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LIMB-RAISING INTERVENTION TO MANAGE PAIN AND IMPROVE POST-PCI PATIENT COMFORT IN INTENSIVE CARE UNIT

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ABSTRACT

Acute coronary syndrome is a circulatory emergency resulting from reduced oxygen supply to the coronary arteries and may lead to myocardial infarction. However, evidence regarding non-pharmacological nursing interventions remains limited, indicating a significant gap in clinical and nursing knowledge. **Objective:** This case report aimed to analyze nursing care using the case study method and limb-raising intervention. **Methods:** Treatment was carried out for 3 days on a patient (61 years old) with a perioperative medical diagnosis of MI-NSTEMI and received post-treatment in the ICU. Revascularization with PCI is necessary in some high-risk ACS cases. The problem of pain and comfort is one of the main nursing problems for patients. Untreated pain can reduce the quality of care, disrupt hemodynamics, and increase hospital length of stay. The limb-raising intervention was applied to the patient by elevating the hand 30^{o} in the area of the stab wound and compression. **Results:** Hemodynamic parameters, such as blood pressure, pulse frequency, oxygen saturation, and body temperature, were always stable. The patient often experienced tachypnea during treatment. The patient's pain scale during treatment was measured using NRS. **Discussion:** Limb-raising can reduce pain because elevation and immobilization at the puncture site lower the nociceptor threshold. **Conclusion:** The limb-raising intervention successfully reduced pain at the post-PCI puncture site from moderate pain (4/10) to no pain (0/10). Other findings included the absence of swelling and the patient's greater comfort with the method used.

Keywords: Acute Coronary Syndrome, Comfort, Pain, Percutaneous Coronary Intervention

BACKGROUND

Acute Coronary Syndrome (ACS) is a potentially life-threatening condition associated with acute myocardial ischemia and infarction caused by a sudden decrease in coronary blood flow or an increase in myocardial demand that exceeds perfusion (Giugliano & Braunwald, 2019). ACS occurs due to a sudden cessation of coronary blood flow, disrupting perfusion to the myocardium. The most common cause of ACS is atherosclerosis, namely plaque blocking the coronary arteries and a lack of oxygen to meet myocardial needs without the obstructing plaque (De Lemos, Newby, & Mills, 2019). Risk factors for ACS that cannot be modified include family history of coronary heart disease, age (over 45 years), male gender, and ethnicity. Modifiable risk factors include hypertension (30.9%), diabetes mellitus (19%), dyslipidemia (19%), cigarette consumption (11.9%), and obesity (9.5%) (Suling, Patricia, & Suling, 2018).

ACS encompasses a spectrum of acute ischemic heart conditions, including ST-segment elevation myocardial infarction (STEMI), non-ST-segment elevation myocardial infarction (NSTEMI), and unstable angina (UA). ACS is characterized by a sudden reduction in coronary

blood flow leading to myocardial ischemia and potential myocardial injury. Chest discomfort, typically substernal and possibly radiating to the arms, neck, or jaw, is the most frequent presenting symptom, though patients may also experience dyspnea, nausea, diaphoresis, or other atypical symptoms. The clinical diagnosis of ACS is established through a combination of thorough history taking, physical examination, electrocardiography (ECG) to differentiate STEMI from non-ST-elevation ACS (NSTE-ACS), and measurement of cardiac biomarkers such as troponin. Coronary angiography may be further employed to assess for obstructive coronary artery disease and guide management (Rao et al., 2025).

Myocardial infarction, defined as irreversible myocardial tissue necrosis due to sustained imbalance between oxygen supply and demand, represents a life-threatening condition with significant impact on cardiac function and systemic physiology if not promptly treated. In ACS, therapeutic goals include the prompt relief of ischemia, limitation of infarct size, preservation of left ventricular function, and reduction of mortality risk. Contemporary ACS management incorporates early risk stratification and initiation of evidence-based pharmacotherapy, including dual antiplatelet therapy, anticoagulation, and high-intensity statins, as well as supportive care such as judicious oxygen supplementation for hypoxemia and symptom relief. Reperfusion strategies remain essential: *primary percutaneous coronary intervention (PCI)* is preferred where available, with procedural approaches optimized to minimize complications, and complete revascularization considered based on coronary anatomy and clinical risk. Coronary artery bypass grafting (CABG) is indicated in selected patients with complex coronary disease or anatomy unsuitable for PCI. Echocardiography is routinely used to assess left ventricular function and identify complications, while intensive monitoring supports timely detection and management of hemodynamic instability and arrhythmias (Rao et al., 2025).

PCI is an option in the management of acute coronary syndrome to increase myocardial perfusion without undergoing cardiac bypass surgery (CABG). The PCI procedure begins with inflating a balloon inside the coronary artery (percutaneous transluminal coronary angioplasty), followed by one or more stents (Khan & Ludman, 2022). Percutaneous arterial puncture is usually performed on the radial or femoral artery. The PCI procedure also uses anticoagulants and antiplatelets, so bleeding at the radial access site is the main risk after cardiac catheterization. The access site is usually pressed for about six hours to stop bleeding from the radial puncture site (Zhang, Yang, & Wang, 2016). In addition, the procedure can also increase anxiety, pain at the puncture site, swelling, numbness, hematoma, and ecchymosis.

PCI transradial is a procedure performed through the radial artery using an invasive tool, such as a guiding wire, to access the coronary arteries. One of the most commonly reported complications following catheterization is pain at the transradial access site (Van Leeuwen et al., 2015). Transradial access for PCI left persistent effects >30 days in 11% of patients. The most common persistent complaint was pain (43%) (Van Leeuwen et al., 2015).

Pain is an unpleasant sensory and emotional experience associated with actual or potential tissue damage (Ignatavicius et al., 2018). Tissue damage from puncture or compression stimulates receptors to initiate a pain response. Pain receptors include mechanical nociceptors, thermal nociceptors, and polymodal nociceptors. Mechanical nociceptors respond to tissue damage from sharp objects, punctures, or pinches. The

physiology of pain involves four processes: transduction, transmission, modulation, and perception. Transduction occurs when afferent nerves translate a puncture at the radial site into nociceptive impulses. Transmission follows, where impulses travel through the dorsal horn of the spinal cord to the brain. Modulation involves inhibitory processes mediated by descending nerves that strengthen or inhibit nociceptive signals in the dorsal horn. The final process is pain perception, which is influenced by psychological aspects and individual characteristics (Bahrudin, 2017).

The implementation of an interventional limb-raising management strategy (ILRMS) could significantly reduce finger pain scores and swelling in the fingers and improve patient comfort (Zhang, Yang, & Wang, 2016). The ability of nurses to provide post-transradial PCI nursing care is needed to minimize complications. The incidence of upper extremity complaints after transradial access is still reported in clinical practice. Approximately 20% of patients experience such complaints, with persistent symptoms (>30 days) in 11% and temporary symptoms (<30 days) in 9%. The most common complaint is pain (43%), followed by other symptoms (26%), tingling (10%), numbness (7%), stiffness (7%), and decreased muscle strength (7%) (Van Leeuwen et al., 2015).

Another study from Adiana et al. (2023) provides empirical evidence that limb-raising significantly reduces pain in patients following percutaneous coronary intervention (PCI). Statistical analysis demonstrated a significant decrease in pain scores in the intervention group after limb-raising ($p = 0.023$), whereas no significant change was observed in the control group. Furthermore, comparison between groups revealed a significantly lower mean pain score in the limb-raising group than in the control group (mean difference = –1.063; $p = 0.035$). These results confirm that limb-raising is an effective non-pharmacological nursing intervention for pain management in post-PCI patients, particularly those undergoing radial artery access.

ACS NSTEMI and type 2 myocardial infarction that occurs perioperatively (intraoperatively and postoperatively) is an interesting matter in the management of ACS. If early identification is delayed (day 3-5 post-surgery), it can increase the risk of death by 30%-70% (Landesberg et al., 2009). Based on these factors, the author is interested in discussing nursing care for these patients and analyzing the application of ILRMS to manage post-PCI pain and discomfort.

METHODS

1. Patient Information

On April 12, 2024, there was one patient who came to the emergency room with an indication for pro laparotomy anterior resection to Hartmann and received post-op treatment in the ICU on April 13, 2024. Intraoperatively, there was ST-segment elevation on ECG (Lead II, III, and aVF). However, there were no complications during intraoperative, bleeding of 100 mL without transfusion, and the rectosigmoid tumor tissue was sent to the Pathology-Anatomy (PA) laboratory. The patient was intubated and had an NGT, post-op laparotomy wound, a stoma in the right abdomen, and a drain in the left abdomen. Patient level of consciousness was under influence of drugs, GCS E4M6Vett, with Icunes 0.4mcg/kg/h. BPS 4/12 (painless or mild pain), Ramsay score 2/6 (awake and cooperative). Based on this, the post-op patient was instructed to have a repeat ECG and troponin check. Based on a serial ECG examination carried out on April 13, 2024, post-op laparotomy, the ECG showed sinus tachycardia with abnormal T waves. On April 14, 2024, the cardiac troponin T level

was 198 ng/L (reference value <50 ng/L). In collaboration with a cardiologist, the patient was diagnosed with NSTEMI-ACS dd/ MI Type 2. The patient was extubated and received oxygen therapy with a 5 lpm nasal cannula. In this situation, the patient's level of consciousness was compos mentis with GCS E4M6V5. The patient complained of chest pain score 2-3/10 with NRS. The patient was managed with anti-ischemia and plaque stabilizer therapy such as Nitrocaf 2x2.5mg, Bisoprolol 1x2.5mg, and Rosuvastatin 1x20mg. Double antiplatelet Aspilet 1x80mg and Clopidogrel 1x75mg are not given in loading doses but are given in maintenance doses because the patient is on the first day post-op.

The patient underwent serial EKG on April 15, 2024, which revealed sinus rhythm with T-wave inversion in V2, V3, V4, V5, V6, I, II, and aVF, indicating ischemia in the anterolateral and inferior regions of the heart. The patient underwent an echocardiogram with a result of LVEF 61%. On April 18 2024, the patient underwent PCI with radial access. Coronary angiography results on April 18, 2024, showed: (1) LM: normal; (2) LAD: 60% stenosis in the mid-segment; (3) LCX: 95% stenosis in the proximal OM1; (4) RCA: normal. PCI was performed on OM1 with recanalization of the LCA using a JL 6 Fr guiding catheter; wiring was done to the distal OM1, predilection was performed with a Ruby balloon 2.0x15mm up to 10 atm, and then stented with an Evrocross 2.5x30mm stent up to 12 atm. The final result showed TIMI flow 3.

Post PCI, the patient experienced pain and discomfort at the puncture site due to TR band compression, requiring nursing interventions, including limb-raising and regular monitoring. Based on an assessment conducted on April 17, 2024, several nursing problems were identified, including ineffective airway clearance related to post intubation as evidenced by excessive mucus and cough, acute pain related to surgical incision, chest pain, and puncture site post PCI as evidenced by verbal report of pain rated 4/10 on the NRS for puncture site post PCI and guarding behavior, risk of decreased cardiac output related to coronary artery disease as evidenced by intra-operative ST elevation, and Troponin T 198ng/L, risk of bleeding and risk of infection related to major abdominal surgery and puncture site post PCI (Tim Pokja SDKI DPP PPNI, 2016). The nursing diagnosis prioritizes acute pain, and limb-raising is used as an intervention to alleviate pain and enhance patient comfort.

2. Therapeutic Intervention

The patient was given implementation to treat acute pain which aims to monitor the characteristics and scale of post-operative pain and PCI procedures. Apart from that, patients are also facilitated to rest and sleep. The patient was taught to control pain using non-pharmacological pain techniques, namely deep breathing relaxation techniques to deal with post-laparotomy pain on the day before. After the PCI procedure, the patient received limb-raising intervention on the right radial; it was performed without other techniques on the day of implementation. The analgesic given to the patient was Paracetamol 3x1gr IV.

ILRMS was implemented after the patient underwent PCI on April 18, 2024. The ILRMS procedure involved placing a triangular pad at a 30° angle cushioned with a blanket to support the arm used for the PCI puncture site (Figure 1). The patient used the pad for 2 hours post-PCI (Figure 2) and continued for an additional 15 hours. Monitoring during the intervention included assessing comfort levels, pain at the wrist using an NRS, finger swelling, and oxygen saturation in the treated arm. The protocol of ILRMS was getting approval ethics from RSUI with number S-125/KETLIT/RSUI/VIII/2024.

3. Monitoring Results

Pain monitoring was carried out using the number rating scale (NRS). No chest pain was reported, last felt on April 15, 2024. The patient had minimal complaints; he was unable to explain his chest pain complaints, just said the level is 2-3/10 with NRS. Currently, pain is felt in the post-laparotomy and drain wounds, such as stabbing or cutting around the wound, with an NRS of 2/10 felt when the patient coughs. Throughout monitoring, the patient complained of pain on a scale of 2/10 or a low scale.

After PCI on April 18, 2024, monitoring pre-treatment of limb-raising at 17:30 PM, the patient was still using the TR band and reported pain at the wrist, rated 4/10 on the NRS, indicating moderate pain with the characteristic stabbing pain in the area, feeling sore around the wrist, getting worse when moved. The index finger swelling measured 6.7 cm, and oxygen saturation (SaO2) was 98% room air as measured on the patient's index finger. The current comfort level was slightly uncomfortable. During the treatment at 20:30, the TR band at the patient's wrist was removed and replaced with gauze wrapped with Hypafix. The patient reported wrist pain rated 4/10 on the NRS, indicating moderate pain. Index finger swelling remained at 6.7 cm, and SaO2 was 98% room air as measured on the patient's index finger. The current comfort level was comfortable with the presence of the gauze padding. Post-treatment on April 19, 2024, at 08:30 AM, the patient's wrist was still wrapped with gauze and Hypafix. The patient reported no wrist pain (NRS 0/10), indicating the absence of pain. Index finger swelling remained at 6.7 cm, and SaO2 was 98% room air as measured on the patient's index finger. The current comfort level was comfortable with the presence of the gauze padding. During ILRMS intervention, pain was also controlled with Paracetamol analgesics 3x1gr IV, administered at 08.00, 16.00, and 24.00. The monitoring was described in Graph 1.

Additionally, post-angiography monitoring was conducted specifically at the right radial access site from April 18, 2024, at 16:10 PM until April 19, 2024, at 03:40 AM. The monitoring results indicated strong palpable pulsation, no hematoma, a sensation and movement similar to before the procedure, no bleeding, warm skin temperature, red skin color, and capillary refill time (CRT) ≤ 2 seconds.

DISCUSSION

Perioperative myocardial infarction (PMI) is an uncommon and life-threatening event. In a study conducted on 9 million patients aged >45 years who underwent non-cardiac surgery, the incidence of PMI reached 0.9%-11% or higher in patients who were at higher risk (Smilowitz et al., 2018). The patient is 61 years old with a history of uncontrolled hypertension and smoking for more than 30 years, one and a half packs a day (Brinkman index: 30x24 = 720/heavy smoker) based on this, patient has a high risk of acute coronary syndrome, namely factors that cannot be modified include age (over 45 years), and male gender. Modifiable risk factors in patients are hypertension (30.9%) and cigarette consumption (11.9%) (Suling, Patricia, & Suling, 2018). Other causes of ACS that occur in patients are increased stressors and an imbalance in the myocardial need to pump blood due to major abdominal surgery that the patient underwent. Physiological and emotional stress activates the sympathetic nerves system, leading to hemodynamic changes, coronary vasoconstriction, and increased prothrombotic activity that can cause plaque disruption (Landesberg et al., 2009).

Revascularization with Early PCI was carried out on April 18, 2024 at 15.00. The

CAG/PCI procedure was performed via arterial access in the patient or via a right radial puncture. Percutaneous radial access was chosen compared to femoral access because it is lower in complications such as bleeding, difficulty mobilizing post-PCI, and vascular complications, and increases patient comfort, and mortality rates (Mason et al., 2018).

ILRMS is a technique used to position the right radial access site specifically for PCI procedures. This technique aims to address vascular complications at the puncture site, such as pain and swelling, and to enhance patient comfort. The ILRMS procedure for the patient involved providing a triangular pad angled at 30°, cushioned with a blanket, to support the arm at the PCI puncture site. The pad was crafted from cardboard and manually measured with a protractor to ensure patients received appropriate support in accordance with the guidelines for limb-raising implementation.

The pain scale at the wrist during pretreatment was rated 4/10 on the NRS, indicating moderate pain. After three hours (intra-treatment), limb-raising was performed, the patient's pain scale remained unchanged at rated 4/10 on the NRS, indicating persistent moderate pain. Besides that, analgesic PCT 1gr IV was given 30 minutes before this intervention. Based on observations, one factor influencing the pain, in addition to the limb-raising intervention at the puncture site, was the gradual deflation of the patient's TR band within the first 4 hours, followed by the replacement of the bandage with gauze and Hypafix. Additionally, research by Cheng, Chair, & Choi (2013) found that peak post-PCI pain occurs within the first three hours after intervention. Further evaluation was conducted post-treatment, during which the author assessed the patient 15 hours after receiving limb-raising intervention. After 15 hours, the patient's pain scale decreased to 0/10 on the NRS, indicating no pain. This evaluation was carried out before administering analgesic Paracetamol 1gr IV at 08.00 AM. Based on these findings, ILRMS proved effective in reducing pain scale at the PCI puncture site experienced by the patient alongside the administration of analgesic. This is consistent with the study conducted by Zhang, Yang, & Wang (2016) and Adiana et al. (2023), which showed that limb-raising effectively reduces the pain scale at the access puncture site within 6 hours post-PCI intervention.

Post-PCI limb-raising can reduce pain because elevation and immobilization at the puncture site lower the nociceptor threshold (Zhang, Yang, & Wang, 2016). This decrease in the nociceptor threshold is due to the reduced release of bradykinin and prostaglandins, which can increase cell sensitivity to pain (Adiana et al., 2023). Bradykinin is released from plasma and breaks down around blood vessels in injured areas, such as around the wrist. When bradykinin acts on peripheral nerve receptors, it increases pain stimuli. Additionally, bradykinin's action on cells triggers a cascade that releases prostaglandins, which can heighten cellular sensitivity (Bahrudin, 2017).

The pain mechanism is mediated by sensory neurons and responded to by motor neurons. Connections or synapses to pain occur in the spinal cord and central nervous system (CNS). Pain nerve receptors, called nociceptors which are sensitive to pain (noxious stimuli) and provide an immediate response when stimulated. Nociceptors are located at the ends of small afferent neurons and are present in all body tissues, except the brain. Nociceptors are most abundant in the skin and muscles. Pain occurs when biological, mechanical, thermal, electrical, or chemical factors stimulate nociceptor activity in the spinal cord. The sensation caused depends on the intensity and duration of the stimulus (LeMone et al., 2017).

Pain is a complex neurophysiological process involving transduction, transmission, modulation, and perception (Bahrudin, 2017). In post-PCI patients, particularly those with radial artery access, tissue injury at the puncture site activates nociceptors, converting mechanical stimuli into nociceptive impulses transmitted through A-delta and C fibers (LeMone et al., 2017). Modulation occurs at the spinal level through endogenous opioid receptors and descending inhibitory pathways that regulate pain intensity.

In this intervention, we also consider finger swelling as an important factor. Index finger swelling, as an indicator of swelling, was measured on the same patient's index finger using a measuring tape, revealing no increase in size at 6.7 cm during pre-, intra-, and post-treatment periods. Post-PCI, the puncture site is scrutinized due to wire access compression, increased movement of intravascular fluid into the interstitial space, and migration of white blood cells to the injured area. Swelling begins with blood flow changes due to injury, causing blood vessels to dilate, increasing blood flow to surrounding tissues and creating redness and increased permeability, allowing fluid, proteins, and white blood cells to move from circulation to damaged tissue sites (Adiana et al., 2023).

Limb-raising intervention at the puncture site and compression enhances venous return, reducing fluid accumulation in tissues and interstitial spaces, thereby reducing swelling (Adiana et al., 2023). Additionally, elevating the hand can reduce oedema in the distal extremities (Miller, Jerosch-Herold, & Shepstone, 2017). Furthermore, SaO2 levels in the same finger showed oxygen saturation at 98% during pre-, intra-, and post-treatment, indicating no arterial blood supply disturbances to the patient's fingers, making this procedure safe to perform (Zhang, Yang, & Wang, 2016). Another aspect evaluated was patient comfort. During pretreatment, the patient initially felt slight discomfort at the puncture site. After three hours, the patient began to feel comfortable with the pad support position, and this condition persisted post-treatment. This finding aligns with Zhang, Yang, & Wang (2016), which states that limb-raising enhances patient comfort post-PCI.

Limitation noted by the author in performing limb-raising was that the application started only two hours post-PCI and that evaluation needed to be conducted precisely six hours after limb-raising on the patient, which may affect some outcomes. Nevertheless, implementing limb-raising for patient post-PCI provided benefits to reducing pain, preventing finger swelling, and enhancing patient comfort.

Another limitation is that the interventions carried out to overcome acute pain are not limited to non-pharmacological limb-raising techniques. Patients are also given paracetamol 3x1gr IV pain relief therapy. So, it cannot be said that pure limb-raising interventions can overcome acute pain experienced by patients. All interventions provided are pain management nursing care. However, this collaboration has a good impact and makes nursing problems can be solved immediately.

CONCLUSIONS

Patients who have undergone PCI often experience pain, discomfort, and swelling in the fingers. In this particular case, the patient was diagnosed with NSTEMI-ACS dd/ MI Type 2 and needed PCI. Coronary angiography revealed 60% stenosis in the mid-segment of LAD and 95% stenosis in the LCX. Before treatment, the patient reported wrist pain rated at 4/10 on the NRS, indicating moderate pain and leading to the nursing diagnosis of "Acute Pain." The patient's NRS scores before, during, and after the ILRMS showed that

the intervention was effective to the patient alongside with the administration of analgesic. Nurses' role in providing non-pharmacological techniques and ensuring patient comfort is crucial, as pain perception can significantly impact the care provided to the patient.

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Figure 1. Pad Intervention
(personal documentation)

Figure 2. The intervention
of limb-raising on the patient
(personal documentation)