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Cryotherapy as a treatment for Post-Transracial PCI pain and hemostasis: A systematic literature review

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Abstract

Post-PCI transradial patients often experience pain and hemostasis disorders such as bleeding or hematoma at the puncture site. Cryotherapy as a non-pharmacological therapy has been reported to reduce pain and bleeding, but the scientific evidence addressing both outcomes simultaneously is limited and not yet integrated. This study aims to evaluate the effectiveness of cryotherapy against pain and hemostasis in patients with post-transradial PCI based on the findings of available studies. This study uses Systematic Literature Review method by searching articles on various scientific databases such as Pubmed, Cinahl, Cochrane, Web of Science, and Google Scholar in the last ten years. Articles were selected based on inclusion and exclusion criteria until 16 journals relevant to the topic of the effectiveness of cryotherapy in reducing pain and supporting post-transradial PCI hemostasis were obtained. All selected articles were systematically analyzed to synthesize the main findings as the basis for drawing conclusions. The results of the study show that cryotherapy is effective in reducing pain intensity and supporting post-PCI hemostasis through vasoconstriction mechanisms and reducing pain impulses, thus potentially becoming a safe and low-cost nonpharmacological nursing intervention. However, the available evidence is still limited by the heterogeneity of the study design, the variation of cryotherapy protocols, and the lack of studies specifically focusing on transradial PCI. Therefore, further research with controlled randomized trial designs and standardized protocols is needed to strengthen the scientific basis and support the development of evidence-based clinical practice guidelines.

Keywords: Cryotherapy, Pain, Hemostasis, Transradial PCI.

Introduction

The death rate due to non-communicable diseases shows an increasing trend from year to year, with Coronary Heart Disease (CHD) as the main contributor. Based on the *Global Burden of Cardiovascular Disease* (2020) report, the number of cases of cardiovascular disease has increased significantly from around 271 million cases in 1990 to 523 million cases in 2019. Data from the World Health Organization (WHO) also reveals that more than 17 million deaths in the world are caused by heart and blood vessel diseases. In 2020, coronary heart disease is estimated to be the highest cause of death globally, accounting for about 36% of total deaths, a figure that far exceeds cancer deaths. This condition is projected to continue to increase until 2030, making coronary heart disease a major health problem that requires serious attention (Aldi et al., 2024).

One of the invasive procedures used in the treatment of coronary artery blockage is Percutaneous Coronary Intervention (PCI) which is also known as cardiac catheterization procedures. This procedure is performed by inserting a catheter into a blood vessel through the vascular system to assess the condition of the heart structure as well as determine the location and extent of blockage in the coronary arteries with the help of contrast media. This technique aims to improve coronary blood flow so that it can reduce the risk of complications due to coronary heart disease (Baidhowy et al., 2021).

Although this procedure is relatively safe and widely used, patients often experience complaints of pain in the puncture area after the procedure and are at risk of bleeding due to the use of antithrombotic therapy and wounds to vascular access (Abu-Shanab et al., 2025). Therefore, the process of post-PCI transradial hemostasis is an important aspect of patient care to ensure that bleeding can be stopped optimally and prevent the formation of hematoma. Effective pain and hemostasis management not only plays a role in improving patient comfort, but also in reducing the risk of complications as well as supporting faster recovery after PCI procedures (Nuraeni et al., 2023).

Bleeding is one of the most common complications in

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patients undergoing antithrombotic therapy, both in the form of dual antiplatelet therapy (Dapt) and a combination of antiplatelets with oral anticoagulants (OAC), especially in patients with Atrial Fibrillation (AF) who undergo Percutaneous Coronary Intervention (PCI) (Galli et al., 2022). The use of these drugs is necessary to prevent thrombosis, but on the other hand it can increase the risk of bleeding because it inhibits the blood clotting mechanism. The risk of bleeding is known to be directly proportional to the intensity and duration of antithrombotic therapy, especially at the location of vascular access such as the radial artery in the transradial PCI procedure (Fitra & Ekawati, 2025).

Based on a six-year prospective cohort study, the prevalence of bleeding after PCI action was 3.07%. These findings suggest that bleeding is still a significant complication even though PCI techniques continue to evolve (Moghadam et al., 2024). The bleeding is mainly related to the use of antithrombotic therapy as well as vascular access procedures that can affect the hemostasis process in patients. The results of this study confirm the importance of efforts to prevent and manage bleeding after PCI to improve patient safety and comfort.

In addition to bleeding, patients after transradial PCI also often experience pain in the puncture area, so safe, effective, and easy-to-apply nonpharmacological interventions are needed to reduce pain while helping the hemostasis process. One method that has the potential to be used is *cryotherapy* or cold compresses, which work through a vasoconstriction mechanism so as to slow down blood flow and accelerate the clotting process, as well as reduce the sensitivity of nerve endings which play a role in pain perception (Syahputri et al., 2025). The application *of cryotherapy* can help prevent bleeding and the formation of hematoma at the vascular access site, while increasing patient comfort after the procedure (Rafyansyah et al., 2023). Therefore, research on the effectiveness of cryotherapy on pain and hemostasis after transradial PCI is important to be conducted as an effort to improve the quality of nursing care and patient safety through a non-pharmacological approach that is simple but has the potential to provide significant clinical benefits.

Previous research by Patil et al., (2025) explains that this study shows that *cryotherapy* is a promising non-pharmacological intervention to reduce the formation of hematoma after PCI action. The application *of cryotherapy* at two-minute intervals for a total of 10 minutes has been shown to be beneficial, although further research is still needed to determine the most optimal duration, interval and method of application. In addition, large-scale, multicenter clinical trials are needed to ensure their effectiveness in various patient populations as well as assess long-term outcomes. Thus, *cryotherapy* could potentially become part of the standard of care in the prevention and management of hematoma after sheath *release* in post-PCI patients.

Likewise, according to Prado et al., (2025) explained that cooling at the location of the forearm puncture using the new *cryoband* protocol has been proven to be safe and effective. Cold compress therapy for 15–20 minutes has the potential to prevent the occurrence of a hematoma and reduce pain in patients after cardiac catheterization (Sugiharto et al., 2025). Thus, cold compress therapy can be used as one of the intervention strategies in nursing care, especially by nurses, to help increase comfort and prevent complications in patients after cardiac catheterization.

Although various studies have reported that *cryotherapy* reduces pain and prevents hematoma after cardiac catheterization procedures, most studies still focus on a single clinical outcome, such as pain or bleeding, with variations in duration, method of application, and intervention protocols that have not yet been standardized. In addition, scientific evidence specifically examining the effectiveness of *cryotherapy* in addressing two important aspects at once, namely pain and hemostasis in patients after transradial PCI, is still limited and scattered across various research designs. Therefore, the novelty of this study lies in the comprehensive preparation of evidence through a systematic literature review approach to evaluate the effectiveness of *cryotherapy* against pain and hemostasis simultaneously in patients after transradial PCI. The purpose of this study is to analyze and summarize the latest scientific findings regarding the effectiveness of *cryotherapy* in reducing pain and supporting hemostasis improvement, as well as to identify the most effective and optimal intervention protocols as a basis for the development of evidence-based nursing practice recommendations.

Research Methods

This study used the Systematic Literature Review (SLR) method to identify, assess, and synthesize scientific evidence related to the effectiveness of cryotherapy in pain management and hemostasis in patients after transradial PCI. The literature search process is carried out systematically through several databases and scientific search engines, namely Pubmed, Cinahl, Cochrane, Web of Science, and Google Scholar, using relevant keywords including cryotherapy, cold compress, *pain*, *hemostasis*, and transradial pci. The search was limited to articles published in the last ten years to ensure that the evidence used was up-to-date and relevant to current clinical practice.

From the results of the initial search, a number of articles were obtained which were then selected based on inclusion and exclusion criteria, including topic suitability, research design, and the availability of complete text. After going through a thorough screening process of titles, abstracts, and article content, as many as 16 journals were selected that met the criteria and were considered worthy of further analysis. The articles were then analyzed descriptively and comparatively to evaluate the effectiveness of cryotherapy in managing pain and supporting hemostasis, and summarized the main findings as the basis for the preparation of the study's conclusions.

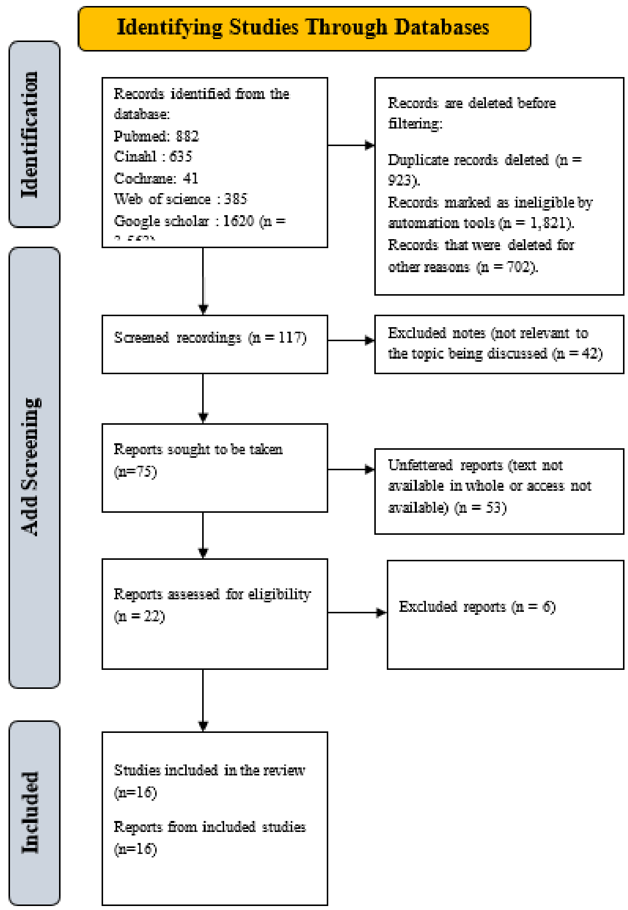

Figure 1. Prism Diagram

Results and Discussion

Table 1. Research results

Author & Year	Research Objectives	Population	Intervention	Comparison	Results
Shimaa, 2016	Assessing the effectiveness of the application of ice on vascular complications after cardiac catheterization.	100 Post-Pci Patients.	Compress the ice 20 minutes before and 20 minutes after the release of the sheath until hemostasis.	Control group without ice compresses (50 vs 50).	The size of the hematoma and pain were significantly lower in the intervention group ($p < 0.05$); Patient comfort is improved.
Bayındır et al., 2017	Assess the effectiveness of ice packs against pain during catheter removal.	104 PCI Patients.	Ice compress 20 minutes at the site before catheter removal.	No ice packs (52 vs 52).	Post-catheter removal pain score was significantly lower in the intervention group ($p < 0.001$).

Çürük et al., 2017	To assess the effect of ice bag use on local vascular complications and post-PCI low back pain.	298 Post-Pci Patients	Ice Bag Application After the Procedure.	sandbags and no application (104 vs 100 vs 94).	The ice pack group showed the fewest vascular complications at follow-up evaluation and the lowest vase pain score compared to the other group (P < 0.001).
Ginanjar et al., 2018	Analyzes the effect of early mobilization and cold compresses on bleeding and hematoma.	30 patients after cardiac catheterization.	Cold compresses accompanied by early mobilization.	Sand pillow and immobilization 6 hours (15 vs 15).	There was no difference in bleeding (p=1,000), but hematoma was significantly lower in the intervention group (p=0.001).
Kurt & Kaşıkçı, 2019	Assess the effect of cold compresses on hematoma, ecchymosis, and post-PCI pain.	200 PCI Patients.	Cold compress under a sand pillow for 15 minutes after catheter removal.	Sand pillows only (100 vs 100).	Hematoma, ecchymosis, and pain were significantly lower in the intervention group (p < 0.01).
Valikhani et al., 2020	Assess the effect of the combination of ice and sand pillows on bleeding and hematoma post-pci.	60 Angioplasty Patients.	A combination of ice packs and sand pillows cyclically.	Sand pillows only (30 vs 30).	Bleeding is significantly reduced, there is a statistically insignificant decrease in hematomas.
Wicaksono et al., 2020	Testing the effect of ice gel cold compresses on post-PCI pain intensity.	30 PCI Patients.	Cold compress ice gel and sand pillow for 20 minutes.	Sand pillows only (15 vs 15).	Pain decreased significantly in the intervention group (δ −2.13; p=0.000), not significant at the control.
Syahri & Andriani, 2021	Comparing the effectiveness of sand pillows and cold packs on the size of the hematom.	40 patients after cardiac catheterization.	Cold Pack 20 Minutes.	2.5 kg sand pillow for 2 hours.	Cold packs are more effective at preventing hematoma, shorter pressing times, and more comfortable.
Al-Bayati & Al-Kassar, 2023	Assessing the effectiveness of direct cold compresses during arterial sheath release against post-PCI local vascular complications.	90 Post-PCI Patients	Cold compresses directly during the release of the sheath until hemostasis is achieved.	Routine nursing care without cold compresses (45 vs 45).	The incidence of local vascular complications (hematoma, bleeding, and ecchymosis) was significantly lower in the intervention group compared to the control group.
Sokhanvar et al., 2023	To assess the effect of ice bag application on pain and vital signs in acute myocardial infarction patients undergoing PCI.	60 Amina Patients Post-Pci	Application of an ice bag at the catheter insertion site after the procedure.	Standard care without ice bags (30 vs 30).	The intervention group showed a significant decrease in pain scores and most vital signs (p < 0.05), with no difference in heart rate.
Al-Zuhairi &	Evaluating the	100 PCI	A cold gel bag is	Standard Care	Post-intervention pain

Abed, 2024	effect of cryotherapy on pain after arterial sheath release.	Patients.	pressed for 20 minutes on the sheath area.	(50 Vs 50).	was significantly lower in the cryotherapy group (p=0.000).
Pamuk & Özkaraman, 2024	Evaluating the effect of cold sand compresses on pain and vascular complications after percutaneous coronary intervention.	210 Post-Pci Patients	A 5 kg (±18.9°C) cold sand compress is applied for 20 minutes after the procedure.	5 kg (±24.1°C) non-cold sand compress (105 vs 105).	Bleeding was lower at the 2nd, 3rd, and 12th hours in the cold compress group (p < 0.05). Bruise diameter and pain score were significantly lower up to 24 hours post-PCI compared to the control group.
Prado et al., 2025	Evaluate the safety of cooling of transradial puncture sites with *cryoband* protocols.	100 patients with diagnostic PCI.	Cooling of the forearm using *cryoband*.	No Comparison Groups.	Hemostasis is effective, minimal pain (90% score 0), low vascular complications, with no serious side effects.
Evinta & Oktarina, 2025	Assessing the effect of *cold packs* on pain and post-PCI hematomas.	2 Post-PCI patients radial access.	*Cold pack* 20 minutes (5–20°C).	No Comparison Groups.	The pain decreases until there is no pain and the hematoma decreases.
Patil et al., 2025	Assessing the effectiveness of cryotherapy in preventing post-PCI hematoma.	70 PCI Patients.	Compress the ice 10 minute interval after the release of the sheath.	Hospital Standard Protocols.	The incidence of hematoma was significantly lower in the cryotherapy group (p=0.0003).
Mohamed et al., 2025	To assess the effect of the application of cold compress-based nursing guidelines on local vascular outcomes after primary PCI.	150 Primary Post-Pci Patients	Implementation of nursing guidelines that include the use of cold compresses in the area of vascular access.	There are no explicit control groups.	There was a significant decrease in the incidence of hematoma (p = 0.014), pain at the insertion site (p = 0.001), and bleeding (p = 0.016). The length of hospitalization at CCU was shorter in the intervention group (p = 0.001).

Percutaneous Coronary Intervention (PCI) with transradial access is increasingly used because it provides an advantage in the form of a reduced risk of vascular complications compared to the femoral approach (Lee & Cho, 2018). However, pain at the insertion site, risk of local bleeding, and hematoma formation are still often encountered after the procedure (Ismiati, 2022). This condition can affect patient comfort and potentially prolong recovery time and length of treatment. Therefore, safe and effective nonpharmacological interventions are needed to support pain management and post-transradial PCI hemostasis.

Cryotherapy is a therapeutic intervention that uses cold temperatures to cause physiological effects in the form of local vasoconstriction, decreased conduction of nerve impulses, and suppression of inflammatory responses (Garcia et al., 2021). This effect plays an important role in reducing pain perception and restricting local blood flow, thus supporting the hemostasis process (Ptaszek et al., 2023). In clinical practice, *cryotherapy* is applied in various forms, such as cold packs, ice packs, or special cooling devices placed on the vascular insertion area after PCI (Kordani et al., 2018).

The results of *this systematic literature review* show that *cryotherapy* is effective and proven to reduce pain intensity and support hemostasis by controlling bleeding and hematoma *after PCI transradial access*. The majority of the studies analyzed reported a statistically significant reduction in pain (p <0.05), this proves the effectiveness of *cryotherapy* compared to standard treatment. In addition, most studies also showed improvements in hemostasis parameters, although the degree of significance varied between studies.

On the transradial approach, specific evidence is still relatively limited, but the findings show promising results of effectiveness. A study by Prado et al. (2025) showed that the effectiveness of the cryoband protocol in cooling the transradial puncture site with effective hemostasis results, minimal pain (90% score 0), and a low incidence of vascular complications. These findings are in line with the report of Evinta & Oktarina (2025) which showed that the application *of cold packs* in post-PCI transradial patients was able to reduce pain to incomprehensible and reduce hematoma, thereby improving patient comfort.

Most of the evidence in this study comes from research with a femoral approach, which consistently supports the effectiveness of *cryotherapy* in the management of pain and vascular complications (Çürük et al., 2017; Sokhanvar et al., 2025; Mohamed et al., 2025; Pamuk & Özkaraman, 2024). Research by Bayındır et al. (2017), Shimaa (2016), Kurt & Kaşıkçı (2019) as well as al-Bayati & Al-Kassar (2023) showed that the effectiveness of cold or ice compress application in significantly lowering pain (P < 0.001 to P < 0.05) post-catheter removal and reducing the size of the hematoma. Although the femoral approach has a higher risk of bleeding than the transradial, the *mechanism of action of cryotherapy* underlying the effect remains relevant to be applied to radial access.

From the aspect of hemostasis, several studies have shown that *cryotherapy* has been shown to be effective in lowering post-PCI bleeding with a consistent success rate against the incidence of hematoma. Ginanjar et al. (2018) reported no significant difference in bleeding, but there was a significant decrease in hematomas in the intervention group. Meanwhile, Valikhani et al. (2020) found a significant decrease in bleeding in the group receiving a combination of ice and sandbags, although the decrease in the incidence of hematoma was not statistically significant. This difference shows the influence of methodological factors and patient characteristics on the results of the study.

The effectiveness *of cryotherapy* is also influenced by various clinical factors, such as the duration and frequency of application, the cold temperature used, suppression techniques, and the physiological condition of the patient. Patil et al. (2025) showed that body mass index and the use of antiplatelet drugs have a significant relationship with the formation of hematoma, indicating that *cryotherapy* should be applied taking into account the patient's individual risk profile to obtain optimal outcomes.

In nursing, *cryotherapy* is a relatively simple, low-cost, and minimally risk-free standalone intervention. Studies by Al-Zuhairi & Abed (2024) and Wicaksono et al. (2020) prove the effectiveness of *cryotherapy* in significantly lowering pain and improving patient comfort during the *post-PCI transradial access treatment phase*. These findings reinforce the role of nurses in the application of evidence-based practices for pain management and prevention of vascular complications following cardiovascular invasive actions.

Thus, the findings in this study conclude that *cryotherapy* has proven to be effective as a nonpharmacological intervention in reducing pain and supporting post-PCI hemostasis, including in the transradial approach. Although most of the evidence comes from the femoral approach, the effectiveness of *the cryotherapy* mechanism demonstrates the relevance of its application to radial access, while still taking into account the need for more focused and standardized follow-up research.

Conclusion

This literature review shows that *cryotherapy* has consistently been shown to be effective in reducing pain intensity and supporting post-PCI hemostasis in a transradial approach. The majority of studies reported a statistically significant reduction in pain (P < 0.05), proving effectiveness accompanied by a reduction in bleeding as well as hematoma size, although the degree of significance varied between studies. These findings indicate that it proves a significant and proven clinical role in post-PCI care. The implications of the findings prove that *cryotherapy* is a safe, proven effective, and low-cost non-pharmacological nursing intervention to improve patient comfort, speed up the recovery process, and potentially lower the risk of vascular complications after invasive cardiology, particularly in evidence-based clinical practice.

However, although the results of this study prove the effectiveness of *cryotherapy*, there are some limitations that need to be considered. First, most of the studies analyzed still focused on the femoral approach, so the evidence of specific effectiveness for patients after *PCI transradial access* is relatively limited and requires further studies. Second, there is a heterogeneity in the study design, sample size, type and duration *of cryotherapy*, and outcome indicators used, which limits the ability to make generalizations and direct comparisons between studies. In addition, some studies did not strictly control confounding factors such as antiplatelet use, body mass index, and suppression techniques. Therefore, further research is recommended to use a randomized controlled trial design with standardized *cryotherapy* protocols, focusing on transradial access, and comprehensively considering the patient's clinical factors to strengthen the scientific evidence and support the development of more specific clinical practice guidelines.

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