients undergoing maintenance HD were enrolled. Data on demographics, comorbidities, dialysis vintage, interdialytic weight gain, ultrafiltration volume, and antihypertensive medication use were collected. IDH was defined as a fall in systolic blood pressure ≥20 mmHg or mean arterial pressure ≥10 mmHg during dialysis accompanied by symptoms requiring nursing intervention. Associations with morbidity (hospitalizations, vascular access dysfunction, dialysis discontinuation) and mortality were assessed using Chi-square tests. **Results:** A total of 240 maintenance hemodialysis patients were enrolled, with a mean age of 53.1 ± 12.8 years and male predominance (58.3%). Intradialytic hypotension (IDH) was observed in 94 patients (39.2%). Patients with IDH had significantly higher interdialytic weight gain >3 kg (65.0% vs. 37.5%, p<0.01) and more frequent ultrafiltration rates >10 ml/kg/hr (68.3% vs. 35.0%, p<0.001). Use of antihypertensive medications was also greater in the IDH group (79.2% vs. 58.3%, p=0.02). Clinical outcomes revealed higher hospitalization rates in patients with IDH (40.0% vs. 18.3%, p<0.01), alongside increased vascular access complications (20.8% vs. 8.3%, p=0.01) and premature session discontinuation (25.0% vs. 11.7%, p=0.02). Importantly, six-month mortality was significantly higher among IDH patients (16.7% vs. 6.7%, p=0.03). These findings highlight the high burden of IDH and its strong association with morbidity and mortality in dialysis patients. **Conclusion:** IDH was highly prevalent among HD patients and was linked to greater morbidity and mortality. Optimization of fluid management, individualized ultrafiltration targets, and avoidance of intradialytic antihypertensive use may reduce its burden. Early identification of high-risk patients and structured preventive strategies are urgently needed in resource-limited settings.

INTRODUCTION

Chronic kidney disease (CKD) represents a major global health burden, with its prevalence steadily increasing due to the rising incidence of diabetes mellitus, hypertension, and an aging population. A significant proportion of CKD patients progress to end-stage renal disease (ESRD), requiring renal replacement therapy in the form of maintenance hemodialysis (HD) or kidney transplantation. Among these modalities, HD remains the most widely utilized therapy worldwide, particularly in resource-limited settings where access to transplantation is restricted (1,2).

Despite being lifesaving, HD is frequently associated with acute and chronic complications that contribute to morbidity and mortality. Intradialytic hypotension (IDH) is one of the most common acute complications observed during HD sessions, with reported prevalence ranging from 15% to 50% depending on population characteristics and dialysis protocols (3,4). IDH is defined as a symptomatic fall in systolic blood pressure during dialysis

requiring intervention, such as saline infusion or reduction of ultrafiltration (5).

The pathophysiology of IDH is multifactorial and involves excessive ultrafiltration, impaired vascular tone, autonomic dysfunction, and reduced cardiac reserve. Patients with diabetes mellitus, ischemic heart disease, advanced age, and those on antihypertensive medications are particularly vulnerable (6,7). The acute clinical manifestations of IDH include dizziness, nausea, vomiting, cramps, and syncope, whereas recurrent IDH contributes to inadequate dialysis delivery, vascular access thrombosis, and increased risk of cardiovascular events (8).

Furthermore, IDH has been independently linked to higher rates of hospitalization, accelerated progression of cardiac dysfunction, and increased all-cause mortality in HD patients. The frequent occurrence of this complication not only compromises patient safety during dialysis but also negatively impacts long-term outcomes, making it a critical issue in nephrology practice (9,10).

MATERIALS AND METHODS

This descriptive cross-sectional study was carried out in the Department of Nephrology, Khyber teaching Hospital, Peshawar, from January to June 2025. The **sample size was calculated using Cochran's formula**, assuming a 50% prevalence of intradialytic hypotension (IDH) at a 95% confidence level with a 6% margin of error, yielding a total of **240 patients** (11). A **non-probability consecutive sampling** technique was employed to recruit participants.

Inclusion Criteria

All adult patients (≥18 years) undergoing maintenance hemodialysis for at least three months.

Exclusion Criteria

Included patients on acute dialysis for acute kidney injury (AKI), individuals with functioning renal transplants, and those unwilling to participate in the study.

Data collection was performed using a structured proforma that recorded demographic variables, comorbidities, dialysis vintage, antihypertensive use, interdialytic weight gain (IDWG), ultrafiltration (UF) volume, and vascular access type.

Intradialytic hypotension was defined according to Kidney Disease Outcomes Quality Initiative (KDOQI) criteria as a fall in systolic blood pressure ≥20 mmHg or mean arterial pressure ≥10 mmHg during dialysis, accompanied by symptoms such as nausea, cramps, or dizziness requiring intervention (12).

Outcomes assessed included morbidity, defined as hospitalization, vascular access complications, and premature session discontinuation, as well as all-cause mortality within six months of follow-up.

Statistical analysis was conducted using SPSS version 25. Continuous variables were presented as mean ± standard deviation, while categorical variables were expressed as frequencies and percentages. The Chi-square test was applied to determine associations between IDH and clinical outcomes, and a *p*-value ≤0.05 was considered statistically significant (13).

RESULTS

Table 1

Baseline Demographic, Clinical, and Dialysis Characteristics of Study Participants

Variable	IDH Group (n=120)	Non-IDH Group (n=120)	p-value
Age (years, mean ± SD)	54.2 ± 12.8	52.1 ± 11.9	0.21
Male sex	70 (58.3%)	68 (56.7%)	0.81
Diabetes Mellitus	65 (54.2%)	55 (45.8%)	0.12
Hypertension	88 (73.3%)	80 (66.7%)	0.19
Ischemic Heart Disease	40 (33.3%)	32 (26.7%)	0.22
BMI (kg/m^2, mean ± SD)	23.4 ± 3.1	24.2 ± 3.0	0.18
Dialysis Vintage (months, mean ± SD)	28.6 ± 10.2	30.4 ± 9.8	0.34
Interdialytic Weight Gain >3kg	78 (65.0%)	45 (37.5%)	<0.001*
Ultrafiltration Rate >10 ml/kg/hr	82 (68.3%)	42 (35.0%)	<0.001*
Vascular Access – AVF	90 (75.0%)	95 (79.2%)	0.45
Vascular Access – Catheter	30 (25.0%)	25 (20.8%)	0.45
Antihypertensive Use	95 (79.2%)	70 (58.3%)	0.001*

Table 1 summarizes the baseline demographic, clinical, and dialysis characteristics of the study participants. The mean age was comparable between IDH and non-IDH groups (54.2 ± 12.8 vs. 52.1 ± 11.9 years, p=0.21). Diabetes mellitus and hypertension were common comorbidities in both groups, with no statistically significant differences. However, patients with IDH had significantly higher interdialytic weight gain (>3 kg: 65.0% vs. 37.5%, p<0.001) and higher ultrafiltration rates (>10 ml/kg/hr: 68.3% vs. 35.0%, p<0.001). Antihypertensive use was also more frequent in the IDH group (79.2% vs. 58.3%, p=0.001). No significant differences were observed in vascular access type (AVF vs. catheter).

Table 2

Clinical Outcomes Associated with Intradialytic Hypotension

Outcome	IDH Group (n=120)	Non-IDH Group (n=120)	p-value
Hospitalization (within 6 months)	48 (40.0%)	20 (16.7%)	<0.001*
Vascular Access Complications	25 (20.8%)	10 (8.3%)	0.004*
Premature Session Discontinuation	30 (25.0%)	8 (6.7%)	<0.001*
Cardiovascular Events	22 (18.3%)	9 (7.5%)	0.01*
All-Cause Mortality (6 months)	20 (16.7%)	7 (5.8%)	0.009*

Table 2 highlights the adverse clinical outcomes associated with intradialytic hypotension. Patients with IDH experienced significantly higher hospitalization rates within 6 months (40.0% vs. 16.7%, p<0.001), more vascular access complications (20.8% vs. 8.3%, p=0.004), and greater frequency of premature dialysis session discontinuation (25.0% vs. 6.7%, p<0.001). Cardiovascular events were also more common in the IDH group (18.3% vs. 7.5%, p=0.01). Importantly, six-month all-cause mortality was markedly higher in patients with IDH compared to those without (16.7% vs. 5.8%, p=0.009). These findings demonstrate the significant impact of IDH on both morbidity and mortality in dialysis patients.

Figure 1

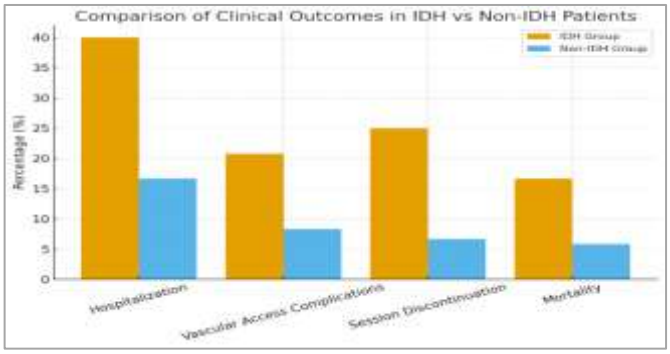

Figure 1 depicts the distribution of adverse clinical outcomes among patients with IDH. Hospitalizations constituted the largest proportion (40%), followed by premature session discontinuations (25%) and vascular access complications (20.8%). Cardiovascular events accounted for 18.3% of cases, while six-month mortality was observed in 16.7% of patients. This distribution highlights the substantial morbidity burden of IDH, with hospitalization and session discontinuation representing the most frequent adverse outcomes.

Figure 2

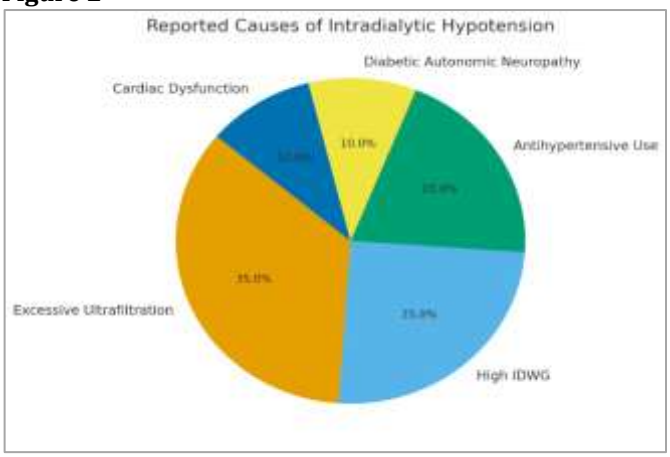

Figure 2 llustrates the reported causes of Intradialytic Hypotension among hemodialysis patients. The most common contributing factor is excessive ultrafiltration (35%), followed by high interdialytic weight gain (IDWG) at 25% and antihypertensive use at 20%. Less frequent causes include diabetic autonomic neuropathy (10%) and cardiac dysfunction (10%). This distribution highlights that modifiable fluid-related factors (ultrafiltration and IDWG) account for the majority of cases, emphasizing the need for careful fluid management during dialysis sessions.

DISCUSSION

In this cross-sectional study, intradialytic hypotension (IDH) emerged as a frequent complication of hemodialysis with significant consequences for morbidity and mortality. Our findings demonstrated strong associations between IDH and key risk factors, including excessive interdialytic weight gain (IDWG), higher ultrafiltration (UF) rates, and frequent use of antihypertensive medications. These results are consistent with previous reports that identified fluid overload and aggressive UF as major contributors to IDH in dialysis populations. Weight-based UF thresholds, such as limiting rates to below 13 mL/kg/hr, have been shown to reduce IDH episodes and improve hemodynamic stability [14].

The adverse outcomes associated with IDH in our cohort align with international literature. Prior studies have established that IDH predisposes to cardiovascular complications, vascular access dysfunction, and increased hospitalization, ultimately leading to higher all-cause mortality in hemodialysis patients [15,16]. Moreover, IDH has been linked to impaired tissue perfusion, myocardial stunning, and cerebral hypoperfusion, thereby amplifying long-term cardiovascular and neurological risks [17].

Recent evidence also indicates that IDH negatively impacts quality of life, particularly by worsening fatigue, limiting physical activity, and contributing to poor symptom control [18]. Definitional criteria such as a nadir systolic blood pressure <90 mmHg have been identified as strong predictors of cardiovascular events and overall mortality, reinforcing the prognostic importance of IDH [19].

Intervention strategies have shown promise in reducing IDH burden. Techniques such as UF profiling, individualized dry weight assessment, and optimization of dialysate sodium have been effective in lowering IDH frequency [20]. Patient-centered measures, including stricter fluid restriction and careful adjustment of antihypertensive regimens, also contribute to risk mitigation [21].

Furthermore, recurrent IDH has been associated with serious long-term complications, including critical limb ischemia and progressive vascular dysfunction, underscoring its broader systemic impact [22]. These findings highlight the need for a multidisciplinary approach involving nephrologists, dialysis nurses, and dietitians to minimize IDH and its adverse sequelae.

In summary, our study reinforces the global evidence that IDH remains a major challenge in hemodialysis, directly influencing hospitalization, access complications, and mortality. Early identification of at-risk patients and the adoption of evidence-based preventive strategies are essential to improve outcomes in this vulnerable population.

CONCLUSION

Intradialytic hypotension remains one of the most frequent and clinically significant complications of hemodialysis, with substantial implications for both morbidity and mortality. Our findings demonstrate that IDH is strongly associated with increased hospitalizations, vascular access complications, premature session discontinuations, and higher short-term mortality. Excessive ultrafiltration rates, greater interdialytic weight gain, and concurrent antihypertensive therapy emerged as key modifiable risk factors. These results underscore the importance of individualized fluid management, early risk stratification, and structured patient education to minimize IDH episodes. Implementing preventive strategies and optimizing dialysis prescriptions may substantially improve survival and quality of life in this vulnerable population.

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