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Effectiveness of Short Term Foot Massage on Mean Arterial Pressure among Neurosurgical Patients at Surgical ICU

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Abstract

This hydrostatic pressure is around 100 mmHg and varies with height. The mean arterial pressure on the foot may therefore increase to 90–190 mmHg and the venous pressure may increase to about 10–110 mmHg upon adoption of the erect position. Passive exercise such as foot massage can have a calming impact by lowering blood pressure and sympathetic nervous system activity. Reducing blood pressure and boosting the body's blood flow. Short-term foot massage is a systematic technique in which the health of connected body parts can be affected by applying pressure to specific points on the hands and feet. This study aimed to examine the immediate effects of brief foot massage on mean arterial Pressure among neurosurgical patients admitted to intensive care units. The following are the objectives of the study, to determine the patient with neurosurgery's pre-test level mean arterial pressure, to evaluate the impact of brief foot massage on patients undergoing neurosurgery's mean arterial pressure, and to relate the post-test mean arterial pressure to a few demographic factors. For this study, a quantitative research strategy was adopted. This study used a quasi-experimental research design as its methodology. The study was carried out at SMCH. Based on inclusion criteria, a total of 60 study participants were chosen through convenience sampling. A demographic questionnaire and a blood pressure data sheet, which were filled out by observation, interviewing, and physiologic measurement, were used to gather study data. The study results show that the calculated paired 't' test value of t = 6.078 between before 1 min and after 5 minutes and after 1 minute and after 5 minutes was found to be statistically significant at p<0.001 level. This infers that the short-term foot massage administered among the neurosurgical patients was found to be effective in reducing the level of mean arterial pressure.

Keywords: *Intensive Care Unit, Mean Arterial Pressure, Neurosurgery, Short-term Foot Massage.*

Introduction

The intensive care unit (ICU) atmosphere may be stressful for patients due to the constant illumination and loudness of the equipment, as well as the absence of important stimulations like touch and dialogue. Patients may exhibit somatic as well as psychological signs of anxiety in such an atmosphere. Sensory overload or deprivation are two variables that can contribute to the high prevalence of time and location disorientation in the intensive care unit. Approximately 75% of patients in critical care have sensory perception abnormalities due to the extreme sensory overload and deprivation they are experiencing. Studies have shown that up to 30%–40% of intensive care patients, particularly those having neurosurgery, experience symptoms like delusion and hallucination [1]. Patients in acute care who

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undergo neurosurgeries due to their chronic diseases are more susceptible to developing physiological problems. Palliative, diagnostic, and therapeutic operations on the central or peripheral nervous system are referred to as neurosurgeries. Such procedures extend patients' hospital stays, which raises their risk of infection, drives up healthcare expenditures, and puts them in a vicious loop where their chronic conditions worsen and their stress levels rise [2].

The average arterial pressure during one cardiac cycle, including systole and diastole, is known as the mean arterial pressure (MAP). Cardiac output and systemic vascular resistance both affect MAP, and each is impacted by a number of different factors. These will be covered in more detail in the section of this text devoted to mechanisms [3].

The sum of the heart rate and the stroke volume is the cardiac output. Ventricle inotropy and preload are used to calculate stroke volume. Blood volume and vein compliance have an impact on preload. Increasing blood volume raises preload, which raises the volume of the stroke and raises cardiac output. The stroke volume is also impacted by afterload because a rise in afterload will result in a reduction in stroke volume. The myocardium's chronotropy, dromotropy, and lusitropy all have an impact on heart rate [4].

Vascular radius is a key factor in determining systemic vascular resistance. Vascular resistance rises when the radius of the vessels is reduced. The opposite would occur if the vessels' radii were increased. Systemic vascular resistance can also be impacted by blood viscosity. Blood viscosity and systemic vascular resistance both rise with an increase in hematocrit. However, it is believed that viscosity only has a small impact on systemic vascular resistance [5].

Where PP denotes the pulse pressure, SP is the systolic blood pressure, and DP denotes the diastolic blood pressure. Since this method provides a quick way to calculate MAP if the blood pressure is known, it is frequently more suitable for measuring MAP in most clinical contexts. A minimum MAP of 60 mmHg must be maintained to perfuse essential organs. End-organ symptoms like ischemia and infarction may happen if MAP falls below this level for an extended period. A large drop in MAP will prevent blood from perfusing cerebral tissues, cause unconsciousness, and swiftly result in neuronal death [6].

The body has many defence systems to control MAP and guarantee that all organs receive enough perfusion to operate properly. Through a complicated interaction between the circulatory, renal, and autonomic nervous systems, MAP is regulated at the cellular level. Under the Mechanism section of this article, the connections between various relevant systems will be covered in more detail. Through cardiac output and systemic vascular resistance, the cardiovascular system determines the MAP. Intravascular volume, preload, afterload, myocardial contractility, heart rate, and conduction velocity all have a role in controlling cardiac output. Through vasodilation and constriction, systemic vascular resistance is regulated [7].

The renin-angiotensin-aldosterone system, a cascade that results in the production of aldosterone and raises salt reabsorption in the distal convoluted tubules of the kidneys and ultimately raises plasma volume, is how the renal system impacts MAP.Through the carotid sinus and aortic arch baroreceptors, the autonomic nervous system regulates MAP. To keep MAP in the desired range, the autonomic nervous system can influence both cardiac output and systemic vascular resistance [8].

Increased MAP causes endothelial cells to produce more nitric oxide (NO) as a result of shearing stresses on the vessel walls. NO diffuses into the guanylyl cyclase-activated smooth muscle cells of the vascular system, where it causes the dephosphorylation of GTP to cGMP. In the cell, the cGMP functions as a

second messenger, finally causing smooth muscle relaxation and vascular dilatation. Bradykinin and other prostaglandins, which also function through comparable pathways to cause the relaxation of vascular smooth muscle, are other vasodilating substances produced locally [9].

A local vasoactive substance called endothelin has the opposite effects on vascular smooth muscle. The endothelial cells' synthesis of endothelin is triggered by a decreased MAP. Following the production of IP3 and the release of calcium from the sarcoplasmic reticulum, endothelin diffuses into the vascular smooth muscle cells to bind the ET-1 receptor, a Gq-coupled receptor, which causes smooth muscle contraction and vessel constriction [10].

Through the baroreceptor reflex, the autonomic nervous system also plays a crucial part in controlling MAP. A negative feedback mechanism is used by the arterial baroreceptors in the carotid sinus and aortic arch to keep the MAP within a desirable range. The glossopharyngeal nerve (cranial nerve IX) in the carotid sinus and the vagus nerve (cranial nerve X) in the aortic arch are the two pathways by which baroreceptors connect with the nucleus tractussolitarius in the medulla of the brainstem. Depending on what the body requires, the nucleus tractussolitarius decides whether to increase or decrease MAP via sympathetic or parasympathetic tone [11].

A symptom that the person reports is pain. Critically sick patients, however, are unable to communicate or express their discomfort because of unconsciousness, head injury, tracheal intestinal tract, stroke, psychosis, and drowsiness [12, 13]. Because nurses frequently pay little attention to the sources of pain in these patients, they may neglect or underestimate their discomfort [14]. Sources of pain in the intensive care unit (ICU) include tracheal suction, physiotherapy, stiffness, contracture, sprains, dislocations of joints, subcutaneous wounds, and tissue hypoxia. Since changing positions is one of the most painful medical operations, pain management is crucial during nursing care for critically sick patients [15].

Utilising drugs is one way to manage pain in the intensive care unit. Drugs can reduce pain, but they can increase the risk of ventilator-dependent infections, postpone patient removal from the ventilator, and raise expenditures [16]. It is advised to employ non-pharmacological techniques in addition to medicinal therapies to ease pain. Non-pharmacological treatments are thought to be generally available, affordable, and secure [17, 18]. Additionally, using complementary medical techniques falls within the purview of a nurse's job description and skill set. Complementary medicine has been employed in the ICU to manage patients' pain, vital signs, tension, anxiety, and lack of sleep [19, 20]. Pain management techniques including routine position changes, regular faeces and urine discharge, and the use of the proper splints can all assist individuals with reduced levels of consciousness feel less pain. According to a review study, listening to music can help seriously ill people feel less discomfort. Therefore, it is advised that such patients consider the impact of alternative complementary therapies on pain management.

Methods and Materials

Study Design: This research used an experimental design with two groups, one of which was a control group and the other an experimental group. **Study setting**: The ICU at SMCH served as the study's setting for the entire month. **Study participants:** A total of 60 patients with elevated mean arterial pressure were divided into experimental group (n = 30) and control group (n = 30) groups, and those who met the inclusion criteria were chosen to participate in the study. Patients undergoing neurosurgery met the inclusion criteria for the study's participants. **Informed**

consent: neurosurgical patients after a thorough explanation of the study's objectives and the effect of short-term foot massage on mean artery pressure provided. The formal permission was obtained from the Principal, of Saveetha Medical College & Hospital, Chennai and the Medical Superintendent, of Saveetha Medical College & Hospital, Chennai. Informed consent was obtained from the patients admitted to the ICU who are under neurosurgery and have increased mean arterial pressure. Confidentiality of shared information was assured to the study participants. The demographic characteristics were collected by using the demographic tool constructed for the study. Inclusion criteria include Inclusion criteria Patients in the ICU who underwent neurosurgery. The exclusion criteria were the following Patients who have received intravenous opioid or non-opioid analgesics. Patients who needed medications that could affect BP and HR or developed vascular disorders in feet. Patients have normal plantar reflexes and a Glasgow Coma Scale (GCS) score of 8. Pre-test before 5mins of short-term foot massage on mean arterial pressure. For the experimental group, foot massage for 5 minutes on each foot for 2.5 minutes to reduce the mean arterial pressure. Post test was done immediately and after 5 minutes mean arterial pressure was assessed. The data collected were then coded and entered in Excel for further data analysis and interpretation.

Results

The analysis demographic data of the study, most of the neurosurgical patients, 13(43.3%) in the experimental group and 11(36.6%) in the control group were aged between 40 – 49 years, 30(100%) in both the groups were female, 15(50%) in the experimental and control group were educated and uneducated respectively, 25(83.3%) in the experimental and control group were married, 11(36.7%) in the experimental group were staying in the hospital for 10 – 19 days and 11(36.7%) in the control group were staying for 20 – 29 days in the hospital, 13(43.3%) in the experimental group had not been administered with oxygen therapy for non-intubated patients and 14(46.7%) in the control group had the oxygen therapy rate between 4 – 5 for non-intubated patients, 13(43.3%) in the experimental group had concentration level of between 21% - 40% for intubated patients and 16(53.3%) had not been administered with oxygen therapy for intubated patients and 20(66.7%) in the experimental group and 16(53.4%) in the control group had GCS score between 8 – 10.

The analysis revealed that in the experimental group before 5 min and before 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After the intervention of short-term foot massage, after 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After 5 min, 25(83.3%) had abnormal arterial pressure and 5(16.7%) had normal arterial pressure.

The analysis findings show that in the control group before 5 min and before 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After the hospital routine measures, after 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After 5 min, 27(90%) had abnormal arterial pressure and 3(10%) had normal arterial pressure.

Discussion

The findings of the analysis revealed in showed that the mean score of mean arterial pressure before 5 minutes in the experimental group was 113.53±9.88, the mean score before 1 minute was 133.27±10.03, the mean score after 1 minute was 113.23±10.01 and the mean score after 5 minutes was 109.60±9.66. The calculated paired 't' test value of t = 1.000 between before 5 min and before 1 minute and before 1 minute and after 1 minute was not found to be statistically significant at $p<0.05$ level. These results were supported by Ozlu. Z.

K. This research investigated the impact of foot massage on hemodynamic indicators, such as MAP, and the autonomic nervous system in patients hospitalized in the intensive care unit. The foot massage was found to have a positive effect on these parameters.

In a study conducted Several hemodynamic measures, such as mean arterial pressure (MAP), heart rate, and respiratory rate among intensive care unit (ICU) patients, were found to be considerably improved by foot massage [21].

The calculated paired 't' test value of t = 6.078 between before 1 min and after 5 minutes and after 1 minute and after 5 minutes was found to be statistically significant at $p<0.001$ level. This infers that the short-term foot massage administered among the neurosurgical patients was found to be effective in reducing the level of mean arterial pressure which was evident from the mean difference score of 3.67 and 3.63.

The study results are supported by Lee, S. M., & Kim, H. S.The findings showed that the intervention group's mean arterial pressure (MAP) decreased as their systolic and diastolic blood pressure significantly decreased. Following massage, the intervention group's heart rate and breathing rate were significantly lower than those of the control group. These modifications were significant, according to the statistical analysis ($p < 0.05$).

The findings of the study were found to be consistent with the study findings conducted by Hiva Azami Short-term foot massage helps regulate the vital signs of patients who are hospitalized for long periods in intensive care units. The purpose of this study was "to examine the immediate impacts of short-term foot massage on mean arterial pressure among neurosurgical patients hospitalized in intensive care units, the results reveal that there is a significant reduction in the mean arterial pressure [22]. This infers that the short-term foot massage administered among the neurosurgical patients was found to be effective in reducing the level of mean arterial pressure.

Masoumeh Momeni (2020) conducted a study on the level of effectiveness of foot massage by a nurse and family members. The results showed that mean arterial pressure decreased after one week of intervention. The study concluded that short-term foot massage administered to the neurosurgical patients was found to be effective in reducing the mean arterial pressure among the neurosurgical patients.

Table 1. Frequency and Percentage Distribution of Arterial Pressure Before and After Short Term Foot Massage among Neurosurgical Patients in the Experimental Group

N = 30

Arterial Pressure	**Experimental Group**							
	Before 5 min		**Before 1 min**		**After 1 min**		**After 5 min**	
	F	**%**	**F**	**%**	**F**	**%**	**F**	**%**
Normal (70 – 100 mmHg)	1	3.3	1	3.3	1	3.3	5	16.7
Abnormal (>100 mmHg)	29	96.67	29	96.67	29	96.67	25	83.3

The above table 1 and figure 1 show that in the experimental group before 5 min and before 1 min29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure.

After the intervention of short-term foot massage, after 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After 5 min, 25(83.3%) had abnormal arterial pressure and 5(16.7%) had normal arterial pressure.

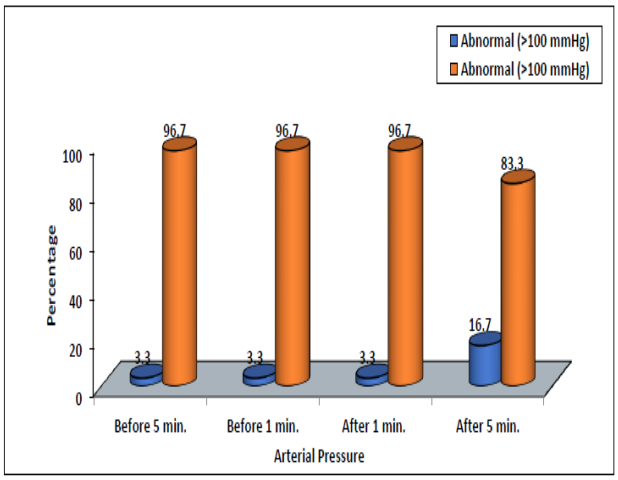

Figure 1. Percentage Distribution of Arterial Pressure Before and After Short Term Foot Massage among Neurosurgical Patients in the Experimental Group

Table 2. Frequency and Percentage Distribution of Arterial Pressure Before and After Short Term Foot Massage among Neurosurgical Patients in the Control Group.

N = 30

Arterial Pressure	Control Group							
	Before 5 min		Before 1 min		After 1 min		After 5 min	
	F	%	F	%	F	%	F	%
Normal (70 – 100 mmHg)	1	3.3	1	3.3	1	3.3	3	10.0
Abnormal (>100 mmHg)	29	96.67	29	96.67	29	96.67	27	90.0

The above table 2 and figure 2 show that in the control group before 5 min and before 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure.

After the hospital routine measures, after 1 min 29(96.67%) had abnormal arterial pressure and 1(3.3%) had normal arterial pressure. After 5 min, 27(90%) had abnormal arterial pressure and 3(10%) had normal arterial pressure.

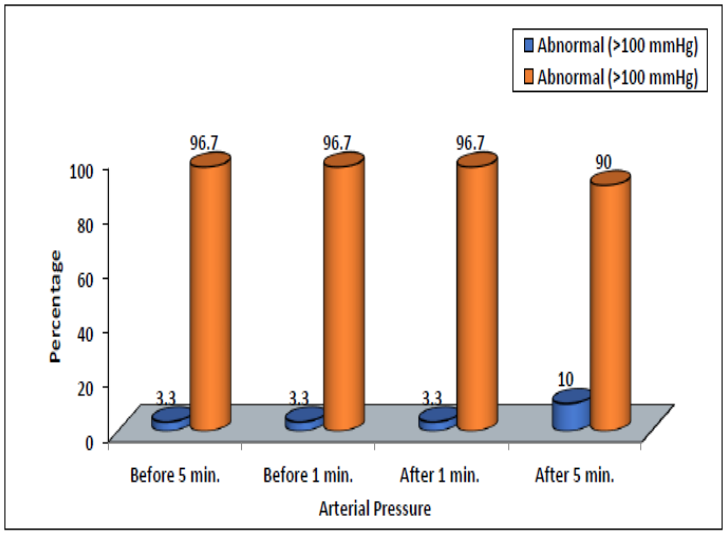

Figure 2. Percentage Distribution of Pretest and Post Test Level of Breast Milk Secretion among Caesarean Mothers in the Experimental and Control Group

Table 3. Effectiveness of Short-Term Foot Massage on Mean Arterial Pressure among Neurosurgical Patients in the Experimental Group.

N = 60(30+30)

Test	Arterial Pressure		Mean Difference score	Paired 't' test & p-value
	Mean	S. D		
Before 5 minutes	113.43	9.88	0.16	t = 1.000
Before 1 minute	133.27	10.03		p=0.326, N. S
Before 1 minute	133.27	10.03	0.04	t = 1.000
After 1 minute	113.23	10.01		p=0.326, N. S
Before 1 minute	133.27	10.03	**3.67**	**t = 6.078**
After 5 minutes	109.60	9.66		**p=0.0001, S*** **
After 1 minute	113.23	10.01	**3.63**	**t = 5.982**
After 5 minutes	109.60	9.66		**p=0.0001, S*** **

***p<0.001, S – Significant, N.S – Not Significant

The **data** depicts that the mean score of mean arterial pressure before 5 minutes in the experimental group was 113.53±9.88, the mean score before 1 minute was 133.27±10.03, the mean score after 1 minute was 113.23±10.01 and the mean score after 5 minutes was 109.60±9.66.

The calculated paired 't' test value of t = 1.000 between before 5 min and before 1 minute and before 1 minute and after 1 minute was not found to be statistically significant at p<0.05 level. The calculated paired 't' test value of t = 6.078 between before 1 min and after 5 minutes and after 1 minute and after 5 minutes was found to be statistically significant at p<0.001 level. This infers that the short-term foot massage administered among the neurosurgical patients was found to be effective in reducing the level of mean arterial pressure which was evident from the mean difference score of 3.67 and 3.63 tabulated in Table 3 and Figure 3.

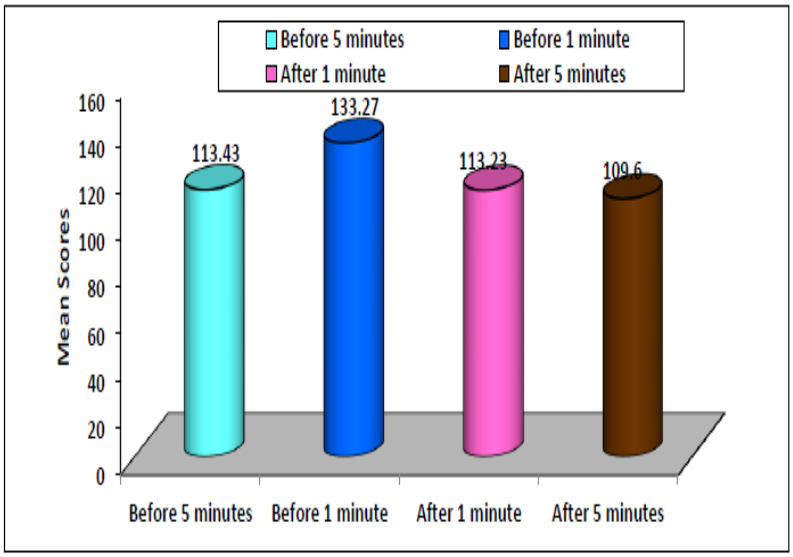

Figure 3. Comparison of Mean Arterial Pressure among Neurosurgical Patients Before and After Short Term Massage in the Experimental Group

Table 4. Comparison of Mean Arterial Pressure among Neurosurgical Patients Before and After Short Term Massage in the Control Group.

N = 60(30+30)

Test	Arterial Pressure		Mean Difference score	Paired 't' test & p-value
	Mean	S. D		
Before 5 minutes	119.03	12.36	-	-
Before 1 minute	119.03	12.36		
Before 1 minute	119.03	12.36	0.00	t = 0.000 p=1.000, N. S
After 1 minute	119.03	12.39		
Before 1 minute	119.03	12.36	**1.00**	**t = 2.693** **p=0.012, S***
After 5 minutes	118.03	12.28		
After 1 minute	119.03	12.39	**1.00**	**t = 4.171** **p=0.0001, S*****
After 5 minutes	118.03	12.28		

***p<0.001, *p<0.05, S – Significant, N.S – Not Significant

The data depicts that the mean score of mean arterial pressure before 5 minutes in the experimental group was 119.03±12.36, the mean score before 1 minute was 119.03±12.36, the mean score after 1 minute was 119.03±12.39 and the mean score after 5 minutes was 118.03±12.28.

The calculated paired 't' test value of t = 1.000 between 1 minute and after 1 minute was not found to be statistically significant at p<0.05 level. The calculated paired 't' test value of t = 2.693 between before 1 minute and after 5 minutes and t = 4.171 after 1 minute and after 5 minutes was found to be statistically significant at p<0.05 and p<0.001 level respectively. This infers that after normal hospital routine measures, there was some reduction in the level of mean arterial pressure which was evident from the mean difference score of 1.0 tabulated in Table 4 and Figure 4.

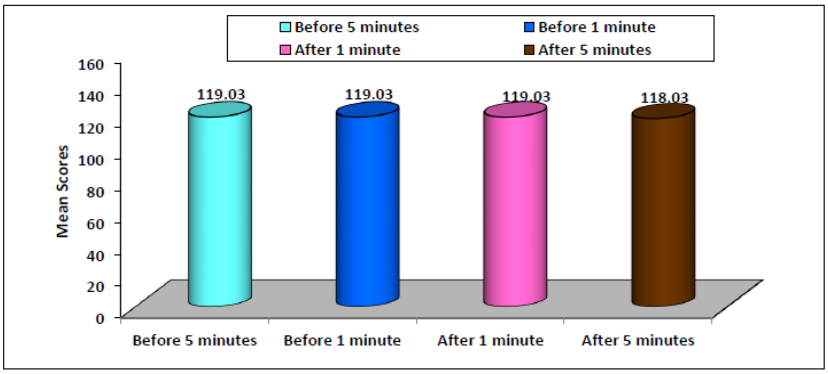

Figure 4. Comparison of Mean Arterial Pressure among Neurosurgical Patients Before and After Short Term Massage in the Control Group

Table 5. Comparison of Mean Arterial Pressure among Neurosurgical Patients Before and After Short Term Massage between the Experimental and Control Groups.

N = 60(30+30)

Test	Experimental Group		Control Group		Mean Difference score	Student Independent 't' test & p-value
	Mean	S. D	Mean	S. D		
Before 5 minutes	113.43	9.88	118.37	11.92	4.94	t = 1.631 p=0.110, N. S

Before 1 minute	113.26	10.03	118.37	11.92	5.11	t = 1.677 p=0.101, N. S
After 1 minute	113.23	10.01	118.37	11.94	5.14	t = 1.686 p=0.099, N. S
After 5 minutes	109.60	9.66	117.20	11.82	**7.60**	**t = 2.544** **p=0.15, S***

*p<0.05, S – Significant, N.S – Not Significant

The data depicts that the calculated student independent 't' test value of t=2.544 after 5 minutes between the group shows that there was a statistically significant difference between the mean arterial pressure between the two groups in which the mean arterial pressure among the patients in the experimental group was reduced significantly which infers that short term foot massage administered was found to be effective in reducing the level of mean arterial pressure than the patients in the control group who had been under normal hospital routine protocol tabulated in Table 5 and Figure 5.

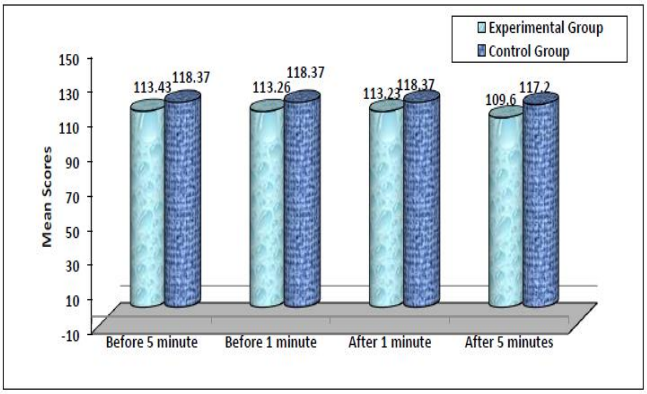

Figure 5. Comparison of Mean Arterial Pressure among Neurosurgical Patients Before and After Short Term Massage between the Experimental and Control Group

Conclusion

The present study assessed the effectiveness of short-term foot massage on mean arterial pressure among neurosurgical patients at the surgical ICU, SMCH. The study concluded that short-term foot massage administered to the neurosurgical patients was found to be effective in reducing the mean arterial pressure among the neurosurgical patients. Thus, short-term foot massage can be considered as a non-pharmacological measure to reduce the mean arterial pressure among neurosurgical patients and can be included and implemented in the day-to-day hospital routines.

Conflict of Interest

Nil

Acknowledgement

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