Effect of Nursing Interventions Protocol on Patients with Arterial Cannulation at Intensive Care Unit

Nora Abd Elazim Mohamed [1,2], Safaa Eid Said ahmed [3], Mona Belogh Elmorad Mohamed [4], Nagwa Said Gomaa [5]

[1] Master student of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt

[2] Bachelor of Nursing Sciences, Faculty of Nursing, Tanta University, Egypt

[3] Prof of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt

[4] Assist. Prof of Anesthesia and Surgical Intensive Care, Faculty of Medicine, Tanta University, Egypt

[5] Lecturer of Critical Care and Emergency Nursing, Faculty of Nursing, Tanta University, Egypt

Abstract: - arterial cannulation is a common invasive operation in the intensive care unit, used for a variety of reasons. nursing care is crucial for patients undergoing arterial cannulation in order to guarantee patient safety and minimize complications,. **Aim**: - Assess the impact of nursing interventions on patients in the intensive care unit who have arterial cannulation. **Design**: is quasi-experimental. **Setting:** Tanta Main University's New Surgeries Hospital's intensive care unit served as the study's site. **Subjects:** A purposeful sample of 60 adult patients undergoing arterial catheterization was split into two equal groups. The study group was overseen by a nursing intervention protocol created and carried out by the researcher, while the control group received standard care from the surgical intensive care unit nursing staff. **Tools:** -An arterial cannulation complications assessment tool and a critically ill patient assessment tool were also utilized. **Results:** Vascular complications and pain intensity were significantly different between the two groups. After arterial catheter removal, there was a significant decrease in peripheral ischemia consequences in the study group as compared to the control group (mean score of 2.00±1.45 vs. 8.10±2.05, respectively). Additionally, the study group experienced much less pain than the control group, with mean scores of 0.00±0.00 and 3.47±0.937, respectively. **Conclusions:** Clinical outcomes for patients with arterial cannulation improved as a result of the nursing interventions strategy. **Recommendations:** Nursing Interventions Protocol should be carried out as a routine care for patients at Intensive Care Units, as there was a significant improvement in the study group in decreasing vascular complications.

Key words: Arterial Cannulation, Intensive Care Unit, Nursing Interventions protocol.

Introduction

Continuous patient monitoring is crucial because critically sick patients frequently experience a life-threatening, multisystem failure process that could cause significant morbidity or death. **(S El-helaly, S abd-alazeem& E Mostafa, 2022; Brown, Ballal & Al-Haddad. 2024).** Monitoring a patient in an intensive care unit (ICU) is done to improve patient care, such as by changing the patient's treatment or moving them to a step-down unit. Arterial blood pressure, central venous pressure (CVP) measurement, pulmonary artery catheterization, arterial blood gas (ABG) analysis, and other measures are all part of invasive monitoring in an intensive care unit. **(Angelucci, Greco, Cecconi & Aliverti, 2025).** The patient's underlying condition and the ICU's equipment availability determine how the physiologic parameters are monitored. **(Renner, Grünewald & Bein., 2016).** An essential ICU operation, arterial cannulation minimizes the need for repeated punctures and enables regular blood gas analysis and direct blood pressure monitoring. **(Walsh, Srivastava & Fitzsimons, 2025; Punja & Schenarts, 2023).**

The US intensive care unit, reported arterial catheter utilization is 51.7% for patients in need of vasopressors and 49.2% for patients on mechanical ventilation. **(Imbriaco, Monesi & Spencer, 2022).** In Egypt, arterial cannulation is performed on 10–97% of patients hospitalized to intensive care units, depending on their clinical circumstances. The dorsalis pedis, posterior tibial, radial, brachial, femoral, and ulnar arteries, as well as the temporal arteries, are potential cannulation sites. **(Elgendy & Ganawc, 2023).** In adults, the radial artery is typically the most accessible location for cannulation because of a number of benefits and a lower incidence of related problems. **(Hager & Burns 2023).**

Artery cannulation is generally a fairly safe technique, although there is a chance that complications could lead to bleeding, hematoma, artery occlusion, pseudoaneurysm, neurological issues, discomfort, inadvertent dislodgment, and catheter-related infections, including bacteremia. **(Novak, 2017; Córdova, Santos, Toebe, Moraes & Souza, 2018).** To lower these risks and guarantee patient safety, a thorough nursing intervention procedure must be developed and put into place. **(Pierre, Ramos & Shimizu, 2024).**

Because of factors like obesity, peripheral edema, and hypotension, critically sick patients are more prone to experience failure even though arterial catheterization has a high success rate and few problems. **(Wang et al., 2020).** 10% of first attempts are known to fail at the moment, and the process frequently results in several punctures. Direct heating of the radial artery and palmar warming of the radial artery (Balbay technique) are usually carried out before

to transradial coronary catheterization in order to lubricate the radial perforation and lower the number of failures at the first attempt of arterial perforation. **(Ahmad, 2023; Ünal et al., 2017).**

Significant pain and suffering are frequently experienced during arterial access. Both invasive and noninvasive methods have been investigated to control and lessen this pain. For example, it has been demonstrated that administering lidocaine intradermally around the puncture site prior to the arterial puncture significantly lowers the frequency and intensity of localized pain. **(Hudson, Dukes, & Reilly, 2016).** Furthermore, applying a cold pack before a surgery is an easy, non-invasive, and economical way to manage pain. **(Pagnucci, 2020; Bastami, Azadi & Mayel, 2015).**

The patency of vascular catheters must be maintained. Normal saline or normal saline plus 1 to 2 units/ml of heparin are the most common infusate fluids. **(Nuraeni, Iqbal, Roulita, Nurlaeci, & Mirwanti, 2022).** It is crucial to routinely check the catheter site for indications of infection. Nurses should inspect the insertion site and make sure the dressings are sterile and undamaged. Regular evaluations lower the chance of major consequences by assisting in the early detection of problems like infection or catheter displacement**(Mariano-Gomes, Ouverney-Braz & Oroski-Paes, 2024; Pereira. Pasrija & Keenaghan, 2024).**

After the arterial cannula is removed, the most crucial nursing action is to guarantee hemostasis by directly and adequately providing pressure to stop the bleeding from the artery catheter. New guidelines for controlling bleeding risks place a strong emphasis on the application of point-of-care tests and hemostatic treatments customized for each patient. **(Hou, Zhou, He, Chen & Zuo, 2023).** Pain and bleeding can be decreased by applying a cold pack to the insertion site during the first five minutes prior to arterial cannula removal. **(Kurt & Kaşıkçı, 2019).**

Furthermore, if a patient's blood supply is impaired, arterial cannulation may result in distal ischemia to the arterial cannula, so the distal pulses in the extremities need to be closely watched. When a patient complains of limb pain, the nurse must be on the lookout for changes in skin color and temperature. As soon as hemodynamic stability is achieved, arterial lines should generally be stopped **(Plowrigt & Sumnall, 2022).**

Significance of the study: Although arterial catheters are used often, little is known about the likelihood of problems. But it's important to be mindful of dangerous consequences like ischemia. Depending on the site of insertion, documented complications from arterial cannulation in adult intensive care units usually range from 10% to 13%. These complications include discomfort, thrombosis, hematoma, pseudoaneurysm, and in rare instances,

limb ischemia (1%) **(Imbriaco, Spencer & Spencer, 2024)**. So, correct arterial line nursing care for critically ill patients is vital to reduce complications and ensure patient safety **(Elkholy, Marzouk & Elhaweet, 2024).**

The aim of this study was to determine the effect of nursing interventions protocol on patients with arterial cannulation at intensive care unit.

Research Hypothesis: study group patients in intensive care unit who were exposed to the protocol showed decrease in arterial cannulation difficulties while the control group wasn't subjected to nursing interventions.

Design: is quasi-experimental. **Setting:** Tanta Main University's New Surgeries Hospital's intensive care unit served as the study's site. **Subjects:** 60 adult patients undergoing artery catheterization were included in the purposeful sample; they were split into two equal groups of 30 individuals each. Critical care nurses provided **the control group** with their usual nursing care. **The study group** was given the nursing interventions protocol that the researcher had created and apply it. The subjects were recently hospitalized patients of both sexes, aged 21 and older, who had no history of vascular surgery or bleeding disorders.

Tools of data collection: -Two tools were used

Tool (1): - Critically- Ill Patient Assessment Tool included two parts: -

Part (A) patient's demographic characteristics: - Such as patient's age, sex and body mass index (BMI).

Part (B) Patient clinical data included current diagnosis, past medical and surgical history and level of consciousness. Laboratory investigations included coagulation profile. Arterial line characteristics as purpose of arterial cannulation, site of artery used, and duration of arterial cannulation.

Tool (II): - Arterial Cannulation Complications Assessment Tool included the following parts: -

Part (A):- Vascular complications such as limb ischemia, temporary artery occlusion, heparin-induced thrombocytopenia manifestations, external bleeding and hematoma. **Total scoring system:**-Abnormal findings (present) was scored (1) and normal findings (absent) was scored (0)

Part (B):- Pain Assessment uses Critical-Care Pain Observation Tool (CPOT) by Gelinas & Johnston (2007). Scoring system: -Based on this scale, the patient's pain status was classified as painless (0), mild (0–3), moderate (3–6), or severe (6–8).

Method

The appropriate authorities at the study location granted official permission to conduct the study. Informed consent was acquired along with approval from the Faculty of Nursing's ethical committee. Privacy and confidentiality were guaranteed, and participants might leave the research at any moment.

Tools (I and II) were created by the researcher following a survey of relevant research, evaluated by specialists for content validity, and examined for dependability utilizing the proper statistical technique. The alpha Cronbach factor was used to test the produced tools' reliability, and the results were 0.883 for tool II and 0.913 for tool I.

A pilot study was performed on 10% of the total sample to evaluate the practicality and suitability of the instruments used. Data collection extended across six months, beginning in March 2024 and concluding in August 2024. To avoid cross-contamination of information, the researcher initiated data gathering with the control group before proceeding to the intervention group. The research process was implemented in four successive stages:

- **Assessment phase:** Upon admission, the investigator collected demographic details and clinical information using Tool I.
- **Planning phase:** The primary objective was to minimize vascular complications while preserving stable hemodynamic parameters; therefore, patient care strategies were formulated with defined goals and anticipated outcomes in mind.

Implementation phase:

- Participants in the **control group** continued to receive the standard nursing care routinely provided by the ICU staff. In contrast, those in the **study group** were managed according to the researcher's structured nursing intervention protocol.
- **Pre-cannulation care:** Prior to arterial cannula insertion, patients underwent both psychological reassurance and physical preparation. The adequacy of collateral circulation was confirmed using the Barbeau (modified Allen's) test. The researcher also checked distal limb pulses, assessed capillary refill, and ensured proper antiseptic cleansing of the puncture site and surrounding skin with chlorhexidine solution, which was allowed to air dry. A sterile drape was then placed over the prepared area.
- **Balbay maneuver:** To promote vasodilation and ease cannula placement, the radial artery site was warmed by covering with the palm for three minutes following local infiltration of 1% lidocaine.
- **During cannulation:** Patients were kept supine and at rest in bed. Continuous hemodynamic monitoring was maintained throughout the procedure to promptly recognize any adverse responses. The insertion site was observed for signs of bleeding or hematoma formation.
- **Post-cannulation care:** The arterial line was stabilized and secured under a transparent dressing, with the date of application recorded. Dressing changes were carried out according

to hospital policy or earlier if there was evidence of bleeding, sweating, or local infection, always under aseptic non-touch technique. Line patency was preserved with heparinized saline. The necessity of the cannula was reviewed daily, and once no longer indicated, the line was removed.

- **During removal:** Coagulation profile was evaluated before removing the cannula. A cold compress was applied for the first five minutes around the site to minimize bleeding and discomfort. After the cannula was withdrawn, direct pressure was maintained on the site until complete hemostasis was achieved.

Evaluation phase:

Assessment for both groups (control and study) was performed at three points: prior to insertion, during the cannulation procedure, and after removal of the arterial line, using Tool II.

Results:

Figure (1) shows distribution of the studied patients with arterial cannulation regarding their age. Observations revealed that nearly half (46.67%) of the patients in control group were between 20 to 30 years old while the highest percentage (60%) of the patients in study group were between 30 to 40 years old. **Figure (2) shows distribution of the studied patients with arterial cannulation regarding gender**, it was noticed that, control group has a slightly higher proportion of males (63.33%) than the study group (50%). **Figure (3) shows distribution of the studied patients with arterial cannulation BMI categories**, it was found that more than half of the patients in both control and stud groups (56.67 %) were over –weight.

Table (1) presents the distribution of patients with arterial cannulation based on their clinical data. In terms of current diagnosis, valvular disease was the most common condition, affecting 50.00% of the control group and 46.67% of the study group. **For past medical history,** cardiovascular diseases were the most frequently reported, affecting 50.00% of the control group and 43.33% of the study group. **In relation of surgical history**, the majority of patients had no prior surgical history, with 66.67% in the control group and 73.33% in the study group.**Regarding level of consciousness**, most patients were fully conscious, accounting for 83.33% of the control group and 76.67% of the study group.

Figure (4) shows the distribution of the studied patients regarding their arterial line characteristics. Regarding the purpose for arterial line insertion, higher proportion of patients required arterial lines for hemodynamic monitoring, with 76.67% in the control group and 86.67% in the study group. **As for the site of artery**, 90% of the control group had radial arterial lines, while 100% of the study group utilized radial lines,**. Regarding duration of arterial**

cannulation, 93.33% of the control group had lines in place for less than one week, compared to 100% in the study group. There was no statistically significant difference between both groups in relation to their arterial line characteristics

Table (2) presents the distribution of total vascular complications among the control and study groups throughout periods of study: before arterial catheter (AC) insertion, during insertion, and after removal.At baseline (before insertion), all patients in both groups had low complication levels (<60%), confirming the absence of significant vascular issues prior to intervention. During AC insertion, the control group showed a marked rise in high complication levels (26.67%), compared to only 3.33% in the study group. This difference widened substantially after AC removal, where 70% of the control group experienced high complication levels, versus only 10% in the study group.The mean complication score in the control group increased sharply from 0.20 ± 0.41 before insertion to 8.10 ± 2.05 after removal, indicating a significant deterioration in vascular status. In contrast, the study group mean rose only from 0.10 ± 0.31 to 2.00 ± 1.45, reflecting substantial protection against vascular complications.

Table (3) shows that pain severity was significantly lower in the study group compared to the control group across all time points. Before insertion, 76.67% of the study group reported no pain, while only 36.67% of the control group did. During insertion, 60% of the control group experienced severe pain, whereas 76.67% of the study group reported only mild pain. After 30 minutes, all patients in the study group (100%) had no pain, in contrast to 53.33% of the control group who still experienced moderate pain.

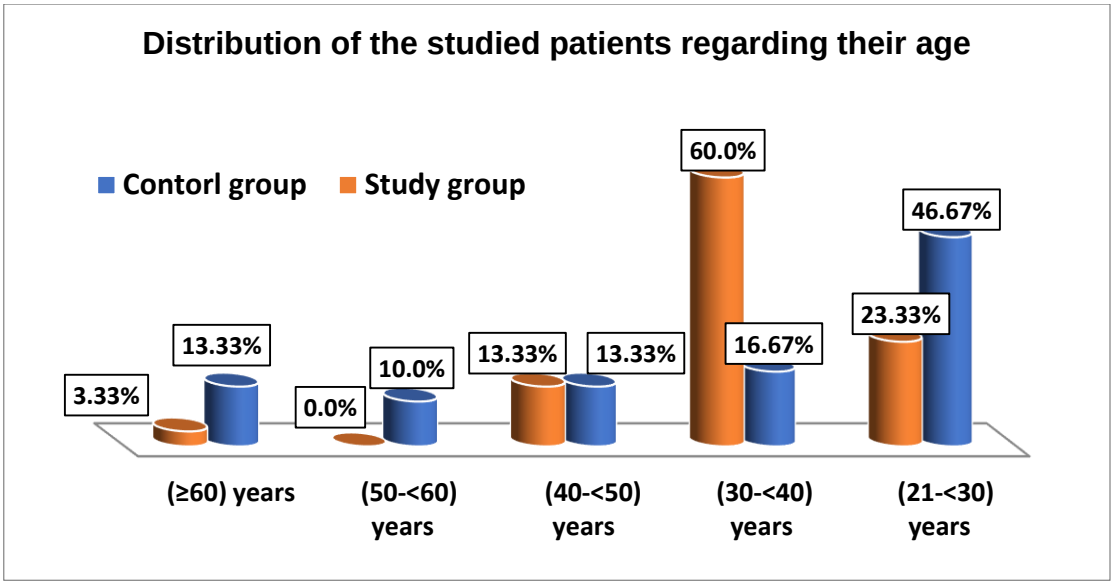

Figure (1): Distribution of the studied patients according to their age (n=60)

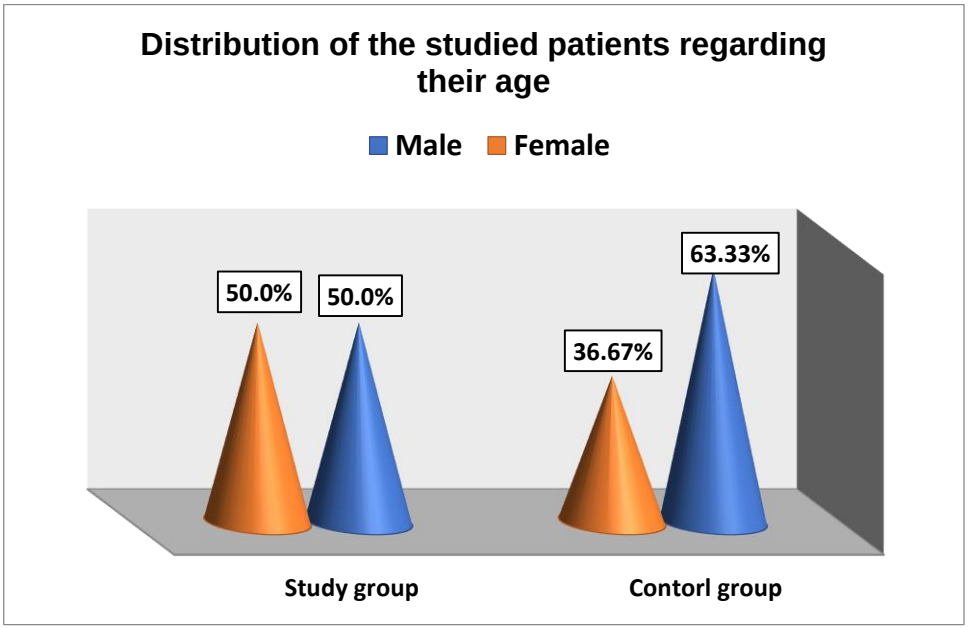

Figure (2): Distribution of the studied patients according to their gender (n = 60)

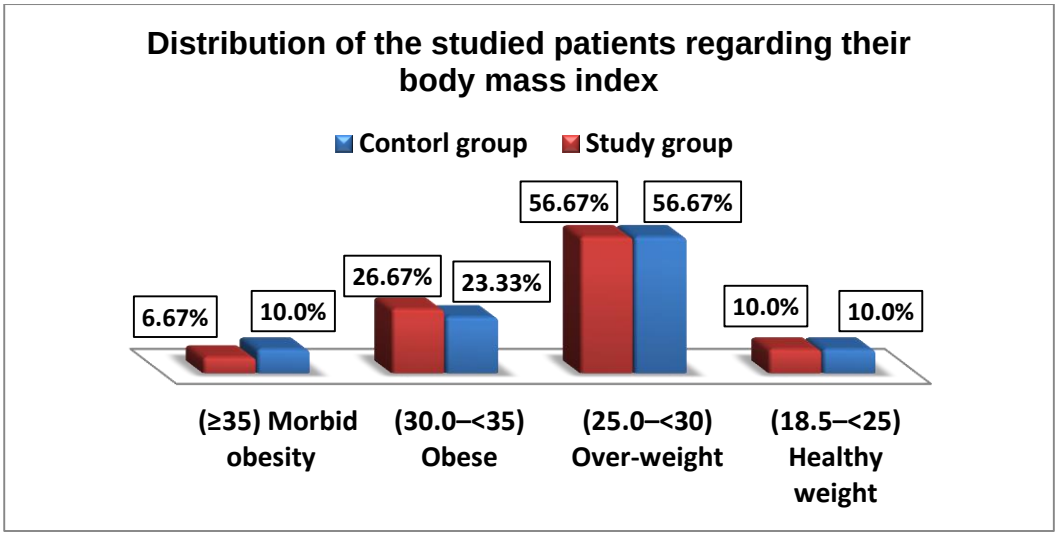

Figure (3): Distribution of the studied patients regarding their body mass index

Table (1) presents the distribution of patients with arterial cannulation based on their clinical data

Clinical data	The studied patients (n=60)				χ^2 P
	Control group (n=30)		Study group (n=30)		
	N	%	N	%	
Current diagnosis					
Abdominal surgeries	3	10.00	3	10.00	
Valvular disease	15	50.00	14	46.67	3.276
Thoracotomy cases	1	3.33	2	6.67	0.513
Head trauma	4	13.33	3	10.00	
Multi-fracture	7	23.33	8	26.67	
# Past medical history					
Cardiovascular diseases	15	50.00	13	43.33	
Respiratory disease	1	3.33	0	0.00	2.343
Endocrinal diseases	1	3.33	2	6.67	0.310
Others	5	16.67	0	0.00	
# Surgical history					
None	20	66.67	22	73.33	
Vascular surgery	4	13.33	0	0.00	0.445
Any invasive procedure	5	16.67	4	13.33	0.505

Abdominal surgeries	7	23.33	6	20.00	
Level of consciousness					
Fully conscious	25	83.33	23	76.67	2.745
Semi-conscious	4	13.33	7	23.33	0.286
Coma	1	3.33	0	0.00	

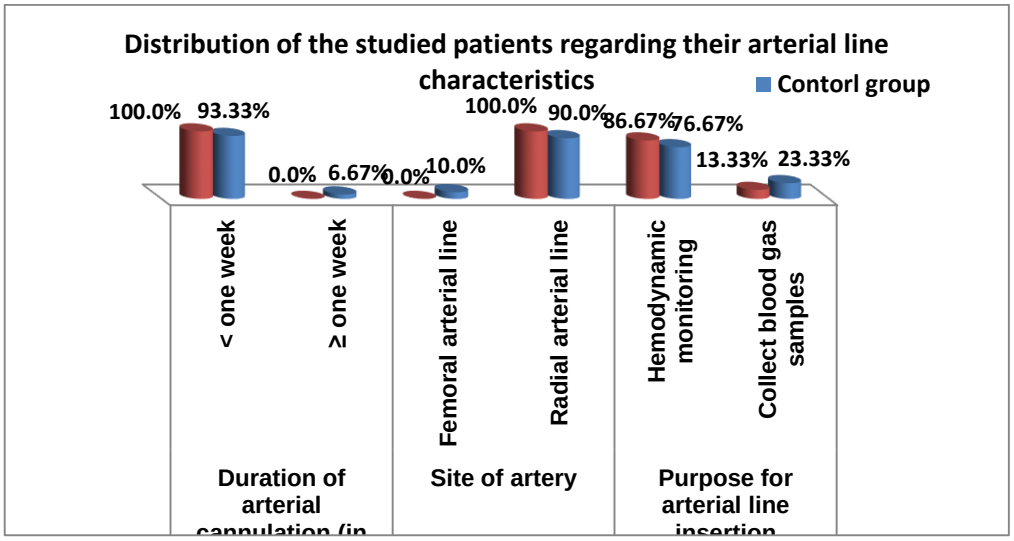

Figure (4): Distribution of the studied patients regarding their arterial line characteristics

Table (2): Distribution of the studied patients regarding total level of vascular complications throughout periods of study

Total vascular complications level	The studied patients (n=60)												
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	Before insertion AC		During insertion AC		After removal AC			Before insertion AC		During insertion AC		After removal AC		
	N	%	N	%	N	%		N	%	N	%	N	%	
▪ Low	30	100.00	22	73.33	9	30.00	**12.45**	30	100.0	29	96.67	27	90.00	8.92
▪ High	0	0.00	8	26.67	21	70.00	**0.000***	0	0.00	1	3.33	3	10.00	0.003*
Range Mean ± SD	**(0-2) 0.20±0.41**		**(2-8) 3.30±1.40**		**(5-12) 8.10±2.05**		**F= 64.32 P=0.000***	**(0-1) 0.10±0.31**		**(0-4) 1.15±0.65**		**(0-5) 2.00±1.45**		**F=28.15 P=0.000***
Control Vs Study t P	**1.10 0.275**		**4.56 0.000***		**7.89 0.000***									

<60 Low ≥60% High

* Significant at level P< 0.05.

Table (3): Distribution of the studied patients regarding pain severity using CPOT scale throughout periods of study

Total CPOT Level	The studied patients (n=60)												
	Control group (n=30)						χ^2 P	Study group (n=30)						χ^2 P
	Before insertion AC		During insertion AC		After 30 min of insertion AC			Before insertion AC		During insertion AC		After 30 min of insertion AC		
	N	%	N	N	%	N		N	%	N	%	N	%	
▪ No pain	11	36.67	0	0.00	0	0.00		23	76.67	0	0.00	30	100.00	
▪ Mild	7	23.33	0	0.00	14	46.67	**74.49**	7	23.33	23	76.67	0	0.00	**92.61**
▪ Moderate	9	30.00	12	40.00	16	53.33	**0.000***	0	0.00	7	23.33	0	0.00	**0.000***
▪ Severe	3	10.00	18	60.00	0	0.00		0	0.00	0	0.00	0	0.00	
Range Mean ± SD	**(0-7) 2.23±2.373**		**(4-8) 6.77±1.331**		**(2-6) 3.47±0.937**		**F=59.69 P=0.000***	**(0-1) 0.23±0.430**		**(2-4) 2.97±0.718**		**(0-0) 0.00±0.00**		**F=349.28 P=0.000***
Control Vs Study t P	**4.541 0.000***		**13.762 0.000***		**20.262 0.000***									

No pain (0) Mild (1-3) Moderate (4-6) Severe (7-8)

* Significant at level P<0.05.

AC: Arterial Cannulation

Discussion

The present study examined the influence of a nursing intervention protocol on ICU patients undergoing arterial cannulation. With respect to sociodemographic variables, the results demonstrated no statistically significant difference between the control and study groups. The mean age in the control group was 37.63 ± 14.177 years, compared to 35.50 ± 7.999 years in the study group. This outcome corresponds with the findings of **Smith, Brown & Lee (2021)**, who emphasized that similarity in age distribution across groups reduces bias in clinical investigations.

Similarly, the current findings align with the work of **Rao & Cheema (2019)**, who assessed evidence-based practices for preventing ventilator-associated pneumonia in ICU patients and observed that most participants were middle-aged. Conversely, these results differ from those of **Tonna et al. (2024)**, who evaluated a quality improvement program targeting sleep and delirium in surgical ICU patients and reported a higher median age of 61 years. In the same context, **Sayed, El Kenany, Ahmed, & Allam (2024)** identified a mean patient age of 47.70 ± 9.259 years, which is also higher than that observed in the current study.

Regarding gender, the analysis showed that male patients formed the majority of ICU admissions, though no significant variation was detected between groups. Comparable trends were noted by **Fowler et al. (2021)**, who indicated that around 60% of ICU admissions were male, pointing to a gender-related imbalance in critical care admissions. This observation is further supported by **Klotz, Heuermann, Hanke, Petersen & Sievers (2015)**, who found that gender had no significant impact on outcomes associated with arterial catheterization.

As for body mass index (BMI), over half of the patients in both groups were classified as overweight, with no significant group differences detected. These results are consistent with the work of **Brown et al. (2019)**, who highlighted the importance of comparable anthropometric profiles in enhancing study validity. Likewise, **Gribsholt et al. (2021)** and **Yang et al. (2022)** documented that nearly half of their studied populations were overweight or obese. They also noted that higher BMI values were associated with increased risks of hospitalization, ICU admission, pain severity, and the likelihood of undergoing invasive interventions.

Concerning current diagnosis, valvular diseases were the most common diagnoses in both groups, followed by cases of multiple fractures. This is because the study was conducted in the surgical care unit. This pattern aligns with **Hou et al., (2023)** who noted that patients with valvular disorders and bone

fractures are among those most likely to require arterial catheterization. However, **Borg & Trapani (2024)** pointed out that variations in diagnoses may affect study accuracy, particularly when a standardized classification of patient conditions is not applied.

Additionally, medical and surgical history, cardiovascular diseases were the prevalent among patients in both groups. Most of the patients had no previous surgical history. These findings are in agreement with **Sengupta et al., (2022)** who stated that patients with cardiovascular diseases often require surgical interventions. However, **Elgendy & Ganawe, (2023)** reported that the absence of previous surgical history does not necessarily imply lower risk, as some patients may still be prone to complications due to other chronic conditions.

Concerning level of consciousness, the majority of patients in both groups were fully conscious, with no statistically significant difference between the groups. This finding is consistent with **Novak (2017)** who found the most of study sample were alert and conscious patients are less likely to experience complications related to anesthesia. Nevertheless, **Andropoulos, (2020)** reported that the presence of patients in a coma or semi-conscious state may influence outcomes, especially in studies assessing anesthesia effectiveness or emergency medical interventions.

The findings revealed notable differences in the purpose and site of arterial line insertion between the control and study groups. A higher proportion of patients in the study group required arterial lines for hemodynamic monitoring compared to the control group. This finding is in line with **Lee, (2025)** who emphasized that hemodynamic monitoring is critical in intensive care settings for optimizing patient outcomes. On the other hand, blood gas sampling was more common in the control group, which may reflect variations in clinical protocols.

Also, the radial artery was the predominant site for cannulation in both groups, which is consistent with **Gutte, Azim, Poddar, Gurjar & Kumar (2023)** who reported that radial access is generally preferred due to its lower rate of complications. Also, study conducted by **Nuttall et al., 2016** found that radial artery was cannulated in majority of patients. Additionally, the duration of cannulation was shorter in the study group, as all patients had lines in place for less than one week. This finding supports **Card et al., (2024)** who stated that earlier removal of arterial lines can help in reducing the risk of infection.

As regarding to vascular complications, the findings demonstrated clear differences between the two groups. The control group experienced more post-cannulation vascular issues such as pallor, pain,

discoloration, and temporary occlusion, while the study group reported no such complications across different time points. The consistent stability of ischemic symptoms in the study group suggests that the applied measures were effective in preventing complications associated with arterial cannulation. These findings were consistent with **Hixson, Jensen, Melamed,& Qadir, (2024)**, who emphasized that advanced management techniques reduce vascular risk. Furthermore, **Majmundar et al., (2022)** and **Dahan, Engberts & Niesters, (2016)** highlighted the importance of continuous assessment and preventive strategies to maintain vascular integrity.

Moreover, the findings indicated that the study group maintained stable vascular conditions after catheter removal, while a considerable portion of the control group experienced various vascular concerns. This supports the effectiveness of the intervention in reducing overall vascular complication levels. The progressive improvement seen in the study group over time suggests that the benefits of the intervention are cumulative and increase with continued application. These outcomes further reinforce the results of **Elkholy et al., (2024)** who emphasized the role of standardized nursing protocols in reducing the risk of complications associated with arterial lines.

In terms of pain assessment during catheter insertion and post-procedural phases, the responses differed clearly between both groups. Patients in the study group appeared more comfortable, with reduced signs of facial tension and muscular reactions during the procedure. Post-procedurally, the study group returned to a state of rest and relaxation more rapidly than the control group. These results provide further evidence for the intervention's positive impact on pain management as Balbay maneuver and cold pack application around insertion site for the first 5 minutes before removal of arterial cannula. Similar findings were reported by **Kurt & Kaşıkçı (2019) and Bastami et al., (2015)** who concluded that the application of cold reduced pain in patients after the withdrawal of the arterial catheter. The absence of overt pain behaviors in the study group supports the argument that the interventions contributed to a more effective pain control strategy that significantly improve patient comfort compared to routine care. However, **Yaseno et al., (2024)** reported That different local ways with no medication during radial arterial puncture not achieve pain relieve effectively.

In summary, the nursing interventions protocol contributed to better outcome as vascular issues, pain control and improved hemodynamic stability, offering a safe and effective alternative

to standard care. The consistent improvements across pain-related and vascular condition suggest that this protocol could be beneficial in enhancing procedural outcomes and minimizing associated complications

Conclusions

Based on the current study's findings, it can be said that the study group experienced less pain, vascular complications, infection and improve patient safety than the control group when interventions were implemented for patients with arterial cannulation in the critical care unit.

Recommendations

A. Clinical Practice

Recommendations:

The standardized arterial cannulation protocol should be implemented as routine practice in all critical care units to minimize complications and improve patient outcomes

Ultrasound guidance should be mandatory for all arterial line placements to increase first-attempt success rates

B. Administrative

Recommendations:

Develop comprehensive training programs for healthcare providers on the protocolized arterial cannulation technique

Establish quality assurance measures to monitor compliance with the standardized protocol

C. Research Recommendations:

Conduct multicenter studies with larger sample sizes to validate these findings across diverse patient populations

References

Ahmad, I. M. (2023). Effect of palmar warming versus transient ulnar compression on the success rate of arterial puncture in critically ill patients. *Egyptian Journal of Nursing and Health Sciences*, *4*(2), 30-45.

Andropoulos, D. B. (2020). Monitoring and vascular access. *Gregory's Pediatric Anesthesia*, 406-443.

Angelucci, A., Greco, M., Cecconi, M., & Aliverti, A. (2025). Wearable devices for patient monitoring in the intensive care unit. *Intensive Care Medicine Experimental*, *13*(1), 26.

Bastami, M., Azadi, A., & Mayel, M. (2015). The use of ice pack for pain associated with arterial punctures. *Journal of clinical and diagnostic research: JCDR*, *9*(8), JC07.

Borg, A. L., & Trapani, J. (2024). The accuracy of radial artery applanation tonometry and intra-arterial blood pressure monitoring in critically ill patients: an evidence-based review. *Nursing in Critical Care*, *29*(6), 1751-1757.

Brown, A., Ballal, A., & Al-Haddad, M. (2024). Recognition of the critically ill patient and escalation of therapy. *Anaesthesia & Intensive Care Medicine*, *25*(10), 637-641.

Brown, S. M., Grissom, C. K., Moss, M., Rice, T. W., Schoenfeld, D., & Hou, P.

C. (2019). Noninvasive ventilation and ICU mortality in acute respiratory failure due to pneumonia. *Journal of Critical Care*, *50*, 23-28.

Card, S., Piersa, A., Kaplon, A., Vanneman, M. W., Dalia, A., Weaver, B., & Hao, D. (2023). Infectious risk of arterial lines: a narrative review. Journal of Cardiothoracic and Vascular Anesthesia, 37(10), 2050-2056.

Dahan, A., Engberts, D. P., & Niesters, M. (2016). Arterial line placement: Safety first. Anesthesiology, 124(3), 528-529.

Elgendy, H. & Ganawe, A. (2023). Risk factors influence the arterial line patency in ICU-bound patients during COVID-19 pandemic: An observational cohort study. *Egyptian Journal of Anesthesia*, *39*(1), 401-411.

Elkholy, M., Marzouk, S., & Elhaweet, E. (2024). Nurses' Compliance with Safety Measures of Arterial Line. *Egyptian Journal of Health Care*, *15*(4), 49-61.

Fowler, R. A., Sabur, N., Li, P., Juurlink, D. N., Pinto, R., Hladunewich, M. A., ... & Martin, C. M. (2021). Sex-and age-based differences in the delivery and outcomes of critical care. *Cmaj*, *177*(12), 1513-1519.

Gelinas, C& Johnston, C. (2007): Pain assessment in the critically ill ventilated adult: Validation of the Critical-Care Pain Observation Tool and physiologic indicators. *Clinical Journal of Pain*,23:497,505.

Gribsholt, S. B., Pedersen, L., Richelsen, B., Sørensen, H. T., & Thomsen, R. W. (2021). Body mass index and 90-day mortality among 35,406 Danish patients hospitalized for infection. In *Mayo Clinic Proceedings* (Vol. 96, No. 3, pp. 550-562). Elsevier.

Gutte, S., Azim, A., Poddar, B., Gurjar, M., & Kumar, A. (2023). Arterial cannulation in adult critical care patients: a comparative study between ultrasound guidance and palpation technique. *Medicina Intensiva (English Edition)*, *47*(7), 391-401.

Hager, H. H., & Burns, B. (2023). Artery Cannulation [Internet]. *StatPearls*. Treasure Island, FL: StatPearls.

Hixson, R., Jensen, K. S., Melamed, K. H., & Qadir, N. (2024). Device associated complications in the intensive care unit. *bmj*, 386.

Hou, Q., Zhou, B., He, J., Chen, X., & Zuo, Y. (2023). Complications and related risk factors of transradial access cannulation for hemodynamic monitoring in general surgery: a prospective observational study. *BMC anesthesiology*, *23*(1), 228.

Hudson, T. L., Dukes, S. F., & Reilly, K. (2016). Use of local anesthesia for arterial punctures. *American journal of critical care*, *15*(6), 595-599.

Imbriaco, G., Monesi, A., & Spencer, T. R. (2022). Preventing radial arterial catheter failure in critical care factoring updated clinical strategies and techniques. *Anesthesia Critical Care & Pain Medicine*, *41*(4), 101096.

Imbriaco, G., Spencer, T. R., & Bardin-Spencer, A. (2024). 10 best practice tips with radial arterial catheterization. *The Journal of Vascular Access*, *25*(2), 363-368.

Klotz, S., Heuermann, K., Hanke, T., Petersen, M., & Sievers, H. H. (2015). Outcome with peripheral versus central cannulation in acute Type A dissection. *Interactive cardiovascular and thoracic surgery*, *20*(6), 749-754.

Kurt, Y., & Kaşıkçı, M. (2019). The effect of the application of cold on hematoma, ecchymosis, and pain at the catheter site in patients undergoing percutaneous coronary intervention. *International journal of nursing sciences, 6*(4), 378-384.

Lee, G. R. (2025). Clinical applications of blood gas analysis: a comparative review of arterial and venous blood gas monitoring in critical care. *Acute and Critical Care*, *40*(2), 153.

Majmundar, N., Wilkinson, D. A., Catapano, J. S., Cole, T. S., Baranoski, J. F., Ducruet, A. F., & Albuquerque, F. C. (2021). Reaccessing an occluded radial artery for neuroendovascular procedures: techniques and complication avoidance. *Journal of neuro-interventional surgery, 13*(10), 942-945.

Mariano-Gomes, P. M., Ouverney-Braz, A., & Oroski-Paes, G. (2024). Adverse events with arterial catheters in intensive care units: a scoping review. *Enfermería Intensiva, 35*(4), 410-427.

Novak, T. (2017). An Anesthesiologist's Perspective of Radial Artery Catheterization. *Cardiac interventions today, 11*(5), 52-56.

Nuraeni, A., Iqbal, M., Roulita, R., Nurlaeci, N., & Mirwanti, R. (2022). Comparison of Arterial Line Patency in Heparinized Normal Saline with Normal Saline Flushing among Critically ill Patients: A Literature Review. *Jurnal Aisyah: Jurnal Ilmu Kesehatan, 7*(4), 1225-1232.

Nuttall, G., Burckhardt, J., Hadley, A., Kane, S., Kor, D., Marienau, M. S., ... & Oliver, W. C. (2016). Surgical and patient risk factors for severe arterial line complications in adults. *Anesthesiology, 124*(3), 590-597.

Pagnucci, N. (2020). Reducing Pain during Emergency Arterial Sampling Using Three Anesthetic Methods: A Randomized Controlled Clinical Trial. *The Journal of Emergency Medicine, 58*(6), 857-863.

Pierre, J., Ramos, M., & Shimizu, K. (2024). Reducing risks in arterial catheterization: A nursing protocol approach. *Journal of Advanced Nursing, 80*(3), 112-125.

Pierre, L., Pasrija, D., & Keenaghan, M. (2024). Arterial lines. In *Stat Pearls [Internet]*. Stat Pearls Publishing.

Plowrigt, C. & Sumnall, R. (2022). Essential Critical Care Skills3: arterial line care. *Nursing Times (online), 118*(1), 24-26.

Punja, V. P., & Schenarts, P. J. (Eds.). (2023). *Emergency General Surgery, An Issue of Surgical Clinics, E-Book* (Vol. 103, No. 6). Elsevier Health Sciences.

Rao, I., & Cheema, P. K. (2019). Evidence based guidelines for prevention of ventilator-associated pneumonia among intensive care unit staff nurses. *International Journal of Advances in Nursing Management, 7*(4), 301-304.

Sayed, S. E., El Kenany, H. E. S., Ahmed, S. A., & Allam, Z. A. (2024). Effect of Implementing Modified Bundle of Care on Early Detection and Prevention of Ventilators Associated Pneumonia. *Tanta Scientific Nursing Journal, 32*(1), 157-179.

S El-helaly, A., S abd-alazeem, E., & E Mostafa, I. (2022). Organ Dysfunction in Critically Ill Patients. *Benha Journal of Applied Sciences, 7*(6), 57-67.

Sengupta, A., Gauvreau, K., Kohlsaat, K., Colan, S. D., Newburger, J. W., Del Nido, P. J., & Nathan, M. (2022). Long-term outcomes of patients requiring unplanned repeated interventions after surgery for congenital heart disease. *Journal of the American College of Cardiology, 79*(25), 2489-2499.

Smith, J., Brown, K., & Lee, R. (2021). Age-related factors influencing ICU survival rates: A comparative study. *Journal of Critical Care Medicine, 45*(2), 145-159.

Tonna, J. E., Dalton, A., Presson, A. P., Zhang, C., Colantuoni, E., Lander, K., ... & Kamdar, B. B. (2021). The effect of a quality improvement intervention on sleep and delirium in critically ill patients in a surgical ICU. *Chest, 160*(3), 899-908.

Ünal, S., Açar, B., Yayla, Ç., Balci, M. M., Ertem, A. G., Kara, M., ... & Balbay, Y. (2017). Manual heating of the radial artery (Balbay maneuver) to facilitate radial puncture prior to transradial coronary catheterization. *Revista Portuguesa de Cardiologia (English Edition), 36*(6), 409-414.

Walsh, E. C., Srivastava, S. D., & Fitzsimons, M. G. (2025). Prevention and management of complications associated with arterial catheters. *BJA education, 25*(5), 173-180.

Wang, A., Hendin, A., Millington, S. J., Koenig, S., Eisen, L. A., & Shiloh, A. L. (2020). Better with ultrasound: arterial line placement. *Chest, 157*(3), 574-579.

Yang, Y., Wang, L., Liu, J., Fu, S., Zhou, L., & Wang, Y. (2022). Obesity or increased body mass index and the risk of severe outcomes in patients with COVID-19: a protocol for systematic review and meta-analysis. *Medicine, 101*(1), e28499.

Yasuo, S., Hayashi, M., Suda, C., Kataoka, Y., Taito, S., Imai, E., & Sazanami, K. (2024). Efficacy of Local Anesthesia for Radial Artery Puncture

Pain: A Systematic Review and Network Meta-Analysis. Cureus, 16(7), e64682. https://doi.org/10.7759/cureus.64682