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CASE REPORT

Application of Nursing Cold Therapy Intervention to Reduce Pain in Pneumothorax Patients

Aplicación de la terapia de frío de enfermería para reducir el dolor en pacientes con neumotórax

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ABSTRACT

Introduction: pneumothorax patients commonly experience acute chest pain due to increased intrathoracic pressure, which significantly impacts their quality of life. Cold pack therapy has emerged as a promising non-pharmacological intervention for pain management.
Objective: to evaluate the effectiveness of cold pack therapy in reducing pain intensity among pneumothorax patients.
Method: a descriptive case study was conducted involving two pneumothorax patients at Padang Pariaman Regional General Hospital. Cold packs (5-10°C) were applied to the affected chest area for 10-15 minutes, three times daily for three consecutive days. Pain intensity was assessed using Visual Analogue Scale (VAS) before and after each intervention.
Results: patient 1 (45-year-old male) showed pain reduction from scale 4 to 2 (50 % reduction), while Patient 2 (51-year-old female) demonstrated pain reduction from scale 6 to 3 (50 % reduction) over the three-day period. Both patients maintained stable vital signs with no adverse reactions.
Conclusions: cold pack therapy effectively reduced pain intensity in pneumothorax patients, supporting its use as a safe, cost-effective non-pharmacological intervention complementary to standard medical care.

Keywords: Pneumothorax; Cold Pack Therapy; Pain Management; Non-Pharmacological Intervention; Nursing Care.

RESUMEN

Introducción: los pacientes con neumotórax comúnmente experimentan dolor torácico agudo debido al aumento de la presión intratorácica, lo que impacta significativamente su calidad de vida. La terapia con compresas frías ha surgido como una intervención no farmacológica prometedora para el manejo del dolor.
Objetivo: evaluar la efectividad de la terapia con compresas frías en la reducción de la intensidad del dolor en pacientes con neumotórax.
Método: se realizó un estudio de caso descriptivo con dos pacientes con neumotórax en el Hospital General Regional de Padang Pariaman. Se aplicaron compresas frías (5-10°C) en el área torácica afectada durante 10-15 minutos, tres veces al día durante tres días consecutivos. La intensidad del dolor se evaluó usando la Escala Visual Analógica (EVA) antes y después de cada intervención.

Resultados: el Paciente 1 (hombre de 45 años) mostró reducción del dolor de escala 4 a 2 (50 % de reducción), mientras que el Paciente 2 (mujer de 51 años) demostró reducción del dolor de escala 6 a 3 (50 % de reducción) durante el período de tres días. Ambos pacientes mantuvieron signos vitales estables sin reacciones adversas. **Conclusiones:** la terapia con compresas frías redujo efectivamente la intensidad del dolor en pacientes con neumotórax, apoyando su uso como una intervención no farmacológica segura y costo-efectiva complementaria a la atención médica estándar.

Palabras clave: Neumotórax; Terapia con Compresa Fría; Manejo del Dolor; Intervención No Farmacológica; Cuidados de Enfermería.

INTRODUCTION

Pneumothorax is a serious medical condition characterized by the accumulation of air in the pleural cavity, leading to lung collapse and compromising respiratory function. This condition requires immediate medical intervention to restore normal lung function and alleviate associated symptoms. Patients with pneumothorax commonly experience various complications including edema, acute pain, limited mobility, dyspnea, and increased risk of infection, all of which significantly impact their quality of life and recovery process.[1]

According to the Indonesian Health Profile data from 2016, transportation accidents accounted for 47,7 % of disaster incidents in 2020, compared to 84 % in 2015 and 74 % in 2021.[2] Data from the Indonesian Ministry of Health in 2018 revealed that approximately 8 million people experienced pneumothorax.[1] Further analysis by the Indonesian Ministry of Health team indicated that 25 % of pneumothorax patients died, 45 % experienced physical complications, 15 % suffered psychological distress including anxiety and depression, while only 10 % recovered completely.[1,2,3,4,5] The World Health Organization (WHO) reported that traffic accidents reached 120,222 incidents (72 %) annually in 2018, highlighting the significant burden of trauma-related pneumothorax cases.

Pain represents one of the most prominent and distressing symptoms experienced by pneumothorax patients. It is defined as a sensory and emotional experience associated with actual or potential tissue damage, characterized by sudden or gradual onset.[3] Pneumothorax-related pain is typically described as sharp, stabbing, or moderate to severe in intensity.[4] The pathophysiology of pneumothorax pain involves increased intrathoracic pressure, which interferes with normal respiratory mechanics and causes lung collapse. This pressure elevation occurs when air enters the pleural cavity but cannot be expelled, disrupting normal breathing patterns and preventing effective oxygen absorption, ultimately resulting in severe chest pain and dyspnea.

Pain management in pneumothorax patients can be approached through pharmacological and non-pharmacological interventions. Non-pharmacological techniques include relaxation methods, massage therapy, compress application, music therapy, recitation therapy, distraction techniques, and guided imagery.[4,5] These non-pharmacological approaches represent independent nursing interventions that can effectively reduce patient-reported pain levels. Among these interventions, cold therapy has emerged as a particularly promising technique due to its accessibility, safety profile, and proven efficacy in clinical settings.[6,7,8]

Cold compress therapy, specifically using cold packs, has demonstrated significant effectiveness in managing acute pain across various clinical conditions. Cold packs offer several advantages over traditional ice applications, including longer duration of therapeutic effect, reusability, and consistent temperature maintenance. The physiological mechanism of cold therapy involves vasoconstriction, reduced inflammatory response, decreased nerve conduction velocity, and localized analgesic effects.[9,10] Research has shown that cold compress therapy can effectively reduce pain intensity when applied for 10-15 minutes at temperatures between 5-10°C.

Previous studies have provided substantial evidence supporting the effectiveness of cold therapy in pneumothorax management. A study conducted in South Sumatra Province demonstrated that combining cold compresses with deep breathing relaxation techniques significantly reduced pain intensity in pneumothorax patients.[11] Similarly, research at Sleman Regional Hospital in Yogyakarta confirmed that deep breathing relaxation techniques could effectively reduce post-operative pain in pneumothorax patients.[12] Additional research in Bengkulu Hospital showed significant pain reduction following deep breathing relaxation therapy in post-caesarean section patients.[6]

The gate control theory provides a theoretical framework for understanding cold therapy's analgesic effects. According to this theory, cold application activates inhibitory neurons that prevent nociceptive signals from reaching the brain, effectively "closing the pain gate." This mechanism, combined with cold therapy's anti-inflammatory properties, makes it an ideal non-pharmacological intervention for pneumothorax patients.[13,14]

Despite the growing body of evidence supporting cold therapy's effectiveness, there remains a need for systematic evaluation of its application in pneumothorax patients. Understanding the optimal implementation protocols, patient selection criteria, and outcome measures is essential for establishing evidence-based nursing

care standards. Therefore, the primary objective of this study is to evaluate the effectiveness of cold pack therapy in reducing pain intensity among pneumothorax patients. Specifically, this research aims to assess the baseline pain levels in pneumothorax patients before cold pack intervention, implement standardized cold pack therapy protocols, measure changes in pain intensity following cold pack application, and determine the optimal duration and frequency of cold pack therapy for maximum pain reduction in pneumothorax patients.

METHOD

This study employed a descriptive case study design using a nursing process approach to evaluate the effectiveness of cold pack therapy in reducing pain intensity among pneumothorax patients. The descriptive methodology was selected to provide detailed documentation of patient responses to cold pack intervention and to establish baseline data for future experimental studies. The study was conducted at Padang Pariaman Regional General Hospital, West Sumatra, Indonesia, involving two pneumothorax patients who were selected using purposive sampling based on predetermined inclusion criteria.

The inclusion criteria for this study encompassed patients diagnosed with pneumothorax, aged 18-65 years, experiencing moderate to severe pain with pain scale 4-8 on Visual Analogue Scale, hemodynamically stable, able to communicate effectively, and who provided informed consent. Exclusion criteria included patients with contraindications to cold therapy, skin conditions at the application site, severe cardiovascular complications, cognitive impairment preventing accurate pain assessment, and concurrent use of topical analgesics.

This study was conducted in accordance with the Declaration of Helsinki and approved by the Institutional Review Board of Padang Pariaman Regional General Hospital. Written informed consent was obtained from all participants after explaining the study procedures, potential risks, and benefits. Patient confidentiality was maintained throughout the study, and participants were informed of their right to withdraw from the study at any time without affecting their medical care.

The data collection utilized multiple instruments to ensure comprehensive assessment. The Visual Analogue Scale (VAS) was used to measure pain intensity, consisting of a 10-cm horizontal line with anchors of “no pain” (0) and “worst possible pain” (10). Patients were asked to mark their pain level on the line, and measurements were taken using a ruler for precise scoring. A standardized assessment form was developed to collect demographic data, medical history, pneumothorax characteristics, and baseline vital signs. Additionally, a structured observation form was used to document patient responses during cold pack application, including vital signs, pain behaviors, and any adverse reactions.

The cold pack intervention protocol employed commercial cold packs that were gel-based and pre-cooled to 5-10°C in a medical-grade freezer. Each cold pack was wrapped in a thin towel to prevent direct skin contact and potential cold injury. The application procedure involved positioning patients comfortably in semi-Fowler’s position, assessing the chest area for skin integrity and sensation, applying the prepared cold pack to the affected chest area for 10-15 minutes duration, with applications performed three times daily for three consecutive days while continuously monitoring for adverse reactions and comfort levels.

Data collection procedure included baseline assessment on Day 0 involving demographic data collection, medical history documentation, initial pain assessment using VAS, and baseline vital signs measurement. Daily assessments during Days 1-3 included pre-intervention pain assessment, cold pack application according to protocol, immediate post-intervention pain assessment conducted 0-5 minutes after removal, vital signs monitoring, and documentation of patient responses and adverse events.

Descriptive statistics were used to analyze patient characteristics and pain scores. Pain intensity changes were calculated as the difference between pre- and post-intervention VAS scores. Data were presented as means, standard deviations, and percentage changes. Given the case study design and small sample size, inferential statistics were not applied. The study variables included cold pack therapy intervention as the independent variable, pain intensity measured by VAS score as the dependent variable, and age, gender, pneumothorax severity, concurrent medications, and time since pneumothorax onset as confounding variables.

To ensure data quality and reliability, standardized protocols were followed for all procedures, multiple pain assessments were conducted by the same trained nurse, cold pack temperatures were verified before each application, patient safety was monitored continuously during interventions, and data were double-checked for accuracy and completeness. This study has several limitations including small sample size, lack of control group, potential observer bias, and limited generalizability due to single-center design. Future research should consider randomized controlled trials with larger sample sizes to establish definitive evidence for cold pack therapy effectiveness in pneumothorax patients.

RESULTS

Patient Characteristics

This case study involved two pneumothorax patients treated at Padang Pariaman Regional General Hospital. Patient 1 was a 45-year-old male diagnosed with pneumothorax, while Patient 2 was a 51-year-old female

diagnosed with dextra pneumothorax. Both patients met the inclusion criteria and provided informed consent for participation in the study.

Pain Assessment Results

Patient 1 (45-year-old male with pneumothorax):

The initial pain assessment revealed that the patient experienced pain during breathing. Using the PQRST pain assessment method, the following findings were documented: P (Provocation/Palliation) - pain increased with movement and decreased when remaining still; Q (Quality) - patient described the pain as stabbing; R (Region/Radiation) - patient reported pain in the right chest area; S (Severity) - patient rated pain scale as 4 on the Visual Analogue Scale; T (Timing) - patient stated the pain occurred intermittently, lasting approximately 5 minutes per episode, with visible facial grimacing during pain episodes.

Patient 2 (51-year-old female with dextra pneumothorax):

The pain assessment showed similar characteristics: P (Provocation/Palliation) - pain increased with movement and decreased with rest; Q (Quality) - patient described the pain as stabbing; R (Region/Radiation) - patient reported pain in the right chest area; S (Severity) - patient rated pain scale as 6 on the Visual Analogue Scale; T (Timing) - patient stated the pain occurred intermittently, lasting approximately 5 minutes per episode, with visible facial grimacing during pain episodes.

Nursing Diagnoses

Based on the comprehensive assessment data, the following nursing diagnoses were established for both patients:

1. Acute pain related to physical injuring agent
2. Impaired physical mobility related to respiratory problems (pneumothorax)

Cold Pack Therapy Implementation and Results

Patient 1 Results:

- Day 1 (Baseline): Pain scale 4
- Day 2 (After first cold pack application): Pain scale reduced to 3
- Day 3 (After second cold pack application): Pain scale further reduced to 2

Patient 2 Results:

- Day 1 (Baseline): Pain scale 6
- Day 2 (After first cold pack application): Pain scale reduced to 5
- Day 3 (After second cold pack application): Pain scale further reduced to 3

Treatment Response and Patient Compliance

Both patients demonstrated excellent compliance with the cold pack therapy protocol. The supporting factor during the application of cold pack therapy was that both patients consistently followed the research instructions, enabling maximum effectiveness of the cold pack application in reducing their pain scales. No adverse reactions or complications were observed during the three-day treatment period.

Vital Signs and Safety Monitoring

Throughout the intervention period, both patients maintained stable vital signs. Continuous monitoring revealed no adverse effects from cold pack application. Skin integrity was preserved at all application sites, and no signs of cold injury were observed.

Overall Treatment Outcomes

The results demonstrated a consistent pattern of pain reduction in both patients over the three-day intervention period. Patient 1 showed a 50 % reduction in pain scale (from 4 to 2), while Patient 2 showed a 50 % reduction in pain scale (from 6 to 3). Both patients reported improved comfort levels and better ability to perform breathing exercises following cold pack therapy.

DISCUSSION

Effectiveness of Cold Pack Therapy

The results of this case study demonstrate that cold pack therapy was effective in reducing pain intensity in both pneumothorax patients. The consistent reduction in pain scales over the three-day treatment period supports the therapeutic value of this non-pharmacological intervention. By providing cold pack therapy, patients were able to overcome their pain through multiple physiological mechanisms. Cold pack application

reduces body temperature, prevents widespread inflammation, reduces congestion, reduces local bleeding, and provides pain relief in localized areas.[15]

The mechanisms by which cold pack therapy increases the pain threshold include decreased nerve conduction, decreased muscle spasms, and prevention of edema after injury.[16] In this study, we implemented these mechanisms on both patients by applying cold packs for 10-15 minutes at temperatures between 5-10°C, three times daily.[17] The analgesic effect of cold therapy can be explained by the gate control theory, where the application of cold activates inhibitory neurons that prevent nociceptive neurons from transmitting pain signals to the brain, thus cold compresses can close the pain gate.[18] This theoretical framework was practically applied to both patients, resulting in measurable pain reduction.

Patient Characteristics and Pain Response

The analysis of patient characteristics showed that both patients were adults (45 and 51 years old), which aligns with the typical demographic for pneumothorax cases. Age plays an important role in pain perception and expression. The explanation of age-related pain perception provides context for understanding why both patients, despite different baseline pain levels, responded positively to cold pack therapy. Pain intensity related to age is often influenced by misperceptions, unstable emotions, prejudice, and defensive attitudes, which can cause individuals to mask the actual pain sensation they experience.

An study[19] regarding characteristics related to pain levels in pneumothorax patients found that adults comprised the highest number of respondents (38,1 %), followed by teenagers (33,3 %) and elderly patients (28,6 %). This supports our patient demographics, where both subjects fell within the adult age range most susceptible to pneumothorax and associated pain.

Gender Differences in Pain Response

The inclusion of both male and female patients in this study provided insights into gender-related pain responses. Gender characteristics play a special role in responding to pain and should be considered in nursing assessments as a guide for formulating nursing care. Our male patient (Patient 1) had a lower baseline pain score (4) compared to the female patient (Patient 2) with a score of 6, which is consistent with literature suggesting that gender differences may influence pain perception and reporting.

According to previous research, gender differences showing that women experience more pain than men can be influenced by several factors: men may have lower sensitivity than women or feel less pain, and women may be less tolerant of painful stimuli than men. However, both patients in our study showed similar response patterns to cold pack therapy, suggesting that the intervention's effectiveness transcends gender differences.

Comparison with Previous Research

The results of this study are consistent with previous research demonstrating the effectiveness of cold therapy in pain management. Research by Mujahidin et al.[20] on the combination of cold compresses and deep breathing relaxation techniques showed significant pain reduction in pneumothorax patients in South Sumatra Province, supporting our findings. Similarly, research at Sleman Regional Hospital in Yogyakarta confirmed that relaxation techniques could effectively reduce post-operative pain in pneumothorax patients.

Research by Suryani et al.[21] also obtained similar results, showing that cold compress therapy administered for 3 days successfully reduced pain in pneumothorax patients. This aligns with our three-day protocol and observed outcomes. The consistency of results across different studies strengthens the evidence base for cold pack therapy in pneumothorax pain management.

Clinical Significance and Practical Applications

One of the clinical manifestations of pneumothorax is pain, which affects nerve fibers and causes discomfort. Pneumothorax patients experience sharp, stabbing pain due to pressure on sensory nerves.[22,23] Our study demonstrated that cold pack therapy effectively addresses this pain mechanism through its analgesic properties. The decrease in pain intensity experienced by both patients aligns with Price & Wilson's theory that cold therapy not only reduces muscle spasms but also provides analgesic effects by slowing nerve conduction speed, resulting in fewer pain impulses reaching the brain.

The practical application of cold pack therapy offers several advantages for clinical practice. It is an easy, simple, and cost-effective therapy that can be used as a complement to pharmacological interventions.[24,25,26] The therapy requires minimal equipment and can be safely administered by nurses with appropriate training. Good collaboration between patients and healthcare providers, particularly nurses, minimizes nursing problems in pneumothorax patients and improves the provision of more effective and efficient nursing care.[27,28,29,30]

Limitations and Future Research Directions

This case study presents several limitations that should be acknowledged. The small sample size of two

patients limits the generalizability of findings. The lack of a control group prevents definitive conclusions about the superiority of cold pack therapy over other interventions or no treatment. Additionally, the study's single-center design may limit external validity.

Future research should consider conducting randomized controlled trials with larger sample sizes to establish definitive evidence for cold pack therapy effectiveness in pneumothorax patients. Longitudinal studies examining the long-term effects of cold pack therapy and its impact on overall recovery outcomes would provide valuable insights for clinical practice.

Implications for Nursing Practice

The findings of this study have important implications for nursing practice in pneumothorax management. Cold pack therapy can be incorporated into standard nursing care protocols as a safe, effective, and evidence-based intervention for pain management. The results support the use of cold pack therapy as a non-pharmacological approach that can reduce reliance on analgesic medications and their associated side effects.

Healthcare workers can utilize cold compress therapy as a complementary intervention to reduce pain intensity in pneumothorax patients. The standardized protocol developed in this study provides a framework for implementation in clinical settings. Socialization and training of nurses regarding pain reduction therapy using cold packs is essential for widespread adoption and optimal patient outcomes.

Patient and Family Role

The success of cold pack therapy also depends on patient compliance and family support. Both patients in this study demonstrated excellent adherence to the treatment protocol, which contributed to the positive outcomes. Family support plays a crucial role in motivating patients to comply with treatment and can significantly influence recovery outcomes. The family's role includes providing motivation, education, and nursing support during the treatment period.

Cost-Effectiveness and Resource Utilization

Cold pack therapy offers a cost-effective alternative to more expensive pain management interventions. The therapy requires minimal resources while providing significant therapeutic benefits. This makes it particularly valuable in resource-limited settings where access to pharmacological pain management may be restricted. The reusability of cold packs and the simple application procedure make this intervention economically viable for healthcare institutions.

In conclusion, this case study demonstrates that cold pack therapy is an effective, safe, and practical intervention for reducing pain intensity in pneumothorax patients. The consistent pain reduction observed in both patients over the three-day treatment period supports the integration of cold pack therapy into standard nursing care protocols for pneumothorax management.

CONCLUSIONS

This case study provides evidence that cold pack therapy is an effective non-pharmacological intervention for reducing pain intensity in pneumothorax patients. The systematic application of cold packs at 5-10°C for 10-15 minutes, administered three times daily over three consecutive days, resulted in a consistent 50 % reduction in pain scores for both patients studied. The intervention demonstrated excellent safety profiles with no adverse reactions observed and maintained hemodynamic stability throughout the treatment period. The findings support the integration of cold pack therapy into standard nursing care protocols for pneumothorax management as a complementary approach to pharmacological pain management. This intervention offers several clinical advantages including cost-effectiveness, ease of application, reusability, and minimal resource requirements, making it particularly valuable in diverse healthcare settings.

The theoretical framework provided by the gate control theory adequately explains the analgesic mechanisms of cold therapy, where cold application activates inhibitory neurons that prevent nociceptive signals from reaching the brain. This mechanism, combined with the anti-inflammatory and vasoconstrictor effects of cold therapy, provides a comprehensive approach to pain management in pneumothorax patients. However, the limitations of this study, including the small sample size and lack of control group, necessitate further research through randomized controlled trials with larger populations to establish definitive evidence for widespread clinical implementation. Future studies should also examine optimal timing, duration, and frequency of cold pack applications to maximize therapeutic outcomes.

Healthcare institutions should consider implementing standardized protocols for cold pack therapy in pneumothorax care, supported by appropriate staff training and patient education programs. The positive patient compliance observed in this study suggests that cold pack therapy is well-accepted by patients and can be effectively integrated into routine nursing care practices.

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CONFLICT OF INTEREST

The authors declare that there is no conflict of interest.

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