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Does Hand Massage Have Sustained Effects on Pain Intensity and Pain-Related Interference in the Cardiac Surgery Critically Ill? A Randomized Controlled Trial

Madalina Boitor, RN, PhD(c) [*], Géraldine Martorella, RN, PhD [†], Christine Maheu, RN, PhD [*], Andréa Maria Laizner, RN, PhD [*], Céline Gélinas, RN, PhD [*]

[*] *Ingram School of Nursing, McGill University, 680 Sherbrooke West, Montréal, Québec, Canada*
[†] *College of Nursing, Florida State University, Tallahassee, Florida*

A R T I C L E I N F O

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A B S T R A C T

Background: Despite the promising short-term pain relief effect of massage, little is known regarding its sustained effects on pain intensity and pain-related interference with functioning.
Aims: To evaluate the sustained effect of hand massage on the pain intensity and pain-related interference with functioning of cardiac surgery patients.
Design: A randomized controlled trial.
Settings: A medical-surgical intensive care unit in Canada.
Participants/Subjects: Adult patients undergoing cardiac surgery and at low risk for postoperative complications were eligible.
Methods: In the intensive care unit, patients were randomly assigned to either 20-minute hand massage, hand holding, or rest. Pain intensity and pain-related interference with functioning were assessed on the second postoperative day.
Results: A total of 60 patients were randomly allocated and 46 completed data collection on the second postoperative day. Although no significant differences were identified across groups, the hand massage group reported a maximum pain intensity (median 5.75, range: 2-10) that was lower than the hand-holding (median 6.50, range: 1-10) and standard care groups (median 6.25, range: 0-10). The hand massage group could reach 0 pain intensity throughout a 24-hour period (median 0, range: 0-7), contrary to the hand-holding (median 2, range: 0-5) and standard care groups (median 2, range: 0-4.5). A trend for statistical significance was noted for dichotomized ratings on pain interference with walking ($p = .176$) and sleep ($p = .050$).
Conclusions: Hand massage could help patients experience longer periods without pain and lower levels of maximum pain intensity. When coupled with recovery activities, hand massage could reduce pain-related interference with functioning.

Cardiac surgery is one of the most commonly performed surgical procedures worldwide that requires routine admission to the intensive care unit (ICU). Acute postoperative pain is a common consequence of cardiac surgery (Choiniere et al., 2014; Denault et al., 2014; Gelinas, 2007; Watt-Watson et al., 2004) and, when poorly relieved, can interfere with functioning, sleep, and recovery. Many pre-, intra-, and postoperative interventions and management approaches have evolved for relieving postoperative pain, yet more than half of patients undergoing surgery reported that pain continues to be undermanaged (Gan, Habib, Miller, White, & Apfelbaum, 2014).

Both clinical practice guidelines from the Society of Critical Care Medicine for the management of pain in the ICU (Barr et al., 2013) and guidelines on the management of postoperative pain from the American Pain Society (Chou et al., 2016) support the use of multimodal regimens, including the use of a variety of analgesic medications combined with nonpharmacologic interventions. Despite the growing popularity and clinical use of nonpharmacologic interventions in the management of acute pain, research gaps persist regarding the strength of evidence for their effectiveness in decreasing pain (Gordon et al., 2016). Massage is

Address correspondence to Madalina Boitor, RN, PhD(c), Ingram School of Nursing, McGill University, 680 Sherbrooke West, Montreal, Quebec H3A 2A7, Canada.
E-mail address: madalina.boitor@mail.mcgill.ca (M. Boitor).

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one nonpharmacologic intervention that has shown promise to reduce pain and anxiety in surgical pain populations including cardiac surgery (Boitor et al., 2018; Boyd et al., 2016). Although these beneficial effects of massage are highly valued after cardiac surgery, it is equally important to evaluate if massage can have a positive impact on other clinically relevant outcomes in the ICU such as pain-related functional deficits and sleep.

Most randomized controlled trials focus on the immediate postadministration effect of massage on pain intensity but fail to consider its sustained effect and whether the decreases in pain intensity as a result of massage translate into less interference with functioning in the early recovery phase. The National Institute of Health Patient-Reported Outcomes Measurement Information System defines pain interference as a measure of the extent to which pain hinders engagement with physical, cognitive, emotional, and recreational activities; sleep; and enjoyment in life (Amtmann et al., 2010). Improvements in pain intensity and ability to engage in activities such as walking are predominant indicators used to evaluate the recovery progress in postoperative patients (Gornall et al., 2013; Myles, Weitkamp, Jones, Melick, & Hensen, 2000) and should be measured in an effort to restore the physical and psychosocial health of patients in pain.

Sleep is a basic human need that is often fragmented and disrupted in the ICU. Critically ill patients are susceptible to having very little deep or restorative sleep during the ICU stay (Friese, 2008; Kamdar, Needham, & Collop, 2012) and to continue to experience sleep disturbances even 6-12 months after discharge (Franck, Tourtier, Libert, Grasser, & Auroy, 2011). Despite the fact that opioids can promote sleep by relieving pain, they are also known to cause disturbed sleep in the ICU because they interact with the natural sleep pathway (Saper, Scammell, & Lu, 2005) and may decrease deep sleep and increase nocturnal wake time (Dimsdale, Norman, De Jardin, & Wallace, 2007).

The Society of Critical Care Medicine also advocates for the use of nonpharmacologic interventions to enhance sleep in the ICU (Barr et al., 2013) and suggests that they could become a promising alternative to pharmacologic treatments, which may contribute to disturbed sleep, drug tolerance, withdrawal, and delirium (Pulak & Jensen, 2016). One randomized controlled trial (RCT) with critically ill men with cardiovascular illness compared three interventions: a 6-minute back massage, relaxation plus relaxing music (combined muscle relaxation, mental imagery, and audiotape), and usual care (Richards, 1998). Participants in the back massage group (mean = 319.82 minutes of sleep, standard deviation [SD] = 48.45) slept more than 1 hour longer than those in the usual care group (mean = 257.33 minutes of sleep, SD = 108.22; p value not reported). In another RCT, cardiac surgery patients receiving massage after ICU discharge reported an increased sleep effectiveness compared with control ($p = .019$) (Nerbass, Feltrim, de Souza, Ykeda, & Lorenzi, 2010), thereby supporting the potential benefit of massage in this surgical patient population. To date, the effect of massage on sleep in the ICU is largely unexamined (Hu et al., 2015), and more research is awaited to verify its potential to improve the much needed quantity and quality of sleep in the critically ill after cardiac surgery.

Aims

This research study aimed to compare the sustained effect of standard care plus three 20-minute hand massage interventions by a trained nurse within 24 hours after cardiac surgery versus hand holding plus standard care and standard care alone on the pain intensity and pain-related interference with functioning of critically ill adults. The second aim of this study was to describe participants' perceptions of sleep in the ICU on the second postoperative day.

Methods

Design and Trial Registration

This experimental study used a randomized controlled single-center trial design with three parallel groups. The study follows the modified CONSORT guidelines for RCTs of nonpharmacologic treatments (Boutron et al., 2008). This RCT is registered with ClinicalTrials.gov (NCT 02679534), and the protocol is published in the *Journal of Medical Internet Research* (Boitor et al., 2016). Results of the immediate effects of massage on pain intensity, pain unpleasantness, anxiety, muscle tension, and vital signs are published elsewhere (Boitor et al., 2018).

Setting

This research study was conducted in a medical-surgical ICU in a university-affiliated hospital in Montreal, Canada. In an attempt to standardize the routine care, pain management practices, and physical context of the ICU across all participants, a single setting was used. The study ICU uses a pain management protocol based on regular opioids and acetaminophen for cardiac surgery patients and has only single-patient rooms allowing to control for environmental light and noise.

Participants

Patients were considered eligible for inclusion in this RCT if they were admitted in the ICU after undergoing their first elective cardiac surgery, 18 years and older, French or English speaking, able to self-report, at low risk for postoperative complications, and without contraindications to having their hands massaged (Boitor et al., 2016).

Sample Size and Randomization

The power analysis for this RCT was based on pain intensity reduction of 1.5 points on a 0-10 scale (SD = 2.0) with a two-sided significance level of .05, power of 0.80 and a 10% dropout rate, resulting in a required total sample size of 79 patients (Boitor et al., 2016). The 1.5 reduction in pain intensity was based on what has been reported in previous massage studies and given that it is approximating the clinically significant 2-point reduction in acute pain intensity (Cepeda, Africano, Polo, Alcala, & Carr, 2003). A data analyst generated a permuted-block randomization using SAS software (SAS Institute Inc., College Station, Texas, USA) based on block sizes of three, one strata and 1:1:1 allocation ratio. The randomization schedule was transcribed in sequentially numbered opaque sealed envelopes by a research coordinator not involved in assignment allocation.

Procedures

Patients were first screened preoperatively to verify the language spoken, if admitted for first cardiac surgery, and the risk factors for postoperative complications (e.g., ejection fraction < 35%). Once admitted to the ICU after surgery, patients were screened for ability to self-report and eligibility for safe massage administration (e.g., peripheral intravenous lines, hypersensitivity to touch). Eligible patients were asked to self-report their pain intensity, pain unpleasantness, and anxiety (Boitor et al., 2018), and then were assigned the next envelope in the sequence to allocate to either the hand massage, hand-holding, or standard care groups. Group assignment was concealed from participants, family members, and ICU clinicians.

Interventions

One interventionist delivered all hand massages and hand holdings except for one, which was given by a research coordinator. The interventions were standardized across participants. The interventionist was a registered nurse trained in massage therapy through an accredited workshop of 6 hours as done in the pilot RCT (Boitor et al., 2015). The training was provided by a professional therapist and consisted of practical exercises and verification of competency in administering hand massage as per protocol.

This RCT aimed to repeat each intervention (i.e., hand massage or hand holding) three times within 24 hours postoperatively and while patients were still in the ICU. The first intervention was administered in the evening of the day of surgery (postoperative day [POD] 0) or early evening the day after (POD 1), and the remaining ones in the evening of POD 1.

Passive Control Group

The passive control group received the standard care provided in the ICU and a 20-minute rest period. There was no contact with the interventionist throughout the 20 minutes. Patients received the routine pain management protocol for ICU patients after cardiac surgery including the nonpharmacologic interventions (e.g., repositioning) used to promote comfort.

Active Control Group

In addition to the standard ICU care, patients assigned to this group received 20-minute hand holding with occasional stroking. After the door was closed, the lights dimmed and patients were comfortably positioned; the interventionist held their hands for 5-10 seconds, applied unscented hypoallergenic cream to both hands, and held each of the patient's hands for 10 minutes. Occasional stroking was added to ensure patient, family, and clinician blinding, given that it was seemingly identical to massage and to limit dropout from this group.

Experimental Group

The experimental group received 20-minute hand massage by the interventionist in addition to the standard ICU care. The same environmental adjustments were done as for the active control group, the interventionist held each hand for 5-10 seconds, applied unscented hypoallergenic cream, and massaged both hands using moderate pressure, stroking, and kneading techniques for a total of 20 minutes. The massage protocol is inspired by the procedure by Kolcaba et al. (Kolcaba, Schirm, & Steiner, 2006) and was developed with the support of the professional massage therapist who provided the training. The detailed massage protocol can be consulted in the published protocol of this RCT (Boitor et al., 2016).

Outcomes

Here we present the results related to the sustained effects of massage on pain intensity and pain-related interference with functioning and descriptive data on sleep. An adapted version of the Brief Pain Inventory (BPI) was used to assess the sustained effects of massage on pain intensity on POD 2 as well as the interference of the pain on patient's functioning (Cleeland & Ryan, 1994; Larue, Colleau, Brasseur, & Cleeland, 1995). The four pain intensity items are rated individually on a 0 to 10 numeric rating scale (0 for “no pain” and 10 for “pain as bad as you can imagine”) for pain at the time of interview (pain now) and the worst, least, and average pain during the last 24 hours.

The pain interference items comprise seven 0 to 10 numeric rating scales with the anchors 0 for “no interference” and 10 for “interferes completely.” The seven items of pain interference included in the actual BPI evaluate the impact of pain on general activity, mood, walking/mobilization, work, relationships, sleep, and enjoyment of life. The version used in this study does not include the item “work” because it is not considered relevant in the early postoperative context, but comprises items that could generate moderate-severe pain interference in cardiac surgery patients such as coughing, deep breathing, appetite, and concentration (Choiniere et al., 2014; Martorella, Cote, Racine, & Choiniere, 2012; Watt-Watson et al., 2004).

The BPI has been found to have internal consistency for this patient population, with Cronbach's α coefficients between .84-.89 for the severity scale and .91-.94 for the interference scale. Scores on both scales declined significantly from baseline to the 6 months postoperative follow-up, thus testifying to the responsiveness of the BPI for detecting changes (Gjeilo, Stenseth, Wahba, Lydersen, & Klepstad, 2007).

The Richards-Campbell Sleep Questionnaire (RCSQ) was used to evaluate patients' perception of their sleep quality while in the ICU. The questionnaire was developed as a five-item scale for patients to report on the sleep in the critical care environment (Richards, O'Sullivan, & Phillips, 2000)—more specifically, on the depth, latency, awakenings, amount of time awake, and overall quality of sleep. Each item is scored on a 0-100 mm visual analog scale, and the full questionnaire takes approximately 2 minutes to complete. Items of the RCSQ correlated with polysomnography on sleep onset, sleep depth, awakenings, and total sleep time (Richards et al., 2000). The RCSQ has been validated with ICU patients and was found to have good internal consistency, convergent validity with polysomnography (Richards et al., 2000), and good interrater correlation between patients and nurses (Frisk & Nordstrom, 2003).

Data Collection

Sociodemographic and medical-surgical data were collected using standardized data collection sheets. On POD 2, research assistants and the interventionist met 22 and 24 participants, respectively, for a brief interview using the BPI. On the same occasion, they were invited to mark an X along each of the five scales of the RCSQ.

The interventionist collected field notes that covered comments made by patients related to the intervention administered (i.e., hand massage, hand holding) and observations such as falling asleep during and/or after the intervention.

Data Analysis

The data were entered in the SPSS software (version 22.0; IBM Corp., Armonk, NY, USA), which was used for statistical analysis. This study uses intention-to-treat analysis by including every participant who has been randomized.

Descriptive statistics were calculated for sociodemographic and medical-surgical data to describe the study sample. Group differentiation on these variables was investigated using χ^2 tests of independence for nominal level variables and Kruskal-Wallis for interval and ratio level non−normally distributed variables. The Kruskal-Wallis test was used to evaluate group differences in scoring of the BPI items. A dichotomized score was calculated for each BPI item of the pain intensity and pain interference scales, where ratings less than 4 out of 10 (i.e., mild) (Barr et al., 2013) were assigned a score of 0, and ratings of moderate to severe (i.e., 4 out of 10 and greater) were assigned a score of 1. Pearson χ^2 test was used for the analysis of the dichotomized BPI items.

Descriptive statistics were calculated for each item of the RCSQ and the total score to provide preliminary data on the quality of sleep of cardiac surgery critically ill.

Ethics

The Research Ethics Committee of the study setting approved the conduct of this study in February 2016. Throughout the study, sleep resurfaced as an important aspect of the ICU experience of the cardiac surgery critically ill, who fell asleep during and after the hand massage administration, and who reported that hand massage promoted sleep. Consequently, an amendment of the protocol was done in June 2016 to include the RCSQ. Informed and written consent was obtained from participants.

Results

A total of 138 patients were screened, 95 met the eligibility criteria, and 83 consented for participation in the study (see Fig. 1 for the modified CONSORT flow diagram). Of these, only 60 were randomly allocated because eight were not able to self-report on a 0-10 NRS, eight had cancelled or postponed surgery, six were medically unstable, and one withdrew consent after surgery. Among those who consented to participate in this trial, there were no significant differences in sociodemographic characteristics between those randomly allocated and those lost postoperatively (Pearson χ^2, $p > .09$).

On POD 2, 46 patients (18 hand massage, 16 hand holding, 12 standard care) were available and willing to complete the BPI. Main reasons for dropout (n = 14) were being discharged home or to another hospital (n = 4), finding it challenging to report pain interference on a 0 to 10 scale (n = 3), experiencing confusion (n = 2), not being available for interview (n = 2), being medically unstable (n = 1), undergoing second surgical procedure on POD 2 (n = 1), and refusal (n = 1). The 46 patients completing data collection on POD 2 had a mean age of 64 years and the majority were male (n = 35, 76.1%) (Table 1). They were not significantly different across groups in terms of sociodemographic and medical characteristics except for the surgical technique employed for the cardiac surgery (Pearson $\chi^2 = 7.06$, $p = .029$). All 18 patients from the massage group who completed the BPI had surgery via sternotomy, whereas those undergoing robotic surgery were distributed across the hand-holding (n = 2) and standard care groups (n = 4).

The RCSQ was completed by only 25 patients (hand massage, n = 10; hand holding, n = 9; standard care, n = 6) given that it was added to the BPI questionnaire 3 months after the beginning of recruitment and data collection.

Sustained Effects on Pain

The pain intensity index of the BPI provided insight into the sustained effects of hand massage and hand holding on pain. Although no significant differences were identified across groups, the hand massage group reported a maximum pain intensity (median = 5.75, range: 2-10) that was lower than what was reported by the hand holding (median = 6.50, range: 1-10) and standard care groups (median = 6.25, range: 0-10) (Table 2). Those receiving hand massage were also able to reach 0 pain intensity over the course of 24 hours (median = 0, range: 0-7) contrary to those assigned to hand holding (median = 2, range: 0-5) and standard care (median = 2, range: 0-4.5). The average pain over 24 hours was moderate and similar across the three groups (Kruskal-Wallis test = 0.03, $p = .984$). When dichotomized, ratings on pain intensity BPI items were similar across groups (Pearson χ^2, $p > .10$).

Pain-Related Interference

Regardless of group assignment, patients reported small to moderate interference of pain with early recovery activities (Table 2). Pain interfered most with coughing (medians between 2 and 5) and taking deep breaths (medians 3 and 5) and least with humour, appetite, relations with others, concentration, and enjoyment with life (median = 0). Overall, no statistically significant differences were identified in pain-related interference across groups (Kruskal-Wallis test, $p > .224$).

A trend for statistical significance was noted for dichotomized ratings on pain interference with walking (Pearson $\chi^2 = 3.47$, $p = .176$) and pain interference with sleep (Pearson $\chi^2 = 5.98$, $p = .050$). A higher proportion of patients in the hand massage group (n = 12, 71%) reported none or mild (i.e., <4) pain interference with walking compared with hand holding (n = 6, 40%) and standard care (n = 8, 67%). Pain interfered little with sleep for most patients in the hand massage (n = 14, 82%) and standard care groups (n = 10, 90%) compared with those receiving hand holding (n = 6, 50%).

Sleep

Patients in the hand massage group reported that the massage was relaxing and conducive to falling asleep. All patients fell asleep during and continued to sleep after the hand massage administration, except for two occasions when they were sitting in chair.

Overall, patients in all groups reported predominantly light sleep (medians 68.75-91.88) and being awake roughly 50% of the night time (medians 47.50-71.88) (Table 3). The quality of sleep was also reported to be rather poor (medians 50-88.75). There were mixed reports across groups regarding their ability to fall asleep and going back to sleep once awaken such that the standard care and hand massage groups experienced the greatest challenges in falling asleep (median = 87.50) and going back to sleep (median = 60.00), respectively.

Discussion

This RCT is one of the first three-arm RCTs evaluating the sustained effect of hand massage administration in the ICU on the pain and pain-related interference with activities and to provide preliminary results on the sleep of cardiac surgery patients. Results suggest that hand massage may help cardiac surgery patients to experience pain-free periods and to have a lower maximum pain intensity over 24 hours. Trends for statistical significance were identified regarding the interference of pain with walking and sleep. This study also indicates that cardiac surgery patients in the ICU experience nocturnal sleep that is generally light, short, and poor in quality.

Cardiac surgery patients continue to experience, on average, moderate pain intensity throughout the first and second post-operative days regardless of their group assignment. Although massage has been found to have significant short-term pain relief effects with the cardiac surgery (Boitor et al., 2018) and other surgical patient populations (Boyd et al., 2016), its sustained effects have been rarely examined. There were no statistically significant differences in least and most intense pain intensity between groups, yet the calculated medians suggest that hand massage could help patients attain 0 pain levels and lower the maximum pain intensity reached. The lack of statistical significance could be due to the smaller sample size of patients who were available and able to complete the BPI on POD2. In a previous RCT with 40 cardiac surgery ICU patients, the administration of hand massage did not have sustained pain relief effects compared with hand holding ($p = .10$), and the average pain was moderate for both groups (Boitor et al., 2015). Future massage trials are needed to verify if the pain relief effects can be sustained over time.

One of the negative consequences of unrelieved postoperative pain is its potential to interfere with recovery activities, including taking deep breaths, coughing, walking, and sleep, as reported in

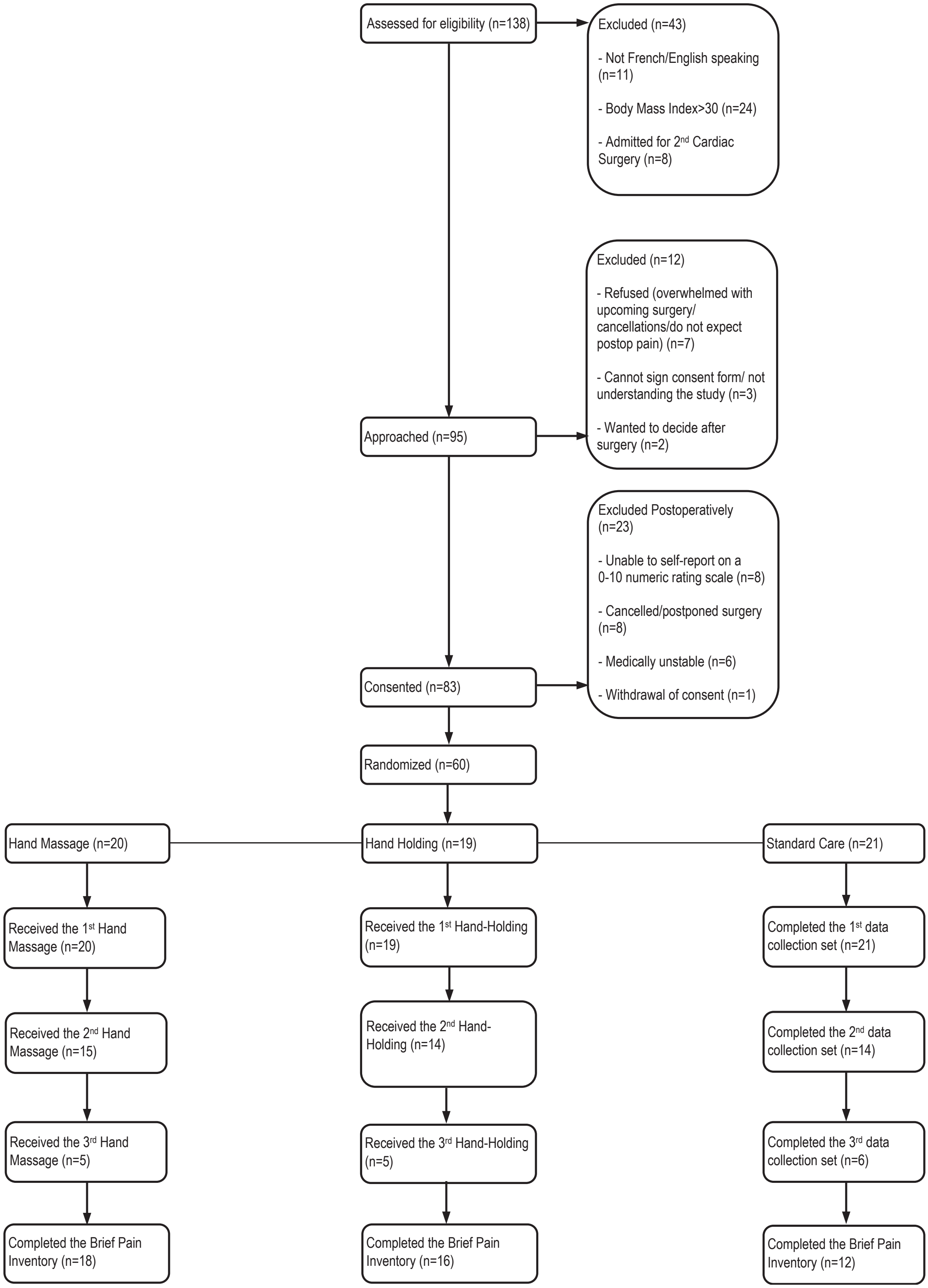

Figure 1. CONSORT flow diagram.

this RCT and other studies with postoperative patients (Leegaard, Rustoen, & Fagermoen, 2010; Miller, Roth, Roehrs, & Yaremchuk, 2015; Wu et al., 2005). The effects of hand massage did not appear to significantly benefit patients in terms of pain-related interference, but a higher proportion of patients in the hand massage group reported little or no interference with walking compared with those in the standard care and hand-holding groups. The administration of hand massage was not coupled with any of the recovery activities, which may explain the nonsignificant effect on pain-related interference. Hand massage could facilitate engaging in recovery activities such as walking if they are initiated immediately after the delivery of hand massage

Table 1
Sociodemographic and Medical-Surgical Characteristics for Each Group (N = 46)

	Massage	Hand Holding	Standard Care	Overall	Statistical Comparison Between Groups
	N = 18	N = 16	N = 12	N = 46	
Gender (n)					
Male	12	13	10	35	$\chi^2 = 1.46$, $p = .482$
Female	6	3	2	11	
Age (years)					Kruskal-Wallis = 1.88, $p = .391$
Median	64	68	62	65	
Range	36-78	51-79	44-84	36-84	
Race (n)					
White/Caucasian	18	14	8	40	$\chi^2 = 7.95$, $p = .093$
Asian	0	2	3	5	
Black/African American	0	0	1	1	
First language (n)					
French	10	9	5	24	$\chi^2 = 5.98$, $p = .650$
English	6	4	6	16	
Bilingual	1	1	0	2	
Other	1	2	1	4	
Education (n)					
Primary	0	2	1	3	$\chi^2 = 2.31$, $p = .890$
Secondary	9	7	6	22	
College	2	2	1	5	
University	6	5	4	15	
NR	1	-	-	1	
Nonanginal chronic pain (n)					
No	10	11	9	30	$\chi^2 = 1.34$, $p = .513$
Yes	8	5	3	16	
Use of Treatments	5	4	2	11	
Prior use of massage therapy (n)					
Yes	8	6	4	18	$\chi^2 = .40$, $p = .818$
No	10	10	8	28	
Prior use of other alternative therapies than massage (n)					
Yes[a]	3	1	0	4	$\chi^2 = 2.70$, $p = .259$
No	15	15	12	42	
Surgery (n)					
CABG	14	14	9	37	$\chi^2 = 3.82$, $p = .431$
VR	4	1	3	8	
CABG & VR	0	1	0	1	
Surgical technique (n)					
Via sternotomy	18	14	8	40	$\chi^2 = 7.06$, $p = .029$
Robotic	0	2	4	6	
Opioid use POD 0[b] (mg morphine)					Kruskal Wallis = 1.39, $p = .498$
Median	13.75	16.75	12.25	15.00	
Range	4.5-20	0-30	5-23	0-30	
Opioid use POD 1 (mg morphine)					Kruskal-Wallis = 0.78, $p = .677$
Median	24.5	26.25	23	25.00	
Range	0-32.5	10-40.5	6-40	0-40.5	

CABG = coronary artery bypass graft; ICU = intensive care unit; NR = not reported; VR = valve replacement; POD = postoperative day.
[a] Responses included music therapy, chiropractic, and light therapy.
[b] Length of stay was variable depending on the time patients were admitted in the ICU from the operating room.

Table 2
Medians (Minimum-Maximum) of Scores Obtained With the Brief Pain Inventory on the Second Postoperative Day

Brief Pain Inventory Item	Hand Massage (n = 18)	Hand Holding (n = 16)	Standard Care (n = 12)	Level of Significance (p) Kruskal-Wallis Test
Most intense pain	5.75 (2-10)	6.50 (1-10)	6.25 (0-10)	$p = .987$
Least intense pain	0.00 (0-7)	2.00 (0-5)	2.00 (0-4.5)	$p = .435$
General pain	4.00 (0-9)	4.50 (1-7)	4.00 (0-7)	$p = .984$
Pain now	2.00 (0-9)	3.00 (0-7)	2.50 (0-5)	$p = .717$
General activity	3.50 (0-9)	4.00 (0-9)	0.00 (0-9)	$p = .403$
Humor	0.00 (0-9)	0.00 (0-8)	0.00 (0-10)	$p = .957$
Walk	2.00 (0-8)	5.00 (0-8)	1.25 (0-10)	$p = .588$
Cough	5.00 (0-10)	2.00 (0-7)	4.50 (0-9)	$p = .224$
Deep breaths	3.00 (0-10)	5.00 (0-7)	3.00 (0-7)	$p = .388$
Relations with others	0.00 (0-5)	0.00 (0-9)	0.00 (0-5)	$p = .628$
Sleep	0.00 (0-9)	2.50 (0-8)	0.00 (0-8)	$p = .267$
Appetite	1.00 (0-8)	0.00 (0-8)	0.00 (0-10)	$p = .857$
Concentration	0.00 (0-7)	0.00 (0-9)	0.00 (0-10)	$p = .755$
Enjoyment with life	0.00 (0-9)	0.00 (0-10)	0.00 (0-10)	$p = .583$

Table 3
Medians (Minimum-Maximum) of Scores Obtained With the Richards-Campbell Sleep Questionnaire on the Second Postoperative Day

Richards Campbell Sleep Questionnaire Item	Hand Massage (n = 10)	Hand Holding (n = 9)	Standard Care (n = 6)
Sleep depth	90.00 (1.25-95.00)	68.75 (3.75-90.00)	91.88 (5.00-100.0)
Falling asleep	43.13 (2.50-90.00)	16.25 (0.00-85.00)	87.50 (8.75-100.0)
Awake	71.88 (15.00-92.50)	47.50 (0.00-100.0)	51.25 (18.75-100.0)
Falling back asleep	60.00 (3.75-91.25)	22.50 (2.50-100.0)	43.75 (25.00-100.0)
Quality of sleep	88.75 (2.50-97.50)	50.00 (0.00-78.75)	83.75 (0.00-98.75)
Total	65.13 (12.75-88.50)	50.00 (7.25-56.75)	58.25 (47.00-86.00)

given its clinically significant short-term reductions in pain and anxiety (Boitor et al., 2018).

The descriptive self-reports of nocturnal sleep quality are preliminary data that concur with previous descriptive research studies on the poor quality of sleep in the ICU (Nicolas et al., 2008; Zhang et al., 2013) and highlight the need to improve this important aspect of the experience of cardiac surgery patients in the ICU. Although the data collected are insufficient to examine the effectiveness of hand massage in promoting sleep in the ICU, the field notes and anecdotal reports of patients seem to indicate that hand massage could potentially promote sleep during and after its administration. Hand massage has been found to decrease pain intensity and unpleasantness, lower anxiety, and promote muscle relaxation in the ICU (Boitor et al., 2018), all of which could promote comfort and create a state of decreased arousal that is conducive to sleep. Indeed, critically ill patients identify pain as a significant factor that contributes to worsened sleep (Nicolas et al., 2008; Zhang et al., 2013). Anxiety has also been found to produce significant sleep disturbance by causing patients to take longer to fall asleep and have a greater percentage of light sleep (Fuller, Waters, Binks, & Anderson, 1997; Gould, Beaudreau, O'Hara, & Edelstein, 2016). In fact, the relationship between sleep disturbance and affective symptoms such as anxiety and depression appears to be bidirectional. Poor sleep increases daytime anxiety, which then triggers greater sleep difficulties the next night (Kalmbach, Arnedt, Swanson, Rapier, & Ciesla, 2017). Therefore the assessment and treatment of anxiety has become a focus of sleep research and has been used as a means to address sleep problems (Spoormaker & van den Bout, 2005).

Depending on the time of administration, hand massage could promote sleep during daytime or nighttime. Given that RCSQ provides data on the patient's perception of nocturnal sleep, future RCTs aiming to test the effectiveness of massage on sleep quality in the ICU should also seek to use assessment tools that evaluate sleep throughout the day. In the ICU, approximately 50% of sleep occurs during daytime (Freedman, Kotzer, & Schwab, 1999; Tembo, Parker, & Higgins, 2013), which underscores the importance of equally promoting daytime sleep.

Limitations

This RCT should be interpreted in the context of some limitations. Not all patients who were randomized were available or able to participate in the BPI interview, thereby weakening the power of this study. The RCSQ was only added later throughout the data collection phase, which did not allow for sufficient data to be collected and to test the effectiveness of hand massage on sleep in the ICU. The BPI interview is based on patient's recall of interference in the preceding 24 hours and allows for the possibility of recall bias. The amount of analgesia administered on POD 2 was not documented and could have varied across groups.

Although patient self-report is recommended for sleep assessment in the ICU (Jacobi et al., 2002), critical care patients who are at risk for experiencing circadian rhythm abnormalities and who receive sedative drug regimens may have a poor recall of their own sleep quality and quantity (Bourne, Minelli, Mills, & Kandler, 2007). The RCSQ allows patients to report on the depth, latency, awakenings, amount of time awake and overall quality of sleep but is limited to critically ill patients able to complete the questionnaire and those without active cognitive dysfunction. Polysomnography could be used in future massage trials because it provides a more comprehensive evaluation of sleep, including its duration, continuity, and physiology, and has been found to be feasible for unattended use in the ICU (Knauert et al., 2014).

Implications for Nursing Education, Practice, and Research

Nurses are vital agents in assisting patients with postoperative activities, including recovery exercises such as taking deep breaths and walking. The present RCT does not present statistically significant effects of hand massage on pain-related interference with activities but suggests that coupling hand massage with recovery activities could assist patients in performing them.

Descriptive data of this study suggest that sleep is inadequate for the cardiac surgery critically ill patients despite being admitted in single-patient rooms, which allows for noise and light reduction by having the doors closed and lights turned off, respectively. Hand massage could create conditions that are conducive to sleep, as reported in this RCT, through its pain-relieving, anxiolytic, and muscle relaxant effects (Boitor et al., 2018). Future research is still needed to test the effectiveness of this intervention on diurnal and nocturnal sleep in the ICU.

Conclusions

In the context of a multimodal pain management approach, this RCT provides promising results on the preliminary sustained effectiveness of hand massage on pain intensity and pain-related interference with activities, and descriptive data on the quality of sleep in the ICU. In regard to pain intensity, patients could experience longer periods without pain and lower levels of maximum pain intensity, which would promote recovery. Although the coupling of hand massage with recovery activities could maximize the benefits of massage in assisting patients to initiate them, future research is needed to unravel the sustained effects of this intervention on postoperative activities on the long term. Preliminary observations come in support of the potential of this intervention to promote sleep, yet future RCTs are currently awaited to test this hypothesis.

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