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Effects of localized cryotherapy on the severity of thoracic pain in patients undergoing coronary artery bypass grafting

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ABSTRACT

Background: Open heart surgery is associated with severe postoperative pain due to the incision of chest wall anatomical components. Cryotherapy is a simple, cost-efficient, non-pharmacological method of pain relief. This study aimed to evaluate the effects of localized cryotherapy on the severity of thoracic pain in patients undergoing coronary artery bypass grafting (CABG).

Methods: This clinical trial was conducted on 50 patients undergoing CABG in a teaching hospital in Zahedan, Iran in 2015. Patients were selected via convenience sampling and randomly allocated to two groups of intervention and control (n=25). Initially, postoperative pain was measured after three cycles of deep breathing and coughing using the visual analogue scale (VAS). In the intervention group, ice packs were placed on the chest wound dressing of the patients at five-minute intervals for 20 minutes. Afterwards, both groups received emotional support for 15 minutes, and pain scores were measured again. Data analysis was performed in SPSS version 21 using Chi-square, independent and paired t-test, and analysis of covariance (ANCOVA).

Results: Mean pain scores before the intervention in the intervention and control groups were 60.16±13.45 and 58.64±14.42, respectively. After localized cryotherapy, these values were 45.16±15.25 in the intervention group and 58.60±14.40 in the control group (P<0.001).

Conclusion: According to the results of this study, localized cryotherapy could reduce the severity of thoracic pain caused by coughing and deep breathing in patients undergoing CABG. Therefore, this method is recommended as a non-pharmacological method for pain relief.

1. Introduction

Coronary artery disease (CAD) is the leading cause of mortality and disabilities across the world, and it is predicted that cardiac disorders associated with CAD become the major health concern by 2020.[1]

One of the most common interventions in the treatment of CAD is coronary artery bypass grafting (CABG), also known as open heart surgery.[2] CABG has been practiced for over 40 years in the field of health care and medicine.[3] Although CABG is an effective method for the treatment of CAD, it must be considered as the last option to reduce or eliminate angina and mortality in CAD patients. Annually, more than eight million open heart surgeries are carried out in the world, 40,000 of which are reported in Iran. Approximately 50-60% of these surgeries account for CABG.[4, 5]

Undoubtedly, cardiac surgeries are among the most complex medical procedures associated with several potential complications.[6] Such examples are tissue contractions and postoperative pain after CABG, which might occur in the sternal incision (breastbone), transplantation site, and internal tissue sections at the insertion site of catheter and chest tube.[7] Sternal pain is a prevalent complication caused by CABG, and it is estimated that 50-60% of CAD patients experience a moderate-to-severe pain that is imperceptible, sharp and exhausting.[8] Sternal pain normally initiates within a few hours after surgery, and with poor control, it is likely to

predispose the patients to chronic pains lasting for six months to one year postoperatively.[9]

Sternal pain may occur due to changing positions, coughing, deep breathing, use of a spirometer and movement in bed.[10] Patients with defected respiration or excessive coughing associated with sternal pain and changes of the chest wall and diaphragm are at a higher risk of inadequate lung expansion, fluid retention, reduced lung volume and inertia.[11] Pain control improves the quality of respiration, increases the ability to cough, and reinforces patient mobility, thereby diminishing postoperative complications. Therefore, pain reduction after thoracic surgeries is considered the foremost postoperative care intervention.[12]

Today, various methods are applied to reduce or control pain effectively,[13] which are classified into two categories of pharmaceutical (narcotic and non-narcotic analgesics) and non-pharmaceutical approaches (local anesthesia and complementary medicine).[14] Pharmaceutical methods of pain relief are associated with numerous side effects on the mental and physical conditions of the patients. In addition to the risk of drug dependency, pain relievers may cause hypotension, poor vital functions, drowsiness, nausea and vomiting, and anaphylactic shock in some cases. Furthermore, pharmaceutical analgesics impose great costs on the healthcare system. As such, use of this approach is not recommended while easier, more cost-efficient methods of pain relief are available.[15] For instance, localized cryotherapy (cold therapy) is effectively used after orthopedic surgeries, as well as in sport and exercise medicine, with limited side effects.[16]

Cold therapy is an ancient method of pain control, which is remarkably influential in relieving inflammation, treatment of soft-tissue injuries, and wound healing. This simple approach has been applied since the time of Hippocrates to reduce the effects of trauma. The cooling effect of localized cryotherapy on surface and intramuscular tissues leads to physiological changes (e.g., vasoconstriction) and reduces metabolism, muscle cramps, inflammation, and pain perception.[17, 18] Moreover, previous studies have shown localized cryotherapy to have analgesic properties in the management of postoperative pain, which could control the pain and increase pain threshold.[19]

In the clinical trials conducted by Challier et al. (2010) and Khalkhali et al. (2014), cold gel packs were used to relieve the postoperative pain of the patients undergoing cardiac surgery, and patients reported that thoracic pain reduced while breathing deeply or coughing.[20, 21]

Given the importance of postoperative pain control, and considering that pharmaceutical approaches are widely used for the management of pain, which is associated with high treatment costs and various side effects, special attention must be paid to the application of localized pain relieving methods. Cryotherapy has been used frequently to reduce surgical incision pain and other tissue injuries.[20, 21] Pain is a physical response influenced by individual, psychological and social factors, and studies in this regard have been conducted with different methodologies (without control). This study aimed to evaluate the effect of localized cryotherapy on the severity of thoracic pain in patients undergoing CABG.

2. Methods

2.1. Design

This clinical trial was conducted on all the patients undergoing CABG in a teaching hospital in Zahedan, Iran in 2015.

2.2. Participants and setting

Sample size was calculated at 23 subjects per each group based on previous studies[22] and the following formula, (μ_2=0.4, μ_1=2.3, S_2=1.45, S_1=2.44, $Z_{1-\alpha/2}$=1.96, $Z_{1-\beta}$=1.28, β_1=0.8, α=0.05) Considering the possible sample loss, final sample size of the study was determined at 25 patients per each group (total: 50).

Subjects were selected via convenience sampling and randomly assigned to two groups of intervention and control (n=25). For random allocation of the selected patients, we used simple random sampling. To do so, the researcher chose one of the two cards labeled as “control” or “intervention” and placed them in an envelope; the patients were assigned to the study groups accordingly.

Inclusion criteria were as follows: 1) age of 35-75 years; 2) no emergency surgery; 3) no vision problems to use the visual analogue scale (VAS); 4) no use of sleeping pills, sedatives, benzodiazepines, drugs and alcohol (as reported by patients); 5) minimum score of 40 in the VAS; 6) no diabetes or diabetic history of less than five years; 7) patients undergoing their first thoracic surgery; 8) absence of chronic respiratory diseases; 9) use of saphenous and mammary artery vein graft and 10) ejection fraction of less than 40%. Exclusion criteria of the study were severe pain and restlessness, chest tube replacement at the time of data collection, and postoperative complications (e.g., infection, hemorrhage, uncontrolled dysrhythmias, open surgical wounds, and acute emotional stress).

2.3. Instruments

Data collection instruments included demographic questionnaires (age, gender, marital status, education level, and number of grafts) and VAS. VAS was first developed by Taal and Faber in 1997 to measure the severity of pain in patients. This measurement tool is composed of a 10-cm graded ruler, the two ends of which demonstrate minimum and maximum pain severity.[23] In this study, patients marked the severity of their pain, and the researcher measured and recorded the values in millimeter. In this scale, severity of pain is scored as follows: no pain (scores 0-4), mild pain (scores 5-44), moderate pain (scores 45-74), and severe pain (scores 75-100).[24]

Reliability of VAS was determined via the test-retest method. To do so, we asked 20 patients to report their pain severity on this scale, and after a one-hour interval, the test was repeated under the same circumstances with the assumption of no significant difference in the severity of pain. By calculating the correlation-coefficient of the two test scores, reliability of VAS was confirmed at 0.93.

2.4. Data Collection

In this study, Severity of pain was measured 48 hours after CABG when the patient was transferred to the cardiac surgical ward, and intervention was performed on the first day after patient transfer.

Before the intervention, a suitable environment was provided for the patients. To prepare the patients for research procedures, we attempted to gain their trust through appropriate introduction and orientation. Moreover, a private environment was provided by pulling the curtains and dismissing patient companions from the study setting.

Intervention was carried out in three stages of preliminary, intervention, and patient support. In the preliminary stage, demographic data were collected and recorded by the researcher via interviews. This stage was considered as the pre-test phase, which consisted of three cycles of deep breathing and coughing. Following that, a nurse who was blinded to the intervention group measured pain severity using the VAS.

Since evening shifts in the hospital are normally less crowded, the intervention stage was performed during these hours. In this stage, before the placement of ice packs (diameters: 10×14 cm, 175 grams) for cryotherapy, the researcher reassured the convenience of the patients and asked them to sit in a semi-upright position. One hour before the intervention stage, ice packs were taken out of the freezer and wrapped in a fabric cover at zero temperature. Afterwards, depending on the tolerance of the patient, the ice pack was placed on the sternum dressing (two layers of gauze and adhesive) at five-minute intervals for 10 minutes.

In the support stage, the researcher stayed with patients for 15 minutes to provide emotional support by responding to their questions. Following that, secondary pain assessment (i.e., post-test phase) was performed similar to previous stages by the same nurse using the VAS after three cycles of deep breathing and coughing.

Patients in the control group only received routine care in a similar environment to the intervention group. To measure the severity of pain in control subjects, patient companions were asked to leave the room for 10 minutes, and patients were encouraged to rest in bed. Afterwards, similar to the intervention group, pain severity was measured in a preliminary stage and 15 minutes after resting.

2.5. Ethical considerations

Before data collection, required permits were obtained from the authorities and Ethics Committee of Zahedan University of Medical Sciences. Study procedures and objectives were explained to the patients, and informed consent was obtained from all the participants. Moreover, participants were assured of confidentiality terms, and participation in the study was voluntary. Study results were made available for authorities. Since the researcher was the main physician of the selected patients, all the necessary precautions were considered for patient safety during the study.

2.6. Statistical analysis

Data analysis was performed in SPSS version 21 using descriptive statistics (mean and standard deviation) and Chi-square test to compare the demographic variables of study groups (e.g., gender, marital status, type of grafts). In addition, independent t-test was used to compare the age differences between the intervention and control groups, and analysis of covariance (ANCOVA) was applied to determine the effectiveness of cryotherapy in reducing pain by controlling the effects of pretest. In this study, P value of less than 0.05 was considered statistically significant.

3. Results

Demographic characteristics of the patients are presented in Table 1. According to the information in this table, there were no significant differences in the demographic variables of the two study groups.

According to the information in Table 2, there were no significant differences in the pain severity of the patients in the intervention and control groups

before localized cryotherapy. Findings of this study were indicative of a significant reduction in the mean score of pain after the intervention (P<0.001), and the difference between the groups in this regard was significant (P=0.002).

Results of ANCOVA through controlling the effects of pretest indicated that the mean score of pain in the intervention group was significantly lower after localized cold therapy compared to the control group (P<0.0001).

Table 1. Demographic characteristics of patients

Variable	Group	Intervention N (%)	Control N (%)	*P-value
Gender	Female	13 (52)	12 (48)	*0.7
	Male	12 (48)	13 (52)	
Marital Status	Married	22 (88)	21 (84)	*0.6
	Widowed	3 (12)	4 (16)	
Education Level	Literate	14 (56)	19 (76)	*0.07
	Illiterate	11 (44)	6 (24)	
Graft Type	Mammary artery or saphenous vein graft	4 (16)	1 (4)	*0.2
	Both	21 (84)	24 (96)	
Age (year)	M±SD	57.80±10.06	62.40±10.27	**0.1

*Chi-square; **independent t-test

Table 2. Comparison of mean changes of pain scores before and after intervention in two groups

Time / Group	Before Intervention M±SD	After Intervention M±SD	Pain Score Changes M±SD	*P-value
Intervention	60.16±13.45	45.16±15.25	-15.00±8.04	<0.0001
Control	58.64±14.42	58.60±14.40	0.001±0.001	0.99
**P-value	0.7	0.002	<0.001	

*Paired t-test; **independent t-test

4. Discussion

According to the results of the present study, localized cryotherapy using ice packs significantly reduced the postoperative pain of the patients undergoing CABG, lowering the severity of pain to the mild level.

In a crossover clinical trial, Chailler et al. (2010) evaluated the level of sternal pain after deep breathing and coughing in four stages (twice with ice packs and once without ice pack, 10 minutes each). According to the findings, severity of pain reduced by one score in patients receiving cold therapy with ice packs compared to the intervention without ice pack.[20] Another study by Khalkhali et al. (2014) was performed on 50 CAD patients undergoing CABG through four stages of intervention with and without ice packs (15 minutes),[21] reporting similar results regarding the reduction of sternal pain after cold therapy. Despite the absence of control groups in the aforementioned studies, the results are in congruence with our findings.

Studies by Heydari Gorji et al. (2014), Mazloom et al. (2012), and Khorshid and Demir (2010) were conducted to evaluate pain alleviation after the removal of chest tube in patients undergoing cardiac surgery. Cryotherapy was carried out for 20 minutes before the removal of chest tube. According to the findings, anxiety and pain significantly decreased in patients who received cold therapy.[19, 25, 26] In another research, Hasan Zadeh et al. (2016) investigated the effects of cold therapy and inhalation of lavender oil on the level of pain and anxiety during the removal of chest tube in patients in the cardiac intensive care unit undergoing CABG. According to the results, cold therapy and aromatherapy led to the significant reduction of pain and anxiety in the patients.[27] Results of the aforementioned studies are in line with our findings, and this compatibility could be due to the similarity of target populations, type of interventions and time of applying cold therapy. In a study in this regard, Watkins et al. (2014) assessed patients with extensive abdominal surgery and claimed that cryotherapy effectively decreased the postoperative pain of the patients. Although this is consistent with the results of the current study, duration of cryotherapy in our study depended on the tolerance of the patients.[28] In another research, Feng et al. (2012) evaluated the effects of cold therapy on the intensity of pain after arthroscopy and reported this approach to be effective in alleviating postoperative pain.[29] Similarly, in a systematic review, Markert (2011) confirmed the effectiveness of cold therapy in the reduction of pain in patients receiving arthroplasty. In general, consistency of the findings between our research and the mentioned study could be due to the effects of localized cryotherapy on the reduction of bleeding and wound inflation, which reinforces the convenience and mobility of patients.[30]

According to the literature, localized cryotherapy decreases nerve conduction velocity, thereby closing

the pain valves and alleviating pain.[31] On the other hand, Sauls (2002) reported that use of ice packs had no significant effect on the reduction of postoperative pain in patients undergoing CABG,[32] which is inconsistent with the results of the present study. This discrepancy could be due to the time of applying cold therapy. In the study by Sauls (2002), ice packs were placed on the surgical site for only 10 minutes, while in the study by Kol et al. (2013), the recommended time for the application of localized cryotherapy was at least 20 minutes to obtain the desirable physiological effect. It is also noteworthy that localized cryotherapy for more than 20 minutes has been reported to cause reflexive vasodilation.[33]

One of the limitations of the present study was that pain perception varies in different individuals since pain is a multidimensional physical response influenced by neurophysiological, biochemical, cognitive, cultural and environmental factors. This might have affected the evaluation of pain severity in the reports provided by the patients. Another limitation of our research was the mental support of the patients by the researcher during the intervention. Although the support stage only involved proper responding to the questions of patients through the direct presence of researcher, it might have affected the generalizability of the results.

5. Conclusion

According to the results of this study, localized cryotherapy could reduce the intensity of thoracic pain in patients undergoing CABG. This non-pharmaceutical method of pain relief is safe and cost-efficient to be used by nurses to alleviate postoperative pain and prevent pulmonary complications caused by the pain of coughing and deep breathing. Therefore, it is recommended that future studies assess the effects of cryotherapy in different post-surgical periods and compare them with other non-pharmaceutical techniques.

Conflicts of interest

The authors declare no conflicts of interest.

Authors' contributions

Zahra Pishkarmofard: study design, contribution to study procedure, preparing the first draft of the manuscript. Ali Navidian: contribution to study design, data analysis, final approval of the manuscript. Changiz Azadi Ahmadi: contribution to study design, consultation, contribution to the writing of the manuscript. Elham Ali Ahmadi: study design, data collection, contribution to the writing of the manuscript.

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References

1. Wiener C, Fauci A, Braunwald E, Kasper D, Hauser S, Longo D, et al. Harrisons principles of internal medicine self-assessment and board review. 18th Edition. McGraw Hill Professional; 2012:1983.
2. Academy for Guided Imagery, research findings using guided imagery for heart surgery. www.acad emyforguidedimagery.com. 2006. Available from: http://acadgi.com/whatisguidedimagery/index.html.
3. Hinkle JL, Cheever KH. Brunner & Suddarth's textbook of medical-surgical nursing. Lippincott Williams & Wilkins; 2013.
4. Sadeghi Shermeh M, Bozorgzad P, Ghaforian A, Ebadi A, Razmjuee N, Afzali M. Effect of foot reflexology on sternotomy pain after CABG surgery. Iranian Journal of Critical Care Nursing 2009; 2(2): 51-4. [Persian]
5. Siavoshi S, Roshandel M, Zareyan A, Ettefagh L. The effect of cardiac rehabilitation care plan on quality of life in patients undergoing coronary artery bypass surgery. Alborz University of Medical Sciences 2013; 2(4):217-26. [Persian]
6. Sadeghi A. Investigation the outcomes of CABG in patients with left ventricular dysfunction. Journal of Guilan University of Medical Sciences 2009; 19(73): 97-101. [Persian]
7. Mehta Y, Kumar S. New horizons for critical care in cardiac surgery. Indian Journal of Critical Care Medicine 2004; 8(1): 11-3.
8. Pogatzki-Zahn EM, Zahn PK, Brennan TJ. Postoperative pain clinical implications of basic research. Best Practice & Research Clinical Anaesthesiology 2007; 21(1): 3-13.
9. Gjeilo KH, Klepstad P, Wahba A, Lydersen S, Stenseth R. Chronic pain after cardiac surgery: a prospective.study..Acta.Anaesthesiologica Scandinavica 2010; 54(1): 70-8.
10. Gélinas C. Management of pain in cardiac surgery ICU patients: Have we improved over time? Intensive and Critical Care Nursing 2007; 23(5): 298-303.
11. Nerbau BF, Feltrim Z, De Souza AS, Ykeda SD, Lorency FG. Effects of massage therapy on sleep quality after CABG clinic 2010; 659(11): 1807-55.
12. Bédard D, Purden MA, Sauvé-Larose N, Certosini C, Schein C. The pain experience of post surgical patients following the implementation of an evidence-based approach. Pain Management Nursing 2006; 7(3): 80-92.
13. Yazdi-moghaddam H, Memarian R, Mohammadi I. The effect of pain management by nurses on the satisfaction rate of patients after abdominal surgery. Journal of Kerman University of Medical Sciences 2006; 13(2): 121-8. [Persian]
14. Farhadi A, Esmailzadeh M. Effect of local cold on intensity of pain due to penicillin benzathin intramuscular injection.

International Journal of Medicine and Medical Sciences 2011; 3(11): 343-6.
15. Kshettry VR, Carole LF, Henly SJ, Sendelbach S, Kummer B. Complementary alternative medical therapies for heart surgery patients: Feasibility, safety, and impact. The Annals of Thoracic Surgery 2006; 81(1): 201-5.
16. Algafly AA, George KP. The effect of cryotherapy on nerve conduction velocity, pain threshold and pain tolerance. British Journal of Sports Medicine 2007; 41(6): 365-9.
17. East C, Begg L, Henshall N, Marchant P, Wallace K. Local cooling for relieving pain from perineal truama sustained during childbirth. Cochrane Database of Systematic Reviews 2012; 1(5): 1-38.
18. Hubbard TJ, Denegar CR. Does cryotherapy improve outcomes with soft tissue injury? Journal of Athletic Training 2004; 39(3): 278-90.
19. Demir Y, Khorshıd L. The effect of cold application in combination with standard analgesic administration on pain and anxiety during chest tube removal: a single-blinded, randomized, double-controlled study. Pain Management Nursing 2010; 11(3): 186-96.
20. Chailler M, Ellis J, Stolarik A, Woodend K. Cold therapy for the management of pain associated with deep breathing and coughing post-cardiac surgery. Canada Journal Cardiovasc Nursing 2010; 20(2): 18-24.
21. Khalkhali H, Tanha ZE, Feizi A, Ardabili SS. Effect of applying cold gel pack on the pain associated with deep breathing and coughing after open heart surgery. Iranian Journal of Nursing and Midwifery Research 2014; 19(6): 545-9.
22. Cutshall SM, Wentworth LJ, Engen D, Sundt TM, Kelly RF, Bauer BA. Effect of massage therapy on pain, anxiety, and tension in cardiac surgical patients: a pilot study. Complementary Therapies in Clinical Practice 2010; 16(2): 92-5.
23. Taal LA, Faber AW. Burn injuries, pain and distress: exploring the role of stress symptomatology. Burns 1997; 23(4): 288-90.
24. Jensen MP, Chen C, Brugger AM. Interpretation of visual analog scale ratings and change scores: a reanalysis of two clinical trials of postoperative pain. The Journal of Pain 2003; 4(7): 407-14.
25. Heidari Gorji MA, Bagheri Nesami M, Ayyasi M, Ghafari R, Yazdani J. Comparison of ice packs application and relaxation therapy in pain reduction during chest tube removal following cardiac surgery. North American Journal of Medical Sciences 2014; 6(1): 19-24.
26. Mazloum SR, Abbasi Teshnizi M, Kianinejad A, Gandomkar F. Effect of applying ice bag on pain intensity associated with chest tube removal after cardiac surgery. Quarterly of Ofoghe Danesh 2012; 18(3):109-14. [Persian]
27. Hasanzadeh F, Mohammadi Kashouk N, Amini Sh, Asili J, Emami SA, Behnam Vashani HR, et al. The effect of cold application and lavender oil inhalation in cardiac surgery Patients undergoing chest tube removal. Excli Journal 2016; 15(1): 64-74.
28. Watkins AA, Johnson TV, Shrewsberry AB, Nourparvar P, Madni T, Watkins CJ, et al. Ice packs reduce postoperative midline incision pain and narcotic use: a randomized controlled trial. Journal of the American College of Surgeons 2014; 219(3): 511-7.
29. Fang L, Hung CH, Wu SL, Fang SH, Stocker J. The effects of cryotherapy in relieving postarthroscopy pain. Journal of Clinical Nursing 2012; 21(5-6): 636-43.
30. Markert SE. The use of cryotherapy after a total knee replacement: a literature review. Orthopaedic Nursing 2011; 30(1): 29-36.
31. Herrera E, Sandoval MC, Camargo DM, Salvini TF. Effect of walking and resting after three cryotherapy modalities on the recovery of sensory and motor nerve conduction velocity in healthy subjects. Brazilian Journal of Physical Therapy 2011; 15(3): 233-40.
32. Sauls J. The use of ice for pain associated with chest tube removal. Pain Management Nursing 2002; 3(2): 44-52.
33. Kol E, Erdogan A, Karsl B, Erbil N. Evaluation of the outcomes of ice application for the control of pain associated.with.chest.tube.irritation..Pain Management Nursing 2013; 14(1): 29-35.

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