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EFFECT OF VEIN VISUALIZATION DEVICE ON PERIPHERAL INTRAVENOUS CATHETER INSERTION PAIN, ANXIETY, AND CANNULATION SUCCESS RATE AMONG PATIENTS RECEIVING CHEMOTHERAPY

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Abstract

Background: integrating vein visualization technology into oncology nursing practice contributes to improved clinical outcomes, including reduced pain, reduced anxiety level and higher successful insertion rates among chemotherapy patients. **Aim:** To evaluate the effect of using vein visualization device on (pain, anxiety, cannulation success rate) among patients receiving chemotherapy. **Design:** Quasi-experimental after -only nonequivalent control group design was utilized. **Sample:** A convenience sample of 60 adult male and female patients receiving chemotherapy for a period of six consecutive months, 30 in each group. **Tools:** the following tools were utilized in the current study: 1.Demographic and Medical Data Form (DMDF), 2. Adult Difficult Intra Venous Access (A-DIVA), 3. Numerical Rating Scale (NRS-11), 4. State Anxiety Inventory (SAI), 5. Success Rate Assessment Tool and 6. Vein Visualization Device (Pigeon Medical DVA30). **Results**: All participants in both groups received a 22-gauge cannula inserted in the hand (100%). 83.3% in the control group and 90.0% in the study group had severe insertion difficulty, there was highly statistically significant differences between the control and study groups regarding PVC insertion (pain, anxiety, and cannulation success rate) ($p < 0.001$). (83.3%) of the study group and 16.7% of the control group had successful insertion from the first attempt. Moreover, 80.0% of the control group need visualization time of 10–15 seconds, there was a highly statistically significant differences between both groups in pain scores as well complications during PVC insertion ($p < 0.001$; $p< 0.002$ respectively), , there was no statistically significant difference between the control and study groups regarding anxiety scores during PVC insertion ($p > 0.05$). **Conclusion:** vein visualization devices in PIVC insertion for chemotherapy patients is an effective intervention that significantly reduces pain, improves insertion success rates, but had no effect on anxiety levels. **Recommendation:** Future research with larger sample sizes should explore the integration of vein visualization devices within broader vascular access management programs in oncology practice.

Keywords: Vein Visualization Device, Cannulation Success Rate and Chemotherapy.

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INTRODUCTION

Peripheral intravenous catheterization (PIVC) is one of the most frequently performed invasive procedures in clinical practice, particularly among patients receiving chemotherapy. Repeated administration of cytotoxic drugs can damage the endothelial lining of veins, resulting in reduced vein visibility and fragility of peripheral vessels. (Yılmaz, Karacan, Macun, & Evrensel, 2025).Difficult peripheral intravenous access is a common clinical problem in oncology settings. Chemotherapy-related vascular changes, including sclerosis, thrombosis, and decreased vein elasticity, often make traditional visual and palpation techniques insufficient for identifying suitable veins. As a result, unsuccessful cannulation attempts may occur frequently, which can lead to increased pain, anxiety, and dissatisfaction among patients. Moreover, repeated needle insertions may cause additional complications such as hematoma formation, delayed treatment administration, and decreased patient trust in healthcare providers (Aung, Sengupta, Win, Rajkanna, & Oyibo, 2025). Several studies have evaluated the effectiveness of vein visualization devices in improving peripheral intravenous cannulation outcomes. These technologies can shorten the time required to locate suitable veins and increase the likelihood of successful cannulation. In patients receiving chemotherapy, the use of vascular imaging devices has been associated with improved vein identification and reduced catheter placement time compared with conventional methods. Additionally, both patient and nurse satisfaction levels have been reported to be significantly higher when vein visualization devices are used during the cannulation process (Xu, Zhao, Dong, & Lian, 2026).

Beyond improving procedural efficiency, vein visualization devices may also influence patient-related outcomes such as pain perception and anxiety levels. Difficult venous access and repeated needle attempts can significantly increase procedural stress among patients undergoing frequent intravenous treatments such as chemotherapy. Vein visualization can reduce the number of insertions attempts and shorten procedure duration, which may contribute to reduced procedural discomfort and improved psychological experience during cannulation (Eren, & Caliskan, 2022). However, additional research is required to clarify their impact on cannulation success rates, procedural pain, and patient anxiety in oncology populations (Behairy, Abdel Hakeim, & Abd El-Naby, 2023).

Significance of the study

Peripheral intravenous catheter insertion is the most common invasive procedure performed in healthcare settings, with up to 70% of inpatients requiring a PIVC during hospitalization (Liu et al., 2022). Despite their importance, up to 69% of PIVCs are removed before therapy completion due to dislodgement, phlebitis, occlusion, infiltration, or infection. Globally, more than two billion PIVCs are used annually (Larsen et al., 2021). PIVC failure leads to negative patient outcomes such as increased pain, anxiety, delays in treatment, and repeated reinsertions, as well as increased workload for nurses and higher healthcare costs. Consequently, strategies to prevent these negative outcomes are essential.

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It is observed from researcher experience that, the majority of patients who receiving chemotherapy verbalized the feeling of anxiety and pain from unsuccessful insertion of PIVC from first attempts. Currently, many studies reported the efficacy of vein visualization device in success rate, pain and anxiety (Alsbrooks & Hoerauf, 2023). It is hoped that the findings of this study might establish evidence-based data that can promote nursing practice research. Also, it is hoped that this effort will generate attention and motivation for further researches in this area of new technology and may benefit nurse practitioners, other healthcare providers, researchers, nursing educators as well as health care decision makers. Finally, it is hoped to employ new technology such as vein visualization device in the nursing curriculum and provide it to train student nurses and use it as a teaching device in clinical area.

MATERIALS AND METHODS

Aim of the Study

The aim of the current study was to evaluate effect of vein visualization device on peripheral intravenous catheter insertion pain, anxiety, and cannulation success rate among patients receiving chemotherapy**.**

Research Hypothesis

To achieve the aim of the study, the following hypotheses was postulated and tested:

H_1. Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have less total mean pain scores than those who don't.

H_2. Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have less total mean anxiety scores than those who don't.

H_3. Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have increase success rate than those who don't.

Research Design

Quasi-experimental after -only nonequivalent control group design was utilized in this study to evaluate the causal impact of using vein visualization device (independent variable) on insertion pain, anxiety level and cannulation success rate (dependent variable).

Setting

This study was conducted in Chemotherapy Outpatient Clinic at Kafer Elsheikh University Hospital. This outpatient clinic provides chemotherapy for patients with different types of cancer such as breast, colorectal and lung cancer, the most common of which is breast cancer. The chemotherapy outpatient clinic consists of two rooms, the first room for male patients and the second for female patients. Each room contain six beds and there is a room for nurses and doctor.

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Sample

A convenience sample of 60 adult male and female patients receiving chemotherapy; 30 in each group was recruited in the current study for a period of six consecutive months. The following inclusion criteria was utilized.

Inclusion criteria

1) Adult male and female patients between 18-60 years old who received the first cycle of chemotherapy
2) Patients who had moderate and severe difficult PIVC insertion as measured by Adult-Difficult Intravenous Access tool.

Exclusion criteria

1) Patients who had porta-cath or sub-clavian line.
2) Patients who had dark skin.
3) Patients who had obesity (BMI more than 30). The study sample was divided randomly into two equal groups (study and control groups). The researcher collected the data started with the control group then the study group to prevent contamination.

Data Collection Tools

The researcher collected data using the following tools:

1) Demographic and Medical Data Form (DMDF): It was developed by the researcher and consists of two parts: Part I: Patient's personal data related to age, gender, marital status, level of education, occupation…etc. Part II: Medical data pertinent to medical diagnosis, BMI, previous exposure to intravenous cannulation, size of cannula, site of cannula onset of receiving chemotherapy, and vital signs and…. etc.

2) Adult Difficult Intra Venous Access (A-DIVA): It has been adapted internationally and accepted as standard tool for measuring the degree of difficult cannulation developed by (Van Loon et al. ,2019), it includes five items (a known history of difficult intravenous access, an expectation of difficult intravenous access by the practitioner prior to the intravenous cannulation, the inability to detect a dilated vein through palpation and/or visualization of the extremity, and a target vein diameter of less than 3 mm).

3) Numerical Rating Scale (NRS-11): It has been adapted internationally and accepted as standard tool for measuring pain intensity in adults developed by (McCaffery, Beebe 1989). It used for measuring pain intensity in adults. The pain Numeric Rating Scale (NRS-11) is an 11–point Likert scale.

4) State Anxiety Inventory (SAI): It has been adapted internationally and accepted as standard tool for measuring state anxiety developed by Charles & Speilberger (1964). It evaluated the state of anxiety, asking how respondents feel “right now,” using items that measure subjective feelings of apprehension, tension, nervousness, worry, and activation/arousal of the autonomic nervous system.

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5) Success Rate Assessment Tool: It is an adopted tool that measures PIVC success rate was developed by the researcher based on extensive literature review. It involved items related to first attempts success rate, number of attempts …etc.

6) Vein Visualization Device (Pigeon Medical DVA30): Is a portable near -infrared, non- invasive vein visualization device designed and manufactured by Pigeon Medical Company. It was used to scan and locate veins more easily, typically for intravenous access. It was designed for ease of use with various adjustable setting such as brightness adjustment, color mode and depth recognition.

Ethical Consideration

Official permission was obtained from the Ethical and Research Committee of the Faculty of Nursing – Cairo University with approval No. (RHDIRB2019041701). As well as Kafer Elsheikh hospital' administrators to conduct the study. The purpose and nature of the study as well as the importance were explained to the potential participants who met the selection criteria. Signed informed consent was obtained from all patients who choose to participate in the study. Also, anonymity and confidentiality were assured through coding the data. Participants were assured that participation in this study is completely voluntary and they have the right to withdraw from the study at any time without any penalty. Also, all researches viewed that vein visualization device is non- invasive, safe to use and there is no any harm from it.

Procedure

Once official permission was granted from Research Ethics Committee at Faculty of Nursing Cairo University, an official permission was obtained from hospital administrators to proceed with the proposed study, then the researcher initiated the data collection through three phases: preparatory, implementation and evaluation phase**. Preparatory phase**: It was carried out after obtaining official permission from the Research Ethics Committees in Faculty of Nursing Cairo University and from the head of the center to proceed. The researcher started to collect data from the control group then the study group. After that, the participants who met the inclusion criteria was recruited individually to explain the nature and purpose of the current study. In the study group. The researcher assessed ADIVA for study and control group if patient ADIVA score is moderate or severe was selected in the current study, BMI was assessed (BMI more than 30 was excluded from the study) and place of vein during PIVC insertion will be the same for all participants .Also, demographic and medical data gathered at that time and the time required for this phase take 45-60 minutes. **Implementation phase**: The researcher met the participants who fulfilled the selection criteria and agreed to participate in the study to obtain written consent from them. For the study group PIVC insertion was performed with vein visualization device, the patients was on semi setting position and the most ideal viewing is performed at 15 cm distance perpendicular to the skin manually or by fixing it on the table near to the patients, then when veins become visible the researcher selected one suitable vein and put the tourniquets and started to insert PIVC. The same cannula size and the same anatomical site of vein was chosen for all patients during the venous access

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insertion to prevent the variation of pain and anxiety in both groups. Peripheral intravenous catheter insertion in control group was using traditional method. The same researcher inserted PIVC for both control and study group. This phase took approximately 15-20 minutes. **Evaluation phase**: Immediately following the procedure tool II (Numerical Pain Scale) III (State anxiety Inventory), tool IV (Succes Rate Assessement Tool) was measured for both groups. This phase took 30-45 minutes.

Statistical Analysis

Obtained data was tabulated, computed and analyzed using statistical package for the social science (SPSS) program version 23(IBM Corp. Released 2015. IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: IBM Corp). Descriptive as well as inferential statistics was utilized to analyze data pertinent to the study. Pearson correlation test (r -test) assessed correlation between the study variables. Level of significance adopted at p≤0.05.

RESULTS

Table 1: Frequency & percentage distribution of demographic data among the study participants in both groups (N=60)

Variables	Control group (n=30)		Study group (n=30)		Chi square test	
	No.	%	No.	%	χ^2	P
Age (years):						
20-<30	0	0.0	0	0.0		
30-<40	2	6.7	2	6.7	4.0	.41
40-<50	9	30.0	9	30.0		
50-<60	19	63.3	19	63.3		
Gender:						
Male	6	20.0	4	13.3	1.58	.45
Female	24	80.0	26	86.7		
Marital status:						
Single	1	3.3	1	3.3		
Married	23	76.7	24	80.0	1.02	.80
Divorced	1	3.3	0	0.0		
Widow	5	16.7	5	16.7		
Education:						
Can't read or write	17	56.7	16	53.3		
Can read and write	9	30.0	8	26.7		
Primary school	3	10.0	0	0.0	8.09	.09
Secondary school	0	0.0	5	16.7		
Bachelor	1	3.3	1	3.3		
Employment:						
Employed	0	0.0	2	6.7		
Not employed	6	20.0	3	10.0	4.08	.25
Retired	23	76.7	25	83.3		
Housewife	1	3.3	0	0.0		
Residence:						
Urban	6	20.0	5	16.7	.11	.74
Rural	24	80.0	25	83.3		

*p value is significant at ≤0.05, highly significant at ≤0.001.

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Table (1) shows that there is no statistically significant differences between the control and study groups regarding personal characteristics ($p > 0.05$), 63.3% of participants in both groups are aged between 50 and less than 60 years, 80.0% in the control group and 86.7% in the study group are females, 76.7% and 80.0% among two groups are married respectively. 56.7% among control group and 53.3% among study group are unable to read and write, 76.7% and 83.3% among two groups are retired and residing in rural areas 80.0% and 83.3% respectively.

Table (2): Frequency and Percentage Distribution of Medical Data among Control and Study Groups (N=60)

Variables	Control group (n=30)		Study group (n=30)		Chi square test	
	No.	%	No.	%	χ^2	P value
Current diagnosis: Colon cancer	7	23.3	8	26.7	3.16	.21
Breast cancer	20	66.7	22	73.3		
Brain cancer	3	10.0	0	0.0		
Chemotherapy sessions: 1	30	100.0	30	100.0	1.02	.31
Chronic diseases: Yes	16	53.3	18	60.0	.27	.60
No	14	46.7	12	40.0		
If yes: DM	7	23.3	10	33.3	3.16	.21
HTN	1	3.3	1	3.3		
DM& HTN	5	16.7	1	3.3		
BMI: Underweight	4	13.3	2	6.7	8.19	.02
Normal	15	50.0	6	20.0		
Overweight	11	36.7	22	73.3		

*p value is significant at ≤0.05, highly significant at ≤0.001.

Table (2) illustrates that there were no statistically significant differences between the control and study groups concerning current diagnosis, number of chemotherapy sessions, and presence of chronic diseases ($p > 0.05$). 66.7% in the control group and 73.3% in the study group diagnosed with breast cancer. 96.7% and 100%, of two groups respectively had received one chemotherapy session. There was a statistically significant difference regarding BMI ($p = 0.02$), where overweight patients constituted in the study group (73.3%), compared to 36.7% in the control group.

Table 3: Comparison between Control and Study Groups Regarding Pain Score (n=60)

Variables	Control group (n=30)		Study group (n=30)		Chi square test	
	No.	%	No.	%	χ^2	P value
2	0	0.0	1	3.3	50.77	<.001
3	0	0.0	12	40.0		
4	0	0.0	14	46.7		
5	6	20.0	0	0.0		
6	10	33.3	3	10.0		
7	9	30.0	0	0.0		
8	5	16.7	0	0.0		

*p value is significant at ≤0.05, highly significant at ≤0.001.

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Table (3) reveals that there is a highly statistically significant difference between the control and study groups in pain scores during PVC insertion ($p < 0.001$). In the control group, 30.0% and 16.7% of participants experienced pain scores of 7 and 8, respectively. In contrast, 40.0% and 46.7%, respectively of the study group reported pain scores of 3 and 4.

Table (4): Comparison between Control and Study Groups As Regard Anxiety Scores (n=60)

Anxiety score	Control group		Study group		t-test	
	Mean	SD	Mean	SD	t	P
	42.97	2.03	35.43	2.94	11.55	.15

*p value is significant at ≤0.05, highly significant at ≤0.001.

Table (8) demonstrates that there is no statistically significant difference between the control and study groups regarding anxiety scores during PVC insertion ($p > 0.05$). However, the mean anxiety score was (42.97 ± 2.03) in the control group compared to (35.43 ± 2.94) in the study group.

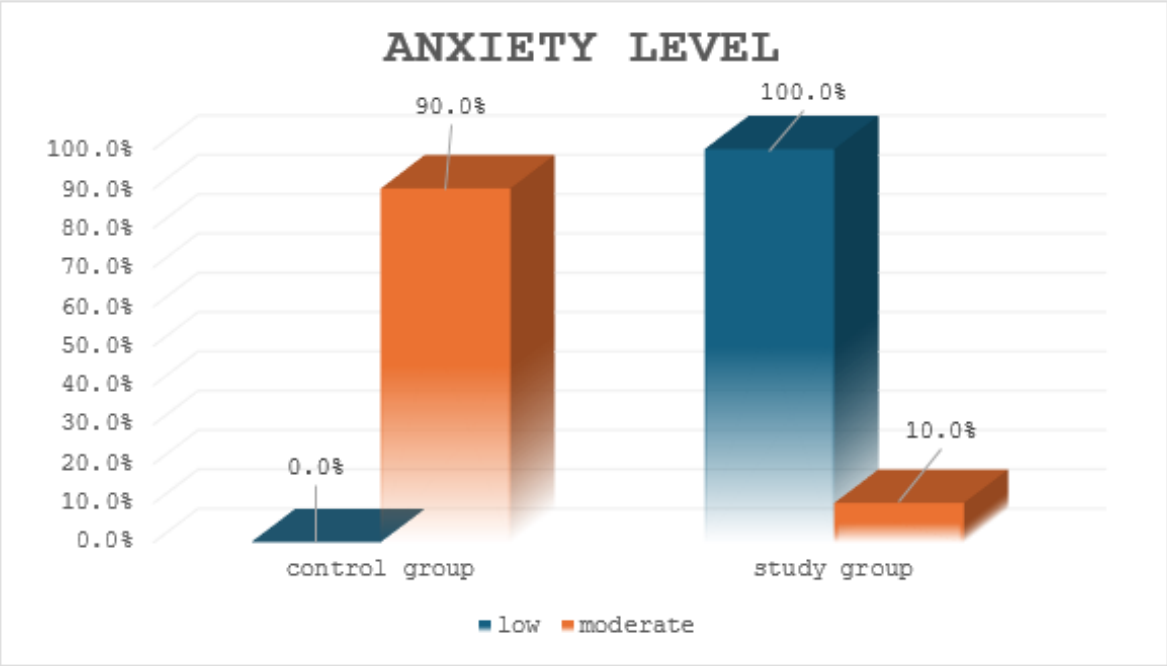

Figure 1: Comparison between control and study groups regarding anxiety level during PVC insertion

Figure (1) illustrates that there were lower anxiety level during PVC insertion at study group moderate anxiety was (10%) than control group (90%).

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Table 4: Comparison between Control and Study Groups Regarding Successful PVC Insertions (n=60)

Variables	Control group (n=30)		Study group (n=30)		Chi square test	
	No.	%	No.	%	χ^2	P
First attempt: No	25	83.3	5	16.7	26.67	<.001
Yes	5	16.7	25	83.3		
If no, number of trials: 2	10	33.3	15	50	30.81	<.001
3	9	30	9	30		
4	6	20	1	3.3		
Visualization time: <5 seconds	1	3.3	9	30.0	33.18	<.001
5-10 seconds	5	16.7	19	63.3		
10-15 seconds	24	80.0	2	6.7		
Mean ∓ SD	12.09 ± 1.10		6.22 ± 0.93			
Time taken for insertion: 2 minutes	1	3.3	8	26.7	23.10	<.001
3 minutes	4	13.3	17	56.7		
4 minutes	22	73.3	2	6.7		
≥5 minutes	3	10	3	10		
Mean ± SD	3.99±0.98		2.01±0.18			

*p value is significant at ≤0.05, highly significant at ≤0.001.

Table (4) demonstrates that there is highly statistically significant differences between the control and study groups regarding PVC insertion outcomes ($p < 0.001$). (83.3%) of the study group and 16.7% of the control group had successful insertion from the first attempt. Moreover, 80.0% of the control group need visualization time of 10–15 seconds, whereas 63.3% in the study group ranged between 5–10 seconds. And the average visualization time needed was (12.09 ± 1.10) in control group and (6.22 ± 0.93) in study group. The average visualization time taken is higher in control group (12.09 ± 1.10) than in study group (6.22 ∓ 0.93) in seconds. And the average time taken for insertion is higher in control group (3.99 ± 0.98) than in study group (2.01 ± 0.18) in minutes.

DISCUSSION

Regarding the sample characteristics of the study participants, the current study findings showed that there was no statistically significant differences between the control and study groups regarding personal characteristics such as age, gender, marital status, literacy level, occupational status, and place of residence ($p > 0.05$). This similarity between groups may be due to appropriate sample selection and allocation, which ensured homogeneity and minimized the influence of confounding demographic variables on the study outcomes. This finding is consistent with the study conducted by Yılmaz, Karacan, Macun, & Evrensel, (2025), entitled “The effect of near-infrared vein visualization on vein visibility, pain, fear, and patient satisfaction during peripheral intravenous catheterization in adult oncology patients: a randomized controlled trial”, which reported no significant differences between study groups in baseline demographic

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characteristics (P > 0.05), while demonstrating improved vein visibility scores in the intervention group using near-infrared vein visualization devices. Similarly, Kuramoto and Watanabe (2022), in their study titled “Effectiveness of vein visualization devices for peripheral intravenous catheterization in patients with difficult venous access”, emphasized that patient demographics such as age and gender were not significant predictors of venous access success, whereas repeated chemotherapy exposure played a major role in vein deterioration, supporting the present study findings. Likewise study conducted by Radwan, Kanona, & Abd-Elghafar, (2022), entitled Effect of moist heat on vein’s integrity and pain among patients receiving peripheral intravenous chemotherapy and the researchers reported the same findings

Regarding age, the current study findings showed that there were no statistically significant differences between the control and study groups regarding age distribution with the majority of participants in both groups, theiraged ranged between 50 to less than 60 years. This might be because of the decreased elasticity of the blood vessels at an advanced age, which could contribute to difficult insertion and cannulation additionally, this may be due to the fact that chemotherapy services predominantly serve middle-aged and older adults, who are more vulnerable to chronic diseases and malignancies. This finding is in agreement with Yılmaz, Karacan, Macun, & Evrensel, (2025), which demonstrated no statistically significant differences in age between intervention and control groups while reporting that vein visualization technology improved vein visibility regardless of patient age. Similarly, Sou, McManus, Mifflin, Frost, & Alexandrou, (2021). A clinical pathway for the management of difficult venous access reported that although older age was associated with difficult venous access, the use of vein visualization devices reduced age-related cannulation difficulties.

As regards gender, the current study findings showed that there were no statistically significant differences between the control and study groups regarding gender with females constituting the majority of participants in both groups. This may be attributed to the higher prevalence of certain cancers among females and their increased utilization of chemotherapy services and venous access difficulties due to subcutaneous fat distribution and vein diameter among female, as well, catheter insertion procedure is more difficult in women compared to men because of the smaller caliber of peripheral veins in women. This finding matched the results of Perry, Caviness, & Hsu, (2020) emphasized that gender was not a significant predictor of cannulation success when assistive vein visualization tools were used. Furthermore, this study agreed with Radwan, Kanona, & Abd-Elghafar, (2022), about effect of moist heat on Vein’s integrity and pain among patients receiving peripheral intravenous chemotherapy which found that the majority of the studied patients were females. While, this is different from the results Sarsar et al. (2019) with “Study to Assess the Effect of Moist Heat Therapy on Ease of Peripheral Venous Cannulation among Patients Admitted in Selected Hospital of Ambala” mentioned that the majority of the studied groups were males. Concerning educational level, the current study findings showed that there were no statistically significant differences between the control and study groups regarding educational level with more than half of participants in both groups being unable to read and write. This may be

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explained by the advanced age of participants and the predominance of rural residence, where educational opportunities are often limited. This finding is consistent with Kuramoto and Watanabe (2022) in their study titled “Effectiveness of vein visualization devices for peripheral intravenous catheterization in patients with difficult venous access”, which reported no significant association between patients’ educational level and cannulation success when vein visualization devices were used.

Regarding residence, the current study findings showed that there were no statistically significant differences between the control and study groups regarding place of residence, with the majority of participants residing in rural areas. This may be due to the hospital serving a large rural catchment area and acting as a referral center for oncology patients. Rural residence has been associated with delayed cancer diagnosis and prolonged chemotherapy exposure, which can exacerbate venous damage and increase the difficulty of venous access. This finding is supported by McLaughlin, Anderson, & Ferketich (2020) in their study “Rural–urban disparities in cancer treatment and outcomes”, which reported that rural patients commonly experience repeated venous access due to delayed presentation. As regards employment status, the current study findings showed that there were no statistically significant differences between the control and study groups regarding employment status with the majority of participants in both groups being retired. This may be attributed to the age distribution of the study sample, as most participants were aged between 50 and less than 60 years, an age group commonly affected by chronic illnesses and malignancies that limit occupational engagement. This finding is consistent with Yılmaz, Karacan, Macun, & Evrensel, (2025), which reported no statistically significant differences between intervention and control groups regarding occupational status indicating adequate baseline equivalence prior to intervention. Similarly, Aulagnier et al. (2019), in their study “Efficacy of infrared vein visualization devices in adults with difficult venous access”, found that employment status did not significantly influence venous access success rates when assistive vein visualization technologies were used, supporting the current study findings

Regarding current diagnosis, the current study findings showed that there were no statistically significant differences between the control and study groups regarding current diagnosis near two thirds in the control group and more than two thirds in the study group diagnosed with breast cancer. This may be due to the high prevalence of breast cancer among adults receiving chemotherapy, as it remains one of the most commonly treated malignancies worldwide. This finding is supported by Erişen and Yılmaz (2023) in their study titled “Comparison of chemotherapy treatment administration via venous port and peripheral vascular access…”, where breast cancer patients constituted over two third of their sample and there was no significant difference in cancer type between groups prior to intervention indicating that diagnostic distribution did not influence outcomes related to venous access success or patient satisfaction. As regards number of chemotherapy sessions, the current study findings showed that there were no statistically significant differences between the control and study groups in terms of number of chemotherapy sessions and the highest percent of the control group and of the study group having received only one session. This similarity may be attributed to recruitment of patients early

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in their chemotherapy regimens, where vascular damage and sclerosis are minimal. Similar results were observed in the systematic review by Zaki et al. (2025) titled "Outcomes of POCUS-Guided Peripheral Intravenous Access in Difficult Venous Access Patients", which reported that 85% of participants in analyzed trials had ≤ 2 chemotherapy cycles and there were no significant baseline differences in session number between intervention and comparison groups, whereas cumulative cycles correlated with increased venous access difficulty.

About presence of chronic diseases, the current study findings showed that there were no statistically significant differences between the control and study groups regarding the presence of chronic diseases, in which more than half among two had chronic disease especially diabetes mellitus. It is explained that certain chronic diseases may cause the deterioration and hardening of the vascular structure, rendering the catheter placement process difficult especially diabetes mellitus, and vascular diseases are among the conditions that render vein access difficult. In addition to that most of patients had breast cancer and intravenous chemotherapy treatment or surgical procedure/ dissection of the lymph nodes associated with breast cancer reduces the visibility and palpability of the vein. This aligns with the findings by Bahl, Alsbrooks, Zazyczny, Johnson, & Hoerauf, (2024), in their research "An Improved Definition and Safe Rule for Predicting Difficult Intravascular Access", which reported that chronic comorbidities were present in approximately 40% of patients across groups but did not independently predict venous access success after adjusting for other factors such as BMI or vein visualization technique.

Regarding body mass index (BMI), the current study findings showed that there was a statistically significant difference between the control and study groups regarding BMI ($p = 0.02$), with more than two thirds of the study group constituting overweight patients compared to more than one third of the control group. This may be due to the increase in weight may cause an increase in the adipose tissue and, therefore, a decrease in the visibility of the veins and palpability. The effect of adipose tissue on venous anatomy and accessibility has been documented by Liu et al. (2023) in their study titled "Effect of skinfold thickness on arm venous access port in cancer patients", where patients with higher skinfold thickness (BMI ≥ 25 kg/m²) had significantly lower vein palpability and higher difficulty scores for peripheral access compared to individuals with normal BMI ($p < 0.01$). Furthermore, Fraifeld and Thompson (2023) found that integration of near-infrared vein visualization technology significantly improved first-attempt peripheral IV success in overweight patients (BMI ≥ 25 kg/m²) from 42% to 68% success rate, indicating that BMI is a modifiable predictor of venous access difficulty when appropriate assistive tools are used.

In relation to the study findings on research hypotheses, **H_1. Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have less total mean pain scores than those who don't.** The current study findings showed that there was a highly statistically significant difference between the control and study groups in pain scores during peripheral venous catheter (PVC) insertion, whereas after using vein

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visualization device, near half of the study group reported lower pain scores of 3 and 4, while, in the control group, about one third reported high pain scores of 7 and 8, respectively,. This marked difference suggests that using vein visualization device contributed to reduced procedural pain, in which pain reduction during cannulation may be due to fewer needle passes and decreased tissue trauma when veins are accurately visualized prior to insertion, resulting in less nociceptive stimulation. These findings are supported by Carr et al. (2021) in their randomized trial titled “Effect of vein visualization technology on pain perception during peripheral intravenous catheterization”, which found that patients in the visualization-assisted group reported significantly lower pain scores (mild pain) compared to the conventional technique group (severe pain). Their study showed that around two third of the visualization group reported mild pain, compared with only 18% in the control group reporting severe pain.

This is further confirmed by Myles et al. (2020) in “Peripheral intravenous catheterization pain: an observational study”, where patients with difficult venous access using standard techniques had pain scores predominantly in the high range (severe pain), while those aided by vein access devices reported significantly lower pain scores (mild pain); Additionally, Bates et al. (2022) reported that pain scores during catheterization are directly correlated with the number of insertion attempts, and first-attempt success significantly decreases pain perception (lower pain score mean) compared to multiple attempts (higher pain score mean)

For the study hypothesis: **Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have less total mean anxiety scores than those who don’t,** the current study findings showed that there was no statistically significant difference between the control and study groups regarding anxiety scores during peripheral venous catheter (PVC) insertion after using a vein visualization device. However, the mean anxiety score was noticeably lower in the study group) compared to the control group. This reduction, although not statistically significant, may reflect the psychological reassurance provided by vein visualization devices, which can enhance patients’ perception of procedural control and reduce anticipatory fear associated with needle insertion.

These findings are consistent with Kaddoum et al. (2020) in their randomized clinical trial titled “Near-infrared vein visualization and anxiety levels during peripheral intravenous cannulation”, which reported no statistically significant difference in anxiety scores between visualization-assisted and conventional cannulation groups. Nevertheless, the authors observed a lower mean anxiety score in the visualization group compared with the control group, suggesting a potential clinical benefit despite the absence of statistical significance. Similarly, Park & Kim (2021) examined anxiety responses during PVC insertion in adult oncology patients in their study “Psychological outcomes of vein visualization–assisted intravenous access”. They found that although anxiety reduction did not reach statistical significance, patients in the visualization group demonstrated lower mean anxiety scores than those in the standard care group. The authors attributed this trend to reduced uncertainty and increased confidence in the procedure when

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visualization devices were used. In contrast, Taddio et al. (2019) highlighted that anxiety during needle-related procedures is multifactorial and not solely dependent on technical success. Their study “Psychological determinants of anxiety during needle procedures” emphasized that prior experiences, fear of pain, and individual coping mechanisms significantly influence anxiety levels, which may explain why improved technical approaches, such as vein visualization, do not always result in statistically significant anxiety reduction.

In relation to improving vein visualization before using vein visualization the current study hypothesized that; **Using vein visualization device in PIVC insertion for patients receiving chemotherapy will have increase success rate than those who don’t,** the current study findings showed highly statistically significant differences between the control and study groups regarding peripheral venous catheter (PVC) insertion outcomes where the majority of the study group achieved successful insertion from the first attempt after using vein visualization device compared to only few percent of the control group. This difference may be attributed to the effectiveness of vein visualization techniques in enhancing vein contrast, facilitating accurate vein selection, and minimizing blind insertion attempts, especially among patients with difficult venous access. This finding is consistent with the study conducted by Eren, & Caliskan, (2022), about effect of a vein imaging device and of fist clenching on determination of an appropriate vein and on catheter placement time in patients receiving chemotherapy: a randomized controlled trial, who found that the durations of determining the appropriate vein and successful peripheral intravenous catheter insertion were shorter in the device group at a significant level compared with the control group and finally concluded that the vascular imaging device was effective in determining the proper vein and in successful intravenous catheter insertion time in patients who were receiving chemotherapy.

Moreover, in an study carried out by Hess (2019) entitled “Use of vein visualization technology to improve peripheral intravenous cannulation success”, which reported that first attempt success increased from 41% using conventional techniques to 69% when vein visualization devices were utilized, with statistically significant differences between groups. Similarly, Park et al. (2021) demonstrated that visualization-assisted cannulation significantly improved first-attempt success among oncology patients with difficult venous access, achieving success rates exceeding 70% compared to less than 30% in standard practice groups. Regarding visualization time, the current study findings revealed highly statistically significant differences between the control and study groups regarding vein visualization time (. after using vein visualization device, more than half of the study group required only 5–10 seconds, with a significantly lower mean visualization time in the study group (6.22 ± 0.93 seconds) compared to the control group (12.09 ± 1.10 seconds), whereas the majority of the control group required 10–15 seconds to identify an appropriate vein. This reduction in time may be explained by the real-time mapping of superficial veins provided by visualization devices, which decreases reliance on palpation and repeated inspection. Comparable findings were reported by Chapman et al. (2020) in their study “Time efficiency of near-infrared vein visualization during peripheral intravenous catheter insertion”, where the mean vein identification time decreased from

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13.6 seconds in the standard group to 7.1 seconds in the visualization group). Additionally, Ramer et al. (2022) found that visualization-guided techniques reduced vein localization time by approximately 45%, particularly in patients with high venous difficulty scores .

The significant improvement in first-attempt success and reduction in visualization time observed in the current study has important clinical implications for chemotherapy care. Faster and more accurate vein identification reduces patient discomfort, procedural anxiety, and the risk of vascular trauma associated with multiple insertion attempts. This is supported by Fields et al. (2021) in their study “Impact of failed peripheral intravenous attempts on patient experience and vascular outcomes”, which reported that patients experiencing multiple insertion attempts had a 2.5-fold increase in pain scores and higher rates of phlebitis compared to those with first-attempt success .

CONCLUSION

Based on the findings of the present study, the use of a vein visualization device during peripheral intravenous catheter (PIVC) insertion for patients receiving chemotherapy demonstrated a clear positive impact on several key clinical outcomes. Patients in the study group reported significantly lower pain scores compared to those in the control group, indicating that visualization-assisted cannulation effectively reduces procedural pain by minimizing multiple insertion attempts and tissue trauma. As well as, the use of a vein visualization device would lead to lower total mean scores of anxiety. In relation to the success rate of PIVC insertion, the study findings, demonstrated a significantly higher first-attempt success rate among the study group, along with reduced visualization and insertion time, confirming the effectiveness of vein visualization technology in enhancing procedural efficiency and accuracy.

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