



EFFECTIVENESS OF COLD COMPRESS IN PREVENTING HEMATOMA IN POST PERCUTANEOUS CORONARY INTERVENTION (PCI) PATIENTS: A SYSTEMATIC LITERATURE REVIEW

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ABSTRACT

Percutaneous Coronary Intervention (PCI) is currently indicated for patients experiencing acute coronary syndrome and individuals with chronic stable angina that is refractory to optimal medical therapy. Advancements in devices, stent design, adjunctive technology, and the development of more potent and effective antiplatelet therapies have contributed to improved outcomes. However, major periprocedural complications during PCI remain a concern, with an overall translunar access site complication rate of 41%, a vasospasm incidence of 7%, and a hematoma occurrence of 29%. Cold compress application is widely used due to its physiological effects, including vasoconstriction, reduced tissue metabolism, increased blood viscosity, and local anesthetic properties. Cold compresses can decrease blood flow and capillary permeability by inducing arteriolar vasoconstriction, thereby reducing bleeding. Objective: This study aims to examine the implementation of cold compress therapy in preventing hematoma in post-Percutaneous Coronary Intervention (PCI) patients. Methods: This study employs a systematic literature review approach. Data synthesis was conducted by analyzing eight studies that met quality assessment standards and inclusion-exclusion criteria. The databases used for literature retrieval included Google Scholar, PubMed, ScienceDirect, EBSCO, and ProQuest. The findings were processed and presented in tabular form. Result: Cold compresses can help reduce hematoma and pain after a Percutaneous coronary Intervention (PCI), cold compresses can also help prevent hematomas. How cold compresses help cold compresses vasoconstrict blood vessels and cold compresses speed up blood clotting. Conclusion: The reviewed articles indicate that the application of an ice pack or cold compress is more effective in reducing pain and preventing hematoma caused by catheter removal in patients undergoing Percutaneous Coronary Intervention (PCI).

Keywords: hematoma; ice pack; percutaneous coronary intervention (PCI)

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INTRODUCTION

The prevalence of cardiovascular disease in Indonesia remains high. Cardiovascular diseases are the leading cause of death worldwide, accounting for nearly one-third of global mortality. According to the World Health Organization (WHO), heart disease is one of the major cardiovascular conditions and a leading cause of cardiovascular-related deaths. In Indonesia, heart disease ranks as the second most common cause of mortality. Beyond its role as a primary cause of death, heart disease also significantly impacts patients, families, and the healthcare system. In 2023, Indonesia's Social Security Administering Agency for Health (BPJS Kesehatan) reported that heart disease had the highest healthcare expenditure, amounting to IDR 17.62 trillion across 20 million cases (Badan Pusat Statistik, 2024) Acute Coronary Syndrome (ACS) is a life-threatening cardiac condition associated with a sudden decrease in blood flow to the heart. Patients with ST-Elevation Myocardial Infarction (STEMI) should undergo cardiac catheterization within 90 minutes of arriving at the

emergency department (ED) or receive thrombolytic therapy within 30 minutes if treated at a facility without PCI capabilities. The goal is to reopen completely occluded arteries and limit infarct size. Patients with coronary artery disease typically undergo elective cardiac catheterization during hospitalization to diagnose and assess disease severity, without requiring primary PCI. Guidelines recommend catheterization within 12 to 72 hours of hospital admission, with PCI performed if indicated. Depending on findings and patient factors, some individuals receive medical therapy, while others are referred for coronary artery bypass grafting (CABG) surgery (Wu et al., 2023)

Percutaneous Coronary Intervention (PCI) is currently indicated for patients with coronary artery disease. Advances in device technology, stent design, adjunctive techniques, and the development of more potent and effective antiplatelet therapies, coupled with the rapid execution of PCI, have improved procedural safety. However, major periprocedural complications remain a concern. These complications involve access site issues, coronary ostia intubation difficulties, and procedural interventions themselves. Potential complications during PCI include coronary perforation, sudden vessel closure (SVC), stent deformation, embolization, and rotational atherectomy burr entrapment (Giannini et al., 2018) Bleeding complications at the access site following cardiac catheterization via transfemoral, transulnar, or transradial access are possible. Ulnar access is associated with significant complications that can lead to permanent functional morbidity in the hand. Overall, access site complications occur in 13% of cases, with vasospasm occurring in 8% and local bleeding in 5%. Conversely, transulnar access exhibits a higher overall complication rate of 41%, with vasospasm occurring in 7% and hematoma in 29%. Patients experiencing post-PCI pain and discomfort require close observation, and some may necessitate overnight hospitalization for further monitoring (Grasso et al., 2024)

Post-PCI hematoma can lead to various complications, including prolonged bleeding and oozing at the access site, causing patient discomfort and delaying recovery. Additionally, hematoma formation may create an environment conducive to bacterial growth, increasing the risk of access site infections, which can progress to cellulitis or systemic infection if left untreated (Kaur & Singh, 2024) According to Lu et al (2024), the use of cold compresses can also help reduce anxiety by stimulating the vagus nerve, signaling the body to relax. Cold compresses are not only effective in alleviating anxiety but also in reducing insomnia, respiratory issues, and gastrointestinal problems. Cold compress application is widely utilized due to its physiological effects, such as vasoconstriction, reduced tissue metabolism, increased blood viscosity, and local anaesthesia. Cold compresses can reduce blood flow and capillary permeability by inducing arteriolar vasoconstriction, thereby minimizing bleeding. Furthermore, they slow blood flow, enhance viscosity, and promote coagulation. This study aims to examine the implementation of cold compress therapy in preventing hematoma in post-Percutaneous Coronary Intervention (PCI) patients.

METHOD

Search Strategy

This study adopts a systematic literature review (SLR) approach, a research methodology designed to collect and evaluate studies related to a specific research focus. The review process includes defining a search strategy, selecting studies based on quality assessment and eligibility criteria, and performing data synthesis and extraction. Keywords and Boolean operators used in the literature search include: "ice pack" OR "ice bag" OR "Percutaneous Coronary Intervention (PCI)" AND "hematoma" OR "bleeding" OR "cardiac catheterization."

Information Sources

The databases used for literature retrieval in this study include Google Scholar, PubMed, ScienceDirect, EBSCO, and ProQuest.

Eligibility Criteria

The eligibility criteria comprise inclusion and exclusion parameters. The inclusion criteria include articles published in English and Indonesian, articles published between 2014 and 2024, and articles using Randomized Controlled Trials (RCTs) and Experimental Research methods. The exclusion criteria include articles that do not clearly present the literature and research methodology and meta-analysis articles. Additionally, to narrow the research scope, the PICO (Population/Problem, Intervention, Comparison, Outcomes) framework is applied, as shown in the following table.

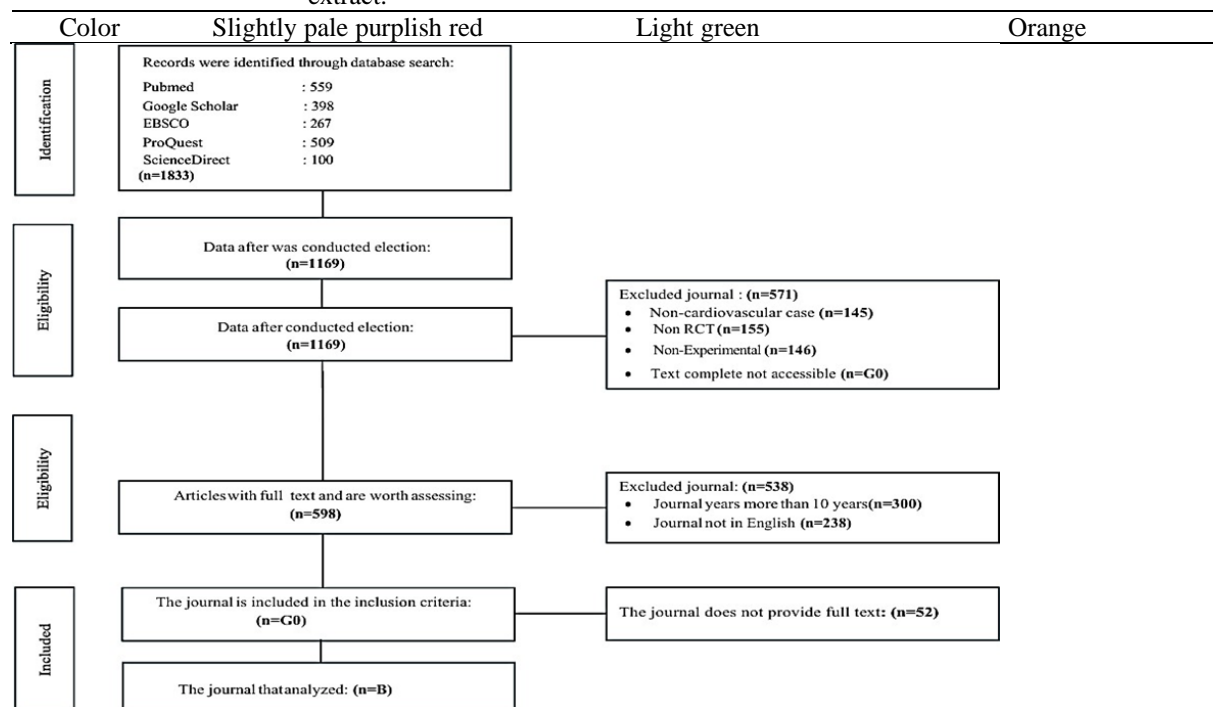
RESULT

Results

Characteristic of Rainbow Meatball Formulation

Table 1.
Characteristic of Rainbow Meatball

Indicator	Formulation		
	Formula 1 (meatball + beetroot extract)	Formula 2 (meatball + pokcoy + broccoli extract)	Formula 3 (meatball + carrot extract)
Taste	The distinctive taste of savory beef meatballs with a slight bitter sensation after eating	Savory beef meatballs with a hint of vegetable bitterness and languor.	Savory beef meatballs with a hint of carrot sweetness
Texture	Chewy and soft	Chewy and soft	Chewy and soft
Aroma	Savory aroma of beef meatballs	Savory aroma of beef meatballs	Savory aroma of beef meatballs
Appearance	Round in shape with a slight rough texture on the surface with a color according to the characteristics of beet fruit extract.	Round in shape with a slight rough texture on the surface with a color characteristic of pakcoy and broccoli extracts	Round in shape with a slight rough texture on the surface with a color characteristic of carrot extracts



RESULT

**Table 1.
Article Analysis**

No.	Database	Authors, Country, Year	Article Title	Journal Title	Aim	Design	Sample	Results
1.	PubMed	(Pamuk & Özkaraman, 2024) Turkey	Florence Nightingale Journal of Nursing	The Effect of Cold Sand Pack on Percutaneous Coronary Intervention-Induced Vascular Complications and Pain: A Randomized Controlled Trial	To examine the effect of cold compress application on vascular complications and pain in patients undergoing PCI	A Randomized Controlled Trial	Patients registered for PCI in the hospital between 30 November 2021 and 3 April 2022	The application of a cold compress during the first 20 minutes prevented bleeding, reduced ecchymosis diameter, and decreased pain intensity.
2.	Google Scholar	(Sokhanvar et al., 2023) Iran	The Open Nursing Journal	Effect of Ice Bag Application to Femoral Region on Pain and Vital signs in Patients with Acute Myocardial Infarction Undergoing Percutaneous	To investigate the effect of ice bag application on the femoral region on pain and vital signs in coronary heart disease patients undergoing PCI	A Randomized Controlled Trial	The study sample consisted of 60 coronary heart disease patients, with 30 patients assigned to the intervention group and 30 to the control group using a	The application of an ice bag to the femoral region was effective in stabilizing vital signs and reducing pain caused by femoral catheter removal in myocardial

DISCUSSION

Invasive interventions are currently widely used for the treatment of patients with coronary heart disease; however, these methods pose risks of complications that require nursing interventions. Typically, the femoral artery sheath is removed, and hemostasis following percutaneous coronary intervention (PCI) is achieved through manual compression using sterile gauze for 15–20 minutes, followed by continuous pressure with a bandage for 10 hours, and ambulation after 6 hours. To reduce the occurrence of vascular complications, patients must remain on bed rest for an extended period, which can be uncomfortable for both patients and healthcare providers (Park et al., 2022)The adverse effects of PCI range from painful hematomas that resolve spontaneously to life- threatening retroperitoneal bleeding. Hematomas may occur if access is gained too distally (relative to the inguinal fold). Bleeding is the most common non-cardiac complication among patients undergoing PCI. Variations in post-PCI bleeding are associated with the access site (radial versus femoral), the operator's skill level, and the administration of antiplatelet and anticoagulant medications (Heidary Moghadam et al., 2024)

A study (Zaki et al., 2020), hematoma is also one of the side effects of enoxaparin use, and cooling it provides therapeutic benefits. The administration of Enoxaparin in a cold state at the subcutaneous injection site can help control bleeding and induce vasoconstriction in the arterioles. Additionally, the application of cold alleviates acute pain by producing a local anesthetic effect at the injection site.The selection of vascular access sites for puncture plays a crucial role in preventing access site-related bleeding and vascular complications such as hematoma. To mitigate hematoma complications, fluoroscopy and ultrasonography or micro-puncture techniques can be employed. Additionally, the use of vascular closure devices is highly recommended to reduce bleeding and hematoma formation, particularly in large-bore access sites (Galli et al., 2022)Hematoma at the access site has been observed in 6.9% of cases. The use of larger sheaths and catheters (6F) significantly contributes to hematoma

formation. Small hematomas that do not extend to the forearm can generally be managed conservatively. Loose compression bandages, gentle limb elevation, and close observation may be sufficient in most cases. Larger or expanding hematomas require monitoring. Applying pressure bandages around the forearm is typically highly effective, and additional pressure can be applied using an inflated blood pressure cuff on the upper arm or forearm (Garg et al., 2019)

Currently, the sandbag method remains in use to control vascular complications following PCI. However, studies have demonstrated that sandbag application causes increased pain and discomfort, making it less tolerable for patients. An alternative method for preventing vascular complications is the application of cold compresses. The use of sandbags and cold compresses in patients with femoral hematomas following cardiac catheterization has been shown to reduce hematoma risk. Cold compress application is a far more effective approach, as it significantly reduces hematoma formation and size (Baqal & Mahmood, 2022) Cold compress application controls bleeding by reducing capillary blood flow and permeability through arteriolar vasoconstriction. Furthermore, it enhances blood clotting by decreasing blood flow velocity and increasing viscosity. Consequently, the progression of bleeding, ecchymosis, and hematoma formation is mitigated. These findings align with previous research by Kurt and Kaşıkçı (2019), Bayindir et al. (2017), and Çürük et al. (2017). Kurt and Kaşıkçı (2019) reported that pain was reduced in PCI patients at the catheter insertion site compared to the control group. According to Bayindir et al. (2017), post-procedural pain decreased after the application of a cold compress in PCI patients, both during and after femoral catheter removal.

Research on practices that prevent vascular complications post-PCI is considered beneficial. The effects of a 15-minute cold compress application on the femoral artery region following catheter removal were evaluated in PCI patients. The study determined that cold application reduced hematoma, ecchymosis, and post-sheath removal pain. Several studies evaluating bleeding after femoral arterial catheter removal have reported that bleeding primarily manifests as minor hemorrhaging. The use of cold compresses reduces the occurrence of skin discoloration at the catheter entry site. Hematoma formation is another complication that can cause post-PCI pain. Additionally, the application of a cold compress for two minutes at the injection site following subcutaneous heparin administration has been shown to effectively reduce hematoma and ecchymosis. These findings confirm that cold compress application prevents ecchymosis formation (Kurt & Kaşıkçı, 2019) A study by Qiao et al., (2025), the study group that used a specialized semiconductor cooling device to maintain a stable forearm surface temperature of 10°C to 15°C experienced greater cooling compared to the body's natural surface temperature when using ice. This study demonstrated that patients in the research group experienced a reduction in pain levels and an increase in comfort during hematoma compression therapy. Cold compress application controls bleeding through arteriolar vasoconstriction and enhances the coagulation process. Cold compresses are a cost-effective and simple non-pharmacological technique to reduce the side effects of heparin administration. Additionally, when tissues are exposed to cold, blood flow is initially restricted due to sympathetic vasoconstriction. Conversely, prolonged exposure to cold induces a secondary protective vasodilatory effect (Mohammady & Sadeghi, 2020)

A study by Al-Bayati & Al-Kassar, (2023) found that the use of a cold pack is a non-pharmacological method that promotes coagulation by inducing vasoconstriction. Their findings indicate that direct application of a cold compress during femoral artery sheath removal effectively reduces local vascular complications, including hematoma, bleeding, and ecchymosis. Cold compresses the coagulation process by inducing vasoconstriction, which

reduces blood flow and increases blood viscosity. The use of cold compresses to stabilize the arterial sheath in patients after cardiac catheterization can help reduce the occurrence of hematoma, bleeding, and ecchymosis. Additionally, cold compresses can inhibit small-diameter nerve fibers from transmitting pain stimuli (Kareem & Hamza, 2023). Following PCI, nurses must evaluate the puncture site for bleeding and hematoma formation. They must ensure that dressings remain clean, dry, and properly positioned, assess the temperature, color, and sensation of the affected limb, and document all patient responses. When evaluating arterial pulses, nurses should be vigilant for the "5 Ps" syndrome, which includes pain, pallor, pulselessness, paresthesia, and paralysis. Any abnormalities in these indicators suggest ischemia and should be immediately reported to a physician. Furthermore, nurses must provide comprehensive patient education upon discharge, advising patients to avoid strenuous activity in the affected limb, refrain from applying heat to the wound, and avoid twisting towels for at least 30 days post-PCI (Zhi et al., 2024). Based on the results of several studies, it can be concluded that the application of local cold compresses is effective in managing lower back pain, hematoma, and vascular complications in patients undergoing coronary angiography. Therefore, cold compresses can be used as a safe intervention that provides comfort for patients undergoing angiography. (Ebrahimi-Shalmani et al., 2020)

CONCLUSION

Hematoma is one of the complications observed in patients following Percutaneous Coronary Intervention (PCI). A review of the relevant literature has led to the conclusion that applying a cold compress or ice for 15 minutes, in conjunction with sandbag application, has a positive effect in reducing vascular complications. Certain vascular complications can be either prevented or minimized. Evaluations conducted at the 15-minute mark, the fourth hour, and on the second and third days post-procedure indicate that the frequency and size of hematomas, ecchymosis, and pain at the femoral artery puncture site significantly decreased. Additionally, hematomas and ecchymosis that developed following cold compress application were found to be smaller in size.

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