

Research Paper

The Effect of Foot Bath on Physiological Parameters and Anxiety in Patients With Acute Stroke: A Randomized Controlled Trial



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ABSTRACT

Objectives: Stroke is one of the most important neurological diseases in the world. Anxiety is one of the most common mental disorders associated with stroke that can disrupt the daily functioning of patients. The aim of this study was to determine the effect of foot baths on physiological parameters and anxiety in patients with stroke.

Methods: The present study was a single-blind clinical trial that was performed on 60 patients with stroke admitted to Tohid Hospital in Sanandaj. The available method was used for sampling and the samples were randomly divided into two groups of test and control (30 people in each group). For the patients of the experimental group, between 2 and 5 PM., a foot bath was performed for 15 minutes by a researcher colleague. For patients in both the experimental and control groups, blood pressure, temperature, heart rate, respiration rate, SpO₂, and anxiety in the supine position were measured before and half an hour after the intervention. Data were analyzed using SPSS software, version 19 by the independent and paired t-tests at a significance level of P<0.05.

Results: The mean age of the subjects was 60.98±9.53 years. After the intervention in the experimental group, the mean scores of systolic (159.73 vs. 149.87) and diastolic (90.87 vs. 89.03) blood pressures, heart rate (86.47 vs. 85.37), and anxiety (51.8 vs. 48.4) significantly reduced and the amount of SpO₂ (96.2 vs. 97.67) significantly increased (P<0.05). Based on the independent t-test, no statistically significant difference was observed between the experimental and control groups in terms of physiological parameters and anxiety (P>0.05).

Discussion: Given the importance of the role of nurses in the rehabilitation of patients with stroke, complementary medicine methods, such as foot baths can be considered safe, inexpensive, and uncomplicated methods in patients with stroke to reduce anxiety and improve physiological parameters.

Keywords:

Stroke, Anxiety, Physiological parameters, Foot bath

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Highlights

- Stroke is known as the most important neurological disease in the world
- Anxiety is the most common neurological disorder associated with stroke
- A foot bath as a method of complementary medicine, is beneficial for the whole body and human brain and can also cause positive physiological effects, comfort, relaxation, improved sleep, and reduced stress
- Foot baths reduce stress and improve physiological parameters in stroke patients

Plain Language Summary

Stroke is known as the most important neurological disease in the world and also one of the most important debilitating factors in Iran. Anxiety is one of the most common mental disorders associated with stroke. Anxiety affects all aspects of rehabilitation of these patients and will delay rehabilitation worsen their physical condition and ultimately increase the mortality rate of these patients, especially in the first ten years after stroke. A foot bath as a method of complementary medicine, is beneficial for the whole body and human brain and can also cause positive physiological effects, and cause comfort, relaxation, improved sleep, and reduced stress. The use of foot baths as one of the areas of complementary medicine is recommended as a safe, inexpensive, and uncomplicated method in patients with stroke. Considering the effect of foot baths in reducing stress in stroke patients, it is suggested to investigate its effect on other stroke complications and anxiety and physiological indicators in other clinical conditions.

Introduction

Stroke is known as the most important neurological disease in the world, which annually kills about 5.5 million people worldwide and causes disability for many people [1]. Statistics from the [American Heart Association \(AHA\)](#) show that on average, one stroke occurs every 40 seconds in the United States, with about 600,000 people experiencing a stroke for the first time and 185,000 experiencing a stroke annually [2, 3]. In Asia, stroke is the most common vascular and neurological disease [4]. Stroke is also one of the most important debilitating factors in Iran. According to statistics available in Iran, the annual incidence of stroke is about 372 people per 100,000 people, which is significantly higher than most Western countries [5].

Stroke is responsible for long-term disabilities, decreased independence, and reduced quality of life in patients [6]. More than 50% of patients will suffer from severe permanent neurological damage [7]. Sensory and motor impairments, such as hemiparesis, imbalance, decreased mobility, decreased muscle tone, spasticity of limbs, and cognitive impairments are common after stroke [8]. In addition to sensory and motor complications, mental health problems are also high in patients with stroke. Anxiety is one of the most common mental

disorders associated with stroke. The prevalence of anxiety in patients with stroke is 14-28% in the acute stage of the disease, which can last up to three years [9]. The effects of anxiety on stroke patients include increased treatment costs and caregivers' burden, inability to perform daily activities, poor cognitive function, inability to return to work and social activities, and poor speech performance. In addition, anxiety affects all aspects of the rehabilitation of these patients and will delay rehabilitation worsen their physical condition, and ultimately, increase the mortality rate of these patients, especially in the first ten years after stroke [9].

Specialists emphasize the importance of using non-pharmacological methods in anxiety treatment and control [9]. One of the therapies that is more emphasized today is complementary and alternative medicine, which has gained new value and respect along with modern medical knowledge [10]. A foot bath as a method of complementary medicine, helps maintain the function and integrity of the skin of the foot. In addition, it is beneficial for the whole body and human brain and can also cause positive physiological effects, comfort, and relaxation, improve sleep, and reduce stress [11]. A foot bath increases blood flow through the legs and the surface of the skin and reduces congestion in the internal organs and brain [12]. Research on the general physiological effects of foot baths on the human body has shown that foot baths promote relaxation in the autonomic nervous system. Azimian et

al. [13] declared that foot baths reduced the pain after hand transplant surgery, reduced back pain in pregnant women, and decreased the symptoms of fatigue and insomnia in patients with cancer. Miyazato et al. [14] showed the effect of a foot bath on muscle relaxation in the uterus of pregnant women by reducing sympathetic activity. Disability due to cerebrovascular diseases is one of the problems that encourages people to use complementary and alternative medicine [10]. Due to the high prevalence of anxiety after stroke and few studies in this field, and also in order to determine the safety of foot baths in stroke patients, this study aimed at determining the effect of foot baths on physiological parameters and anxiety in patients with acute stroke.

Materials and Methods

Study design and participants

The present study was a single-blind clinical trial that was performed on patients with stroke admitted to the neurology ward of Tohid Hospital in Sanandaj in 2018-

2019. The sample size was estimated to be 30 people for each group with a confidence of 95% and a power of 80% using the following Equation 1:

$$1. n = \frac{(\sigma_1^2 + \sigma_2^2) (z_{1-\frac{\alpha}{2}} + z_{1-\beta})^2}{(\mu_1 - \mu_2)^2}$$

A total of 70 samples were selected using available methods, of whom ten cases were excluded from the study due to the lack of inclusion criteria, and the rest were randomly divided into the experimental and control groups using sealed envelopes (Figure 1). Inclusion criteria included the patient's alertness, the age of 30 years and above, the health of at least one of the lower limbs in terms of sensation and movement, the definitive diagnosis of stroke by the treating physician, voluntary participation of the patient in the study, no acute and severe physiological disorders, no history of drug use, no skin disorders and deformities in the lower extremities, no circulatory disorders and oxygen delivery to the lower extremities, and no neuromuscular diseases in the lower

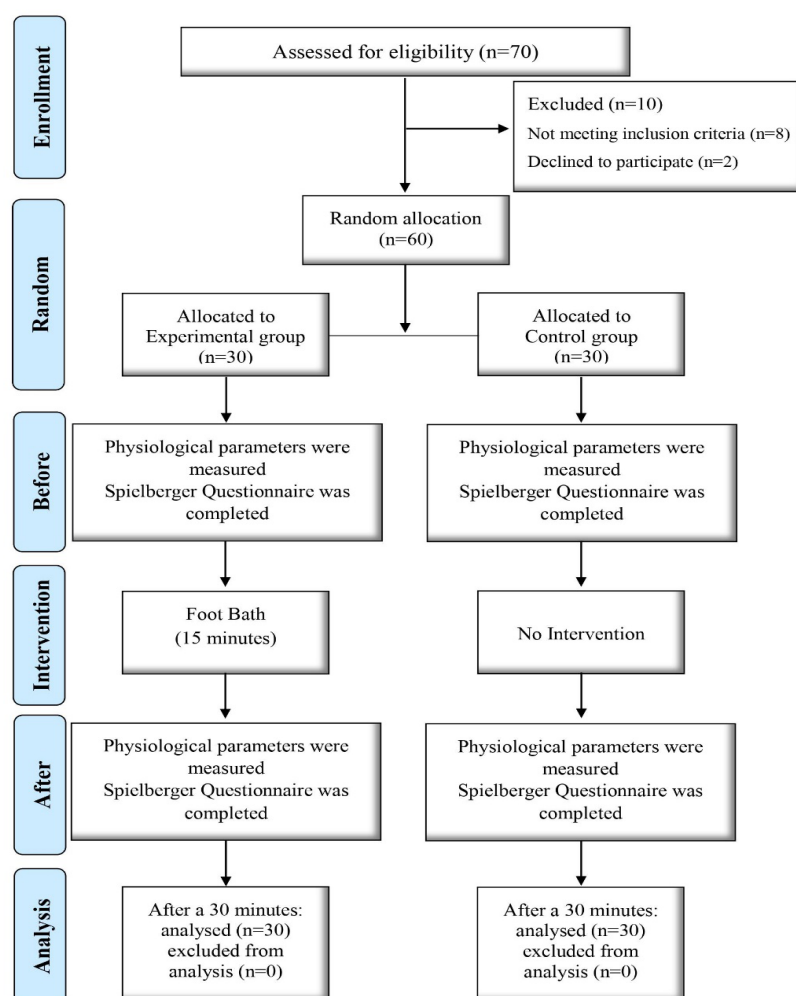


Figure 1. CONSORT flowchart of the study

extremities. Exclusion criteria also included the onset of symptoms less than 24 hours before (due to the possibility of transient ischemic attack), receiving more than three liters of serum or intravenous drugs that increase or decrease blood pressure, reluctance to continue cooperation by the patient, patient's death, threatening changes in the patient's physiological condition, and a sudden drop in the patient's level of consciousness.

Data collection

Data collection tools included a checklist of demographic and clinical status of patients (age, sex, marital status, education, smoking, underlying disease, affected limb, day of hospitalization, type of stroke, location of stroke, and the severity of stroke), the form of physiological parameters (systolic blood pressure, diastolic blood pressure, heart rate, respiration rate, temperature, and arterial blood saturation) and a standard Spielberger questionnaire. This questionnaire (1983) has two parts as a measure of anxiety. The first part (20 questions) measures the anxiety of the respondents or the obvious anxiety of the respondents at the moment of answering. The second part (20 questions) also measures the level of personality or latent anxiety and the general and ordinary feelings of the respondents. Each option will be given a score of one to four, respectively. Finally, the total scores are placed in one of the three groups: Mild anxiety (score 40-79), moderate anxiety (score 119-80), and severe anxiety (score 120-160) [15, 16]. The validity of this tool has been examined and confirmed in various studies in Iran [17, 18]. In this study, the reliability of the tool was evaluated by conducting a preliminary study on 20 samples of the study and was equal to 0.79.

Ethical considerations

To conduct the research, the necessary permission was obtained from the [Kurdistan University of Medical Sciences](#) Ethics Committee and the officials of Tohid Hospital in Sanandaj. Patients were selected as a sample at least 24 hours after admission according to the inclusion criteria. After obtaining written consent, they were randomly assigned to one of the experimental and control groups. After the research, a foot bath was performed for the patients in the control group similar to the patients in the experimental group.

Interventions

In order to conduct the research, before the intervention in the experimental group, blood pressure, temperature, heart rate, respiration rate, and arterial hemoglobin satu-

ration was measured and the Spielberger questionnaire was completed for both patients in the experimental and control groups while lying in the bed. In order to perform the intervention for the patients of the experimental group, between 2 and 5 PM, the patient first sat on the edge of the bed (or chair) for 10 minutes and immediately a foot bath was performed for 15 minutes by a researcher colleague. The patient's feet were immersed in water (40°C) without any massage up to the ankles and then dried with a disposable towel. During the intervention, the patient or the patient's caregiver did not talk to the patient so as not to affect the patient's anxiety status. Patients in the control group did not receive any intervention and sat on the edge of the bed for only 10 minutes. Half an hour later, blood pressure, temperature, heart rate, respiration rate, and arterial blood oxygen saturation while lying on the bed (similar to before the intervention) were measured for patients in both experimental and control groups. Then, the Spielberger questionnaire was completed.

Statistical analysis

Data were analyzed using SPSS software, version 19 using descriptive and inferential statistical methods. The normality distribution of the variables was investigated using the Kolmogorov-Smirnov tests. To investigate the similarity of qualitative and quantitative demographic variables in the two groups, the independent and paired t-tests were used and the effect of the intervention on anxiety variables and physiological indicators were assessed.

Results

Participants' characteristics

The mean age of the subjects was 60.98±9.53 years and 55% (33 people) were male. In terms of education, 56.7% (34 people) were illiterate. 50% (30 people) had no history of smoking, and 66.7% (40 people) were married (Table 1). There was no significant difference between the experimental and control groups except for the two variables of affected hemisphere ($P=0.039$) and stroke severity ($P=0.007$) (Table 1).

Based on the results of the independent t-test, before the intervention, the experimental and control groups were identical in all physiological variables and anxiety and there was no significant difference between them ($P>0.05$). Within-group comparison based on the paired t-test showed that in the control group, systolic blood pressure ($P=0.001$), diastolic blood pressure ($P=0.043$),

Table 1. Demographic characteristics of the samples by group

Variables	Mean±SD/No. (%)			P	
	Intervention	Control	Total		
Age (y)	62.13±9.8	59.8±9.2	60.98±9.53	0.355	
Hospitalization (d)	6.87±2.50	6.07±3.43	6.47±3.0	0.307	
Sex	Male	18(60)	15(50)	33(55)	0.445
	Female	12(40)	15(50)	27(45)	
Education	Illiterate	19(63.3)	15(50)	34(56.7)	0.654
	Elementary	1(3.3)	9(30)	10(16.7)	
	Middle school	5(16.7)	5(16.7)	10(16.7)	
	Diploma	4(13.3)	0(0)	4(6.7)	
	Higher than diploma	1(3.3)	1(3.3)	2(3.3)	
Marriage	Married	19(63.3)	21(70)	40(66.7)	0.646
	Unmarried	11(36.7)	9(30)	20(33.3)	
Smoking	Yes	17(56.7)	13(43.3)	30(50)	0.310
	No	13(43.3)	17(56.7)	30(50)	
Underlying disease	No	1(3.3)	3(10)	4(6.7)	0.127
	Cerebrovascular accident	9(30)	7(23.3)	16(26.6)	
	Diabetes	4(13.3)	5(16.6)	9(15)	
	Coronary	10(33.3)	6(20)	16(26.6)	
	Hypertension	10(33.3)	10(33.3)	20(33.3)	
	Dislipidemia	4(13.3)	2(6.6)	6(10)	
Affected limbs	Right arm	7(23.3)	17(56.6)	24(40)	0.870
	Left arm	15(50)	10(33.3)	25(41.6)	
	Right leg	6(20)	5(16.6)	9(15)	
	Left leg	4(13.3)	1(3.3)	5(8.3)	
Affected hemisphere	Right	19(63.3)	11(36.7)	30(50)	0.039
	Left	11(36.7)	19(63.3)	30(50)	

Variables	Mean±SD/No. (%)			P
	Intervention	Control	Total	
Stroke type	Ischemic	23(76.7)	22(73.3)	0.770
	Hemorrhagic	7(23.3)	8(26.7)	
Muscle strength (MRC)*	0	17(56.7)	10(33.3)	0.007
	1	10(33.3)	8(26.7)	
	2	2(6.7)	7(23.3)	
	3	1(3.3)	2(6.7)	
	4	0(0)	2(6.7)	
	5	0(0)	1(3.3)	

Iranian Rehabilitation Journal

*MRC: 0=No movement, 1=only a trace or flicker of movement is seen or felt, or fasciculations are observed, 2=Muscle can only move if resistance of gravity is removed, 3=Strength further reduced such that joint can be moved only against gravity with examiner’s resistance completely removed, 4=Strength reduced, but contraction can still move joint against resistance, 5=Muscle contracts against full resistance

heart rate (P=0.003), and SPO₂ (P=0.001) before and after the study were significantly different. In the experimental group, after the intervention, the mean scores of systolic and diastolic blood pressure, heart rate, and anxiety significantly reduced and SPO₂ significantly increased (P<0.05). Based on independent t-test results, no statistically significant difference was observed between the experimental and control groups in terms of physiological parameters and anxiety (P>0.05) (Table 2).

Discussion

Hemodynamic disorders and neuropsychological problems, such as anxiety are one of the most common consequences in patients with stroke. The development of these disorders can lead to negative effects on the process of management and treatment of stroke patients, especially in the early stages of the disease, and cause interference in the rehabilitation process and more com-

Table 2. Mean values of physiological indices and anxiety of samples before and after the intervention by group

Parameters	Control		P*	Intervention		P*	P**
	Mean±SD			Mean±SD			
	Pre-intervention	Post-intervention		Pre-intervention	Post-intervention		
Systolic BP	154.67±21.21	147.10±17.37	0.001	159.73±15.17	149.87±12.20	0.001	0.298
Diastolic BP	100.50±10.15	88.33±8.69	0.043	90.87±6.30	89.03±6.70	0.016	0.867
Heart rate	81.67±10.89	79.57±9.9	0.003	86.47±8.19	85.37±9.01	0.058	0.060
Respiratory Rate	18.80±2.12	18.67±2.09	0.326	19.67±1.39	19.47±1.52	0.396	0.067
Temperatures	37.04±0.21	37.02±0.25	0.522	37.08±0.26	37.07±0.28	0.876	0.526
SPO ₂	96.40±1.27	97.33±1.47	0.001	96.20±1.44	97.67±1.29	0.001	0.527
Anxiety	50.76±6.2	49.86±4.68	0.554	51.80±4.08	48.40±3.02	0.001	0.451

* Paired t-test, **Independent t-test.

Iranian Rehabilitation Journal

plications and problems in these patients [19]. Considering the importance of physiological and psychological stability of stroke patients, especially during the acute period of hospitalization, the effect of foot bath on physiological parameters and the level of anxiety in patients with acute stroke were compared with previous studies.

The level of anxiety after the intervention in the experimental group significantly reduced compared to before the intervention, although it was not statistically significant compared to the control group. Consistent with the results of our study, in the study of Yu et al. [20], the implementation of an intensive care program in stroke patients was effective in reducing anxiety and improving cognitive function in these patients. Zhang et al. [21] also stated that nursing rehabilitation interventions are effective in reducing anxiety in stroke patients. Reduction of anxiety in patients with stroke following slow stroke back massage (SSBM) was reported [9], which is in accordance with the results of our study.

Given the effectiveness of most interventions in reducing the anxiety of patients with stroke, it seems that factors, such as the effectiveness, side effects, cost, and ease of performing each of these interventions should be considered more. By comparing foot baths with other interventions, their use can be considered as a low-cost and uncomplicated complementary medicine. It can be used in these patients even in the early and acute stages of stroke, which may not be possible due to the condition of the disease. In addition, in various other studies, the use of foot baths as a complication-free, low-cost, and effective method in various situations has been investigated and its effectiveness has been reported. In the study by Kim et al. [22], the use of foot baths in combination with aromatherapy reduced stress and improved sleep quality in patients with end-stage cancer. Raut et al. [23] also showed that the use of warm foot baths can be beneficial in the quality of sleep and relaxation in the elderly. Effati Dariani et al. [24] stated that using foot baths with and without lavender cream reduced postpartum stress, anxiety, and depression. In another study, Azimian et al. [13] reported the effectiveness of foot baths in reducing the pain caused by fistula needle placement in hemodialysis patients. The effect of foot bath use on other conditions of stroke patients still needs further studies. However, due to the effectiveness of foot baths in reducing the anxiety of stroke patients and also its effects on patients with various other conditions, its use can be suggested to control the anxiety of these patients.

According to the results of the study, foot bath intervention was effective in systolic blood pressure, diastolic blood pressure, heart rate, and arterial blood oxygen saturation of patients. In other words, it reduced systolic and diastolic blood pressures and heart rate and increased arterial blood oxygen saturation. Although the changes in these physiological indices were also significant in the control group, the difference between the two groups was not significant. Perhaps one of the reasons for the lack of difference between the two groups is the heterogeneity of patients in the experimental and control groups in terms of stroke severity so that the patients in the experimental group had more severe degrees of stroke and this reduced the effect of foot bath intervention on patients in this group. Mohammadpour et al. assessed the effect of foot reflexology massage on the physiological parameters of patients with stroke and showed a significant reduction in heart rate [25] and hypotension [26] in these patients. In these studies, foot reflexology massage did not affect other physiological parameters. Similar to our study, Khost et al. [27] showed that foot massage increased the oxygen saturation of arterial blood in patients with stroke. Rubinowicz-Zasada et al. [28] also showed that electrical neuromuscular stimulation in combination with diabetes treatments in diabetic patients with stroke can be effective in lowering blood pressure in these patients.

The constant physiological status of patients with stroke can be very important in the treatment and long-term prognosis and rehabilitation of these patients [29]. Considering the significant changes in physiological characteristics, especially in the experimental group, as well as reviewing related studies in this field, it can be said that complementary medicine interventions, such as foot baths, massage therapy, reflexology, electrical stimulation, etc., can be used as low-cost, effective, and complementary methods in the treatment and rehabilitation of these patients.

Conclusion

Considering the important role of nurses in the rehabilitation of stroke patients and the prevention and control of stroke complications in these patients, and also as we showed that foot bath was effective in stabilizing physiological parameters and reducing anxiety in patients with stroke, the use of this method is recommended as a safe, inexpensive, and uncomplicated method in patients with stroke. Considering the effect of foot baths in reducing stress in stroke patients, it is suggested to investigate its effect on other stroke complications and anxiety and physiological indicators in other clinical conditions.

Study limitations

Due to time constraints, it was not possible to continue the study of the long-term effects of the intervention in this study. In addition, due to the fact that the number of samples was selected only from one medical center, to generalize the results to larger communities, studies with larger sample sizes and longer follow-up periods should be performed.

Ethical Considerations

Compliance with ethical guidelines

This study was approved by the ethics committee of the [Kurdistan University of Medical Sciences](#) (Code: IR.MUK.REC.1397/58) and registered at [Iranian Registry of Clinical Trials](#) (Code: IRCT20180411039274N1).

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Authors' contributions

Ideas and study design: Jamal Seidi and Fazel Dehvan; Statistical analysis and data analysis: Reza Ghanei Gheshlagh; Performing the intervention and data collection: Yaser Nourifard; Writing the final manuscript: All authors.

Conflict of interest

The authors declared no conflict of interest.

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