Evidence Based Care Journal
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The online version of this article can be found at
http://ebcj.mums.ac.ir/article_13274.html

Evidence Based Care Journal 2019 09:31 originally published online 01 July 2019
DOI: 10.22038/ebcj.2019.35641.1918

Online ISSN: 2008-370X

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Evidence Based Care Journal

Original Article

OPEN ACCESS JOURNALS

Effect of Mirror Therapy on Arteriovenous Fistula Cannulation-Related Pain Severity in Hemodialysis Patients

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Received: 11/11/2018
Accepted: 11/06/2019

Evidence Based Care Journal, 9 (2): 31-37

Abstract

Background: Hemodialysis patients experience pains induced by cannulation of an arteriovenous (AV) fistula. The effect of mirror therapy on patients' pain severity has not been investigated in individuals living with hemodialysis.

Aim: The purpose of the present study was to investigate the effect of mirror therapy on AV fistula cannulation-related pain severity in hemodialysis patients.

Method: This study was conducted on 30 hemodialysis patients admitted to two hospitals in Mashhad, Iran, during 2018. Pain severity was measured using the Visual Analogue Scale for pain.

Results: The mean pain scores in the control session (pre-intervention phase), non-adaptive phase (immediately after looking in the mirror), and adaptive phase (ten minutes after looking in the mirror) were 4.8±1.1, 3.9±1.1, and 2.6±1.22, respectively. The results showed a statistically significant difference between the given sessions (P<0.001).

Implications for Practice: Mirror therapy could be effective in reducing AV fistula cannulation-related pain severity in hemodialysis patients.

Keywords: Arteriovenous fistula, Hemodialysis, Pain

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Introduction

Pain induced by arteriovenous (AV) fistula cannulation is known as the most stressful part of hemodialysis treatment in patients (1). These individuals undergoing hemodialysis constitute 95% of all those with end-stage renal failure (ESRD) whose prevalence rate across the world was estimated to be 3730000 people by the end of 2016. In Iran, the population of patients with ESRD was reported by 58000 individuals at the end of 2016 with an annual growth of 4-5% (2).

Fistula cannulation in hemodialysis patients results in excruciating pain due to the diameter and length of the cuts at the top of fistula needles (3).

Given that these patients usually undergo hemodialysis three times a week, they approximately experience painful needles by 300 times a year (4). Therefore, the recurrence of this excruciating intervention can have devastating effects on the patients' body and soul (1). More than one-fifth of these individuals describe fistula cannulation-related pains as unbearable ones (5). The results of several studies revealed the effectiveness of topical medications, such as lidocaine gel or spray (4, 6) and EMLA cream (3). However, they have not been welcomed due to some complications, including allergic reactions and arrhythmias in the case of using lidocaine gel and long onset time for the effect of EMLA cream (one hour after administration), as well as not being cost-effective (7).

Non-pharmacological interventions, including cryotherapy (8, 9), thermotherapy (10), aromatherapy (7, 11, 12), and acupressure (4, 13) have been also investigated; however, most of these methods have had their own drawbacks. For instance, there are growing concerns about the openness of arteriovenous (AV) fistula in case of vascular contraction for cryotherapy (12).

In the same line, deep touch pressure therapy has not been mainly addressed by healthcare providers. Researchers have not also observed the utilization of this intervention in clinical settings, and studies in this field have been extensive and insufficient (7). Majority of non-pharmacological interventions and complementary and alternative medicine have been advocated beside pharmacological methods. However, non-pharmacological interventions are only allowed in nursing (8) and inadequate pain management can also bring about physiological, psychological, and socioeconomic consequences for patients, their families, and communities. Therefore, new certain treatment options with fewer complications need to be explored in order to make patients feel more comfortable (12).

With this background in mind, mirror therapy has been introduced as one of the non-pharmacological interventions in the domain of pain management. Therefore, by placing a mirror in the center of two limbs, the reflection of the healthy limb can be matched with the affected one (14). These adaptations lead to temporary changes in patients' mental perceptions in a way that these individuals can create a picture of two healthy hands in their minds (15).

This method was first developed by Ramachandran as an intervention to reduce phantom limb pain and the results of his study urged other researchers to conduct further studies in this domain (16). Mancini also reported that viewing the picture of a healthy limb could moderate pain perception in the affected one (17).

Although, the effect of mirror therapy on pain severity was not confirmed in a similar study conducted by Johnson (18), the investigation of the effect of mirror therapy on relieving pain in patients with fibromyalgia (19) and complex regional pain syndrome (20) led to favorable results.

Mirror therapy is a simple intervention with no complications that does not impose extra work on nurses due to being patient-centered (15). This method is completely independent of nursing intervention and does not require physicians' orders. For more than two decades, mirror therapy has been employed in clinical practices. However, due to inadequate evidence and few studies in this domain, it is still not widely accepted and does not benefit from any standard treatment protocols.

Although clinical evidence provided in this domain is promising, they are not state-of-the-art yet (15). Despite investigations on the impact of mirror therapy on pain severity, no studies have so far examined the effect of mirror therapy on pain severity induced by fistula cannulation in hemodialysis patients. Accordingly, the purpose of this study was to investigate the effect of mirror therapy on fistula cannulation-related pain severity in hemodialysis patients.

Methods

The present study used a one-group pretest-posttest design which was conducted on 30 hemodialysis patients referring to hemodialysis centers affiliated to Montasserieh and 17 Shahrivar hospitals in

Mashhad, Iran, from 15th June to 25th August 2018.

The sampling was fulfilled through convenience sampling method based on inclusion and exclusion criteria. To this end, 20 patients were initially enrolled based on the inclusion criteria at a specialized hospital for an organ transplant, and the sampling was conducted at 17 Shahrivar Hospital due to incomplete sample size.

To determine the sample size, mean scores of pain were calculated in the pilot study on 10 individuals at the control session, as well as non-adaptive and adaptive phases. Subsequently, they were compared in a pairwise manner using the formula of comparison of two means at 95% (1.96) and 80% (0.84) confidence interval and test power, respectively. The largest sample size was also estimated at 22. To be more reliable, a total number of 33 patients were included in the study.

In total, one individual due to an unwillingness to continue the study and two patients because of their needs for injections in more than two consecutive sessions on each vascular path were excluded from the study. Eventually, the final analysis was conducted on 30 patients per session.

The inclusion criteria were: 1) over 18 age of years, 2) hemodialysis sessions three times a week, 3) vascular access to AV fistula, 4) at least six months after hemodialysis onset through current fistula, 5) lack of low vision and visual disturbances (30 cm or less), 6) ability to speak and understand Persian language, 7) no addiction, 8) lack of skin disorders at injection site (e.g., lesion, sensitivity, redness, discharge), 9) ability to maintain a sitting position on the bed,10) awareness of time, place, and person, 11) no use of oral or topical analgesics and sedatives six hours before dialysis, 12) no use of psychotropic medications 24 h prior to hemodialysis, 13) and absence of oral (mouth) temperature higher than 37.5°C.

On the other hand, the patients who were unwilling to continue the study, had incidence of skin disorders (e.g., lesion, sensitivity, redness, discharge) at injection site and malfunction of fistulas, used analgesics and sedatives less than 6 h before hemodialysis treatment in two consecutive sessions, used psychoactive drugs 24 h prior to hemodialysis in two consecutive sessions, had incidence of oral (mouth) temperature higher than 37.5°C for more than two consecutive sessions, required injections more than twice in each vascular path in two consecutive sessions, and were absent for two consecutive sessions were excluded from the study.

Moreover, those who used analgesics, sedatives, psychoactive drugs, or the patients that had high temperature and required injections, and were absent for two consecutive sessions were temporarily excluded from the study at the same session. However, they were re-included in the next hemodialysis session. If this process was recurring in two sessions, the patient was completely removed from the study.

Data were collected using the demographic characteristic form and Visual Analog Scale (VAS) for Pain. The demographic characteristic form sought information regarding age, gender, level of education, hemodialysis duration, age of fistula, the hand with fistula, dominant hand, and underlying diseases affecting pain perception (i.e., Diabetes, Guillain-Barre syndrome, neuropathy, multiple sclerosis). The validity of the form was confirmed by 10 faculty members in nursing. Since the items in this form were objective and had been frequently used in other previous studies, its reliability was also verified in this study. This form was completed by the researcher on the basis of patients' self-reports as well as information contained in their medical records.

The VAS for pain included a 10 cm graduated vertical line in which number zero at the bottom and number 10 at the highest point represented lack of pain and the most severe pain that could be imagined, respectively.

It should be noted that the given scale is a standard tool to examine pain, which had been used in several studies and its reliability had been confirmed by 0.95-0.99% (21). In all hemodialysis sessions and following insertion of the needle into the fistula, pain severity induced by this instrument was questioned via this scale.

To control the confounding variables, the whole process of AV fistula cannulation was performed in hemodialysis sessions per patient by the same nurses who were working currently in the same center with at least 6 months of experience in hemodialysis treatment.

The needle type in terms of size (size 16), shape, and manufacturing company was also the same. By doing this, there was coordination regarding the manner of inserting the needles (the needle was inserted with respect to a distance of about 0.5 cm from the previous fistula site in a proper sitting position into patient's skin).

The correct administration of the cannulation, intervention, and records of the results was conducted by one of the researchers. In the first hemodialysis session (control session), the needle was cannulated by a nurse working in the hemodialysis center without any interventions. In the intervention sessions (i.e. the second and third hemodialysis sessions), a flat mirror with a 40 cm diameter and a table stand holder was placed between patients' hands in a way that the healthy hand was in front of the mirror and the hand with fistula was behind it.

The distance of the index finger of each hand from the mirror was equally considered by 30 cm. The patients were only asked to look at the picture of their healthy hands in the mirror. The fistula cannulation was also conducted in mirror therapy sessions at two different times as follows: in the first intervention session, immediately after viewing the healthy hand in the mirror (non-adaptive phase), and in the second intervention session, ten minutes after observing the picture of the healthy hand in the mirror (adaptive phase).

Moreover, ten minutes was allotted as an adaptive phase to determine the effect of the duration of adaptation of the picture observed in the mirror on pain severity (17).

The sampling began after taking the required permission from the authorities at the hospitals and hemodialysis centers as well as the Ethics Committee of Mashhad University of Medical Sciences, Mashhad, Iran (code: 1397.9 IR.MUMS.REC).

All patients were informed of the research objectives and procedures, voluntary participation in the study, confidentiality of data, and the right to withdraw from the study by the researcher.

In addition, informed consent forms were also obtained from the patients. The data were analyzed using SPSS software (version 22 at a 95% confidence interval. To determine the quantitative variables of the study and normal distribution of the data, Kolmogorov-Smirnov and Shapiro-Wilk tests were used, respectively. Furthermore, repeated measures analysis of variance (ANOVA) and the Bonferroni post hoc test were employed in order to meet the research objectives. Since the data did not follow a normal distribution in the statistical analysis, the Mann-Whitney U test (for quantitative variables of two groups) and Kruskal-Wallis test (for qualitative variables of more than two groups) were utilized in this study.

Results

A total number of 30 hemodialysis patients were examined in this study. Out of these subjects, 26 individuals (86.7%) were male. The mean values of patients age and duration of hemodialysis treatment were 49.5±17.1 years and 52.4±44.3 months, respectively. The mean age of fistula in these individuals was 52.9±42.6 months. Most of the patients were right-handed (n=27, 90%) and the majority of them had fistulas in their left hands (n=24, 80%).

Table 1 illustrates the other demographic characteristics of the patients. The mean score of pain induced by AV fistula cannulation before the intervention was 4.8±1.1 and such values were reported by 3.9±1.3 and 2.6±1.2 after using the mirror in adaptive and non-adaptive phases, respectively.

Table 1. Demographic characteristics of patients undergoing hemodialysis

Variables	Mean±SD
Age (year)	49.5±17.1
Hemodialysis duration (month)	52.4±44.3
Age of fistula (month)	52.9±42.6
	Number (percentage)
Gender	
Male	26 (86.7)
Female	4 (13.3)
Level of education	
University degree	7 (23.3)
High school diploma	11 (36.7)
Secondary school	3 (10.0)
Elementary school	7 (23.3)
Illiterate	2 (6.7)
Underlying diseases affecting pain (diabetes, Guillain-Barre syndrome, neuropathy, MS)	
Diabetes	12 (40.0)
No diseases	18 (60.0)

Table 1. Continued	
Hand with fistula	
Left	24 (80.0)
Right	6 (20.0)
Dominant hand	
Left	3 (10.0)
Right	27 (90.0)
Fistula site	
Wrist	14 (46.7)
Forearm	2 (6.6)
Elbow	14 (47.6)
Hemodialysis center	
Montasserieh Hospital	20 (66.7)
17 Shahrivar Hospital	10 (33.3)

Table 2. Mean±SD of arteriovenous fistula cannulation-related pain severity in terms of control and intervention sessions

Sessions	Phases	Mean±standard deviation
Control	-	4.8±1.1
Intervention	non-adaptive phase	3.9±1.3
	adaptive phase	2.6±1.2
Results of repeated measures ANOVA		P<0.001

The results of repeated measures ANOVA showed a difference between the mean scores of pain severity in the session before the intervention and those after the intervention regarding adaptive and non-adaptive phases (P<0.001). According to the results of the Bonferroni post hoc test, a significant difference was observed between the mean scores of pain severity before the intervention and those after the intervention regarding adaptive and non-adaptive phases (P<0.001).

Moreover, a significant difference was observed between adaptive and non-adaptive phases in terms of the mean pain severity (P<0.001). Furthermore, the control session and the adaptive phase correlated with the highest and the lowest levels of pain severity, respectively (Table 2). In the same line, the results of Mann-Whitney U test and Kruskal-Wallis test revealed no significant differences in terms of the mean scores of pain severity among patients based on their demographic characteristics (P<0.001).

Implications for Practice

The results of this study demonstrated that mirror therapy in adaptive and non-adaptive phases could reduce AV fistula cannulation-related pain severity in hemodialysis patients. Accordingly, ten minutes of mirror therapy could relieve pain severity in these individuals. Therefore, mirror therapy is a simple non-pharmacological method which can be used as an independent nursing intervention without physicians' orders to reduce pain severity induced by fistula needles in hemodialysis patients.

One of the most important problems in this study was patients' constant concerns about the health of fistulas which could affect and even disturb their concentration in the course of mirror therapy. It is expected that children do not have such concern since they can focus better on their reflections in the mirror and obtain accurate results. Therefore, it was recommended to conduct further studies on children undergoing hemodialysis. It was also suggested to compare the effect of this intervention with other pain management methods in subsequent studies using a control group.

Acknowledgments

This article was extracted from an MA thesis approved by the Research Committee of Mashhad University of Medical Sciences, Mashhad, Iran, on January 21st, 2018 (Code: 961541) and archived in the Iranian Registry of Clinical Trials (IRCT20180412039277N1). The authors would like to sincerely appreciate the authorities of Mashhad University of Medical Sciences, Mashhad, Iran, respected officials at the School of Nursing, presidents of Montasserieh and 17 Shahrivar Hospitals in Mashhad, Iran, and all nurses working in hemodialysis centers for their collaboration in this study. The authors also express their thanks to all hemodialysis patients who participated in this study.

Conflicts of Interest
The authors declared no conflict of interest.

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