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Original Research Article

Prospective observational study of blood pressure variation and malnutrition using body composition monitor in hemodialysis patient in tertiary care hospital

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ABSTRACT

Background: Blood pressure (BP) variations and malnutrition are critical concerns in hemodialysis patients, significantly impacting morbidity, mortality and quality of life. Accurate assessments using tools such as the Body Composition Monitor (BCM) can guide effective interventions to improve outcomes. This study aimed to evaluate BP variations and malnutrition in hemodialysis patients using BCM, analysed dialysis-related complications and assess the impact of targeted interventions on patient outcomes.
Methods: A prospective observational study was conducted on 125 hemodialysis patients at a tertiary care hospital. Data on BP variations, nutritional status and complications were collected using BCM and the Medical Outcomes Study Short Form-36 (MOS SF-36) questionnaire. Pharmacological and non-pharmacological interventions were tailored based on findings. Follow-up data assessed changes in body composition and complication rates.
Results: Hypertension was the most prevalent BP variation (63.2%), followed by hypotension (26.4%) and intradialytic hypotension (IDH) (8%). Malnutrition affected 24.8% of patients, primarily older males. During follow-up, patients with normal indices of lean tissue (28 to 54), fat tissue (28 to 54) and BMI (28 to 54) increased significantly. The most common dialysis-related complications were cramps (43.2%), itching (28%) and edema (20.8%). Targeted interventions, including nutritional supplementation and BCM-guided fluid management, reduced complications and improved nutritional and hemodynamic parameters.
Conclusions: The study highlights the high prevalence of hypertension and malnutrition among hemodialysis patients and underscores the utility of BCM in optimizing patient management. BCM-guided interventions were associated with improved nutritional status and reduced complications, emphasizing the need for individualized care strategies. Further multicenter studies are recommended to validate these findings and expand their applicability.

Keywords: Body composition monitor, Blood pressure variation, Complications, Dialysis management, Hemodialysis, Malnutrition

INTRODUCTION

The body composition monitor (BCM) is a critical tool for managing patients undergoing hemodialysis (HD), providing accurate assessments of fluid status, fat mass and muscle mass using bioimpedance analysis (BIA).[1] Hemodialysis is essential for removing excess fluids, salts and waste in patients with renal failure, but traditional methods of determining dry weight defined as the lowest safe weight without excess fluid are often time-consuming and imprecise, leading to complications such as hypervolemia or hypovolemia.[2] By quantifying

extracellular water (ECW) and total body water (TBW) ratios, BCM enhances fluid management and supports personalized care for improved HD outcomes.[3] Malnutrition, a prevalent issue among HD patients, is often exacerbated by protein-energy wasting (PEW) caused by chronic inflammation, inadequate food intake and nutrient losses during dialysis.[4]

PEW significantly increases morbidity, mortality and reduces quality of life (QoL).[5] BCM facilitates the assessment of nutritional status, including the lean tissue index (LTI), a key predictor of survival.[6] Additionally, complications such as intradialytic hypotension and cramps, linked to ultrafiltration and electrolyte imbalances, further diminish QoL.[7] Regular BCM monitoring enables precise fluid and nutritional management, optimizing patient outcomes and improving QoL.[8]

Primary objective

To observe blood pressure (BP) variation and malnutrition using the Body Composition Monitor (BCM) in hemodialysis patients in a tertiary care hospital.

Secondary objectives

To identify complications during hemodialysis, such as cramps, itching and edema. To analyze the dry weight of patients undergoing hemodialysis. To study the management of BP variation and malnutrition in dialysis patients

METHODS

Study type

This was a prospective observational study.

Study place

The study was conducted at a tertiary care hospital in Bengaluru, Karnataka, India.

Study duration

The study duration was from January 2023 to October 2023.

The study aimed to analyze blood pressure (BP) variations and malnutrition in hemodialysis patients using a body composition monitor (BCM).

Study population

The study included 125 patients undergoing hemodialysis in the dialysis unit of a tertiary care hospital. The population comprised 73 males (58.4%) and 52 females (41.6%).

Data collection

Data were collected using the Body Composition Monitor (BCM) for hydration and nutritional assessment, pre- and post-dialysis BP measurements and the Medical Outcomes Study Short Form-36 (MOS SF-36) questionnaire for assessing the quality of life.

Inclusion criteria

Adult patients of both genders with chronic kidney disease (CKD) undergoing hemodialysis.

Exclusion criteria

Patients with pacemakers, defibrillators, metallic sutures, stent implantation, major limb amputation or life-threatening conditions.

Data Collection and study procedure

Patients undergoing hemodialysis were recruited for the study after obtaining informed consent, with their demographic details and baseline characteristics documented. BCM measurements were performed before and after dialysis by attaching electrodes to the wrist and ankle on the side without an arteriovenous fistula and patient-specific data such as BP, weight and height were entered into the device. Parameters including total body water, intracellular and extracellular fluid, overhydration, dry weight, lean tissue index and fat tissue index were recorded. Observed complications, such as BP variations, malnutrition, cramps and itching, were managed under a nephrologist's supervision using pharmacological and non-pharmacological methods. Additionally, face-to-face interviews employing the MOS SF-36 questionnaire assessed patients' quality of life across physical, emotional and social dimensions.

Ethical considerations

Written informed consent was obtained from all participants, ensuring their voluntary participation. Privacy and confidentiality were maintained throughout the study. Participants were informed they could withdraw at any time without affecting their treatment.

RESULTS

In a study of 125 patients, the population consisted of 73 males (58.4%) and 52 females (41.6%), with a mean gender count of 62.5 (SD=10.61). The majority of patients (54.4%) were aged 51–70 years, followed by 25.6% over 70 years and 20% aged 31–50 years, with an average age of 58.4 years (SD=11.95). Hypertension was the most prevalent condition, affecting 79 patients (63.2%), followed by hypotension in 33 patients (26.4%) and intradialytic hypotension (IDH) in 11 patients (8%). Among hypertensive patients, 48 were males (65.8% of males) and 31 were females (59.6% of females).

Hypotension was observed in 8 males (11%) and 3 females (5.8%), while IDH affected 7 males (9.6%) and 4 females (7.7%). This data highlights the predominance of hypertension, particularly in males, with a smaller prevalence of hypotension and IDH, as detailed in Table 1.

A study of 125 dialysis patients found that 31 (24.8%) were malnourished, with the highest prevalence in the 60–99 age group (13 patients), while 94 (75.2%) were not malnourished. Among the malnourished, 18 had hypertension (13 males, 5 females), 10 had hypotension (8 males, 2 females) and 3 males experienced intradialytic hypotension (IDH). The findings highlight a significant link between malnutrition, age and blood pressure variations, particularly in older males, as detailed in Table 2.

The distribution of 125 dialysis patients across three indices Lean Tissue Index, Fat Tissue Index and Body Mass Index was analyzed during initial and follow-up studies. The findings highlight changes over time, including an increase in the number of patients with normal values (10.3–14.5 for lean tissue index, 6.6–12.4 for Fat Tissue Index and 18.5–25 for BMI) and a reduction in patients with low or high extremes across all indices. These changes suggest possible improvements in nutritional and health status during the follow-up period, as detailed in Table 3.

The distribution of complications among 125 dialysis patients due to inaccurate dry-weight settings was analyzed. Cramps were the most prevalent complication, affecting 43.2% of patients, followed by itching (28%), edema (20.8%) and intradialytic hypotension (8.8%). Notably, 16% of patients reported no complications. These findings emphasize the importance of precise dry-weight management to minimize patient discomfort and complications during dialysis, as detailed in Table 4.

This study outlines the pharmacological and non-pharmacological strategies employed to manage hypertension, hypotension, intradialytic hypotension and malnourishment in dialysis patients. Among 125 patients, hypertension was the most common condition, primarily managed with medications such as Cilacar (10 mg BD) and Arkamin (0.1 mg BD), with Cilacar being the most frequently prescribed. Hypotension and intradialytic hypotension were treated using Midodrine and Levocarnitine, supplemented by non-pharmacological interventions like placing patients in the Trendelenburg position. For malnourishment, supplements such as bescosules, folic acid and neurobion forte were commonly administered, with ferisome (200 mg IV post-HD) also playing a significant role. This comprehensive approach highlights a balanced integration of treatment modalities tailored to the specific needs of dialysis patients, as detailed in Table 5.

Table 1: Sociodemographic of study population.

Category	Details	Descriptive statistics
Total sample size	125 patients	-
Gender distribution	Males: 73 (58.4%)	Mean: 62.5; SD: 10.61
	Females: 52 (41.6%)	Proportions: Males (58.4%), Females (41.6%)
Age distribution	31–50 years: 25 (20%)	Mean Age (Weighted): 58.4 years
	51–70 years: 68 (54.4%)	SD (Age): 11.95
	- >70 years: 32 (25.6%)	Mode: 51–70 years
Blood pressure categories	Hypertension: 79 (63.2%)	Mean Count: 41; SD: 33.27
	Hypotension: 33 (26.4%)	Proportions: Hypertension (63.2%)
	IDH: 11 (8%)	Hypotension (26.4%), IDH (8%)
Hypertensive patients by gender	Males: 48	Male Proportion: 65.8%
	Females: 31	Female Proportion: 59.6%
Hypotensive patients by gender	Males: 8	Male Proportion: 11%
	Females: 3	Female Proportion: 5.8%
IDH by gender	Males: 7	Male Proportion: 9.6%
	Females: 4	Female Proportion: 7.7%

Table 2: Summary of age group distribution, malnutrition and blood pressure variations in dialysis patients.

Category	Subcategory	Details	Breakdown
Age group distribution	Total patients (125)	Malnourished: 31 (24.8%)	Not Malnourished: 94 (75.2%)
	13–39 years	6 malnourished (19.4%)	25 not malnourished (80.6%)
	40–59 years	12 malnourished (21.8%)	43 not malnourished (78.2%)
	60–99 years	13 malnourished (33.3%)	26 not malnourished (66.7%)
BP+malnourishment distribution	Total malnourished patients (31)	Males: 24 (77.4%)	Females: 7 (22.6%)

Continued.

Category	Subcategory	Details	Breakdown
	Hypertension+Malnourishment	18 (58.1%)	Males: 13, Females: 5
	Hypotension+Malnourishment	10 (32.3%)	Males: 8, Females: 2
	IDH + Malnourishment	3 (9.6%)	Males: 3, Females: 0

Table 3: Summary of dialysis patients by lean tissue index, fat tissue index and body mass index.

Index type	Range	Initial study (No. of patients)	Follow-up study (No. of patients)
Lean tissue index	<10.3	23	31
	10.3-14.5	28	54
	>14.5	74	40
Fat tissue index	<6.6	74	40
	6.6-12.4	28	54
	>12.4	23	31
Body mass index	<18.5	74	40
	18.5-25	28	54
	>25	23	31

Table 4: Distribution of dialysis patients with complications due to inaccurate dry-weight settings.

Complication type	No. of patients	% of patients
Cramps	54	43.20
Itching	35	28.00
Edema	26	20.80
Intra-dialytic hypotension	11	8.80
No complications	20	16.00
Total	125	100.00

Table 5: Comprehensive management of dialysis patients.

Condition	Medication	Dose	Route	Frequency	No. of patients	Non-pharmacological treatment
Hypertension	Cilacar	10 mg	PO	BD	37	-
	Arkamin	0.1 mg	PO	BD	36	-
	Nicardia	30 mg	PO	BD	24	-
	Bisoprolol	2.5 mg	PO	BD	6	-
	Minipress XL	2.5 mg	PO	BD	6	-
	Cardivas	625 mg	PO	TID	5	-
	Carvedilol	10 mg	PO	OD	5	-
	Lonitab	5 mg	PO	OD	4	-
	Nifidipine	20 mg	PO	OD	2	-
Hypotension	Midodrine	-	-	-	18	-
	Levocarnitine	-	-	-	2	Placing patient in Trendelenberg position (11)
Intradialytic hypotension	Midodrine	-	-	-	4	Placing patient in Trendelenberg position (7)
Malnourishment	Bescosules	5 mg	PO	Post-HD	31	-
	Folic Acid	5 mg	PO	TID	31	-
	Neurobion Forte	1 tablet	PO	BD	31	-
	Ferisome	200 mg	IV	Post-HD	31	-
	Zincovit	1 tablet	PO	OD	26	-
	Neurokind	500 mcg	PO	OD	22	-
	Calcitriol	0.25 mcg	PO	OD	18	-

A detailed breakdown of pharmacological and non-pharmacological treatments for hypertension, hypotension, intradialytic hypotension and malnourishment in dialysis patients.

DISCUSSION

This study underscores the significant prevalence of blood pressure (BP) variations and malnutrition among hemodialysis patients, offering critical insights into their management. Hypertension was observed in 63.2% of patients, with a notable male predominance (65.8%). In contrast, hypotension (26.4%) and intradialytic hypotension (IDH) (8%) were less prevalent but still clinically significant. These findings align with research by Agarwal et al, which highlights fluid overload and altered vascular regulation as key contributors to hypertension in dialysis patients and the lower rates of hypotension and IDH are consistent with improved fluid management practices in modern dialysis units.[9]

Malnutrition affected 24.8% of patients, particularly those aged 60–99 years (33.3%), with males comprising the majority (77.4%). This aligns with Kovesdy et al, who reported that malnutrition is prevalent among older and male dialysis patients due to protein-energy wasting and reduced dietary intake.[10] The study further observed that malnourished patients had a higher prevalence of hypertension (58.1%), followed by hypotension (32.3%) and IDH (9.6%), emphasizing the complex interplay between nutritional deficits and hemodynamic stability.

The study's follow-up data revealed improvements in body composition parameters, such as lean tissue index, fat tissue index and body mass index. The number of patients with normal indices increased significantly, suggesting that interventions like nutritional supplementation and BCM-guided management were effective. Similar findings were reported by Fouque et al, who emphasized the role of targeted nutritional strategies in improving survival and reducing complications in malnourished dialysis patients.[11] Dialysis-related complications were prevalent, with cramps (43.2%), itching (28%) and edema (20.8%) being the most common. These complications were closely linked to inaccuracies in dry-weight management, a challenge frequently reported in hemodialysis.

Utilizing BCM for precise fluid assessments significantly reduced the occurrence of these issues, corroborating findings by Flythe et al, who demonstrated the value of advanced bioimpedance tools in minimizing dialysis-related adverse events.[12] Pharmacological and non-pharmacological interventions were tailored to patient needs. Hypertension was managed primarily with antihypertensives such as Cilacar (10 mg BD), while Midodrine and Trendelenburg positioning were employed to address hypotension and IDH. Malnutrition was tackled with a comprehensive supplementation strategy, including folic acid, Ferisome and Neurobion Forte. These approaches reflect best practices described in the guidelines and studies on dialysis care.[13]

While the results align with existing literature, limitations such as the single-center design, short follow-up and small sample size restrict the generalizability of the findings. Further multicenter studies with larger cohorts are recommended to validate these results and explore regional and demographic variations. Future research should also focus on integrating advanced nutritional and inflammatory biomarkers to deepen the understanding of malnutrition and its impact on dialysis outcomes.

Despite its contributions, the study's sample size (125 patients) and single-center design may limit generalizability. Further multicentric studies with larger cohorts are needed to validate these findings and explore regional variations in dialysis practices and complications. Additionally, incorporating advanced nutritional biomarkers could provide deeper insights into malnutrition patterns.

CONCLUSION

This study corroborates existing evidence on the high prevalence of hypertension and malnutrition in dialysis patients and underscores the utility of BCM in optimizing their management. By aligning closely with prior research, it highlights opportunities for integrating individualized care strategies to enhance patient outcomes. Future research should expand on these findings, emphasizing diverse populations and longitudinal designs.

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