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RESEARCH ARTICLE

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An intervention study of a combined intervention of positioning and hand massage in patients undergoing radiofrequency catheter ablation

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Abstract

Aim: To identify the effectiveness of a combined intervention of 25° upper body elevation and hand massage in patients undergoing radiofrequency catheter ablation.

Design: A quasi-experimental study using a non-equivalent control group pre-test–post-test design.

Methods: A total of 46 participants were assigned to an intervention group ($N = 21$) and a control group ($N = 25$). To test the effectiveness of the combined intervention, the major variables were low back pain and discomfort, including physical, psychological and environmental factors.

Results: The control group had low back pain, and the physical, psychological and environmental discomfort scores increased over time, whereas the experimental group showed low back pain, and the physical, psychological and environmental discomfort scores were statistically significantly decreased. The combined intervention can be applied in clinical practice not only in patients who have undergone radiofrequency catheter ablation but also in those who require an immobile position due to puncture of a femoral blood vessel.

KEYWORDS
catheter ablation, low back pain, massage

1 | INTRODUCTION

Recently, the number of patients dying from heart disease has increased as a result of poor eating habits, increased obesity rates, smoking and alcohol consumption (Kang & Hwang, 2019; Leclerc et al., 2019). According to the 2019 cause-of-death statistics in South Korea, the number of deaths from heart disease increased rapidly from 43.4 per 100,000 population in 2008 to 60.4 per 100,000 population in 2019, and heart disease was the second leading cause of death in 2019 (Statistics Korea, 2020). Approximately 55% of patients die from heart diseases, including conduction disorders and cardiac arrhythmias (Statistics Korea, 2020).

Conduction disorders and cardiac arrhythmias can result from various causes of electrical signal transmission in the heart or abnormalities in the surrounding heart region, which are generally classified as bradycardia, tachycardia and premature contraction (Roh et al., 2018). Recently, radiofrequency catheter ablation (RFCA) has attracted attention as a treatment option for conduction disorders and cardiac arrhythmias (Shinoda et al., 2020). RFCA eliminates electrically stimulated arrhythmias after puncturing the femoral vein

and placing an electrode conductor in the heart (Roh et al., 2018). Patients who are unresponsive to antiarrhythmic drugs can undergo RFCA, which is simple and has a high success rate and good prognosis (Oh, 2016). In addition, administration of anticoagulants after the procedure is not necessary. This technique not only reduces treatment costs but also prevents deterioration of patient's quality of life caused by the use of anticoagulants (Roh et al., 2018). However, bleeding, hematoma and phlebitis may occur in 2%–4% of patients who have undergone RFCA (On, 2016).

2 | BACKGROUND

To prevent RFCA complications, patients should be immobilized during the procedure; thereafter, both the femoral vein puncture sites should be hemostated using hand compression, a haemostatic device and a blood vessel closure device for 5–30 min (Kim, 2016; Mohanty et al., 2019; Sciarretta et al., 2015). Thereafter, the patient should take absolute bed rest (ABR) while maintaining immobility with the compression dressing for 4 hr; ABR should be continued for at least 1 hr while monitoring complications, such as bleeding and hematoma, after removing the compression dressing (Burstein et al., 2018; Kim, 2016; Mohanty et al., 2019). At this time, patients who have undergone RFCA reportedly complain of back pain or discomfort (Dörschner et al., 2017; Kim, 2016; Yun & Cho, 2011) due to reduction in the movement of the spine and lumbar spine and increase in muscle tension and fatigue because of the prolonged immobile posture (Mohammady et al., 2014). The degree of back pain and discomfort experienced by patients continues to increase with time following the procedure (Dörschner et al., 2017; Lee, 2014). Intervention is needed to reduce low back pain and physical, psychological and environmental discomfort felt by patients undergoing RFCA.

Interventions that are commonly performed in clinical settings to alleviate low back pain or discomfort are limited in patients who have undergone femoral vein puncture. Previous studies evaluating reduction in low back pain include a study that used heat therapy in patients with percutaneous coronary intervention (Yun & Cho, 2011) and position change in patients with cerebrovascular angiography and cardiac catheterization (Heravi et al., 2015; Kang & Park, 2017; Vati et al., 2016). In addition, to reduce discomfort, previous studies adopted structured pain management after catheter ablation (Dörschner et al., 2017) and back massage or hand massage in patients with percutaneous coronary intervention (Kim et al., 2008; Park et al., 2004; Shin & Kim, 2018). However, the subjects in these previous studies were mainly limited to patients who had undergone procedures related to coronary angiography and cerebrovascular angiography, wherein only one femoral blood vessel was punctured.

Since RFCA includes puncturing of both the femoral veins and injecting heparin, the risk of bleeding complications is higher with RFCA than that reported with intervention of previous studies (On, 2016; Roh et al., 2018). Therefore, the application of interventions based on previous studies is limited in patients undergoing RFCA. There are limitations in simply applying interventions used in previous studies because warm/cold therapy or exercise intervention for patients who have undergone RFCA may increase the risk of infection or bleeding. Therefore, it is necessary to develop and verify an appropriate intervention to alleviate back pain and discomfort in patients with RFCA.

Position change and hand massage are considered relatively reliable interventions for patients undergoing RFCA. About position change, elevation of the upper body at various angles from 15°–60° has been used in previous studies (Heravi et al., 2015; Kang & Park, 2017). However, to the best of our knowledge, there are no studies that have used upper body elevation changes as intervention in patients undergoing RFCA; therefore, it is necessary to confirm a safe angle, given the risk of bleeding in patients undergoing RFCA. In addition, hand massage is more effective when combined with other interventions and is safe from the risk of bleeding because it is an indirect intervention to the puncture site. Therefore, it is necessary to confirm the effect of an intervention that applies both upper body elevation and hand massage to improve the safety of patients undergoing RFCA.

To address this gap in knowledge, this study aimed to identify the effectiveness of a combined intervention approach of upper body elevation and hand massage in patients with RFCA. The specific purposes of this study are as follows: (1) to identify the effectiveness of combined intervention of positioning and hand massage in terms of low back pain and (2) to determine the effectiveness of the combined intervention of positioning and hand massage in terms of physical, psychological and environmental discomfort.

3 | THE STUDY

3.1 | Design

The design involved a quasi-experimental study using a non-equivalent control group pre-test–post-test design to evaluate the effectiveness of the combined intervention of positioning and hand massage.

3.2 | Method

3.2.1 | Study setting and participants

The subjects of this study were patients who underwent RFCA at redacted university hospital. The redacted university hospital was a tertiary general hospital in Jeonlla province and a cardiovascular centre accredited by the government. The participants who met the criteria were recruited for this study. The inclusion criteria were as follows: (1) Patients who are conscious and able to communicate, (2) those who understood the purpose of the study and agreed to participate in the study, (3) those who had not been treated for psychiatric problems and (4) those who did not have wounds, rashes or

oedema in the area of the hand to be massaged. The exclusion criteria were as follows: (1) Patients who had been diagnosed or surgically treated for a back pain condition in the past, (2) those currently being treated for a condition accompanied by back pain, (3) those who had undergone the procedure in the past, (4) those who had taken painkillers for severe pain after the procedure and (5) those who had complications after the procedure.

The required sample size was calculated using the G*Power version 3.1.2 (Faul et al., 2007). A total of 42 participants were needed for this study using a one-tailed test, a statistically significance level of .05, a statistical power of .80 and a large effect size (Heravi et al., 2015; Shin & Kim, 2018). In this study, 25 participants were assigned to the control group and 21 participants to the experimental group, and a total of 46 participants were finally analysed without dropping out (Figure 1).

3.2.2 | Measurements

Numeric rating scale

Low back pain was measured using a numeric rating scale (NRS). The NRS measures the degree of back pain through the patient's subjective feelings, ranging from "not painful at all" (0 points) to "very painful" (10 points). The higher the perceived pain scores, the more severe the low back pain.

The discomfort measurement scale

The discomfort measurement scale was developed by Park et al. (2004) for patients undergoing percutaneous transluminal coronary angioplasty. The original tool consists of 22 items, and in this study, 10 items of physical discomfort, seven items of psychological discomfort and three items of environmental discomfort, for a total of 20 items, were modified to correspond to the study objectives. The revised and supplemented items were used after being verified for content validity by a professor of the nursing department, a chief nurse and two nurses who had worked in the cardiology department for more than 5 years. Each item was rated on a 4-point Likert scale with 1 point for "rarely," 2 points for "sometimes," 3 points for "often," and 4 points for "always." The question "A medical professional treats me kindly" was treated as a counter question. A higher score indicated a higher degree of discomfort. Cronbach's α was .71 in a previous study (Park et al., 2004), whereas it was .70 in this study.

3.2.3 | Intervention

The protocol of the combined intervention of positioning and hand massage is shown in Figure 2. Based on previous studies on coronary intervention or cardiac catheterization and advice from a professor of cardiovascular medicine majoring in arrhythmias, the participants' position was determined to be 25° upper body elevation. Since the half-life of heparin administered during the procedure in patients undergoing RFCA is approximately 90 min, the risk of haemorrhagic complications decreases following the end of the half-life (On, 2016). Additionally, pain and discomfort increase from 90 min after the procedure (Dörschner et al., 2017; Lee, 2014). Therefore, in this study, the participant's upper body was raised by 25°, including a pillow, 90 min after the RFCA procedure.

Hand massage was developed by Snyder et al. (1995) and modified by Cho (1999). Hand massage is more effective when applied in combination with other procedures or when performed repeatedly (Kim & Cho, 2012; Park et al., 2004). In this study, hand massage was performed twice in the following order: back of the hand, palm, fingers and wrap-up massage using hand lotion (Vaseline Hand and Nail Lotion, Aekyung) while maintaining upper body elevation. The required time was 40 s on the back of the hand, 40 s on the palm, 50 s on the fingers and 20 s for the wrap-up massage, 2 min and 30 s for each hand and 5 min for both hands.

The control group performed manual haemostasis after RFCA and applied sandbags for 3 hr. During this time, the position was maintained in a supine position with ABR.

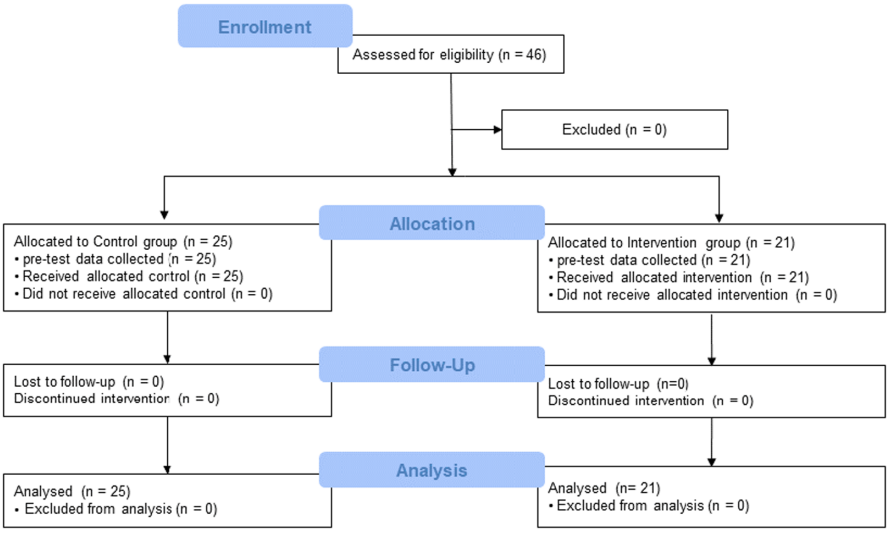


FIGURE 1 Participant recruitment process

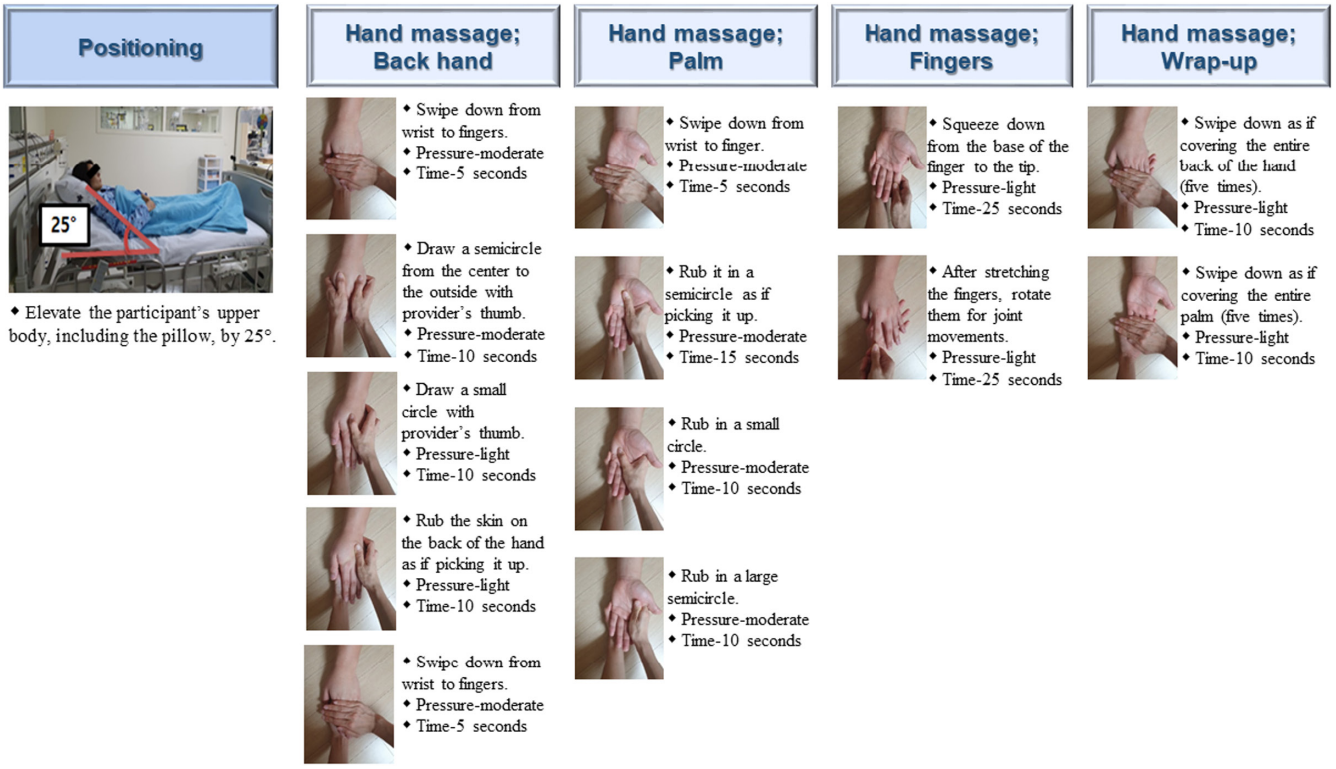
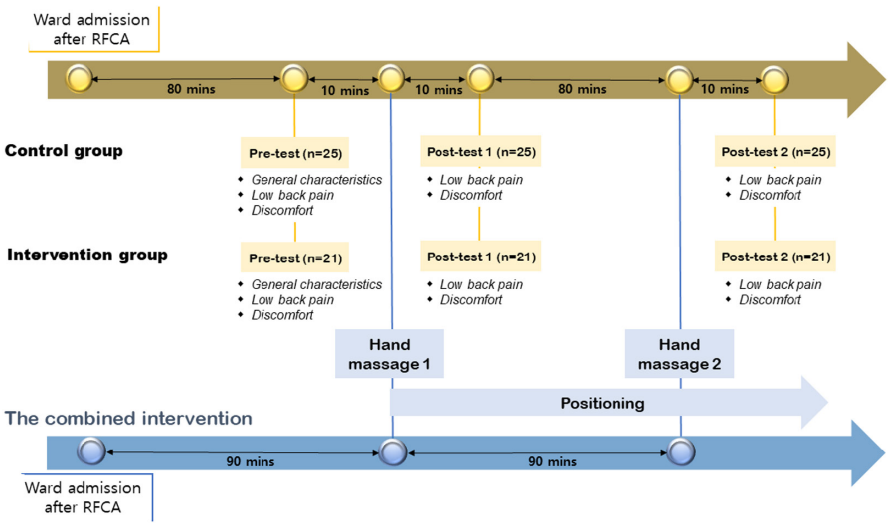


FIGURE 2 The combined intervention of positioning and hand massage

FIGURE 3 Process of this study



3.2.4 | Data collection

Data were collected from June 25, 2018–September 13, 2018, for the control group and September 17, 2018–May 21, 2019, for the intervention group. To avoid the effect of interactions during the study, data from the control group were collected first, and then data from the experimental group were collected after all the control groups were discharged. The process of this study is shown in Figure 3.

For the control group, a pre-test was conducted on participants who were immobilized with sandbags placed on both thighs for haemostasis 80 min after admission for the RFCA procedure. In the pre-test, general characteristics, low back pain and discomfort were measured. The first post-test was conducted 20 min after the pre-test to measure low back pain and discomfort. In the second post-test, low back pain and discomfort were measured 90 min after the first pre-test while maintaining immobility and sandbags applied to both thighs. The control group took ABR to maintain immobility.

For the intervention group, a pre-test was performed on participants who were immobilized with sandbags placed on the two thighs for haemostasis 80 min after admission for RFCA. Low back pain and discomfort were measured during the pre-test. A combined intervention with positioning and hand massage was applied 90 min after admission. For the first post-test, low back pain and discomfort were evaluated 20 min

after the pre-test (5 min after hand massage). The upper body elevation position was maintained, and a second hand massage was performed at 90-min interval. The second post-test was performed 5 min after the end of the second hand massage (90 min after the first post-test), and low back pain and discomfort were measured.

3.3 | Data analysis

Data analysis was conducted using the SPSS 22.0 software. Homogeneity of variables was determined using the Shapiro–Wilk test. The general characteristics of the participants and outcome variables were analysed using descriptive statistics. Homogeneity tests between the two groups were performed using the χ^2 test, independent *t* test and Mann–Whitney *U* test for non-normalized variables. The outcome variables were non-normalized, and the Friedman test was performed to identify the changes in the outcome variables according to the time of the intervention. The Mann–Whitney *U* test was used to analyse the differences between the two groups at the time points.

3.4 | Ethics

This study was approved by the Institutional Review Board (IRB) of redacted hospital (IRB No. 2018-05-038). The study background, study purpose, research methods, side effects or disadvantages, privacy and confidentiality were explained to the participants. Written informed consent forms were obtained from subjects who voluntarily agreed to participate in the study. To protect the subjects' privacy, an individual number was assigned to the information collected, and the information entered on the computer was encrypted.

4 | RESULTS

4.1 | Homogeneity test for general characteristics and outcome variables

No differences between the experimental group and the control group were observed with about to the participants' sex, age, religion and inpatient wards, body mass index and duration of procedure. There were no statistically significant differences in the pre-test score for the outcome variables between the two groups. Therefore, the homogeneity between the two groups was confirmed (Table 1).

4.2 | Comparison outcome variables in the groups

Figure 4 shows the low back pain and discomfort scores of the control and experimental groups at three time points. The differences in low back pain and discomfort scores between the two groups are presented in Table 2.

TABLE 1 Homogeneity test between control and experimental group ($N = 46$)

Variables	Categories	Control group ($N = 25$) N (%)/$M \pm SD$	Intervention group ($N = 21$) N (%)/$M \pm SD$	$\chi^2/t/z$	p
General characteristics					
Sex	Male	16 (64.0)	15 (71.4)	0.29	.592
	Female	9 (36.0)	6 (28.6)		
Age (years)	>65 years	13 (52.0)	15 (71.4)	1.81	.179
	≤65 years	12 (48.0)	6 (28.6)		
Religion	Yes	10 (40.0)	8 (38.1)	0.02	.895
	No	15 (60.0)	13 (61.9)		
Inpatient ward	General ward	11 (44.0)	5 (23.8)	2.05	.152
	ICU	14 (56.0)	16 (76.2)		
BMI (kg/m^2)		25.54 ± 3.09	24.26 ± 3.19	0.31	.758
Duration of procedure (min)		211.88 ± 122.26	249.76 ± 101.29	−1.13	.264
Pre-test					
Low back pain		2.43 ± 1.72	2.36 ± 2.11	−0.27[a]	.788
Discomfort		26.48 ± 4.38	25.16 ± 2.39	−0.80[a]	.423
	Physical	13.12 ± 2.17	13.52 ± 2.46	−0.79[a]	.431
	Psychological	9.60 ± 0.91	9.95 ± 1.83	−0.35[a]	.726
	Environmental	3.44 ± 0.58	3.71 ± 1.15	−0.31[a]	.760

[a]Mann–Whitney *U* test.

The degree of back pain statistically significantly increased with time in the control group ($\chi^2 = 15.23$, $p < .001$), whereas it decreased in the experimental group; however, no statistically significant difference was observed ($\chi^2 = 5.47$, $p = .065$). The degree of discomfort statistically significantly increased in the control group ($\chi^2 = 28.76$, $p < .001$), and the change in the experimental group was not statistically significant ($\chi^2 = 3.09$, $p = .214$). Looking at each sub-factor, the control group's score for physical discomfort statistically significantly increased ($\chi^2 = 20.99$, $p < .001$), whereas the experimental group's score statistically significantly decreased ($\chi^2 = 10.92$, $p = .004$). For psychological discomfort, no statistically significant change in the score was observed in the control group ($\chi^2 = 2.25$, $p = .325$), whereas the experimental group showed a statistically significant decrease ($\chi^2 = 8.05$, $p = .018$). Lastly, the environmental discomfort score of the control group statistically significantly increased ($\chi^2 = 18.22$, $p < .001$), whereas no statistically significant change was observed in the experimental group ($\chi^2 = 1.20$, $p = .549$).

In the control group, the post-test levels of back pain and discomfort, including physical and environmental discomfort, were statistically significantly increased compared with that in the pre-test, whereas the degree of psychological discomfort did not show any statistically significant change. In contrast, in the experimental group, the post-test levels of physical and psychological discomfort were statistically significantly reduced after the intervention, and the degrees of back pain and environmental discomfort did not show any statistically significant change. Therefore, the combined intervention was found to be effective in reducing back pain and discomfort.

4.3 | Comparison outcome variables between the groups

Table 3 shows the results of the differences between the control and experimental groups. The comparison levels were based on the changes between the first post-test and pre-test, between the second post-test and the first post-test, and between the second post-test and the pre-test.

The degree of back pain increased in the control group, whereas it decreased in the experimental group. The differences at all time points were statistically significant ($z = -2.74$, $p = .006$; $z = -2.97$, $p = .003$; $z = -3.76$, $p < .001$, respectively). The discomfort level increased in the control group, whereas it decreased in the experimental group. The differences at all time points were statistically significant ($z = -4.00$, $p < .001$; $z = -2.31$, $p = .021$; $z = -4.27$; $p < .001$, respectively). The physical discomfort increased in the control group and decreased in the experimental group, and the differences between the two groups during the first post-test and the pre-test ($z = -3.95$, $p < .001$) and the second post-test and pre-test ($z = -4.48$, $p < .001$) were statistically significant. The degree of psychological discomfort increased in the control group and decreased in the experimental group between the first post-test and pre-test, and the difference between the two groups was statistically significant ($z = -2.96$, $p = .030$). The degree of environmental discomfort increased in the control group and increased in the intervention group in the first post-test and decreased in the second post-test. Statistically significant differences were observed between the two groups in terms of the changes in the first post-test and pre-test ($z = -2.17$, $p = .030$) and the second post-test and pre-test ($z = -2.27$, $p = .023$).

The degree of back pain and discomfort in the control group showed an increasing trend, whereas that in the experimental group showed a decreasing trend. The difference between the two groups at each time point showed a statistically significant difference. Therefore, the combined intervention was considered effective for back pain and discomfort.

5 | DISCUSSION

The results of this study showed that the low back pain scores were statistically significantly decreased in the experimental group where the combined intervention of upper body elevation and hand massage was applied. This was similar to the results of studies by Heravi et al. (2015) and Boğa and Öztekin (2019), who reported that a 45° upper body position was effective for low back pain in coronary angiography patients. There is a limitation in simple comparison with subjects of this study who underwent RFCA through both femoral veins, because the subjects of these previous studies were patients who underwent angiography performed by the puncture of one femoral vein. However, considering that the subjects of this study had a greater restriction of movement than patients who underwent coronary angiography due to puncture of both femoral veins, the result that the raised position of 25°, which is lower than 45°, had an impact on low back pain was considered statistically significant.

In addition, a previous study reporting that pain was reduced as a result of repeatedly applying hand massage to both hands for 2 min and 30 s in patients undergoing coronary intervention and spinal surgery (Shin & Kim, 2018) was similar to the results of this study. Hand massage alleviates pain and promotes physical relaxation by stimulating the hands (Kim & Cho, 2012; Shin & Kim, 2018). Repeated hand massage interventions are reported to be effective in relieving pain because they activate nerve fibres through repeated skin irritation (Kim & Cho, 2012; Park et al., 2004). The application of a two-time hand massage was considered statistically significant in this study.

Kim and Cho (2012) suggested merging with other types of interventions when offering hand massage interventions to improve its efficacy. In this study, since hand massage was combined with upper body elevation, it can be interpreted that it was effective in relieving low back pain even at 25° lower than that in the previous study (Boğa & Öztekin, 2019; Heravi et al., 2015). However, in

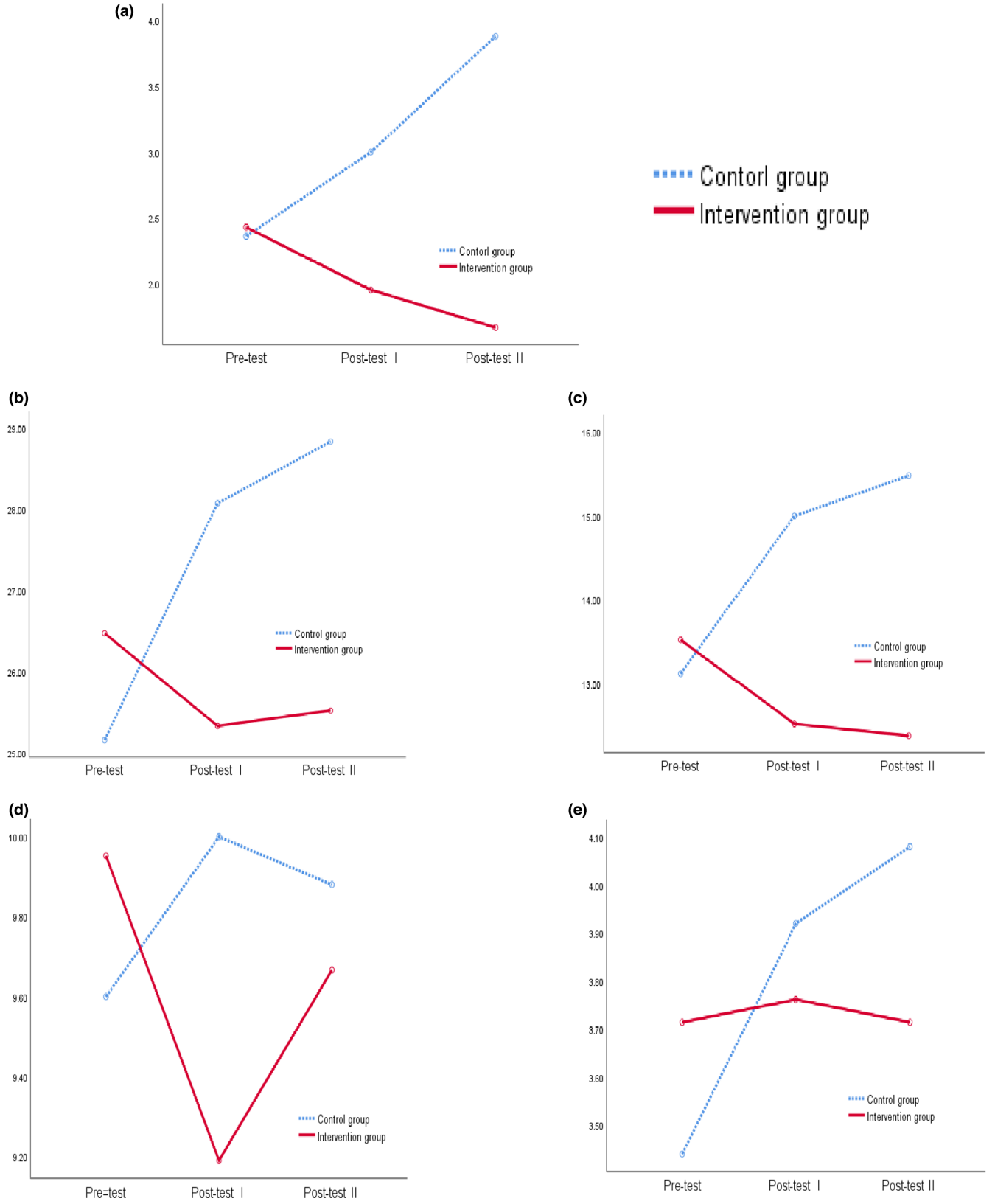


FIGURE 4 Change in scores of low back pain and discomfort. (a) Low back pain. (b) Discomfort. (c) Physical discomfort. (d) Psychological discomfort. (e) Environmental discomfort.

the design of this study, various comparisons could not be made with the control group to which upper body elevation and hand massage were applied. Therefore, there is a limitation in not being able to identify whether the results of this study are the individual effects of each intervention or the effects of the combined intervention.

TABLE 2 Comparison outcome variables in the groups ($N = 46$)

Variables	Control group ($N = 25$)		Intervention group ($N = 21$)	
	Mean ± *SD*	Median (Q1–Q3; IQR)	Mean ± *SD*	Median (Q1–Q3; IQR)
Low back pain				
Pre-test	2.36 ± 2.12	2 (0.50–3.50; 3.00)	2.43 ± 1.72	2 (1.50–3.00; 2.00)
Post-test I	3.00 ± 2.36	3 (1.00–5.00; 2.00)	1.95 ± 1.32	2 (1.00–2.50; 1.50)
Post-test II	3.88 ± 2.18	4 (2.00–4.00; 5.00)	1.67 ± 0.97	2 (1.00–2.00; 1.00)
χ^2 (*p*)	15.23 (<.001)		5.47 (.065)	
Discomfort				
Pre-test	25.16 ± 2.39	25 (23.00–26.50; 3.50)	26.48 ± 4.38	25 (24.00–28.00; 4.00)
Post-test I	28.08 ± 3.97	28 (25.00–30.00; 5.00)	25.33 ± 2.20	25 (23.00–27.00; 4.00)
Post-test II	28.84 ± 3.84	28 (26.00–32.00; 6.00)	25.52 ± 3.75	24 (23.00–27.50; 4.50)
χ^2 (*p*)	28.76 (<.001)		3.09 (.214)	
Physical discomfort				
Pre-test	13.12 ± 2.17	12 (12.00–14.00; 2.00)	13.52 ± 2.46	13 (12.00–14.50; 2.50)
Post-test I	15.00 ± 3.69	15 (12.50–16.00; 3.50)	12.52 ± 1.66	12 (11.00–14.00; 3.00)
Post-test II	15.48 ± 2.79	15 (13.00–17.50; 4.5)	12.38 ± 1.77	12 (11.00–14.00; 3.00)
χ^2 (*p*)	20.99 (<.001)		10.92 (.004)	
Psychological discomfort				
Pre-test	9.60 ± 0.91	10 (9.00–10.00; 1.00)	9.95 ± 1.83	9 (9.00–10.00; 1.00)
Post-test I	10.00 ± 1.15	10 (9.00–11.00; 2.00)	9.19 ± 1.50	9 (8.00–9.00; 1.00)
Post-test II	9.88 ± 1.20	10 (9.00–11.00; 2.00)	9.67 ± 2.01	9 (8.00–9.00; 1.00)
χ^2 (*p*)	2.25 (.325)		8.05 (.018)	
Environmental discomfort				
Pre-test	3.44 ± 0.58	3 (3.00–4.00; 1.00)	3.71 ± 1.15	3 (3.00–4.00; 1.00)
Post-test I	3.92 ± 0.81	4 (3.00–4.00; 1.00)	3.76 ± 1.00	3 (3.00–4.00; 1.00)
Post-test II	4.08 ± 1.08	4 (3.00–4.50; 1.50)	3.71 ± 1.01	3 (3.00–4.50; 1.00)
χ^2 (*p*)	18.22 (<.001)		1.20 (.549)	

Abbreviations: IQR, interquartile range; Q1, first quartile; Q3, third quartile.

The study found that the combination of upper body elevation and hand massage was effective in relieving physical, psychological and environmental discomfort. The physical discomfort in the experimental group was statistically significantly reduced, which was similar to the findings of a previous study (Nam & Choi, 2010), wherein the intervention involving position changes to the semi-Fowler position in patients who have undergone coronary angiography 2 hr after the procedure statistically significantly reduced the physical discomfort. Because elevating the upper body relieves pressure on the body and prevents spasticity (Cha & Sok, 2016), it is considered an effective procedure to relieve physical discomfort. In addition, previous studies by Kim et al. (2008) and Shin and Kim (2018) in patients undergoing percutaneous coronary intervention found that the patients' physical discomfort was reduced after offering a hand massage, similar to the findings of our study. Hand massage is effective in alleviating discomfort because it relaxes muscles and increases blood circulation (Kim & Cho, 2012; Shin & Kim, 2018). Therefore, our study results can be considered of statistically significance to confirm that providing a combined intervention of 25° upper body elevation and hand massage to patients who have undergone RFCA with limited movement is effective in alleviating physical discomfort.

Psychological discomfort was statistically significantly reduced in the experimental group in which the combined intervention was applied, which is considered to be related to hand massage. Hand massage builds a positive relationship between healthcare providers and patients and fosters psychological and mental stability (Çavdar et al., 2020; Lee et al., 2016). It also helps in creating a positive rapport because healthcare providers and patients are in regular contact during the hand massage procedure (Çavdar et al., 2020; Kim & Cho, 2012). A previous study (Kim et al., 2008) reported that the application of hand massage to patients who have undergone coronary angiography was effective in alleviating psychological discomfort, supporting the findings of our study. Therefore, in our study, providing a hand massage to patients who have undergone RFCA is considered to be helpful in alleviating discomfort because it relieves psychological tension by increasing the trust relationship between Registered Nurses and patients.

TABLE 3 Comparison outcome variables between the groups ($N = 46$)

Variable	Control group ($N = 25$)		Intervention group ($N = 21$)			
	Mean ± *SD*	Median (Q1–Q3; IQR)	Mean ± *SD*	Median (Q1–Q3; IQR)	*z*	*p*
Low back pain						
Post I - Pre	0.64 ± 1.50	0 (0.0–1.5; 1.5)	−0.48 ± 1.17	−1 (−1.0–0.0; 1.0)	−2.74	.006
Post II - Post I	0.88 ± 1.36	1 (0.0–1.5; 1.5)	−0.29 ± 1.10	0 (−1.0–0.0; 1.0)	−2.97	.003
Post II - Pre	1.52 ± 1.92	2 (0.0–2.5; 2.5)	−0.76 ± 1.61	−1 (−2.0–0.5; 2.5)	−3.76	<.001
Discomfort						
Post I - Pre	2.92 ± 3.04	2 (0.0–5.0; 5.0)	−1.14 ± 3.28	0 (−2.5–1.0; 3.5)	−4.00	<.001
Post II - Post I	0.76 ± 3.67	0 (0.0–2.5; 2.5)	0.19 ± 2.44	0 (−1.0–0.0; 1.0)	−2.31	.021
Post II - Pre	3.68 ± 3.60	3 (1.0–7.0; 6.0)	−0.95 ± 3.32	0 (−1.0–0.0; 1.0)	−4.27	<.001
Physical discomfort						
Post I - Pre	1.88 ± 2.71	2 (0.0–3.0; 3.0)	−1.00 ± 1.92	−1 (−2.0–0.0; 2.0)	−3.95	<.001
Post II - Post I	0.48 ± 3.65	0 (0.0–2.0; 2.0)	−0.14 ± 1.20	0 (0.0–0.0; 0.0)	−1.75	.081
Post II - Pre	2.36 ± 3.13	2 (0.0–4.5; 4.5)	−1.14 ± 1.98	−1 (−1.0–0.0; 1.0)	−4.48	<.001
Psychological discomfort						
Post I - Pre	0.40 ± 1.08	0 (0.0–1.0; 1.0)	−0.76 ± 1.41	0 (−1.0–0.0; 1.0)	−2.96	.003
Post II - Post I	−0.12 ± 0.53	0 (0.0–0.0; 0.0)	0.48 ± 1.72	0 (0.0–0.0; 0.0)	−1.63	.104
Post II - Pre	0.28 ± 1.10	0 (−1.0–1.0; 2.0)	−0.29 ± 2.19	0 (−1.0–0.0; 1.0)	−1.56	.119
Environmental discomfort						
Post I - Pre	0.48 ± 0.59	0 (0.0–1.0; 1.0)	0.05 ± 0.86	0 (0.0–0.0; 0.0)	−2.17	.030
Post II - Post I	0.16 ± 0.55	0 (0.0–0.0; 0.0)	−0.05 ± 0.22	0 (0.0–0.0; 0.0)	−1.58	.113
Post II - Pre	0.64 ± 0.91	0 (0.0–1.0; 1.0)	0.00 ± 0.89	0 (0.0–0.0; 0.0)	−2.27	.023

Environmental discomfort includes noise, unfamiliar surroundings and excessive attention (Park et al., 2004). Nam and Choi (2010), who applied upper body elevation to patients who have undergone coronary angiography, reported that there was no statistically significant difference in environmental discomfort between the experimental and control groups. Therefore, in our study, the combined intervention that has proven effective in alleviating environmental discomfort can be interpreted as the effect of hand massage. In other words, it is considered that this is because the nurse played a role in calling the patients' attention while arranging the hand massage and helped them focus on their own treatment process rather than the noise around them. However, the detailed discussion due to the lack of previous related research is limited. Therefore, for evidence-based practice, it is necessary to repeatedly determine the effects of combined intervention with positioning and hand massage and to conduct an extended study to compare and analyse the results of this study.

Combined intervention was applied to patients who underwent the RFCA procedure, and the effect was confirmed using repeated measures. This study was meaningful in that it attempted an experimental study on patients undergoing coronary angiography who had a greater risk of bleeding due to puncture of both femoral veins and discomfort due to immobility. Furthermore, the strength of this study was that the lower-angle position change compared with the 45° position, which is often used in previous studies, combined with hand massage was effective in reducing low back pain and physical, psychological and environmental discomfort. Therefore, based on the study findings, the application of this approach can be extended to patients undergoing procedures similar to RFCA.

However, in this study, since the interval between the pre-test and the first post-test was only 20 min, the halo effect may appear because the learning effect and the researcher performed both the intervention and the measurement. A limitation of this study is that there was only one control group, which did not individually consider upper body elevation and hand massage. In addition, this study was non-randomized controlled trial. Consequently, the results of this study should be interpreted with caution.

6 | CONCLUSION

This study aimed to confirm the effect of a combined intervention of positioning and hand massage on low back pain and discomfort in patients undergoing RFCA. The control group who did not receive the combined intervention had low back pain, and the physical, psychological and environmental discomfort scores had increased over time, whereas the experimental group who received the combined intervention showed low back pain, and the physical, psychological and environmental discomfort scores had statistically significantly

decreased. Therefore, it was confirmed that the combined intervention in our study was effective in reducing back pain and discomfort in patients with RFCA.

This study has implications for nursing practices. It is possible to apply the combined intervention of 25° upper body elevation and hand massage in the clinical field to not only patients who have undergone RFCA, but also patients who need to take an immobile position due to puncture of a femoral blood vessel, which is hard to expect in a single intervention that only changes the position. Even a slight change in position can be expected to relieve back pain and psychological and environmental discomfort.

Based on the results of this study, the following recommendations were made. First, in the follow-up study, the control group should be further divided into a group that performed both positioning and hand massage intervention, a group that performed only positioning, a group that only performed hand massage, and a group that only performed routine treatment. As such, the researchers propose a study comparing the intervention effects with various control groups. Second, because there is a lack of related studies that can compare and analyse the results of physical, psychological and environmental discomfort, a future study that can be generalized through repeated analysis of these variables is suggested.

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CONFLICT OF INTEREST

The authors report no actual or potential conflicts of interests. This article is partially based on the first author's master's thesis from Wonkwang University.

DATA AVAILABILITY STATEMENT

The data that support the findings of this study are available on request only from the corresponding author. The data are not publicly shared due to privacy or ethical restrictions.

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