INTRADIALYTIC HYPOTENSION DURING HEAMODYALYSIS

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ABSTRACT

OBJECTIVES

Haemodialysis (HD) is a form of renal replacement therapy commonly prescribed for chronic kidney disease (CKD) patients. However, it is not without deleterious haemodynamic responses which may occur either during or immediately after the termination of the procedure. These may include hypotension or hypertension. The objective of this study was to determine the frequency of intradialytic blood pressure changes in chronic kidney disease patients on maintenance hemodialysis.

METHODOLOGY

Patients with chronic kidney disease on maintenance hemodialysis were enrolled. Predialysis and immediate post dialysis blood pressure was recorded. Increase in postdialysis blood pressure by >20mmHg was called intradialytic hypertension and decrease by >20mmHg was called intradialytic hypotension.

RESULTS

A total of 203 patients on maintenance hemodialysis were enrolled. Age of the patients ranged from 18 to 50 years. Mean age of the patients was 39.80 ± 5.245 years. Male to female ratio was 1.8:1. Intradialytic hypotension was observed in 36 patients (17.7%) while intradialytic hypertension was observed in 22 patients (10.8%).

CONCLUSION

Intradialysis blood pressure fluctuations such as hypotension and hypertension are common complications during hemodialysis. Intradialytic hypotension is more frequent.

KEYWORDS: *Intradialysis Blood Pressure; Intradialytic Hypotension; Intradialytic Hypertension, Hemodialysis; Chronic Kidney Disease*

INTRODUCTION

Chronic kidney disease (CKD) is defined as decreased kidney function shown by glomerular filtration rate (GFR) of less than 60 mL/min per 1.73 m², or markers of kidney damage, or both, of at least 3 months duration, regardless of the underlying cause. It is ranked fourteenth in the list of leading causes of death accounting for 12.2 deaths per 100000 people. Incidence, prevalence and progression of CKD vary widely among countries by ethnicity and social determinants of health. Diabetes and hypertension are the main causes of CKD. Renal transplant and renal replacement therapy are the treatment modalities for patients suffering from CKD.[1] Hemodialysis is form of renal replacement therapy in which nitrogenous wastes and toxic products are removed from the patients' blood through the process of diffusion occurring through an external semipermeable membrane called dialyzer. Hemodialysis is recommended for stage 5 CKD patients (eGFR < 15 ml/min/1.73m^2). Hemodialysis has several complications but one considerably common is its impact on blood pressure.[2] Though, hemodialysis complicated by reduced blood pressure during or immediately after the process (intradialytic hypotension) is common, a paradoxical increase in blood pressure has also been reported in some patients (intradialytic hypertension).[3] Johanna Kuipers et al. and Ulrich Steinwandel et al. reported 10.1% and 13.1% prevalence of intradialytic hypotension respectively with over all prevalence ranging from 5% to 15%.[4,5] Intradialytic hypertension is relatively less common with 5% to 10% prevalence but more deleterious outcomes have been observed with intradialytic hypertension in the form of 6% increase in 2-year mortality with every 10 mm Hg increase in predialysis to post dialysis systolic blood pressure.[6] The ability to predict intradialytic blood pressure changes in CKD patients on hemodialysis plays an important role in the initial counselling of patient undergoing dialysis. While intradialytic hypotension is more common, paradoxical intradialytic

hypertension is also reported.[3] Such intradialytic blood pressure changes carries deleterious outcomes with it.[6] This study will help us in knowing the percentage of patients developing intradialytic blood pressure changes. It will also help us in patients counselling regarding the reduction in interdialytic weight gain, increasing the frequency and duration of dialysis.

METHODOLOGY

This cross sectional study was conducted at Department of Nephrology and Dialysis, Lady Reading Hospital, Peshawar from 1st August 2021 till 31st January 2022. Sample size was calculated by WHO sample size formula using the proportion (expected frequency of intradialytic hypotension) p= 5% , margin of error= 3%, Confidence Level= 95%. Both male and female patients of age 18-50 years, with chronic kidney disease as per operational definition for more than 6 months undergoing session of hemodialysis were included in the study. Patients having atrial fibrillation, history of autoimmune diseases, congestive heart failure, history of hypothyroidism, history of hyperthyroidism, having adrenal malignancy and Cushing disease were excluded from the study.[4] It included 203 patients by using Non-probability convenient sampling technique as it is easier and convenient, after the approval of the hospital ethical committee and research department of Lady Reading Hospital Peshawar. The data was collected on prescribed preforma. Informed consent was taken from each patient at the time of admission in dialysis unit, ensuring confidentiality and fact that there is no risk involved to the patient while taking part in this study. Basic demographics like age, gender, weight in kilograms (on weighing scale) and height in meters (using stadiometer) were noted. Complete medical history including the duration of CKD, underlying cause of CKD and duration of dialysis dependency were noted, followed by detailed physical examination including general physical examination and abdominal examination. At our institution, for CKD patients, hemodialysis is performed three times weekly with a dialysis time of four hours per session. For intradialytic blood pressure changes, the systolic blood pressure of the patient in seating position was measured by 4th year medical resident using cardiac monitors just prior to the initiation of hemodialysis session and immediately after the session to get predialytic and postdialytic systolic blood pressure respectively. Patient were followed for the next two consecutive hemodialysis sessions and predialysis and postdialysis systolic blood pressures was recorded on these occasions in similar way. Finally, all 3 predialysis SBP were averaged to get mean predialytic SBP. Similarly all 3 postdialytic systolic blood pressure were averaged to get mean postdialytic SBP. The mean predialysis and postdialysis systolic blood pressure was then compared. Data for intradialytic blood pressure changes was recorded as per operational definition in term of frequency of intradialytic hypotension (a decrease in immediately measured postdialysis systolic blood pressure (SBP) by ≥20 mmHg compared to predialysis systolic blood pressure) and frequency of intradialytic hypertension (an increase in immediately measured postdialysis systolic blood pressure (SBP) by ≥20 mmHg compared to predialysis systolic blood pressure). It was analyzed with statistical analysis program (IBM-SPSS version 22). Frequencies and percentages were computed for qualitative variables like gender, intradialytic hypotension and intradialytic hypertension. Mean ±SD were computed for quantitative variables like age, weight, height, BMI, predialysis systolic blood pressure, postdialysis systolic blood pressure and serum creatinine. Effect modifiers like age, gender and BMI will be controlled by stratification. Post-stratification chi square test was applied. p-value ≤0.05 was considered statistically significant.

RESULT

In this study, age of the patients ranged from 18 to 50 years. Mean age was 39.80 ± 5.245 years, mean weight 45.22 ± 7.101 kg and mean BMI was 21.381 ± 1.020. There were 132 male and 71 females. BMI below 20 was in 98 patients and 105 patients were having BMI more than 20. Intradialytic hypotension was recorded in 36 patients (17.7%) while intradialytic hypertension was recorded in 22 patients (10.8%). Stratification of intradialytic hypotension with respect to gender, age and BMI are shown in Table-I, II and III respectively. While stratification of intradialytic hypertension with respect to gender, age and BMI are shown in Table-IV, V and VI respectively.

Table 1: Stratification of Intradialytic Hypotension with respect to Gender (N = 203)

Gender * Intradialytic Hypotension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
Gender	Male	27 (20.4%)	105 (79.6%)	132 (100.0%)	
	Female	09 (12.7%)	62 (87.3%)	71 (100.0%)	0.073
Total		36 (17.7%)	167 (82.3%)	203 (100.0%)	

Table 2: Stratification of Intradialytic Hypotension with respect to Age (N = 203)

Age * Intradialytic Hypotension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
Age (Years)	30 years or more	23 (19.3%)	96 (80.7%)	119 (100.0%)	0.235
	less than 30 years	13 (15.5%)	71 (84.5%)	84 (100.0%)	
Total		36 (17.7%)	167 (82.3%)	203 (100.0%)	

Table 3: Stratification of Intradialytic Hypotension with Respect to BMI (N = 203)

BMI* Intradialytic Hypotension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
BMI (kg/m^2)	20 kg/m^2 Or below	15 (15.3%)	83 (84.7%)	98 (100.0%)	0.726
	More than 20 kg/m^2	31 (29.5%)	74 (70.5%)	105 (100.0%)	
Total		36 (17.7%)	167 (82.3%)	203 (100.0%)	

Table 4: Stratification of Intradialytic Hypertension with Respect to Gender (N = 203)

Gender * Intradialytic Hypertension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
Gender	Male	16 (13.8%)	116 (86.2%)	132 (100.0%)	0.061
	Female	06 (8.4%)	65 (91.6%)	71 (100.0%)	
Total		22 (10.8%)	181 (89.2%)	203 (100.0%)	

Table 5: Stratification of Intradialytic Hypertension with Respect to Age (N = 203)

Age *Intradialytic Hypertension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
Age (years)	30 years or more	18 (15.1%)	101 (85.9%)	119 (100.0%)	0.039
	Less than 30 years	04 (4.8%)	80 (95.2%)	84 (100.0%)	
Total		22 (10.8%)	181 (89.2%)	203 (100.0%)	

Table 6: Stratification of Intradialytic Hypertension with Respect to BMI (N = 203)

BMI * Intradialytic Hypertension					
		Intradialytic Hypotension		Total	P-Value
		Yes	No		
BMI (kg/m^2)	20 kg/m^2 Or below	10 (10.2%)	88 (89.8%)	98 (100.0%)	0.855
	More than 20 kg/m^2	12 (11.4%)	93 (88.6%)	105 (100.0%)	
Total		22 (10.8%)	181 (89.2%)	203 (100.0%)	

DISCUSSION

This study has shown that the duration of dialysis as well as an increased number of antihypertensive medication use significantly affect blood pressure changes in an advanced CKD cohort with a higher frequency of diabetic patients. There were more males with higher mean age, which portrays the tendency for the development of CKD in older males and the commonest cause of CKD in patients on maintenance HD is diabetic nephropathy. These findings are in consistent with other studies.[7,8,910] Furthermore, Intradialysis hypotension has appeared more frequent than intradialysis hypertension. This finding is in coherance with other studies where the prevalence of intradialysis hypotension was higher but this is in conformity with results from our locality.[11] It may also be related to more advanced CKD and poorly functioning hearts as well as autonomic neuropathy related to uraemia in our subjects. In addition, subjects with intradialysis hypotension were younger and had higher levels of serum creatinine when compared with their counterparts with no significant change intradialysis. This is similar to findings in other studies although in our study these parameters were not statistically significant.[5,12] Our study demonstrates that haemodynamic responses during haemodialysis were associated with pre-dialysis or post-dialysis systolic BP, diastolic BP or MAP. These changes have been demonstrated in other studies to be strongly associated with hospitalization or death.[12] However, our study may suggest that haemodynamic responses to haemodialysis may be used in identifying patients at increased risk of important short-term clinical events due to the intradialysis blood pressure changes observed. Stidley *et al.* in their investigation of incident hemodialysis patients, showed that elevated pre-dialysis SBP (>160mm/Hg) was associated with lower mortality, and low post-dialysis SBP (<110mm/Hg) was associated with increased mortality but a study by Foley *et al.* found that neither pre-dialysis nor post-dialysis SBP was significantly associated with all-

cause mortality after controlling for demographics, comorbid conditions, and percentage of interdialytic weight gain.[13,14] In this present study, subjects with intradialysis hypotension had higher pre-dialysis systolic BP, diastolic BP and MAP, with lower post-dialysis systolic, diastolic BP and MAP, and were on less antihypertensive medications when compared with those with increased blood pressure and no significant change intradialysis. However, these parameters were not statistically significant except for the less number of antihypertensive medications. In addition, when subjects with intradialyis hypotension is compared to those with intradialysis hypertension alone or with those with unchanged intradialysis blood pressure alone; those with hypotension had lower post-dialysis systolic BP, diastolic BP and MAP, and these parameters were statistically significant. Our study showed that the duration of HD is longer in subjects with intradialysis hypertension, although hypotension has been shown to be associated with longer duration of HD.[15] Our finding probably reflects current understanding of the pathophysiologic mechanism which links failure to lower BP with dialysis, enhanced renin-angiotensin system and/or increased sympathetic nervous system activity in response to decreases in blood volume.[10] Furthermore, intradialytic hypertension may be associated with lower dry weights of the patients but our study showed a higher dry weight. Our patients pay out of pocket for dialysis and are consequently generally under dialysed. Interestingly a number of studies supported our findings but for a different reason. Patients who do not reach target dry weights are thought to be less likely to respond to HD with an appropriate lowering of BP.[16] Also, the subjects with intradialysis hypertension had higher post-dialysis SBP, MAP and greater number of antihypertensive medications when compared with subjects that had no significant blood pressure changes during dialysis. This is in keeping with findings from other studies, but the study by Buren et al. further evaluated the relationship between intradialytic hypertension and interdialytic ambulatory blood pressure.[17,18]

LIMITATIONS

Patients with chronic kidney disease on maintenance hemodialysis were enrolled. Predialysis and immediate post dialysis blood pressure was recorded.

CONCLUSION

Intradialysis blood pressure fluctuations such as hypotension and hypertension are common complications during hemodialysis. Intradialytic hypotension is more frequent than intradialytic hypertension. Older male patients with comorbid conditions like anemia are more likely to have intradialytic hypotension than intradialytic hypertension.

CONFLICT OF INTEREST: None

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