Nursing Strategies to Minimize Vascular Complications among Patients Undergoing Cardiac Catheterization

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Abstract

Background: Cardiac catheterization is considered the gold standard for the diagnosis, evaluation and treatment of cardiac diseases. Nursing intervention strategies are essential to prevent vascular complications post cardiac catheterization including compression time, assessing vital signs, ensuring bed rest and assessing access site. **Aim of the study:** To evaluate the effect of nursing strategies on minimizing vascular complications among patients undergoing cardiac catheterization. **Research Design:** Quasi-experimental research design was utilized. **Subjects**: A purposive sample of (72) patients undergoing cardiac catheterization. **Setting:** The study was conducted at Cardiothoracic Minia University Hospital in the cardiac catheterization unit. **Tools**: Three tools were utilized to collect data, First Tool: Interview Questionnaire which includes two parts (patient's demographic and medical data), Second Tool: Cardiac Catheterization Knowledge Assessment Sheet, Third Tool: Post Cardiac Catheterization Complications Observational Checklist. **Results** the study group had a satisfactory knowledge level about cardiac catheterization after receiving the nursing intervention with a highly statistical significant difference (0.001**), there are statistically significant negative correlation between the studied patients' level of knowledge regarding cardiac catheterization and the presence of complications after the implementation of nursing intervention. **Conclusion**: Based on the results of the study, the implementation of nursing interventions has reduced the vascular complications post cardiac catheterization in the study group compared to the control group. **Recommendations** There are obvious needs for conducting educational and training programs to improve nurses' knowledge, practice and attitude regarding care of patients undergoing cardiac catheterization

Keywords: Cardiac Catheterization, Nursing Strategies, Vascular Complications

Introduction

Nurses play an important role in providing patients with high-quality care during the cardiac catheterization (CC). Knowledge and current evidence-based practice: the key to becoming an effective and efficient nurse. Nurses who have received specialized cardiac training must assess and monitor patients carefully. Cardiac catheterization staff and nurses who care for post-cardiac catheterization procedure patients should collaborate to reduce complications and treat them when they occur when possible. (Saad et al, 2024)

More than one million cardiac catheterization procedures are performed each year in the United States. They are performed for diagnosing and ultimately treating patients with suspected or confirmed coronary artery disease. Right heart catheterizations allow for direct measurement of right-sided cardiac and pulmonary hemodynamics. Left heart catheterizations and coronary angiography provide a diagnostic and therapeutic role in those with coronary artery disease. Left heart catheterization is commonly performed by accessing the radial or femoral artery (senger et al 2024). Radial vascular access is utilized in 10% of patients undergoing cardiac catheterization procedures annually in Eygept (Ibrahem et al., 2024).

Cardiac catheterizations are becoming the standard gold for the diagnosis and treatment of cardiac diseases. Despite all the beneficial effects of cardiac catheterization in reducing morbidity and mortality of cardiovascular disease, this invasive procedure is not free of complications. Radial access has fewer complications compared to the femoral vascular access sites (Bafadhel et al., 2024).

Diagnostic cardiac catheterization (DCC) can be used to assess blood flow to the heart, measure blood pressure, check for narrow or blocked blood vessels, and assess the hemodynamics of the heart. It is also used to evaluate and determine the need for further treatment (Amin et al., 2020). Therapeutic cardiac catheterization (TCC) is a type of cardiac revascularization procedure that can be performed through femoral or radial artery access. It is performed to reopen obstructed coronary arteries and restore blood flow without open heart surgery. (ibrahem et al 2024)

Significance Of The Study

Incidence of vascular complications and risk factors for vascular complications among patients undergoing the cardiac catheterization procedure performed at the critical care department of Cairo University hospitals concluded that the most common minor complication was oozing before femoral sheath removal (20%) when compared with after sheath removal (12%). On the other hand, the most common major vascular complication was hematoma after sheath removal only (22%) and the common risk factors for vascular complications were old age, female sex, increased body mass index (BMI) and femoral sheath size **(Ebeed, et al., 2018)**.

According to the patient records in the catheterization unit at Minia University Hospital, through 2019. It was round that there were 1100 cases of cardiac catheterization admitted in the cardiothoracic unit. The most of them did femoral cardiac catheterization, and the most common complications that occurred were oozing, hematoma, and ecchymosis. Through 2023, there were around 1000 cases of cardiac

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catheterization admitted in the cardiothoracic unit of the Minia University Hospital.

Aim of the Study

To evaluate the effect of nursing strategies on minimizing vascular complications for patients undergoing cardiac catheterization.

Research Hypothesis:

1- Patients who receive nursing strategies will have lesser vascular complications post-cardiac catheterization.
2- Radial and femoral complications are anticipated to reduce after implementing nursing strategies.

Research Design:

A quasi-experimental research design was utilized to fulfill the aim of this study.

Setting:

Study was conducted at Cardiothoracic Minia University Hospital in the Cardiac Catheterization Unit.

Sample:

Purposeful sample of 72 patients undergoing cardiac catheterization. The sample size was selected according to the following equation:

$$N = \frac{t^2 \ \times \ p\,(1-p)}{m^2}$$

$$N = \frac{(1.96)^2 \ \times \ 0.04\,(1-0.04)}{0.05^2}$$

Description:

N = required sample size

t = confidence level at 95 % (standard value of 1.960)

p = estimated prevalence of vascular access complications at cardiothoracic Minia University Hospital (0.04)

m = margin of error at 5 % (standard value of 0.050)

(https://www.surveymonkey.com/mp/sample-size-calculator/)

Inclusion Criteria:

Age ranged from 20 to 60 years.

Patients undergoing cardiac catheterization procedures for the first time.

The studied groups divided into two group study and control (36 in each group)

Tools:

Three tools were designed and used for collecting data for this study. These tools were prepared by the investigator after an extensive literature review and then reviewed by a panel of five experts in the field of Medical Surgical Nursing and Critical Care Nursing at the Nursing Faculty at Minia and Assuit University.

First Tool: Interview Questionnaire

First Part: Patients Demographic Data. It consists of six items: age, gender, residence, marital status, level of education, and occupation.

Second Part: Medical Data, including Medical History (Palpitations, chest pain, cough, dyspnea, extremity pain, and edema), Health habits (tea and coffee consumption, smoking, and daily exercise), Assessment of risk factors (obesity and diabetes mellitus), Physical examination (measuring vital signs, inspection of cyanosis of nail beds, lips, and lower extremities, capillary refill, and edema), medical diagnosis, and hospital stay.

Second Tool: Assessment of patient's knowledge regarding cardiac catheterization by asking patients about: definition of cardiac catheterization, purposes, causes, sites of catheter insertion, patient preparation before the procedure, laboratory investigation before the procedure, type of anesthesia and time of the procedure, position after the procedure, post-procedure complications, post-operative care and instructions, and management of the complications and danger signs after hospital discharge .

Scoring System:

Each right answer was given one score. Those who obtained less than 60% were considered as having unsatisfactory level of knowledge. Equal or more than 60% were considered having satisfactory level.

Third Tool: Post Cardiac Catheterization Complications Observational Checklist, which included 8 items as following

A- Radial Vascular Access Site Complications which includes 3 items as: Radial artery bleeding, radial artery spasm, and radial hematoma

B- Femoral Vascular Access Site Complications which includes 5 items as: Femoral artery bleeding, femoral hematoma, pseudo aneurysm, retroperitoneal hemorrhage, and arteriovenous fistula.

Nursing Strategies to Minimize Vascular Complications for Patients Undergoing Cardiac Catheterization

- The investigator nursing strategies aimed to minimize vascular complications that include immediately at recovery room and after discharged come back to the home as following
- Ensure compression time of 20 to 30 minutes after sheath removal with either manual or mechanical compression devices.
- Assess vital signs and site every 15 minutes for 1 hour after sheath removal and then every hour until the patient is allowed to walk (i.e., 3 to 6 hours).
- Assess Site by palpating to assess temperature, color, and pulse present in the extremity.
- Assess patient discomfort at the site
- Patients will be allowed to ambulate after one to two hours of diagnostic catheterization. While should ensure bed rest for two to six hours after therapeutic cardiac catheterization after hemostasis.
- Ensure head of bed is not elevated more than 30 degrees.
- Assess Site for hematoma formation post cardiac catheterization and its characteristics.
- Insertion Site of Cardiac Catheterization Care Instructions
- Home care for the catheter insertion site (wound site).
  - The morning after procedure, may take the dressing off. The easiest way to do this is when showering: get the tape and dressing wet and remove them.
  - Cover the area with a small adhesive bandage. It is normal for the catheter

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insertion site to be black and blue for a couple of days. The site may also be slightly swollen and pink, and there may be a small lump (about the size of a quarter).

- Wash the catheter insertion site at least once daily with soap and water. Place soapy water on the hand or washcloth and gently wash the insertion site; do not rub.
- Keep the area clean and dry.
- Do not use creams, lotions, or ointments on the wound site.
- Wear loose clothes, and underwear.
- Do not take a bath, tub soak, go in a Jacuzzi, or swim in a pool or lake for one week after the procedure.

- Patient should drink eight to ten glasses of clear fluids (water is preferred) to flush the contrast material.
- Patient should not submerge the puncture site in water for a week. It means the patient shouldn't sit in a bathtub or pool or go swimming for a week.
- Femoral Cardiac Catheterization Procedure
  - Do not strain during bowel movements for the first 3–4 days after the procedure to prevent bleeding from the catheter insertion site.
  - Avoid heavy lifting (more than 4.5–5 kg) and pushing or pulling heavy objects for the first 5 to 7 days after the procedure.
  - Do not participate in strenuous activities for 5 days after the procedure. This includes most sports: jogging, golfing, playing tennis, and bowling.
  - Patient Climb stairs when needed, but walk up and down the stairs more slowly than usual.
  - Gradually increase your activities until reach a normal activity level within one week after the procedure.

Radial Cardiac Catheterization Procedure
  - Do not participate in strenuous activities for 2 days after the procedure. This includes most sports: jogging, golfing, playing tennis, and bowling.
  - Gradually increase activities until they reach a normal level within two days after the procedure.

Doctor advises the patient that it is safe to
  - Return to work within 48–72 hours.
  - Resume sexual activity within one to two weeks.
  - Resume driving. Most people are able to resume driving within 24 to 48 hours after going home.

Validity and Reliability:
Validity

The content validity was done to identify the degree to which the used tools measure what was supported to measure. The developed tools were tested by jury committee consisted of five academic experts in the field of Medical Surgical Nursing and Critical nursing from the Nursing Faculty at Minia and Assuit University were responsible for ensuring the content and construct validity, completeness, tool item clarity, and necessary modifications.

Reliability

`Reliability was done for the first, second, and third tools, and they were tested for internal consistency by using Cronbach's' alpha test, which indicated that strong and good reliable tools were 0.907, 0.687, and 715, respectively.

Pilot Study:

A pilot study was conducted in order to establish the clarity, feasibility, and applicability of the study tools. It was carried out on 10% of the study patients, which equals seven patients who fulfilled the inclusion criteria to test the feasibility, objectivity, and applicability of the study tools and to estimate the needed time to complete the data collection at the Cardiac Catheterization Unit Cardiothoracic in Minia University Hospital. The necessary modifications were carried out accordingly.

Ethical Considerations:

Official permission to conduct the study was obtained from the Research Ethics Committee, Nursing Faculty Minia University. An official letter of approval to conduct the study from the Director of Minia University Cardio Thoracic Hospital and oral consent were obtained by the investigator from the patients before data collection and after an explanation of the aim of the study. The privacy of the study participants was asserted. The confidentiality of the collected data was maintained. The patient was informed that his or her participation in the study is voluntary, and he or she can withdraw at any time.

Study Procedure

Participants were divided randomly into two equal groups (study and control), with 36 patients in each group. The investigator started data collection, first from the control group and then from the study group, using three tools. The investigator obtained oral consent from participants after the first tool was fulfilled through an individual interview. This tool took about 15–20 minutes, according to the patients' tolerance, and every patient was allowed to ask any question to clear any misunderstanding. The second tool took about two hours with each participant, followed by the third tool, which took about one hour with each participant by observing patients for the presence of vascular complications post-cardiac catheterization.

First patient interview for assessment, the investigator used the first tool. 1st Part: Demographic Data: To assess the patient data 2nd Part: Medical Data to Assess the Medical Data of the Patient Second Tool: Assessment of patient's knowledge, which includes the assessment of patient's knowledge about cardiac catheterization, by asking patients about: definition of cardiac catheterization, purposes, causes, sites of catheter insertion, patient preparation before the procedure, laboratory investigation before the procedure, type of anesthesia and time of the procedure, position after the procedure, post-procedure complications, post-operative care and instructions, and management of the complications and danger signs after hospital discharge. Third tool, the postcardiac catheterization complications observational checklist, which included 8 items Radial Vascular Access Site Complications, which includes three items: radial artery

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bleeding, radial artery spasm, and radial hematoma. Femoral vascular access site complications, which include five items: femoral artery bleeding, femoral hematoma, pseudo-aneurysm, retroperitoneal hemorrhage, and arteriovenous fistula.

Statistical Data

Data were organized, tabulated, categorized analyzed, and data entry was performed using the Statistical Package of Social Science (SPSS) version (20). Data presented using descriptive statistics in the form of frequency distribution, percentages, means, and standard deviations (SD) as a measure of dispersion. A Pearson's correlation coefficient was used to compare two sets of quantitative variables. Probability (P-value) is the level of significance of the results was considered: (p-value > 0.05) indicates a not significant (NS), (P-value ≤ 0.05) was considered significant (S) and the (p-value ≤ 0.01) was taken in to account as highly significant

Results

Table (1): Distribution of Studied Groups Regarding Demographic Data (n=72)

Demographic Data	Study (n=36)		Control (n=36)		X^2	P-value
	No.	%	No.	%		
Age						
40- 49 years	٦	16.7	7	19.4	15.1	0.947
50- 59 years	11	30.6	15	41.7		
60- 64 years	19	54.8	14	38.9		
Mean ± SD	56.4 ± 6.86		54.5 ± 7.02		0.936	0.352
Gender						
Male	22	61.1	27	75	1.59	0.206
Female	14	38.9	9	25		
Residence						
Urban	10	27.8	9	25	0.071	0.789
Rural	26	72.2	27	75		
Marital Status						
Single	0	0	0	0	5.71	0.057
Married	32	88.9	24	66.7		
Divorced	0	0	2	5.6		
Widowed	4	11.1	10	27.8		
Illiterate	10	27.8	6	16.7	1.69	0.792
Read and Write	7	19.4	9	25		
Diploma	13	36.1	16	44.4		
University	6	16.7	5	13.9		
Occupation						
House Wife	13	36.1	5	13.9	6.24	0.100
Free Work	11	30.5	18	50		
Governmental Work	6	16.7	4	11.1		
Retired	6	16.7	9	25		
Health Habits						
Coffee	6	16.7	6	16.7	2.25	0.134
Tea	30	83.3	30	83.3	0.094	0.759
Smoking						
Smoker	17	47.2	١٣	36.1	2.02	0.155
None Smoker	١٩	52.8	23	63.9		
Doing Physical Activity						
No	32	88.8	36	100	2.46	0.291
Regular	2	5.6	0	0		
Irregular	2	5.6	0	0		

Table (1) Shows that the highest percentage (54.8%) of the study group's age was located between 60 and 64 years, while 41.7 percent of the control group's age was located between 50 and 59 years. In addition, it was noticed that (61. % and 75%) of the study and control groups, respectively, Moreover, it was found that (72.2% and 75%) of the study and control groups, respectively, lived in rural areas. Regarding marital status, it was seen that (88% and 66.7%) respectively, among the study and control groups were married.

Concerning the educational level, it was revealed that (36.1% and 44.4%) of the study and control groups, respectively, had diplomas. As regard occupation, 36.1% of the study group were housewives, and 50% of the control group were free workers. The table demonstrated that 52.8% of study group compared 63.9% of control group were not smoking

As regard physical activity, the results of the present study showed that (80.8 % and 100%) respectively, among the study and control groups, they aren't doing physical exercises

Table (2): Distribution of Studied Groups Regarding Their Medical Data (n=72)

Medical Data	Study (n=36)		Control (n=36)		X^2	P-value
	No.	%	No.	%		
Family History of Cardiac Disease						
- Yes	13	36.1	13	36.1	0.000	1.000
- No	23	63.9	23	63.9		
Medical History						
Associated Diseases						
- Hypertension	27	75	31	86.1	1.41	0.234

Medical Data	Study (n=36)		Control (n=36)		X^2	P-value
	No.	%	No.	%		
- Diabetes Mellitus	20	55.6	27	75	3.00	0.083
- Pulmonary Diseases	3	8.3	1	2.8	1.05	0.303
- Cardiovascular Diseases	2	5.6	3	8.3	0.215	0.643
Present History						
Chief Complaints						
- Palpitation	24	66.7	25	69.4	0.06	0.800
- Chest Pain	36	100	35	97.2	1.01	0.314
- Cough	9	25	٣	8.3	3.60	0.058
- Dyspnea	31	86.1	35	97.2	2.90	0.088
- Edema						
o Yes	11	30.6	10	27.8	0.067	0.795
o No	25	69.4	26	72.2		
Medical Diagnosis						
- Coronary Artery Disease	21	58.3	19	52.8	1.27	0.518
- Ischemic Heart Disease	10	27.8	14	38.9		
- Valve Disease	5	13.9	3	8.3		

Table (2) Revealed that 36.1% of the studied patients had a family history of cardiac disease. In relation to associated diseases, 75% of the study group, compared to 86.1% of the control group, were hypertension. It was found that 100% of the study group, compared to 97.2% of the control group, complained of chest pain. In addition, it was found that 86.1% of the study group, compared to 97.2% of the control group, complained of edema. Concerning medical diagnosis, the study findings showed that 58.3% and 52.8% of the study and control groups, respectively, had coronary artery disease.

Table (2): Distribution of Studied Groups Regarding Their Medical Data (n=72)   Continued,

Medical Data	Study (N=36)		Control (N=36)		X^2	P-value
	No.	%	No.	%		
Heart Rate						
- Normal	19	52.7	21	58.3	2.17	0.333
- Bradycardia	6	16.7	9	25		
- Tachycardia	11	30.6	6	16.7		
Blood Pressure						
- Normal	6	16.7	1	2.8	0.561	0.755
- Hypotension	3	8.3	4	11.1		
- Hypertension	21	75	31	86.1		
Capillary Refill						
- 1-2 Second	20	55.6	26	72.2	2.27	0.320
- 2- 3 Second	16	44.4	10	27.8		
Cardiac Catheterization Procedure Type						
- Therapeutic	25	69.4	26	72.2	0.067	0.795
- Diagnostic	11	30.6	10	27.8		
Site of Catheter Insertion						
- Radial	8	22.2	9	25	0.077	0.781
- Femoral	28	77.8	27	75		
Type of Medications Used						
- Antihypertensive & Hyperglycemic	5	13.9	15	41.7	4.50	0.210
- Antihypertensive, Hyperglycemic & Anticoagulant	20	55.6	10	27.8		
- Antihypertensive & Anticoagulant	11	30.5	11	30.5		
Hospital Stay Days						
- One Day	31	86.1	11	30.6	22.8	0.001**
- 2 Days	5	13.9	25	69.4		
Mean ± SD	1.13 ± 0.350		1.69 ± 0.467		5.70	0.001**

* Statistical Significant Difference (P ≤ 0.05)   ** Highly Statistical Significant Difference (P ≤ 0.01)

Table (2): Documented that 52.7% of the study compared to 58.3% of the control group had a normal heart rate. There was also 75%, 86.1% of the study, and control groups, respectively, had hypertension. It was noticed that 55.6% of the study group, compared to 72.2% of the control group, had 1-2 seconds of capillary refill time. Related to cardiac catheterization types, the study findings showed that 69.4% of the study group, compared to 72.2% of the control group, had a therapeutic cardiac catheterization. In addition, it was noticed that 77.8% of the study group, compared to 75% of the control group, had a femoral catheter inserted. Regarding medication used, it was found that 55.6% of the study group, compared to 27.8% of the control group, used antihypertensive, hyperglycemic, and anticoagulant drugs. Concerning hospital stay, it displays that 86.1% of the study group, compared to 30.6% of the control group, stayed one day in the hospital after a cardiac catheterization procedure, with a highly statistically significant difference.

Table (3): Distribution of Study Group in Relation to Their Knowledge Regarding Cardiac Catheterization, Pre and Post Implementing Nursing Intervention (n=36)

Cardiac Catheterization Knowledge	Study Group (n=36)		Mc Nemar test	P-value
	Pre Nursing Intervention No. (%)	Post Nursing Intervention No. (%)		
Definition of Cardiac Catheterization				
	7 (19.4)	32 (88.9)	5	0.001**
Purpose of Cardiac Catheterization				
	4 (11.1)	31 (86.1)	5.19	0.001**
Indications of Cardiac Catheterization				
	15 (41.7)	33 (91.7)	4.24	0.001**
Sites of Cardiac Catheterization Insertion				
	5 (13.9)	29 (80.6)	4.89	0.001**
Place of Cardiac Catheterization Unit in Hospital				
	6 (16.7)	32 (88.9)	5.09	0.001**
laboratory Investigation before the Procedure				
	15 (41.7)	33 (91.7)	4.02	0.003**
The Reason of PCR Analysis before the Procedure				
	16 (44.4)	27 (75)	3.50	0.014*
Patient Preparation before the Procedure				
	11 (30.6)	33 (91.7)	4.49	0.003**
The tip on which the catheter was installed must not be moved from its place after the Cardiac Catheterization Procedure				
	11 (30.6)	23 (63.9)	3.50	0.003**
The patient position after Cardiac Catheterization				
	8 (22.2)	32 (88.9)	4.70	0.002**
Complications that could be happened after radial insertion of Cardiac Catheterization				
	7 (19.4)	27 (75)	3.92	0.001**
Complications that could be happened after femoral insertion of Cardiac Catheterization				
	6 (16.7)	30 (83.3)	4.89	0.001**
Symptoms that should be reported immediately after exit from Cardiac Catheterization				
	11 (30.6)	33 (91.7)	4.31	0.001**
The time of patient movement after the catheterization procedure				
	7 (19.4)	23 (63.9)	3.77	0.001**
The creatinine level in the blood should be examined after the Cardiac Catheterization Procedure				
	4 (11.1)	27 (75)	4.79	0.001**
Blood coagulation should be monitored in the case of stent placement through Cardiac Catheterization				
	3 (8.3)	18 (50)	3.63	0.001**
Prevention of bleeding after Cardiac Catheterization				
	2 (5.6)	24 (66.7)	4.69	0.001**
The patient in the first days after Cardiac Catheterization must practice simple activities of daily living				
	13 (36.1)	35 (97.2)	4.49	0.001**

* Statistical Significant Difference (P ≤ 0.05)　　　** Highly Statistical Significant Difference (P ≤ 0.01)

Table (3): Distribution of Study Group in Relation to Their Knowledge Regarding Cardiac Catheterization, Pre and Post Implementing Nursing Intervention (n=36)　　　Continued

Cardiac Catheterization Knowledge	Study Group (n=36)		Mc Nemar test	P-value
	Pre Nursing Intervention Study (n=36) No. (%)	Post Nursing Intervention Study (n=36) No. (%)		
Serious signs and symptoms that may occur to a patient with Cardiac Catheterization after discharge from the hospital and require contact with the doctor				
- Fever	2 (5.6)	25 (69.4)	4.79	0.001**
- Shivering	3 (8.3)	27 (75)	4.89	0.001**
- Pain at Site of Cardiac Catheter Insertion or its Extension	5 (13.9)	26 (72.2)	4.37	0.001**
- Edema	13 (36.1)	29 (80.6)	2.13	0.033*
- Bleeding at Site of Insertion	16 (44.4)	26 (72.2)	3.41	0.021*
- Numbness	23 (63.9)	28 (77.8)	1.50	0.227
- Chest Pain	20 (55.6)	30 (83.3)	2.67	0.013*
- Dyspnea	16 (44.4)	26 (72.2)	2.50	0.011*
- Sudden and Excessive Sweating	14 (38.9)	28 (77.8)	3.30	0.001**
- Nausea	12 (33.3)	30 (83.3)	4.02	0.001**
- Vomiting	8 (22.2)	31 (86.1)	4.79	0.001**
- Fainting	13 (36.1)	29 (80.6)	3.41	0.001**

* Statistical Significant Difference (P ≤ 0.05)　　　** Highly Statistical Significant Difference (P ≤ 0.01)

Table (3) Reveals that there is a significant improvement in the study groups' knowledge regarding all items of cardiac catheterization knowledge post **implementing** nursing intervention compared to pre **implementing** nursing intervention, with a highly statistically significant difference.
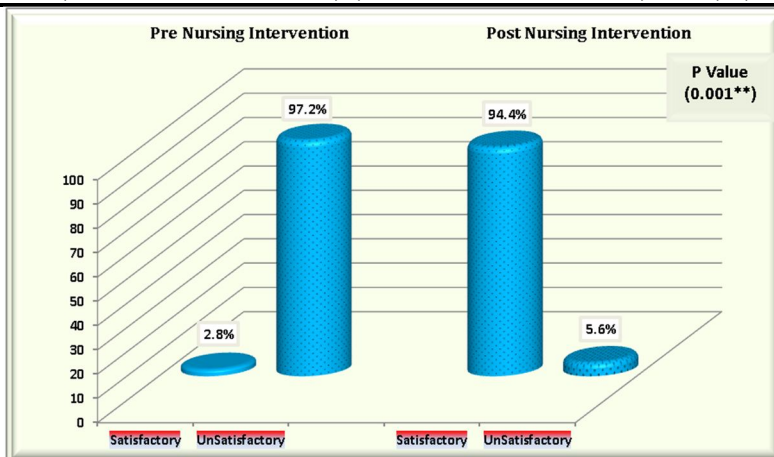
Figure (1): Distribution of Study Group Regarding Their Total Score of Cardiac Catheterization Knowledge Level Pre and Post Implementing Nursing Intervention (n=36)

Figure (1) Reveal that a significant improvement in total score of cardiac catheterization knowledge level among study group presented by 94.4% after implementing nursing intervention, with a highly statistically significant difference.

* Statistical Significant Difference (P ≤ 0.05)   ** Highly Statistical Significant Difference (P ≤ 0.01)
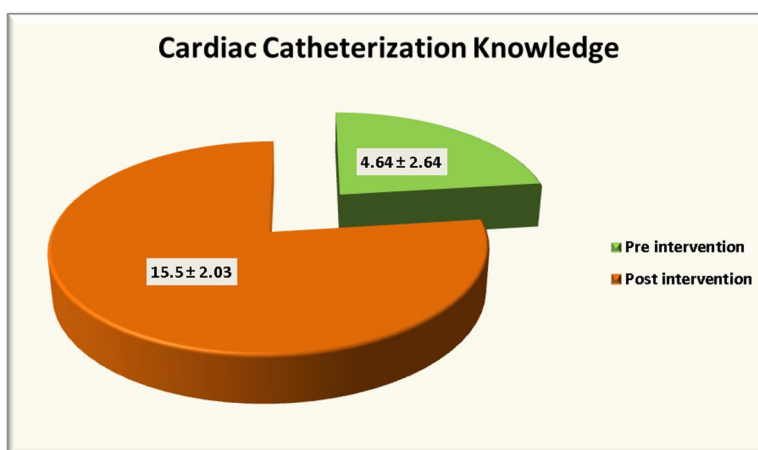

Figure (2): Mean Score of Study Group Regarding Their Total Score of Cardiac Catheterization Knowledge Pre and Post Implementing Nursing Intervention (n=36)

Figure (2): Shows that there is a significant increase in the mean and standard deviation of the study group's total knowledge score of cardiac catheterization knowledge after implementing a nursing intervention, with a highly statistically significant difference represented by 15.5 ± 2.03.
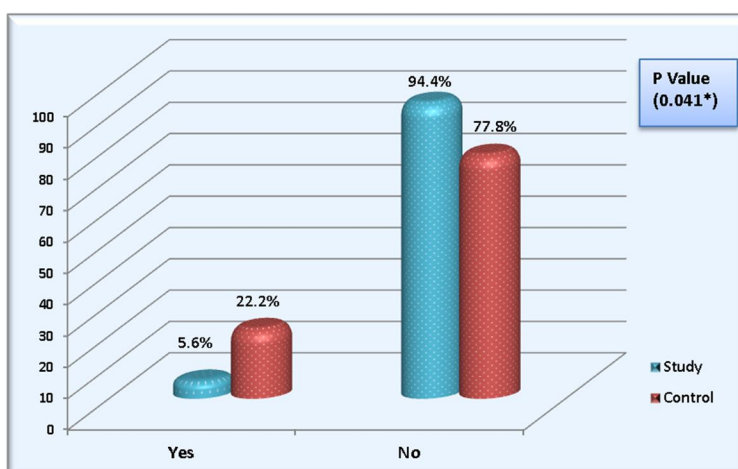

Figure (3): Distribution of Studied Groups Regarding Presence of Complications after Cardiac Catheterization (n=36)

Figure (3) Demonstrated that 94.4% of the study group, compared to 77.8% of the control group, had no complications after cardiac catheterization.
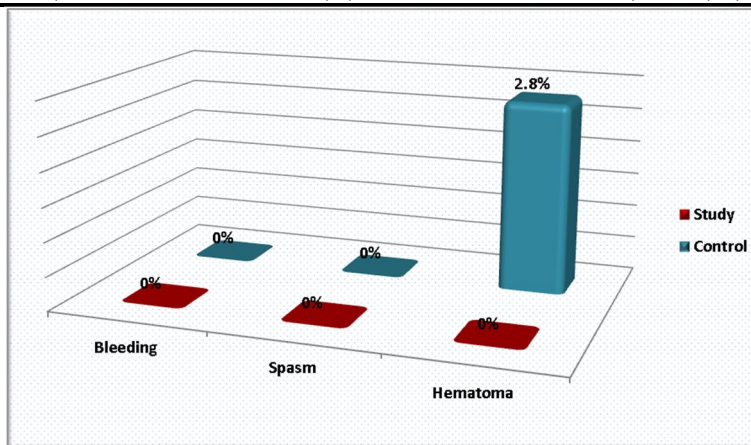
Figure (4): Distribution of Studied Groups Regarding Frequency of Radial Complications after Cardiac Catheterization (n=72)

Figure (4): Illustrated that all studied groups had no radial artery bleeding. In addition, it was found that zero percent of the study group, compared to 2.8% of the control group, had radial artery hematoma as a radial complications.
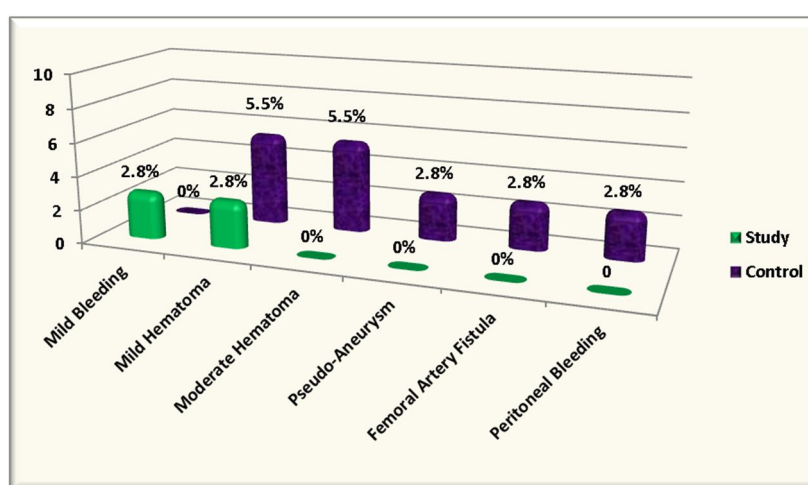

Figure (5): Distribution of Studied Groups Regarding Frequency of Femoral Complications after Cardiac Catheterization (n=72)

Figure (5): Displays that 2.8% and 0% of the study and control groups, respectively, had mild bleeding. In addition, 2.8% of the study group, compared to 5.5% of the control group, had a mild degree of a femoral hematoma after cardiac catheterization. Moreover, it was found that zero percent of the study group, compared to 2.8% of the control group, had pseudoaneurysm, peritoneal bleeding, and a femoral artery venous fistula.

Table (6): Relation between Demographic Data and Total Score of Cardiac Catheterization Knowledge among Study Group Post Implementing Nursing Intervention (n=36)

Demographic Data	Total Score of Cardiac Catheterization Knowledge among Study Group (n=36)	
	Satisfactory (n=34)	Unsatisfactory (n=2)
	No. (%)	No. (%)
Age		
40- 49 years	6 (17.6)	0 (0)
50- 59 years	9 (26.5)	2 (100)
60- 64 years	19 (55.9)	0 (0)
X^2 (P-value)	3.54 (0.111)	
Gender		
Male	20 (58.8)	2 (100)
Female	14 (41.2)	0 (0)
X^2 (P-value)	1.34 (0.246)	
Residence		
Urban	10 (29.4)	0 (0)
Rural	24 (70.6)	2 (100)
X^2 (P-value)	0.814 (0.367)	
Marital Status		
Single	0 (0)	0 (0)
Married	30 (88.2)	2 (100)
Divorced	0 (0)	0 (0)
Widowed	4 (11.8)	0 (0)

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Demographic Data	Total Score of Cardiac Catheterization Knowledge among Study Group (n=36)	
	Satisfactory (n=34)	Unsatisfactory (n=2)
	No. (%)	No. (%)
X^2 (P-value)	0.265 (0.607)	
Education		
Illiterate	10 (29.4)	0 (0)
Read and write	7 (20.6)	0 (0)
Diploma	11 (32.4)	2 (100)
University	6 (17.6)	0 (0)
X^2 (P-value)	3.74 (0.441)	
Occupation		
House wife	13 (38.3)	0 (0)
Free work	9 (26.5)	2 (100)
Governmental work	6 (17.6)	0 (0)
Retired	6 (17.6)	0 (0)
X^2 (P-value)	4.81 (0.186)	

Table (6): Reveals that there is no relation between demographic data and the total score of cardiac catheterization knowledge among study group after **implementing** nursing intervention.

Table (7): Relation between Demographic Data and Presence of Complications after Cardiac Catheterization among Studied Groups Post Implementing Nursing Intervention (n=72)

Demographic Data	Presence of Complications after Cardiac Catheterization			
	Study Group (n=36)		Control Group (n=36)	
	No (n=34)	Yes (n=2)	No (n=28)	Yes (n=8)
	No. (%)	No. (%)	No. (%)	No. (%)
Age				
40- 49 years	6 (17.7)	0 (0)	5 (17.9)	2 (25)
50- 59 years	10 (29.4)	1 (50)	14 (50)	1 (12.5)
60- 64 years	18 (52.9)	1 (50)	9 (32.1)	5 (62.5)
X^2 (P-value)	0.618 (0.734)		3.73 (0.154)	
Gender				
Male	21 (61.8)	1 (50)	21 (75)	6 (75)
Female	13 (38.2)	1 (50)	7 (25)	2 (25)
X^2 (P-value)	0.876 (0.)		0.267 (0.606)	
Residence				
Urban	9 (26.5)	1 (50)	6 (21.4)	3 (37.5)
Rural	25 (73.5)	1 (50)	22 (78.6)	5 (62.5)
X^2 (P-value)	0.521 (0.470)		0.857 (0.355)	
Marital status				
Single	0 (0)	0 (0)	0 (0)	0 (0)
Married	30 (88.2)	2 (100)	18 (64.3)	6 (75)
Divorced	0 (0)	0 (0)	2 (7.1)	0 (0)
Widowed	4 (11.8)	0 (0)	8 (28.6)	2 (25)
X^2 (P-value)	0.265 (0.607)		0.707 (0.702)	
Education				
Illiterate	10 (29.4)	0 (0)	6 (21.4)	0 (0)
Read and Write	7 (20.6)	0 (0)	6 (21.4)	3 (37.5)
Diploma	12 (35.3)	1 (50)	13 (46.5)	3 (37.5)
University	5 (14.7)	1 (50)	3 (10.7)	2 (25)
X^2 (P-value)	2.52 (0.471)		3.38 (0.336)	
Occupation				
House Wife	13 (38.2)	0 (0)	5 (17.9)	0 (0)
Free Work	11 (32.4)	0 (0)	14 (50)	4 (50)
Governmental Work	5 (14.7)	1 (50)	3 (10.7)	1 (12.5)
Retired	5 (14.7)	1 (50)	6 (21.4)	3 (37.5)
X^2 (P-value)	4.23 (0.237)		2.08 (0.554)	

Table (7): Documented that there is no relation between demographic data presence of complications among studied groups after cardiac catheterization.

Table (8): Relation between Medical Data and Presence of Complications after Cardiac Catheterization among Studied Groups Post Implementing Nursing Intervention (n=72)

Medical Data	Presence of Complications after Cardiac Catheterization			
	Study Group		Control Group	
	yes (n=2)	No (n=34)	yes (n=8)	No (n=28)
	No. (%)	No. (%)	No. (%)	No. (%)
Family History of Cardiac Disease				
- Yes	1 (50)	١٢ (35.3)	1 (12.5)	12 (42.9)
- No	1 (50)	22 (67.4)	7 (87.5)	16 (57.1)
X^2 (P-value)	0.177 (0.674)		2.48 (0.115)	
Medical Diagnosis				
- Coronary Artery Disease	٢ (١٠٠)	١٩ (55.9)	4 (50)	15 (53.6)
- Ischemic Heart Disease	0 (0)	10 (29.4)	3 (37.5)	11 (39.3)

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Medical Data	Presence of Complications after Cardiac Catheterization			
	Study Group		Control Group	
	yes (n=2)	No (n=34)	yes (n=8)	No (n=28)
	No. (%)	No. (%)	No. (%)	No. (%)
- Valve Disease	0 (0)	5 (14.7)	1 (12.5)	2 (7.1)
X^2 (P-value)	1.85 (0.810)		1.19 (0.470)	
Type of Procedure				
- Therapeutic	1 (50)	24 (70.6)	6 (75)	20 (71.4)
- Diagnostic	1 (50)	10 (29.4)	2 (25)	8 (28.6)
X^2 (P-value)	1.51 (0.469)		0.234 (0.889)	
Site of Catheter Insertion				
- Radial	0 (0)	8 (23.5)	1 (12.5)	8 (28.6)
- Femoral	2 (100)	26 (76.5)	7 (87.5)	20 (71.4)
X^2 (P-value)	0.605 (0.437)		0.857 (0.355)	
- Antihypertensive & Hypoglycemic	1 (50)	4 (11.8)	٤ (٥0)	11 (39.3)
- Antihypertensive, Hypoglycemic & Anticoagulant	1 (50)	19 (55.9)	2 (25)	8 (28.6)
- Antihypertensive & Anticoagulant	0 (0)	١١ (32.4)	2 (25)	٩ (32.1)
X^2 (P-value)	2.64 (0.266)		0.304 (0.859)	

Table (8): Demonstrate that there are no relationships between medical data and **the presence** of complications after cardiac catheterization among studied groups after cardiac catheterization.

Table (9): Correlation between the Studied Patients' Level of Knowledge Regarding Cardiac Catheterization and the Presence of Complications Post implementing Nursing Intervention (n=72)

Presence of Complications Post Intervention	Cardiac Catheterization Knowledge			
	Study Group (n=36)		Control Group (n=36)	
	R	P	r	P
Complication	- 0.333	0.047*	0.073	0.670

* Statistical Significant Difference (P ≤ 0.05)

Table (9): Revealed a statistically significant negative correlation between the studied patients' level of knowledge regarding cardiac catheterization and the presence of complications after the implementation of nursing intervention.

Discussion

Cardiac catheterization (CC) is an invasive procedure used to diagnose and treat coronary artery disease (CAD). It may lead to many complications after the removal of the femoral arterial sheath, which may contribute to morbidity and mortality and increase the patient's length of stay and hospital costs. Death, myocardial infarction, and stroke are considered major complications. Minor complications include arrhythmias, transient ischemic attacks, vascular access site complications, renal failure, and allergic reactions to contrast agents **(Kareem & Hamza, 2023).**

One invasive method for treating and diagnosing coronary artery disease (CAD) is cardiac catheterization (CC). Following the removal of the femoral arterial sheath, there may be a number of problems that add to the patient's length of stay, hospital expenses, and risk of morbidity and mortality. Stroke, myocardial infarction, and death can be considered major complications. Minor complications include arrhythmias, vascular access site complications, renal failure, transient ischemic episodes, and allergic reactions to contrast chemical substances **(Kareem & Hamza, 2023).**

Nurses play a critical role in preventing endovascular procedure-related complications; they are able to recognize patients who are at a higher risk of complications. Nurses with proper education can educate patients on ways to reduce the risk of adverse effects. Frequent evaluation and observation of the wound are necessary for the early identification of complications and the implementation of preventive measures. Nurses with proper education can educate patients on ways to reduce the risk of adverse effects. Frequent evaluation and observation of the wound are necessary for the early

identification of complications and the implementation of preventive measures **(Dziekiewicz et al., 2023)**

Nursing care is the cornerstone in preventing complications for patients undergoing cardiac catheterization. The nurse explains the procedures and methods to prevent complications through providing both verbal and written patient education **(Abozaid et al., 2021).**

From this concept, this study aimed to evaluate the effect of nursing intervention to minimize vascular complications among patients undergoing cardiac catheterization.

Regarding demographic data, the results of the present study show that studied groups were aged from 60 to 64 years old and more than two-thirds of them were male. From the investigator's point of view, this is related to the risk of heart diseases that increased with aging; also, cardiovascular disease is known to be higher in men than in women of similar age.

This finding agrees with **(Aljanabi & Hassan 2020)** a study that reported that more than two-thirds of both study and control groups were male.

As regards marital status, the findings of the current study demonstrated that the majority of study and control groups were married. This finding comes in line with **(Abd El Hafeez et al., 2018)** who reported that the majority of study and control groups were married.

Concerning educational level, the present study findings demonstrated that the lowest percentage of studied groups had university degrees. Regarding residence, the majority of studied groups lived in rural areas. This finding is in line with the findings of **(Omar et al., 2021)** who found

that around half of the patients were illiterate and unemployed and were living in urban areas.

Regarding smoking, the current study revealed that over half of the studied groups were nonsmokers. This finding is in contrast with (**Abouelala et. al., 2022**) who found that about two thirds of both study and control groups were nonsmokers. The current finding diverges with (**Abd El Hafeez, et al., 2018**) who found that more than half of patients in the study and the control groups were smokers. In addition, in contrast with the finding of (**Mustafa, & Hassan, 2020**) who found that more than half of the patients in the experimental and control groups have active smoking.

Concerning family history of cardiac diseases, the present study showed that less than half of studied groups had a family history of cardiac disease, which was supported by (**Kutkut et al., 2020**)

Related to the associated diseases, the current study documented that the majority of studied groups had hypertension and diabetes mellitus. This is agreed by (**Abd-allah et al., 2021**) whose study revealed that all of both groups suffered from hypertension. In addition, the majority of them had diabetes mellitus

Regarding physical exercises, the findings of the present study revealed that the majority of studied groups hadn't done physical exercises. The findings were contradictory with (**El-Gawad et al.**, **2022**) who mentioned that one third of the studied sample had low physical activity

Concerning chief complaints, the findings of the present study revealed that most of studied groups had chest pain, in addition to about two-thirds of them having palpitations, and also the majority of them had dyspnea

The present study showed that there are no statistically significant differences among the studied groups related to age, gender, occupation, residence, marital status, and education. A similar study was reported by (**Ibdah et al., 2020**) who documented that there were no significant differences between both groups regarding age, gender, and occupation.

Regarding medical data, the findings of the present study revealed that more than two-thirds of the studied groups had a normal heart rate. The highest percentage of the studied group had hypertension, and two-thirds of them had one to two seconds of capillary refill time. This finding was contradicted by a study by (**Abouelala, et al., 2022**) who found that the majority of studied patients had normal parameters with no statistically significant differences. In addition, most of the studied groups had a therapeutic cardiac catheterization. This disagreed with (**Mall et al., 2020**) who found that 89% of the study participants received a diagnostic type of CC procedure.

Regarding catheter site insertion, it was noticed that more than two-thirds of the studied groups had a femoral catheter inserted. The present study revealed that nearly two-thirds of the study group and one-third of the control group used antihypertensive, hyperglycemic, and anticoagulant medications with no statistically significant differences.

Regarding the length of hospital stay, the findings of the present study revealed that the majority of the study group decreased the length of hospital stay with statistically significant differences. Similar findings have been reported by (**Abalı et al., 2022**) who mentioned that local vascular complications constituted about half of all complications and they cause prolonged hospitalization

The current study revealed an improvement in patient knowledge level related to all items of cardiac catheterization post-implementing nursing intervention with a highly statistically significant difference. These findings were in the same line with the study of (**Amin et al., 2020**) who found that most of the patients had an unsatisfactory knowledge level about basic knowledge of cardiac catheterization.

The present study showed that the study group had a satisfactory level of knowledge related to the total score of all items of cardiac catheterization knowledge post-implementing nursing intervention.

The current study revealed a significant increase mean score of the study group's total knowledge of cardiac catheterization post-implementing nursing intervention with a highly statistically significant difference

The current study represented that the majority of the study group had no complications after cardiac catheterization. This proves the effectiveness of nursing intervention implementation. The results of the currents study were in the same line as those of (**Karaem & Hamza, 2023**) the study results revealed a significant reduction in all complications post-cardiac catheterization. From the investigator's point of view, the current research findings explained the effectiveness of nursing interventions.

Regarding radial complications, the present study results illustrated that all studied groups had no radial artery bleeding or spasm. In addition, it was found that nearly three percent of the control group and zero percent of the study group had radial artery hematoma post implementing nursing intervention. The current finding is supported by (**Sania, 2022**) who mentioned that the rate of hematoma development after coronary intervention was reduced after the implementation of good nursing care.

Concerning femoral complications, the current results reveal that femoral hematoma had the highest percentage incidence compared to radial hematoma. In this regard, (**Sania 2022**) concluded that the radial site procedure reflected fewer rates of hematoma development as compared to the femoral site procedure. Additionally, (**Abozaid et al., 2021**) showed that local complications at the radial access site were less than those at the femoral site. From the researcher's point of view, the current findings could be related to the fact that the radial access site is more superficial and has a smaller diameter that allows using a small sheath size, which results in a decreased incidence of local complications.

The current study found that there were no statistically significant differences between patient's demographic data and total score of cardiac catheterization knowledge among the study group post-implementing nursing interventions. The present findings were contradicted by (**Omar et al., 2021**) who documented no significant association between patient level of knowledge and socio-demographic data except with educational level and residency.

The current study concluded that there is no relation between demographic data and the presence of complications among studied groups after cardiac catheterization. In addition, in the present study, there were no statistically significant relationships between medical data and the presence of complications among studied groups after cardiac catheterization. The present finding contradicts (**Mahmoud 2023**), who documented that significant relationship between socio-demographic and clinical data and incidence of vascular complications.

The current study result showed a correlation between the studied patients' level of knowledge regarding cardiac catheterization and the incidence of vascular complications. A similar finding was concluded by (**Amin et al., 2020**) the study group has better knowledge than the control group, as it was clarified that the early preparation and providing patient's information before cardiac catheterization improved patient's knowledge and decreased complications.

Conclusion

In light of the current study results and research hypothesis, the present result revealed that implementation of nursing interventions has reduced the vascular complications post cardiac catheterization in the study group compared to the control group.

Recommendations

Based on the findings of the recent study, the researcher suggested that:

Nurses Recommendations:

Orientation and in-service training for nurses to update nurse's knowledge and practice regarding cardiac catheterization.

Patients Recommendations:

Design leaflet includes instructions regarding the cardiac catheterization to improve patient's knowledge and practice regarding cardiac catheterization care.

Future Research Recommendations:

Replication of the current study on a larger sample size from different Egyptian geographical areas to generalize the findings.

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