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# The Effects of Local Warm Compresses on Peripheral Intravenous Cannulation of Patients Undergoing Chemotherapy.

Amany Youssef Sharaf[1], Mervat Mohammed Abdel Fatah[2], Maher Soliman. MD., PhD[3].
*Assistant professor. Medical Surgical Nursing Department- Faculty of Nursing, Alexandria University. Egypt*
*Assistant professor. Medical Surgical Nursing Department- Faculty of Nursing, Alexandria University. Egypt*
*Assistant professor of oncology. Oncology Department- Faculty of Medicine, Alexandria University. Egypt*
*Corresponding Author: Amany Youssef Sharaf*

***Abstract***
***Background****: Insertion of intravenous cannula is the most distressing procedure for both patients and nurses in oncology practice. Warm compresses is a safe, and cost-effective technique that facilitates IV cannulation for patients receiving chemotherapy*
***Objectives****: This study aims to determine the effects of local warm compresses on the visibility and palpability of peripheral veins before peripheral venous cannulation of patients undergoing chemotherapy, and to determine the effects of local warm compresses on pain, and patients' satisfaction after peripheral venous cannulation.*
***Setting****: This study was conducted at the Oncology Department at the Main University Hospital, Alexandria. Egypt.*
***Materials and Methods****: This is a quasi-experimental study. Data were collected from 100 patients attending the above-mentioned health setting. Five tools were utilized: 1. Socio demographic, and Clinical Characteristics Structured Questionnaire. 2. Characteristics of IV Catheterization Questionnaire. 3. Five-Level Vein Assessment Scale*
*4. The Visual Analogue Scale (VAS). 5. Patient Satisfaction Likert scale. Study participants were conveniently enrolled, into either a control or an intervention group.*
***Results:*** *Female patients exceeded males in both intervention, and control groups 68% & 52% respectively; the mean age was 48.02 ± 10.98 years in the intervention group, and 42.56 ± 10.23 in the control. Significant improvements of veins status were detected after warm compresses within the intervention group ($p_1$<0.001*). Pain scores in the intervention group were significantly decreased compared to that in the controls ($\chi^2$=11.492*,MC p= 0.003*). High satisfaction levels were elicited among patients in the intervention group, compared to their controls. High significant relationships were detected between patients' sex, age, and their percent improvement in vein status ($\chi$2=12.121*& p=0.001*, $\chi$2=15.817*& p=0.001* respectively)*
***Conclusion****: Using local warm compresses before IV cannulation improved peripheral veins status, decreased pain, and increased patients' satisfaction in the majority of patients in the intervention group.*
***Recommendations:*** *warm compresses before IV cannulation of patients on chemotherapy is highly recommended for nurses working at oncology units to improve their practice.*
***Keywords****: Warm compresses, peripheral, intravenous cannulation, chemotherapy*

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## I. Introduction

Chemotherapy is one of the main cancer treatment modalities that provide cure, control, or palliation. Most of the chemotherapeutic drugs are delivered intravenously [(1)]. Intravenous (IV) catheter insertion is a common invasive nursing activity that is performed in up to 70% - 80% of hospitalized patients [(2-5)]**.** In chemotherapy unit**,** peripheral intravenous (PIV) insertion is a basic procedure that nurses perform routinely [(6, 7)]**.**

It has been reported that rates of IV catheter insertion failure are alarming, as they are ranging from 33% to 69% [(8-12)]**.** As first attempt has failed, the sympathetic nervous system is activated leading to difficult subsequent attempts in almost all patients [(13)]. Also, the high risk of infection, through repeated breaks in skin integrity, is another harmful consequence of unsuccessful peripheral intravenous attempts [(6)]**.**

In this context, Bayram and Caliskan (2016) mentioned that attaining venous access is often challenging particularly in patients undergoing chemotherapy because of the repeated exposure to IV cannulation[(2)]. Also, the high PH and osmolality of chemotherapy drugs irritate the endothelial layer causing extravasation of the drug, pain, erythema, ecchymosis, infiltration at the IV catheter site and sympathetically induced vasoconstriction [(14-16)]**.** In addition, insertion of intravenous cannula is usually a source of cancer

patients' anxiety, and discomfort, which also activates the sympathetic nervous system causing peripheral vasoconstriction leading to difficulty in visualizing and palpating the veins [13, 17, 18].

It has been postulated that the repeated intravenous insertion attempts negatively affect chemotherapy patients' satisfaction, increase their anxiety, increase costs of used supplies, increase time and effort of nurses. Accordingly, it is imperative to improve the success rate of first IV attempt [5]. Many authors stated that the larger the vein diameter, the greater the success rate for first IV attempt [19-21]. In clinical settings, nurses use many venodilation techniques to facilitate the IV insertion, including tourniquet application, limb dependency, vein tapping & milking, and fist clenching [5, 6, 22].

Among the various venodilation techniques, local application of heat is the preferable method frequently used by nurses to enhance vasodilation especially for patients with difficult veins especially those receiving chemotherapy [23- 25]. Application of heat incorporates wrapping the entire extremity in a warm, moist towel, immersing in warm water, or place the patient's arm under warm running water before applying the tourniquet [7, 26]. Many authors found that local warm compresses significantly reduce the number of attempts, decrease pain, relax muscles, and decrease the nursing time of IV cannulation[2,5, 24, 25].

Warm compresses is a safe, evidence based, and cost-effective technique that nurses should use to facilitate IV cannulation for patients receiving chemotherapy and to improve the quality of nursing care [2]. Consequently, this study sought to determine whether local warm compresses improves peripheral veins' assessment score in accordance with the number of attempts, and duration for IV procedure in patients undergoing chemotherapy. Warm compresses' effects on patients' comfort, and satisfaction related to IV insertion, will be also investigated.

**Aims of the study:**

1. To determine the effects of local warm compresses on the visibility and palpability of peripheral veins before peripheral venous cannulation of patients undergoing chemotherapy
2. To determine the effects of local warm compresses on pain, and patients' satisfaction after peripheral venous cannulation of patients undergoing chemotherapy

**Research hypothesis:**

1. The application of local warm compresses before peripheral intravenous cannula insertion will improve visibility and palpability of peripheral veins.
2. The application of local warm compresses before peripheral intravenous cannula insertion will increase patients 'comfort and satisfaction.

## II. Methodology

**Materials**

**Design**: A quasi-experimental, research design was used to achieve this study.

**Setting: This study was conducted in Oncology Department at the Alexandria Main University Hospital, Egypt.**

**Subjects:** The study subject comprised a convenience sample of 100 male/female cancer patients, attending the pre-mentioned health setting and meeting the following inclusion criteria:

- Age ranging from 20- 60 years old.
- Undergoing intravenous chemotherapy

**Exclusion criteria** included the following:

- Peripheral vascular disease (diabetes) or peripheral neuropathy.
- allergies or sensitivity to warm compresses
- Acute trauma, , ecchymosis, at the involved extremity site
- No clinical evidence of bleeding tendency, or anticoagulant treatment
- No communication or cognitive problems.

**Sample size calculation:** Epi info -7 programs was used to estimate the sample size using the following parameters:

1. Population size = 792 patients /year
2. Expected frequency = 50 %
3. Acceptable error = 5%
4. Confidence co efficient =95 %
5. Minimum sample size = 86 patients

**Tools**: Based on an extensive review of related literature; Five tools were used for the purpose of data collection.

**Tool I: Patients' socio-demographic and clinical characteristics structured questionnaire:** This sheet included questions related to the socio demographic characteristics of the studied patients (age, sex, education, occupation, social status, area of residence) and questions related to the clinical characteristics of the studied patients (presence of chronic diseases, number of treatment courses, presence of problems during catheter insertion)

**Tool II: Characteristics of IV cannulation questionnaire:** This sheet was developed by the researchers after review of related literatures [1,2,5,7, 10]. It comprised questions for the nurse about peripheral intravenous insertion parameters namely: the site of intravenous cannula insertion, the duration of the procedure from application of the tourniquet to completion of the catheter insertion, the degree of difficulty experienced when placing the cannula and number of attempts made to insert the cannula successfully.

**Tool III: A five-level vein assessment scale**. This scale was adopted from Sanderson et al 2007 [27] to evaluate the visibility and palpability of the patients' veins either before or after warm application to the vein site as follows**:**

1. veins are neither visible nor palpable
2. veins are visible but not palpable
3. veins are barely visible and palpable
4. veins are visible and palpable
5. veins are clearly visible and easily palpable.

**Tool IV: Visual analogue scale (VAS):** This scale was adopted from Hawker et al (2011) [28] to assess pain intensity during IV cannula insertion. It is composed of numerical levels ranging from 0–10.

- A score of zero indicates "no pain", 1-3 indicates "mild" pain, 4-6 indicates "moderate" pain, and 7-10 indicates "severe" pain.
- Each patient in the study was asked to mark the line at the point which she\ he believed represented her\his pain

**Tool V: Patients' satisfaction likert scale**: This scale was developed by the researchers in accordance with the relevant literatures to measure patients' satisfaction regarding the cannulation procedure [29]. It is expressed by five response categories anchored on "strongly satisfied" and ends with the words "strongly unsatisfied at all"

- Analyzing patients' satisfaction scores regarding IV insertion were calculated then converted into mean percent score and plotted under three main categories <60%; Low satisfaction, 60-75%; Fair satisfaction, and >75%; High satisfaction.

**Methods**

- Permission to carry out the study was obtained from the responsible authorities of the identified setting, after explaining the study aims.
- The study tools were developed/ adopted based on recent review of literature.
- Content validity and clarity of the developed tools were ascertained by a jury of five experts in the fields of Medical Surgical Nursing, and Oncology. The necessary modifications were introduced accordingly.
- After obtaining patients' consents to participate in the study, they were equally , and sequentially recruited into either control or study group (50 patients each) as following**:**

✓ Control group who would receive routine hospital peripheral IV therapy.
✓ Intervention group who would receive local moist warm compresses, to the arm prepared for intravenous cannula insertion before chemotherapy drug administration.

- A pilot study was conducted on 10% of patients fulfilling the inclusion criteria to test feasibility, clarity and applicability of the developed tools and necessary modifications was done accordingly. Pilot study patients were excluded from the study sample.
- Tools reliability were tested by Cronbach's co-efficiency alpha test (r= 0.77)
- Aims of the study were explained to all study subjects, and all of them signed the informed consent preceding data collection. For illiterate patients, verbal explanation of the study purpose, and patients' oral consents were secured. Patients were assured about the confidentiality and freedom to participate in the study.
- Upon patients' enrollment, data were collected using the study tools.
- Data were collected initially from the control group followed by the intervention group.

- All intravenous cannulas insertion of both groups (intervention and control) were carried out by two qualified research assistants as follows:

✓ Patient was placed in semi fowler or supine position during IV procedure.
✓ Routine PIV cannulation site care for both groups' subjects was carried out. It comprised; checking doctor's written order for PIV cannulation**,** and careful site selection and assessment (edematous, injured or inflamed sites were excluded).
✓ Hand hygiene was performed prior to IV cannulation. Aseptic precautions were specifically considered during PIV cannula insertion for all of the studied subjects.
✓ The non-dominant forearm was used for peripheral intravenous cannulation with a gauge size 18-20.
✓ Standard technique for PIV cannula placement was followed for both group subjects which include: Tourniquet application to the arm 10 cm proximal to the selected site where the IV cannula was to be inserted, vein tapping and fist clenching.
✓ The vein was assessed using the vein assessment scale and the score was recorded on the data collection sheet for both groups.
✓ For the control subjects, single vein assessment for each patient was carried out following application of standard technique for PIV cannula placement then, the score was recorded in the data collection sheet.
✓ For the intervention subjects, a small towel dipped in warm water (40ºC), placed on the IV site selection for 10 minutes, then the skin was dried. The tourniquet was applied to the arm proximal to the selected site, where the IV cannula was to be inserted.
✓ The selected patients' vein was reassessed after reapplying the tourniquet post warm compresses, using the vein assessment scale. The score was recorded in the data collection sheet.
✓ When starting to insert IV cannula into basalic or cephalic veins, the time for successful IV placement was recorded for both groups: the time interval from when the tourniquet was applied, till successful PIV cannulation was achieved, blood was drawn and saline was flushed.
✓ When multiple attempts were required, total time was recorded as the sum of individual PIV attempts. Number of attempts was also recorded.
✓ After each insertion, the difficulty encountered during IV insertion was also recorded.
✓ The VAS was used to measure subjects' level of pain intensity during cannula insertion time for both group subjects by using tool IV.
✓ Patients' satisfaction likert scale was used to measure patient satisfaction after procedure for both group subjects by using tool V.
✓ The average time needed for tool completion was around 15- 30 minutes.
✓ Data were collected throughout a period of six months.

- **Statistical analysis** :

Data were fed to the computer and analyzed using IBM SPSS software package version 20.0**.** Qualitative data were described using number and percent. Quantitative data were described in terms of mean, standard deviation. Significance of the obtained results was judged at the 5% level.

**The used tests were**

**1 - Chi-square test**

For categorical variables, to compare between different groups

**2 - Monte Carlo correction**

Correction for chi-square when more than 20% of the cells have expected count less than 5

**3 - Marginal Homogeneity Test**

Used to analyze the significance between before and after findings.

**4 - Student t-test**

For normally distributed quantitative variables, to compare between two studied groups

## III. Results

**Table (1): Displays distribution of the studied patients according to their socio-demographic characteristics (n=100)**

It illustrates that female patients exceeded males in both intervention, and control groups 68% & 52% respectively. The mean age is 48.02 ± 10.98 years in the intervention group, and 42.56 ± 10.23 years in the control group. The majority of the studied patients in both intervention, and control groups (88% &76%) are married, while none of them hold bachelor degree. Also 38% of the intervention group is not working, while 44% of the controls were house wives. The mean number of treatment cycles in both intervention, and control groups is 5.18 ± 1.77& 4.60 ± 1.51 respectively. More than three quarter of patients (84%) in both groups have history of problems during cannulas insertion

**Table (1): Distribution of the studied patients according to their socio-demographic characteristics (n=100)**

| Socio-demographic characteristics | Intervention group (n = 50) | | Control group (n = 50) | |
|---|---|---|---|---|
| | No. | % | No. | % |
| **Sex** | | | | |
| Male | 16 | 32.0 | 24 | 48.0 |
| Female | 34 | 68.0 | 26 | 52.0 |
| **Age (years)** | | | | |
| 20 > 35 | 6 | 12.0 | 14 | 28.0 |
| 35 >50 | 19 | 38.0 | 18 | 36.0 |
| 50 – 60 | 25 | 50.0 | 18 | 36.0 |
| Min. – Max. | 26.0 – 60.0 | | 24.0 – 60.0 | |
| Mean ± SD | 48.02 ± 10.98 | | 42.56 ± 10.23 | |
| **Marital status** | | | | |
| Single | 4 | 8.0 | 8 | 16.0 |
| Married | 44 | 88.0 | 38 | 76.0 |
| Divorced | 2 | 4.0 | 4 | 8.0 |
| Widow | 4 | 8.0 | 8 | 16.0 |
| **Educational level** | | | | |
| Illiterate | 16 | 32.0 | 14 | 28.0 |
| Read and write | 21 | 42.0 | 20 | 40.0 |
| Diploma | 13 | 26.0 | 16 | 32.0 |
| Bachelor degree | 0 | 0.0 | 0 | 0.0 |
| **Occupation** | | | | |
| Clerical work | 10 | 20.0 | 4 | 8.0 |
| Professional work | 4 | 8.0 | 16 | 32.0 |
| House wife | 17 | 34.0 | 22 | 44.0 |
| not working | 19 | 38.0 | 8 | 16.0 |
| **Chronic diseases** | | | | |
| Hypertension | 21 | 42.0 | 8 | 6.0 |
| Diabetes | 12 | 24.0 | 10 | 20.0 |
| Asthma | 0 | 0.0 | 0 | 0.0 |
| None | 17 | 34.0 | 32 | 64.0 |
| **The number of treatment cycles** | | | | |
| Min. – Max. | 2.0 – 10.0 | | 2.0 – 7.0 | |
| Mean ± SD | 5.18 ± 1.77 | | 4.60 ± 1.51 | |
| **History of problems during cannulas insertion** | | | | |
| Yes | 42 | 84.0 | 42 | 84.0 |
| No | 8 | 16.0 | 8 | 16.0 |

**Table (2) & Fig1, Fig2 Shows distribution of the studied patients according to characteristics of IV cannulation (n = 100)**

It demonstrates that the subjects in the intervention, and control groups received chemotherapy mainly through cephalic (48%, 44% respectively), and basilic vein (52%, 56% respectively). Also, more than half of the respondents in the intervention group (52%) had one cannula insertion attempt, whereas the majority of them in the control group (80%) failed first cannula insertion attempt. The mean time to successful insertion in seconds is 200.4±182.0 in the intervention group, while it is nearly doubled in the controls 396.0±246.1. The majority of both nurses, and patients didn't perceive difficulty during cannula insertion in the intervention group (72%, 58% respectively), while the majority of controls (80%, 76% respectively) had perceived difficulty.

**Table (2) Distribution of the studied patients according to characteristics of IV cannulation (n = 100)**

| Characteristics of IV cannulation | Intervention group (n = 50) | | Control group (n = 50) | |
|---|---|---|---|---|
| | No. | % | No. | % |
| **Site of IV cannulation** | | | | |
| Cephalic vein | 24 | 48.0 | 22 | 44.0 |
| Basilic vein | 26 | 52.0 | 28 | 56.0 |
| **Number of cannula insertion attempts** | | | | |
| One attempt | 26 | 52.0 | 10 | 20.0 |
| Two or more attempts | 24 | 48.0 | 40 | 80.0 |
| **The mean cannulation time (seconds)** | | | | |
| Min. – Max. | 60.0 – 900.0 | | 60.0 – 900.0 | |
| Mean ± SD | 200.4±182.0 | | 396.0±246.1 | |
| **Nurse-perceived difficulty** | | | | |
| Yes | 14 | 28.0 | 40 | 80.0 |
| No | 36 | 72.0 | 10 | 20.0 |

| | | | | |
|---|---|---|---|---|
| **Patient-perceived difficulty** | | | | |
| Yes | 21 | 42.0 | 38 | 76.0 |
| No | 29 | 58.0 | 12 | 24.0 |

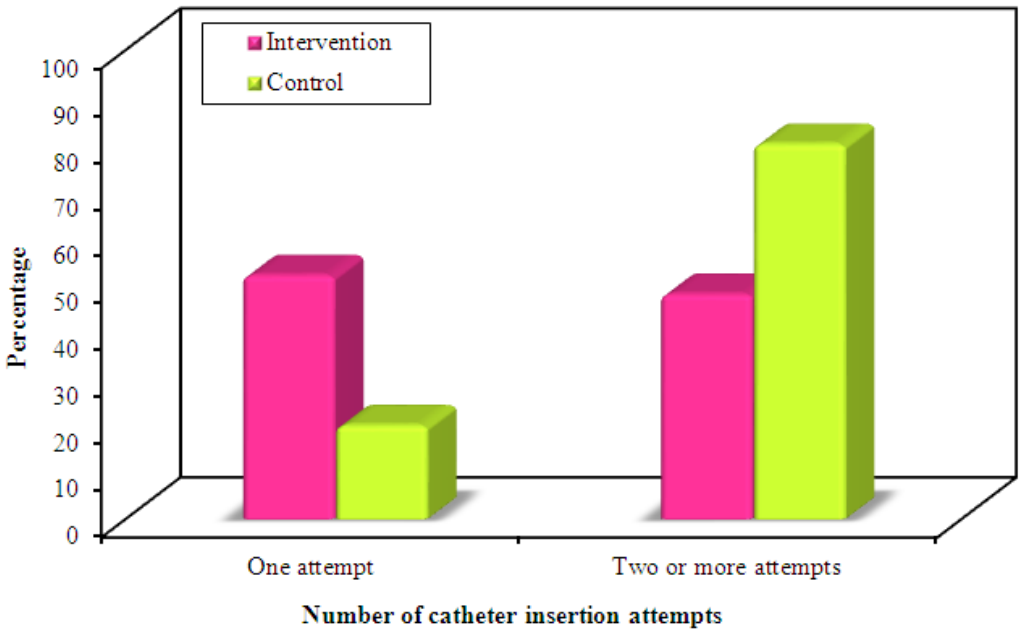


**Fig.1: Distribution of the studied patients according to the number of cannual insertion attempts (n = 100)**

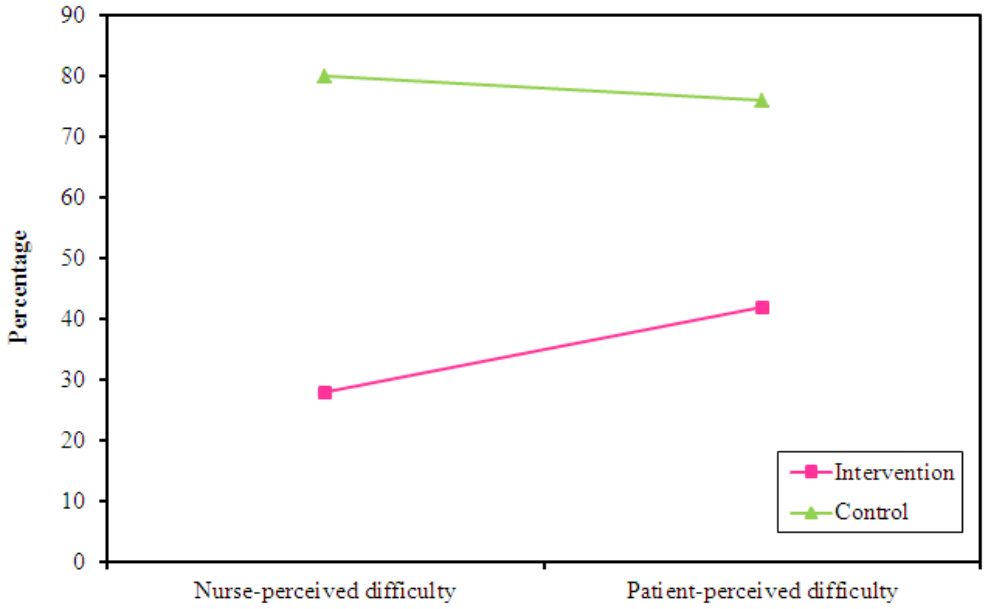


**Fig. 2: Distribution of the studied patients according to nurse and patients perceived difficulty during IV insertion (n = 100)**

**Table (3) & Fig 3. Demonstrates distribution of the studied patients according to vein status using vein assessment scale**

It shows that more than half of the cannulated veins in the control group (54.0%) had the score of 2 (veins are visible, but not palpable), and 40% of them had the score of 1(Veins neither visible nor palpable). In the intervention group, more than two third of the cannulated veins (68%) had the score of 1(Veins neither visible nor palpable), and 32% of them had the score of 2 (veins are visible, but not palpable) before applying heat on the affected site.

Following application of warm compresses, 28% of the cannulated veins in the intervention group were rated a score of 3 (veins are barely visible, and palpable), 18% of them were rated a score of 4 (veins are visible and palpable), and 20% of them rated a score of 5(veins are clearly visible and easily palpable). High significant improvements were detected between veins status before and after applying warm compresses in the intervention group, and also significance difference emerged between veins status in the control group and vein status following applying warm compresses in the intervention group ($p_1$<0.001*, $^{MC}p_2$=0.007*)

**Table (3): Distribution of the studied patients according to vein status using vein assessment scale**

| Vein assessment | | Intervention group (n = 50) | | | | Control group (n = 50) | |
|---|---|---|---|---|---|---|---|
| | | Before Warm compresses | | After Warm compresses | | | |
| | | No. | % | No. | % | No. | % |
| 1. | Neither visible nor palpable | 34 | 68.0 | 0 | 0.0 | 20 | 40.0 |
| 2. | Visible but not palpable | 16 | 32.0 | 17 | 34.0 | 27 | 54.0 |
| 3. | Barely visible and palpable | 0 | 0.0 | 14 | 28.0 | 3 | 6.0 |
| 4. | Visible and palpable | 0 | 0.0 | 9 | 18.0 | 0 | 0.0 |
| 5. | Clearly visible and easily palpable | 0 | 0.0 | 10 | 20.0 | 0 | 0.0 |
| **Test of significance** | | $p_1$<0.001*, $^{MC}p_2$=0.007* | | | | | |

MC: Monte Carlo

$p_1$: p value for Marginal Homogeneity test for comparing between veins status before and after applying warm compresses in the intervention group

$p_2$: p value for comparing between veins status in the control group and vein status after applying warm compresses in the intervention group

*: Statistically significant at $p \leq 0.05$

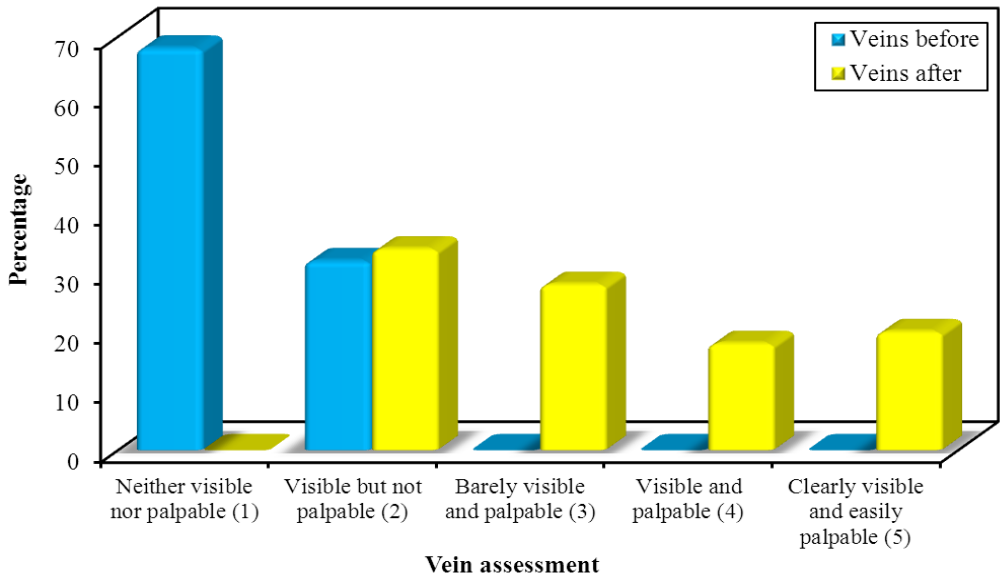


**Figure (3): The effect of warm compresses on vein status within the intervention group using vein assessment scale.**

**Table (4) & Fig (4) Displays distribution of the studied patients according to percent improvement of vein status within the intervention group after applying warm compresses (n = 50)**

It represents that the majority of patients (66%) in the intervention group had improvement in their vein status after applying warm compresses, while only 34% of them have unchanged vein status, and none of them had deteriorated vein status

**Table (4): Distribution of the studied patients according to percent improvement of vein status within the intervention group after applying warm compresses (n = 50)**

| Vein status after applying warm compresses | The intervention group (n = 50) | |
|---|---|---|
| | No. | % |
| Deteriorated | 0 | 0.0 |
| Not improved | 17 | 34.0 |
| Improved | 33 | 66.0 |

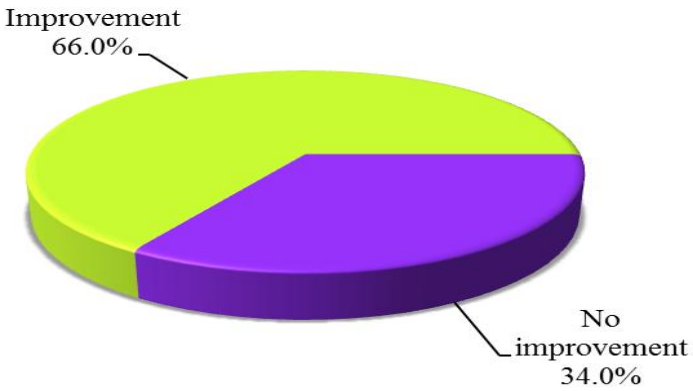


**Figure (4):Distribution of the studied patients according to percent improvement of vein status in the intervention group after applying warm compresses (n = 50)**

**Table (5): Shows distribution of the studied patients according to levels of pain during cannula insertion (n = 100)**

It demonstrates that 40% of patients in the intervention group had mild pain during cannula insertion. Also, more than half of patients (56%) in the intervention group had moderate pain compared to 80% of the control group who suffered from moderate pain. High statistical significant differences were detected between levels of pain in both groups as determined by pain scores as those of the intervention group were decreased compared to those in the control ($\chi^2$=11.492*,$^{MC}$p= 0.003*).

**Table (5): Distribution of the studied patients according to levels of pain during cannula insertion (n = 100)**

| Levels of pain during cannula insertion | Intervention group (n=50) | | Control group (n=50) | | $\chi^2$ | P |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| No pain 0 | 0 | 0.0 | 2 | 4.0 | | |
| Mild 1 – 3 | 20 | 40.0 | 6 | 12.0 | 11.492* | $^{MC}$p= 0.003* |
| Moderate 4 – 6 | 28 | 56.0 | 40 | 80.0 | | |
| Severe 7 – 10 | 2 | 4.0 | 2 | 4.0 | | |

$\chi^2$: Chi square test MC: Monte Carlo
p: p value for comparing between the two groups
*: Statistically significant at p ≤ 0.05

**Table (6): Presents distribution of the studied patients according to level of satisfaction after cannulation (n = 100)**

The table shows that the majority of patients in the intervention group (88%) were highly satisfied after cannulation, while the majority of the controls (64%) had low satisfaction. High statistical significant differences are detected between the two groups ($\chi^2$=79.380*, p <0.001*)

**Table (6): Distribution of the studied patients according to level of satisfaction after cannulation (n = 100)**

| Level of Patients' satisfaction | Intervention group (n=50) | | Control group (n=50) | | $\chi^2$ | P |
|---|---|---|---|---|---|---|
| | No. | % | No. | % | | |
| Low satisfaction <60% | 2 | 4.0 | 32 | 64.0 | | |
| Fair satisfaction 60–75% | 4 | 8.0 | 18 | 36.0 | 79.380* | <0.001* |
| High satisfaction >75% | 44 | 88.0 | 0 | 0.0 | | |

$\chi^2$: Chi square test
p: p value for comparing between the two groups
*: Statistically significant at $p \leq 0.05$

**Table (7): Shows relationships between socio-demographic characteristics and percent improvement in vein status within the intervention group (n=50)**

The table illustrates that within the intervention group, high statistical significant relationships are detected between patients' sex, age, and their percent improvement in vein status ($\chi2=12.121$*& p=0.001*, $\chi2=15.817$*& p=0.001* respectively). All male patients have improved vein status after interventions compared to only 50% improvement in females. The majority of patients (92%) in the improved vein status group were between 50-60 years.

Also, all patients with no history of problems during cannula insertion had vein improvement, and this result was highly significant ($\chi^2= 4.906^{*,FE}$p= $0.039^{*}$). However, no statistical associations were declared between the number of treatment cycles, and percent improvement in vein status.

**Table (7): Relationships between socio-demographic characteristics and percent improvement in vein status within the intervention group (n=50)**

| socio-demographic characteristics | Improvement in vein status | | | | Test of Sig. | P |
|---|---|---|---|---|---|---|
| | Not improved (n = 17) | | Improved (n = 33) | | | |
| | No. | % | No. | % | | |
| **Sex** | | | | | | |
| Male | 0 | 0.0 | 16 | 100.0 | $\chi^2=$ | |
| Female | 17 | 50.0 | 17 | 50.0 | 12.121* | <0.001* |
| **Age (years)** | | | | | | |
| 20 > 35 | 4 | 66.7 | 2 | 33.3 | | |
| 35 >50 | 11 | 57.9 | 8 | 42.1 | $\chi^2=$ | $^{MC}$p |
| 50 – 60 | 2 | 8.0 | 23 | 92.0 | 15.817* | <0.001* |
| Min. – Max. | 26.0 – 59.0 | | 30.0 – 60.0 | | t = | 0.002* |
| Mean ± SD | 41.59 ± 10.93 | | 51.33 ± 9.56 | | 3.251* | |
| **The number of treatment cycles** | | | | | | |
| Min. – Max. | 3.0 – 10.0 | | 2.0 – 9.0 | | t = | 0.321 |
| Mean ± SD | 5.53 ± 1.66 | | 5.0 ± 1.82 | | 1.002 | |
| **History of problems during cannula insertion** | | | | | | |
| Yes | 17 | 40.5 | 25 | 59.5 | $\chi^2=$ | $^{FE}$p= |
| No | 0 | 0.0 | 8 | 100.0 | 4.906* | 0.039* |

$\chi^2$: Chi square test MC: Monte Carlo FE: Fisher Exact t: Student t-test
p: p value for comparing between the two groups
*: Statistically significant at $p \leq 0.05$

**Table (8) Displays relationships between percent improvement in vein status and characteristics of (IV) cannulation within the intervention group (n = 50)**

The table illustrates that within the intervention group, there were no significant relationships between site of IV cannulation and vein percent improvement. There were significant improvement in vein status for almost all patients (96.2%) with one cannula insertion attempt, as ($\chi^2$= 21.948*, p<0.001*). Also, there was high significant reduction in the mean cannulation time in the improved vein status patients (t=2.510*, p=0.016*). The majority of both nurses, and patients in the improved vein status group didn't perceive difficulty during IV cannulation, and these results are highly significant, where ($\chi^2$= 12.139*, FE p=0.001*), ($\chi^2$= 22.603* , p<0.001*) respectively.

**Table (8): Relationships between percent improvement in vein status and characteristics of (IV) cannulation within the intervention group (n = 50)**

| Characteristics of (IV) cannulation within the intervention group | Improvement in vein status | | | | Test of Sig. | P |
|---|---|---|---|---|---|---|
| | Not improved (n = 17) | | Improved (n = 33) | | | |
| | No. | % | No. | % | | |
| **Site of IV cannulation** | | | | | | |
| Cephalic vein | 9 | 52.9 | 15 | 45.5 | $\chi^2$= 0.252 | 0.616 |
| Basilic vein | 8 | 47.1 | 18 | 54.5 | | |
| **Number of cannula insertion attempts** | | | | | | |
| One attempt | 1 | 3.8 | 25 | 96.2 | $\chi^2$= 21.948* | <0.001* |
| Two or more attempts | 16 | 66.7 | 8 | 33.3 | | |
| **The mean cannulation time (SD) (seconds)** | | | | | | |
| Min. – Max. | 120.0 – 900.0 | | 60.0 – 600.0 | | t = 2.510* | 0.016* |
| Mean ± SD | 285.9 ± 239.3 | | 156.4 ± 127.2 | | | |
| **Nurse-perceived difficulty** | | | | | | |
| Yes | 10 | 71.4 | 4 | 28.6 | $\chi^2$= 12.139* | FE p= 0.001* |
| No | 7 | 19.4 | 29 | 80.6 | | |
| **Patient-perceived difficulty** | | | | | | |
| Yes | 15 | 71.4 | 6 | 28.6 | $\chi^2$= 22.603* | <0.001* |
| No | 2 | 6.9 | 27 | 93.1 | | |

$\chi^2$: Chi square test MC: Monte Carlo FE: Fisher Exact t: Student t-test
p: p value for comparing between the two groups
*: Statistically significant at $p \leq 0.05$

## IV. Discussion

Insertion of IV cannula is a most distressing procedure for both patients and nurses in oncology units. The current study aimed to determine the effects of local warm compresses on the visibility and palpability of peripheral veins before peripheral venous cannulation for patients undergoing chemotherapy. The study also examined warm compresses' effects on patients' pain, and satisfaction related to IV insertion.

The results of our study showed high statistically significant difference between veins status before and after applying warm compresses in the intervention group (p <0.001*) and also, between veins status in the control group and intervention group following warm compresses ( p =0.007*). Moreover, the study findings revealed that about two third of the studied patients in the intervention group have significant improvement in their vein scores after warm applications, while more than third of them have unchanged vein scores, and none of them have deteriorated vein scores. These findings are in accordance with Fink et al (2009), who found that warm compresses improved the vein assessment score [30]. In addition**;** Kaur (2011), Ichimura et al (2011), and Robinson-Reilly (2016), found that, patients who applied heat 10 min before IV cannulation had improved veins visibility, relaxed muscles, and relieved pain[31-33]**.**

As regards to cannulation site, the present study revealed that**,** cephalic and basilic veins were the most commonly used sites for both intervention, and control subjects. In addition, there were no statistical differences between the use of these veins and the percent improvement in veins status within the intervention group. This finding is in accordance with Dougherty and Lister (2011), and Culverwell (2013) who mentioned that; cephalic/basilic veins were the sites of choice for cannulation in patients receiving chemotherapy as they can accommodate a variety of large sized cannula[34, 35]. In addition, Weinstein (2007) stated that basilica / cephalic veins are easily stabilized and cause very limited restriction in patient activity [36].

The results of the present study also declared that there were significant reduction in the mean insertion time in seconds in the intervention group (p = 0 .016), while it was nearly doubled in the control group. In other words, local warm application in the present study halved the mean insertion time from 396.0±246.1

seconds (control group) to 200.4±182.0 seconds (intervention group). In the same context, Jones et al (1989) and Piredda (2017) reported that the duration of IV cannulation, including vein selection, application of antiseptic solution to the site, and insertion of cannula, requires only 2–4 minutes to complete[37,38] . Also, Sumitani and Watanabe (2010) reported that the median time required for vein selection was 50 second, for antiseptic solution application was 10 seconds, and for cannula insertion was 70 seconds [39].

The present study findings revealed that more than half of the respondents in the intervention group had successful first cannula insertion attempt. This could be related to the vasodilatation effect of warm compresses before cannula insertion which leads to easy, and successful first attempt.

Similar findings were reported by Lenhardt et al (2002) and Lapostolle et al (2007), who found that the first successful cannula insertion rates were significantly higher in the intervention group who used warm applications than those in the controls [13, 40]. Also, these findings are nearly similar to the finding of Weinstein (2007), and Sabri et al (2013), who reported successful first IV insertion attempt in the majority of their patients after applying warmth on the insertion site[36,41]. Interestingly, our results revealed statistical significant correlation between percent improvement of vein status and the number of insertion attempts in the intervention group ($p < 0.001$*).

On the other hand, the results of the present study indicated that, more than three quarters of patients in the control group had failed first insertion attempt. This result is line with witting (2012), who found that the majority of participants had failed first IV attempt [42]. This could be related to decreased visibility of the veins and the irritating effect of chemotherapy that complicates the insertion of the IV cannula, causing several attempts.

In this regard, Kiger et al (2014) mentioned that; repeated intravenous attempts increase the risk for skin infection from multiple punctures, increase pain, and cause limitation of extremity movement [43]. Also, Weinstein (2007), Robert et al (2015), and cook et al (2018) reported that; the first attempt of IV cannulation mainly fails in the majority of adult patients [36, 44, 45].

Lenhardt et al (2002) mentioned that repeated intravenous insertion attempts increase patients' suffering, pain, and negatively affect their satisfaction [13]. In this regard, the present study findings indicated statistically significant difference between intervention and control groups in relation to levels of pain during cannula insertion. Nevertheless, Bayram et al (2016) reported significant reduction in pain scores in the intervention group compared to that in the control group ( $p= 0.011$*)[2]. However, Robinson – Reilly (2016) found a little difference in pain scores between the two groups during cannula placement, but it wasn't significant [33].

The study results presented that the majority of patients in the intervention group had higher satisfaction scores after IV cannulation, compared to the majority of the controls who had low satisfaction scores, and the differences were highly significant where ( $p< 0.001$). In contrast, Bayram et al (2016) found no statistical significant difference in patient satisfaction scores, between the intervention and control groups after IV cannulation[2]

Tokizawa et al (2017) illustrated that repeated, failed IV insertion attempts increase costs, time and effort of nurses [5]. In this regard, the present study findings declared that the majority of both nurses, and patients in the intervention group didn't perceive difficulty during cannula insertion, while the majority in the control group perceived difficulty. Supporting our findings, Bayram et al (2016), and Vitto et al (2016) found a significantly decreased mean nurse-perceived difficulty in the intervention group following warm application than those in the control group subjects [2, 46].

However, the current study findings differ from those findings of Kaur et al (2011), who found no significant differences related to nurses' perceived difficulty during cannula insertion in both control group and warm application group[1].

The present study has highlighted the high significant relationships between patients' sex, age, and their percent improvement in vein status within the intervention group. All male patients have improved vein status after interventions compared to only fifty percent improvement in females. This could be due to the fact that men have less subcutaneous fat, and more visible veins than women. Also, the bulky muscles of men require more nutrients, higher blood volume, and flow, which mean bigger and more visible veins.

In addition, the present study showed that, statistical relationships were observed between patients' age and percent improvement in veins status within the intervention group, as the majority of patients who achieved improvement in vein status were between 50-60 years, compared to two third of them , were between 20-30 years, who had no improvement in vein status after interventions. This finding is in accordance with Chiao et al (2013), who found a strong relationship between percent improvement in veins status following warm applications, and patients' age, where older patients achieved more percent improvement than younger adults [47]. In addition, Schwartz, et al (1990), and Fu & Fung (1995), stated that veins tend to become more prominent as we get older, and this is due to relocation of subcutaneous fat into visceral adipose tissue with age.[48, 49].

As chemotherapeutic agents are irritating the endothelial layer which causes tenderness, warmth or erythema on the skin, it was noticed that the smaller the number of chemotherapy cycles, the better the effectiveness of warm application. Similar findings were reported by Kaur et al (2011) and Kiger et al (2014), who detected significant improvement in patients' vein scores following warm compresses [1, 43]. However, the current study findings differ from those previous findings as statistical relationships between percent improvement in vein status, and the number of treatment cycles within the intervention group, were not verified. This could be due to the temporary improvement in vein status after warm application.

Local warm compresses is safe, easy, and cost effective nursing practice that facilitates the cannulation of veins in patients undergoing chemotherapy.

## V. Conclusions

In conclusion, using warm compresses before IV cannulation improved peripheral veins status in the majority of patients in the intervention group in accordance with the number of attempts, and the duration of IV procedure. Based on our findings, warm compresses improved patients' satisfaction, as the majority of patients in the intervention group (88%) were highly satisfied after cannulation. Also, high statistical significant relationships were detected between levels of pain in both groups as pain scores in the intervention group were decreased compared to that in the control group. In addition, high significant relationships are detected between patients' sex, age, and their percent improvement in vein status.

**Recommendations**

1. Implement studies to investigate the effect of infra-red vein technology device.
2. Assess factors that interfere with difficult peripheral intravenous cannulation.
3. Comparing the effect of dry and moist heat application on peripheral intravenous cannulation is advocated.
4. Implementing further researches, using a larger sample from other oncology units.
5. An in-service training programs regarding warm application before IV catheter insertion should be provided for nurses working at oncology units to improve their practice.

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