Effectiveness of Ice-Cold Application for Pain Relief During Chest Tube Removal in Postoperative Cardiothoracic Patients

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Abstract

Introduction: Chest tube removal (CTR) is a painful procedure after cardiothoracic surgery. Non-pharmacological measures that are inexpensive and easy to administer may complement routine analgesia. This study evaluated the effectiveness of local ice-cold application on pain associated with CTR.

Methods: A quantitative experimental pretest–posttest control-group study was conducted among 60 postoperative cardiothoracic patients in the cardiothoracic vascular surgery intensive care unit of a 600-bed tertiary/superspecialty cardiothoracic hospital in Western Maharashtra. Participants were randomly allocated by lottery to an ice-cold application group (n=30) or control group (n=30). Both groups received routine analgesia. In the intervention group, two ice packs (17 × 8 cm), wrapped in sterile gauze, were placed around the chest-tube insertion site for 15 min before removal. Pain was assessed before, immediately after, and 15 min after CTR using the Numeric Pain Rating Scale (NPRS) and Modified Comfort Scale. Between-group comparisons used the Mann–Whitney test; within-group comparisons used the Wilcoxon signed-rank test.

Results: Immediately after CTR, mean NPRS was 4.77 ± 1.135 in the intervention group versus 7.10 ± 0.995 in controls ($Z=5.81$, $p<0.0001$). At 15 min, mean NPRS was 3.13 ± 0.973 versus 3.97 ± 1.217 ($Z=2.58$, $p=0.01$). Modified Comfort Scale scores immediately after CTR were 10.63 ± 1.650 versus 14.40 ± 1.610 ($Z=5.92$, $p<0.0001$); at 15 min the difference was not significant (8.17 ± 1.821 vs 8.43 ± 1.716; $Z=0.73$, $p=0.47$). Within the intervention group, pain decreased significantly from baseline to both post-CTR assessments ($p<0.0001$). No adverse incident was reported.

Conclusion: A 15-min local ice-cold application before CTR was associated with lower immediate pain and lower NPRS at 15 min after removal. It may be considered as a simple adjunct to routine

INTRODUCTION

Chest tube drainage is routinely used after cardiothoracic surgery to evacuate air, blood and fluid and to support postoperative thoracic and cardiovascular function. Removal of the tube is frequently reported as an unpleasant and painful procedure. Pain during and after removal may impair comfort, mobility and participation in postoperative recovery and may increase the need for pharmacological analgesia.

Effective management of procedural pain is an important component of quality postoperative nursing care. Pharmacological analgesics are commonly used; however, their use may be associated with adverse effects and may not completely relieve the acute pain associated with chest tube removal. Therefore, complementary non-pharmacological approaches may have an important role as adjuncts to conventional analgesic therapy.

Cold application is a low-cost non-pharmacological intervention that can reduce local nerve conduction, produce temporary local anaesthesia and alter nociceptive transmission. Evidence from controlled trials and systematic reviews suggests that cold application can reduce pain associated with chest tube removal, although results across studies are not completely consistent.[1–4]

The present study was undertaken to evaluate whether local ice-cold application before chest tube removal reduces pain in postoperative cardiothoracic patients receiving routine analgesic care.

Problem statement

A study to assess the effectiveness of ice-cold application on pain in postoperative cardiothoracic patients undergoing chest tube removal in selected tertiary care hospitals of Western Maharashtra.

Aim of the study

Assess the effectiveness of ice-cold application on pain in postoperative cardiothoracic patients undergoing chest tube removal.

Objectives of the study

i. To assess the level of pain prior to chest tube removal in the experimental and control group.

ii. To assess the level of pain after chest tube removal in experimental and control group.

iii. To assess the effectiveness of ice-cold application on level of pain in experimental group

iv. To establish the association between the selected demographic variables and the level of pain among the experimental and control groups.

v. To draw association between selected clinical variables and the level of pain among the experimental and control groups.

MATERIALS AND METHODS

Study design and setting

A quantitative experimental pretest–posttest control-group design was used. The study was conducted in the Cardio Thoracic Vascular Surgery Intensive Care Unit of a selected 600-bed superspecialty cardiothoracic hospital in Western Maharashtra. Main data collection was conducted during November–December 2022.

Participants and sampling

The study population comprised adult postoperative cardiothoracic patients with chest-tube drainage. Inclusion criteria were age >18 years, postoperative cardiothoracic status with chest-tube drainage and haemodynamic stability. Patients with altered sensorium, poor tolerance to cold, or unwillingness to participate were excluded. The dissertation reports a calculated sample size of 30 per group (80% power and 95% confidence level). Subjects meeting the eligibility criteria were enrolled and then randomly allocated to the intervention or control arm using the lottery method.

Intervention and control

Routine hospital analgesia was continued in both groups. In the intervention group, two ice packs measuring 17 × 8 cm were wrapped in sterile gauze and placed around the chest-tube insertion site for 15 min before tube removal. The chest tube was removed immediately after the cold application. Pain assessment was performed by an observer other than the researcher; three nursing officers were trained for this assessment. The control group received routine care without ice-cold application.

Outcome measures

Pain was assessed before CTR, immediately after CTR and 15 min after CTR using the Numeric Pain Rating Scale (NPRS) and Modified Comfort Scale. Sociodemographic variables included age, sex, education, occupation and lifestyle. Clinical variables included type of surgery, surgical incision, previous chest-tube insertion, number of chest tubes, time of tube removal and body mass index.

Statistical analysis

Data were analysed using SPSS version 23. Descriptive statistics were used for frequencies, percentages, means and standard deviations. The Mann–Whitney test was used for between-group comparisons and the Wilcoxon signed-rank test for within-group comparisons. Chi-square/Fisher exact tests and ANOVA were used for associations. Statistical significance was set at $p<0.05$.

Ethics

The study was approved by the Institutional Ethics Committee and permission was obtained from the participating hospital. Written informed consent was obtained in a language understood by participants, and confidentiality and the right to withdraw were maintained. (The IEC approval date : 21/08/2022.)

Results

All 60 enrolled participants completed the study, with 30 in each group. The groups were broadly comparable in demographic and clinical characteristics. In both groups, the largest age category was ≥59 years. Most participants were male, had undergone CABG, had an open sternotomy, had two chest tubes, and had a normal BMI. Detailed selected baseline characteristics are shown in Table 1.

Table 1. Selected baseline demographic and clinical characteristics of participants

n=60

Characteristic	Ice-cold group n (%)	Control group n (%)	Total n
Age ≥59 yr	16 (53.3)	15 (50.0)	31
Male sex	18 (60.0)	22 (73.3)	40
Primary education	16 (53.3)	7 (23.3)	23
Unemployed	18 (60.0)	18 (60.0)	36
Moderate lifestyle	14 (46.7)	16 (53.3)	30
CABG	17 (56.7)	17 (56.7)	34
Open sternotomy	26 (86.7)	29 (96.7)	55
No previous chest-tube insertion	28 (93.3)	27 (90.0)	55
Two chest tubes	21 (70.0)	22 (73.3)	43
Removal at 49–72 h	14 (46.7)	19 (63.3)	33
BMI 18.5–24.9 kg/m²	25 (83.3)	26 (86.7)	51

Values are n (%) unless otherwise stated. CABG, coronary artery bypass grafting; BMI, body mass index.

Table 2. Between-group comparison of pain after chest tube removal

Outcome/time	Ice-cold group Mean ± SD	Control group Mean ± SD	Mann–Whitney Z	p value	Interpretation
NPRS, immediately	4.77 ± 1.135	7.10 ± 0.995	5.81	<0.0001	Significant
NPRS, 15 min	3.13 ± 0.973	3.97 ± 1.217	2.58	0.01	Significant
Modified Comfort, immediately	10.63 ± 1.650	14.40 ± 1.610	5.92	<0.0001	Significant
Modified Comfort, 15 min	8.17 ± 1.821	8.43 ± 1.716	0.73	0.47	Not significant

SD, standard deviation; NPRS, Numeric Pain Rating Scale. Lower scores indicate less pain.

Within-group change in the intervention arm

In the ice-cold application group, mean NPRS decreased from 6.53 ± 1.306 before CTR to 4.77 ± 1.135 immediately after removal and to 3.13 ± 0.973 at 15 min. Wilcoxon Z values were 4.68 for baseline versus immediate assessment and 4.84 for baseline versus 15-min assessment (both p<0.0001). Modified Comfort Scale scores similarly decreased from 12.50 ± 2.097 at baseline to 10.63 ± 1.650 immediately and 8.17 ± 1.821 at 15 min (both p<0.0001).

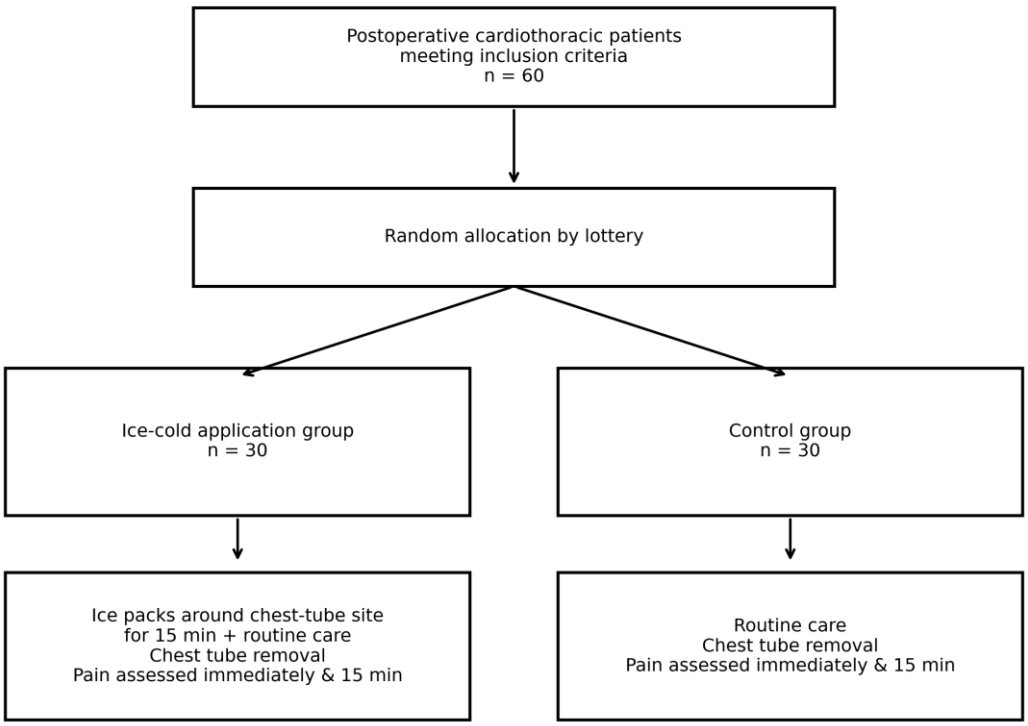

Figure 1. Participant allocation and outcome assessment. 60 enrolled participants, randomly allocated 30:30, with pain assessed at baseline, immediately after removal and 15 min after removal.

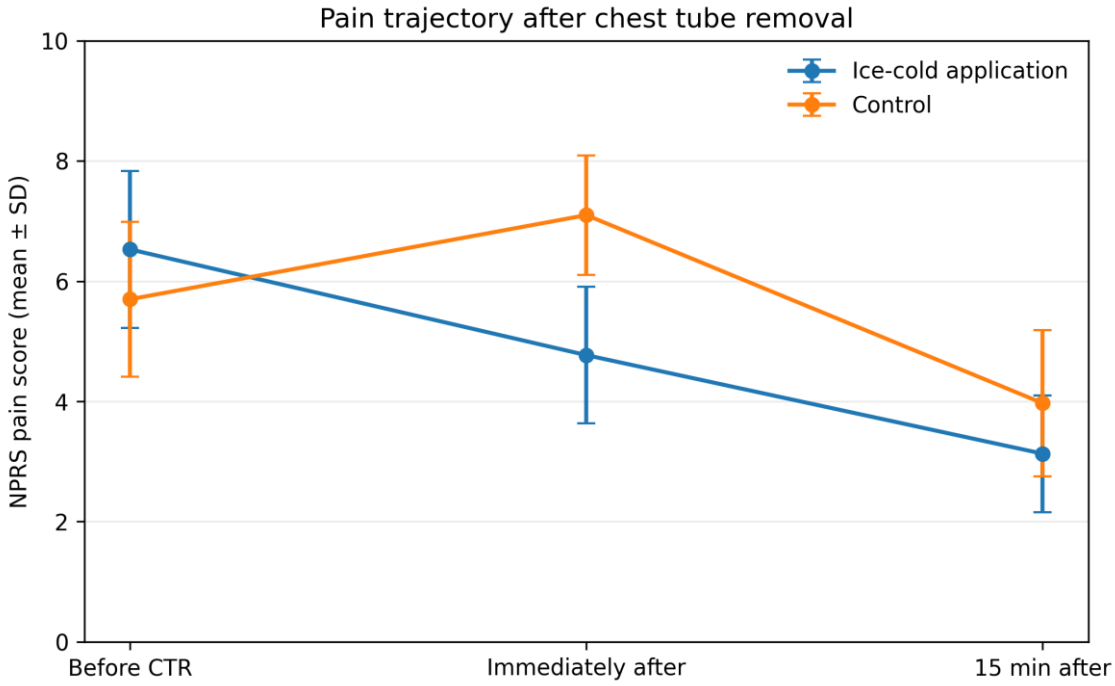

Figure 2. Mean NPRS pain scores over time in the ice-cold application and control groups. Error bars represent SD.

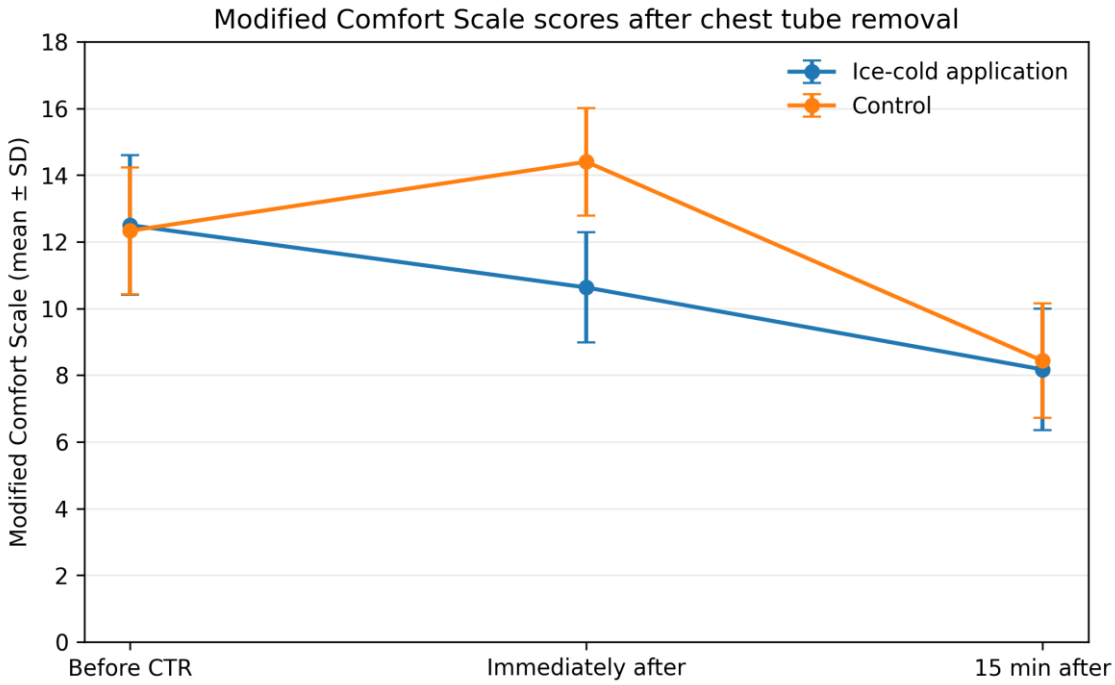

Figure 3. Mean Modified Comfort Scale scores over time in the ice-cold application and control groups. Error bars represent SD.

Association with participant characteristics

The study revealed no significant association between pain scores and age, education, occupation or lifestyle. A significant association with sex was observed for NPRS in the intervention group ($Z=2.77$, $p=0.006$), but not in the control group ($Z=1.84$, $p=0.065$). No significant association was reported between pain and the evaluated clinical variables, including surgical incision, previous chest-tube insertion, number of tubes, timing of removal and BMI.

DISCUSSION

The present randomized study found that local ice-cold application for 15 min before chest tube removal reduced immediate post-removal pain compared with routine care. The magnitude of the between-group difference was 2.33 NPRS points immediately after removal and 0.84 points at 15 min. The intervention-group trajectory also demonstrated a sustained reduction from baseline.

These findings are consistent with previous controlled studies. Ertuğ and Ülker reported lower pain immediately after chest tube removal in patients receiving cold application compared with controls.[5] Soydan and Uğraş, in a three-arm randomized trial, also found that ice-pack application reduced pain during and after chest tube removal.[6] A systematic review and meta-analysis by Chen et al. found that cold application could reduce pain and anxiety after chest tube removal, although the certainty of evidence was low.[7] Another meta-analysis reported a large pooled effect favouring cold application for pain during chest tube removal.[8]

The present findings also highlight that the effect was clearer on the NPRS than on the Modified Comfort Scale at 15 min. The absence of a significant between-group difference in the latter measure at 15 min suggests that the analgesic benefit may diminish over time or that the two scales capture somewhat different dimensions of postoperative discomfort. This is clinically relevant because cold application should be regarded as an adjunct rather than a replacement for multimodal analgesia.

The study has practical nursing implications. The intervention required only ice packs, sterile gauze and 15 min of preparation and can be integrated into the pre-removal nursing sequence when clinically appropriate. However, the small single-centre sample, short follow-up and limited generalisability mean that the findings should be interpreted cautiously. Larger multicentre randomized trials with standardized cold temperature, duration, analgesic exposure and longer follow-up are warranted.

Limitations

- Small sample size (n=60) limits generalisability.
- Single-centre study in a tertiary cardiothoracic setting in Western Maharashtra.
- Pain is subjective and may be influenced by individual, environmental and peri-procedural factors.
- Follow-up was limited to 15 min after chest tube removal.
- The study did not evaluate analgesic consumption as a primary outcome.

CONCLUSION

In postoperative cardiothoracic patients, local ice-cold application for 15 min before chest tube removal, in addition to routine care, was associated with significantly lower immediate NPRS and Modified Comfort Scale scores and a lower NPRS score 15 min after removal. The intervention is simple and inexpensive and may be incorporated as an adjunct to multimodal pain management after appropriate clinical assessment.

Declarations

Ethics approval: Institutional Ethics Committee approval was obtained. (The IEC approval date : 21/08/2022.)

Consent to participate: Written informed consent was obtained from all participants.

Funding: No funding.

Conflict of interest: Nil

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