

Risk of Complications in Patients Undergoing Diagnostic Cardiovascular Catheterization at Radial versus Femoral Vascular Access Sites

Amal Metwaly Ibrahim Abozaid^{1*}, Amr Mahmoud ThanaaEldin Zaky²,
Amany Youssef mohamed Sharaf³, Rasha Fathy Ahmed Dawood⁴

¹Teacher in Nursing Institute – Medical Surgical Nursing / Ministry of Health, Alexandria, Egypt.

²Professor of Cardiology- Cardiology Department/ Cardiology Department, Alexandria University, Egypt.

³Assistant Professor of Medical - Surgical Nursing / Faculty of nursing, Alexandria University, Egypt.

⁴Lecturer of Medical-Surgical Nursing/ Faculty of nursing, Alexandria University, Egypt.

Corresponding author: Amal Metwaly Ibrahim Abozaid – Email: amalabozaid29@yahoo.com

Abstract: Diagnostic cardiac catheterization is among the most commonly performed procedure. There are a number of potential complications from cardiac catheterization. The complications can be minor as discomfort at the site of catheterization to major ones like death. Aim of the study: Assess risk of complications in patients undergoing diagnostic cardiovascular catheterization at radial versus femoral vascular access sites. Setting: The study was conducted at the The International Cardiac Center Hospital (ICC), Alexandria. Subjects: A convenience sample of 180 adult patients. Tools: One tool was used in this study: Radial versus Femoral Access Site Assessment Sheet. Results: The study revealed that females exceeded males in the radial groups, 53.4%, 46.6% respectively 56.8% of radial group patients and 45.7% of femoral group patients had read and write. Diabetic patients represented 26.1% of the patients radial group, while chronic obstructive pulmonary disease patients represented 22.8% of the femoral group. More nearly two fifth of the studied patients 38.1% were post myocardial infarction, compared to 45.5% of them in the radial group who had unstable angina. cases with complication was (30.7%) in radial group and was (51.1%) in femoral group, while cases without complication was (69.3%) and (48.9%). There was statistical significant difference between two studied groups regarding incidence of complications ($P < 0.05$). Conclusion: The radial approach would ensure better patient safety, satisfaction and comfort which would help reduce the patients length of stay and increase patients treated with timely discharges. Recommendations: Develop and apply an educational programs should be implemented to each patient about how to care for access site after coronary angiography.

Keywords: Diagnostic cardiac catheterization, radial/femoral vascular access site, risk, complications.

I. INTRODUCTION

Coronary artery disease (CAD) is the most prevalent of heart diseases and it is one of the most common causes of death worldwide. It is also, a major cause of physical disability, particularly in rapidly growing elderly population. According to world health organization (WHO), cardiovascular diseases account around 29.3% of total world mortalities (Roger et al., 2012).

Coronary artery disease occurs when coronary arteries blood supply is decreased that causing inadequate delivery of both oxygen and nutrients to the myocardium. The major cause of CAD is coronary atherosclerosis that is an abnormal accumulation of lipid, or fatty substances, and fibrous tissue in the lining of arterial blood vessel walls. These substances block and narrow the coronary vessels which reduce the blood flow to the myocardium. Clinical manifestations of coronary

artery disease are diverse with a spectrum that encompasses various forms of acute coronary syndrome (ACS), including angina pectoris, myocardial infarction (MI), and sudden cardiac death, as well as chronic coronary heart disease (Benjamin et al., 2017). The management of CAD encompasses life style modifications, medical therapy (MT) or revascularization by percutaneous coronary intervention (PCI) or coronary artery bypass grafting (CABG) both in combination with MT. Coronary artery disease (CAD) is a disease of the blood vessels supplying the heart muscle. It is caused by atherosclerosis of the coronary arteries that leads to cutoff the blood flow to the heart. Depending on the degree of stenosis and plaque characteristics, patients may experience angina pectoris or may be asymptomatic until a plaque ruptures and thrombosis arises (Roger et al., 2012). Coronary artery disease is the first principal cause of death worldwide. The world health organization (WHO) has estimated that more than 1 in 7 deaths in 2017 were caused by coronary artery diseases. According to the latest WHO data issued in 2017, coronary artery disease is responsible for 24.585% of total deaths in Egypt and the adjusted death rate was 216.82 per 100,000 population (Benjamin et al., 2017). The treatment approaches for coronary artery disease differ between medical, surgical intervention, and percutaneous coronary interventions (PCI) (Merriweather & Sulzbach-Hoke, 2012). Cardiovascular catheterization is the introduction of a catheter through a vein or artery, usually from a groin or beneath the forearm access site, which is then navigated into the heart. This procedure is done for both diagnostic and interventional indications. Diagnostic catheters are used to estimate blood flow and pressures in the chambers of the heart, valves and coronary arteries, and to assist in the diagnosis/management of congenital heart defects (Mozaffarian et al., 2016; The Royal Children's Hospital Melbourne, 2017). Interventional catheters are the management of choice as they are utilized as a substitute to open-heart surgery. These techniques include closure of septal defects (ventricular septal deformity device closures, atrial septal deformity closure), extension of narrowed passages (pulmonary stenosis), and stent placement (Faccini & Butera, 2018). Percutaneous coronary interventions (PCI) are non-surgical methods for treating obstructed coronary artery disease that reduce noticeably the mortality and morbidity rates (Merriweather & Sulzbach-Hoke, 2012). It can be performed via the, radial or femoral arteries. The femoral method has traditionally been and still the crucial method for most surgeons (Qi et al., 2017). On the other hand, Piers et al., (2015), claimed that transradial PCI is a safe, and cost effective procedure compared to the classic transfemoral approach as it requires less access site, and lesser tendency for complications. Additionally, patient comfort is amplified and outpatient treatment is accessible. However, percutaneous section through the femoral artery and vein approach for PCI is frequently preferred because of the width diameter of these vessels, which improves the speed and simplicity of the procedure (Damluji et al., 2013). Recently, the anticoagulant harvests benefits, and major advances in PCI have been accomplished including: progressively complex antiplatelet and antithrombotic regimens (Roger et al., 2012). Although it may lead to the incidence of vascular access site complications (VASCs), including hematoma, hemorrhage, aneurysm, arteriovenous fistula, arterial occlusion, neuropathy, and infection (White et al., 2018). Although the advances in catheterization procedures have diminished the prevalence of cardiac catheter related complications, statistics showed that complications remain a substantial source of morbidity and mortality in these patients (Abhishek et al., 2011). Non modifiable risk factors for VASC are characteristics of patients that cannot be reformed in the PCI setting. These include sex, advanced age, body mass index (BMI), hypertension, and renal dysfunction. Every one of these causes alone, and particularly in combination, can influence the probability that a patient will experience a VASC after a technique (Kirchhof et al., 2016). Many authors reported that the revealed frequency of VASCs among PCI is from 5.4% to 20%, depending on the definition and criteria. VASCs remain an important cause of expanded morbidity, mortality length of stay and cost, as the expense of PCI in case of bleeding complications emerge is more than double the costs of uncomplicated PCI. Interventions aiming at decreasing the danger of adverse events no doubt are likely to improve both financial and clinical outcomes (Sulzbach-Hoke et al., 2010). Nurses have a great role in monitoring patients. The homeostasis process is watched by the nurse unless a vascular closure device is positioned (Deshmukh et al., 2013).

Removing catheter sheaths and handling related complications after PCI are mainly the responsibilities of nurses. Therefore, it is necessary for nurses to realize the causes of and predisposing factors for VASCs (Rolantova et al., 2019).

Nursing care for patients undergoing cardiac catheterization is the corner stone in preventing and identifying complications. In addition, the nurse must provide both verbal and written patient education to explain the procedure, any complications and methods to prevent that complication (Mlekusch et al., 2016). Considering the important rudiments in vascular access complications risk assessment as well as the nurse's vigorous monitoring of patients vital signs, initial vascular access site assessment including changes in color, temperature, pulse, capillary refill, skin integrity and any discomfort present in the extremity used for access before starting the procedure are mandatory (Dumont et al., 2006).

Although there are no consistent standards of care in the literature, nursing care activities are essential to prevent vascular complications during the procedure, the nurse should assess puncture site, size of sheath, numbers of trails, and patient's possible abnormal replies during the procedure in relation to the technique used. After interventions, the nurse should also assess the puncture site for bruit which compromises the vascular flow leading to pseudoaneurysm or arteriovenous fistula. In sheath removal, the nurse should apply continuous manual pressure on access site for 20-30 minutes to achieve hemostasis. Finally, the nurse should also document site assessment findings as hematoma site and characteristics, as well as presence of distal pulses, bruits, tenderness or both (Manici, 2018). Nurses who are able to promptly distinguish complications are in the ideal situation to improve critical action and improve patient outcomes. Therefore, nurses who care for patients undergoing cardiac catheterization are the key to lower mortality and morbidity rates for those patients (Manici, 2018). Accordingly, the aim of this study is to assess risk of complications at radial and femoral vascular access sites for patients undergoing percutaneous coronary interventions.

II. MATERIALS AND METHOD

MATERIALS

Research Design:

A descriptive comparative research design was utilized.

Setting: The study was conducted at The International Cardiac Center Hospital (ICC). Alexandria.

Subjects:

A convenience sample of one hundred and eighty patients was included in the study according to the following criteria:

- Adult patients aged from 21-60 years.
- Confirmed diagnosis with Coronary artery disease by a cardiologist.
- Free from uncontrolled chronic diseases such as renal failure & peripheral vascular diseases.
- Able to Communicate verbally, alert, and able to follow instructions.
- Willing to participate in the study.

Statistical Program Epi-Info was used to estimate the sample size using the following parameters:

- Population size=2400 femoral access patient and 900 radial in (2018)
- Expected frequency=50%
- Acceptable error =10%
- Confidence Coefficient =95%
- Sample size =92 femoral +88 radial =180 patient

Study Tools:

One tool was used in this study.

Tool:

Radial versus Femoral Access Site Assessment Sheet

This tool was developed by the researcher was used to assess patients' condition before, during and after diagnostic cardiovascular catheterization (Hamel, 2009; Merriweather & Sulzbach-Hoke, 2012) It consisted of three parts as follows:

Part I: Patient's socio-demographic characteristics including: Patients' age, gender, education, occupation, marital status and associated diseases as hypercholesterolemia, allergies, medical history, past history, previous hospitalization, reason for hospitalization, frequency of measuring vital signs, body weight and height, medications used, laboratory investigations, type of percutaneous catheterization diagnostic or treatment and Doppler results.

Part II: Vascular access's site assessment sheet: It included 3 parts.

Pre procedure assessment (Merriweather & Sulzbach-Hoke, 2012).

- a. Inspection of the vascular access site skin for color changes such as hyperpigmentation, pallor, cyanosis of the involved extremity.
- b. Palpation of the vascular access site for edema, temperature, capillary refill and presence of distal pulses "Allen's test " (for radial catheter only).

During procedure assessment (Basiouny, 2011).

- a. Puncture site, size of sheath.
- b. Number of trials, and patient's abnormal reactions.

Post procedure assessment (Hamel, 2009).

- a. Duration of procedure, length of pressure hold to achieve homeostasis.
- b. Vital signs checking.
- c. Patients' level of consciousness.
- d. Reassessment for the access site by inspection & palpation.

Part III: - Risk of complications at femoral versus radial vascular access-sites in diagnostic cardiovascular catheterization assessment checklist:-

Local complication:

1. Hematoma Rating Scale (Suggs et al., 2013). It is a two point scale ranging from minor hematoma <5cm – to major hematoma >5cm.

It was adopted from (Hamel, 2009). to measure:

- a. Visible swelling surrounding the puncture site. Size, onset and type of hematoma parameters were also included.
- b. Area of hardening under the skin surrounding the puncture site (palpable).

2. Bleeding (Reich et al., 2018). Vascular site bleeding measured through:

- a. Observing Site (internal /external).
- b. Observing amount using Oozing scale which is adopted from (Basiouny, 2011). It is a four point scale as follows:-
 - No oozing (dry dressing).
 - Mild oozing (< 2cm² in diameter dressing soaked with blood.
 - Moderate oozing (2≤ 5cm² in diameter dressing soaked with blood.
 - Severe oozing (5≤ 10 cm² in diameter dressing soaked with blood.

3. Pseudoaneurysm, (Fonseca et al., 2017) : This complication was assessed for by presence of:

- a. Swelling at insertion site.
- b. Pulsatile mass.
- c. Bruit and/or thrill in the insertion site.

4. Arteriovenous fistula, (Fonseca et al., 2017) This complication was checked for by:

- a. Bruit and/or thrill at access site.
- b. Skin elevation.

5. Neurovascular compromise (Basiouny, 2011; Fonseca et al., 2017). This complication was assessed for by:

Changes in access site colors, temperature, capillary refill, pulse, and presence of swelling, abnormal sensation, or pain of the access limb.

6. Vascular injury (Rashid et al., 2016).

- Dissection: (Occlusive → chest pain) (Non Occlusive → fluoro " screening angiography")
- Perforation: (↓ blood pressure 100/60mmhg, Tachycardia pulse ↑ 120b/m neck veins → prominent "distended")

Systemic complications:

- 1- Arrhythmia (Rashid et al., 2016).
 - Atrial Fibrillation (AF) and Ventricular tachycardia (VT) (↓ blood pressure 100/60mmhg, tachycardia pulse ↑ 120b/m, Chest pain.)
 - Ventricular fibrillation (VF) (Cardiac arrest, Cyanotic, lost consciousness, convulsion.)
- 2- Anaphylactic reaction (Rashid et al., 2016; Rigattieri et al., 2016).
 - Contrast induced Nephrotoxicity: Anuria, (↑ urea ,creatinine test)
 - Allergic reaction (Bl.p ↓ 100/60mmhg, nausea, flushing.)
- 3- Air embolism (Rigattieri et al., 2016).

Was watched for by:

(Chest pain , tremors, feeling of stress, aching joint)

4- vagal reaction. (Fonseca et al., 2017; Rigattieri et al., 2016)

Was assessed for by:

(↓ HR (↓ 60b/m), ↓ Bl.p (↓ 100/60mmhg) Sweating, nausea, vomiting, dizziness)

Scoring System

- Scores " One" and " Zero" was allotted to "present", and "not present" respectively. Total observation scores was calculated, then converted into mean percent score as follows:
 - > 75 % high risk for complications.
 - 50 – 75 % moderate risk for complications .
 - < 50 % low risk for complications .Patients' adherences were evaluated as the follows:
 - ✓ Scoring of less than 50% was considered as "low adherence" to therapeutic regimen.
 - ✓ Scoring of 50% to 65% was considered as "moderate adherence" to therapeutic regimen.
 - ✓ Scoring more than 65% was considered as "high adherence" to therapeutic regimen.

Method

The study was accomplished as follows:

- Written Approval:

Written approval to carry out the study was obtained from Ethical Committee of the Faculty of Nursing, Alexandria University. Also, an official letter was submitted from Faculty of Nursing, Alexandria University, to the director of the The International Cardiac Center Hospital and to the director of nursing in order to obtain their approval for conducting the study, after explaining the aim of the study.

- Tool development:

Tool I: Patients' socio-demographic characteristics and clinical data that were utilized to elicit the information related to socio-demographic and clinical data. In addition, tool II: Adherence to therapeutic regimen among patients undergoing

CABG surgery that was used to identify the patients' adherence to therapeutic regimen was developed by the researcher based on a review of the recent relevant literature.

- content validity:

The tools were submitted to the jury members of five experts in the field of medical surgical nursing and Cardiology, to test its contents validity, completeness and clarity of its items. Every jury member was informed about the aim and method of the study. Comments and suggestions of jury were considered and the tools were modified accordingly.

- Reliability:

The reliability of the developed tool was tested by using the Cronbach's Alpha Statistical Test. The tool proved to be internally reliable, with a Cronbach's Alpha Test at 0.892.

- Pilot study:

Before embarking on the actual study, a pilot study was conducted on 10% of the subjects for testing clarity, and applicability of the study tool. Appropriate modifications were done. Those patients were excluded from the actual study sample.

Data collection:

- Data collection was started after securing the administrative approval.
- The final drafts of the developed tools were used to collect data in order to achieve the objective of this study.
- The data were collected by the researcher from each patient using the structured individualized interview.
- After explaining the purpose of the study by the researcher, the interview session for each subject was required approximately 30- 60 minutes.
- Data were collected in the morning shift at The International Cardiac Center Hospital (ICC).
- Data were collected throughout a period of six months from the beginning of June 2019 to the end of January 2020.

- Statistical analysis

- Data were coded, computerized and analyzed using the Statistical Package for Social Sciences (SPSS) version 25.
- Qualitative data were described using number and percent.
- Quantitative data were described using mean, standard deviation and range (minimum and maximum).
- Comparisons between different studied groups regarding categorical variables were tested using Chi-Square Test.
- Monte Carlo Test was used as an alternative for chi-square test in presence of many small expected values.
- The significance of the results was at the 5% of significance (p value is considered statistically significant if ($p \leq 0.05$)).

III. RESULTS

Table (1): Illustrates frequency distribution of the studied patients of both radial and femoral groups according to their socio-demographic characteristics. As regards patients' age, the table shows that about one third of the studied patient in radial access group (33 %) were between 50 - 60 years, whereas more than two fifth of them in the femoral group (42.4%) were also between 50 -60 years. Regarding sex, the table illustrates that females exceeded males in the radial groups 53.4%, 46.6% respectively, While males exceeded females in the femoral groups 55.4%, 44.6% respectively. In relation to level of education. It was observed that 56.8% of radial group patients and 45.7% of femoral group patients had read and write. Regarding occupation, the table denotes that about one third of the studied patients (33%) in the radial group were house wives or had manual occupation, compared to 59.8% of them in the femoral groups who had manual occupation. In relation to marital status, the table shows that majority of the studied patients in both groups were married (69.3%, 76.1% respectively).

Table (1): Frequency distribution of the studied patients of both radial and femoral groups according to their socio-demographic characteristics (radial n=88, femoral n=92)

socio-demographic characteristics	Radial group "n=88"		Femoral group "n=92"	
	No.	%	No.	%
Age groups (years)				
20<30	4	4.5	4	4.3
30<40	28	31.8	24	26.1
40<50	27	30.7	25	27.2
50 – 60	29	33.0	39	42.4
Sex				
Male	41	46.6	51	55.4
Female	47	53.4	41	44.6
Level of education				
Illiterate	0	0.0	3	3.3
Read and write	50	56.8	42	45.7
Diploma degree	23	26.1	27	29.2
University	15	17.1	19	20.7
Master	0	0.0	1	1.1
Occupation				
Professional	26	29.5	30	32.6
Manual	29	33.0	55	59.8
House wife	29	33.0	2	2.2
Not working	4	4.5	5	5.4
Marital status:				
Single	6	6.8	5	5.4
Married	61	69.3	70	76.1
Widow	11	12.5	10	10.9
Divorced	10	11.4	7	7.6

Table (2): Displays distribution of the studied patients of both radial and femoral groups according to their clinical data. (radial n= 88, femoral n= 92).

As regards associated diseases, this table shows that diabetic patients represented 26.1% of the patients radial group, while chronic obstructive pulmonary disease patients represented 22.8% of the femoral group.

In relation to previous hospitalization, the results show that one half of the studied patients in the radial group 50% had previous hospitalization, compared to 51.1% of them patients in femoral group

Regarding reason of hospitalization, one fourth of the studied patients had equal percentage of either chest pain or syncope, compared to (27.7%, and 25.5%) of patients in the femoral group who had syncope, and palpitation respectively.

As regards indications for diagnostic cardiac catheterization, more nearly two fifth of the studied patients 38.1% were post myocardial infarction, compared to 45.5% of them in the radial group who had unstable angina.

Table (2): Distribution of the studied patients of both radial and femoral groups according to their clinical d (radial n= 88, femoral n= 92).

Clinical data	Radial group		Femoral group	
	"n=88"		"n=92"	
	No.	%	No.	%
Associated disease				
Allergies	7	7.9	7	7.7
Dyslipidemia	13	14.8	17	18.5

Diabetes mellitus	23	26.1	20	21.7
Hypertension	11	12.5	14	15.2
Chronic obstructive pulmonary disease	19	21.7	21	22.8
Vasculitis	15	17.0	13	14.1
Previous hospitalization				
Yes	44	50	47	51.1
No	44	50	45	48.9
Reason for hospitalization				
Chest pain	11	25.0	7	14.9
Dyspnea	8	18.1	7	14.9
Headache	5	11.4	8	17.0
Syncope	11	25.0	13	27.7
Palpitation	9	20.5	12	25.5
Indications for diagnostic cardiac catheterization				
Stable Angina	27	30.6	32	34.7
Unstable Angina	40	45.5	25	27.2
Post myocardial infarction	21	23.9	35	38.1

Table (3): Shows distribution of the studied patients of both radial and femoral group according to their anthropometric measurements (radial n=88, femoral n=92)

This table shows that the mean value of the studied patients' body weight is (84.73±9.76) in the radial group, compared to (85.05±10.55) of patients in the femoral group. As regards patients' height, the table illustrates that the mean value of the studied patients' body height is (167.6±4.95) of patients in the radial group, compared to (168.99±5.35) of patients in femoral group. Also the mean value of BMI was 25.1±3.44 in radial group, while it was 24.9±3.11 of the femoral group. There was no statistical significant difference are detected between two studied groups regarding anthropometric measurements (P > 0.05).

Table (3): Distribution of the studied patients of both radial and femoral group according to their anthropometric measurements (radial n=88, femoral n=92)

Anthropometric measurements	Radial group "n=88"	Femoral group "n=92" Mean±SD	P value
Body weight	84.73±9.76	85.05±10.55	0.83
Height	167.6±4.95	168.99±5.35	0.625
BMI	25.1±3.44	24.9±3.11	0.231

P was significant if ≤ 0.05

Table (4): Displays distribution of the studied patients of both radial and femoral groups regarding their medication and laboratory investigations (radial n=88, femoral n=92).

In relation to medications, the majority of the studied patients of both radial and femoral groups received aspirin (77.3%, 76.1% respectively). Regarding laboratory investigations. The table shows that the majority of patients in both groups had normal hemoglobin, serum blood urea, creatinine, and platelets levels. (radial group 93.2%, 96.6%, 97.7%, 94.3% respectively) and femoral group (91.3%, 97.8%, 97.8%, 92.4% respectively). Also, all patients in both group had normal prothrombin time and had negative HIV, HCV and HBV markers. no statistical significant difference are observed between the two studied groups regarding their medication and laboratory investigations.

There was no statistical significant difference between two studied groups regarding their medications and laboratory investigations.

Table (4): Distribution of the studied patients of both radial and femoral groups regarding their medication and laboratory investigations (radial n=88, femoral n=92).

	Radial group		Femoral group		P value
	"n=88"		"n=92"		
	No.	%	No.	%	
Medications					
Aspirin	68	77.3	70	76.1	0.562 N.S.
Clopidogril	42	47.7	45	48.9	0.489 N.S.
Coumadin	25	28.4	36	39.1	0.136 N.S.
Ticagrelor	10	11.4	22	23.9	0.221 N.S.
Laboratory investigation					
Hemoglobin					
Normal	82	93.2	84	91.3	0.856 N.S.
Low	6	6.8	8	8.7	
Serum blood urea					
Normal	85	96.6	90	97.8	0.952 N.S.
Elevated	3	3.4	2	2.2	
Serum creatinine					
Normal	86	97.7	90	97.8	0.98 N.S.
Elevated	2	2.3	2	2.2	
Prothrombin time					
Normal	88	100.0	92	100.0	-
Abnormal	0	0.0	0	0.0	
Platelet count					
Normal	83	94.3	85	92.4	0.685 N.S.
Abnormal	5	5.7	7	7.6	
Markers HIV-HCV-HBV					
Negative	88	100.0	92	100.0	-
Positive	0	0.0	0	0.0	

Table (5): Displays distribution of the studied patients of both, radial and femoral groups according to their vital signs at different periods pre and post procedure (radial n=88, femoral n=92) .

The table shows that more than 90% of the studied patients in both groups had normal pulse rate either pre or post procedure. In addition, all patients in both groups had normal body temperature on discharge. The table also displays that all patients (100%) in the femoral group had normal pulse rate, had normal blood pressure, and respiratory rate. on discharge, compared to 95.5%, 97.7%, and 94.3% of patients in the radial group respectively. There was no statistical significant difference between two studied groups at different period of follow up regarding vital signs (P > 0.05).

Table (5): Distribution of the studied patients of both, and femoral groups according to their vital signs at different periods pre and post procedure (radial n=88, femoral n=92).

vital signs	Radial group "n=88"										Femoral group "n=92"															
	pre procedure					Post procedure					pre procedure					Post procedure										
	1 st time		2 nd time		Imm. after		1 st hr		2 nd hr on discharge		1 st time		2 nd time		Imm. after		1 st hr		2 nd hr		3 rd hr		4 th hr		5 th hr On discharge	
	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%	No.	%
Pulse rate																										
Normal	85	96.6	85	96.6	86	97.8	85	96.6	84	95.5	89	96.7	90	97.8	86	93.5	84	91.3	86	93.5	87	94.6	89	96.7	92	100
Tachycardia	2	2.3	2	2.3	1	1.1	1	1.1	1	1.1	2	2.2	1	1.1	4	4.3	5	5.4	5	5.4	3	3.3	2	2.2	0	0
Bradycardia	1	1.1	1	1.1	1	1.1	2	2.3	3	3.4	1	1.1	1	1.1	2	2.2	3	3.3	3	3.3	2	2.1	1	1.1	0	0
Sig. with before			1.0		0.412		0.532		0.612				0.65		0.254		0.421		0.521		0.611		0.426		0.521	
Body temperature																										
Normal	88	100.0	88	100.0	88	100.0	88	100.0	88	100.0	92	100.0	92	100.0	92	100.0	92	100.0	92	100.0	92	100.0	92	100.0	92	100.0
Fever	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0
Sig. with before			-		-		-		-				-		-		-		-		-		-		-	
Respiration rate																										
Normal	85	96.6	86	97.7	87	98.9	85	96.6	86	97.7	90	97.8	91	98.9	88	95.6	89	96.7	90	97.8	91	98.9	91	98.9	92	100
Tachypnea	3	3.4	2	2.3	1	1.1	3	3.4	2	2.3	2	2.2	1	1.1	4	4.4	3	3.3	2	2.2	1	1.1	1	1.1	0	0
Sig. with before			0.821		0.621		1.0		0.821				0.826		0.622		0.792		1.0		0.826		0.826		0.69	
Blood pressure																										
Normal	85	96.6	85	96.6	86	97.8	87	98.9	83	94.3	91	98.9	91	98.9	90	97.8	89	96.7	88	95.7	89	96.7	91	98.9	92	100.0
Hypertension	2	2.3	2	2.3	1	1.1	1	1.1	2	2.3	1	1.1	1	1.1	1	1.1	2	2.2	3	3.2	2	2.2	1	1.1	0	0.0
Hypotension	1	1.1	1	1.1	1	1.1	0	0.0	3	3.4	0	0.0	0	0.0	1	1.1	1	1.1	1	1.1	1	1.1	0	0.0	0	0.0
Sig. with before			1.0		0.882		0.76		0.521				1.0		0.89		0.785		0.698		0.752		1.0		0.882	

Table (6): Displays distribution of the studied patients of both radial, and femoral groups according to their vascular access site assessment at pre, during cardiac catheterization (radial n=88, femoral n=92).

As regards pre-procedure assessment the table illustrates that all of the studied patients in both radial and femoral groups had normal body temperature, while the majority of them in both radial and femoral groups had normal skin color (96.6%, 93.5% respectively) and normal capillary refill(94.3%, 93.5% respectively).

In relation to during procedure assessment, the table denotes that the majority of the studied patients in both radial and femoral groups had normal site of puncture (89.8%, 81.5%respectively), and normal pulse oximetry monitoring (98.9 %, and 97.8% respectively). Also, most of patients in both groups passed one trail only (92%, and 90.2% respectively).

As regards size of sheath, the results show that the majority of patients in both radial and femoral groups had size number seven (56.8% , 45.6% respectively).

No statistical significant difference between the two studied groups regarding vascular access site assessment (P > 0.05)

Table (6): Distribution of the studied patients of both radial, and femoral groups according to their vascular access site assessment at pre, during cardiac catheterization (radial n=88, femoral n=92).

vascular access site assessment	Radial group "n=88"		Femoral group "n=92"		P value
	No.	%	No.	%	
1. Pre- procedure assessment:					
Color					
normal	85	96.6	86	93.5	0.552 N.S.
Hyperpigmentation	0	0	1	1.1	
Pallor	2	2.3	2	2.2	
Cyanosis	1	1.1	3	3.2	
Temperature					
o Normal	88	100	92	100	-
o Hotness	0	0	0	0	
o Coldness	0	0	0	0	

Capillary refill					
Normal	83	94.3	86	93.5	0.93 N.S.
Delayed	3	3.4	4	4.3	
Distal pulse	2	2.3	2	2.2	
II. During procedure assessment					
Site of puncture					
High	4	4.5	9	9.8	0.210 N.S.
Normal	79	89.8	75	81.5	
Low	5	5.7	8	8.7	
Size of sheath					
6	28	31.8	30	32.6	0.134 N.S.
7	50	56.8	42	45.6	
8	10	11.4	20	21.8	
Number of trails					
Once	81	92	83	90.2	0.84 N.S.
Twice	6	6.8	7	7.6	
3 times or more	1	1.2	2	2.2	
Pulse oximetry monitoring					
Normal	87	98.9	90	97.8	0.586 N.S.
Abnormal	1	1.1	2	2.2	
Activated clotting time(ACT)					
Normal	85	96.6	86	93.5	0.338 N.S.
Abnormal	3	3.4	6	6.5	

Table (7): Represent distribution of the studied patients of both radial and femoral groups related to vascular access site assessment post procedure (radial group n=88, femoral group n=92).

The table illustrates that almost half of the studied patients in both radial and femoral groups had 15-30 minutes sheath time (48.9%, 58.7% respectively). Also 45.4% of studied patients in the radial groups needed more than 15 – 30 mints of pressure holds to maintain hemostasis compared to 57.6% of them of the femoral groups. Most of the studied patients in both radial and femoral groups suffered from pain post procedure(64.8%, 96.7% respectively).in relation to site of pain the majority of studied patients suffered from pain at insertion site as patients 52.3% in the radial group pain at arm compared to 87% of the patient of femoral group had leg pain. More than one third of the studied patients had chest pain in the radial group compared to nearly half of them femoral group chest pain (34.1%,45.7% respectively) .Regards pain intensity post procedure, the table shows that pain intensity in both radial and femoral groups reached its peak immediately post procedure (5.66±0.61&7.01±0.36) respectively.

Statistical significant difference in pain intensity are detected between both groups immediately, after 30 minutes, and 1 hour post procedure (P < 0.05), Meaning that patients in the radial group had higher degree pain intensity those in femoral group.

Table (7): Distribution of the studied patients of both radial and femoral groups related to vascular access site assessment post procedure (radial group n=88, femoral group n=92).

	Radial group "n=88"		Femoral group "n=92"		P value
	No.	%	No.	%	
1. Post- procedure assessment:					
Sheath time					0.258
15-30 Minutes.	43	48.9	54	58.7	
30-45 Minutes.	20	22.7	21	22.8	
45-60 Minutes	25	28.4	17	18.5	
Duration of pressure holds to hemostasis:					0.257 N.S.
15-30 Minutes.	40	45.4	53	57.6	
		30.7		22.8	

30-45Minutes.	27		21	19.6	
>45 Minutes	21		18		
Pain					
Yes	57	64.8	89	96.7	
No	31	35.2	3	3.3	0.037*
Site of pain					
Chest	30	34.1	42	45.7	0.002*
Back	25	28.4	40	43.5	0.007*
Arm	46	52.3	0	0.0	0.001*
Leg	0	0	80	87.0	0.001*
Pain intensity (mean ± SD)					
Time					
Immediately	5.66±0.61		7.01±0.36		0.022*
30 min.	5.2±0.46		5.21±0.71		0.036*
1 hrs	3.72±0.41		4.23±0.55		0.036*
3 hrs	2.65±0.34		4.1±0.15		0.103 N.S.
5 hrs	-		3.66±0.41		-
On discharge	-		2.69±0.46		-

Table (8): Display distribution of the studied patient’s according to assessment of their risk of Local complications at both radial and femoral access sites (radial=88) – (femoral = 92)

As regards external bleeding, the table shows that 14.8% of patients in the radial group suffered from external bleeding, compared to 21.7% of them in the femoral group patients .Regarding to Oozing scale, more than three quarter of patients in both radial, and femoral groups groups had no oozing with percent (79.5%) and (76.1%) respectively. Hematomas represents (7.9%) and (21.7%) in both groups.Also, 2.3% of patients in the radial group had arteriovenous fistula, bruit and/or thrill at the access site compared to 4.3% of them in the femoral group. Skin elevation represented (4.5%, 9.8%) in both radial, and femoral groups respectively.As regards pseudoaneurysm, swelling at the insertion site, the table shows that 17.1% of patients in the radial group suffered from swelling at the insertion site, compared to 27.2% of them in the femoral group patients.Also, 3.4% of patients lower in radial group had Neurovascular compromise, compared to 8.7% of them in the femoral group. Vascular injury in radial group (4.5%, 4.5% and 1.1%) was less than in femoral group (7.6%, 7.6% and 3.3%).

Table (8): Distribution of the studied patient’s according to assessment of their risk of Local complications at both radial and femoral access sites (radial=88) – (femoral = 92)

Local complication.	Radial group "n=88"		Femoral group "n=92"		P value
	No.	%	No.	%	
1-Bleeding					
-Not present	70	79.5	62	67.4	0.039*
- present (type):					
Internal	5	5.7	10	10.9	
External	13	14.8	20	21.7	
b)-Oozing					
No oozing	70	79.5	70	76.1	0.0397*
Mild oozing	4	4.4	8	8.7	
Moderate oozing	12	13.5	9	9.8	
Severe oozing	2	2.6	5	5.4	
2-Hematomas					
-Not present	81	92.1	72	78.3	0.013*
- present	7	7.9	20	21.7	
3-Arteriovenous fistula					
-Normal	82	93.2	79	85.9	0.0125*
	2	2.3	4	4.3	0.0491*

Bruit and/or thrill at access site	4	4.5	9	9.8	
Skin elevation					
4-Pseudoaneurysm					
- None	64	72.7	51	55.4	0.041*
-Swelling at insertion site	15	17.1	25	27.2	
- Pulsatile mass	5	5.7	7	7.6	
-Bruit and/or thrill in the insertion site	4	4.5	9	9.8	
5-Neurovascular compromise					
-Not present	85	96.6	84	91.3	0.033*
- present	3	3.4	8	8.7	
6-Vascular injury					
- None	79	89.9	75	81.5	0.169
Dissection	4	4.5	7	7.6	
chest pain	4	4.5	7	7.6	
Perforation	1	1.1	3	3.3	

Table (9): Distribution of studied patients according to assessment of their risk of Systemic complication at both radial and femoral access sites. (Radial=88), (femoral =92)

Regarding to arrhythmia, it was observed that atrial fibrillation was 6.0% in radial group patient while it was 8.8% in femoral group. In relation to anaphylactic reaction, it was noticed that contrast induced nephrotoxicity was 6.1% and 9.6% respectively and allergic reaction was 3.7% and 4.5% respectively. In relation to vagal reaction it was observed that of 3.4% patients in radial group complaining from low heart rate were as in femoral group patient the percent was 6.5% also 11.4%, 12.5% in radial group patient suffered from sweating and nausea while the percent was 20.7%, 18.5% of patient in femoral group. There was statistical significant difference between two studied groups regarding ↓HR (↓60b/m), Sweating and nausea ($P < 0.05$) while there was no statistical significant difference regarding arrhythmia, anaphylactic reaction and air embolism

($P > 0.05$)

Table (9): Distribution of studied patients according to assessment of their risk of Systemic complication at both radial and femoral access sites. (Radial=88), (femoral =92)

Systemic complication	Radial group "n=88"		Femoral group "n=92"		P value
	No.	%	No.	%	
1.Arrhythmia					
-None	77	87.5	72	78.2	0.904 N.S.
-Atrial Fibrillation	5	6.0	8	8.8	
-Ventricular Tachycardia	4	4.2	7	7.6	
-Ventricular Fibrillation	2	2.3	5	5.4	
2.Anaphylactic reaction					
-None	80	90.2	79	85.9	0.750 N.S.
- Contrast induced nephrotoxicity	5	6.1	9	9.6	
-Allergic reaction	3	3.7	4	4.5	
Air embolism	1	1.22	2	2.17	0.11 N.S.
Vagal reaction					
-None	48	54.5	24	26.1	0.038* 0.101 N.S.
↓HR (↓60b/m)	3	3.4	6	6.5	
↓Bbl.(↓100/60mmhg)	5	5.7	8	8.7	

Sweating	10	12.5	19	18.5	0.033*
Nausea	11	6.8	17	10.8	0.046*
Vomiting	6	5.7	10	8.7	0.038*
Dizziness	5		8		0.104
					N.S.
					0.22
					N.S.

Table (10): Displays incidence of complications of the studied patients in both radial VS femoral groups.

The table denotes that cases with complication was (30.7%) in radial group and was (51.1%) in femoral group, while cases without complication was (69.3%) and (48.9%). There was statistical significant difference between two studied groups regarding incidence of complications ($P < 0.05$).

Table (10): Incidence of complications of the studied patients in both radial VS femoral groups.

	Radial group "n=88"		Femoral group "n=92"	
	No.	%	No.	%
With complication	27	30.7	47	51.1
Without complication	61	69.3	45	48.9
p- value	0.0054*			

*: Statistically significant at $p \leq 0.05$

Table (11): Shows relationship between socio-demographic and clinical data of the studied patients in both radial and femoral group, and their incidence of complications.

This table shows that there is a significant association between patients age and the occurrence of complications ($P < 0.001^*$), were the majority of patients in the radial group were between $50 \leq 60$ (the majority of patients in the radial group 59.3%), while the majority of patients in the femoral groups 72.2% were in the age group between 30 – 50 years old. Also, there is significance association between the patients sex and occurrence of complications ($P < 0.05^*$) as two third of the studied patients in the radial group were male compare to 62.3% of them in the femoral group were female.

Table (11): Relationship between socio-demographic and clinical data of the studied patients in both radial and femoral group, and their incidence of complications.

Scio demographic characteristics	Radial "n=27"		Femoral "n=47"		P value
	No.	%	P value \leq 0.05	%	
Age groups (years)					0.010*
20<30	0	0.0	4	6.6	
30<40	6	22.2	22	36.1	
40<50	5	18.5	22	36.1	
50≤ 60	16	59.3	13	21.2	
Sex					0.012*
Male	18	66.7	23	37.7	
Female	9	33.3	38	62.3	
Associated					

diseases					0.48 N.S.
Allergies	1	3.7	6	9.8	
Dyslipidemia	6	22.3	7	11.5	
Diabetes mellitus	8	29.6	15	24.6	
Hypertension	4	14.8	7	11.5	
Chronic obstructive	4	14.8	15	24.6	
Vasculitis	4	14.8	11	18.0	
Previous hospitalization					0.105
Yes	17	63.0	27	44.3	
No	10	37.0	34	55.7	
Indication of catheter					0.22 N.S.
Stable Angina	6	22.2	21	34.4	
Unstable Angina	16	59.3	24	39.3	
Post MI	5	18.5	16	26.3	

P was significant if ≤ 0.05

* Significant difference

IV. DISCUSSION

Diagnostic cardiovascular catheterization is an invasive procedure used to confirm medical diagnosis for patients with coronary artery disease. The most common approach for performing the procedure is the femoral approach. The radial approach can also be used and is the management of choice by some clinicians (Louvard et al., 2004).

Cardiac catheterization via the radial artery is increasingly frequent due to reduced vascular complications compared to access via the femoral or brachial route. However, infrequent, radial access can be associated with the same problems deriving from puncture, hemostasis or guide management, such as hematoma, pseudoaneurysm, arteriovenous fistula, or perforation of the artery. The main difference to the femoral route is in the treatment indicated, as well as the less blood loss via the radial artery. Nurses play an important role in reducing patients' morbidity and mortality rate through early detection and prevention of access complications. So, the aim of this study was to assess risk of complications in patients undergoing diagnostic cardiovascular catheterization at radial versus femoral vascular access sites.

Regarding bio-socio demographic characteristic of the studied patients, As regards patient's age, the present study results showed that about one third of patients in the radial access group and more than two fifth of patients in the femoral access group were between 50 - 60 years, that may be attributed to that coronary artery disease is more common in older age patients due to the higher exposure to life stress with age. These results were supported by (Abd-Elmaged et al., 2018), who found that the largest percentages of their patients with radial and femoral access were between 51 to 60 years old. Also (Andrea et al. 2010) found that the largest numbers of patients submitted to cardiac catheterization mean age was 59.7 years. In this context, (AL-khadher 2015) mentioned that age related changes such as decrease in HDL/total cholesterol level and increase in systolic blood pressure are considered the major risk factors for the development of atherosclerosis.

Regarding the sex, the study results illustrate that females exceeded males in the radial groups, that could be related to females themselves, as they highly preferred radial access site to ensure their privacy specially during menstruation period. On the other hand, males exceeded females in the femoral group, as males preferred the most familiar and popular access site. These results were supported by (Israeli et al., 2017), who found that females mostly preferred radial access. also, it was found that female gender had an independent predictor of local hematoma despite the use of smaller catheter size compared to males. (Marcos et al., 2009)

Regarding educational level, the results of the present study showed that approximately half of patients in both radial and femoral groups were read and write that might be a risk factor for developing vascular access complications, where these patients found some difficulties in reading the written instructions by their physician. These results were supported by (Abd-Elmaged et al., 2018), who found that more than half of the studied patients were read and write.

Concerning occupation, the present study results denote that about one third of the studied patients in the radial group were unemployed or had manual occupation, compared to more than half of femoral group patients who had manual occupation, these results were agreed with (Mehrdad et al., 2016), who reported that more than half of their studied patients were employed.

In relation to marital status, the study results, showed that the majority of the studied patients in both groups were married, which may be attributed to religious and social norms of our culture. Also, this could be attributed to the fact that marriage increases the responsibilities as well as increases the life stressors during this period of life which lead to increase the risk for heart disease. These results were matched with (Abd-Elmaged et al., 2018), and (Dias, 2014) who found that the majority of their studied groups patients were married.

Regarding associated diseases, the present study results showed that diabetic patients represent the majority of radial group patients and more than one fifth of the femoral group patients. These findings could be explained by the fact that diabetes mellitus is a risk factor for coronary artery disease and for coronary angiography complications. Also it was found that chronic obstructive pulmonary disease represented more than one fifth of the radial group patients, and the majority of the femoral group patients, which could be a risk factor for vascular access oozing and bleeding related to increase patients intra-abdominal pressure, during coughing. These results were in agreement with (Louvard et al., 2004), who found that diabetes mellitus is a common associated disease in both radial and femoral groups' patients. Also (Alburikan & Nazer, 2017; Milane et al., 2014), mentioned the fact that DM affect endothelial function and lead to the development of fatty streaks in coronary arteries. (Takousi et al., 2016)

In relation to previous hospitalization, the current study results showed that one half of the studied patients in both groups had previous hospitalization, these results agreed with (Louvard et al., 2004) who found that the majority of both radial, and femoral groups had previous hospitalization.

As regards indications for diagnostic cardiac catheterization, the current study results denoted that nearly two fifth of the studied patients in the femoral group, were post myocardial infarction, compared to nearly half of the radial group patients who suffered from unstable angina. These results were supported by (Dehmer et al., 2012), who found that the majority of their studied patients in both radial and femoral group were post myocardial infarction, and unstable angina.

In relation to medication, the current study results showed that both radial and femoral groups patients received aspirin that has antiplatelet actions which prevent clots formation during catheterization procedure. These results were supported by (Louvard et al., 2004) who found that the majority of their patients in both radial, and femoral groups received aspirin.

Regarding laboratory investigations, the present study results showed that the majority of both studied groups had normal hemoglobin, serum blood urea, creatinine and platelets levels. These results were supported by (Nazer 2017) who found that the majority of their studied patients in both radial, and femoral groups had normal laboratory investigations levels, as these patients should be hemodynamically stable.

Regarding vital signs assessment at different periods, pre and post procedure of both radial and femoral group. The results of current study illustrated that the majority of the studied patients in both groups had normal pulse rate, respiratory rate, and blood pressure at different periods pre and post procedure. These results in two groups were important to eliminate the effect of different risk factors on the net results. These findings were agreed with (Kral et al. 2014), who found that vital signs in the radial, and femoral groups were matched.

Regarding vascular access site assessment pre, and during cardiac catheterization of both radial and femoral groups, the findings of the present study elaborate that all studied patients in both radial and femoral groups had normal body temperature, skin color and capillary refill in order to ensure that the patients had no vascular complications before performing diagnostic cardiac catheterization. In agreement with the present study results, (Agostoni 2014) mentioned

that it is mandatory to perform careful assessment of the access site skin concerning color, temperature and capillary refill to ensure that there is no ischemic complications before performing diagnostic cardiac catheterization.

In relation to during procedure assessment, the results of the present study denote that the majority of the studied patients in both radial and femoral groups had normal puncture site, and pulse oximetry. Also most of the studied patients in both groups passed one trail only. These findings were supported by (Anjum 2017) who stated that both studied group patients must undergo the same approach in order to eliminate the possible risk of complications.

Concerning vascular access site assessment post procedure for both radial and femoral groups, the present study results illustrate that almost half of studied patients in both groups had 15-30 minutes sheath time and needed more than 15-30 minutes of pressure hold to maintain hemostasis. These findings could be attributed to anticoagulant medications usage. Also, most of the studied patients in both radial and femoral groups suffered from pain post procedure that may be related to catheter insertion. In relation to site of pain, more than half of the studied patient in the radial groups suffered from pain at the insertion site, compared to 87% of them in the femoral group who had leg pain. These findings could be related to catheter insertion. Similar findings were reported by (Piva et al. 2014) who found that patients who performed the procedure via the femoral artery reported more discomfort than patient who performed the procedure via radial access and these complications may be directly related to prolonged bed rest.

Regarding pain intensity post procedure, the study results showed that pain intensity in both radial and femoral groups reached its peak immediately post procedure. These results were supported by (Israell et al. 2017) who carried out a study on three hundred fifty two participant and the majority of them suffered for pain immediately post procedure.

As for incidence of complications of the studied patients in both radial versus femoral group, the results of the presented study showed that more than two third of patients in radial group were free from access complications, compared to nearly half of them in the femoral group. These findings could be interpreted that radial approach decreases major vascular complications because of little manipulation and short procedure durations. These results agreed with (Jolly et al 2009)

who stated that radial approach decreases bleeding and other ischemic complications compared to femoral approach.

Concerning assessment of patients' risk of local complications at both radial and femoral access site. The results of the present study showed that of local complications of the access site in the radial group patients were less than those of the femoral group. These local complications include: external bleeding, hematoma, arteriovenous fistula, bruit, thrill, skin elevation, pseudoaneurysm, swelling, neurovascular compromise, and vascular injury. These findings could be related to the fact that radial access site is more superficial and has smaller diameter that allows using small sheath size, which result in decreased incidence of local complication in patients with radial access site. On the other hand, cardiac catheterizations via femoral route is performed using large artery behind large vein and require large size sheath that may lead to increase susceptibility to local complications. Also, it requires repeated access over a period of time. All these factors predispose to a significant number of peripheral vascular complications.

The previous results agreed with (Jolly 2009) who, studied complications of the access routes in patients undergoing diagnostic cardiac catheterization, he found that ecchymosis and other local complications are common in femoral group patients. Also (Chenget et al 2013) found that bleeding, hematoma and pseudo aneurysm were the most frequent complications in the femoral route. Contrary to these findings, (Cosman 2011) found that femoral access route complications were detected in low numbers of patients.

As regards to assessment of patients' risk of systemic complications at both radial and femoral access site. The results of the current study denote that patients in the radial group were complaining of less systemic complications than those in the femoral group. In agreement with the present study results, (Azraai et al 2019) found that the incidence of systemic complications as arrhythmia, anaphylactic reaction, air embolism and vagal reaction was significantly higher in patients of the femoral group than those in the radial group. In addition, the results detected statistical significant difference between the two studied groups regarding the incidence of both local, and systemic complications.

On studying the relationships between patients' demographics/ clinical data, and their incidence of complications in both radial and femoral groups. The results of the present study revealed that there are significant associations between

patients' age /sex , and the incidence of complications in both radial , and femoral groups. The majority of patients in both radial and femoral group were between 50-60 years old, that may be attributed to age related change of patients' blood vessels which is considered the major risk factor for the development of vascular access complications. Also, there is a significance association between the patients' sex and the occurrence of complications, as two third of the studied patients in the radial group were male, compared to nearly two third of them of in the femoral group who were females. This is likely related to smaller size of females' artery that increases their risk of developing complications, compared to males in the femoral access, whereas male patients engage in the risk taking due to behaviors such as smoking that contribute to radial access complications. These results were supported by (jollet 2011) who stated that female sex and shorter body surface area were found to be independent predictors of femoral access failure.

V. CONCLUSION & RECOMMENDATIONS

Conclusion

Based on the findings of the present study , it can be concluded that the radial approach would ensure better patient safety, satisfaction and comfort which would help to reduce the patients' length of stay and increase patients' treated with timely discharges.

It could also help to decrease the nurses' workload due to the lesser complication rates.

More extensive use of radial approaches would ensure the above benefits for the patients, staff and the organization.

Recommendations

oBased on the findings of the present study, the following recommendations should be considered:-

1)- Recommendations for patients :

o Educational programs should be implemented for patients about how to care for access site after diagnostic cardiovascular catheterization.

oColored illustrated booklet should be available and distributed for each patient with diagnostic cardiac catheterization about the therapeutic regimen.

2)- Recommendations to nurses:

Regular staff meeting training and conferences must be conducted to discuss how to assess , and prevent vascular access complications.

3)-Recommendations for organization:

oPolicies and procedures about caring for patients undergoing diagnostic cardiovascular catheterization should be developed, updated and continually reviewed.

oRoles and regulates should be taken against incompetent nurses through hospital administration.

4)-Recommendations for further research:

oThe effect of implementing a protocol of nursing care of patients clinical outcomes for patients undergoing diagnostic cardiovascular catheterization.

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