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The effect of foot massage in lowering intradialytic blood pressure at Hemodialysis Unit in Indonesian Hospital11
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ABSTRACT

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Objective: To determine the effect of foot massage on reducing blood pressure in patients with intradialytic hypertension.**Method:** This study is a randomized controlled trial (RCT). Subjects were 32 hemodialyses (HD) patients randomly allocated into two groups: the control group and the intervention group. Foot massage was performed three times in intradialytic phase for 5–10 min in the first, second, and third HD hours. Measurement of blood pressure (BP) used portable sphygmomanometer. The measurement was conducted every 20 min.**Results:** There is a different effect of foot massage on systolic and diastole blood pressure between the control group and intervention group with $p < 0.05$. The difference in median value for systolic blood pressure between the two groups was 25 mmHg, and diastole was 10 mmHg.**Conclusion:** The foot massage is beneficial in controlling intradialytic hypertension and can be applied in the management of hemodialysis patients by nurses.

1. Introduction

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Patients with chronic kidney disease (CKD) have a relatively high mortality rate. Disclosed in Hallan et al. that the countries in Asia, Europe, and America have a high incidence of CKD with a percentage of 15%, mainly in adults.¹ Data from the World Health Organization in 2013 put the number of patients with CKD in the world exceeds 500 million, with 1.5 million people undergoing hemodialysis (HD).² In Indonesia, it was estimated that the dialysis population in 2011 were 15.353 people and in 2012 were 19.621 people.³ As the high prevalence of HD patients keep increasing, it is necessary to focus on one of the most common cardiovascular complications during HD process, the intradialytic hypertension (IDH). (see Fig. 1)Intradialytic hypertension is defined as 10 mmHg increase in systolic blood pressure which occurs during HD period. The incidence of IDH is 15% of all HD patient population.⁴ Patients with intradialytic hypertension have a risk of death within six months.⁵ The age factor, interdialytic weight gain (IDWG), urea reduction ratio (URR), residual renal function (RRF), duration of HD, psychological conditions, and the amount of anti-hypertensive drugs are allegedly associated with the incidence of IDH.⁶ In HD services, lowering quick blood (Qb) and ultrafiltration (Uf) by stopping the HD, are taken as a precaution to theintradialytic hypertension risk. Because of that, the HD process is not performed as prescribed (inadequate). If IDH is not resolved, it can cause seizures, nausea, cramps, chest pain, loss of consciousness, and headache.⁷Therefore, it is necessary to apply complementary therapy in reducing complications and improving the quality of HD care so that patients can be freed from the symptoms of uremia.⁸ With the achievement of adequacy, HD nurse can ensure the comfort of the patients as a step to improve the quality of health care and nursing intervention. One of the nursing intervention could be implemented by nurses during HD is foot massage.Foot massage has been widely used over the last decade in health care and has been known to improve peripheral circulation, mechanically assist the displacement of venous and lymphatic fluid, and manipulate nerve, blood vessels, and cells in the exchange network.^{9,10} Foot massage is chosen because of the relatively small side effects, economic and comfortable to be applied.^{9,11} Foot massage has been shown to lower blood pressure in patients with primary hypertension.¹² However, in the HD population, foot massage is only applied to increase the quality of sleep and fatigue.^{13,14} The effect of foot massage to control IDH has not been studied, even though based on the theory, with controlled IDH, the risk of life-threatening complications can be

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minimized. Therefore, the researchers intend to determine the effect of foot massage on intradialytic blood pressure reduction.

2. Method

2.1. Design

This study was conducted in 2019 at Hasanudin University Hospital, South Sulawesi, Indonesia. Subjects were patients with CKD who were undergoing HD in the HD unit and had intradialytic hypertension. The sampling technique in this study used simple random sampling. Randomization was conducted by entering the name of the patient based on the schedule of HD into a sealed envelope and a draw to determine the intervention group and the control group was conducted. The researchers also used medical records to determine the prognosis of subjects.

2.2. Recruitment of subjects

Thirty-two subjects were recruited and randomized into two groups, the control group, and the intervention group based on their scheduled HD. A flowchart of the participants in this study is provided in Fig. 1. The inclusion criteria of subjects were patients with CKD or end-stage renal disease (ESRD), intradialytic hypertension, ≥ 18 years old, compos mentis, HD > 3 months with a frequency of three times a week, no change in the prescription of HD therapy (Qb, Uf, fluid withdrawal target UFg, and extended dialysis for 4 h), interdialytic

weight gain (IDWG) 1–4 Kg, and have no sleeping disorder the previous night. Clinical characteristics of respondents with IDH other than increasing SBP > 10 mmHg per HD session is palpitations, headaches, aches, and also accompanied by dry skin appear blackish due to uremia syndrome.

The exclusion criteria were patients with an unrecommended condition by the nurses due to shortness of breath, femoral access, peripheral vascular disorders, and mental disorders. The termination in the HD process because of unstable patient conditions was considered to be dropped out of the study. The initial data of patients were collected in three days by tracing medical record information to determine the demographic data. After the initial data collected, foot massage intervention was applied to the intervention group based on their scheduled HD.

2.3. Ethical considerations

The protocol of this study was approved by the Health Research Ethics Commission of the Medical Faculty of Hasanuddin University Indonesia with recommendations number: 412/UN4.6.4.5.31/PP36/2019. All subjects signed informed consents before participating in this study.

2.4. Measurement of blood pressure

Measurement of blood pressure (BP) used portable sphygmomanometer ABN (Padalarang, Indonesia) and a Littmann Classic

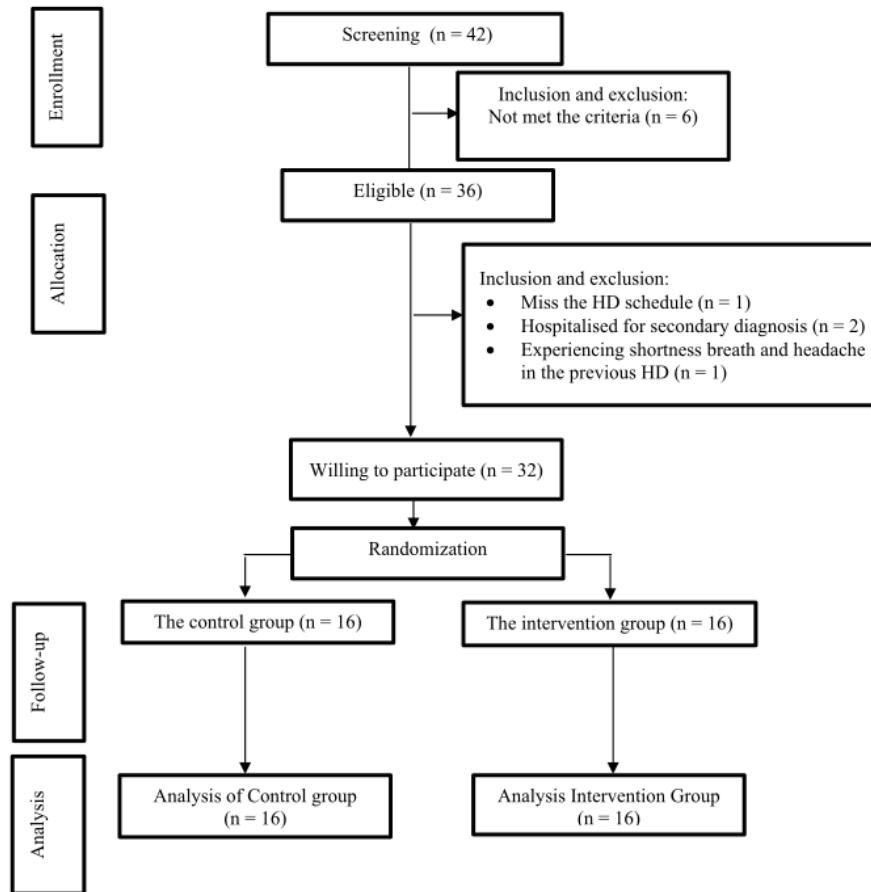


Fig. 1. Flowchart of subjects (15).

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Table 1

The frequency distribution based on demographic data of respondents.

Characteristics	Control group (n = 16)		Intervention group (n = 16)		p *
	Mean ± SD	Min-Maks	Mean ± SD	Min-Maks	
Age	44.75 ± 16.279		47.06 ± 16.192		0.836
Characteristics	N	%	N	%	p **
Sex					
Man	5	31.3	5	31.3	1.000
Woman	11	68.8	11	68.8	
HD to					
< 100	2	12.5	3	18.8	0.312
100–200	5	31.3	2	12.5	
201–300	5	31.3	4	25.0	
301–400	2	12.5	3	18.8	
401–500	0	0	1	6.3	
> 500	2	12.5	3	18.8	
Anti-hypertensive Drugs					
Two types	15	93.8	12	75.0	0.154
> 3 types	1	6.3	4	25.0	
Interdialytic weight gain (IDWG)					
1 Kg	4	25.0	4	25.0	1.000
2 Kg	7	43.8	7	43.8	
3 Kg	4	25.0	4	25.0	
4 Kg	1	6.3	1	6.3	
Quick target blood (Qb)					
220 ml/min	1	6.3	1	6.3	1.000
230 ml/min	8	50.0	8	50.0	
240 ml/min	4	25.0	4	25.0	
250 ml/min	2	12.5	2	12.5	
280 ml/min	1	6.3	1	6.3	
Ultrafiltration goals					
1 L	4	25.0	4	25.0	1.000
2 L	7	43.8	7	43.8	
3 L	5	31.3	5	31.3	

SD (standard deviation), *Mann U Withney test, ** Test of homogeneity of Variances, Chi Square.

Stethoscope (3 M Science, St. Paul, Minnesota, USA). Blood pressure measurements performed on pre HD, the 1st, 2nd, an 3rd hours, and post HD.

2.5. Foot massage intervention

Foot massage intervention was performed by researchers who had been certified in performing foot massage after 32 h of training. Foot massage was conducted on the 1st, 2nd, and 3rd hours for 10 min (started at 51st – 60th minutes) followed by observation of blood pressure. Foot massage procedure was adapted from Joachim study and developed by Puthusseril^{16,17} as follows:

1. Wash hands with warm water or use warm olive oil
2. Place patients in a quiet place while conducting feet inspection to check for foot massage contraindications,
3. Give a soft touch on both feet, then start with rubbing the right foot from the inside to the outside direction using the palm of hand for ± 15 s,
4. Rotate the ankle clockwise, and then in the opposite direction three times each for ± 15 s,
5. Move the toe back and forth three times for ± 15 s,
6. Move feet to the front and back three times each for ± 15 s (both thumbs press the soles and the rest of the fingers on the back foot for ± 15 s)
7. The left hand support the ankle, and the right-hand massage toes for ± 15 s,
8. Grasp the back of the foot, apply gentle massage for ± 15 s,
9. Support foot, apply pressure and massage on the spaces between with up and down movement for ± 15 s,
10. The right hand hold the toe, and the left hand gently put pressure

on 29 soles for ± 15 s,

11. Do the same on the left foot,

12. End the intervention by grasping the patient's feet and let it relax for 2 s.

2.6. Statistical analysis

The variables were analyzed using descriptive statistics after the process of data entry and data tabulation. The frequency distribution was tested using Shapiro Wilk using SPSS 24.0 for Windows along with Friedman test¹⁶ and post hoc Wilcoxon test. The comparison between the intervention and control groups used the Mann Whitney test. $P \leq 0.05$ is a threshold of significance or degree of freedom (df) with 95% confidence intervals (CI).

3. Results

Table 1 shows the demographic characteristics of subjects. The distribution of subjects based on gender is dominated by women (68.8%). The same number of subjects, i.e., 9 (28.2%) are in the 51–60 year age range and 201–300 times of HD. Almost all subjects (84.4%) consumes the two types of anti-hypertensive drugs. For an interdialytic weight gain, about 14 people (43.8%) of the subjects increased by 2 kg. Half of the subjects have quick target blood of 230 ml/min, and almost half (43.8%) of the subjects have 2 L target ultrafiltration. Homogeneity test shown that each characteristic variables from both groups were homogenic. In addition, p value of those variables were > 0,05.

Table 4 shows that there is a significant difference of systolic blood pressure between the control group and the intervention group after the first intervention in the 1st hour of HD to post HD ($p < 0.05$). The difference in diastolic blood pressure is found in the 2nd hour of HD to

Table 2
Differences in median value (percentile) between the control group and the intervention group.

Variables	pre HD		1st hour		2nd hour		3rd hour		Post HD	
	Control (N = 16)	Intervention (N = 16)	Control (N = 16)	Intervention (N = 16)	Control (N = 16)	Intervention (N = 16)	Control (N = 16)	Intervention (N = 16)	Control (N = 16)	Intervention (N = 16)
Systolic	140 (130–180)	130 (120–180)	160 (150–210)	150 (140–200)	175 (160–220)	140 (130–200)	175 (150–220)	140 (130–190)	165 (150–210)	140 (130–170)
Diastolic	80 (70–90)	80 (60–90)	90 (80–120)	85 (70–110)	90 (80–100)	80 (60–100)	90 (80–120)	80 (70–90)	90 (90–100)	80 (70–90)
			<i>p</i> *		<i>p</i> *		<i>p</i> *		<i>p</i> *	
			0.340		0.022		0.000		0.000	
			0.114		0.114		0.003		0.000	

**p* < 0.05. HD. *Differences between groups using the Mann Whitney test (data is not normally distributed). Blood pressure measurement was performed on pre HD, 1st hour, 2nd hour, 3rd hour, and post HD.

post HD ($p < 0.05$). Median range value for systolic blood pressure in both groups during the pre HD increased by 20 mmHg each in the first hour of HD. After the foot massage, the first visible difference in systolic blood pressure is observed 10 mmHg at the intervention group, while the control group increased by 15 mmHg in the second hour. By the application of foot massage every hour, the median value in the intervention group remained stable at 140 mmHg in the 2nd hour of HD to post HD or only increase 10 mmHg of systolic blood pressure compared to pre HD. In the control group, the systolic blood pressure is 175 mmHg in the 2nd and 3rd hours of HD, and in the post HD, the blood pressure declined to 165 mmHg or increased 25 mmHg of systolic blood pressure compared to pre HD. It can be calculated that the systolic blood pressure difference between the control group and the intervention group is 15 mmHg. The diastolic blood pressure in the intervention group is stable at 80 mmHg from the 1st hour HD to post HD — no change in diastolic blood pressure in the intervention group during the hourly application of foot massage. A different result is observed in the control group with the diastolic blood pressure increase of 10 mmHg–90 mmHg at the post HD.

Table 3 shows that during the HD process, both groups experienced a significant change in systolic and diastolic blood pressures (p -value of < 0.05).

4. Discussion

The aim of this study is to determine the effect of foot massage on intradialytic blood pressure reduction. Foot massage intervention was significantly effective in lowering blood pressure, both systolic and diastolic. This reduction was higher than a study by Ju et al. that found a significant decrease in blood pressure by 15 mmHg for systolic and 4 mmHg for diastolic.¹⁸ However, the decrease of diastolic blood pressure in this study occurred only once in the 2nd hour and remained stable until post HD. The similar intervention was carried out by Malekshahi, Aryamanesh, & Fallahi by investigating the application of foot massage for 10 min, three times, during HD in patients with IDH.¹³ The duration of the 10-min foot massage can give a significant change in blood pressure. A study by Moyle et al. showed significant results in lowering systolic and diastolic blood pressure with the same duration.¹⁰ The result of this study supported Abdelaziz and Mohammed study that found a decrease in blood pressure after the 10 min foot massage.¹⁹

During HD, the withdrawal of excess fluid that causes the Renin-Angiotensin System (RAS) induced peripheral resistance and thus, an increase in blood pressure occurs.²⁰ The mechanism of lowering blood pressure with foot massage occurs through the activation of the parasympathetic nervous system during the massage that induces the relaxation response.²¹ Foot massage relaxation technique is one of the nursing intervention in dealing with hypertension and anxiety.²² It has been proven to lower blood pressure.^{23,24} Massage will give effect on the contraction of the capillary walls so that the capillary blood and lymph vessels dilated. According to Potter & Perry,²⁵ foot massage can improve muscle tone and provide a relaxing effect. The pressures given on the feet will stimulate the peripheral nervous system through the neural grooves and go toward the central nervous system and stimulate the adrenal hormones to make vessels dilate and calm the body (relaxation). Foot massage is an intervention that can be performed by nurses, as Joachim has compiled simple steps to make it easier to be conducted by nurses.¹⁶ On the research process, HD nurses on duty have learned FM techniques, indications, contraindications, as well as applying them to research respondents. To carry out foot massage in daily routine requires at least 10 min every hour or a total of 30–40 min in a HD session for each IDH patient. The HD unit in this study had 3–4 nurses for each HD session, so possible to apply foot massage because not all patients experience IDH.

It was noted from the subject statement that foot massage intervention had a soothing effect on them. It will be beneficial to learn more about the nursing comfort plan in nursing education. The foot

Tab 21
The difference in blood pressure between the control group and the intervention group.

Variables	pre HD		1st hour		2nd hour		3rd hour		Post HD		p ^a
	Median (min-max)		Median (min-max)		Median (min-max)		Median (min-max)		Median (min-max)		
The control group (n = 16)											
Systolic	140	(130–180)	160	(150–210)	175	(160–220)	175	(150–220)	165	(150–210)	0.000
Diastolic	85	(70–90)	90	(80–120)	90	(80–120)	90	(80–120)	90	(80–100)	0.000
The intervention group (n = 16)											
Systolic	130	(120–180)	150	(140–200)	140	(130–200)	140	(130–190)	140	(130–170)	0.000
Diastolic	80	(60–90)	85	(70–100)	80	(60–100)	80	(70–90)	80	(70–90)	0.038

^a p < 0:05. HD. * Difference between the groups using the Friedman test (data is not normally distributed). Blood pressure measurement was performed on pre HD, 1sthour, 2nd hour, 3rd hour, and post HD.

massage is one of the nursing interventions for patients with CKD to improve the quality of HD therapy. Another nursing education to prevent the poor prognosis of IDH and primary hypertension can also be applied salt-reduction and efficacy-maintenance.²⁶ Patients will feel comfortable and give a pleasant impression during the therapy session, as their health condition is getting better. Patient comfort is an indicator of the success of hospital services and development. Initially there were respondents who did not believe that foot massage can reduce IDH, but after knowing the results of the blood pressure measurements on hourly observations, respondents felt that FM provided was very comfortable, make it easy to sleep and enjoy the HD process. Some even involve their families to learn FM movements so that they can be done independently.

5. Conclusions

This study showed that foot massage for 10 min every hour for 4 h of HD resulted in improving systole and diastole blood pressure on people with intradialytic hypertension during HD.

Strengths and weaknesses of the study

FM is an efficient, easy, inexpensive, no-risk, simple but proven intervention for its benefits in controlling IDH. Controlling IDH also means that the risk of complications during HD can be suppressed. But the majority of respondents in this study were female so their effects could not be generalized for men, and blood pressure measurements were carried out without similiar on just one leg.

3 Declaration of competing interest

The authors declare that the publication of this paper has no conflict of interests.

Acknowledgments

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