Impact of Foot Reflexology on Physiological Indicators and Pain among Open-Heart Surgery Patients

[1,2] Rania Reafaat Abdelkader Atia

[1] Assistant Professor of Physiology Department Faculty of Medicine Zagazig University

[2] Basic Medical Science Faculty of Applied Medical Science, AlBaha University, Al Baha, Saudi Arabi

Abstract

Background: physiological instability and pain are among the most common problems of patients post-open heart surgery. Many studies reported that non-pharmacological and complementary interventions improve physiological instability and reduce post-operative pain; Therefore, introducing non-pharmacologic interventions such as reflexology became an issue of concern for critical care nurses. Hence **the study aimed to** determine the impact of Foot reflexology on physiological indicators and pain among open-heart surgery patients. **Design**: A Quasi-experimental research design was used to fulfill the aim of the present study. **Setting**: the study was carried out at Cardio-Thoracic intensive care unit (CTCU) at Sohag University Hospital. **Subject**: A convenience sampling technique was used, the study was performed on 100 patients, they were divided into two groups (foot reflexology and control group) who underwent open heart operation, the intervention group received (foot reflexology) and the control group received (routine care). **Two tools were used**: the patient's assessment sheet and the visual Analog Scale. **Results**: a statistically significant difference between the two groups was found regarding all physiological indicators (P=0.001) after applying foot reflexology and improvement was more significant in the reflexology group than control group. Also, a statistically significant difference between the groups was found regarding pain intensity between the two groups. **Conclusion**: Foot reflexology significantly improved the physiological indicators and pain of patients among open-heart surgery patients. **Recommendation**: Apply a training program for critical care nurses working at open heart surgery units about foot reflexology techniques to be able to use it as a part of routine nursing care for patients.

Keywords: Reflexology, Physiological indicators, Pain, and Open heart surgery patients.

Introduction:

Cardiovascular disease is one of the leading causes of death, and disability, and reduces the quality of life worldwide, accounting for half of all fatalities in developing nations. One of the most important approaches in the treatment of heart diseases is open heart surgery, which has been linked to a reduction in patient mortality **(Teimori et al, 2019).** Cardiac surgery including coronary artery bypass grafting (CABG) and heart valve surgery represent the most common classes of surgical procedures performed globally (**Elsaed et al, 2020).**

Acute Pain is a critical problem following cardiac surgeries. In the context of etiology Skin incisions, sternal retraction, dissections, internal mammary artery graft preparation, endotracheal intubation, chest drain, and sternal wires **(Bigeleisen, et al; 2015).** Pain stimulates the hypothalamic–pituitary adrenal axis and activates the sympathetic nervous system. Blood pressure rises, heart rate rises, and a hyperglycemic condition develops as a result of increased adrenaline release. This unfavorable circulatory condition can cause arrhythmias, such as atrial fibrillation, and increase myocardial oxygen demand, making patients more susceptible to ischemic events **(Jayakumar, et al; 2019).**

Pain following open heart surgery is often undertreated. In the literature, the prevalence of moderate to severe pain after cardiac surgery is 17% to 40% **(Abdou & Abd El-Hafez, 2018).** One of the essential issues for patients following cardiac surgery is postoperative pain management, which is considered one of the challenging problems for critical care nurses. It is widely recognized that postoperative pain hurts cardiac surgery outcomes, Patients continue to report poorly regulated pain despite this, and current polls show extremely limited effectiveness in treating pain and

research indicates that pain is undertreated and not adequately alleviated **(Wic, et al, 2017).**

Assessment, appropriate pharmaceutical and non-pharmacological therapies, and patient response evaluation are all necessary for successful pain management in a critical care situation. Various pharmaceutical and non-pharmacological therapies are available to reduce patients' pain, anxiety, and stress (**Engelman, et al., 2019**). Nevertheless, pharmacological intervention presents several challenges, including altered awareness and an increasing drug dependence risk (**Vincent, 2017**).

Nurses currently use non-pharmacological therapies, like diversion, soothing music, relaxation techniques, reflexology massage, and biofeedback, to improve patients' healing and well-being and lessen pain **(Shehata, et al, 2021).**

Comparing complementary and non-pharmacological approaches to pharmaceutical ones reveals that the former are noninvasive, straightforward, and less costly, while the latter have negligible or no side effects (**Elsayed, E, A. et al, 2019**). Reflexology is one of the most well-known alternative therapies, yet it's still unknown how exactly it functions. It is thought that energy circulates throughout the body during reflexology by traveling through vertical zones from the leg into the brain. Therefore, all organs, glands, bones, and muscles can be affected when pressure is applied to an organ's reflecting point. Experts in reflexology believe that because the body's organs are reflected in the foot, palm, and ear, the hands and feet act as the body's mirror and map **(Rahmani et al; 2017).**

By reflexology massage creates a feeling of security. Applying deep pressure to particular body regions can help relieve pain. (**Kandemir and Oztekin, 2019**).

According to several studies, foot reflexology can quickly reduce pulse rate, and improve arterial oxygen saturation, and both systolic and diastolic blood pressure (**Elsayed, et al, 2019)**. Additionally, research has shown that it is a successful method for reducing anxiety, regulating incisions, and reducing postoperative discomfort (**Koraş & Karabulut, 2018**). Pain post open heart surgery (**Elsayed, et al, 2019**).

After cardiac surgery and in a critical care environment, the care plays a crucial role in stabilizing the patient's condition and regulating, managing, and treating severe post-operative pain. Given the high expense of pharmaceuticals, more nurses must receive training on the application of non-pharmacological treatments in critical care. foot reflexology is also useful because it is simple, inexpensive, and poses little to no risk to the patients.

Significant of the study:

Hemodynamic stability and pain control are two major post-open heart surgery concerns that are difficult for front-line critical care health professionals to handle.

Aim of the study:

To determine the impact of Foot reflexology on physiological indicators and pain among open-heart surgery patients.

Research hypothesis

1) - Open-heart surgery patients who receive foot reflexology intervention will have better physiological indicators than those who do not receive this intervention.
2) - Open-heart surgery patients who receive foot reflexology intervention will have less pain intensity than those who do not receive this intervention.

Subjects and methods

Research design:

A Quasi-experimental research design was used to fulfill the aim of the present study.

Setting:

The study was carried out at the Cardio-Thoracic intensive care unit (CTCU) at **Sohag** University Hospital.

Sample:

A convenience sampling technique was used, and the study was performed on 100 patients, they were divided into two groups (50 patients in each group) (foot reflexology and control group) who underwent open heart operation, the intervention group received (foot reflexology) and the control group received (routine care).

Study tools:

Tool one: Patient's assessment sheet:

It was developed by the researcher after reviewing the related literature to assess the studied patients' personal and medical data, it includes two parts as follows.

Part one: Patients' data

The section includes personal data such as age, sex, marital status, occupation, and residence.

Part two: Patients' physiological parameters assessment:

including the following vital signs: blood pressure (BP) in millimeter-Hg (systolic, diastolic, mean arterial blood pressure, oxygen saturation (Sapo2), temperature (C), pulse rate (B/m), respiration rate (C/m), and temperature (C).

Tool two: Using Visual Analog Scale: It was used to assess chest pain intensity, this was used to measure the intensity of chest pain from (**Mann & Carr, 2006**). The average score change on pain intensity as measured by the Visual Analogue Scale. The scale is a measuring device that is 0–10 cm long. High-scale scores imply high levels of pain severity. and it is a numeric rating scale of the severity of the pain with a score ranging from (0-3) the score zero (0) shows no pain and the top score (3) shows the worst possible pain.

Scoring system of pain:

No pain = (0) score, Mild pain score = (1) score Moderate pain score = (2) score Sever pain = (3) score.

Methods:

The preparatory, implementation, and assessment phases comprised the three primary stages of the study's conduct.

Preparatory phase:

1- Following an explanation of the study's purpose, official permission was obtained from the **Sohag** University Hospital administration to facilitate the study's implementation.
2- The study was approved by the local ethical committee and adhered to the standard ethical guidelines for clinical research.
3- **Content validity:**
Six experts from **Sohag** University who specialize in critical care medicine evaluated the instruments for content-related validity and made the required adjustments.
4- **A pilot study**
To test the tools' clarity and applicability, it was conducted on 10 patients or 10% of the study group. There was no alteration, and the tool was useful. based on the findings of the pilot study participants who were part of the research.
5- **Ethical considerations: -**
Each patient provided their informed permission. The researcher stressed that individuals' confidentiality and anonymity were guaranteed by encrypting the data and that participation is completely optional. Participants in the study were given the assurance that they might leave at any moment and without cause.

Implementation phase:

- The implementation phase took place from January 2023 to June 2023, spanning one year.
- "-50 ambulatory individuals who agreed to participate in the trial were chosen at this point to form the control group. Forty more interested participants were recruited to form the reflexology group after the control group.
- The two groups' clinical and personal data were assessed using component one of the first instrument, which was derived from the patient records.

Control group:

- Obtained routine care following open heart surgery.
- **For the Reflexology group:**
- Both the patients' physiological indicators and their level of discomfort were monitored twice before the foot reflexology massage technique was started (immediately and one hour before the intervention).
- To assist with massage, the researcher removed any metal objects from her hands (such as a ring), cleaned and warmed them, and oiled them with baby oil. The patients' legs were then cleaned and dried.
- The procedure for doing foot reflexology involved the following steps: first, the patient was positioned supine with a pillow beneath their feet, bending their feet slightly and angling their head between 30 and 45 degrees. Starting around 10 cm above the patient's knee, the massaging region was exposed. The researcher first checked the feet to see whether

there were any massage barriers before starting to massage.

- While standing in front of the patient, the researcher started general reflexology by massaging all reflex points in the plantar with the thumb and forefinger, and then specialized reflexology was done through the pressure point of foot reflex such as (solar plexus, hypothalamic, pituitary, spinal cord, and adrenal gland and pelvic). First, for the left foot, followed by the right foot (20 minutes for each).
- After the foot reflexology massage technique, the physiological parameters of the patients and pain level were recorded twice (immediately and one hour after the intervention).
- The patients in the two groups were followed for three consequent days.

Statistical analysis:

Using SPSS version (19), the data entry and analysis were completed. The data were shown as mean standard deviation, percentage, and number. To compare the qualitative variables, a chi-square test was employed. The mean standard deviation (SD) was used to describe quantitative data (HR, RR, SBP, DBP, MAP, and SPO2) if they were normally distributed. The Chi-Square test or Fisher's exact test was used to assess how comparable the demographic attributes of the two groups were. To investigate potential differences in the physiological parameter fluctuations between the groups, the repeated measurements of analysis of variance (RM-ANOVA) test was utilized. Statistically significant P-Values are determined when P <0.05.

Results:

Table (1): demonstrates that 80% of the control group of the sample compared to 70% in the reflexology group belonged to the 46–65 years, and 78% in the control group of the sample compared to the Reflexology group (68%) were men. Furthermore, it demonstrates that 20% of them had a university education in the control group compared to the 42.0% reflexology group.

Table (2):- displays a statistically significant drop in heart rate in reflexology following the intervention when compared to the control group, with changes in the first and second groups that are statistically significant (P=0.015 & P=<0.001 respectively), while showing no significant difference between three groups in 3rd day (.P=0.987).

Table (3):- shows a statistically significant drop in the respiratory rate in the reflexology after the intervention compared to the control group. There is a statistically significant difference between the groups on the first and second days (P=<0.001& P=<0.001), but on the third day (.P=0.244) there is no statistically significant difference between the two groups.

Table (4): A statistical reduction in the **systolic blood pressure (SBP)** was observed in both Reflexology groups after the intervention compared to the control group, with a statistically significant difference between groups in the 1st and 2nd day (P=<0.001), while shows no statistically significant difference between groups in the 3rd day (P=0.074). Concerning **Diastolic Blood Pressure (DBP)** the table revealed a decrease in both Reflexology groups after the intervention compared to the control group, with statistically significant differences in the first and second day's groups were P=<0.001 and P=0.002, respectively.

Table (5):- About the MAB, the table shows statistically lower improvement in the Reflexology group following the intervention when compared to the control group, the first and second-day groups showing statistically significant variance (P=0.003 & P=<0.001, respectively).

Table (6): Following the intervention, there was a statistically significant improvement in both the Reflexology group's oxygen saturation as compared to the control group, with a statistically significant difference between the groups on the first and second day. (P=<0.001)

Table (7): shows that there was a statistically significant difference (P <0.001) in the three groups' levels of pain. Additionally, after implementing each intervention compared to the control group over three days, reflexology groups showed a decrease in pain severity scores.

Table (8): demonstrates that there was no statistically significant difference between the groups on the first day before the intervention, but there was a statistically significant difference between Reflexology and Control after the intervention was applied (p value <0.001).

Table (1): Personal data of the control and reflexology groups patients

Variables \ Groups	Control group (n=50)		Reflexology group (n=50)		Chi-square test	P. value
	No	%	No	%		
Age						
from 36-45 year	10	20.0	15	30.0	χ^2= 1.440	0.487
from 46-65 year	40	80.0	35	70.0		
Gender						
Male	39	78.0	34	68.0	χ^2=1.993	0.381
Female	11	22.0	16	32.0		
Education						
Illiterate	17	34.0	10	20.0	χ^2= 9.132	0.166
Primary	9	18.0	15	30.0		
Secondary	14	28.0	4	8.0		
University	10	20.0	21	42.0		

Table (2): Mean score differences between Control and Reflexology groups regarding heart rate

Pulse	Groups	1hr.pre-intervention	Immediately pre-intervention	immediately post-intervention	1hr.post-intervention	RM-ANOVA Between Groups
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
1st day	Control	100.66±21.3	102.67±12.14	105±15.22	106.4±15.19	F=2.177 P=0.015* Partial η2=0.072
	Reflexology	101.2±23.89	98.8±20.32	95.83±21.24	96.33±18.99	
2nd day	Control	106.88±16.78	107.88±18.05	106.67±19.59	107.48±15.79	F=3.144 P=<0.001** Partial η2=0.079
	Reflexology	110.3±20.24	106.77±16.33	101.83±12.89	96.77±19.6	
3rd day	Control	104.4±13.66	102.31±12.77	101.65±12.62	98.8±11.72	F=0.223 P=0.986 Partial η2=0.054
	Reflexology	101.09±16.26	99.78±13.20	92.88±9.04	93.62±9.63	

(RM-ANOVA) test ****Significant level at P value < 0.05, **Significant level at P value < 0.001***

Table (3): Mean score differences between Control and Reflexology groups regarding Respiratory Rate

RR	Groups	1hr.pre-intervention	Immediately pre Intervention	Immediately post Intervention	1hr.post-intervention	RM-ANOVA Between Groups
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
1st day	Control	24.56±8.87	28.7±9.55	26.44±8.22	27.77±8.53	F=5.068 P=<0.001** Partial η2=0.156
	reflexology	20.52±5.87	24.49±7.77	18.14±3.67	22.76±6.09	
2nd day	Control	28.12±7.88	29.76±7.33	28.55±6.68	32.14±5.79	F=11.219 P=<0.001** Partial η2=0.278
	reflexology	22.89±7.33	24.8±6.65	22.69±7.57	22.88±5.57	
3rd day	Control	30.5±6.43	29.5±4.44	29.8±5.32	28±4.73	F=1.356 P=0.242 Partial η2=0.312
	Reflexology	25.6±7.2	23.33±7.05	21.45±4.8	21.3±1.86	

(RM-ANOVA) test *****Significant level at P value < 0.01***

Table (4): Mean scores differences between Control and Reflexology groups regarding systolic and diastolic blood pressure

Day	Variables	Groups	1hr.pre-intervention	Immediately pre-intervention	Immediately post-intervention	1hr.post-intervention	RM-ANOVA Between Groups
			Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
1st day	SBB	Control	126.2±23	128.5±19.22	125.76±18.87	125.67±15.79	F=6.536 P=<0.001** Partial η2=0.163
		Reflexology	138.6±21.77	130.22±15.92	123.33±8.66	120.27±12.72	
	DBB	Control	68.44±13.55	75.18±13.36	72.55±12.86	69.57±11.14	F=3.079 P=0.001** Partial η2=0.097
		Reflexology	71.53±15.52	65.8±14.49	64.66±13.62	62.23±13.66	
2nd day	SBB	Control	122.46±15.77	123.2±17.64	123.8±17.55	126.47±14.95	F=12.137 P=<0.001** Partial η2=0.266
		Reflexology	132.19±22	131.2±10.25	123.6±10.71	124.23±13.3	
	DBB	Control	72.23±11.33	71.34±12.44	72.2±10.32	72±11.57	F=2.723 P=0.002** Partial η2=0.075
		Reflexology	71.34±12.41	68.8±11.31	69.8±12.78	71.07±11.21	
3rd day	SBB	Control	123.55±12.22	125.6±12.79	127.34±11.55	125±10.76	F=2.047 P=0.076 Partial η2=0.509
		Reflexology	140.2±10.34	132.45±11.72	122.05±8.23	116.46±5.04	
	DBB	Control	71.08±10.32	72.3±12.04	72.8±10.37	73.57±9.03	F=0.687 P=0.734 Partial η2=0.257
		Reflexology	71.66±13.35	69.62±7.78	71.96±10.01	62.77±16.57	

Repeated measures of analysis of variance (RM-ANOVA) test *****Significant level at P value < 0.01***

Table (5): Mean scores differences between Control and Reflexology groups regarding Mean Arterial Pressure (MAP)

MAP	Groups	1hr.pre-intervention	Immediately pre-intervention	Immediately post-intervention	1hr.post-intervention	RM-ANOVA Between Groups
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
1st day	Control	85.55±17.33	90.88±12.8	88.89±12.79	87.32±13.2	F=2.608 P=0.003** Partial η2=0.079
	Reflexology	92.22±14.89	90.77±8	89.7±13.83	85.7±12.85	
2nd day	Control	85.4±13.21	86.33±14.86	85.22±13.49	87.5±9.67	F=3.355 P=<0.001** Partial η2=0.103
	Reflexology	89.5±12.42	93.89±13.85	87.8±10.77	91.75±8.74	
3rd day	Control	86.79±11.8	89.72±11.22	88.5±12.66	87.43±10.72	F=0.614 P=0.809 Partial η2=0.144
	Reflexology	92.66±13.34	90.1±10.88	83.79±9.88	75.46±7.87	

Repeated measures of analysis of variance (RM-ANOVA) test *****Significant level at P value < 0.01***

Table (6): Mean scores differences between Control and Reflexology groups regarding Oxygen Saturation

SPO2	Groups	1hr.pre-intervention	Immediately pre Intervention	Immediately post Intervention	1hr.post-intervention	RM-ANOVA Between Groups
		Mean ±SD	Mean ±SD	Mean ±SD	Mean ±SD	
1st day	Control	97.78±3.52	97.4±4.33	98.04±2.55	98.7±1.05	F=12.049 P=<0.001** Partial η2=0.295
	Reflexology	97.11±2.02	94.3±3.28	99.36±1.89	99.35±1.42	
2nd day	Control	98.40±1.66	97.7±1.22	97.52±2.79	97.15±2.88	F=7.865 P=<0.001** Partial η2=0.213
	Reflexology	97±2.88	97.34±1.58	99.3±0.89	99.5±0.77	
3rd day	Control	96.81±2.83	96.23±3.33	96.5±3.77	97.21±2.02	F=1.189 P=0.322 Partial η2=0.229
	Reflexology	96.33±2.72	96.32±2.47	97.53±1.69	96.78±2.07	

(RM-ANOVA) test *****Significant level at P value < 0.001***

Table (7): Mean scores differences between Control and Reflexology groups regarding Chest Pain intensity

Days	Chest Pain intensity	Control group N=50	Reflexology group N=50	P. value
		Mean ±SD	Mean ±SD	
1st day	Pre-intervention	9±1.33	9.2±0.55	<0.001**
	Post-intervention	9.39±1.55	7.22±1.9	<0.001**
2nd day	Pre-intervention	8.34±0.9	4.24±0.66	<0.001**
	Post-intervention	7.88±0.8	1.45±0.77	<0.001**
3rd day	Pre-intervention	6.55±0.76	1.87±1.33	<0.001**
	Post-intervention	6.69±0.79	1.4±0.66	<0.001**

(RM-ANOVA) test *****Significant level at P value < 0.001***

Table (8): Mean scores differences between the two studied groups regarding pain intensity.

Group	Pain intensity	
1st day	**Pre**	**Post**
Reflexology and Control	0.062	<0.001**
2nd day	**Pre**	**Post**
Reflexology and Control	0.054*	<0.001**
3rd day	**Pre**	**Post**
Reflexology and Control	0.013*	<0.001**

Discussion

Around the world, cardiothoracic surgeries are becoming more and more important as common critical care procedures. **Stephens, & Whitman, (2015)** study that Optimal postoperative care in the critical care unit is crucial for favorable outcomes, regardless of the type of operation carried out. Most of the preventable problems that arise after surgery have been related to postoperative difficulties in the ICU (**Abdou, &Abd El-Hafez, 2018).**

To provide the necessary care for preventing and decreasing disability, compassion must assess and look into any patient's experience of pain and anxiety following open heart surgery (**Ahmadi, 2014**). Pharmaceutical and non-pharmacological pain alleviation techniques are the two categories of pain management strategies identified by the study. Hospital settings are using non-pharmacological methods more often to improve physiological parameters and reduce or eliminate pain (**Abdou, &Abd El-Hafez, (2018).**

Hence the current study was conducted to examine the effect of foot reflexology on physiological indicators and pain among post-open heart surgery patients.

According to the study's results, there was a significant difference between the two groups during the first two days of the intervention, and on the third day, there was no difference between the groups. This can be explained by the fact that, from the first to the third day, there was a significant drop in the reflexology group's mean arterial blood pressure, systolic and diastolic blood pressure, pulse, breathing rate, and blood pressure both immediately and one hour after each intervention compared to the control group **Kandemir, and Oztekin, (2019)** Who stated that the hands, feet, and ears of every organ, gland, and bodily component have reflected points? Reflexology massage eases tension and stress and fosters a feeling of safety and security that improves physiological markers in the post-operative phase of cardiothoracic surgery. These findings coincide with those of Elsayed, E., A. et al. (2019), who investigated the Impact of Foot Reflexology on Physiological Indicators among Open-Heart Surgery Patients, who reported the effectiveness of foot reflexology massage on improving physiological parameters including heart rate, respiratory rate, systolic blood pressure, diastolic blood pressure and oxygen saturation among most of patient categories.

Similar to this, there was a notable improvement in several vital indicators, such as diastolic blood pressure, cardiac rhyme, and breathing rate, in the study conducted by **Khaledifar et al., (2017)**, which examined the effects of reflex therapy and massage therapy on vital signs and tension before cardiac angiography. The systolic blood pressure change, they found, was not statistically significant.

In a different investigation, **Zolfaghari et al. (2012)** looked at how therapeutic touch affected the vital signs and dysrhythmia of female cardiac catheterization patients. The results showed that the study group's blood pressure, breathing rate, and cardiac pulse were all significantly decreased during the catheterization process. This study's findings are also in line with those of The mean heart rhythm of critically ill ICU patients varied significantly in a study by **Hosseini et al. (2017)** that looked at the effect of foot massage on vital indicators.

According to the researchers, these results may be explained by the fact that reflexology coactivates two autonomic nervous system branches, which may enhance hemostasis, improve physiological parameters, and lessen discomfort.

Additionally, foot reflexology was found to lower Mean Arterial Pressure in neurosurgical ICU patients, according to a study by **Azami et al., (2015**) However, a great deal of research has not been able to prove that foot reflexology improves physiological markers. There could be several reasons for this, such as the fact that two different people used foot reflexology (**Ebadi, et al., 2015).**

From the researchers' point of view, the reflexology procedure is simple plus quick to perform, and it doesn't involve any special skills or equipment. Furthermore, this approach can be used on critically ill patients. Therapeutic methods to reduce sympathetic activity and prevent related outcomes with an overactive

sympathetic nervous system in patients group.

When comparing the Reflexology group to the control group after the intervention, the current study's results regarding oxygen saturation Sao2 showed a statistically significant increase in oxygen saturation. There was a statistically significant difference between the groups on the first and second days (P=<0.001), but not on the third day. This is in line with **Sayari, et al., (2018**) investigation into the effects of foot reflexology massage on physiological markers in patients suffering from acute myocardial infarction, which showed that while the percentage of blood oxygen saturation in the experimental group was increasing (P 0.001), there was no discernible difference between the placebo and control groups. In the two groups, there was a significant difference in the incremental changes in blood oxygen saturation 20 minutes and immediately following the intervention compared to the preintervention period. The study group's rise was consistently higher with (P<0.001). Still, compared to the two groups' immediate post-intervention, these differences were not statistically significant 20 minutes after the procedure was applied. Heart rhythm and vital sign variations were not substantially different between the two groups at various intervals.

The current findings revealed a statistically significant difference between the control group's mean pain score and that of reflexology after each intervention was applied, to the mean score of pain intensity. When comparing the intervention groups to the control group, the study shows a decrease among those who were exposed to the foot reflexology approach, in the mean pain score.

This conclusion was comparable to that of **Brent et al. (2010**), who documented the viability and efficacy of massage therapy administered following a cardiovascular procedure and found that patients who received it experienced noticeably less pain, and latest 104 open heart surgery patients participated in a trial that showed reduced pain and stress for those who received massage therapy. The researchers believe that because critically ill patients have particular challenges (long operative times, substantial musculoskeletal instability, and positional needs), we should support critical care nurses in the ICU in using the foot reflexology technique with these patients.

Abdou & Abd El-Hafez, (2018) reported the same findings, declaring that the mean pain score of the study group and the control group differed statistically significantly at the beginning, after 15 minutes, and after 55 minutes. Additionally, a slight variation in the average pain score was found among the study participants who had foot reflexology. Furthermore, **ELmetwaly**, (**2020**) studied the effects of foot reflexology on the quality of sleep, anxiety level, and pain intensity of patients undergoing thoracic surgery. They found that the study group's level of pain improved significantly more than the control group's after using the technique, particularly before and three days after the procedure.

Additionally, Keihani, (2019) study's findings showed that foot reflexology significantly affected how uncomfortable post-operative spinal anaesthesia was. Pre- and post-intervention mean pain scores for the control group were more respectively (P. <003), whereas the study group's mean pain scores were less, respectively (P. <001). Additionally, the research by **Ju et al., (2019)** included a comprehensive assessment and meta-analysis of the effectiveness of relaxation therapy as a nursing intervention for post-operative pain management in patients who had abdominal surgery, revealed similar outcomes.

Conclusion

The results of the present investigation indicate that the use of foot reflexology following open cardiac surgery greatly enhances physiological indicators, such as vital signs, oxygen saturation, and pain threshold. Reflexology showed a more notable and substantial improvement after open heart surgery than the control group.

Recommendations:

Based on the results findings it recommended that:

1- As part of their standard care for patients following open heart surgery, critical care nurses should apply foot reflexology training.

2- Every cardio-thoracic intensive care unit

should have an illustrated brochure explaining the reflexology technique.

3- To generalize, this study should be repeated with a larger sample size in future research.

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