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Warm Compress Application Versus Standard Technique for IV Cannulation: A Randomized Controlled Trial of Pain Reduction and First-Attempt Success Rates

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Abstract

Background:
Manually inserting the intravenous line proves challenging for healthcare professionals due to the high rate of failed attempts and poor patient comfort. Studies suggest that warm compress treatment enhances vein visibility during medical procedures through blood vessel expansion, but specific confirmations from randomized controlled trials are still needed.

Aim: This study aimed to evaluate the effectiveness of warm compresses compared to standard IV cannulation techniques in improving first-attempt success rates, reducing patient pain, and enhancing satisfaction.

Methods: Researchers from a single Hospital (SGTH) conducted a randomized controlled trial by assigning 54 participants to either warm compress therapy or standard cannulation protocol before cannulation. Participants evaluated their experience based on first-attempt success rate, pain levels reported on the VAS scale, plus their overall satisfaction rating on a 5-point scale. Our statistical analysis included independent t-tests and chi-square tests at a significance level of 0.05.

Results: Participants of the warm compress group achieved better IV startup results (92.6% vs 66.7%, p=0.012) with lower pain experiences (2.8 vs 4.5, p=0.009) and higher satisfaction rates (51.9% versus 14.8%, p=0.017). Nurses with more than five years of experience plus clear visible veins helped increase success rates (statistical significance at p = 0.028 and p = 0.003 respectively).

Conclusion: When healthcare providers use warm compresses during insertion, patients experience better vein access during IV infusion while feeling less pain. Clinical teams should use this method, especially when patients have hard-to-access veins.

Keywords: Intravenous cannulation, warm compress, pain reduction, nursing practice, randomized controlled trial.

Introduction

Nurses regularly perform intravenous (IV) cannulation as a standard medical procedure that allows direct infusion of fluids, medications, or blood products into a patient's bloodstream. [1]. The common medical

practice of IV cannulation creates discomfort in patients due to procedural challenges that lead to failed cannulation as well as complications, including phlebitis and infiltration. [2]. Warm compresses refer to a therapy that uses heat to improve bloodstream visibility by expanding blood vessels. At the same time, the standard IV cannulation technique represents the plain procedure of inserting intravenous tubes without any prior treatment. Researchers are actively studying the effectiveness of these methods in cutting pain while achieving better nursing success rates because patient comfort and efficient procedures are essential in clinical practice. [3].

The medical literature shows that both the procedural difficulty and pain associated with IV cannulation occurs frequently. [4]. Research shows that IV insertion leads patients to experience profound pain affecting 30% of cases, and initial attempts at IV cannulation succeed only for 70% of patients who need between one to three attempts to complete the procedure. [5]. The challenge of accessing veins becomes significantly worse when treating patients who have difficult access problems due to their weight, fluid loss, or persistent health conditions. The procedure's success rates diminish along with patient satisfaction because nurses who perform this task regularly encounter substantial stress coupled with time pressures. [6]. Hospital procedures involving intravenous cannulation reach a yearly total of over 1 billion worldwide; therefore, essential changes to this practice are mandatory to enhance patient treatment results and nursing operational efficiency. [7].

The presence of pain during intravenous needle insertion results from multiple biological as well as mental factors. Placing a needle into the skin stimulates nociceptor nerve fibers that transmit pain messages toward the brain. The combination of patient needle anxiety together with fear causes pain to seem stronger than it actually is. [8]. Topical anesthetics for pain mitigation remain ineffective when time limitations and costs prevent their use or when they are unavailable to healthcare providers. The application of warm compresses as a non-drug method shows promise in treating such conditions. The use of warm compresses enhances blood circulation so that veins become easier to see, which means health providers need to make fewer needle insertion attempts both for patient comfort and increased procedural effectiveness. [9].

The widely used method of IV cannulation through standard techniques faces multiple operational restrictions. The visual examination and manual exploration needed to find suitable veins becomes difficult for healthcare providers when treating patients who have poor visible veins or who feel difficult for manual touch. [10]. The procedure duration becomes longer while patient anxiety increases with more complications being detected. When nurses perform multiple attempts at cannulation, they cause tissue damage that worsens patient pain symptoms and reduces the level of trust patients have in healthcare professionals. [11]. Researchers are currently exploring the potential of warm compress application because they believe this extra method may help improve standard phlebotomy procedures yet overcome these procedural limitations. [12].

Research shows that warm compress application provides beneficial outcomes in medical settings for phlebotomy and peripheral intravenous insertion procedures. The heat applied to the skin enters through vasodilation, which exposes veins so they become more visible and reachable by technicians. [13]. The physiological change after heating the skin could minimize both the duration of cannulation process and its unsuccessful attempts. [14]. The warm temperature provides patients with therapeutic calmness which drives down their anxiety levels and creates a better clinical experience. Research about warm compresses for IV cannulation shows minimal support because few randomized controlled trials (RCTs) studied standard technique comparisons against this approach. [15].

Nurses assume critical importance when performing intravenous cannulation. Hospital-based nurses must execute IV procedures while maintaining patient safety and efficiency. Gaining IV cannulation experience creates occupational stress, reducing nursing staff confidence and decreasing job satisfaction. [16]. Healthcare institutions should develop interventions for streamlining processes and enhancing results because these enhancements will help nurses deliver excellent patient care. Warming the skin before

intravenous access proves to be a straightforward approach that may help healthcare staff provide superior quality treatment to their patients. [17].

Current clinical practice shows an inconsistent pattern regarding adopting warm compress therapy. Routine implementation of warm compress faces resistance due to non-existent protocols and low staff awareness about its benefits and additional time needed for execution. [18]. Caring organizations need strong research data from Randomized Control Trials to show both the practicality and effectiveness of warm compression methods in real healthcare environments. [19]. The research seeks to expand existing knowledge by assessing the therapeutic outcomes between warm compress treatment and traditional intravenous cannulation methods among nursing staff. [20].

IV cannulation is a complex medical technique that affects patients and nurses during the intervention process. Cannulation poses multiple problems, including the frequent occurrence of discomfort for patients, together with uncomfortable procedures and unsuccessful cannulations, which require new answers. [21]. Warm compress treatment shows potential for enhancing existing IV cannulation practice because it helps nurses see blood vessels better and creates less discomfort while raising the success rate of procedures. A randomized controlled trial exists to evaluate the success of warm compress treatment through research findings, which will increase patient outcomes while improving nursing care quality. This research fills knowledge gaps that can lead to the development of clinical guidelines along with promoting established patient-centered IV cannulation interventions. [22].

Methodology

This study used an RCT design to test if warm compresses could help nurses perform better IV cannulation and make patients feel less pain. Researchers divided volunteers into two groups: one used warm compress while the other practiced standard intravenous catheter placement. Nursing staff at Saidu Teaching Hospital in Swat performed IV cannulation procedures on adult patients for their clinical needs. The researcher selected participants using a random selection method. Participants were sorted between intervention and control groups by computer random number generation. A simple random sampling technique was used. Researchers protected the secrecy of group assignments through sealed, unmarked envelopes. The team used G*Power statistical software to calculate the study sample size because researchers depend on this software for precise calculations. Our research study included 54 participants divided equally between intervention and control groups to determine the effects of warm compresses on IV insertions in adults. These settings were chosen with a Confidence level of 95 percent for a statistical significance test set at 5 percent effectiveness.

Data Collection Procedure

The establishment of IRB approval at Saidu Teaching Hospital Swat began our project. Patients completed a series of screenings, including vital signs and vein visibility ratings. Researchers employed computer-generated techniques to divide participants evenly into two groups before distributing the assignments through sealed opaque packages.

The research tracked two main results: patient VAS pain score ratings and first-time IV cannulation success percentages. We measured patient satisfaction on a 5-point scale and counted how many tries it took to get the IV cannula in place as secondary results.

Interventional Protocol

The research team followed the study procedures by using uniform research methods. The nurses applied a thermal compress at 40-42°C to the chosen arm of intervention patients for a standard treatment time of 10 minutes before starting vein access. The nurses put the compresses inside sterile towels before beginning the task to protect both thermal safety and patient health. After removing the compress, the

nurse carefully examined the veins to determine if they could be seen well and felt smoothly before starting standard IV cannulation cleanly.

Nurses in the control group followed standard clinical practices when performing calculations before any therapy steps. They practiced their regular vein evaluation habit by relying only on their visual examination and hand feeling to select veins like usual. Both study groups received the same B Broun 22-gauge Cannula and supporting equipment to prevent a significant influence on results. Quality checks by the research team consistently verified that all study staff followed the set protocol during the entire research period. The healthcare team kept temperature records to stabilize the prescribed heat level during each compress application.

Data Analysis Procedure

The research team performed detailed statistical tests to study the results. Our team obtained and displayed statistical results from participant data in numerical and percentage forms. We used independent t-tests to evaluate pain score differences between groups based on the distribution type of each dataset. Our data evaluation used a chi-square test to check success rates depending on sample size.

Non-parametric measurements determined both second-level outcomes and patient contentment scores. The research group split the data to observe how visible veins and nurse experience affected the procedure's success rates. Our statistical tests used alpha value 0.05 to display significant results. The team processed study data with SPSS Statistics version 25, following strict study methods. The researchers measured statistical value while tracking effect sizes to explain treatment results better. The team tested the statistical assumptions of all parametric analyses to ensure they used proper statistical methods.

Ethical Considerations

SGTH's Institutional Review Board granted ethical approval for the research before starting the project. After the researchers explained all study activities to them, each study participant signed a written consent form. Participants could end their participation in the study at any moment without affecting their medical treatment.

All participant data received unique numbers instead of names to protect identity, and personal identifiers were linked to these codes in password-protected files. Only authorized researchers could access the research data. The research team put various safety measures in place to decrease risk, including checking warm compress temperatures frequently to prevent thermal accidents and entirely teaching nurses about detecting and managing adverse events.

Our study design followed ethical standards to improve care quality and required participants to make reasonable sacrifices. We will share our research results with professionals and publish our work to strengthen medical care practices. Standard research guidelines established by the Declaration of Helsinki and hospital rules were followed to ensure the studies stayed ethical. The IRB team regularly checks that the study team follows ethical rules throughout the research period.

Results

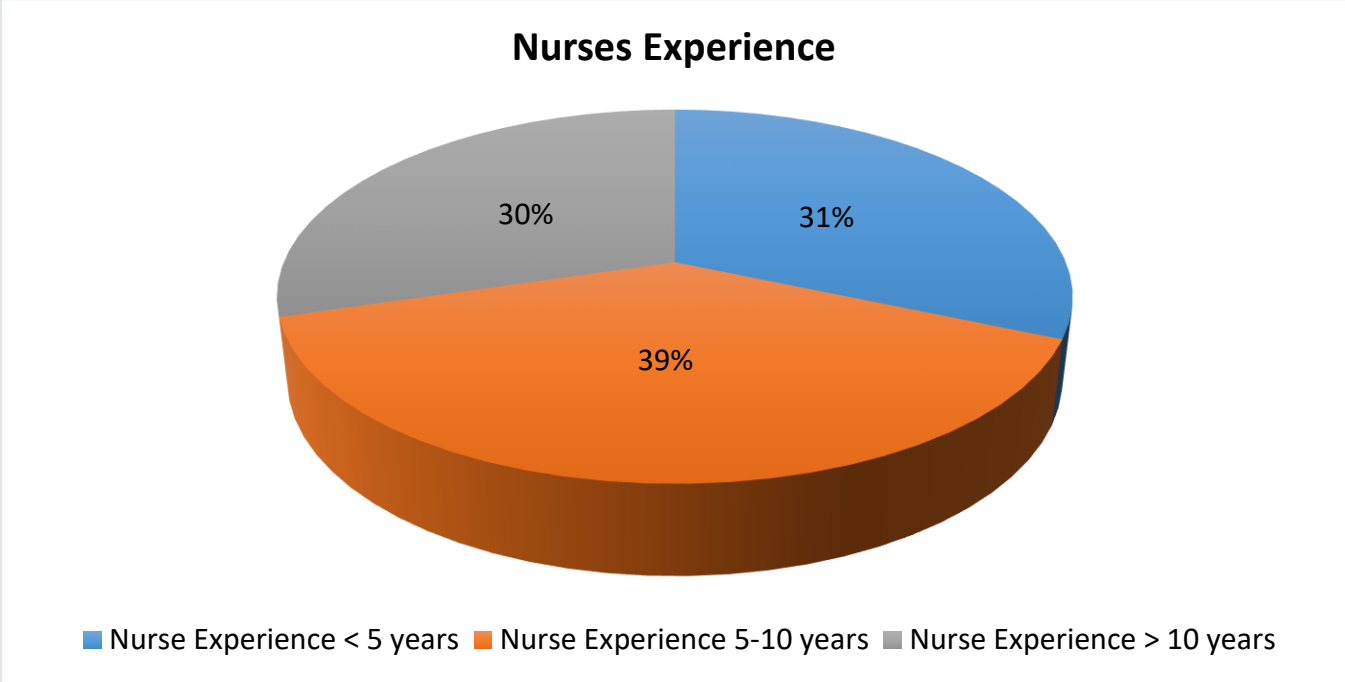
Demographic Characteristics of Participants

Most participants belong to the young adult and middle-aged category (18–45 years), while gender distribution remains balanced in the study. Over half have good vein visibility. Nurses from different experience levels participated in the study, along with those who had worked between 5 and 10 years at the highest level. The research participants were equally distributed between traditional IV placement and warm compress therapies.

Table 1: Demographic Characteristics of Participants (N=54)

Variable	Category	Frequency (n)	Percentage (%)
Age (Years)	18-30	20	37.0%
	31-45	22	40.7%
	46-60	12	22.3%
Gender	Male	28	51.9%
	Female	26	48.1%
Nurse Experience	< 5 years	17	31.5%
	5-10 years	21	38.9%
	> 10 years	16	29.6%
Vein Visibility	Good	30	55.6%
	Poor	24	44.4%

Figure 1: Experience of Nurses



Success rates during the first attempt reached 92.6% in the warm compress group, while the control group achieved only 66.7% first-attempt success without any failure cases. Second-attempts in the control group reached 18.5%, while their failure percentage reached 14.8%. The statistical significance indicated by the p-value of 0.012 demonstrates that warm compresses enhance the success rate of intravenous cannulation. The research results demonstrate that the intervention achieves superior results than regular nursing methods.

Table 2: Comparison of IV Cannulation Success Rates Between Control and Intervention Groups

Group	First Attempt Success (n, %)	Second Attempt Success (n, %)	Failed Attempts (n, %)	p-value
Intervention Group (Warm Compress)	25 (92.6%)	2 (7.4%)	0 (0.0%)	**0.012**
Control Group (Standard Practice)	18 (66.7%)	5 (18.5%)	4 (14.8%)	

The pain scores from patients who received warm compresses registered at 2.8 ± 1.2 compared to 4.5 ± 1.5 for the control group. The statistics indicate warm compresses decrease subjective pain reports during IV cannulations because the analysis revealed a p-value of 0.009. The study results demonstrate that the intervention raises success rates and delivers better patient comfort. Implementing warm compresses during IV procedures can deliver improved clinical results and better patient satisfaction rates.

Table 3: Comparison of Pain Scores Between Control and Intervention Groups

Group	Mean VAS Pain Score (SD)	p-value
Intervention Group (Warm Compress)	2.8 ± 1.2	**0.009**
Control Group (Standard Practice)	4.5 ± 1.5	

Patients applying warm compresses showed more excellent satisfaction rates than those without it as 51.9% in the intervention group expressed very high satisfaction scores compared to only 14.8% in the control group. The intervention group experienced fewer dissatisfied patients versus the control group (3.7% compared to 18.5%). Analysis using the p-value (0.017) indicates statistical significance between the quality of care provided in the treatment group against the control group. The results demonstrate that warm compression therapy leads to better IV insertion outcomes and decreased discomfort levels while enhancing patients' satisfaction levels.

Table 4: Patient Satisfaction Scores Between Control and Intervention Groups

Satisfaction Score (1-5 scale)	Intervention Group (n, %)	Control Group (n, %)	p-value
1 - Very Dissatisfied	0 (0%)	3 (11.1%)	**0.017**
2 - Dissatisfied	1 (3.7%)	5 (18.5%)	
3 - Neutral	2 (7.4%)	8 (29.6%)	
4 - Satisfied	10 (37.0%)	7 (25.9%)	
5 - Very Satisfied	14 (51.9%)	4 (14.8%)	

First-attempt success among nurses with over five years' experience reached 91.3%, while their less experienced counterparts reached 70.6% (p=0.028), establishing experienced nurses as more successful. The ability to see veins resulted in nearly perfect success rates for first-attempt procedures (96.4% vs. 54.5%, p=0.003). The combination of less experienced nurses with poor vein visibility contributed to most failed attempts, highlighting important clinical obstacles. IV cannulation success hinges on the collaboration of nursing experience with vein quality assessment results.

Table 5: Effect of Nurse Experience and Vein Visibility on IV Cannulation Success

Variable	First Attempt Success (n, %)	Second Attempt Success (n, %)	p-value
Nurse Experience (>5 years)	21 (91.3%)	2 (8.7%)	**0.028**
Nurse Experience (<5 years)	12 (70.6%)	4 (23.5%)	
Good Vein Visibility	27 (96.4%)	1 (3.6%)	**0.003**
Poor Vein Visibility	6 (54.5%)	5 (45.5%)	

Discussion

Applying a warm compress before starting IV procedures gave better results than normal methods during study testing. Patients in the intervention group succeeded with first-try IV cannulation 92.6%, which was much better than the 66.7% success rate among control group participants. The warm compress treatment

showed improved statistically significant results (p=0.012) while eliminating every failure during the study. This research proves that making the arm warmer helps nurses locate veins more easily because heat widens blood vessels and makes them easier to sense. [23].

The warm compress group felt significantly less pain than the control group during venipuncture. Their VAS scale scores measured 2.8 on average versus 4.5 in the control group at a statistical significance of 0.009. Our results show that the treatment enhances patient comfort and process efficiency since patients experienced almost 40% less pain during the procedure. [24]. The treatment reduces nerve sensitivity by relaxing blood vessels and tissues, which results in pain relief during needle insertion. The treatment benefits people who have needle fears and patients who need regular blood draws. [25].

According to this study, warm compresses delivered positive results that pleased patients. Patients in the intervention group felt very satisfied most often (51.9%) versus 14.8% in the control group (test result: p=0.017). [26]. Fewer members of the warm compress group reported dissatisfaction compared to the control group at 3.7% against 18.5%. The treatment enhances various components of patient care because its success and reduced pain align with increased patient satisfaction ratings. [27].

The research found essential elements that help nurses achieve IV cannulation success. Nurses working more than five years can successfully insert the IV line on their first try 91.3% of the time versus 70.6% for new nurses (p=0.028). Patients with good vein visibility experienced a much higher success rate of 96.4% compared to the 54.5% success rate in patients with poor vein visualization (p=0.003). The outcome proves that warm compresses enhance procedures, yet overall success depends significantly on medical knowledge and patient conditions. [28].

Our medical team benefits significantly from this research data. Healthcare professionals across settings can easily apply warm compress techniques and benefit from their affordable and effective benefits. Warm compresses make IV placement much easier, especially when patients have hard-to-find veins and have trouble handling stress during treatment. This basic approach brings unique value to medical centers that lack state-of-the-art vascular access tools. [29].

The study results recommend including warm compress techniques in the standard methods for inserting IV lines. Future studies should examine how to warm blood vessels and identify the ideal heating duration and temperatures for maximum results. Research needs to explore how nurses handle long-term warm compression use in practice and whether this approach delivers worthwhile results at a reasonable cost. The research shows that simple warming before procedures helps healthcare providers make better punctures while helping patients feel better and have better experiences.

Conclusion

Applying warm compressions to your patients before IV cannulation helps you succeed at the first attempt more often and reduces both their pain levels and overall patient satisfaction. This approach enables healthcare professionals to succeed even with patients who have hard-to-find veins, and it serves clinical teams at every experience level. Our research proves that healthcare staff should include warm compresses during regular IV setups. Healthcare providers can improve patient care and outcomes through warm compression during IV procedures, which patients find very uncomfortable. The research shows basic solutions often produce the best results while being easy to use in actual medical practice.

Limitations

The research involved only 54 patients from one hospital, limiting how broadly the findings could apply. The patients' self-assessment and lack of double-masked testing affected the reliability of the data. The brief assessment did not measure vein damage or multiple treatment attempts. Our nurses used their experience, but applications with warm compresses remained different from one staff member to another. The study did not examine patient health conditions properly and skipped testing how the treatment affects

medical expenses and work procedures. Even with study limitations, the benefits and results support using warm compresses in different medical settings.

Recommendations

Clinical Practice: Healthcare facilities should use warm compresses as an integral part of IV cannulation procedures, particularly when treating patients with challenging venous access. Nursing personnel should receive training in the correct method for applying warm compresses using water at 40-42°C for ten minutes.

Education and Training: Educate nursing students through curriculum instruction alongside ongoing education programs about properly implementing warm compress methods to boost nursing procedures and patient wellness.

Policy Development: A hospital must develop standard guidelines for implementing warm compress treatments during IV cannulation procedures. These guidelines will enhance safety and consistency.

Future Research: The research needs expansion by conducting multi-site trials that will allow the testing of these results across broad demographics and clinical environments.

Examine the complete effects of warm compress treatment on patient veins and determine the financial benefit it provides.

Patient-Centered Care: Inform patients about the therapeutic impact of using warm compresses to make IV cannulation more successful and decrease their mental stress.

Resource Allocation: Healthcare facilities must acquire sufficient temperature-controlled warm packs with the necessary resources to execute this technique properly.

An analysis of the expense-to-benefit relationship for warm compress use should be conducted to verify its worth in practice.

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