

Risk Factors Associated With Intradialytic Hypotension in Patients of End Stage Renal Disease on Maintenance Haemodialysis

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ABSTRACT

Introduction: Intradialytic hypotension is one of the most common complications to be observed during hemodialysis, occurring in about 15-20% of all sessions. The risk factors like interdialytic weight gain, UF rate, net ultrafiltration, pyrexia, food intake, cardiac events dialyzer type etc have been controlled due to modern hemodialysis equipments like hemodialysis machines with their better volumetric controls, sodium profiling, temperature control and patient counseling but still intradialytic hypotension is a major dialysis related complication.

Objectives: Identify the risk factors responsible for intradialytic hypotension.

Subjects and Methods: This cross-sectional study was comprised of one hundred patients of end stage renal disease carried out in the Department of Nephrology, Shaikh Zayed Hospital, Lahore between 1st January 2010 to 31st March 2010. All adult patients on maintenance hemodialysis were included in this study. The patients on maintenance hemodialysis <3 months duration and vomiting, diarrhea or bleeding episodes pre-hemodialysis were excluded. These dialysis sessions were categorized in two groups (Group I and Group II). Group I included those dialysis sessions in which the patients developed hypotension during dialysis and Group II included those dialysis sessions in which patients did not develop intradialytic hypotension. Following factors were noted like interdialytic weight gain, ultrafiltration rate, dialyzer type, cardiac events, antihypertensive medication, food intake during dialysis, pyrexia.

Results: Total 1907 hemodialysis sessions were included there were 103 (5.4%) patients of symptomatic hypotension (Group I) and 1804 (94.6%) patients of no symptomatic hypotension (Group II). The mean weight gain in group I was 2.2±0.7 kg and 2.1±0.9 kg in group II. The mean ultrafiltration rate in group I was 978±636 ml/h and in group II was 636±367ml/h. In group I, 4 (3.8%) and in group II, 20 (1.1%) sessions had cardiac events during dialysis (P= 0.04). Change in mean pulse rate was -2.1±14.1 in group I and -2.4±11.1 in group II (p=0.8). the Odd ratios for total time of dialysis was 5.50 (3.59 – 8.43), for lowest systolic blood pressure 5.43(3.55 – 8.32), and lowest diastolic blood pressure 4.85(3.14 – 7.48).

Conclusions: We found that interdialytic weight gain, net ultrafiltration, ultrafiltration rate and acute cardiac event were responsible factors causing intradialytic hypotension. Autonomic dysfunction was also a contributing factor among symptomatic hypotensive group.

Key Words: Intradialytic hypotension (IDH), dialysis sessions, ultrafiltration rate (UFR), interdialytic weight gain.

INTRODUCTION

Intradialytic hypotension is defined as lowering of mean blood pressure up to 20 mmHg or more during hemodialysis associated with symptoms. If the patients on maintenance hemodialysis has pre hemodialysis systolic blood pressure <100 mmHg then fall in systolic blood pressure up to 10mmHg or more during hemodialysis associated with symptoms is called Intradialytic hypotension. If systolic blood pressure is more than 100mmHg

then fall in systolic blood pressure up to 30 mmHg or more with related symptoms is called Intradialytic hypotension.¹ Intradialytic hypotension occurs more in elderly patients (over 65 years of age) compared to younger patients (under 45 years of age).² The incidence of symptomatic hypotensive episodes is particularly high in patients who have normal or low blood pressure at the initiation of dialysis and in patients who have large interdialytic weight gains.^{3,4} Intradialytic

hypotension is one of the most severe complications during hemodialysis. Its appearance is caused in part by rapid fluid removal with concomitant failure in blood pressure regulation but also by other dialytic-dependent and independent factors. In conclusion, multifrequent bio impedance assay is not capable to predict hypotension in the individual patient during a particular dialysis session.⁵

Intradialytic hypotension is the most common complication associated with hemodialysis, and its cause is multifactorial. We investigated the influence of predialysis blood pressure and antihypertensive drugs on intradialytic hypotension. Diabetes, excessive interdialytic weight gain, low ejection fraction, and low left ventricular volume are independent risk factors for intradialytic hypotension. Thus, hypertension may be controlled without aggravating intradialytic hypotension in hemodialysis patients.⁶ Intradialytic hypotension is associated with significant mortality and morbidity. It is associated with increase risk of seizures, cerebral infarction, cardiac ischemia, arrhythmia and vascular access thrombosis. It is also associated with rapid loss in residual renal function and impairs the dialysis adequacy due to frequent interruptions and results in reduction in quality of life. It is common observation that dialysis patients are prone to episodes of IDH, if we found exact frequency and factors related to IDH, then we were able to reduce the frequency of IDH in patients by modifying the risk factors and dialysis prescription. This improved the quality of life of these patients.

SUBJECTS AND METHODS

This cross-sectional study was comprised of one hundred patients of ESRD carried out in the Department of Nephrology, Shaikh Zayed Hospital, Lahore between 1st January 2010 to 31st March 2010. All adult patients on maintenance hemodialysis were included in this study. The patients on maintenance hemodialysis <3 months duration and vomiting, diarrhea or bleeding episodes pre-hemodialysis were excluded. These patients were dialyzed on hemodialysis Fresenius 4008S and 4008H machines. All the dialysis sessions which fulfilled the inclusion and exclusion criteria over a period of three months were monitored for the occurrence of the hypotension, accumulated ultrafiltration till episode of hypotension, timing of hypotension and the rate of ultrafiltration. These dialysis sessions were

categorized in two groups (Group I and Group II). Group I included those dialysis sessions in which the patients developed hypotension during dialysis and Group II included those dialysis sessions in which patients did not develop intradialytic hypotension. Following factors were noted like interdialytic weight gain, ultrafiltration rate, dialyzer type, cardiac events, antihypertensive medication, food intake during dialysis, pyrexia. The comparison between two groups were made by using t-test and relation of net ultrafiltration rate, total time of dialysis, lowest systolic & diastolic blood pressures, and mean arterial pressure were found by using binary logistic regression analysis and odd ratios were measured along 95% confidence intervals.

RESULTS

A total 1907 hemodialysis sessions were monitored in one hundred patients over a period of three months for the occurrence of hypotension and associated risk factors. Out of one thousand nine hundred and seven dialysis sessions symptomatic hypotension occurred in 103 sessions with frequency of 5.4%. All the dialysis sessions were divided into two groups, group I in which symptomatic hypotension occurred and group II included dialysis sessions not associated with symptomatic hypotension. The pre-dialysis systolic, diastolic, mean blood pressures and pulse rate were observed higher in group I as compared to group II with the significant P-values ($P < 0.05$), while the lowest systolic, diastolic and mean blood pressures were noted lower in group I with comparison to group II. However the mean change in pulse between the two groups (group I, -2.1 ± 14.1 vs group II, -2.4 ± 11.1 ($P > 0.5$)) did not change significantly with drops of blood pressure according to table 1. Interdialytic weight gain and ultrafiltration rate were significantly higher in group I as compared to group II (2.2 ± 0.7 vs 2.1 ± 0.9 , 978 ± 636 vs 636 ± 367) while net ultrafiltration was higher in group II as compared to group I, i.e. 1519 ± 750 vs 1905 ± 890 which means that higher net ultrafiltration was achieved with lower ultrafiltration rate without any significant intradialytic hypotension in group II. The conductivity and dialysate temperature remained indistinct between two groups as shown in table 1.

The binary logistic regression analysis explained that net ultrafiltration, total time of dialysis, lowest systolic and diastolic blood pressures are the significant predictor of

symptomatic hypotension with cutoffs given in table.2 “calculated by using ROC curve at 90 % percent specificity”. The total time less than 1.225 hours indicates 5.50 time higher risk of getting hypotensive as compare to those with higher total

time of dialysis. Similarly the lowest systolic and diastolic blood pressures at cutoffs of 90 and 47 mmHg were giving 5.43 and 4.85 times high risk of hypotension respectively (Table 2).

Table 1: Comparison of dialysis sessions between symptomatic hypotension and no symptomatic hypotension

Parameters	Group I (n=103) Mean±SD	Group II (n=1804) Mean±SD	P value
Systolic blood pressure before dialysis (mmHg)	150±27	143±31	0.02
Diastolic blood pressure before dialysis (mmHg)	76±6	72±17	0.04
Mean blood pressure before dialysis (mmHg)	100±118	96±9	0.02
Pulse rate before dialysis (min)	84±13	81±14	0.05
Lowest systolic blood pressure (mmHg)	104±28	130±31	0.001
Lowest diastolic blood pressure (mmHg)	56±16	67±16	0.001
Pulse at lowest BP (min)	86±15	84±15	0.1
Lowest mean BP (mmHg)	72±19	88±19	0.001
Change in systolic BP (mmHg)	46±22	13±28	0.001
Change in diastolic BP (mmHg)	20±15	6±16	0.001
Change in mean BP (mmHg)	29±15	8±18	0.001
Change in pulse (per min)	-2.1±14.1	-2.4±11.1	0.8
Age (Years)	48±6	51±15	0.07
Weight gain (kg)	2.2±0.7	2.1±0.9	0.03
Net ultrafiltration (ml)	1519±750	1905±890	0.001
Ultrafiltration rate (ml/hour)	978±636	636±367	0.001
Conductivity (mS/cm)	13.9±0.3	13.9±0.3	0.2
Dialysate temperature (°C)	37.1±0.2	37.1±0.2	0.8

Table.2: Relation of parameters by logistic regression analysis by backward Wald method

	B	S.E.	Wald	df	Sig.	Exp (B)	OR	95 % C.I
Net Ultra filtration < 608.5 ml	-1.286	0.419	9.403	1	0.002	0.267	0.76	0.36–1.59
Total time of dialysis < 1.225 hrs	2.115	0.249	71.858	1	0.000	8.288	5.50	3.59–8.43
Lowest Systolic Blood Pressure < 90 mmHg	1.003	0.327	9.415	1	0.002	2.728	5.43	3.55–8.32
Lowest Diastolic Blood Pressure < 47 mmHg	0.884	0.317	7.757	1	0.005	2.421	4.85	3.14–7.48
Constant	-3.606	0.157	530.173	1	0.000	.027		

DISCUSSION

Intradialytic hypotension is one of the most common complication observed during hemodialysis, occurring in about 15-20% of all sessions.⁷ Intradialytic hypotension is defined as lowering of mean blood pressure up to 20mmHg or

more during hemodialysis associated with symptoms. If the patients on maintenance hemodialysis has pre hemodialysis systolic blood pressure <100 mmHg then fall in systolic blood pressure up to 10mmHg or more during hemodialysis associated with symptoms is called

Intradialytic hypotension. If systolic blood pressure is more than 100mmHg then fall in systolic blood pressure up to 30 mmHg or more with related symptoms is called Intradialytic hypotension.¹ In our study the overall frequency of intradialytic hypotension was 5.4% as compared to internationally reported of almost 7%.⁸ The largest study included 44,000 dialyses in France⁹ and found the most common symptom was hypotension in 6.8% patients. A smaller but more detailed analysis found a higher incidence with hypotension being reported in 8.4% patients.¹⁰ There is much decrease in frequency of intradialytic hypotension probably because of modern dialysis machines equipped with UF profiling module, sodium and UF profiling, use of bicarbonate dialysate and trained dialysis staff.

Intradialytic weight gain is one of the recognized factor of intradialytic hypotension. In our study, the mean weight gain during hemodialysis sessions in group I was 2.2 ± 0.7 kg and in group II was 2.1 ± 0.9 kg with significant P value of 0.03. In a study conducted by Bland et al¹¹ the mean weight gain of hypotensive patients during hemodialysis sessions was 3.8kg. In another study conducted by Takeda et al¹² the mean weight gain of hypotensive patients in hemodialysis sessions was 2.45kg with P value of 0.01, which is comparable with our study. According to the study conducted by Tang et al¹³ the interdialytic weight gain with sodium ramping haemodialysis was greater compared with constant sodium haemodialysis 3.1 ± 1.0 vs 2.7 ± 1.1 kg, $P<0.001$.

Cardiovascular events are leading cause of morbidity and mortality during hemodialysis which is closely associated with intradialytic hypotension. In our study 3.8% sessions had cardiac events during dialysis in group I. The mechanism of cardiac events occurred due to high UF rate causing rapid removal of intravascular fluid resulting in hypovolaemia, peripheral vasoconstriction and myocardial ischemia. In another study conducted by Herzog¹⁴ in hypotensive patients, 8% sessions had acute myocardial infarction during dialysis.

In our study the change in pulse rate in group I was -2.1 ± 14.1 and in group II was -2.4 ± 11.1 . Normally pulse rate should rise with the drop of blood pressure, but in group I, change in pulse rate is less probably due to autonomic dysfunction which is decreased sympathetic activity and negative inotropic effect on cardiovascular

system. As more than half of our patients were diabetic, and autonomic dysfunction is one of the complications in diabetes mellitus. As in Straver et al¹⁵ study however, no significant differences in autonomic function were shown between hypotensive and stable patients. Although both groups showed impaired autonomic function, no significant correlation between changes in haemodynamics during dialysis and autonomic function at rest could be ascertained. In conclusions, hypotension during haemodialysis is not related to a patient's autonomic function at rest. This suggests that structural neuronal differences are not responsible for the severe decrease in systemic vascular resistance in intradialytic hypotension.

CONCLUSION

It is concluded that 5.4% frequency of intradialytic hypotension which was smaller, probably due to technically improved hemodialysis centers, modern hemodialysis equipments, better dialysis techniques, use of bicarbonate dialysate and trained dialysis staff. However Interdialytic weight gain, cardiac events and ultrafiltration rate were significantly associated with intradialytic hypotension and it is likely that autonomic dysfunction also had contributory role particularly in diabetics.

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