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REVIEW

# A Systematic Review of the Potential of Cold Compresses Therapy: Strategy for Preventing Hematoma and Alleviating Pain in Post Cardiac Catheterization Patients

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**Background:** Patients still frequently report complications after cardiac catheterization procedures, such as hematoma and pain. These complications increase the length of stay and hospital costs. Several studies have determined cold compress therapy's effectiveness in preventing hematomas and reducing pain in patients after cardiac catheterization. However, to date, no review study has synthesized this comprehensively.

**Purpose:** This review aimed to explores the potential of cold compress therapy as a strategy for preventing hematoma and alleviating pain in post-cardiac catheterization patients.

**Methods:** Systematic review was reported based on the PRISMA Extension. A literature search used relevant keywords from six primary databases, such as CINAH Medline Plus, PubMed, ScienceDirect, Scopus, Taylor and Francis, and one search engine, Google Scholar. The quality of evidence was assessed using the Joanna Briggs Institute critical appraisal checklist and Risk of Bias. Data synthesis was used thematically with an explorative, descriptive approach.

**Results:** This review found and analyzed twelve articles. Based on the results of the analysis, cold compress therapy for 15 to 20 minutes can potentially prevent hematomas and reduce pain in patients after cardiac catheterization.

**Conclusion:** This review concludes that cold compress therapy can potentially prevent hematomas and reduce pain in this population. Health workers, especially nurses, can consider cold compress therapy as a strategy in the nursing care program for patients after cardiac catheterization.

**Keywords:** cardiac catheterization, cold compress, coronary heart disease, hematoma, pain

## Introduction

Coronary heart disease (CHD) is the main cause of death in the world. Globally, in 2020, as many as 19.05 million people died from heart disease, including CHD.[1] The most recent data recorded in the United States for the last 10 years, from 2012 to 2022, shows that there were 1,522,669 deaths due to CHD.[1] The prevalence of the disease tends to be higher in low- and middle-income countries, with estimates accounting for up to 82% of total deaths.[2] Meanwhile, in Indonesia, as many as 1.5% or 15 out of 1000 Indonesians suffer from heart disease, including myocardial infarction.[3] This death rate is expected to continue to increase until it reaches 24.2 million people in 2030.[4]

CHD is caused by a decrease in coronary blood flow due to atherosclerotic plaque.[5] Nearly 70% of fatal CHD events are caused by occlusion of atherosclerotic plaque.[6] Furthermore, cardiac catheterization with percutaneous coronary intervention (PCI) is the most effective acute management strategy for CHD patients.[7] The PCI procedure requires



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arterial access to reach the coronary arteries and heart chambers, which is carried out by installing a ring/stent to prevent restenosis.[6] This procedure is used in 60% to 80% of patients undergoing PCI worldwide.[8] To date, many complications have been reported due to the PCI procedure.[9]

Complications after PCI occur more often than other cardiac catheterization treatments.[9] Moreover, PCI revascularization is becoming more complex, thereby increasing the severity and frequency of complications.[10] The most common vascular complications that occurred after PCI was performed were hematoma (15.5%), bleeding (1.5%), arteriovenous fistula (1.0%), and pseudoaneurysm (0.7%).[10] These complications cause patients to undergo additional diagnostic and treatment procedures, thereby increasing the length of stay and even the risk of death.[9] Therefore, managing most post-PCI complications is one of the primary responsibilities of nurses in the critical care setting.[11]

Hematoma is one of the most frequently reported vascular complications and has the potential to cause severe complications after cardiac catheterization.[12] Previous studies concluded that hematoma, ecchymosis, and pain are common complications at the patient's catheter entry site after cardiac catheterization.[10,13] In addition, pain is also widely reported by post cardiac catheterization patients after stent removal.[14,15] Pain is an unpleasant sensory and emotional experience resulting from actual or potential tissue damage.[15] Pain is caused by the stent removal procedure in the femoral area from the femoral access to the femoral artery.[14] Therefore, to prevent hematoma complications and reduce the pain of post cardiac catheterization patients, it is necessary to provide excellent and comprehensive post-cardiac catheterization care.[12]

Pain caused by catheter removal can be controlled using pharmacological methods.[16] Providing appropriate non-pharmacological nursing pain relief interventions to patients can significantly reduce the use of various medications and complications and increase patient satisfaction with nursing care.[17] Non-pharmacological nursing interventions have also been proven to help reduce and eliminate pain in post-PCI patients.[17–19]

Cold compress therapy is an intervention that can be applied to prevent complications such as hematoma and reduce pain in post cardiac catheterization patients.[10,15,17–20] Cold compresses are widely used because their physiological effects can reduce blood flow and capillary permeability by causing arteriolar vasoconstriction, thereby reducing bleeding.[10] In addition, this intervention can also reduce blood flow velocity and increase viscosity and coagulation.[21] The use of ice gel at cold temperatures to treat injury or tissue damage impacts the surface of body tissue, such as reducing pain, relaxing muscles, changing blood vessels, and affecting connective tissue.[15]

Based on the results of a literature search, there have been many studies that have examined the effectiveness of cold compress therapy to prevent hematomas and reduce pain in post cardiac catheterization patients. However, to date, no review study has summarised and analyzed these results and disseminated them globally. Previous reviewed studies did not specifically discuss cold compress therapy to reduce the risk of hematoma and reduce pain after PCI.[22] Therefore, this review aimed to determine the potential for cold compress interventions that can be applied to prevent hematomas and reduce pain in post-PCI patients.

# Materials and Methods

## Design

The study design used is a systematic review. This study followed the guidelines of the Cochrane Handbook for Systematic Reviews of Interventions and the Preferred Reporting Item for Systematic Reviews and Meta-analysis (PRISMA).[23,24]

## Eligibility Criteria

Six reviewers selected articles for this review based on PRISMA (see Figure 1).[23] Research questions and eligibility criteria for research articles use the PICO (Population, Intervention, Comparators, and Outcome) approach.

P (Population): Patients Post Cardiac Catheterization

I (Intervention): Cold Compress Therapy

C (Comparator): Usual Care

O (Outcome): Hematoma and Pain

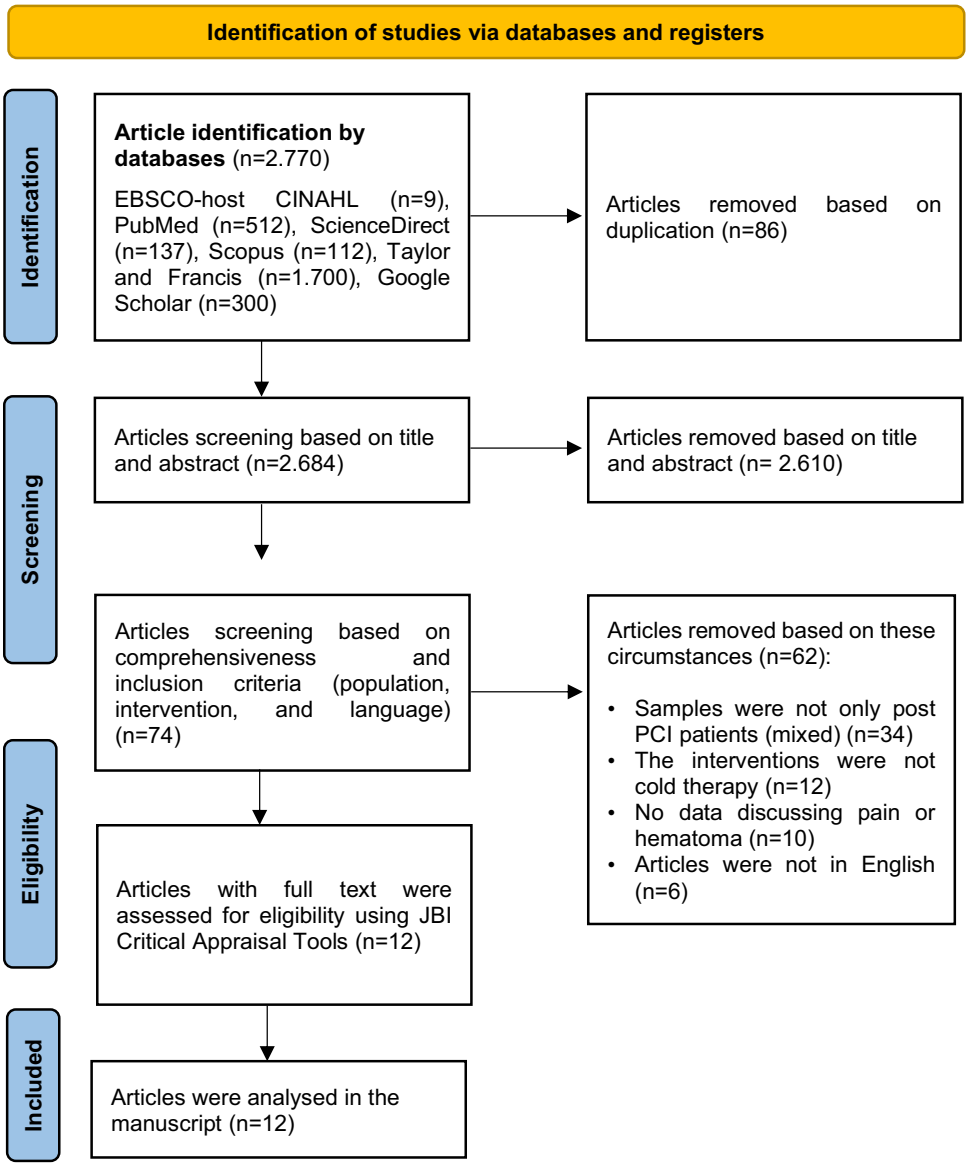


**Figure 1** PRISMA Flow Diagram. Adapted from Page MJ, McKenzie JE, Bossuyt PM et al. The PRISMA 2020 statement: an updated guideline for reporting systematic reviews. *BMJ*. 2021;372:n71. Creative Commons.[23]

This review excluded inaccessible full-text articles, publications not in English, and secondary research. The inclusion criteria in this review are full-text articles that can be accessed and published in English and articles with an experimental design (Randomized controlled trial and Quasi-Experimental) that discuss the effectiveness of cold compress therapy to prevent hematomas and reduce pain in post-cardiac catheterization patients. Then, this review has no criteria for limiting the year of publication, which aims to identify relevant studies comprehensively.

## Data Collection and Analysis

### Search Strategy

The identification of articles was carried out systematically using five main databases: CINAHL Plus with Full Text and Academic Search Complete, PubMed, ScienceDirect, Scopus, Taylor and Francis, and one search engine, namely Google Scholar. The keywords used were coronary heart disease OR coronary artery disease OR heart disease AND cardiac catheterization OR percutaneous coronary intervention OR PCI OR AND cold therapy OR cold compress OR ice pack

OR cold pack AND hematoma AND pain. The author uses the Boolean operators "AND" and "OR" to trim or expand the search results for various tenses.

### Study Selection and Quality Appraisal

All authors independently selected studies that met the eligibility criteria. Using the Mendeley reference manager, the authors checked for duplication in the initial selection process. Then, check the title, abstract, and full text for relevance to the research topic and establish inclusion and exclusion criteria. All authors checked each text completely using the Joanna Briggs Institute (JBI) critical appraisal checklist in the final process.[25] There are 13 statements for articles with a randomized control trial design and 9 statements for articles with a quasi-experimental design. Each statement has answer choices: Yes, No, Not Applicable, and Unclear. The answer "Yes" was given a score of 1, and other answers were given a score of 0. After assessment, the authors eliminated all studies with a JBI score <75%. Next, the author decides whether there is a discrepancy in the election results. All authors had no differences of opinion regarding the appropriateness of this research.

## Data Extraction and Analysis

In this review, data extraction from the studies is analyzed using tables that can describe all the results related to the topic discussed. The information in the extraction table relates to research characteristics: author, design, country, sample, intervention, comparators and results. All included studies were experimental studies (RCTs and quasi-experiments). Therefore, data analysis was carried out thematically using an exploratory descriptive approach.

The data analysis process begins with identifying and presenting the data obtained in tabular form based on the articles reviewed. After obtaining the data, the author analyzes and explains each finding based on the extraction results. Finally, the author re-checked the included studies to ensure and minimize errors during the extraction stage.

### Assessment of Risk of Bias in Included Studies

Six reviewers (F.S, I.Y, W.P.S, E.Y, Y.T, and A.N) independently assessed the Risk of Bias (RoB) for RCT studies included in this review analysis using the Cochrane Risk of Bias (RoB) tool. RCT studies consist of five RoB domains, including (1) randomization process, (2) deviation from the intended intervention, (3) missing outcome data, (4) outcome measurement, and (5) selection of reported outcomes.[26] RoB is defined as "high", "low", or "some concern", or "no information" for each domain.

RoB assessment for quasi-experimental design used the Cochrane Review of Nonrandomized Intervention Studies (ROBINS-I).[27] ROBINS-I consists of 7 domains: Bias due to confounding, bias in the selection of participants into the study, bias in classification of interventions, bias due to deviations from intended interventions, bias due to missing data, Bias in measurement of the outcome, and Bias in selection of the reported result. Discrepancies in the assessment results were then discussed, and review by the all authors determined the decision.

# Results

## Study Selection

Initial literature searches from several databases and Google Scholar obtained 2.770 research articles. Next, the author filtered research based on title and abstract so that 2.684 articles remained. Furthermore, the author excluded 2610 articles because they did not match the abstract and title, leaving 74 articles remaining. Then, these articles were read in full-text, and the author excluded 62 articles because the samples were not only post-PCI patients (mixed) (n=34), the interventions were not cold therapy (n=12), not discussing pain or hematoma (n=10), and articles were not in English (n=6). After the selection stage based on eligibility criteria, 12 research articles remained, and the quality of the articles was assessed using the JBI critical appraisal tool. As a result, the authors included 12 studies in this review. Figure 1 depicts the number of studies retrieved using the PRISMA flow chart diagram.

## Study Characteristics

In this review, 12 articles were included and analyzed, consisting of eight RCT studies and four quasi-experimental studies. All participants in the articles analyzed amounted to 1.096 (IG=548; CG=548) post-cardiac catheterization patients, and most were post-PCI. All articles analyzed came from countries on the Asian continent, including Turkey (n=4), Iran (n=3), Indonesia (n=3), Egypt (n=1), Indonesia (n=3), and Iraq (n=1) and all articles analyzed were of good quality (>75%) (See Tables 1 and 2).

## Quality Assessment and Risk of Bias Within Studies

Based on the critical appraisal results, all articles analyzed were of good quality (>75%) (See Table 1). Most studies do not provide clear information regarding the blinding of outcome measurements and the blinding of the intervention provider. In addition, Figures 2 and 4 illustrate the risk of bias in the research analyzed. As many as 3 of the 8 RCTs were included in the some concern category,[19,29,31] the other three studies are in the low category,[17,28,33] and 2 studies were included in high risk.[20,30] The RoB results in studies with a quasi-experimental design showed that 3 of the studies were categorized as serious risk,[15,18,32] and only Kurt and Kasikci (2019) which is included in the moderate risk.[10] Then, Figures 3 and 5 describe the summary of RoB in included studies.

## Effectiveness of Cold Compress Therapy

Based on the analysis results, ice compress therapy can prevent hematomas and reduce patients' pain before, during, and after PCI stent removal (see Tables 2 and 3). Several types of cold compress therapy are used in the studies analyzed in this review (see Table 3). Several studies combined ice compress therapy with sandbags, and the study by Ginanjar et al (2018) combined it with early ambulation.[30] In most studies, cold compress therapy was carried out for 20 minutes and in the range of 15 to 20 minutes. The temperature for cold compress therapy is 15–20° C, but only two studies included the temperature of the ice used.[28,29] All study participants analyzed in this review had vascular access from PCI placement in the femoral area.

**Table 1** JBI Critical Appraisal Results

| Study | Design | JBI Critical Appraisal Tool |
|---|---|---|
| [28] | RCT | 12/13 (92,3%) |
| [19] | RCT | 10/13 (77%) |
| [10] | Experimental study with a control group | 9/9 (100%) |
| [29] | RCT | 10/13 (77%) |
| [18] | Quasi-experiment | 7/9 (77.7%) |
| [15] | True experiment | 7/9 (77.7%) |
| [30] | RCT | 10/13 (77%) |
| [31] | RCT | 11/13 (84%) |
| [20] | RCT | 10/13 (77%) |
| [32] | Quasi-experiment | 8/9 (88.8%) |
| [17] | RCT | 13/13 (100%) |
| [33] | RCT | 13/13 (100%) |


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**Table 2** Characteristics of Study

| Study, Country, and Design | Sample | Instrument | Intervention | Comparators | Study Outcomes | |
|---|---|---|---|---|---|---|
| | | | | | Hematoma | Pain |
| [28]<br>Turkey<br>RCT | 210 patients post PCI<br>IG (n=105)<br>CG (n=105) | Visual Analog Scale for Pain<br>PCI monitoring form for Hematoma | Cold sand pack (CSP) (femoral area)<br>Given a temperature of 18–20°C for 20 minutes, and then at an average temperature of 24.1°C for 3 hours and 40 minutes. | Normal sand pack (NSP) (femoral area)<br>Compresses with an average temperature of 24.1°C were applied locally for 4 hours. | Yes<br>First hour<br>(IG 1; 1%) (CG 1; 1%)<br>Second hour<br>(IG 1; 1%) (CG 2; 1.9%)<br>Third hour<br>(IG 1; 1%) (CG 3; 2.9%)<br>Fourth hour<br>(IG 1; 1%) (CG 4; 3.8%)<br>Fifth hour<br>(IG 1; 1%) (CG 3; 2.9%)<br>Sixth hour<br>(IG 1; 1%) (CG 1; 1%)<br>12th hour<br>(IG 1; 1%) (CG 1; 1%)<br>24th hour<br>(IG 1; 1%) (CG 1; 1%) | Yes<br>First hour<br>(IG 1.96 ± 1.35) (CG 4.08 ± 1.91)<br>Second hour<br>(IG 1.50 ± 1.18) (CG 3.45 ± 1.73)<br>Third hour<br>(IG 1.00 ± 1.12) (CG 2.85 ± 1.70)<br>Fourth hour<br>(IG 0.49 ± 0.88) (CG 2.08 ± 1.73)<br>Fifth hour<br>(IG 0.26 ± 0.65) (CG 1.34 ± 1.64)<br>Sixth hour<br>(IG 0.15 ± 0.50) (CG 0.93 ± 1.42)<br>12th hour<br>(IG 0.14 ± 0.45) (CG 0.75 ± 1.24)<br>24th hour<br>(IG 0.13 ± 0.44) (CG 0.69 ± 1.14) |
| [19]<br>Iran<br>RCT | 60 patients post PCI<br>IG (n=30)<br>CG (n=30) | Numerical rating scale (NRS) for pain | Sandbag Combined with Ice Bag<br>After initial coagulation, a transparent dressing was placed on the site, and an ice bag with a cloth cover and a sandbag (3 kg) was placed over it for 15 minutes. After 15 minutes, the ice bag was carefully removed, and the sandbag was placed alone at the location for 45 minutes. This cycle is repeated 4 times (total 4 hours). | Sandbag<br>After initial coagulation, a transparent dressing was placed in place with hand pressure, and the patient was placed in that position again for up to 4 hours, and a sandbag with a fixed weight of 3 kg was placed at the angiography site. Then the bag is removed and the patient rests for 3 hours searah dengan kaki sehatnya. | N/A | Before the intervention<br>(IG 2.5±1.4) (CG 3.0±1.2)<br>Three hours after the sheath removal<br>(IG 1.1±1.0) (CG 32.4±0.9)<br>Six hours after the sheath removal<br>(IG 0.7±0.7) (CG 1.0±0.8)<br>Twelve hours after sheath removal<br>(IG 0.2±0.4) (CG 0.4±0.6) |

| | | | | | | |
|---|---|---|---|---|---|---|
| [10]<br>Turkey<br>Experimental study with a control group | 200 patients post PCI<br>IG (n=100)<br>CG (n=100) | Numeric Pain Rating Scale for pain<br>Hematoma measurement method | Cold pack<br>(femoral area)<br>Cold pack covered with sterile gauze was placed under the sandbag for a duration of 15 minutes | Sandbag<br>(femoral area)<br>Routine protocol with a sandbag (5 kg) in the femoral artery area after catheter removal. | 15 minutes (IG 0; 0%) (CG 0; 0%)<br>4th hour (IG 5; 5%) (CG 9; 9%)<br>48th hour (IG 19; 19%) (CG 44; 44%)<br>72th hour (IG 20; 20%) (CG 49; 49%) | During removal of the catheter<br>(IG 99; 99%) (CG 99; 99%)<br>15 minutes (IG 14; 43%) (CG 43; 43%)<br>4th hour (IG 1; 1%) (CG 23; 23%)<br>48th hour (IG 0; 0%) (CG 18; 18%)<br>72th hour IG 0; 0%) (CG 17; 17%) |
| [29]<br>Turkey<br>RCT | 120 patients post-PCI<br>IG (n=40)<br>CG (n=40)<br>CG2 (n=40) | Visual Analogue Scale for pain<br>Individual Observation Form for hematoma, ecchymosis, haemorrhage | Sandbag and Cold Application<br>(femoral area)<br>Cold pack pad with a temperature of 15–18°C, not in direct contact with the skin and finally a sandbag is applied to this pack for 15 minutes, and after the time is up, the cold pack pad is taken from the bottom of the sandbag and the area is checked, and the pressure is maintained with a sandbag for 4 hours. Cold compress pads are only applied once within a 4 hour pressure application period. | Sandbag<br>(femoral area)<br>Pressure was applied to the femoral area for 4 hours<br>Close pad<br>(femoral area)<br>The nurse places a close pad with a balloon bag on the femoral area, the close pad balloon bag is inflated with 40–50 cc of air with the help of a syringe, and pressure is continued on the femoral area for 3 hours with a close pad. | 15 minutes after procedure (IG 2; 5%) (CG 4; 10%)<br>4 hours after procedure (IG 2; 5%) (CG 4; 10%)<br>1st day after procedure (IG 1; 2.5%) (CG 3; 7.5%)<br>2nd day after procedure (IG 0; 0%) (CG 0; 0%) | 15 minutes after procedure<br>Mild (IG 4; 10%) (CG 7; 17.5%)<br>Moderate (IG 2; 5%) (CG 4; 10%)<br>Severe (IG 0; 0%) (CG 4; 10%)<br>4 hours after procedure<br>Mild (IG 3; 7.5%) (CG 10; 25%)<br>Moderate (IG 0; 0%) (CG 4; 10%)<br>Severe (IG 0; 0%) (CG 0; 0%)<br>1st day after procedure<br>Mild (IG 0; 0%) (CG 4; 10%)<br>Moderate (IG 0; 0%) (CG 0; 0%)<br>Severe (IG 0; 0%) (CG 0; 0%)<br>2nd day after procedure<br>Mild (IG 0; 0%) (CG 0; 0%)<br>Moderate (IG 0; 0%) (CG 0; 0%)<br>Severe (IG 0; 0%) (CG 0; 0%) |
| [18]<br>Indonesia<br>A quasi-experimental study design | 32 patients post cardiac catheterization patients<br>IG (n=16)<br>CG (n=16) | Numeric Rate Scale for pain | Ice pack gel<br>(femoral area)<br>Ice pack gel was given immediately after hospital protocol and observed for 20 minutes. | Usual care<br>(femoral area)<br>Bandage pressure for 4 hours. | N/A | Baseline (IG 4.63 ± 1.02) (CG 4.75 ± 0.77)<br>Post intervention (IG 1.63 ± 0.81) (CG 2.31 ± 0.60) |
| [15]<br>Indonesia<br>True experimental research | 30 patients post PCI<br>IG (n=15)<br>CG (n=15) | Numeric Pain Rating Scale for pain | Cold compress therapy with ice gel<br>(femoral area)<br>Pressed for 20 minutes. | Sand pillow compress therapy<br>(femoral area)<br>Pressed for 20 min. | N/A | Baseline (IG 4.53±0.915) (CG 4.40±0.828)<br>Post-intervention (IG 2.40 ±0.986) (CG 4.27±1.033) |

(*Continued*)

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**Table 2** (Continued).

| Study, Country, and Design | Sample | Instrument | Intervention | Comparators | Study Outcomes | |
|---|---|---|---|---|---|---|
| | | | | | Hematoma | Pain |
| [30] Indonesia RCT | 30 patients post cardiac catheterization IG (n=15) CG (n=15) | Observation sheet to measure the occurrence of bleeding, tape, and haematoma. | Early ambulation with cold pack (femoral area) The stitch marks were given a cold pack for 20 minutes, then 1 hour after removing the sheath catheter after angiography, the respondent was asked to walk 10 meters, with a note that the respondent should not fold his thighs. | Sand pillow and immobilization for 6 hours (femoral area) After removing the catheter after angiography, the suture mark was given a sand pillow weighing 2.5 kg and immobilized for 6 hours. | Hematoma size 0 (IG 5; 33%) (CG 0; 0%) 0–1 (IG 8; 53.3%) (CG 7; 46.7%) 1.1–5 (IG 2; 13.3%) (CG 8; 53.3%) | N/A |
| [31] Turkey RCT | 104 patients post PCI IG (n=52) CG (n=52) | Numerical Rating Scale for pain | Ice Bag Application (femoral area) Cold application for 20 minutes by placing an ice bag to the site of the femoral catheter | Standard clinic procedure (femoral area) | N/A | Before the catheter removal (IG 0.1 ± 0.4) (CG 0.1 ± 0.4) During the catheter removal (IG 3.6 ± 1.4) (CG 5.6 ± 2.3) After the catheter removal (IG 3.8 ± 1.4) (CG 5.5 ± 2.1) |
| [20] Iran RCT | 60 patients post PCI IG (n=30) CG (n=30) | Physiological Report Sheet for measuring hemorrhage and hematoma | Sand and ice bag (femoral area) A transparent dressing was applied to the affected area, and a cloth ice bag (<100 g) topped with a sandbag (3 kg) was placed simultaneously for 15 minutes. Then, for 45 minutes, with sandbag pressure only. | Sandbag (femoral area) The patient lay in bed in a supine position for another 4 hours with a 3 kg sandbag placed in the angiography area. | 1st pre-interventional stage (IG 5.8 ± 2.0) (CG 4.8±1.6) 3 hours after sheath removal (IG 1.8 ± 0.7) (CG 2.7 ± 1.3) 6 hours after sheath removal (IG 1.0 ± 0.5) (CG 1.7 ± 0.7) 12 hours after sheath removal (IG 1.3 ± 0.7) (CG 2.3 ± 0.8) | • N/A |
| [32] Egypt A quasi-experimental design | 100 patients post cardiac catheterization IG (n=50) CG (n=50) | Visual Analog Scale (VAS) for Pain Hematoma Characteristics form | Ice application (femoral area) Apply an ice compress for 20 minutes to the femoral area continuously. | Routine hospital care (femoral area) | Baseline <5cm (IG 14; 70%) (CG 12; 63.2%) 5–10cm (IG 4; 20%) (CG 5; 26.3%) >10cm (IG 2; 10%) (CG 2; 10.5%) Post Intervention <5cm (IG 0; 0%) (CG 7; 36.8%) 5–10cm (IG 1; 5%) (CG 3; 15.8%) >10cm (IG 1; 5%) (CG 2; 10.5%) Treated hematoma (IG 18; 90%) (CG 7; 36.7%) | At the time of sheath removal (IG 1.84 ±0.80) (CG 2.41 ±0.93) Hemostasis (IG 3.0 ±0.0) (CG 3.11 ±1.13) One hour post hemostasis (IG 1.33 ±0.20) (CG 1.87 ±0.83) 12 to 16 hours post hemostasis (IG 1.11 ±0.33) (CG 1.0 ±0.74) After Two weeks (IG 1.0±0.0) (CG 2.62 ±0.51) |

| | | | | | | |
|---|---|---|---|---|---|---|
| [17]<br>Turkey<br>RCT | 60 patients post PCI<br>IG (n=30)<br>CG (n=30 | Numerical Rating Scale for pain | Ice bag<br>(femoral area)<br>Apply an ice compress to the femoral area for 20 minutes before removing the femoral catheter. | Routine hospital care<br>(femoral area)<br>Manual compression to the catheter site with sandbag (2kg) was placed in the femoral region for 4–6 hours | N/A | Before the catheter removal<br>(IG 0 ± 0) (CG 1.43±0.27)<br>During the catheter removal<br>(IG 1.10±1.39) (CG 5.77±2.73)<br>After the catheter removal<br>(IG 0 ± 0) (CG 1.72±0.83 0) |
| [33]<br>Iraq<br>RCT | 90 patients post PCI<br>IG (n=45)<br>CG (n=45) | Checklist for Determination of Local Vascular Complications | Cold bag compression<br>(femoral area)<br>Direct cold bag compression for femoral arterial sheath removal for 15–20 minutes until the hemostasis is done, and then apply a light dressing | Usual nursing care<br>(femoral area) | 1st hour<br>Not Present (IG 45; 100%) (CG 39; 86.7%)<br>Small Hematoma (IG 0; 0%) (CG 2; 4.4%)<br>Moderate Hematoma (IG 0; 0%) (CG 4; 8.9%)<br>Large Hematoma (IG 1; 5%) (CG 2; 10.5%)<br>2nd hour<br>Not Present (IG 45; 100%) (CG 39; 86.7%)<br>Small Hematoma (IG 0; 0%) (CG 4; 8.9%)<br>Moderate Hematoma (IG 0; 0%) (CG 2; 4.4%)<br>3rd hour<br>Not Present (IG 45; 100%) (CG 38; 84.4%)<br>Small Hematoma (IG 0; 0%) (CG 6; 13.3%)<br>Moderate Hematoma (IG0; 0%) (CG 1; 5%)<br>4th hour<br>Not Present (IG 45; 100%) (CG 41; 91.1%)<br>Small Hematoma (IG 0; 0%) (CG 4; 8.9%)<br>1 day<br>Not Present (IG 1; 5%) (CG 11; 24.4%)<br>Small Hematoma (IG 0; 0%) (CG 2; 10.5%)<br>Moderate Hematoma (IG 0; 0%) (CG 3; 6.7%)<br>Large Hematoma (IG 1; 5%) (CG 1; 2.2%) | N/A |

**Abbreviations**: CSP, Cold sand pack; NSP, Normal sand pack; PCI, Percutaneous Coronary Intervention; RCT, Randomized Controlled Trial.

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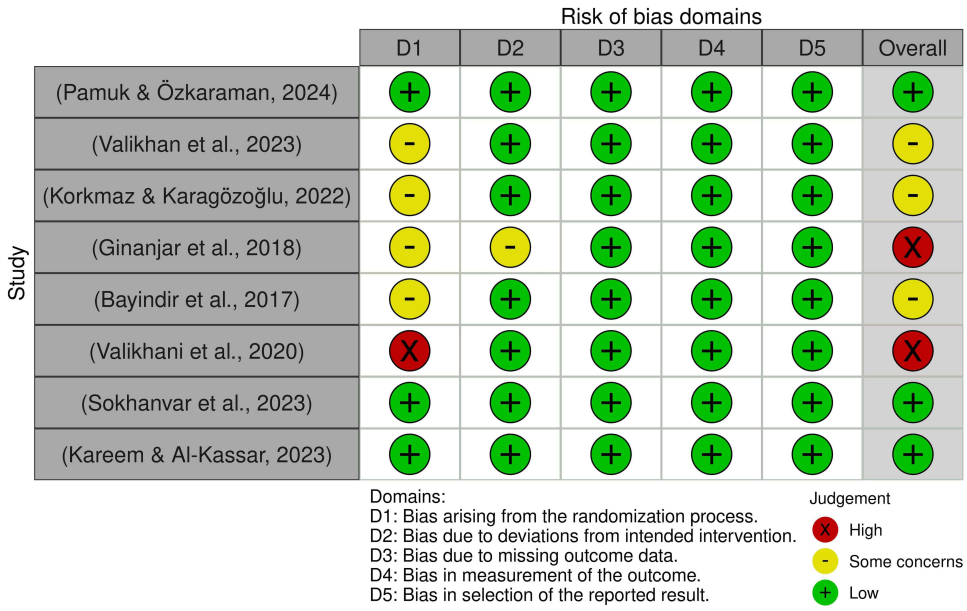


**Figure 2** Risk of Bias Assessment of RCT's Studies.

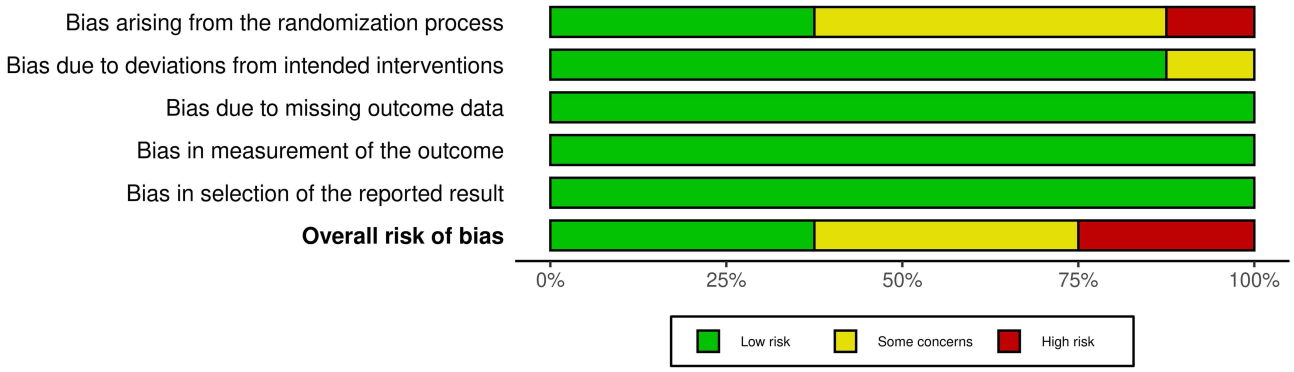


**Figure 3** Summary Risk of Bias Assessment of RCT's Studies.

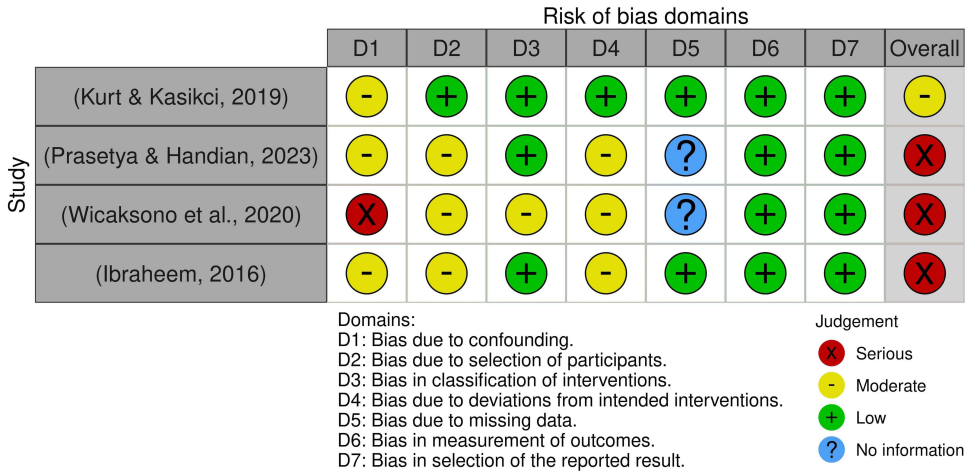


**Figure 4** Risk of Bias Assessment of Quasi Experimental Studies.

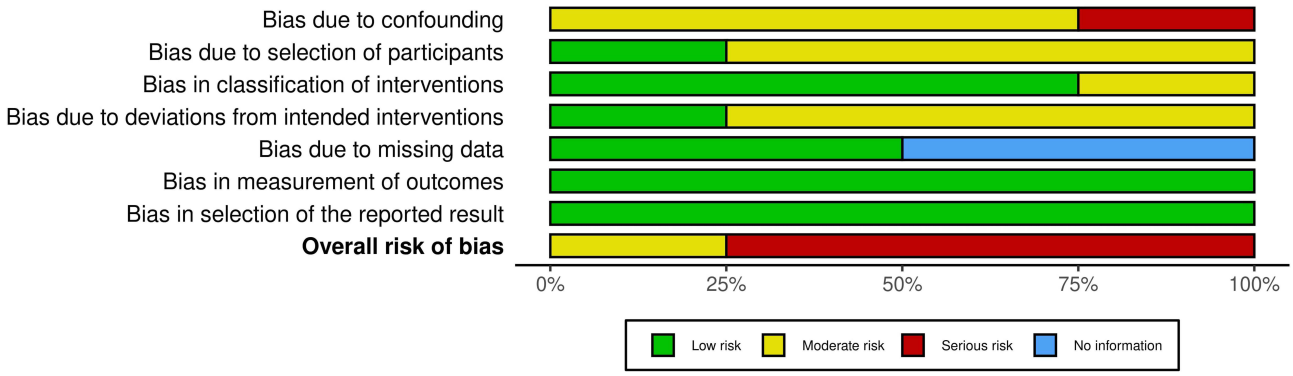


**Figure 5** Summary Risk of Bias Assessment of Quasi Experimental Studies.

## Discussion

Complications after cardiac catheterization, including PCI, such as the appearance of hematomas and pain felt by patients before, during and after stent removal, are problems that are still widely reported.[14,28,29,34] Hematomas can occur due to the accumulation of blood around the tissue due to the puncture area not being closed properly.[34] Given the severe impact of this complication, implementing preventive measures and interventions to reduce the risk of hematoma and reduce the patient's pain after PCI should be considered by nurses.[34] To overcome this problem, this review succeeded in identifying the potential of using cold compress therapy to prevent hematomas and reduce pain in post-PCI patients.

Previous studies reported minor bleeding in patients after removal of the femoral artery catheter.[10,35] These complications certainly impact short-term and long-term adverse outcomes after PCI and the length of hospital stay.[36] Independent predictors that influence this complication are age, female gender, previous PCI, previous heart failure,

**Table 3** Characteristic of Cold Therapy

| Study | Intervention | Vascular Access | Temperature | Duration | Outcome | |
|---|---|---|---|---|---|---|
| | | | | | Prevent Hematoma | Alleviating Pain |
| [28] | Cold sand pack | Femoral area | Begin: 18–20°C<br>Next: 24.1°C | 20 minutes<br>40 minutes | Yes | Yes |
| [19] | Sandbag Combined with Ice Bag | N/I | N/I | 15 minutes | N/A | Yes |
| [10] | Cold pack | Femoral area | N/I | 15 minutes | Yes | Yes |
| [29] | Sandbag and Cold Application | Femoral area | 15–18°C | 15 minutes | Yes | Yes |
| [18] | Ice pack gel | Femoral area | N/I | 20 minutes | N/A | Yes |
| [15] | Cold compress therapy with ice gel | Femoral area | N/I | 20 minutes | N/A | Yes |
| [30] | Early ambulation with cold pack | Femoral area | N/I | 20 minutes | Yes | N/A |
| [31] | Ice Bag Application | Femoral area | N/I | 20 minutes | N/A | Yes |
| [20] | Sand and ice bag | Femoral area | N/I | 15 minutes | Yes | N/A |
| [32] | Ice application | Femoral area | N/I | 20 minutes | Yes | N/S |
| [17] | Ice bag | Femoral area | N/I | 20 minutes | N/A | Yes |
| [33] | Cold bag compression | Femoral area | N/I | 15–20 minutes | Yes | N/A |

**Abbreviations**: N/A, Not Applicable; N/I, No Information; N/S, Not significant.


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hemodialysis, ST and non-ST elevation myocardial infarction, and cardiogenic shock.[36] However, among the factors that increase the incidence of bleeding, studies are showing that the use of drugs is effective in reducing coagulation.[37,38] However, previous studies reported that the low bleeding rate was because they did not include patients taking thrombolytic and glycoprotein drugs.[10] In addition, in the study, the blood clotting parameters in the patients were within normal limits, which may explain the reason for the low bleeding rate in the study.[10]

The findings in this review conclude that cold compress therapy has the potential to reduce the risk of hematoma while reducing the pain felt by post-PCI patients.[10,15,17–20,28–33] Cold compresses are a treatment that can be used to prevent or reduce the severity of hematomas in post-PCI patients.[28–30,32] This is because cold compresses help vasoconstrict blood vessels and speed up blood clotting time and the formation of blood clots.[39] In addition, the pathophysiological effect of cold compresses is that they can reduce blood flow to tissues through vasoconstriction and reduce tissue metabolism, oxygen use, inflammatory processes and muscle spasms.[22] Nervous effects are also mediated through vasoconstriction, which causes decreased oedema, decreased release of local pain mediators, and slowed nerve conduction of fibres in peripheral nerves.[40]

Previous evidence showed that applying cold compresses can prevent and reduce the size of hematomas in patients following cardiac catheterization.[10,19,29,30] Previous studies reported that the hematoma size before cold compress intervention for 20 minutes in each group (IG=70%, CG=63.2%) had a hematoma size of <5cm.[32] After being given therapy, patients who experienced hematomas (<5 cm) decreased drastically (IG=0%, CG=36.8%), especially in the intervention group.[32] In addition, Kareem et al (2023) reported that in the first 2 hours after the intervention, there were two patients (CG) experiencing small hematomas and two patients (CG) with moderate hematomas. In contrast, in the intervention group, no patients experienced hematomas.[33] Then, another study reported that after 12 hours post-PCI, as many as 20% of patients still experienced hematomas in the control group who were only given sandbag therapy for 4 hours. Meanwhile, in the experimental group, it was only 6.7%.[20]

Cold compress therapy also has the potential to relieve the pain felt by post-PCI patients.[17,18,31] Previous studies reported that the mean pain score during femoral catheter removal was 2.73 ± 77.5 in the control group and 1.1 ± 1.39 in the intervention group ($p$<0.001). In addition, the mean pain scores after femoral catheter removal were 1.72±0.83 and 0 ±0 in the control and intervention groups, respectively ($p$<0.001).[17] In another study, ice gel pack intervention could reduce pain scores from 4.63 ± 1.02 to 1.63 ± 0.81 after arterial sheath removal.[18]

An interesting thing was done in research conducted in Indonesia.[30] In Ginanjar et al (2018), the intervention did not only use cold packs but also the addition of an early ambulation intervention of 10 meters, which was carried out after 1-hour post-cardiac catheterization.[30] Early ambulation carried out 1 hour earlier can prevent the accumulation of platelet clots for a long time, which can cause thrombosis because excessive accumulation of platelets can cause a decrease in blood flow to the tissue or cause embolism to form.[30] Almost all of the control group were given the sandbag intervention only.[10,19,20,29,35] However, pressing with a sand pillow can cause tingling and difficulty moving the extremities in the catheterization access area, so cold compresses are superior in patient comfort compared to using a pillow.[41]

The positive effect of applying ice compresses to post-PCI patients is that cold compresses can be an effective and affordable method to reduce the incidence of hematomas and pain in hospital post-PCI patients.[42] Nurses, as part of the healthcare team, are well positioned to implement evidence-based practices that promote optimal patient care and positive treatment outcomes.[10] By implementing comprehensive nursing strategies, such as patient education, vigilant monitoring, and timely intervention, nurses can significantly reduce the incidence of post-PCI hematomas and contribute to improved patient well-being.[22,43–46] Early recognition and prevention of complications after PCI is critical.

## Implications of Practice

The use of cold compress therapy in post-cardiac catheterization patients is effective in reducing the risk of hematoma and reducing pain intensity. By applying cold compresses for 15 to 20 minutes, nurses can improve the quality of care by accelerating local vasoconstriction and coagulation, helping stabilize tissue and reduce bleeding. This strategy can be integrated into the nursing protocol in the cardiology intensive care unit to minimize post-procedure complications and improve overall patient comfort.

Furthermore, the use of this therapy not only supports a non-pharmacological approach to pain management but also reduces dependence on painkillers that can cause side effects. Therefore, further training for health workers in applying cold compress therapy and intensive monitoring of patient reactions will strengthen the implementation of this intervention in health facilities. This is expected to reduce the incidence of complications and shorten the length of hospitalization, ultimately increasing health services' efficiency.

This review does suggest that cold compress therapy has the potential to prevent hematoma and reduce pain. However, the treatment approach for each patient may require adaptation depending on the individual's clinical condition. Therefore, while this evidence supports the use of cold compress as part of the standard of care, nurses and healthcare providers need to consider patient-specific factors, such as response to cold therapy, vascular condition, and additional interventions, to optimize safe and effective treatment outcomes.

## Strengths and Limitations

There were several limitations to this review. First, all studies included in this review were conducted in countries on the Asian continent (Turkey, Iran, Indonesia, Egypt, Indonesia, and Iraq). Second, the research sample remains small, only 1.096 (IG=548; CG=548) patients after cardiac catheterization. Third, most studies do not include the temperature of cold compress therapy, which needs to be clarified for future researchers when they want to implement similar interventions. However, despite these limitations, all of the included articles are of the best quality (RCTs and quasi-experiments) and have passed critical appraisal, which can be an advantage of this review. This systematic review cannot be continued to the meta-analysis stage because each article's measurement of study outcomes is considered very heterogeneous (see Table 2). Therefore, from these limitations, the author suggests that it is necessary to carry out additional studies in the future by considering the characteristics of cold compresses from the results of this review, which was carried out in other countries so that the level of generalization will be better and more comprehensive and quantitative assessment (meta-analysis) can be achieved and identified to determine the efficacy of cold compress therapy.

# Conclusions

This review concluded that from the 12 articles analyzed, cold compress therapy for 15 to 20 minutes after cardiac catheterization has excellent potential to prevent hematomas and reduce pain in patients. The results of this study can provide an alternative for health workers, especially nurses in coronary care unit, to maximize interventions for coronary heart disease patients after PCI. Then, it is still open to carry out similar research in different populations to increase the generalization of the findings in this review because all the studies identified were carried out in CHD patient populations on the Asian continent to strengthen the evidence from the conclusions of this study.

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