How to Cite:
Mohamed, E. A., Abdelkader, A. F., & Mostafa, M. H. (2022). Effect of dry body weight on intra-dialytic hypertension in patients on regular hemodialysis. *International Journal of Health Sciences*, *6*(S1), 4347–4356. https://doi.org/10.53730/ijhs.v6nS1.5852

Effect of dry body weight on intra-dialytic hypertension in patients on regular hemodialysis

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***Abstract*---**Background: In chronic kidney disease, hypertension is influenced by both blood pressure (BP) and the progression of renal disease. In end stage renal disease (ESRD) on maintenance hemodialysis, hypertension is a main feature and more than 85% of new patients with ESRD present with hypertension. The aim of this study: was to assess the relationship between dry body weight and intra-dialytic hypertension in patients on regular hemodialysis. Patients and Methods: This was an observational cohort study with retrospective data analysis including (age and sex matched) patients with end stage renal disease. The study will be conducted in Nephrology Unit national institute of nephrology &urology. Results: there was statistically significant difference found between the two studied groups regarding LL edema, Sacral edema, Pl. effusion, Increased cardio/thoracic ratio, and Increased IVC diameter with (p-value= 0.016, 0.027, 0.019, 0.003 and 0.008) respectively. Conclusion: IDH is preventable if we control modifiable risk factors such as, reducing interdialytic weight gain, correction of serum albumin and urea reduction ratio. This will reduce cardiovascular morbidity and mortality in CKD patients on maintenance hemodialysis.

***Keywords*---**Hemodialysis, hypertension, chronic kidney diseases, albumin, relationship, intra-dialytic, cardiovascular.

International Journal of Health Sciences ISSN 2550-6978 E-ISSN 2550-696X © 2022.
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Manuscript submitted: 27 Feb 2022, Manuscript revised: 18 March 2022, Accepted for publication: 09 April 2022

Introduction

ESRD is defined as Kidney damage for ≥3 months by structural or functional abnormalities of the kidney, with GFR<15 ml/min (1). The current prevalence and projected growth in the ESRD population worldwide reflects the increasing burden of CKD and the conditions that cause CKD. The Global Burden of Disease study ranked CKD as the 19th leading cause of global years of life lost in 2013, an increase from 36th in 1990 (2). An accepted consequence of hemodialysis is the tendency for blood pressure (BP) to change frequently both during and between hemodialysis treatments. Large variability in BP measurements during hemodialysis is a risk factor for increased mortality in end-stage kidney disease patients. (3).

In recent years, numerous studies shave explored the possible mechanisms responsible for intradialytic hypertension yielding potential interventions to consider in this high-risk group of patients (4). The concept of dry body weight has been established at dialysis work up, the standard HD prescription targets fluid removal to a clinically derived estimate of dry weight (5). Dry body weight definition include that patient weight without volume overload (edema, hypertension.etc..) &also without hypovolemia (6). Regardless of the obvious technological progress in the development of dialysis procedures, the adequacy of hemodialysis (HD) and nourishment are important determinants of the quality of life and have a direct impact on morbidity and mortality of patients who are being treated with chronic HD (5).

Patients and Methods

This was an observational cohort study with retrospective data analysis including (age and sex matched) patients with end stage renal disease. The study will be conducted in Nephrology Unit national institute of nephrology &urology.
Inclusion criteria: Patients aging 16 years or more, duration of dialysis > 3 months, in stable condition and use of arterio-venous fistula in the patients.
Exclusion criteria: Age <16 years, serum hemoglobin< 10.5gm/dl, patients who known to be hypertensive, patients with history of chronic hypertension, patients who have malignant diseases, patients with hepatic impairment or infectious diseases in nearly a month and patients with congestive heart failure.

At enrollment, all patients will be subjected to the following

Full history taking from patients including sex, age, weight, dialysis vintage, primary kidney disease, EPO use, and iron treatments. Complete clinical examination focusing on volume status, Echocardiography for all patients with estimation of IVC diameter. Basal laboratory work-up:(serum creatinine, Blood Urea, BUN pre, BUN post, CRP, iron profile, S. Albumin, CBC, Ca, Phosphorus, I PTH). All patients will undergo hemodialysis 3 times per week and 4 h per dialysis. All patients will use heparin anticoagulants and standard dialysis fluids; the dialysate flow was 500 mL/min, and the blood flow rate was 200–350 mL/min, All patients have URR>65%.

All patients were divided into 2 groups: group A who are developing intradialytic hypertension and group B who don't develop intradialytic hyper tension. Dry body weight (by clinical examination, CXR), will be conducted for both groups aim to investigate role of both variant in developing & sustaining intradialytic hypertension.

Ethics and patient consent: All procedures will follow Al-Azhar University ethical committee regulations, and patient written consent will be taken from patients.
Statistical Analysis: Data management and statistical analysis were done using SPSS version 25. (IBM, Armonk, New York, United States). Quantitative data were assessed for normality using Kolmogorov–Smirnov test, the Shapiro-Wilk test, and direct data visualization methods. According to normality, numerical data were summarized as means and standard deviations or medians and ranges. Categorical data were summarized as numbers and percentages. Quantitative data were compared between two groups using independent t-test or Mann-Whitney U test for normally and non-normally distributed numerical variables, respectively. For more than two groups, quantitative data were compared using one way ANOVA or Kruskal Wallis test for normally and non-normally distributed numerical variables, respectively. Categorical data were compared using the Chi-square test. Correlation analyses were done using Spearman's correlation. All statistical tests were two-sided. P values less than 0.05 were considered significant.

Results

Table 1
Descriptive data regarding: Age, sex, Diabetes, Cause of ESKD and Duration on haemodialysis

		No.= 70
Age	Mean±SD	46.66 ± 12.00
	Range	24 – 66
Sex	Female	36 (51.4%)
	Male	34 (48.6%)
Diabetes	No	49 (70.0%)
	Yes	21 (30.0%)
Cause of ESKD	Unknown	51 (72.9%)
	APKD	2 (2.9%)
	Interstitial Nephritis	4 (5.7%)
	Kidney stones	6 (8.6%)
	UT obstruction	2 (2.9%)
	Glomerulopathy	5 (7.1%)
Duration on haemodialysis	Median (IQR)	51 (30 – 86)
	Range	6 – 300

The Previous table shows that there was no statistically significant difference found between the two studied groups regarding Age, sex, DM, cause of ESKD, and duration on haemodialysis with (p-value>0.05). Figure (1)

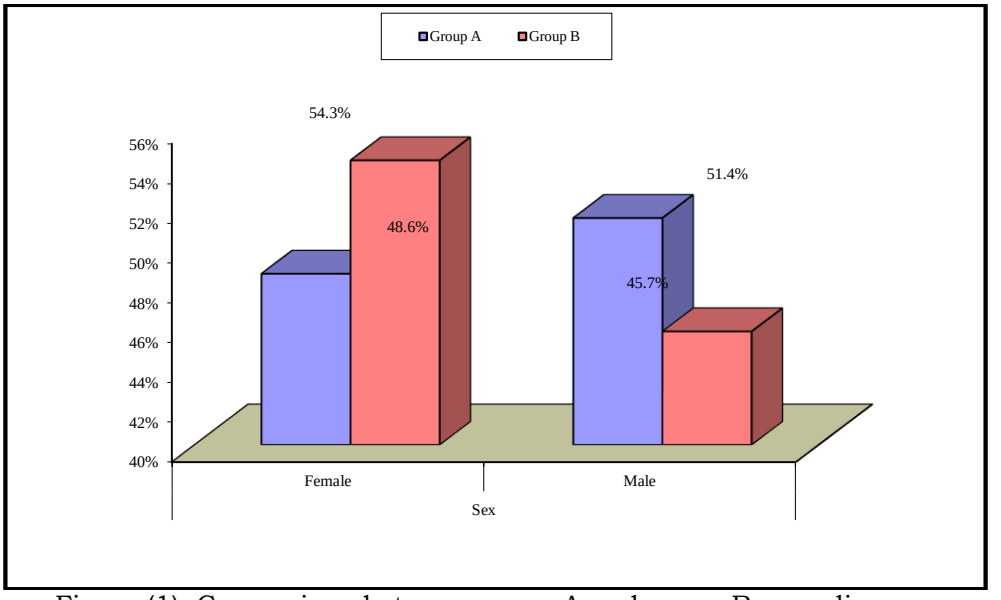

Figure (1): Comparison between group A and group B regarding sex

Table 2
Comparison between group A and group B regarding: LL edema, sacral edema, Pl. effusion, increased cardio/thoracic ratio and Increased IVC diameter

		Group A No.= 35	Group B No.= 35	Test value	P-value	Sig.
LL edema	No Yes	10 (28.6%) 25 (71.4%)	20 (57.1%) 15 (42.9%)	5.833 *	0.016	S
Sacral edema	No Yes	17 (48.6%) 18 (51.4%)	26 (74.3%) 9 (25.7%)	4.884 *	0.027	S
Pl. effusion	No Yes	20 (57.1%) 15 (42.9%)	29 (82.9%) 6 (17.1%)	5.510 *	0.019	S
Increased cardio/thoracic ratio	No Yes	15 (42.9%) 20 (57.1%)	27 (77.1%) 8 (22.9%)	8.571 *	0.003	HS
Increased IVC diameter	No Yes	11 (31.4%) 24 (68.6%)	22 (62.9%) 13 (37.1%)	6.937 *	0.008	HS

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant
*: Chi-square test

The Previous table shows that there was statistically significant difference found between the two studied groups regarding LL edema, Sacral edema, Pl. effusion, Increased cardio/thoracic ratio, and Increased IVC diameter with (p-value= 0.016, 0.027, 0.019, 0.003 and 0.008) respectively.

Table 3
Comparison between group A and group B regarding: Urea Reduction Ratio, S. albumin, S. calcium, S.phosphorus, IPTH, Use of ESA and Iron therapy.

		Group A	Group B	Test value	P-value	Sig.
		No.= 35	No.= 35			
Urea Reduction Ratio	Mean±SD	65.74 ± 0.64	66.26 ± 1.07	-2.472•	0.016	S
	Range	65.1 – 67.2	65.1 – 68.5			
S. albumin	Mean±SD	3.68 ± 0.27	3.88 ± 0.24	-3.267•	0.002	HS
	Range	3.1 – 4.2	3.3 – 4.3			
S. calcium	Mean±SD	8.35 ± 0.51	8.34 ± 0.51	0.047•	0.963	NS
	Range	7.7 – 9.1	7.7 – 9.1			
S. phosphorus	Mean±SD	5.89 ± 1.26	5.72 ± 1.17	0.559•	0.578	NS
	Range	3.9 – 8.1	3.9 – 8			
IPTH	Mean±SD	490.89 ± 206.79	489.97 ± 197.70	0.019•	0.985	NS
	Range	149 – 851	149 – 851			
Use of ESA	No	10 (28.6%)	13 (37.1%)	0.583*	0.445	NS
	Yes	25 (71.4%)	22 (62.9%)			
Iron therapy	No	24 (68.6%)	26 (74.3%)	0.280*	0.597	NS
	Yes	11 (31.4%)	9 (25.7%)			

P-value > 0.05: Non significant; P-value < 0.05: Significant; P-value < 0.01: Highly significant
*: Chi-square test; •: Independent t-test

The Previous table shows that there was statistically significant difference found between the two studied groups regarding Urea Reduction Ratio, S. albumin, with (p-value= 0.016 and 0.002) respectively, while there was no statistically significant difference found between the two studied groups regarding S. calcium, S.phosphorus, IPTH, Use of ESA and Iron therapy , with (p-value>0.05). Table (3)

Discussion

In chronic kidney disease, hypertension is influenced by both blood pressure (BP) and the progression of renal disease. In end stage renal disease (ESRD) on maintenance hemodialysis, hypertension is a main feature and more than 85% of new patients with ESRD present with hypertension (7).

From the viewpoint of fluid overload, inappropriate ultrafiltration may be the most important factor contributing toward arterial blood pressure (8). In the DRIP study, Agarwal et al., (9) noted that additional volume reduction would result in an improvement in blood pressure (BP) among hypertensive patients after hemodialysis (HD), despite these patients having well-controlled dry weights. Inappropriate ultrafiltration may also result in excessive activation of the renin-

angiotensin–aldosterone system (RAAS) and dysfunction of endothelial cells, which may elicit a sudden increase in intradialytic blood pressure. At present, reports on the effects of IDH on dry-weight reduction, which affects both activation of the RAAS and dysfunction of endothelial cells, are not consistent.

The main aim of this study was to assess the relationship between dry body weight and intra-dialytic hypertension in patients on regular hemodialysis. In the present study comparison between IDH and non-IDH groups regarding: age, sex, diabetes, cause of ESKD and duration on haemodialysis showed that there was no statistically significant difference found between the two studied groups regarding age, sex, DM, cause of ESKD, and duration on haemodialysis with (p-value>0.05).

In agreement with the current study Zhang et al., (10) aimed to investigate whether additional volume reduction by ultrafiltration can improve blood pressure in patients with intradialytic hypertension (IDH). The study enrolled 11 IDH patients with normal predialytic blood pressure (BP) (group A), 11 IDH patients with high predialytic BP (group B), and 18 patients without IDH as control. They found that there was no statistically significant difference found between the studied groups regarding age, sex, diabetic nephropathy, and duration on haemodialysis with (p-value>0.05).

Also, the study by Nilrohit et al., (11) aimed to evaluate the incidence of IDH, to study factors responsible for IDH and effect of IDH on mortality in patients attending regular dialysis sessions at a single dialysis unit. The study included 142 patients; 49(34.51%) patients were found to have IDH. The study reported that there was no statistically significant difference found between the IDH and non-IDH groups regarding age, sex and Diabetes mellitus (p-value>0.05).

Also, Merlyn & Vatvani, (12) aimed to identify the prevalence of IDH and compare the clinical characteristics of patients with and without IDH. A total of 114 patients was included in this study. IDH was present in 47 (34.1%) patients. The study reported that there was no statistically significant difference found between the IDH and non-IDH groups regarding age, sex and duration on HD (p-value>0.05).

As well, the study by Van Buren et al., (13) aimed to assess the prevalence of persistent intradialytic hypertension in a hemodialysis population with extended follow-up. The study reported that there was no statistically significant difference found between the IDH and non-IDH groups regarding age, sex, diabetes mellitus and duration on HD (p-value>0.05).

Also, in contrast to our results, Diakité et al., (14) aimed to determine the prevalence of intradialytic hypertension and the factors associated with it. The study reported that there was statistically significant difference found between the IDH and non-IDH groups regarding age range and duration on HD. These disagreements may be due to the differences in sample size and cases characteristics.

While, Patrice et al., (15) reported that Male gender, Age ≥ 50 years, Duration on dialysis ≥ 30 months were all associated factors to intradialytic hypertension. In the present study we found that there was statistically significant difference found between the two studied groups regarding LL edema, Sacral edema, Pl. effusion, Increased cardio/thoracic ratio, and increased IVC diameter with (p-value= 0.016, 0.027, 0.019, 0.003 and 0.008) respectively.

In agreement with our results Nilrohit et al., (11) reported that a significant relationship was found between incidence of IDH and presence of oedema, with greater incidence of IDH in oedematous patients secondary to volume overload. Similar findings were shown in studies by Inrig et al., (16) and Agarwal & Light (17).

Our results were supported by Zhang et al., (10) who reported that the change in dry weight from the first to the 13th session (kg) was highly significantly associated with intradialytic Hypertension. Also, Diakité et al., (14) reported that the Dry weight ≥ 70 Kg was significantly correlated with the incidence of intradialytic Hypertension (p=0.030).

Similarly, Patrice et al., (15) reported that Dry weight ≥ 67 kg was significantly correlated with the incidence of intradialytic Hypertension (p<0.001). However, the study by Merlyn & Vatvani, (12) reported that there was statistically nonsignificant difference found between the IDH and non-IDH groups regarding Dry body weight.

Similarly, Van Buren et al., (13) reported that estimated dry weight and fractional changes in interdialytic weight gain and ultrafiltration volume were similar between IDH and non-IDH groups. Indeed, sodium and fluid accumulation during the interdialytic interval results in both brachial and aortic BP increase, which are proportionate to weight gain, a phenomenon superimposed on circadian BP variation (18). Thus, the role of ultrafiltration during dialysis to reduce water and sodium overload to achieve dry weight is fundamental for hypertension control (19).

In the present study the comparison of Urea Reduction Ratio, S. albumin, S. calcium, S. phosphorus, IPTH, Use of ESA and Iron therapy between the studied groups showed that that there was statistically significant difference found between the two studied groups regarding Urea Reduction Ratio, S. albumin, with (p-value= 0.016 and 0.002) respectively, while there was no statistically significant difference found between the two studied groups regarding S. calcium, S.phosphorus, IPTH, Use of ESA and Iron therapy , with (p-value>0.05).

However, the study by Zhang et al., (10) reported that there was no statistically significant difference found between the studied groups regarding Kt/V urea, albumin, calcium, sodium, phosphate and parathyroid hormone. While there was statistically significant difference found between the studied groups regarding hemoglobin.

In agreement with our results Nilrohit et al., (11) reported that there was statistically significant difference found between the IDH and non-IDH groups

regarding Serum albumin. Our results were supported by the study of Okpa et al., (20) who reported that intradialytic blood pressure change was non significantly correlated with sodium level.

Also, the study by Merlyn & Vatvani, (12) reported that there was statistically significant difference found between the IDH and non-IDH groups regarding Hemoglobin, Hematocrit, Ureum, Potassium, Calcium, Uric acid, Ferritin, Erythrocyte and Iron. Also, in agreement with our results Diakité et al., (14) reported that the hypoalbuminemia was significantly correlated with the incidence of intradialytic Hypertension (p=0.036), and identified hypoalbuminemia as a risk factor of dialytic high blood pressure.

As well, the study by Egbi & Daz, (21) in logistic regression reported that serum urea and Serum creatinine were non significantly associated with intra-dialytic hypertension (P >0.05). Furthermore, Uduagbamen & Kadiri, (22) reported that pre-dialysis serum albumin was directly related to the risk of developing IDHT as against its inverse relationship with IDH, P=0.002. They also found that low serum sodium was associated with high risk of IDH as higher sodium levels were associated with increased risk of IDHT, sodium efflux from the cell coupled with potassium entry causes obligatory passive calcium influx followed by depolarization, increased inotropy, chronotropy, and blood pressure. They also reported that pre-dialysis Urea was significantly correlated with IDH.

Conclusion

IDH is preventable if we control modifiable risk factors such as, reducing interdialytic weight gain, correction of serum albumin and urea reduction ratio. This will reduce cardiovascular morbidity and mortality in CKD patients on maintenance hemodialysis.

References

1. Kidney Disease: Improving Global Outcomes (KDIGO). Clinical practice guidelines. (Accessed February 14, 2013) Kaptein MJ, Kaptein EM.
2. GBD 2013: Global Burden of Diseases, Injuries, and Risk Factors prevention and control of noncommunicable diseases 2013-2020. Geneva, Switzerland: World Health Organization; 2013.
3. Xue H,Flythe JE, Lynch KE, Curhan GC, Brunelli SM: Association of mortality risk with various definitions of intradialytic hypotension. J Am Soc Nephrol 2015;
4. Park J, Rhee CM, Sim JJ, et al: A comparative effectiveness research study of the change in blood pressure during hemodialysis treatment and survival. Kidney Int 2017.
5. Charra B, Laurent G, Chazot C, Calemard E, Terrat JC, Vanel T, Jean G, Ruffet M: Clinical assessment of dry weight. Nephrol Dial Transplant 11[Suppl 2]: 16–19, 1996 .
6. Dinesh K, Kunaparaju S, Cape K, Flythe JE, Feldman HI, Brunelli SM: A model of systolic blood pressure during the course of dialysis and clinical factors associated with various blood pressure behaviors. Am J Kidney Dis 2015.

7. Bakris, G. L., Burkart, J. M., Weinhandl, E. D., McCullough, P. A., & Kraus, M. A. (2016). Intensive hemodialysis, blood pressure, and antihypertensive medication use. American Journal of Kidney Diseases, 68(5), S15-S23.
8. Chazot, C., & Jean, G. (2010). Intradialytic hypertension: it is time to act. Nephron Clinical Practice, 115(3), c182-c188.
9. Agarwal, R., Alborzi, P., Satyan, S., & Light, R. P. (2009). Dry-weight reduction in hypertensive hemodialysis patients (DRIP) A randomized, controlled trial. Hypertension, 53(3), 500-507.
10. Zhang, Y., Zhang, X., Li, J., Liu, X., Cui, C., Yuan, A., ... & Yu, C. (2019). Dry-weight reduction improves intradialytic hypertension only in patients with high predialytic blood pressure. Blood Pressure Monitoring, 24(4), 185-190.
11. Nilrohit, P., Nilesh, B., Ajeya, U., Kshitija, G., & Sudhir, K. (2017). Study of intradialytic hypertension: A single centre analysis. Nephrol Open J.
12. Merlyn, M., & Vatvani, A. D. (2020). Intradialytic Hypertension in End Stage Renal Disease patient: Prevalence and clinical characteristic. Medicinus, 7(3), 84-89.
13. Van Buren, P. N., Kim, C., Toto, R. D., & Inrig, J. K. (2012). The prevalence of persistent intradialytic hypertension in a hemodialysis population with extended follow-up. The International journal of artificial organs, 35(12), 1031-1038.
14. Diakité, F., Baldé, M. S., Traoré, M., Chérif, I., Diaby, M. T., & Kaba, M. L. (2020). Intradialytic Hypertension and Associated Factors in Chronic Hemodialysis at the National Hemodidiadiasis Center in Donka, Guinea. Open Journal of Nephrology, 10(01), 34.
15. Patrice, H. M., Loïc, B. E., Hermine, F., Pierre, N. M. O. J., Denis, T., François, K. F., & Gloria, A. E. (2018). Intradialytic hypertension and associated factors among chronic haemodialysed patients in sub-Saharan Africa: an example from cameroon. Open Journal of Nephrology, 8(04), 105.
16. Inrig, J. K., Patel, U. D., Toto, R. D., & Szczech, L. A. (2009). Association of blood pressure increases during hemodialysis with 2-year mortality in incident hemodialysis patients: a secondary analysis of the Dialysis Morbidity and Mortality Wave 2 Study. American Journal of Kidney Diseases, 54(5), 881-890.
17. Agarwal, R., & Light, R. P. (2010). Intradialytic hypertension is a marker of volume excess. Nephrology Dialysis Transplantation, 25(10), 3355-3361.
18. Karpetas, A., Sarafidis, P. A., Georgianos, P. I., Protogerou, A., Vakianis, P., Koutroumpas, G., ... & Lasaridis, A. N. (2015). Ambulatory recording of wave reflections and arterial stiffness during intra-and interdialytic periods in patients treated with dialysis. Clinical Journal of the American Society of Nephrology, 10(4), 630-638.
19. Sarafidis, P. A., Persu, A., Agarwal, R., Burnier, M., De Leeuw, P., Ferro, C. J., ... & Zoccali, C. (2017). Hypertension in dialysis patients: a consensus document by the European Renal and Cardiovascular Medicine (EURECA-m) working group of the European Renal Association–European Dialysis and Transplant Association (ERA-EDTA) and the Hypertension and the Kidney working group of the European Society of Hypertension (ESH). Nephrology Dialysis Transplantation, 32(4), 620-640.

20. Okpa, H. O., Effa, E. E., Oparah, S. K., Chikezie, J. A., Bisong, E. M., Mbu, P. N., & Otokpa, D. E. (2019). Intradialysis blood pressure changes among chronic kidney disease patients on maintenance haemodialysis in a tertiary hospital south-south Nigeria: a 2 year retrospective study. The Pan African Medical Journal, 33.
21. Egbi, O. G., & Daz, A. S. (2019). Blood Pressure Changes among Patients Undergoing Hemodialysis in Yenagoa, Nigeria. Nigerian Medical Journal: Journal of the Nigeria Medical Association, 60(6), 290.
22. Uduagbamen, P. K., & Kadiri, S. (2021). Intradialysis hypotension and hypertension in patients with end stage kidney disease in Nigeria: risk factors and clinical correlates. Ghana Medical Journal, 55(1), 34-42.