Suez Canal University Medical Journal Vol. 26 (4), 2023
Pages 1-8

Evaluation of Risk Factors of Intradialytic Hypotension Among Egyptian End-Stage Renal Disease Patients: A Hospital-based study

Mona M. Abo Elfotouh[1*], Gamal A. Tawfik[1], Ahmed S. Salem[2], Heba M. Zaki[1]

[1]*Department of Internal Medicine, Faculty of Medicine, Suez Canal University, Egypt*
[2]*Department of Cardiology, Faculty of Medicine, Suez Canal University, Egypt*

Abstract

Background: **Haemodialysis is the most common and essential method for patients with End Stage Renal Disease (ESRD); It is a critically important treatment that prolongs the survival time and improves the quality of life, Dialysis-induced hypotension remains a major problem.** ***Aim:*** **To assess the prevalence of Intradialytic Hypotension and its risk factors.** ***Patients and Methods:*** **The study was performed as a cross-sectional study including 387 ESRD patients on HD attending Suez Canal University Hospitals, data collected included sociodemographic characteristics, general examinations, blood pressure measurement changes during hemodialysis, laboratory investigations, and Echocardiography.** ***Results:*** **Study results revealed that (82.4%) of the participants had (IDH) and the significant predictors for IDH were Inter Dialytic Weight Gain, serum urea, sodium, albumin, and hemoglobin level in laboratory investigations. In echocardiography, left ventricular septal thickness and left ventricular mass were significant predictors for IDH while ejection fraction and left ventricular fractional shortening were negative significant predictors for IDH.** ***Conclusion:*** **IDH is common. serum urea, sodium, albumin, and hemoglobin levels are significant predictors for IDH besides measurements of Echo including (LVST, LVM, EF, and LVFS).**

Keywords: End Stage Renal Disease – Intra Dialytic Hypotension

Introduction

End-stage renal disease (ESRD) is a major health problem worldwide that causes a high level of disability in different domains of the patient's life, leading to impaired quality of life (QOL)[(1)]. The main causes of ESRD in Egypt, other than diabetic nephropathy, include hypertensive kidney disease, chronic glomerulonephritis (GN), unknown etiology, chronic pyelonephritis, and obstructive uropathy[(2)]. It was found that ESRD because of unknown etiology was prevalent in 25% of patients (the highest proportion), and in 15.2% of patients in entire Egypt in 2008[(3)]. Dialysis-induced hypotension remains a major problem[(4)]. In hemodialysis patients (HD); intra-dialytic hypotension (IDH) is defined as a 20 mmHg reduction in blood pressure

[*]*Corresponding Author: monamohamedouf6@gmail.com*

(BP) in HD-associated symptoms[5]. IDH is a usual clinical feature in HD due to poor dialysis membrane biocompatibility. IDH is associated with a considerable symptom burden and an increased incidence of access failure, cardiovascular events, and mortality[6].

Patients and Methods

The study was a cross-sectional study that included 387 ESRD patients on HD attending Suez Canal University Hospitals. Data collected from each patient included: age, gender, residence, weight, body mass index, and IDWG. Vital signs included: temperature, respiratory rate, Pulse, and blood pressure changes during the session (Systolic blood pressure before the session, diastolic blood pressure before the session, lowest intradialytic systolic blood pressure and lowest intradialytic diastolic blood pressure, (IDH) is defined as 20 mmHg reduction in blood pressure (BP) in HD associated symptoms[5]. Dialysis data included ultrafiltration rate, target UFR should not exceed (10- 13 ml/Kg /hour), and the blood flow rate. Blood chemistry included: Serum creatinine, Urea, albumin, triglycerides, cholesterol, aspartate transaminase, alanine transaminase, sodium, potassium, calcium, phosphorus, Hemoglobin level, Hematocrit value, and Echocardiographic assessment consisting of left ventricular geometry including:(IVST, PWT, LVESD, LVEDD, FS, EF, LVM). Collected data were coded, entered, and analyzed using Statistical Package for the Social Sciences (SPSS) version 24.0 software for analysis.

Results

The mean age of the participants was 38.06 (±14.27) years old. The mean weight of the participants was 62.53 (± 18.22) kgs and their body mass index (BMI) was 22.98 (± 2.72) kg/ m2. The mean of IDWG was (2.97 ± 1.19) Kgs. Their mean vital signs were considered normal including temperature, respiratory rate (RR), and pulse (37 ±0.05, 17.77 ± 0.99°C, and 84.34 ± 9.5 bpm respectively). The mean systolic blood pressure (SBP) before dialysis was (121.05 ± 13.47) mmHg while the lowest SBP during the HD session was (95.94 ± 12.84) mmHg. The mean diastolic blood pressure (DBP) before dialysis was (79.87 ± 11.06), while the lowest DBP during the HD session was 63.95 mmHg (Table 1). Most participants had intradialytic hypotension (82.4%) (Figure 1).

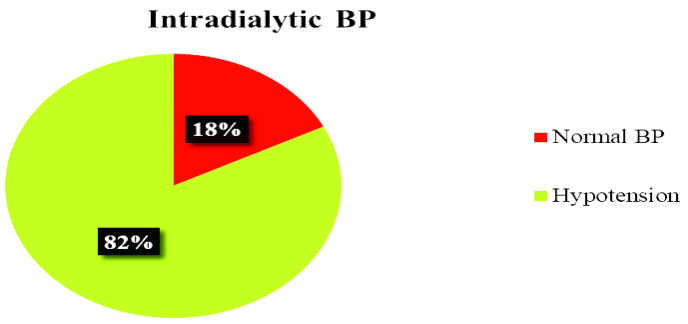

Figure 1: Intradialytic hypotension in participants

The mean of the ultrafiltration rate of the participants was (11.49 ± 4.8) ml /Kg/hour with 64.1% of them in targeted UFR (table 2). None of the participants had normal serum creatinine or urea. More than half of the participants had normal hemoglobin level (Hb) with a mean (10.31 ± 9.22) g /dl. Majority of the participants had normal liver functions and most of them had normal serum electrolytes (Na, K, Ph), but more than half of the participants had hypocalcemia. In the echocardiogram, most of the participants had normal (IVST) (90.2%) (table 3). All the participants had normal (LVFS) and nearly all of them had normal (LVM) (99.5%) but less than half (38.8%) had normal (LVPWT). None of the participants had normal (LVESD) (33.54 **±** 2.44**),** but more than half of the participants had normal EF (61.1 ± 8.65).

Table 1: Sociodemographic characteristics, general examination and blood pressure of the participants.

	Mean ± SD	Median	Minimum	Maximum
Sociodemographic characteristics				
Age (Yrs.)	38.06 ± 14.27	36	17	83
General examination				
Weight	62.53 ± 18.22	60	29	131
BMI	22.98 ± 2.72	23	17	34
IDWG	2.97 ± 1.19	3	0	6
Temperature	37.00 ± .059	37	36.8	38
RR	17.77 ± .99	18	15	20
Pulse	84.38 ± 9.5	89	60	102
Participants' blood pressure before and during dialysis				
SBP before dialysis	121.05 ± 13.47	120	100	160
DBP before dialysis	79.87 ± 11.06	80	60	110
lowest systolic BP	95.94 ± 12.84	100	80	140
Lowest diastolic BP	63.95 ± 10.00	60	50	90

The significant predictors for IDH were IDWG (table 4). In laboratory investigation, serum urea and serum sodium were significant predictors for IDH while serum cholesterol and hematocrit were significant negative predictors. In echocardiography, LVST and LVM were significant predictors for IDH while EF and LVFS were negative significant predictors for IDH.

Discussion

The current study aimed at preventing IDH and its complications through assessment of the risk factors that lead to IDH. IDH is a frequent complication of HD because of an imbalance of intravascular volume removal and the inadequacy of hemodynamic compensatory mechanisms such as vascular shunting to central circulation, increased vascular resistance in splanchnic and cutaneous beds, increasing arterial tone, and increasing cardiac output[7] Socio-demographic results in our study were quietly similar to Narouz, & El-Sayed, 2016[8] who found that the age of more than half of the studied participants ranged from 40 to less than 60 years old and more than two third of them were males. Also, Elmoghazy et al., 2016[9], found that half of the participants were less than 40 years and almost two third of them were males. In the current study, the mean weight of the participants was (62.53 ± 18.22) kg, while most of them had normal BMI. The mean of IDWG was (2.97

± 1.19) Kg and the mean of the ultrafiltration rate of the participants was (11.49 ± 4.8) ml/Kg/hour with 64.1% of them being in targeted UFR. This is close to (Halle et al., 2020)[10] who found that the mean weight of the participants was (69.68 ±12.99) Kg, their IDWG was (3.14± 1.33) Kg, and the mean UFR of the participants was (11.26 ± 3.91) ml/Kg/hour.

Table 2: Participants' laboratory results

Investigation	Normal %	Mean ±SD	Median	Min	Max
Ultrafiltration rate	64.1	11.49 ± 4.8	11	0	23
S. creatinine	0	10.15±1.42	10	6	14
S. urea	0	119.73 ± 31.94	122	65	198
Hb level	52.7	10.31 ± 9.22	10	7	16
HTC level	10.3	30.55 ± 4.81	32	21	45
S. albumin	72.1	3.87 ± 0.68	4	2	5
S. triglycerides	88.9	148.75 ± 53.81	137	58	443
S. cholesterol	83.7	169.29 ± 44.43	167	78	443
S. AST	98.4	13.84 ± 7.8	12	2	57
S. ALT	99.3	9.9 ± 6.42	8	2	57
S. sodium	92.2	139.17 ± 9.73	138	135	145
S. potassium	84	4.62 ± 0.75	4	3	7
S. phosphorus	89.1	4.13 ± 1.02	4	1	8
S calcium	47	8.49 ± 0.68	8	3	10

Table 3: Participants' echocardiography results

Echo	Normal %	Mean ± SD	Median	Minimum	Maximum
IVST	90.2	9.13 ± 1.32	10	6	12
LVPWT	38.8	10.86 ± 1.77	11	7	14
LVESD	0	33.54 ± 2.44	34	23	40
LVEDD	45	43.47 ± 9.22	44	30	51
LVM	99.5	90.5 ± 6.51	90	6	122
LVFS	100	32.84 ± 3.64	32	25	40
EF	61	61.1 ± 8.65	63	15	71

Also, (Kora et al., 2018)[11] found that the mean BMI was (28.8±8.95) in patients with IDH, but was (27.6±6.50) in patients with no IDH, the mean of IDWG in patients with IDH was (2.6±1.19), while in patients with no IDH was (2.2±0.98). In addition, Ozen & Cepken, 2020[12] found that most of the participants had normal BMI. In our study, nearly all the participants had normal vital signs including (temperature, RR, and pulse, also all of them had normal chest and abdominal examination, and more than two-thirds had normal cardiac examinations. The mean SBP before dialysis was (121.05 ± 13.47) mmHg while the lowest SBP during the hemodialysis session was (95.94 ± 12.84) mmHg. The mean DBP before dialysis was (79.87 ± 11.06), while the lowest DBP during the HD session was (63.95 ± 10.00) mmHg. This is close to Al-Etreby et al., 2018[13] who found that in patients with IDH, the mean diastolic BP was (80.0±1.62) mmHg, the mean systolic BP was (132.0±1.86) mmHg, the lowest systolic BP was (78.0±2.47) mmHg, while the lowest diastolic BP was (47.0±1.93) mmHg. In patients without IDH, it was found that the mean diastolic

BP was (83.0±1.63) mmHg, the mean systolic BP was (132.0±1.86) mmHg, the lowest systolic BP was (119.5±1.23) mmHg and the lowest diastolic BP was (77.0±1.05) mmHg in patients with no IDH. In our study, most of the participants had IDH (82.4%), but Okoye et al., 2017[14] found that 45.7% of all patients studied experienced a drop in SBP >20mmHg. Also, Ozen & Cepken. 2020[12] found that IDH developed in 51.6% of the patients with a prevalence of 17.6%, and Halle et al., 2020[10] found that the prevalence of IDH was 11.6%, this could be due to the large sample size in the current study compared to their sample size.

Table 4: Binary logistic regression analysis for predictors of IDH

	B	S.E.	Wald	Sig.	Exp (B)
Sociodemographic					
Age	-.041	.011	13.410	.000	.960
General examination					
IDWG	0.256	0.120	4.568	0.03*	1.292
Laboratory investigation					
S. urea	.033	.008	16.396	.000*	1.034
Hemoglobin level	-.454	.092	24.379	.000*	.635
S. albumin	-.025	.008	9.317	.002*	.976
S. sodium	.183	.066	7.666	.006*	1.201
Echocardiography					
Intra ventricular septal thickness	.402	.204	3.904	.048*	1.495
Lt ventricular mass	.072	.023	9.357	.002*	1.074
Lt ventricular fractional shortening	-.143	.064	4.933	.026*	.867
Ejection fraction	-.075	.033	5.326	.021*	.928
Constant	7.330	4.582	2.559	.110	1525.325

Mean scores of independent variables were used in this analysis
Omnibus Tests of Model Coefficients: Chi-square was 5.88 & statistically significant at p <0.001)
Model Summary: -2 Log likelihood was 353.194, Cox & Snell R Square was 0.015 & Nagelkerke R Square was 0.025,
**Statistically significant at p <0.05*

In our study, none of the participants had normal serum creatinine or urea, half of the participants had normal hemoglobin level, more than two-thirds had abnormal hematocrit and level, more than two-thirds had normal albumin, most of the participants had normal electrolytes (K, Na, Ph) and nearly half of them had normal calcium level, most of them had normal liver enzymes and normal cholesterol and triglycerides level. Al-Etreby, et al., 2018[13] found that none of the participants had normal serum creatinine and urea, most of the participants (with and without IDH) had normal liver enzymes, and nearly half of the participants had normal albumin levels with (3.55±0.15) mean in patients with IDH and (4.03±0.088) mean in patients with no IDH. In addition, (Mahmoud, et al., 2017)[15] found that most participants had normal serum triglycerides, cholesterol, Na, and K, and found the same results regarding hemoglobin and hematocrit levels. Our findings were close to those of Ozen, & Cepken, 2020)[12] who found that the majority had normal ph levels, and most of them (with or without IDH) had

normal calcium levels. In our study, echocardiography showed that most of the participants had normal (IVST), all the participants had normal left ventricular fractional shortening (LVFS), and nearly all of them had normal left ventricular mass (LVM), but less than half had normal (LVPWT) and (LVEDD). None of the participants had normal LVESD or EF and the mean of left ventricular end diastolic diameter was (43.47±9.22). Al-Etreby, et al., 2018[13] found that the mean of left ventricular geometry measurements is quietly similar to our findings. The current study showed that age was a significant predictor for IDH. This was in agreement with Halle, et al., 2020[10]. An alteration of vascular response to a decrease in plasma volume related to arterial stiffness or vascular calcification might be an explanation of the previous finding. Also, IDWG was a significant predictor for IDH, and this was similar to Inrig, et al., 2007[16] who found that an increased percentage of IDWG is associated strongly with greater predialysis BP and a greater decrease in BP with hemodialysis. This could be due to the need to increase the ultrafiltration rate to reach the target dry weight within the prescribed duration of the dialysis session. In the current study, serum urea was a significant predictor for IDH, but this was in contrary to (Al-Etreby E. A., 2018)[13]. Our finding could be explained by that the higher urea level is associated with a greater risk of IDH as rapid solute removal may generate temporary osmolar gradients and predispose to IDH (Mc Causland F, 2013)[17]. Hemoglobin level, serum Na and albumin were significant predictors IDH. This was in agreement with (Narouz & El-Sayed, 2016)[8] and (Chao, 2015)[18] who illustrated that the accompanied poorer malnutrition statuses may have devastating influences and worsening of anemia would lead to pressure overload and contribute to subsequent left ventricular hypertrophy progress. Also, Al-Etreby 2018[13] and (Kora 2018[11] found the same findings regarding albumin. This is due to malnutrition, which is a potential cause of reduced albumin synthesis and decreased albumin levels as serum albumin is the strongest predictor of death in dialysis patients, and even in patients at baseline who are starting dialysis therapy and hypoalbuminemia is a major risk factor of hypotension during HD in patients on HD. One possibility of hypotension during HD is hypovolemia in blood vessels because of low osmolality. Echocardiography findings (IVST, LVM, FS, EF) were significant predictors for IDH. This could be due to the presence of LVH in dialysis patients, which correlates significantly with subsequent CV events and a dose-response relationship. Zoccali C et al., 2004[19] identified that dialysis patients with LVH had 2-3-fold higher mortality than those without. Specifically, every 1 g/m2 /month increase in LV mass index could lead to a 62% increase in the risk of CV events, which in turn leads to IDH (Bonato et al., 2013)[20].

Conclusion

IDH is common and is clearly associated with significant adverse clinical outcomes. The preponderance of available evidence suggests that strategies to limit the frequency and magnitude of IDH are worthwhile. Although general guidelines for the prevention of IDH are available, for treating physicians, a thorough understanding of the underlying pathophysiology may guide the institution of targeted treatment plans for individual patients. We review some potential strategies and highlight their pathophysiologic basis. It must be noted that many of these suggestions lack robust prospective evidence. There-

fore, the prevention and treatment of IDH is a ripe area for clinical investigation and lends itself to the execution of well-designed clinical trials that will definitively answer how we should best treat and prevent excessive BP decline during HD.

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