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Study of Incidence of Intradialytic Hypotension in Patients on Maintenance Hemodialysis in a Tertiary Care Centre in India

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Abstract:

Hypotension is quite common during hemodialysis & despite significant improvements of hemodialysistechniques in the recent years; the frequency of recurrent episodes intradialytic hypotension has remained unchanged.Intradialytic hypotension (IDH) is a serious complication and a major risk factor of increased mortality during hemodialysis (HD). However, predicting the occurrence of intradialytic blood pressure (BP) fluctuations clinically is difficult. The goal of our study was to assess the prevalence of IDH and to identify patients and treatment factors associated with its presence. This was a prospective study of 200 hemodialysis patients observed over 12 months at the tertiary care centre in western region of Maharashtra, India. Subjects with more than two episodes / month of hypotension on dialysis were diagnosed as having IDH. Intradialytic hypotension was found in 19% of subjects (38 patients). Incorrectly assessed ideal body weight was found to be the commonest cause of intradialytic hypotension. Volume assessment and adjusting the ideal body weight was found to be central to the problem of preventing intradialytic hypotension. This study concludes that intradialytic hypotension is a common phenomenon, even in a tertiary care centre. Preventive strategies should be developed in each unit to decrease the future risk for intradialytic hypotension in specific patients.

Keywords: Intradiaytic Hypotension, Hemodialysis, Chronic kidney disease

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Introduction

Blood pressure (BP) monitoring is a fundamental and essential for patients with chronic kidney disease (CKD)[1]. The BP was measured in frequent intervals during hemodialysis (HD) to ensure patient safety. A significant BP fluctuation and variation was found at pre-, intra- and post-dialysis among HD patients so BP management has been very difficult. The extreme changes in blood volume during HD often make obtaining a clear picture of the actual blood pressure in HD patients difficult [2].

IDH is defined as a symptomatic decrease of more than 30 mmHg in systolic blood pressure or as an absolute systolic blood pressure under 90 mm Hg[3]. IDH was defined as per K/DOQI guidelines as decrease in systolic blood pressure >20 mm Hg or a decrease in mean arterial pressure (MAP) by 10 mm Hg associated with clinical events and need for nursing intervention[4]. IDH is the clinical manifestation of an imbalance between the decreases in plasma volume during dialysis and the counter regulatory cardiovascular hemodynamic and neurohumoral mechanisms[5,6] . Our study is aimed to define the pathogenesis of IDH and thereby to apply the most appropriate protective strategies for the hypotension prone hemodialysis patient onan individual basis.

Material and Methods:

This is a prospective study conducted at the tertiary care centre in western region of Maharashtra, India from 1/6/2020 to 30/06/202 (12 months).

• 200 subjects who were on maintenance hemodialysis (4 hours/3 per week) observed over 12months.

• IDH was defined as per K/DOQI guidelines as decrease in systolic blood pressure > 20 mm Hg or a decrease in mean arterial pressure (MAP) by 10 mm Hg associated with clinical events and need for nursing intervention. Subjects with more than two episodes/month of hypotension on dialysis were diagnosed as having IDH.

• Vital statistics, co morbidities, estimated dry weight, pre and post dialysis weight, interdialytic weight gain and medications were recorded. Diet history including salt and water intakewere recorded. Complete Blood Count and Iron studies & 2D-Echocardigraphy were done in all patients. The demographic data were expressed as the mean ± standard deviation (SD) and percentages as appropriate.

Results:

200 patients were included in this study. The mean age of subjects were 42.26 (18-72). Of the 200 patients studied, 75% patients were males & 25% were females. Their demographics are shown in (Table 1).

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Of the 200 patients studied, 19% (38 patients) were found to have hemodynamically significant IDH (Figure 1). Diabetic nephropathy was the leading cause (56%) of ESRD among these patients (Figure 2).

Factors responsible for the pathogenesis of IDH include: incorrect dry weight, poor cardiac function, excess weight gain, medications (antihypertensives and nitrates), and consumption of food while on HD, anemia, autonomic neuropathy and unknown causes (Table 2).

Appropriate interventions that proved effective in preventing the episodes of hypotension during hemodialysis include: increasing the ideal body weight, use of vasoconstrictors, modifying the medications (antihypertensives), limiting interdialytic weight gain, avoiding food consumption while on HD, and correction of anemia (Table 3).

Table 1: Demographic variables of the patients:

Parameters	**Mean values**
Age (years)	42.26 (18-72)
Sex	Males- 75%: Females- 25%
Time on dialysis (years)	4 (1-6)
Nephropathy	
Diabetic Nephropathy	46.5%
Hypertensive nephrosclerosis	8.6%
Glomerulonephritis	7.1%
Tubulointerstitial nephritis	22.4%
Unknown causes	21.4%
Dry weight	59.5 kg (50-89)
Duration of HD per session	242 min (220-260)
Ultrafiltration rate per session	8.5 ml/min
Hemoglobin	8.2g/dl (7-13)
2-D Echocardiography	
Left Ventricular Hypertrophy	76%

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Poor systolic function	87.2%
Poor diastolic function	77.8%

Figure 1: Percentage of patients with Intradialytic hypotension (IDH).

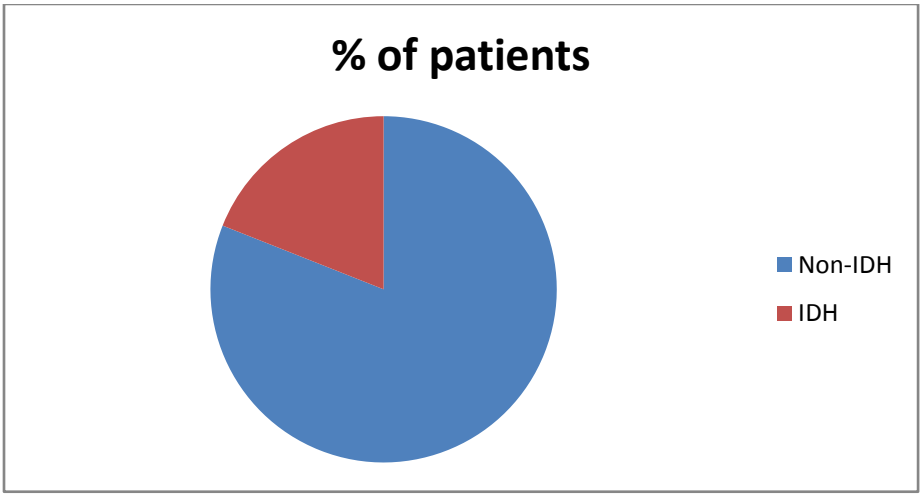

Figure 2: Percentage of diabetic and non-diabetic patients with IDH.

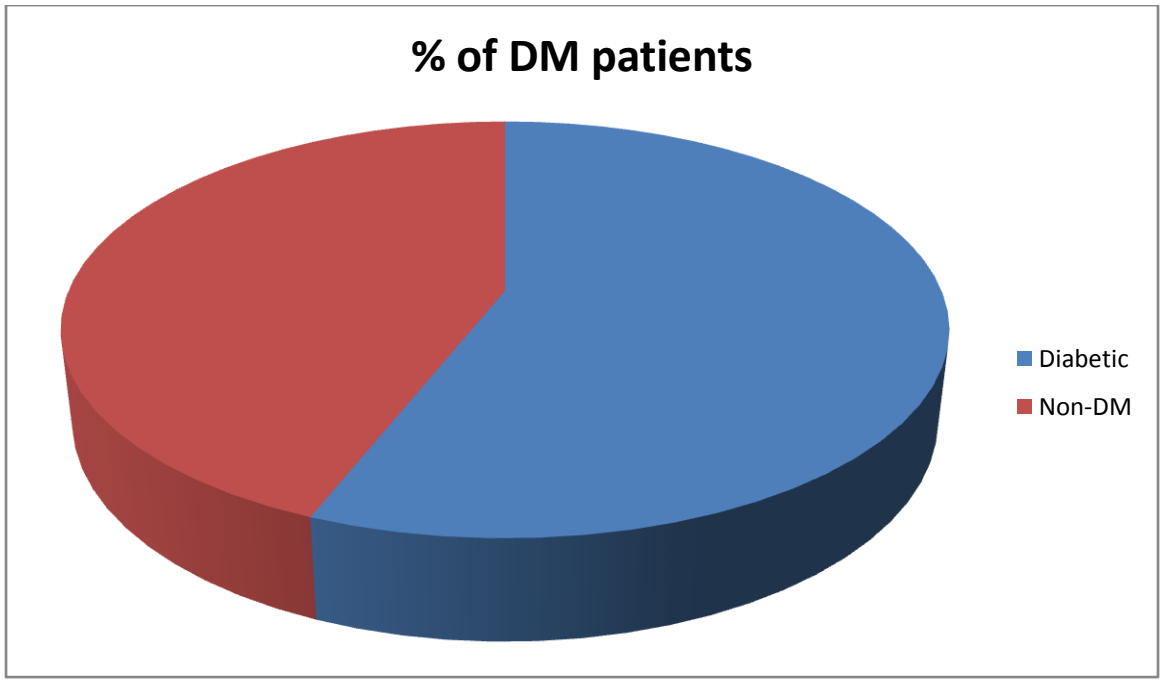

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Table 2: Etiologies for IDH

Aetiology	Percentage %
Incorrect ideal body weight (dry weight)	29%
Poor cardiac function	16%
Excess intradialytic weight gain	13%
Medications	12%
Food on HD	11%
Autonomic neuropathy	7%
Anemia	9%
Unknown causes	3%

Table 3: Interventions that proved useful in preventing IDH

Interventions that proved Useful	% of subjects
Vasoconstrictors	17%
Modifying drugs	12%
Anemia correction	9%
Avoiding foods	13%
Limit weight gain	17%
Increase IBW	32%

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Discussion

Intradialytic hypotension continues to be a leading problem, and its incidence varies from 20 to 30%. Decades of research revealed that the cause of IDH is multifactorial. First describedin 1970[7] , Bergstorm showed in 1978 that intravascular hypovolemia, due to a large volume of ultrafiltration in too short a period of time, was not the sole cause of IDH. Despite the differences between the studies, there was a similarity in the factors that were associated with IDH across studies. Major risk factors associated with IDH across studies were diabetes, a higher IDWG, female gender, and lower body weight.

Diabetes is an obvious risk factor for IDH, explained by a higher prevalence of cardiovascular complications and diabetic complications such as autonomous neuropathy[8]. Higher IDWG is also a well-known risk factor for the occurrence of IDH[9-11]. Rocha et al[12]. found a significant association between lower dry weight and recurrent IDH episodes. A higher refill rate from the interstitial tissues in a more fluid overloaded state can be seen as the cause of the higher BP during the first HD session of the week[13].

Two studies reported that female gender in combination with a lower body weight as a risk factor for IDH[14,15]. This can be explained by the fact that females in general have a lower body weight than men and, consequently, have a higher UF rate (mL/h/kg bodyweight) during HD for a similar IDWG. Risk factors for IDH are both age and co morbidity dependent. The population at risk includes individuals with diabetes (autonomic dysfunction); individuals with left ventricular hypertrophy (LVH) and diastolic dysfunction, a history of prior myocardial infarction, or cardiovascular intervention; individuals with symptomatic coronary heart disease; individuals with high interdialytic weight gains (>3% of body weight); and dialysis patients who are anephric[16].

In various reviews, it is stated that 20–50 % of haemodialysis sessions are complicated by dialysis hypotension (Davenport et al, 2009, Sands et al, 2014). However, in the limited number of studies on this topic, the prevalence of dialysis hypotension was lower, ranging between 2 % and 30 % of dialysis sessions[17-19].

In our study poor cardiac function accounted for 16%, interdialytic weight gain for 13% and autonomic dysfunction for 7% of patients with IDH. Patients experiencing IDH who are usually hypertensive may resume antihypertensive medications at home when the BP is still low. This could lead to further nocturnal decreases in BP that increase the risk for an ischemic event[20]. Improper dosage and frequency of antihypertensive medications administration accounted for 12% of IDH in our patients.

Food ingestion during dialysis will increase splanchnic blood flow and may cause hypotension by causing splanchnic blood pooling [21]. Food ingestion accounted for 11% of IDH in our study. Arteriolar vasoconstriction will help limit pooling of blood in veins, thereby helping to maintain cardiac filling and cardiac output. Local tissue ischemia, via generation of adenosine or other

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local mediators, may aggravate hypotension, and methods that help maintain blood oxygen carrying capacity and oxygenation (eg, maintaining an adequate level of hematocrit) might maintain blood pressure by reducing tissue ischemia[22]. Anemia contributed to 9% of IDH in our patients.

A symptomatic reduction in BP during or immediately after dialysis occurs in approximately 20 to 30% of dialysis sessions. The treatment includes stopping or slowing the rate of ultrafiltration,placing the patient in the trendelenburg position, decreasing the blood flow rate, and restoring intravascular volume. Such episodes predispose the patient to leave the dialysis unit volume overloaded and if repetitive can lead to inadequate clearance. Intradialytic hypotension andorthostatic hypotension after the procedure are significant and independent riskfactors affecting mortality in dialysis patients[23]. This clinical commentary focuses on recent advances in the prevention and management of intradialytic hypotension.

Multiple pharmacologic agents are also available for use in treating IDH. These agents can be used both to avoid IDH events and potentially to decrease the frequency of acute interventions necessary once the blood pressure (BP) decreases and the patient's symptoms are apparent[24]. Educating the dialysis staff and "at-risk" patients can aid in the early recognition and timely treatment of IDH events. The number of patients at risk for IDH and prolonged hypotension has increased with the advancing mean age of dialysis patients and the multiple co morbidities with which end stage renal disease (ESRD) patients present. Considering the potential vascular risk low BP imparts, IDH can no longer be treated as a benign condition apparent[25].

Ultrafiltration profiling is the deliberate use of a high rate of ultrafiltration in the initial part of the treatment, when the volume of interstitial fluid available for vascular refilling is maximal, and then sequentially decreasing the rate so as to parallel the anticipated fall in interstitial fluid volume. Recent studies suggest this approach is particularly effective when combined with sodium modelling[26]. Adjusting dialysis prescription with combined sodium modeling and ultrafiltration profiling and limiting interdialytic weight gains helped in decreasing the frequency of IDH in 17% of patients in our study. A number of interventions can be relied on to decrease the overall risk of the patient for future IDH. These consist of adjusting pre-HD hypertension medications, and aggressively treating anemia to optimize blood volume. These interventions proved effective in our patients as well. Avoiding antihypertensive medications on the day of dialysis was effective in 12% and correction of anemia was effective in 9% of patients in preventing recurrent IDH.

An optimal approach may require a combination of dialysis prescription changes and oral medications. We used midodrine at a dose of 10 mg one to two hours before the initiation of dialysis, with increasing the dose up to 40 mg. We used vasopressin infusion 0.1 to 0.3 mU/ kg/min during hemodialysis session. Usage of these medicines helped to prevent IDH in 16% of our study subjects and helped in achieving the target increase in fluid removal. Eating during

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dialysis should be discouraged in patients with a risk for IDH. This approach provedeffective in 11% of patients in our study.

Conclusion:

Considering the importance of hypotension in overall patient survival, the percentage of patients in each unit who experience IDH and/or present with low BP (systolic BP <110 mm Hg) should be tracked as a quality assurance initiative. Preventive strategies should be developed in each unit to decrease the future risk for IDH in specific patients. Nursing staff and physicians can help educate the HD patient as to risk factors and the short-term and long-term implications for the patient with hypotension.

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