

The Effectiveness of Foot and Back Massage to Stabilize Hemodynamics in Patients Undergoing Hemodialysis: A Quasy Experiment

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Abstract

Objective: To determine the effect of foot and back massage on hemodynamic stability in chronic kidney disease (CKD) patients undergoing hemodialysis. Hemodynamic stability is essential for patients undergoing hemodialysis, as electrolyte disturbances and hypertension significantly impact their clinical outcomes. This study hypothesizes that foot and back massage could serve as effective non-pharmacological interventions to improve hemodynamic parameters, addressing an area with limited research evidence and aiming to enhance patient care.

Material and Method: This study used pre-test and post-test method with non-equivalent control-group design, involving 46 patients divided into 2 groups, intervention group and control group (received routine care). The intervention began with a screening process and pre-test in both intervention and control groups. After the initial assessment, the intervention group began to receive the first intervention session. Foot and back massage interventions were carried out 6 times for 6 days with a duration of 13-15 minutes. Respondents in the control group received routine care. After completing six intervention sessions, post-test was conducted to assess changes in hemodynamics (systolic and diastolic blood pressure, heart rate, respiratory rate, and oxygen saturation).

Results: There was a significant difference after the foot and back massage intervention on hemodynamics stability (Systolic and diastolic blood pressure, heart rate (HR), respiratory rate (RR), oxygen saturation (SPO₂) before and after the intervention, with $p < 0.05$.

Conclusion: There is a significant effect of foot and back massage interventions on hemodynamic stability (Systolic and diastolic blood pressure, heart rate, respiratory rate, oxygen saturation) in CKD patients undergoing hemodialysis.

Keywords: Hemodynamic, foot, back, massage, hemodialysis.

Introduction

Chronic Kidney Disease (CKD) is a condition in which kidney function decreases significantly for more than 3 months. The kidneys play a crucial role

in the elimination of water-soluble waste products ¹. CKD can disrupt the renin-angiotensin-aldosterone system, which regulates blood pressure and fluid balance in the body. Increased activity of this system may lead to hypertension ². Hemodialysis

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(HD) plays a crucial role as a lifeline for patients with CKD. Patient with CKD often experience alterations in hemodynamic parameters³. One aspect of hemodynamics is vital signs. Vital signs are fundamental yet highly significant elements in the physiological evaluation of patients. They are used as a means to monitor how the body's systems are functioning and to assess the clinical status of patients⁴. The prevalence of hypertension among patients with CKD ranges between 76% and 90%⁵.

HD facilitates the removal of metabolic waste—urea, creatinine, phosphate—and excess fluid via a dialyzer, stabilizing blood pressure and correcting electrolyte and acid-base imbalances in patients with kidney failure⁶. HD alters electrolyte levels, including sodium, potassium, and calcium, and influences vascular dynamics during dialysis^{7,8}.

Massage therapy effectively stabilizes hemodynamic parameters in hypertensive patients by inducing muscle relaxation, promoting vasodilation, and sustaining blood pressure reduction⁹. Studies highlight its role in modulating cardiac autonomic function through hormonal mechanisms, directly influencing heart rate, systolic and diastolic blood pressure, and enhancing heart rate variability, indicating increased parasympathetic activity¹⁰. Current research on hemodynamic instability in CKD emphasizes pharmacological and lifestyle interventions, with limited focus on massage therapy. Evidence remains inconclusive, necessitating robust trials to validate its efficacy in hemodialysis and support clinical integration.

Materials and Methods

Research Design and Setting

The research design selected for the study was quasi-experimental, pre-test and post-test with non-equivalent control-group design, at the General Hospital of Aceh. This study was conducted after completing the ethical review process, which was approved by the Health Research Ethics Committee at dr. Zainoel Abidin General Hospital, Banda Aceh, under approval number 255/ETIK-RSUDZA/2024.

All respondents provided written informed consent to participate in this study.

Population and Sample

All patients with CKD undergoing hemodialysis in the provincial hospital of Aceh Indonesia. Based on calculations using Cohen's table and considering a 95% confidence interval with an alpha value of 0.05, the required sample size is estimated to be around 46 patients.

The study involved a total of 46 respondents, evenly divided into two groups, with 23 respondents in the experimental group and 23 in the control group. Inclusion criteria required respondents to be CKD patients undergoing hemodialysis for at least three months, experiencing fatigue confirmed through screening, fully conscious (*compos mentis*), cooperative, able to communicate effectively, and free from hearing or visual impairments. Patients were excluded if they had impaired consciousness, tested positive for HbsAg, or had wounds, secondary infections, or fractures affecting the extremities and spine.

Procedure of Study

Before implementing the intervention, the preparation of enumerators in this study was conducted meticulously through training sessions on massage techniques, provision of relevant guidelines, and practical demonstrations to ensure the successful implementation of the foot and back massage intervention. Three professional nurses, graduates of the Bachelor Program, were hired as enumerators, possessing basic knowledge of massage techniques. They then participated in training sessions, which included both theory and practice on massage techniques, conducted over four sessions. During the first to third sessions, the enumerators were trained to understand effective methods and ways to interact appropriately with patients. The fourth session focused on evaluating massage techniques to ensure the enumerators could apply them correctly. Additionally, mutual understanding regarding the procedural implementation of massage techniques

was emphasized and discussed, ensuring all enumerators shared the same perspective.

The preparation of equipment for this study involved several essential steps. The tools used included a stethoscope, sphygmomanometer, and oximeter, all of which were calibrated to ensure accurate measurements of patients' hemodynamic parameters. The intervention began with a screening process and initial measurements (pre-test) for both the intervention and control groups. Following the initial assessment, the intervention group began their first session of foot and back massage therapy. In this study, the intervention was conducted six times over a period of six days for the intervention group. Respondents in the foot and back massage group received massage sessions lasting 13-15 minutes each. Meanwhile, respondents in the control group continued to receive routine care. Upon completing the six intervention sessions, a final measurement (post-test) was carried out to evaluate changes in hemodynamic parameters.

Results

The systolic blood pressure of the intervention group decreased from an average of 155.48 mmHg before the intervention to 135.00 mmHg after the intervention, while the control group decreased from 144.00 mmHg to 143.22 mmHg. For diastolic blood pressure, the intervention group decreased from an average of 94.87 mmHg to 82.39 mmHg, while the control group increased from 85.87 mmHg to 89.65 mmHg.

The intervention group's heart rate decreased from 85.65 bpm to 75.52 bpm, while the control group increased from 85.65 bpm to 87.65 bpm. The intervention group's breathing rate decreased from 25.65 to 23.39, while the control group increased from 23.70 to 24.70. The oxygen saturation of the intervention group increased from 97.61% to 98.22%, while the control group did not experience significant changes, remaining at 97.83%, See Table 1.

Table 1. Differences in Hemodynamic Parameters of Hemodialysis Patients Before and After the Foot and Back Massage Intervention in the Intervention and Control Groups.

Variable	Intervention Groups (n = 23) Mean/SD		Control Group (n = 23) Mean/SD			Mann-Whitney U-test		
	Pre-test	Post-test	Wilcoxon test	Pre-test	Post-test	Wilcoxon test		
Systolic blood pressure	155.48 (19.503)	135.00 (12.881)	Z = -4.049 <i>p</i> < 0.001	144.00 (20.629)	143.22 (13.460)	Z = -0.122 <i>p</i> = 0.903	Pre-test: Z = -1.962 <i>p</i> = 0.050	Post-test: Z = -2.044 <i>p</i> = 0.041
Score different	20.48		0.78					
Diastolic blood pressure	94.87 (8.761)	82.39 (9.277)	Z = -3.834 <i>p</i> < 0.001	85.87 (11.589)	89.65 (8.731)	Z = -1.895 <i>p</i> = 0.058	Z = -2.537 <i>p</i> = 0.011	Z = -2.424 <i>p</i> = 0.015
Score different	12.48		-3.78					
Heart rate	85.65 (12.029)	75.52 (7.372)	Z = -3.790 <i>p</i> < 0.001	85.65 (12.029)	87.65 (8.788)	Z = -1.794 <i>p</i> = 0.073	Z = 0.000 <i>p</i> = 1.000	Z = -4.198 <i>p</i> < 0.001
Score different	10.13		-2.00					
Respiration rate	25.65 (2.328)	23.39 (1.803)	Z = -3.768 <i>p</i> < 0.001	23.70 (2.721)	24.70 (1.845)	Z = -1.928 <i>p</i> = 0.054	Z = -2.612 <i>p</i> = 0.009	Z = -2.535 <i>p</i> = 0.011

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Score different	2.26		-1.00					
Oxygen saturation	97.61 (0.583)	98.22 (0.671)	Z= -3.500 <i>p</i> <0.001	97.83 (0.650)	97.83 (0.576)	Z= 0.000 <i>p</i> =1.000	Z= -1.138 <i>p</i> = 0.255	Z= -2.002 <i>p</i> = 0.045
Score different	-0.61		0.00					

Discussion

Vital signs are essential indicators for nurses to monitor patients' health conditions. These include blood pressure, measuring blood flow force through arteries, systolic during heartbeats, diastolic when heart rests; pulse rate, heartbeats per minute; respiratory rate, breaths per minute; and oxygen saturation, oxygen bound to hemoglobin⁴. Patients undergoing hemodialysis often experience changes in hemodynamic parameters due to various factors. Declining kidney function in CKD impacts blood pressure regulation, blood volume, and glomerular filtration, often leading to fluid and electrolyte imbalances that affect circulation⁸.

The hemodynamic changes observed in this study, particularly in relation to blood pressure, are described as follows. CKD can lead to imbalances in the renin-angiotensin-aldosterone system, a critical regulator of blood pressure and fluid homeostasis in the body². In patients undergoing regular hemodialysis, fluid and salt retention, as well as electrolyte fluctuations, can occur, leading to an increased volume load on the cardiovascular system¹¹. This aligns with the statistical test results, which demonstrated a highly significant decrease in systolic and diastolic blood pressure in the intervention group following the foot and back massage intervention.

Massage therapy can serve as an integral part of a comprehensive hypertension management strategy, aimed at enhancing patient well-being¹². A study has reported that foot massage intervention during hemodialysis sessions resulted in a significant reduction in systolic and diastolic blood pressure¹³. Back massage interventions have also been shown to influence blood pressure in clients with hypertension, contributing to its regulation and overall cardiovascular health¹⁴.

Massage is one of the most effective therapies for reducing blood pressure in hypertensive patients. It induces a relaxing effect on tense muscles, promoting vasodilation, which leads to a stable decrease in blood pressure⁹. In addition to its significant impact on lowering blood pressure and relieving fatigue, massage also plays a vital role in reducing psychological stress, promoting overall mental well-being¹⁵.

In addition to providing positive effects for patients with intradialytic hypertension, massage also helps relieve complaints of headaches, enhancing overall comfort and well-being¹⁶. Overall, massage therapy enhances relaxation, reduces physiological stress responses, and strengthens the adaptability of the autonomic nervous system, contributing to improved physical and mental well-being¹⁷.

The changes in heart rate (HR) observed in this study affect HD patients as it reflects the balance between sympathetic and parasympathetic nervous system activity, contributing to cardiovascular health and overall circulatory system function¹⁸. HR can fluctuate due to various factors, including hormonal influences. Hormones such as catecholamines, released in response to stress, play a role in modulating sympathetic and parasympathetic activity. This, in turn, affects HR and HRV, highlighting the intricate connection between the endocrine system and autonomic nervous regulation¹⁹.

The statistical test results indicated a significant decrease in heart rate within the intervention group following the intervention. Patients receiving effleurage back massage were able to maintain their heart rate within the normal range, reflecting its potential in supporting cardiovascular stability and relaxation²⁰.

Another study explained that sports massage and reflexology are also effective in reducing heart rate and blood pressure²¹. The relaxation effects and enhanced circulation induced by massage therapy can effectively reduce stress and promote a sense of comfort, contributing to both physical and mental stability²². Massage affects the autonomic function of the heart through hormonal mechanisms, as described in previous studies that highlight its effects on heart autonomic functions. This underscores how massage therapy can support the balance of the autonomic nervous system and contribute to cardiovascular health¹⁰. A 30-minute foot massage has been shown to result in a significant improvement in hemodynamic stability, highlighting its potential as an effective non-pharmacological intervention for enhancing cardiovascular function²³.

Massage can stimulate parasympathetic nerve, leading to the release of acetylcholine and a reduction in depolarization frequency, ultimately slowing the heart rate. Furthermore, the combination of foot massage and aromatherapy enhances relaxation, contributing further to heart rate reduction and overall autonomic stability²⁴. Through autonomic nervous system stimulation, foot massage induces vasodilation and improves peripheral blood flow, thereby supporting more stable hemodynamic status and enhancing overall cardiovascular function²⁵.

The RR changes in this study, observed alterations in RR may be associated with the effects of hypoxemia. Hypoxemia in hemodialysis patients can lead to decreased blood oxygen levels. During hemodialysis, PaO₂ may drop by 10-20 mmHg, potentially triggering cardiac or pulmonary issues, which are often exacerbated by alveolar hypoventilation. This underscores the importance of monitoring oxygen saturation and managing respiratory function in patients undergoing HD to prevent complications²⁶. The results of this study showed that the intervention group experienced a significant reduction in respiratory rate following the intervention. This finding emphasizes the potential benefits of the therapy in improving respiratory function and promoting relaxation.

Effleurage back massage positively impacts respiratory rate by enhancing relaxation, reducing anxiety, and improving blood circulation and oxygenation. This highlights its potential as a therapeutic intervention for promoting both physical and mental well-being²⁰. In addition, foot massage also stimulates the release of acetylcholine. This mechanism slows down the heart rate, enhancing overall relaxation and supporting improved autonomic function and bodily restoration²⁷. By improving the body's physiological balance, this therapy plays a crucial role in supporting asthma management and enhancing the efficiency of lung function in patients. Its impact highlights the potential for integrating such approaches into comprehensive respiratory care strategies²⁸. Thus, foot massage can be utilized as an effective non-pharmacological intervention in managing clinical conditions with a holistic approach. Its benefits extend beyond relaxation, supporting both physical and psychological well-being through improved physiological balance²⁹.

The SPO₂ changes in Hemodialysis (HD) can lead to a decrease in oxygen saturation due to ischemic injury in organs, which is triggered by a reduction in circulating blood volume³⁰. Changes in blood oxygenation levels (SpO₂) due to the effects of the hemodialysis (HD) process are influenced by hemoglobin, blood pH, and lung function. Some issues such as pulmonary edema, and pulmonary calcification also affect oxygen levels³¹.

Massage has a significant effect on the improvement of oxygen saturation and other physiological parameters. The results of the statistical test showed that the intervention group experienced a significant decrease in oxygen saturation after the intervention. Research shows that deep tissue massage (DTM) significantly increases oxygen saturation by 2.67% and vital capacity³². Foot massage can also improve oxygen saturation in CKD patients undergoing hemodialysis³³. This effect is associated with the stimulation of peripheral blood circulation. Massage directly enhances oxygen delivery to tissues²⁵. Massage activities enhance relaxation effects and

reduce anxiety, which support peripheral blood flow and oxygen delivery to tissues³⁴.

Another type of massage, such as back massage administered for 15 minutes daily over a four-day period, has been shown to reduce anxiety. The relaxation effects produced contribute to enhanced pulmonary function and improved blood circulation, which can enhance oxygen saturation levels³⁵. Massage also helps reduce anxiety. This effect contributes to improved oxygen saturation by enhancing parasympathetic nervous system activity and enhancing blood flow. Additionally, effleurage back massage provides a significant reduction in pain levels²⁰.

Conclusion

The intervention demonstrated a significant impact on hemodynamic parameters in CKD patients undergoing hemodialysis, with notable reductions in systolic and diastolic blood pressure, HR, and RR compared to the control group. These findings highlight the effectiveness of foot and back massage in enhancing hemodynamic parameters for patients undergoing hemodialysis.

Limitations of The Study

The study's pharmacological limitations include uncontrolled medication use, such as routine and conditional amlodipine administration, which may influence blood pressure. Hemodynamic assessments were conducted after six intervention sessions rather than immediately following each session, potentially affecting measurement accuracy.

Future Research Recommendations

Future research should also explore the effects of various other therapeutic techniques, such as aromatherapy, acupuncture, or reflexology, that enhances hemodynamic stability in hemodialysis patients. Evaluating these synergistic effects may reveal greater therapeutic benefits.

Ethical Consideration

The research approval was given by the Health Research Ethics Committee at dr. Zainoel Abidin

General Hospital, Banda Aceh, under approval number 255/ETIK-RSUDZA/2024.

Conflict of Interest

All the authors declared that no have conflicts of interest in this study.

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