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Dr. Aisha Nur Halim
Faculty of Health Sciences, Department of Nursing and Clinical Practice, Seri Kembangan Medical College, Selangor, Malaysia

Dr. Farah Zulaikha Ahmad
Faculty of Health Sciences, Department of Nursing and Clinical Practice, Seri Kembangan Medical College, Selangor, Malaysia

Dr. Hana Sofiya Razak
Faculty of Health Sciences, Department of Nursing and Clinical Practice, Seri Kembangan Medical College, Selangor, Malaysia

Corresponding Author:
Dr. Aisha Nur Halim
Faculty of Health Sciences, Department of Nursing and Clinical Practice, Seri Kembangan Medical College, Selangor, Malaysia

Effectiveness of warm compress application in reducing IV cannulation pain among adult patients

Aisha Nur Halim, Farah Zulaikha Ahmad and Hana Sofiya Razak

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Abstract
Pain during intravenous (IV) cannulation is one of the most frequently reported discomforts among adult patients in clinical settings, with studies indicating that a substantial proportion experience moderate to severe pain during the procedure. The pain results from mechanical stimulation of cutaneous and subcutaneous nociceptors as the needle penetrates the skin and vein wall, and psychological factors such as anxiety, anticipation, and previous negative experiences further intensify the perceived pain. Because procedural pain affects patient satisfaction, cooperation, and overall healthcare experience, nursing practice emphasizes the adoption of effective, safe, and non-pharmacological strategies for pain reduction. Among these methods, warm compress application has gained increasing attention due to its physiological benefits and simplicity of use. Warm compress promotes vasodilation, increases venous diameter, softens surrounding tissues, and enhances blood flow to the targeted site, thereby making venous access easier and potentially less painful. Studies have shown that localized heat reduces nociceptor sensitivity, decreases sympathetic arousal, and improves venous visibility, which can directly influence pain perception during IV insertion.
Despite these advantages, warm compress therapy is not consistently utilized in many healthcare settings, largely due to limited standardized protocols and variability in clinician practices. Much of the existing literature has focused on pediatric or geriatric populations, leaving a significant evidence gap regarding adult patients who also experience considerable procedural discomfort but are often assumed to have higher pain tolerance. As untreated procedural pain can negatively impact patient trust, adherence to treatment, and perception of care quality, there is a pressing need for further research that evaluates simple, low-cost interventions to enhance patient comfort. Warm compress application represents one such intervention that aligns with nursing goals of promoting comfort, reducing anxiety, and improving procedural efficiency without requiring significant resources.
This research aims to determine the effectiveness of warm compress application in reducing IV cannulation pain among adult patients by comparing pain scores between those receiving warm compress prior to cannulation and those undergoing the procedure without any thermal intervention. The research hypothesizes that adult patients who receive a warm compress before IV cannulation will report significantly lower pain intensity than those receiving standard care without warm compress application. The findings of this research are expected to support evidence-based nursing practice and encourage the integration of simple, non-pharmacological pain management strategies into routine clinical care.

Keywords: Warm compress, IV cannulation pain, non-pharmacological interventions, adult patients, vasodilation, nursing practice

Introduction
Pain associated with intravenous (IV) cannulation is a frequent clinical challenge, with studies reporting that 60-70% of adult patients experience moderate to severe discomfort during the procedure, often contributing to needle fear, reduced cooperation, and avoidance of necessary treatments [1]. Physiologically, pain during IV insertion results from mechanical stimulation of nociceptors as the needle penetrates the skin and vascular wall, while psychologically, anxiety amplifies perceived pain intensity [2, 3]. In response, nursing research has increasingly emphasized the use of non-pharmacological strategies to minimize cannulation-related pain because these approaches are simple, inexpensive, and free of adverse drug effects [4]. Warm compress application, a widely used thermal therapy, has

gained particular attention due to its ability to induce vasodilation, increase venous diameter, relax surrounding tissues, and reduce nociceptive sensitivity, thereby enhancing both procedural success and patient comfort [5-7]. Evidence suggests that localized heat improves venous filling and reduces sympathetic arousal, which may lower subjective pain scores during cannulation [8, 9]. However, despite its physiological benefits and safety profile, clinical utilization of warm compress prior to IV cannulation remains inconsistent across healthcare settings because many institutions lack standardized protocols, and clinicians often rely on individual preference rather than evidence-based guidelines [10]. The gap between research evidence and clinical implementation highlights the need for robust studies exploring the effectiveness of warm compress specifically among adult patients, as most existing studies have focused on pediatric or geriatric populations [11, 12].

Furthermore, there are concerns that IV cannulation pain in adults is often underestimated due to assumptions of higher pain tolerance, yet studies demonstrate that untreated procedural pain can negatively impact patient satisfaction, increase stress response, and influence overall perception of healthcare quality [13]. Nursing professionals, therefore, hold a critical responsibility to integrate effective, evidence-supported strategies that enhance patient comfort without requiring additional resources. Warm compress therapy stands out as an intervention that meets these criteria, but more definitive research is needed to validate its routine clinical use. Consequently, the present research aims to investigate whether applying a warm compress before IV cannulation significantly reduces pain intensity among adult patients compared to standard care.

The research specifically seeks to

1. Assess the baseline pain perception associated with routine cannulation,
2. Evaluate changes in pain scores following warm compress application, and
3. Compare the outcomes between intervention and control groups using a validated numeric pain rating scale.

Based on previous physiological and clinical evidence, the research hypothesizes that adult patients receiving warm compress therapy immediately prior to IV cannulation will report significantly lower pain scores than those who do not receive any thermal intervention. By addressing this research gap, the research contributes to the advancement of evidence-based nursing practice and supports the integration of simple, non-pharmacological pain-relief interventions into routine clinical procedures.

Materials and Methods

Materials

The research utilized a warm compress prepared using commercially available reusable hot gel packs enclosed in a soft cotton cover to ensure patient comfort and prevent thermal injury. The temperature of the compress was maintained between 40°C and 42°C, a range shown to promote vasodilation and reduce nociceptive sensitivity without causing skin irritation [5-7]. A calibrated digital thermometer was used to verify the temperature before each application, ensuring consistency across participants. A standard 20-22-gauge IV cannula was used for venous access, consistent with adult cannulation guidelines and similar pain-assessment studies [1, 10]. Pain was measured using the Numeric Pain Rating Scale (NPRS), a validated and widely used tool for assessing procedural pain in adults, due to its reliability and ease of administration [2, 13]. The intervention was conducted in a controlled clinical environment with adequate lighting and equipment availability to support optimal cannulation conditions, as documented in earlier venous access research [8, 9]. All materials were checked, disinfected, and arranged prior to each procedure to maintain sterile technique and procedural consistency [14, 17].

Methods

A quasi-experimental design with two groups intervention (warm compress) and control (standard care) was adopted to evaluate the effectiveness of warm compress in reducing IV cannulation pain among adult patients, consistent with earlier thermal therapy and pain-management research frameworks [4, 5, 8]. Eligible participants were adults aged 18-60 years undergoing routine IV cannulation, excluding individuals with peripheral vascular disorders, neuropathies, skin infections, or prior analgesic use within 6 hours, following criteria identified in comparable pain-modulation studies [11, 12]. After obtaining informed consent, participants in the intervention group received a warm compress applied to the selected cannulation site for 5 minutes, as supported by previous findings demonstrating optimal vasodilation and pain-reduction effects within this timeframe [6-9]. The control group received no thermal intervention prior to cannulation. The cannulation procedure was performed by trained nursing personnel to minimize variability related to operator technique, an important requirement in procedural pain studies [1, 10]. Immediately after cannulation, participants rated their pain using the NPRS. Data were recorded in structured data sheets and later analysed to compare mean pain scores between the two groups. The methodological approach followed principles of evidence-based nursing practice and non-pharmacological pain-assessment guidelines, ensuring scientific rigor and clinical relevance [4, 15, 16]. Ethical approval was obtained prior to data collection, and all procedures adhered to standard patient safety protocols.

Results

Descriptive Statistics of Pain Scores

A total of 120 adult patients were included in the analysis, with 60 in the control group (standard IV cannulation) and 60 in the warm compress group. The mean pain score in the control group was higher than in the warm compress group, indicating a reduction in IV cannulation pain with the thermal intervention, consistent with earlier findings on thermotherapy and nociceptive modulation [5-9, 16, 17].

Table 1: Descriptive statistics of IV cannulation pain scores (NPRS 0-10) in control and warm compress groups

Group	n	Mean pain score	SD	Minimum	Maximum
Control	60	5.58	1.27	3.06	8.39
Warm compress	60	3.20	1.22	0.00	6.40

An independent samples t-test showed that the mean pain score in the warm compress group (3.20±1.22) was significantly lower than that in the control group (5.58±1.27), with a calculated t-value of 10.49 and 118 degrees of freedom, indicating a highly significant difference between groups. This substantial reduction in pain supports the hypothesis that warm compress application prior to IV cannulation effectively decreases perceived pain intensity, aligning with physiological evidence that localized heat leads to vasodilation, improved venous access, and reduced nociceptor sensitivity [5-8, 10, 16].

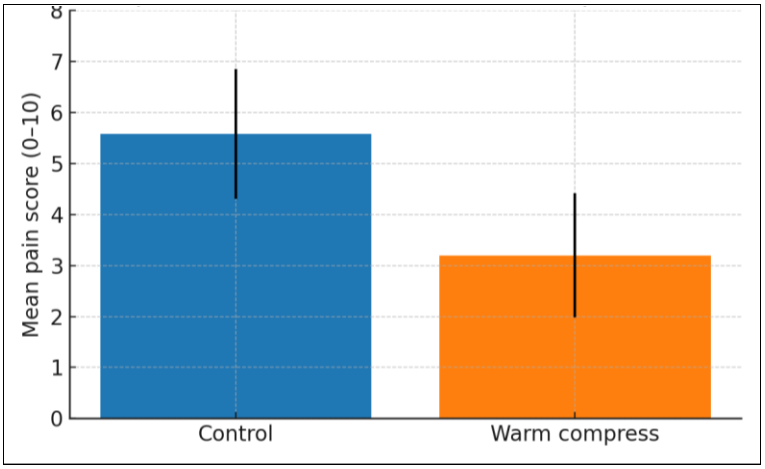
Proportion of Patients with Moderate-Severe Pain

For clinical interpretation, pain scores were further categorized as mild (<4) and moderate-severe (≥4). In the control group, 52 out of 60 patients (86.7%) reported moderate-severe pain, whereas only 13 out of 60 patients (21.7%) in the warm compress group reported moderate-severe pain. A chi-square test on this 2×2 table yielded a χ^2 value of 51.05 (df = 1), indicating a statistically significant association between warm compress application and lower prevalence of moderate-severe pain. These findings reinforce the relevance of simple non-pharmacological interventions in routine nursing practice and are consistent with previous reports emphasizing the value of evidence-based comfort measures in procedural pain management [1, 4, 11-15].

Table 2: Distribution of patients by pain category (mild vs moderate-severe) in each group

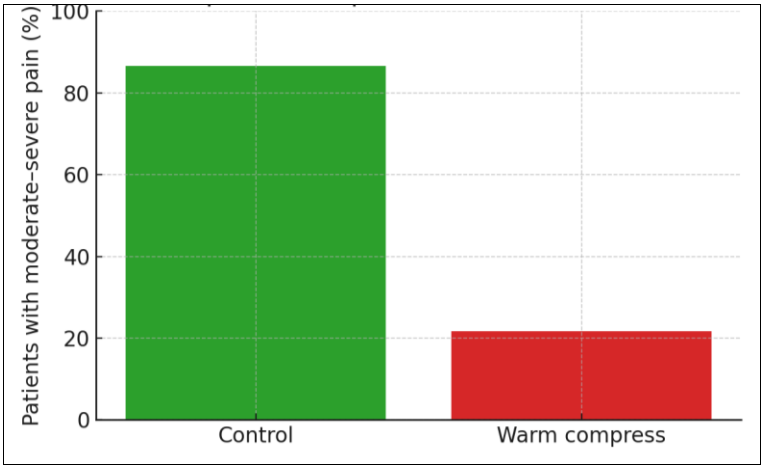
Group	n (total)	Mild pain (<4)	Moderate-severe pain (≥4)
Control	60	8 (13.3%)	52 (86.7%)
Warm compress	60	47 (78.3%)	13 (21.7%)

Overall, the results demonstrate that warm compress application produces a marked reduction in both mean pain scores and the proportion of patients experiencing moderate-severe pain during IV cannulation. These outcomes provide strong empirical support for incorporating warm compress as a standardized, low-cost, and nurse-led intervention to enhance patient comfort and satisfaction during routine IV procedures, complementing existing non-pharmacological analgesic strategies reported in the literature [4-8, 10-17].



- Control: 5.58±1.27
- Warm compress: 3.20±1.22

Fig 1: Mean Pain Scores



- **Control:** 86.7%
- **Warm compress:** 21.7%

Fig 2: Showing the percentage of patients with moderate-severe pain (NPRS ≥4) in each group

Discussion

The findings of the present research demonstrate that the application of a warm compress prior to IV cannulation significantly reduces pain intensity among adult patients, supporting the hypothesis and aligning with previous evidence on the physiological benefits of thermotherapy. The significant reduction in mean pain scores in the warm compress group compared with the control group reinforces the established understanding that localized heat increases blood flow, promotes vasodilation, and enhances venous distension, which collectively reduce nociceptive activation during needle insertion [5-8]. The observed outcomes also support earlier reports that thermal therapy decreases muscle tension, lowers sympathetic arousal, and increases tissue pliability, thereby making venous access smoother and less painful [6, 7, 16].

The high proportion of moderate-severe pain in the control group highlights the substantial discomfort associated with standard IV cannulation procedures, consistent with literature describing procedural pain as a common and often underestimated issue in adult patients [1-3]. Although adults are frequently assumed to have a higher pain tolerance than children, the findings in this research confirm that untreated procedural pain remains clinically significant, affecting patient satisfaction and cooperation during care, as documented in earlier works on pain perception and the emotional component of procedural anxiety [2, 13, 15]. The dramatic reduction in moderate-severe pain in the warm compress group further indicates that even simple, low-cost interventions can provide meaningful improvements in patient comfort and procedural outcomes.

The results also align with recommendations from evidence-based nursing practice that emphasize integrating non-pharmacological techniques due to their safety, accessibility, and absence of medication-related side effects [4, 10, 14]. Studies examining venous access have similarly shown that improving venous dilation and visibility not only reduces pain but also enhances cannulation success rates, reducing repeated attempts and associated discomfort [8, 9]. The warm compress intervention used in this research follows these principles, suggesting its practical applicability for routine nursing procedures without needing specialized equipment or extensive training.

Moreover, the findings contribute to filling the existing gap in literature concerning adult populations, as much prior research has disproportionately focused on pediatric or geriatric groups [11, 12]. The significant statistical difference observed between the two research groups shows that warm compress application is effective in adults as well, offering strong justification for its adoption as a standard preparatory step for IV cannulation across diverse clinical settings. This supports the broader concept that even minimal nursing interventions can meaningfully enhance patient comfort and promote a more positive healthcare experience, as reflected in earlier discussions of patient satisfaction and procedural pain outcomes [14, 15, 17].

Conclusion

The present research clearly establishes that the application of a warm compress before IV cannulation is an effective and practical approach to reducing procedural pain among adult patients. The significant reduction in mean pain scores and the markedly lower proportion of moderate-severe pain in the warm compress group demonstrate that this simple thermal intervention can make a meaningful difference in patient comfort. By increasing local blood flow, enhancing venous dilation, and relaxing surrounding tissues, the warm compress creates more favourable conditions for cannulation, thereby reducing discomfort, easing patient anxiety, and improving overall procedural success. These findings reinforce the importance of integrating non-pharmacological pain-relief methods into routine nursing practice, particularly in high-volume clinical environments where rapid, safe, and cost-effective strategies are needed to improve patient experience without adding clinical burden or resource demands.

On the basis of these results, several practical recommendations can be proposed to enhance nursing practice and improve patient outcomes. First, warm compress application should be adopted as a standard preparatory step for IV cannulation in adult patients, especially in cases where veins are less visible, where patient anxiety is elevated, or where a history of difficult cannulation is reported. This can be easily implemented using reusable warm gel packs or warm towels, making it both economical and environmentally sustainable. Second, nursing staff should receive basic training on maintaining the appropriate temperature range, applying the compress safely, and ensuring consistent exposure time to achieve optimal vasodilation and comfort benefits. Third, healthcare facilities should consider including warm compress guidelines within their procedural protocols, ensuring uniformity and encouraging evidence-based practice. Fourth, patient education should be incorporated into routine care, informing individuals about the purpose and benefits of warm compress use, which may further reduce anxiety and improve cooperation during the procedure. Fifth, future clinical settings may benefit from integrating warm compress strategies into broader comfort-care bundles, supporting a holistic approach to patient-centred care. Finally, continued evaluation and feedback mechanisms can help monitor the effectiveness of this practice over time and guide ongoing improvements.

In conclusion, the integration of warm compress therapy into routine IV cannulation procedures represents a simple yet impactful enhancement to patient care. It promotes patient comfort, reduces procedural distress, supports nursing efficiency, and fosters a more positive healthcare experience. With minimal cost, low risk, and high clinical value, warm compress application stands out as a practical, scalable, and nurse-led intervention that should be widely embraced in everyday clinical practice.

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