10.5152/turkjnephrol.2020.3643

Original Article

Turkish Journal of Nephrology

Examination of the Effects of Nursing Interventions on Intradialytic Hypotension

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Abstract

Objective: This study will contribute to the understanding and management of hemodialysis-related complications, increase hemodialysis nurses' awareness and skills related to intradialytic hypotension management, help establish evidence-based clinical practice, and help develop clinical guidelines for the management of hemodialysis-related complications.

Materials and Methods: This descriptive study involved 57 patients whose blood pressures and interventions for intradialytic hypotension were recorded for six hemodialysis sessions, for a total of 342 follow-ups.

Results: Intradialytic hypotension developed at significantly high rates in cases in which the first hemodialysis session was performed after a 2-day break and in cases of high target ultrafiltration and pump rate values. Intradialytic hypotension developed during 219 of the 342 follow-ups. The Trendelenburg position alone was used in 195 follow-ups (89%) in which intradialytic hypotension developed, and the Trendelenburg position and pump rate reduction were used in 24 follow-ups (11%). Pump rate reduction alone was used in 151 follow-ups (68.9%).

Conclusion: Using the Trendelenburg position alone and reducing the pump rate along with using the Trendelenburg position significantly increased the blood pressure in cases of intradialytic hypotension. Excessive use of the Trendelenburg position and reduction of the pump rate by 20-60 mL/min compared with the onset rate of hemodialysis were more effective in increasing the blood pressure.

Keywords: Hemodialysis, blood pressure, nursing interventions, nursing

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Received: 26.10.2018 **Accepted:** 29.12.2018

Presented in: This study was presented at the 2. Internatıonal Congress of Nursing (ICON)-2018, 13-15 April 2018, İstanbul, Turkey.

Cite this article as: Kesik G, Özdemir L. Examination of the Effects of Nursing Interventions used for Intradialytic Hypotension. Turk J Nephrol 2020; 29(1): 33-8.

INTRODUCTION

Approximately 15% of the world's population suffers from chronic renal failure disease, and nearly 56% of patients are treated with dialysis (19). Hemodialysis is one of the treatment options frequently used in end-stage renal failure. In hemodialysis, the patient's blood is filtered through a hemodialysis device and subsequently re-administered. For this procedure, a water system, a hemodialysis device, arteriovenous sets and needles, a hemodialysate, and acid and bicarbonate solutions are needed.

Although treatment with hemodialysis is life-saving for these patients, it may cause many acute and chronic complications (1, 6, 9, 17). Intradialytic complications refer to acute complications observed during hemodialysis; common intradialytic complications include hypotension (30%-35%), cramps (5%-20%), nausea/vomiting (5%-15%), headache (5%), chest pain (2%-5%), back pain (2%-5%), itching (5%), and fever/shivering (<1%) (2, 12, 17). Intradialytic hypotension (IDH) is defined as a reduction of ≥20 mmHg in the systolic blood pressure or a reduction of ≥10 mmHg in the mean blood pressure during hemodialysis (2, 11, 12). IDH may result because of decrease in the fluid volume, failure to provide vasoconstriction, or cardiac factors. Many studies have identified a close association between the quantity of ultrafiltration and IDH (12, 17). The target ultrafiltration value is determined by the difference between the patient's weight at admission and the dry weight. The pump rate, another parameter for hemodialysis, is calculated by considering the target ultrafiltration and hemodialysis treatment period. By increasing the target ultrafiltration value, a higher quantity of water is drawn within a shorter time, and this is associated with a higher risk of IDH by causing imbalance in the fluid volume.

In addition to being the most common complication during hemodialysis, IDH is an etiological factor for other intradialytic complications such as nausea, vomiting, and cramps (2, 4, 19). Patients with IDH commonly present with symptoms such as tiredness, restlessness, and dizziness. Thus, IDH may affect the treatment progression and may result in an earlier termination of hemodialysis if the blood pressure cannot be normalized (6, 11, 12).

Furthermore, because IDH requires close monitoring and interventions, this complication increases the workload for the nurses (17).

The interventions for IDH should be evidence based, as with the other aspects of nursing practice. However, a thorough literature search found no study on the efficiency or standards of the interventions for IDH, and studies assessing the correlations of the interventions for IDH with blood pressure are needed.

MATERIALS AND METHODS

The present study aimed to examine the interventions used for IDH and their effects on the blood pressure of the patients.

This descriptive study was performed in the hemodialysis units of a university hospital and a public hospital between January and June 2016. A flow diagram of the progression of patients through the phases of the study is shown in Figure 1.

The sample size was determined with a power of 93% and an α-value of 0.05; a power analysis was conducted using the G*Power program, version 3.1.735, and it was based on the rate of the development of IDH.

Patients aged >18 years, those who received hemodialysis treatment because of end-stage kidney failure, and those who received hemodialysis during 4-h sessions were included in the study. Patients who did not have IDH in the preliminary follow-up for six sessions were excluded. In the preliminary evaluation of 180 patients, 123 patients were excluded from the study (121 patients because of not developing IDH during the preliminary monitoring for six sessions and 2 patients because of agitated behaviors that made communication impossible). Finally, 57 patients who developed IDH at least once during the preliminary monitoring for six sessions and who met inclusion criteria were included in the study. The blood pressure of the 57 patients and interventions for IDH during the six sessions were followed; in total, 342 follow-ups were conducted.

Data Collection

The study data were gathered by the primary investigator (PI) from the Patient Description Form, Patient Information for Hemodialysis Sessions and Blood Pressure Monitoring Chart, and Blood Pressure Monitoring and Interventions Chart for Patients with Intradialytic Hypotension. All data collection tools were prepared by the PI following a review of the relevant literature (5-7, 13-15).

In this study, IDH was defined as a decrease of ≥20 mmHg in systolic blood pressure (11, 12, 15). All study data were collected by the PI. The Patient Description Form was used to determine the descriptive characteristics of the patients, such as age, gender, and duration of hemodialysis treatment. The Patient Information for Hemodialysis Sessions and Blood Pressure Monitoring Chart was used to record the vascular access type (permanent catheter, arteriovenous fistula, arteriovenous graft), dry weight, weight at admission, target ultrafiltration value, and pump rate and monitor the blood pressure every 30 min during each hemodialysis session for the detection of IDH. The Blood Pressure Monitoring and Interventions Chart for Patients with Intradialytic Hypotension was used to record the degree of Trendelenburg position, which was classified as minimum Trendelenburg (15–30°) and maximum Trendelenburg (45°), based on the literature; the degree of pump rate reduction (mL/min); and characteristics of the intravenously administrated fluid (1, 3).

After the interventions were performed for the patients with IDH by hemodialysis nurses, the blood pressure was monitored every 15 min by the PI and recorded in their charts.

The project was approved by the Hacettepe University Non-invasive Studies Ethics Committee.

Statistical Analysis

Data analyses were conducted using The Statistical Package for the Social Sciences, version 22.00 (IBM Corp.; Armonk, NY, USA). Frequency and percentage distributions were used for evaluating categorical variables. The chi-square test was used to examine the association between two categorical variables. Differences between two independent groups were evaluated using the independent samples t-test.

RESULTS

Of the patients included in the study, 50.9% were female and 52.6% were aged >60 years. Of all patients, 64.9% were married. A history of familial kidney failure was identified in 71.9% of the patients. In terms of the relatives of the patients diagnosed with kidney failure, 90.9% were first-degree relatives and 38.6% received dialysis treatment. In addition to kidney failure, 52.6%

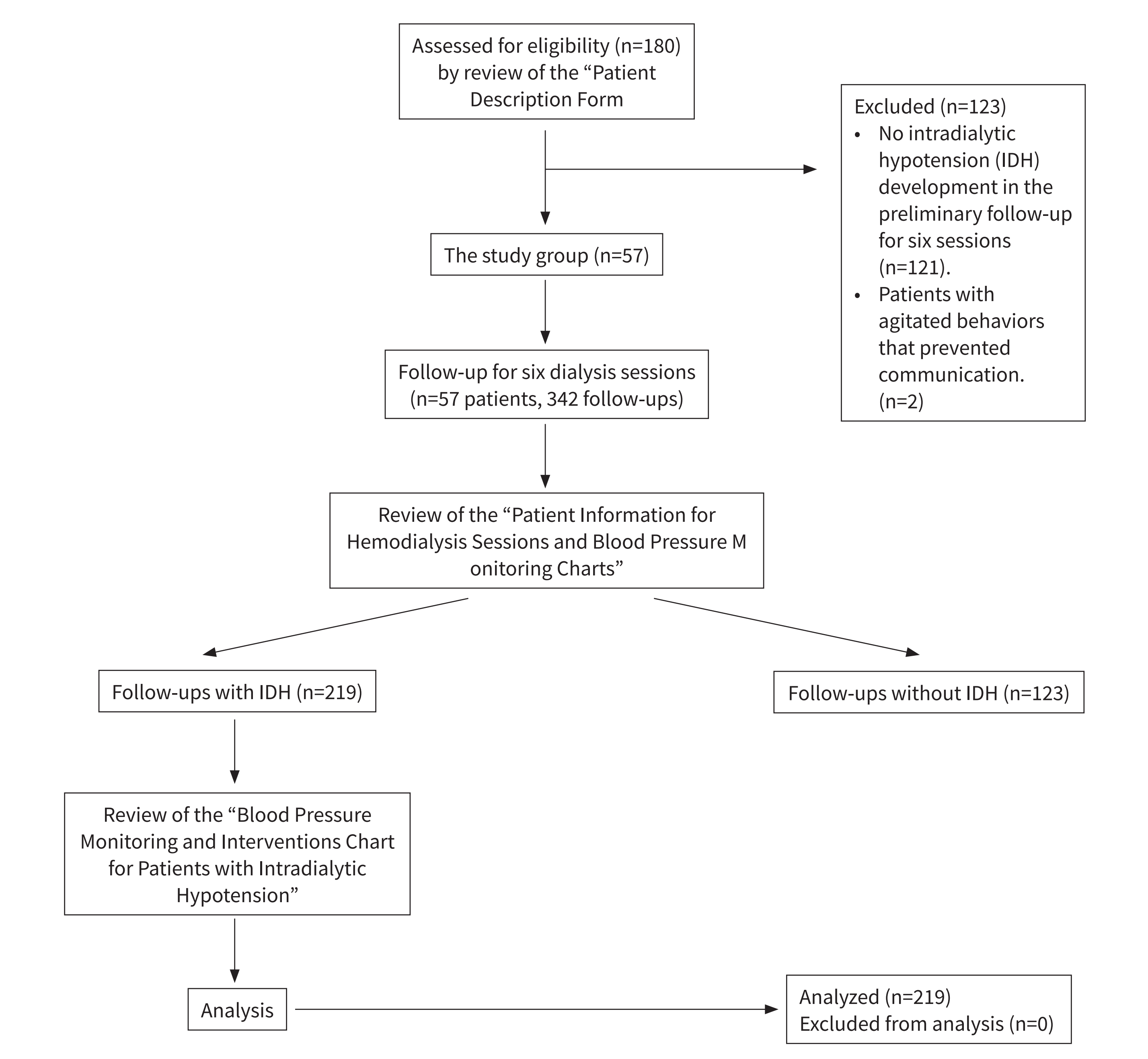

Figure 1. Flow diagram of the subject enrollment through the phases of the study.

of the patients had a concomitant chronic disease (40% hypertension, 33.3% diabetes, 20% cerebrovascular event history, 6.7% coronary heart disease). Hemodialysis treatment was administered to 40.4% of the patients for 91–180 months. All patients had an arteriovenous fistula as vascular access. The most common symptom accompanying IDH was exhaustion, which occurred in 75.4% of the cases. Furthermore, 57.9% of the patients experienced muscle cramps, and 38.6% presented with dizziness. The patients received hemodialysis on Mondays, Wednesdays, and Fridays or on Tuesdays, Thursdays, and Saturdays. The dry weights of the patients ranged between 72.1 and 98.0 kg in 35.1% of patients. The body weight of the patients at admission ranged between 72.1 kg and 101.0 kg in 35.6% of patients. The body weight after hemodialysis was not below the dry weight in the vast majority (99.2%) of patients. When the hemodialysis treatment characteristics were investigated, the target ultrafiltration quantities ranged between 1500 and 2750 in 51.5% of cases and the pump rate was between 341 and 380 ml/min in 68.1% of cases (Table 1).

Significant associations were identified among target ultrafiltration, pump rate values, and development of IDH. The mean target ultrafiltration and pump rate values of the patients with IDH were significantly higher than those in patients without

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IDH (t=5.311, p<0.001). A significant association was found between the IDH development state and the days of hemodialysis (t=5.293, p<0.001). The IDH development rates on Mondays and Tuesdays were significantly higher than those on Thursdays, Fridays, and Saturdays.

Table 1. Distribution of the Descriptive Data Related to the Patients and Treatment (n=57)

	n	%
Gender		
Female	29	50.9
Male	28	49.1
Age (years)		
(Mean=60.7, SD=11.4, Min=44.0, Max=98.0)		
<60 years	27	47.4
>60 years	30	52.6
Duration of hemodialysis treatment (months)		
(Mean=162.6, SD=101.6, Min=30, Max=420)		
0-90 months	20	35.1
91-180 months	23	40.4
>180 months	14	24.5
Dry weight (kg)		
(Mean=67.7, SD=13.6, Min=43, Max=98)		
43.0-61.0 kg	114	33.3
61.1-72.0 kg	108	31.6
72.1-98.0 kg	120	35.1
Body weight at admission (kg)		
(Mean=69.9, SD=13.8, Min=43.75, Max=101)		
43.0-61.0 kg	112	32.8
61.1-72.0 kg	108	31.6
72.1-101.0 kg	122	35.6
Target ultrafiltration quantity		
(Mean=2795.9, SD=624.9, Min=1500, Max=3800)		
1500-2750	176	51.5
2751-3800	166	48.5
Pump rate (ml/min)		
(Mean=348.3, SD=26.9, Min=300, Max=380)		
300-340 mL/min	109	31.9
341-380 mL/min	233	68.1
Body weight at discharge (kg)		
(Mean=67.7, SD=13.7, Min=43, Max=98)		
43.0-61.0 kg	113	33
61.1-72.0 kg	106	31
72.1-98.0 kg	123	36
Difference between the discharge weight and dry weight		
Decreased below the dry weight	3	0.8
Did not decrease below the dry weight	339	99.2

IDH was identified in 219 of the 342 follow-ups. Nurses intervened in all IDH cases. The Trendelenburg position was used in all 219 follow-ups. In 195 of the 219 follow-ups with IDH, the Trendelenburg position was used alone (89%), whereas the Trendelenburg position and pump rate reduction were used in combination in 24 follow-ups as the first intervention (11%). Pump rate reduction alone was used in 151 of 219 follow-ups as the second intervention (68.9%). The isotonic fluid replacement was used alone in 53 follow-ups as the second or third intervention (24.2%). The Trendelenburg positioning alone and pump rate reduction along with the Trendelenburg position increased the blood pressure significantly (p<0.001 for both). No significant association was found between pump rate reduction and isotonic fluid replacement and blood pressure (p>0.05 for both) (Table 2). The increase in blood pressure was found to be significantly higher in cases with maximum Trendelenburg position than in cases with minimum Trendelenburg position. When comparing the amounts of pump rate reduction, reducing the pump rate by >20 mL/min compared with that at the onset of hemodialysis was found to be more effective in increasing the blood pressure than reducing it by ≤20 mL/min (p<0.001). The differences in the effect of using different amounts of isotonic fluid replacement (mL) on the blood pressure increase were not significant (p>0.05) (Table 3).

DISCUSSION

The present study revealed that higher ultrafiltration and pump rate values were associated with increased rates of IDH development. Prolongation of the dialysis session and reduction of the pump rate were effective in preventing IDH in patients with a high target ultrafiltration value. Because the pump rate is adjusted according to the target ultrafiltration value, during sessions in which the target ultrafiltration value is high, the pump rate is also adjusted to be high. Patients with higher pump rates have a higher decrease in the intravascular volume; however, a high decrease in the intravascular volume within a short period may cause IDH in these patients (4). In the present study, the rate of IDH development was found to be significantly higher on Mondays and Tuesdays, i.e., on days when the patients received the first hemodialysis of the week, compared with that on the other days. Because the patients did not receive hemodialysis for 2 days before Monday or Tuesday, the target ultrafiltration rate was increased on these days. Consequently, IDH developed significantly more frequently on these 2 days, as reported previously (9, 16).

The Trendelenburg position was used in all 129 follow-ups with IDH, including Trendelenburg alone in 195 cases and in combination with pump rate reduction in 24 cases. The Trendelenburg position is a common practice because it is both practical and influential and does not lead to any interruption in the treatment process. According to the statistical analysis of the data obtained in the present study, the use of the Trendelenburg position significantly increased the blood pressure in patients with IDH. Furthermore, when the Trendelenburg position grade

Table 2. Effects of the Different Interventions for Intradialytic Hypotension on Blood Pressure (n=423)

Intervention		Effect on Blood Pressure				
		Increased	No Change	Continued to Decrease	χ2	p
Trendelenburg (n=195)	n	67	115	13	26.509	<0.001
	%	34.4	58.9	6.7		
Pump rate reduction (n=151)	n	66	75	10	2.489	0.968
	%	43.7	49.7	6.6		
Isotonic fluid replacement (n=53)	n	29	24	0	0.848	0.087
	%	54.7	45.3	0.0		
Trendelenburg plus pump rate reduction (n=24)	n	24	0	0	24.200	<0.001
	%	100	0.0	0.0		

Table 3. Effects of the Intervention Characteristics on Blood Pressure

Intervention Characteristics			Effect on Blood Pressure					
			Increased	No Change	Continued to Decrease	χ2	p	Difference
Trendelenburg Grade (n=219)	Minimum	n	28	33	12	24.290	<0.001	1-2
		%	30.8	28.7	92.3			
	Excessive	n	63	82	1			
		%	69.2	71.3	7.7			
Pump rate reduction (mL/min) (n=175)	20	n	10	14	1	28.410	<0.001	1-2,3
		%	11.0	18.4	12.5			
	20-40	n	50	62	7			
		%	54.9	81.6	87.5			
	40-60	n	31	0	0			
		%	34.1	0.0	0.0			
			Increased	**No Change**				
Isotonic replacement (mL) (n=53)	100	n	29	21	0.960		0.086	-
		%	100.0	87.5				
	200	n	0	3				
		%	0.0	12.5				

was analyzed, the maximum Trendelenburg position was found to be significantly superior to the minimum Trendelenburg position for increasing the blood pressure. The Trendelenburg position enables the transfer of blood from the lower extremities to the vital organs and upper extremities. Thus, the decreased blood volume in the vital organs and upper extremities is replenished. In this case, applying the Trendelenburg position to patients with IDH may help to increase blood pressure, and the use of maximum Trendelenburg positioning should be applied if possible (10).

The literature suggests reducing the pump rate for the management of IDH (1). This intervention may provide a blood pressure increasing effect via reductions of the volume rate drawn from the patient. However, in the present study, the statistical analysis showed that reducing the pump rate alone did not have a significant effect on the blood pressure increase, whereas reducing the pump rate in addition to using the Trendelenburg position increased the blood pressure significantly. Furthermore, when the blood pressure increase was compared in accordance with different pump rate reduction values, reducing the pump rate by >20 mL/min was found to be more effective. Hence, in cases of IDH, higher reduction of the pump rate and/or Trendelenburg positioning may effectively increase the blood pressure.

Theoretically, intravenous fluid replacement in the treatment of IDH resulting from hypovolemia can be useful (5). Hypovolemia is one of the etiological factors of IDH and results when the weight decreases below the dry weight in hemodialysis. In the present study, the effect of isotonic fluid replacement on the increase in blood pressure was not found to be significant. The discharge weights were not below the dry weights in most patients (99.2%) in this study. Thus, because hypovolemia did not appear to influence the etiology of IDH in our study, isotonic fluid replacement may not be effective in the treatment of IDH.

Limitations

The present study was limited to hemodialysis patients with IDH; therefore, our results cannot be generalized to other populations. The small sample size was another limitation of the study.

CONCLUSION

According to the findings obtained in the present study, the rate of IDH development was the highest on Mondays and Tuesdays, when the first hemodialysis treatment of the week was applied, compared with that on Wednesdays, Thursdays, Fridays, and Saturdays. The rate of IDH development was significantly high in patients with higher target ultrafiltration and pump rate values. The Trendelenburg position was found to be effective for increasing the blood pressure in cases of IDH. In the follow-up where the maximum Trendelenburg position was applied, the increase rate in blood pressure was found to be significantly higher than that in cases of minimum Trendelenburg positioning. The effect of pump rate reduction alone was insignificant, whereas a combination of this method with the Trendelenburg position increased the blood pressure significantly. Analyses of the use of different reduction rates of the pump revealed that reducing the pump rate by 20-60 mL/min increased the blood pressure significantly compared with reducing it by ≤20 mL/min. Furthermore, the effect of isotonic fluid replacement on the blood pressure increase was not significant. Based on the findings of the present study, we conclude that in cases of IDH, using the Trendelenburg position, preferably the maximum Trendelenburg position; reducing the pump rate by 20-60 mL/min; and/or reducing the pump rate together with using the Trendelenburg positioning appear to be most effective. Furthermore, to prevent IDH, patient education regarding reducing the target ultrafiltration rates, such as prevention of maximum weight gain between two sessions and restrictions of salt and fluids, may also be helpful.

Ethics Committee Approval: Ethics Committee approval was received for this study from the Hacettepe University Non Invasive Studies Ethics Committee (Decision No: GO-15/613-17).

Informed Consent: Written informed consent was obtained from the patients who participated in this study.

Peer-review: Externally peer-reviewed.

Author Contributions: Concept – G.K., L.Ö.; Design – G.K., L.Ö.; Supervision – G.K., L.Ö.; Resources – G.K., L.Ö.; Materials – G.K., L.Ö.; Data Collection and/or Processing – G.K., L.Ö.; Analysis and/or Interpretation – G.K., L.Ö.; Literature Search – G.K., L.Ö.; Writing – G.K., L.Ö.; Critical Reviews – G.K., L.Ö.

Conflict of Interest: The authors have no conflict of interest to declare.

Financial Disclosure: The authors declare that this study has received no financial support.

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