Original Article

Incidence Of Hypotension During Hemodialysis; A Cross-Sectional Study

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Abstract

Objective: This study is to estimate the incidence of hypotension and its risk factors in hemodialysis patients in Shifa International Hospital.

Study design: It was a cross-sectional study.

Place and duration of study: The study was conducted in the dialysis unit of Shifa International Hospital(Islamabad, Pakistan) from Auguest 2022 to December 2022.

Material and Methods: Data of 350 dialysis patients was collected. Causes, clinical manifestations and etiology of incidence of hypotension during dialysis was studied. Hypotension is a common complication of hemodialysis. During dialysis hypotension is associated with symptoms such as muscle cramps, abdominal and chest pain, nausea, vomiting, weakness, vertigo, anxiety, etc. Hypotension during dialysis is a risk factor for mortality in dialysis patients.

Results: Hypotension was found in hemodialysis patients however there was no statistical significance in male and female groups with p value >0.05. The average systolic blood pressure of male and female patients was 116.31±21.39 and 115.01±24.69 respectively. The diastolic blood pressure of males and female patients was 66.73±15.35 and 66.1±15.91 respectively. As far as the cause of kidney failure is concerned 212(60.5%) patients had hypertension as the cause of kidney failure out of which male and female population was 111(56.9%) and 101(43.07%). The other major cause of kidney failure was found to be diabetes mellitus with 138(39.4%) patients with male and female population 84(60.08%) and 54(39.13%).

Conclusion: Hypotension was found in hemodialysis patients with no statistical significance in male and female groups.

Keywords: Hypotension, hemodialysis, risk factors

1. Introduction

Hemodialysis Treatment of choice for Patients with End Stage Kidney Disease or kidney failure person's when their kidneys have stopped working properly, and kidneys can't perform their functions. Kidney disease mostly happening due to hypertension, diabetes mellitus and other causes like renal stone disease, Glomerular diseases and medications(NSAIDs).They might have comorbid disorders like Ischemic heart disease, Peripheral vascular diseases, Chronic obstructive pulmonary diseases, and cerebrovascular disease that increases the rate of morbidity and mortality.[(1)] Treatment for End Stage Renal Disease is in the form of Dialysis or Renal transplant needs to be done. Hemodialysis is the lifesaving procedure/treatment for renal failures. Hemodialysis is a procedure that filters/cleans the blood through an artificial kidney called Dialyzer. It removes wastes and excess water from patient's body and maintains PH and electrolytes balance in the blood. Otherwise nitrogenous waste will accumulate in body leads to death of the patient. Dialysis procedure improves the quality of life of patients with End Stage Renal Disease despite.[(2)]

Hemodialysis is usually performed an average of 4-hours sessions and given 3 times/weeks using an access to perform the dialysis procedure like, AV fistula or dialysis Venous catheter that takes blood from the body during a dialysis procedure to filter that blood and after filtration through Dialyzer blood is returned to the patients with chronic kidney disease. In which patient blood is obtained through arterial line and returned to patient with venous line. During therapy vitals are monitored every 15-30 minutes and recorded in individual dialysis patient file (Electronic Medical Record).

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Hemodialysis therapy is done to purify the blood to replace renal function to improve patient quality of life.[3]

Hypotension during hemodialysis will result in hypoperfusion to body organs and damage to vital organs like brain. Therefore, it is crucial to keep it in checks. It also contributes to inability to achieve the target dry weight as dialysis cannot be performed at a low blood pressure as it will further reduce the blood pressure. This leads to insufficient clearance of wastes, water and electrolytes, reduced effectiveness of dialysis and increased mortality of the dialysis patient. A large decrease in the blood water due to large ultrafiltration in a small time, reduced osmolality of the blood due to sodium removal, and a synchronized imbalance between plasma replenishment and loss of blood volume due to ultrafiltration appear to be the causes of hypotension during hemodialysis.[4] Incidence of hypotension depends on both dialysis related and patient related factors. Patient related factors that contribute to hypotension are taking excessive water between the dialysis sessions, not limiting salt intake, diabetes, uremia etc. Hypotension is common in patients who do not limit salt and water intake, thus come to the dialysis unit with too much volume overload that is difficult to remove in one session (4-hours). When this excess gained fluid/water is removed in single session there is drastic drop in blood pressure.[5] High phosphorus causes increased calcification of vessels thus they become less adaptive to change in blood volume as they get stiff due to calcification. Uremia also contributes to low blood pressure as it causes autonomic dysfunction.[6]

There are different risk factors that can cause hypotension in dialysis patients like old age, female gender, high body mass index, second or third dialysis in a weak, low pre-HD systolic blood pressure, diabetes, a high difference between achieved dry weight after dialysis and actual dry weight (calculated by subtracting prescribes dry weight from achieved dry weight after dialysis), low sodium and a higher temperature of dialysate. In most studies Age is a major factor that causes hypotension during treatment as the compensatory mechanisms of the older patients are not working as efficiently as in young patients.[7] A large decrease in the blood water due to large ultrafiltration in a small time, reduced osmolality of the blood due to sodium removal, and a synchronized imbalance between plasma replenishment and loss of blood volume due to ultrafiltration appear to be the causes of hypotension during hemodialysis. Incidence of hypotension depends on both dialysis related and patient related factors.[8]

They also have comorbidities that lead to hypotension. Diabetes is also a contributor to hypotension as is damages nerves leading to diabetic neuropathy and the nerves become less efficient to the stimulus of low plasma volume. Hypertensive patients that take antihypertensive medicines are also at the risk of developing intradialytic hypotension.[9]

Long-term management and prevention of hypotension includes recurrent assessment of dry weight to prevent excessive removal of water and draining of interstitial fluids, guiding the patient to limit salt and water intake during sessions which can prevent excessive need of removal of water during dialysis, thus preventing intradialytic hypotension.[10] It is required for the hypertensive dialysis patients taking antihypertensive medicines to reduce or skip the dose of antihypertensive medicine on the day of dialysis to prevent low blood pressure during dialysis. Long term management of hypotension also requires the use of bio-compatibility with the dialyzer.[11] Incidence of hypotension can also be prevented by using isolated filtration during dialysis i.e., removal of only water and no solutes and wastes during the first hour of dialysis. Cardiovascular stability can be achieved by prolonging individual dialysis sessions, leading to slower and gradual ultrafiltration and thus less burden on the cardiovascular system to maintain blood pressure by increasing heart rate and constricting blood vessels.[12]

One useful but quite costly management technique is the use of short dialysis sessions daily. This is useful to prevent hypotension during dialysis because it doesn't lead to extreme drop in osmolality removes small

amount of blood water daily, therefore no significant drop in blood pressure.[13] Short daily dialysis sessions are also shown to improve treatment of anemia, improved nutrition of patients and prevent increase cardiac workload as compared to conventional dialysis procedure. Some pharmacological treatments are also used to treat anemia like midodrine.[14]

2. Materials & Methods

A cross sectional study was conducted at Nephrology Department (Hemodialysis Unit) of Shifa International Hospital H-8 (SIH) , Islamabad, Pakistan. Adult (males and females) undergoing Hemo-Dialysis treatment on regular basis(Thrice/weekly given 4-hours/session) were enrolled for investigation to recruit the patients suffering from complication of hypotension during Hemo-Dialysis treatment . The included Patients were followed-up from August-2022 to December-2022.This study was approved by Institutional board and Ethics Committee informed consent was taken before data collection voluntarily from all patients. Aim of the study was to find the Incidence of hypotension in patients of End Stage Renal Disease receiving hemodialysis treatment. Sample Size was 315 Calculated by Openepi software and Confidence level (95%).

Self-designed questionnaire filled for Data collection regarding Demographic information including age, gender, dry weight, most common comorbidities Hypertension and Diabetes mellitus. The clinical variables of session were collected, including frequency per week (3-times/week), duration of hemodialysis treatment (4-hours/session), Ultra-Filtration for each session, sodium and temperature of dialysate, Blood flow rate, Dialyser and vascular access of patients and blood pressure monitoring every 15-30 minutes of intervals during the treatment. Baseline laboratory values for the blood analysis were measured using monthly reports. Blood samples collected when required via arterial port of extracorporeal circuit (bloodlines).The parameters included hemoglobin (Hb), Hematocrit (Hct), Sodium (Na^+), and phosphorus (PO_4).

Patients were dialyzed using Fresenius and Dialogue Hemodialysis Machines. Commonly used Blood Pressure Apparatus was manual Sphygmomanometer (BP) or Automated Blood Pressure monitoring through Hemodialysis Machine. Blood Pressure and other vitals were recorded on 15-30 minutes of intervals. Careful monitoring of patients during the whole procedure (dialysis therapy).The symptoms of hypotension occurred during the procedure that was also confirmed through blood pressure monitoring. As decrease of systolic blood pressure ≥20 mmHg from pre-dialysis level or Drop of Systolic blood pressure ≤90mmHg was considered hypotension. Decrease of blood pressure reading below normal levels. Necessary management was taken as the symptoms or drop of blood pressure occurred, and according to patient's condition.

Statistical analysis done using IBM SPSS Statistics for windows, version 22. Mean, median and range is used to express Numerical data .Frequency and percentage (%) has been used to express all the qualitative data. Stratification was done according to gender and chi-square test was applied. A p-value <0.05 was considered statistically significant.

3. Results

Total of 350 patients were included in this study. Out of which 195(55.7%) were males and 155(44.2%) were females participants. This difference in male and female population on hemodialysis may be due to the fact that males are more prone to kidney failure because high testosterone levels may cause a loss in kidney function. Also males do not have estrogen which is protecting kidneys in females till menopause.

Average age of male population was 56.6±15.94 and average age of female populations was 56.03±15.32. This age may be due to decreasing number of functional nephrons with age, increased blood pressure, and hardening of vessels and multiple comorbidities in old age.

Average systolic blood pressure in males was 116.31±21.39 and females were 115.01±24.69. Average diastolic blood pressure in males and females

was 66.73±15.35 and 66.1±15.91 respectively. Hypotension was found in hemodialysis patients however there was no statistical significance in male and female groups and p value was >0.05.

As far as the cause of kidney failure is concerned 212(60.5%) patients had hypertension as the cause of kidney failure out of which male and female population were 111(56.9%) and 101(43.07%). The other major cause of kidney failure was found to be diabetes mellitus with 138(39.4%) patients with male and female population 84(60.08%) and 54(39.13%).

Table 1.1: Association of Different Parameters with Gender.

Parameter	Male	Female	Total	p-value
Age, mean (SD)	56.64(15.94)	56.03 (15.32)	56.37 (15.65)	0.15
Dry weight	69.04(14.88)	64.20(16.88)	66.9(15.96)	<0.01
Systolic BP(SD)	116.31(21.39)	115.01(24.69)	115.73(25.05)	0.16
Diastolic BP(S.D)	66.73(15.35)	66.1(15.91)	66.45(15.58)	0.13
Access, n (%) Fistula Catheter	108 (55.4) 87 (44.6)	79(51) 76(49)	187(53.4) 163(46.6)	0.41
Ultrafiltration(S.D)	2.92(0.92)	3.07(0.93)	2.99(0.92)	0.01
Temperature (S.D)	36.24(0.43)	36.27(0.44)	36.25(0.43)	0.91
Hemoglobin(S.D)	9.61(1.55)	9.51(1.35)	9.57(1.46)	0.56
Sodium(S.D)	139.52(1.49)	138.77(8.44)	139.19(5.73)	0.48
Dialyser(S.D)	49.87(41.27)	53.34(41.7)	51.41(41.44)	0.57
Blood Flow(S.D)	277.69(46.64)	290.84(45.68)	283.51(46.61)	0.16
Hematocrit(S.D)	32.45(4.26)	32.41(3.96)	32.44(4.13)	0.05
Phosphorus	4.124(0.674)	4.048(0.608)	4.090(0.646)	0.03
Cause of kidney failure, n (%) Hypertension Diabetes Others	111(56.9) 84(43.07) 17(8.72)	101(65.16) 54(35.83) 11(70.09)	212(60.5) 138(39.4) 28(8)	0.12 0.12

Hypertension may damage the kidney due to the fact that it causes narrowing and weakening of arteries around kidney. Diabetes may cause kidney failure because high blood glucose levels damages vessels and nephrons.

Discussion:

Our study showed that Ultra-Filtration is the contributor of hypotension. Also the studies of Karmer et al., stated that mortality increased with high fluid gain. A main contributor of incidence of hypotension was high inter-dialytic weight gain and reported by the study of JIN-BOR CHEN et al.,2020 that leading factors of hypotension occurrence during hemodialysis were ultrafiltration amount and hypertension comorbidity.[(15)]

The exact mechanism for hypotension during dialysis is multifactorial and poorly understood like high ultrafiltration, high dialysate temperature, weight gain between session, low sodium, and medications used before procedure etc. Islam et al.,2017 that the most common complication of the hemodialysis procedure is hypotension12.62% of patients.[(16)] Mehmood et al., found occurrence of hypotension is about 24%. Netherland meta analysis found similar occurrence of hypotension 12% of patients. While Habas et al., found in 15.2% patients.[(17)] Ana Rocha et al., reported diabetic patients had higher BP, before and after procedure that was associated with high weight gain and frequent occurrence of hypotension. Also reported that hyperphosphatemia and vascular calcification strongly related which increased arterial stiffness (resistant vessels) that contributes to hypotension.[(18)] The key to avoid hypotension is correct assessment of dry weight. Accurate methods of assessing dry weight include bio-impedance spectroscopy, online continuous blood volume monitoring using hematocrit and protein measurements. Pre-emptive care was given to patients having pre-dialysis hypotension then those who don't have pre-dialysis hypotension.[(19)]

Hemodialysis is the safe modality worldwide with the improvement of technologies and used of modern machines. Common complication can be prevented by counseling of patients as less intra-dialytic weight gain, appropriate use of dialysate sodium and temperature, increasing time of procedure if patient comes with the

need of high fluid removal and proper monitoring of vitals during treatment.

Conclusion:

Hypotension was found in hemodialysis patients with no statistical significance in male and female groups.

Disclosure /Conflict of interest:

Authors declare no conflict of interest.

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