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Prevalence of Intradialytic Hypertension in Patients with End-Stage Renal Disease on Maintenance Hemodialysis

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ABSTRACT

Intradialytic hypertension (IDH) is emerging as a relevant and recurrent problem in end-stage renal disease patients. This can result in escalated morbidity and even fatality in the event of this not being diagnosed promptly. **Objectives:** To determine the prevalence of intradialytic hypertension in end-stage renal disease (ESRD) patients on maintenance hemodialysis. **Methods:** This descriptive cross-sectional study included adult patients with end-stage renal disease (ESRD) on maintenance hemodialysis. Data on demographic and co-morbid conditions were noted. Six dialysis sessions were observed for each patient. Presence of >10 mmHg increases in systolic blood pressure between before and after the start of four out of six dialysis sessions was used to label IDH. Descriptive analysis was run, and the factors associated with IDH were compared through a chi-square test at 5% significance level. **Results:** The participants had a mean age of 48.03 ± 13.2 years, with females comprising 52.8% (n=76) of the total 144 patients. Hypertension emerged as the most frequent comorbidity, affecting 77.8% (n=112), while intradialytic hypertension (IDH) was identified in 19.4% (n=28) of cases. IDH showed a significant association with diabetes (30.9% vs. 12.4%, p=0.006) and was exclusively present in hypertensive patients (p=0.001). **Conclusion:** IDH is a relatively common occurrence and warrants careful monitoring, particularly among individuals with hypertension and diabetes mellitus.

INTRODUCTION

Among the various comorbidities, hypertension (HTN) is commonly observed in patients undergoing continuous hemodialysis (HD) for end-stage kidney disease (ESKD). One contributing factor to this condition is the expansion of extracellular fluid volume in these patients [1]. For ESKD patients, this necessitates the use of pharmaceutical treatment and hydration management to control blood pressure (BP) [2]. Intradialytic hypertension (IDH) and hypotension are two of the blood pressure abnormalities that occur during dialysis treatment [3]. Improving Global Outcomes (KDIGO) guidelines define intradialytic hypertension (IDH) as a rise in systolic blood pressure exceeding 10 mm Hg within the hypertensive range from pre- to post-dialysis in at least four out of six consecutive dialysis sessions [4]. Peripheral vasoconstriction and excess extracellular volume are implicated in the pathogenesis of IDH [5]. In addition to these reasons, dialysate temperature, sodium profiling, dialysate calcium, sodium salinity, and ultrafiltration rate are some other risk factors that influence blood pressure during dialysis [6]. Because several risk factors are involved, the prevalence of IDH has fluctuated with the passage of time and across different regions of the world. Recent studies show a frequency of 81.8% in India [7] and 17% in Pakistan [8]. From Karachi, Pakistan, Mujtaba *et al* studied 263 patients (aged 18 years and older) with ESKD on maintenance hemodialysis. They found that around 16% of patients were found to have IDH [9]. In another study, Diakite *et al*

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reported that out of 131 patients with ESKD on hemodialysis, 53 had intradialytic hypertension (a frequency of 40.5%) [10]. As far as we know, no study has been reported from this part of Punjab, Pakistan, to assess the magnitude of IDH, where the burden of chronic kidney disease (CKD) is large. Therefore, this study has been planned to determine the magnitude of IDH in our local setting. The study results will help in devising strategies to overcome this intradialytic complication so that its associated risks of morbidity and mortality may be reduced. Identifying the prevalence of IDH will encourage routine monitoring during hemodialysis sessions, enabling early detection and intervention. It will provide baseline data for future studies exploring the pathophysiology, risk factors, and long-term outcomes associated with IDH.

The present study aims to determine the prevalence of intradialytic hypertension in end-stage renal disease (ESRD) patients on maintenance hemodialysis.

METHODS

This descriptive cross-sectional study was conducted at the Nephrology department of Sir Ganga Ram Hospital over the duration of six months from 20th July 2024 to 19th January 2025, following approval from the institutional ethics review committee (ERC No. 187-Synopsis /FCPS/FJ/ERC). Adults aged 20–65 years, both male and female, diagnosed with end-stage renal disease (ESRD) and receiving maintenance hemodialysis (HD) were included in the study after obtaining informed consent, using non-probability consecutive sampling. Patients with acute infections such as diarrhea or pneumonia, as well as those with acute-on-chronic kidney injury, were excluded. We recorded demographic data like age, gender, duration of ESRD (in months), and duration of maintenance hemodialysis (in months). We also noted the co-morbidity data for smoking, diabetes mellitus, and hypertension from history and medical records. All the patients were observed for six dialysis sessions for assessment of intradialytic hypertension. Pre-dialysis blood pressure was monitored using an automated monitor, then every thirty minutes during the dialysis session, and after the end of the session. Patients were labeled to have intradialytic hypertension if a systolic blood pressure increase of more than 10 mmHg was observed between the start and end of the dialysis session in four out of six sessions [4]. A sample size of 144 patients was calculated using OpenEpi software with the single proportion formula, considering a 16% prevalence of intradialytic hypertension [9], a 95% confidence level, and a precision of 6%. The sample size formula used was: n = deff×Np^q^/(d^2/1.96^2) (N–1) +p^q^. All statistics were done with SPSS version 23.0. Shapiro-Wilk was used to evaluate normality of numerical data. Summarizing the quantitative data, the results of variably distributed, which are normally distributed ones, are presented as mean (standard deviation), and the results of non-normally distributed ones are reflected as median (inter quartile range). Qualitative data comparison across patients with and without intradialytic hypertension was through chi-square test, whereas Fisher exact test was applied when the cells contained less than 5. Statistical significances were discussed as values of $p<0.05$.

RESULTS

The study enrolled 144 patients with an average age of 48.03 ± 13.2 years, and more than half were females (52.8%, n=76). The prevalence of comorbid conditions was 12.5% for smoking, 38.2% for diabetes mellitus and 77.8% for hypertension. The median (IQR) duration of end-stage renal disease was 36 (66) months, and the duration of hemodialysis was 24 (70) months. All the patients were on thrice-weekly maintenance hemodialysis. Of all the study participants, 28 (19.4%) developed intradialytic hypertension (Table 1).

Table 1: Characteristics of End Stage Renal Disease Patients on Maintenance Hemodialysis (N=144)

Characteristics	Values
Age (years)	48.03 ± 13.2
Male	68 (47.2%)
Female	76 (52.8%)
Smoking – Yes	18 (12.5%)
Diabetes Mellitus – Yes	55 (38.2%)
Hypertension – Yes	112 (77.8%)
Duration of End-Stage Renal Disease (Months)*	36 (66%)
Duration of Hemodialysis (months)*	24 (70%)
Intradialytic Hypertension	
Yes	28 (19.4%)
No	116 (80.6%)

*Median (IQR)

Prevalence of intradialytic hypertension was significantly high in diabetic cases in contrast to non-diabetic cases (30.9% vs. 12.4%, p-value=0.006). All cases of intradialytic hypertension occurred in hypertensive patients in contrast to non-hypertensive patients (100% vs. 0%, p-value=0.001) (Table 2).

Table 2: Clinical and Demographic Factors Associated with Intradialytic Hypertension (N=144)

Factors		Intradialytic Hypertension		p-Value*
		Yes (28)	No (116)	
Age	< 50-years	10 (13.7%)	63 (86.3%)	0.077
	≥ 50-years	18 (25.4%)	53 (74.6%)	
Gender	Male	14 (20.6%)	54 (79.4%)	0.743
	Female	14 (18.4%)	62 (81.6%)	
Smoking	Yes	5 (27.8%)	13 (72.2%)	0.340
	No	23 (18.3%)	103 (81.7%)	

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Diabetes Mellitus	Yes	17 (30.9%)	38 (69.1%)	0.006€
	No	11 (12.4%)	78 (87.6%)	
Hypertension ¥	Yes	28 (25%)	84 (75%)	0.001€
	No	0 (0.0%)	32 (100%)	
Duration of ESRD	≤ 5-years	18 (18.8%)	78 (81.3%)	0.766
	> 5-years	10 (20.8%)	38 (79.2%)	
Duration of hemodialysis	≤ 3-years	18 (20.9%)	68 (79.1%)	0.583
	> 3-years	10 (17.2%)	48 (82.8%)	

*chi-square test, ¥ Fischer's exact test where cell count < 5, €Statistically significant

DISCUSSION

One-fifth of the subjects in our study had intra-dialytic hypertension (IDH). In contrast to previous reports, which have estimated IDH frequencies ranging from 22.3% to 44.5% based on varying definitions, our findings reflect a relatively low prevalence [11-13]. Mujtaba *et al.* reported a 16% prevalence of IDH in patients undergoing hemodialysis , which is lower than our observation [9]. Such differences may arise from variations in ultrafiltration rates, blood pressure monitoring practices, and the criteria used to define IDH across different centers. Our study employed a strict operational definition, requiring a >10 mmHg rise in systolic BP during at least four out of six dialysis sessions. By contrast, earlier studies often considered fewer dialysis sessions or smaller BP changes, which may have inflated reported prevalence rates. These definitional discrepancies are a well-recognized contributor to the variability in IDH estimates across the literature. Prabhu *et al.* conducted a study on 136 patients and reported IDH prevalence of 57%, 24%, and 11% when defined by an increase in systolic blood pressure, mean arterial pressure (MAP), and symptomatic increases, respectively [14]. Similarly, Kakai, who conducted a study on 86 chronic kidney disease patients over 512 hemodialysis sessions, found a frequency of 51.2% [15]. Current study results align more closely with those of Gathmyr *et al.*, who reported a 17.7% prevalence in a cross-sectional study of 130 patients on chronic hemodialysis [16]. The development of IDH has also been linked to dialysis frequency. All our patients underwent thrice-weekly sessions. Patients on less frequent regimens are more likely to be volume overloaded, which, combined with higher ultrafiltration demands, may increase the risk of IDH. Since IDH patients tend to remain, volume overloaded compared to other hemodialysis patients, their hypertension management typically depends on pre- and post-dialysis blood pressure measurements [17]. Standardization of IDH testing and consensus on diagnostic criteria are therefore essential to guide management approaches [18]. IDH has been associated with higher mortality risk, yet its pathophysiology, particularly its link with increased vascular resistance during dialysis and persistent volume overload, remains incompletely understood. This highlights the importance of vigilant fluid management as a first-line strategy [19]. Despite growing evidence, therapeutic options remain limited, largely due to uncertainty regarding underlying mechanisms and a lack of a universally accepted diagnostic definition. In our study, IDH appeared more common in patients aged ≥50 years, though this association did not reach statistical significance. The link between IDH, advancing age, and multiple comorbidities has, however, been demonstrated in earlier studies [20]. Hypertension and diabetes mellitus were the major comorbidities significantly associated with IDH in our cohort, consistent with findings reported by Mujtaba *et al.* [9]. Previous studies have also documented clinical consequences of IDH, including metabolic disturbances, all-cause mortality, cardiac failure, and cardiovascular-related hospitalizations [21]. Prabhu *et al.* reported that both diabetes mellitus and malnutrition (P=0.03) were significantly associated with IDH [14]. Kakai, identified high pulse pressure and elevated systolic BP as significant predictors [15]. While IDH has been linked to shorter dialysis duration in earlier work [19], we did not observe such an association in our study. Effective management of IDH requires a multifaceted approach, including dialysate adjustments, careful assessment of dry weight, improved techniques for blood pressure monitoring, vigilance for signs of chronic fluid overload, and optimization of antihypertensive therapy. Given the elevated mortality risk among IDH patients, collaboration among nephrologists, dialysis nurses, dietitians, and cardiologists are vital to develop individualized care plans [20]. The etiology of IDH is likely multifactorial, involving overlapping contributions from fluid overload, autonomic dysregulation, and hormonal imbalances, though their relative significance remains unclear [21, 22]. Present study adds valuable data to the growing body of literature, but has limitations. It was a single-center study, which may limit generalizability. In addition, its cross-sectional design precluded exploration of temporal or causal associations.

CONCLUSIONS

The study concluded that intradialytic hypertension (IDH) is a frequent occurrence in chronic kidney disease patients on maintenance hemodialysis. Diabetes and pre-existing hypertension are major risk factors. Clinicians should ensure standardized blood pressure monitoring before, during, and after dialysis, with closer surveillance of high-risk patients. Multi-center longitudinal studies and regular quality audits of dialysis facilities are needed to evaluate IDH prevalence and management effectiveness.

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Authors Contribution

Conceptualization: MT,
Methodology: MT, SY, SA
Formal analysis: MT, SY
Writing review and editing: MT, HTU, SA

All authors have read and agreed to the published version of the manuscript

Conflicts of Interest

All the authors declare no conflict of interest.

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