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Nurse-Led Cold Compress Therapy to Mitigate Hemodialysis Cannulation Pain: A Descriptive Case Study

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Abstract:
Repeated arteriovenous fistula cannulation induces significant procedural pain in patients undergoing maintenance hemodialysis, necessitating effective, non-pharmacological pain management strategies. This study aimed to evaluate the efficacy of a simple, nurse-led cold compress therapy in reducing cannulation-related pain among patients with chronic kidney disease (CKD). A descriptive case study was conducted in a hospital hemodialysis unit between June and July 2025. Two adult male patients (aged 45 and 53 years) reporting procedural pain were enrolled. Pain intensity was assessed using the Numeric Rating Scale (NRS) at baseline and following two subsequent hemodialysis sessions. The intervention consisted of applying ice cubes enclosed in a rubber glove to the cannulation site for approximately 10 minutes prior to needle insertion. At baseline, patients reported moderate (NRS 6) and severe (NRS 7) pain, respectively. Following the second intervention session, pain scores decreased to 4 and 5. By the third session, pain further diminished to mild levels (NRS 2 and 3). Notably, no adverse cutaneous or systemic events were observed during the application. Pre-cannulation cold compress therapy represents a feasible, low-cost, and safe nurse-led intervention that progressively mitigates hemodialysis cannulation pain. Larger, randomized controlled trials are warranted to validate these preliminary findings, isolate the analgesic effect, and standardize optimal clinical application protocols.

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INTRODUCTION

Chronic kidney disease (CKD) represents an escalating global health burden, frequently progressing silently to irreversible end-stage renal disease that necessitates life-sustaining maintenance hemodialysis or kidney transplantation (Romagnani et al., 2025). Early evaluation, risk stratification, and proactive management of disease progression remain paramount clinical priorities to mitigate these severe outcomes (Maringhini & Zoccali, 2024). Kidney failure imposes a profound treatment burden that severely compromises long-term patient quality of life and places immense financial and operational strain on global healthcare systems (Ahmed et al., 2025; Manurung et al., 2026).

For patients requiring maintenance hemodialysis, vascular access is the absolute lifeline of their therapy, with the arteriovenous fistula universally recognized as a central component of safe and effective kidney replacement therapy (Besarab et al., 2024). The repeated needle cannulation required to maintain this access often becomes a distressing, unavoidable clinical experience (Duncanson et al., 2023). Cannulation-related pain is not merely a transient sensory signal; it is a

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complex, unpleasant sensory and emotional experience shaped by localized tissue injury, personal interpretation, and the clinical context, which can significantly increase patient anxiety, reduce overall comfort, and negatively affect long-term adherence to crucial hemodialysis sessions (Ozen et al., 2025a).

Cold therapy has emerged as a vital, non-pharmacological intervention routinely utilized by nurses to mitigate procedural cannulation distress (Kassim et al., 2022). The physiological rationale for this clinical approach remains well established in contemporary pain management literature (Kalantar-Zadeh et al., 2022). Localized cold stimulation effectively reduces peripheral nerve conduction velocity, produces a mild local anesthetic effect, and modulates pain transmission via the gate control mechanism before central nervous system interpretation of the noxious stimulus (Ong Sio et al., 2022).

Recent empirical evidence strongly supports the clinical relevance and efficacy of this non-pharmacological approach in nephrology care. For instance, a randomized crossover trial specifically examined the effects of acupressure and cryotherapy for fistula cannulation pain, demonstrating significant symptomatic relief for patients (Dehghan et al., 2023). Furthermore, a recent systematic review and network meta-analysis reported that several non-pharmacological methods, particularly cryotherapy when strategically paired with visual distraction, can substantially reduce cannulation-related pain in hemodialysis patients (Sharifnia et al., 2025).

Contemporary literature predominantly focuses on complex, multimodal interventions and expensive pharmacological alternatives for procedural pain management. This prevailing research priority leaves a distinct scarcity of descriptive data concerning the performance of simple, standalone cold applications over consecutive treatment sessions (Koushki et al., 2023). The current evidence base lacks comprehensive evaluations of these accessible techniques within resource-constrained regional healthcare settings, particularly public hospitals in developing nations.

This case study introduces a novel, highly accessible nursing intervention involving the standardized pre-cannulation application of a basic cold compress. The primary research novelty lies in systematically tracking progressive, session-by-session reductions in patient pain intensity. This methodology provides granular, real-world evidence of cumulative analgesic effects without requiring specialized medical equipment or pharmacological agents (Kesik et al., 2023).

This study aims to describe the changes in cannulation pain among patients with chronic kidney disease undergoing hemodialysis following the implementation of cold compress therapy. Modern nursing care for these patients demands simple, safe, and patient-centered strategies to adequately address holistic symptoms and physical comfort (Kartika & Rezkiki, 2025). Implementing such accessible interventions shifts clinical practice beyond a narrow focus on biochemical laboratory targets, genuinely improving the patient's lived experience and dignity during dialysis.

STUDY DESIGN

This manuscript was prepared as a case study following the structure recommended for case reports in the journal template and informed by the CARE reporting orientation for clinically focused case descriptions. The source data came from a nursing care case study conducted in the Hemodialysis Room of Menggala Regional General Hospital, Indonesia, in June-July 2025. Two adult patients with CKD undergoing hemodialysis were selected because both experienced acute pain during cannulation. Pain intensity was assessed using the Numeric Rating Scale (NRS), ranging from 0 (no pain) to 10 (the worst imaginable pain).

Data collection included patient assessment, observation of behavioral pain responses, NRS pain scoring, application of cold compress therapy, and post-repeated-session evaluation. The

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intervention was applied before cannulation during three hemodialysis encounters. The first encounter functioned as a baseline assessment before cold compress therapy, whereas the second and third encounters documented pain after cold compress application. The original study documented informed consent before the intervention. In this manuscript, all personal identifiers were removed, and initials replaced patient names.

PATIENT INFORMATION

Both patients were male adults diagnosed with CKD and receiving hemodialysis at the same unit. Both were married, Muslim, and had completed senior high school education. Neither patient reported a food or drug allergy in the available nursing assessment. The first patient had undergone hemodialysis for approximately two months. The second patient had undergone hemodialysis for approximately three months and reported a history of smoking since adolescence. The de-identified clinical profile is presented in Table 1.

Table 1. De-identified Clinical Characteristics of the Participants

Characteristic	Case 1	Case 2
Participant code	Mr. S	Mr. Y
Age (years)	45	53
Sex	Male	Male
Marital status	Married	Married
Educational level	Senior high school	Senior high school
Residence	Penawar	Indolampung
Duration of hemodialysis	Approximately 2 months	Approximately 3 months
Primary cannulation-related concern	Pain and discomfort during needle insertion	Pain and discomfort during needle insertion
Baseline NRS pain score	6 (moderate pain)	7 (severe pain)

*NRS = Numeric Rating Scale.

CLINICAL FINDINGS

At baseline, both patients reported pain during hemodialysis needle insertion. Case 1 reported a pain score of 6 on the NRS, categorized as moderate pain. The patient described an aching sensation during cannulation and showed observable pain behaviors, including grimacing and hissing. The available physical data indicated compos mentis consciousness, blood pressure of 170/80 mmHg, pulse of 80 beats per minute, respiratory rate of 20 breaths per minute, and body temperature of 37.6°C.

Case 2 reported a baseline pain score of 7 on the NRS, categorized as severe pain. The patient also described pain and aching during cannulation, showed grimacing and hissing, and initially had difficulty describing the pain clearly. The available physical data indicated compos mentis consciousness, blood pressure of 120/80 mmHg, pulse of 100 beats per minute, respiratory rate of 20 breaths per minute, and body temperature of 36.0°C. Both patients were clinically able to participate in the cold compress intervention and pain evaluation.

THERAPEUTIC INTERVENTION

The nursing intervention consisted of cold compress therapy applied shortly before hemodialysis cannulation. The required materials included a bowl, a rubber glove, ice cubes, and an underpad. After explaining the purpose of therapy and confirming patient agreement, the nurse

positioned the patient comfortably, prepared three to four ice cubes in a rubber glove, placed an underpad to protect the bed, and applied the cold compress to the area of cannulation-related pain for approximately 10 minutes before needle insertion. The compress was replaced if the ice melted before the target duration. After the intervention, the nurse tidied the equipment, reassessed the patient's response, and documented the pain score.

The intervention was repeated across two post-baseline hemodialysis encounters. Pain assessment was conducted consistently using the same NRS method. No adverse skin reaction, intolerance, or unexpected event was recorded in the available case documentation.

Follow-Up and Outcomes

The outcome of interest was the change in pain intensity during hemodialysis cannulation. Table 2 summarizes the pain scores across three encounters. In both cases, pain intensity decreased after cold compress therapy. Case 1 showed a reduction from NRS 6 at baseline to NRS 4 after the second encounter and NRS 2 after the third encounter. Case 2 showed a reduction from NRS 7 at baseline to NRS 5 after the second encounter and NRS 3 after the third encounter.

Table 2. Changes in NRS Pain Intensity Across Hemodialysis Cannulation Sessions

Case	Baseline (26 June 2025)	After Cold Compress (29 June 2025)	After Cold Compress (03 July 2025)	Overall Clinical Change
Case 1	6 (Moderate pain)	4 (Moderate pain)	2 (Mild pain)	Moderate to mild pain
Case 2	7 (Severe pain)	5 (Moderate pain)	3 (Mild pain)	Severe to mild pain

*Pain intensity was assessed using the Numeric Rating Scale (NRS; range 0–10).

The behavioral responses also improved. In Case 1, the patient no longer showed hissing and grimacing after the third application and only reported mild aching. In Case 2, pain behaviors also decreased, although mild aching and slight grimacing persisted at the third encounter. Both cases tolerated the intervention, and the third encounter showed clinically meaningful improvement, with pain shifting to the mild category.

Patient Perspective

The patient perspective was obtained from nurses' observational notes and verbal responses during the intervention. Both patients indicated that the cannulation experience became more tolerable after cold compress therapy. Case 1 appeared calmer and no longer showed marked pain behaviors by the third encounter. Case 2 became more able to describe the remaining discomfort and showed reduced visible distress. These responses suggest that pain reduction also improves communication between the patient and the nurse during cannulation.

DISCUSSION

This case study demonstrates a consistent and clinically relevant reduction in hemodialysis cannulation pain following repeated applications of cold compress therapy, successfully transitioning patients from moderate or severe baseline pain to mild pain. The trajectory of pain reduction observed across both patients underscores the potential of this intervention to transform a routinely distressing procedure into a more tolerable clinical experience. Although the sample size was inherently small, the direction and magnitude of the change hold significant clinical value, as repeated needle cannulation is an unavoidable and frequent component of maintenance hemodialysis care. A sustained reduction in pain intensity from severe or moderate to mild levels

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directly supports enhanced patient comfort, fosters greater cooperation during the procedure, and ultimately strengthens therapeutic trust between the patient and the healthcare team (Zheng et al., 2025).

The observed analgesic effects are biologically plausible, as localized cold stimulation effectively lowers tissue temperature, reduces peripheral nerve conduction velocity, induces vasoconstriction, and limits nociceptive transmission during needle insertion. This physiological mechanism aligns with the broader, well-established conceptualization of pain as a complex sensory and emotional experience that can be actively modulated by peripheral and contextual inputs. By temporarily numbing the superficial nerve endings and slowing the propagation of pain signals along A-delta and C fibers, the cold compress acts as a localized, non-pharmacological anesthetic. In the context of practical nursing care, this modality is particularly attractive because it is remarkably simple to administer, highly cost-effective, and, crucially, does not introduce any additional systemic medication burden to patients who are already managing complex, multidrug treatment regimens for chronic kidney disease (Torreggiani et al., 2022).

These findings align closely with recent clinical evidence evaluating cryotherapy for arteriovenous fistula cannulation, reinforcing the efficacy of non-pharmacological cold-based interventions in nephrology practice. Dehghan et al. (2023) similarly found that the application of cryotherapy, alongside acupressure, was significantly associated with a reduction in mild pain levels following intervention in hemodialysis patients. A more recent self-controlled study by Ozen et al. (2025b) provides additional empirical support for the use of cold-based approaches to specifically target and reduce arteriovenous fistula cannulation pain. The current case study mirrors these outcomes, demonstrating that even a rudimentary, standalone cold compress can yield measurable analgesic benefits comparable to those reported in more structured clinical trials, thereby validating the physiological utility of cold therapy in this specific patient population.

The results of this case study corroborate higher-level evidence indicating that cryotherapy, particularly when integrated with complementary non-pharmacological strategies, ranks among the most effective modalities for mitigating procedural pain in hemodialysis. At a higher level of evidence, a recent systematic review and network meta-analysis concluded that various non-pharmacological interventions can substantially reduce cannulation-related pain, with cryotherapy combined with visual distraction ranking among the most effective strategies (Sharifnia et al., 2025). While the present study did not employ multimodal techniques such as visual distraction, the isolated success of the cold compress suggests that cryotherapy is a foundational, highly effective component of pain management. This implies that adding simple contextual modifications to the cold application could amplify the analgesic effects observed in this study, paving the way for optimized, multimodal nursing protocols.

Translating these findings into clinical practice offers a highly feasible, low-cost bedside intervention that shifts the paradigm of hemodialysis nursing care toward holistic symptom management and enhanced patient experience. The intervention can be readily adopted as a standard component of pre-cannulation comfort care, which is especially critical in healthcare settings where topical anesthetic agents are unavailable, prohibitively costly, or not routinely covered by patient insurance. This study extends the traditional scope of nursing concern beyond mere procedural execution, supporting the contemporary view that hemodialysis nursing care must not focus exclusively on machine parameters and biochemical outcomes. It must actively prioritize symptom control, patient comfort, and the overall quality of the patient's lived experience during repeated, invasive procedures (Elias et al., 2025; Hadi et al., 2026).

Despite its simplicity and accessibility, cold compress therapy requires careful clinical judgment and strict adherence to safety protocols to ensure patient well-being is not inadvertently

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compromised. Nurses must comprehensively assess several critical factors prior to application, including the patient's baseline skin integrity, individual tolerance to cold temperatures, the condition of the vascular access, and adherence to stringent infection control measures aligned with local unit protocols. Cold therapy must not inadvertently delay the cannulation process or replace the essential clinical assessment of the vascular access. Nurses must remain vigilant to ensure that the numbing effect of the cold does not mask early signs of access complications, such as infiltration, localized infection, stenosis, or abnormal bleeding, which require immediate medical intervention (Gouda et al., 2023).

While the clinical relevance and feasibility of this intervention are evident, the study is constrained by several methodological limitations that necessitate a cautious and nuanced interpretation of the findings. Foremost among these limitations is the exceptionally small sample size of only two cases, which inherently limits the generalizability of the results to the broader, highly diverse population of hemodialysis patients. The descriptive case study design lacked a control group, meaning there was no comparative baseline of patients receiving standard care without the cold compress. The ongoing repercussions of the COVID-19 pandemic also significantly limited patient recruitment and the broader implementation of the study, further constraining the scope and statistical power of the observational data collected.

The absence of a control group precludes definitively isolating the physiological analgesic effects of the cold compress from potential confounding variables inherent to the clinical environment. For example, the observed reduction in pain scores over three consecutive sessions could be partially attributed to patient habituation and psychological adaptation to repeated cannulation, rather than the cold therapy alone. The therapeutic nurse-patient relationship increased psychological reassurance, and the placebo effect associated with receiving a novel, attentive intervention may have independently contributed to the lowered pain reports (Camedda et al., 2023). While the findings are highly promising, they should be interpreted strictly as preliminary clinical observations that highlight a need for larger, randomized controlled trials to establish definitive evidence of effectiveness.

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CONCLUSION

This case study demonstrates that pre-cannulation cold compress therapy is a feasible, cost-effective, and well-tolerated non-pharmacological intervention capable of reducing hemodialysis cannulation pain from moderate or severe to mild levels. Hemodialysis nurses can integrate this accessible, bedside strategy into routine pre-procedural comfort care, provided that rigorous assessments of skin integrity, vascular access condition, and adherence to institutional safety protocols are strictly observed to mitigate potential risks. To definitively establish its efficacy, optimize clinical guidelines, and isolate its analgesic effects from contextual variables, future research must transition from descriptive observations to robust, randomized controlled trials featuring larger, diverse cohorts, standardized cryotherapy application protocols, and comprehensive longitudinal outcome measurements.

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CONFLICT OF INTEREST

The authors declare no financial or non-financial conflict of interest related to this manuscript.

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