International Journal of Medical Toxicology & Legal Medicine **Volume 27, No. 4S, 2024**
e-ISSN: 0974-4614
p-ISSN: 0972-0448
https://doi.org/10.47059/ijmtlm/V27I4S/126

Assessment of Incidence and Risk Factors of Hematoma Formation at Femoral Access Site among Saudi Patients post Cardiac Catheterization

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Received: 18.09.2024 Revised: 20.10.2024 Accepted: 26.11.2024

ABSTRACT
Background: Hematoma formation at the femoral access site is a mutual and possibly severe complication of invasive cardiovascular procedures.
Aims: To assess the incidence and risk factors of hematoma formation atfemoral access site among Saudi patients post cardiac catheterization.
Design: Descriptive research design was used.
Subject and setting: All available adult patients (200), aged 18-65 years old, from both sexes who were attend to cardiac Catheterization unit at Makkah Hospital for a diagnostic procedures or interventional cardiac catheterization within 6 months' period.
Tools: two tools were used **(I)** Patient interview questionnaire, and **(II)** risk factors assessment list.
Results: Incidence of femoral access hematoma formation over six months was (20%) percentage. Regarding medical data more than half of the studied patients had hypertension (61.5%), majority had a history of previous hospitalization (84.0%), large portion of them performed cardiac catheterization for diagnostic purposes and were smokers (39.0%). Regarding the modifiable risk factors, obesity was the 29(14.5%), position change during compression 31(15.5%), Number of artery puncture (25 %) Renal dysfunction 19(9.5%), Early ambulation 27(13.5), Use of anticoagulant 17(8.5%). Regarding the non-modifiable risk factors were found among 29(14.5%) of the studied patients who were advanced in age 29(14.5%) andmale gender was 27(13%) While, the non-modifiable risk factors were 14.5 1.5 and 9.5% including advanced age and hypertension among male patients.
Conclusion: There was A hematoma formation among patients after cardiac catheterization There were correlation between medical data, modifiable risk factors & non-modifiable risk factors.
Recommendations: Developing a standardizing protocol about hemostasis, sheath removal for providing education and training to healthcare providers to identify and manage such risk factors.

Keywords: Cardiac catheterization, Femoralaccess, Hematoma, Incidence& Risk factors

INTRODUCTION

In order to diagnose or treat some heart diseases, such as clogged arteries or irregular heartbeats, a thin, flexible tube called a cardiac catheter is directed through a blood vessel to the heart. Doctors can learn vital information about the heart's blood arteries, heart valves, and heart muscle through cardiac catheterization (**Roy et al., 2022).** The most frequent side effect following cardiac catheterization operations is hematomas. Usually, hematomas develop after poorly managed hemostasis after sheath removal. The majority of hematomas are benign and self-

limiting, but big, quickly growing hematomas may induce hemodynamic instability and necessitate blood and fluid resuscitation. Transradial access considerably lowers the incidence of this problem **(Gleich et al., 2021).**
Hematoma is a localized collection of blood outside the blood vessels, usually caused by bleeding fromthepuncturedsiteofthearteryorveinduringthe catheterizationprocedure. Hematomascouldbe ranged from small bruises to large collections ofblood that could cause significant pain, swelling, and other complications **(Chaurasia et al., 2023).**
Risk factors for femoral access site hematoma are the use of complex techniques during Percutaneous cardiac intervention (PCI), insufficient hemostasis after PCI, use of antiplatelet or anticoagulant drugs during or after the procedure, application of a long catheter to the femoral artery and/or long duration of catheter stay **(Ignatavicius et al., 2020).**
In patients with transfemoral access, retroperitoneal bleeding should be suspected if there is a sudden change in the patient's hemodynamic stability with or without back pain, as there may not be any visible swelling in the groin for some of those patients. It is important to monitor patients for signs and symptoms ofhematoma formationafter cardiac catheterization, as prompt recognition and management could help to prevent further complications. Patients who develop symptoms should seekimmediate medical attention **(Roy et al., 2022).**
The incidence of hematoma among such group of patients is less than 0.2%. Strong clinical suspicion along with immediate imaging, usually with a CT scan, helps to diagnose this problem. Identification of the bleeding source is essential for patients with continued hemodynamic deterioration. These life- threatening bleeds are more frequent when the artery is punctured above the inguinal ligament **(Gleich et al., 2021).**
Prevention of hematoma formation at the femoral access site is essential to reduce the risk of complications and improve patient outcomes. Appropriate patient selection, careful arterial access technique, and the use ofclosure devicescould help to minimize the risk of hematoma formation. Prompt recognition and management of hematomas are also critical to prevent further complications **(Roy et al., 2022).**
An interventional cardiologist, assisted by nurses and radiologic technologists, is typically part of an interprofessional cardiac care team that performs cardiac catheterization. A nurse is committed to keeping an eye on the patient's vital signs throughout the process. The nurse is also in charge of making sure the distal extremity pulses remain unharmed and that the access site is not bleeding after the procedure. In addition, the nurse examined the urine production to confirm that there has been no harmful reaction of the dye to the kidney. When performing cardiac catheterization, interprofessional cooperation and candid communication were very beneficial (**Munir et al., 2020).**

Aims of the study
To assess the incidence and risk factors of hematoma formation at femoral access site among patients post cardiac catheterization, through,
1. Determine the incidence of post cardiac catheterization femoral site hematoma.
2. Identify the modified and non-modified risk factors of hematoma formation at the femoral access site among patients post cardiac catheterization.

Research questions
1- What is the incidence of post cardiac catheterization femoral site hematoma?
2- What are the risk factors of femoral site hematoma formation?

Patients and Methods
Research design
A descriptive research design was used to conduct the study.
Settings:
This study was carried out in Cardiac Catheterization Unit and Coronary Care Unit, at MakkahHospital .
Study Sample:
All available adult patients (200), aged from18-65 years old, from both sex who admitted cardiac catheterization unit at Makkah Hospital for diagnostic or interventional cardiac catheterization within 6 months period.
Exclusion criteria:
Patients with; peripheral vascular disease, congenital malformation, or bleeding disorder all was excluded from the study.
Study tools:
Two tools were used for Data collection:
Tool I: Patient interview questionnaire:
It developed by the researcher after reviewing the current relevant literatures, it included 2 parts
Part 1: Demographic data: Age, sex marital status, education level ,occupation, and residence.
Part2:**Medicaldata**:whichincluded medical diagnosis, indications of catheterization, past health history, purpose of catheterization and patient habits.

Tool II: **Risk factors assessment list**: this tool include both modifiable risk factors of femoral accesssite hematoma formation among patients post cardiac catheterization as: obesity, previous catheterization at the same site, anticoagulants, prolonged procedure duration, large sheaths, early ambulation puncturing below the femoral bifurcation, sheath time,method of compression (manual),using of steroids, position change during compression, number of artery, puncture time compression, heparin uses, low platelet count, lower body surface areas-low body weight ,hypertension and renaldys function. While, and non modifiable include older age, gender.

Scoring system:
The presence of the factor was given(1mark) While absence of it was given (zero mark).

Ethical considerations
1. Research proposal was approval from Ethical Committee
2. There was no risk for study subject during application of research .
3. The study followed the common ethical principles in clinical research .
4. Witten consent was obtained from patients who were willing to participate in study, after explaining the nature and purpose the study .
5. Confidentiality and anatomy were assured.
6. Study subject had the right to refuse to participate and or withdraw from the study without any rational and at any time .
7. Study subject privacy was considered during data collection.

Procedure
An official approval was obtained. Soliciting the necessary approval to conduct the present research after explaining the nature of study obtain their cooperation.
1. An official approval for data collection was obtained from responsible hospital authorities
2. Content validity was done by 5 expertise and necessary modifications were done .
3. A pilot study was conducted on (10%) 20 patients of sample in the selected setting to test the feasibility and applicability of the tools (were added to the main sample later), as well as to estimate the time needed to fill in the data collection tools, and then the tools were modified according to the results of the pilot study.
4. Patient's agreement for voluntary participationwas obtained and purpose and nature of the study was explained to them.
5. Patients were assessed for demographic data, and medical data before cardiac catheterization using (tool I), It took about 30 minutes.
6. Patients were assessed for risk factors of femoral site hematoma formation during and post cardiac catheterization using tool (II), It took about 30 minutes.
7. Each patient was interviewed for 10 minuteseither before or after cardiac catheterization.
8. Patients were followed for hematoma formation during hospitalization and after discharge for 5days postcardiac catheterization neither through telephone contactor some patients return to the outpatient clinicin case of any complications appears
9. Data were collected from January 2024 to June 2024.

Statistical analysis
Collected data was analyzed and tabulated. The researcher used an appropriate statistical analysis method and testes for analysis of the result. The statistical package for (SPSS) version (23) was usedto analyze data. Descriptive statistics were used for the quantitative data. It included frequencies, percentage, mean ± SD. Person correlation (correlation is significant at the 0.05 level). The level of significant for this study was set at ($P<0.05$) to detect any indication of differences found in the data available.

RESULTS

Table 1: Demonstrated that the mean age of the studied patients was (52.58±6.91 years), all of them were married, and the highest percentage of patients were male (58.0%), secondary education (54.5%), housewife (42.0%)

Demographic characteristics	N.	%
Gender		
Male	116	58.0
Female	84	42.0
Age(Mean±SD)	52.58±6.91	

Marital status		
Single	0	0.0%
Married	200	100
Education level		
Illiterate	9	4.5
Read and write	19	9.5
Primary education	11	5.5
Secondary education	109	54.5
High education	52	26.0
Occupation		
Manual work	3	1.5
Skilled worker	76	38.0
Office work	37	18.5
House wife	84	42.0

Table (2): Showed that 49.0% of the studied patients haddiabetesmellitusand61.5%hadhypertension.As well 52.0% of patients had a history of previous hospitalization, 84.0 % performed cardiac catheterization for diagnostic purposes, and 39.0% of them were smokers. Statistically significant differences were found between patients with diabetes mellitus, hypertension, previous hospitalization and formation of hematoma.

Medical data	Total No%	Hematoma				P.value
		Not present		**Present**		
		N.	**%**	**N.**	**%**	
Chronic diseases						
-Diabetes mellitus	98 (49%)	84	42.0	14	%7.0	0.04*
-Hypertension	123 (61.5%)	106	53.0%	17	8.5%	.01*
-Chronic obstructive pulmonary disease	5 (2.5%)	4	2.0%	1	0.5%	.413 ns
-Dyslipidemia	13 (6.5%)	10	5.0%	3	1.5%	.128 ns
-Others (renal failure-pepticulcer)	4 (2%)	4	2.0%	0	0	.402 ns
Previous hospitalization	104 (52.0%)	89	44.5%	15	7.5%	.025*
Purpose of catheterization:						
-Diagnostic	168 (84.0%)	153	76.5%	15	7.5%	.196 ns
-Therapeutic	32 (16.0)	27	13.5%	5	2.5%	
Personal habits						
-Smoking	78 (39.0%)	73	36.5%	5	2.5%	.132 ns

Table 3: Revealed that the majority of studied patients192 (96%) had normal site of puncture, while 6(3.0%) of the studied patients were having low siteof puncture. Regarding number of puncture trial the majority of studied patients 140 (70%) were found to had tow time number of trial. All studies patients 200 (100%) had activity clotting times. Furthermore, all studied patients use Frenchsheathsize(6). Regarding time of compression, it was found that most 198 (99.0%) of the studied patients had the longest period of compress time from 15-30 minutes. As well the majority of studied patients 197(98.5%) had longest duration of sheath time.

Assessment data	Total	Hematoma				P.value
		Not present		**Present**		
		N.	**%**	**N.**	**%**	
Siteof puncture						0.001**
- High	2	0	0	2	%1.0	
- Normal	192	177	%88.5	15	%7.5	
- Low	6	3	%1.5	3	%1.5	
Number of artery puncture						
- Once	33	33	%16.5	0	0	.001**
- Twice	140	134	%67.0	6	3.0%	
- 3 times	27	13	%6.5	14	7.0%	
Sheath time						
- 15-<30mintes	197	178	89.0%	19	9.5%	.272 ns
- 30-45mintes	3	2	1.0%	1	0.5%	

Fig (1): Displayed that distribution of Incidence of hematoma among femoral access, showed that the majority of the patients didn't had any hematoma.

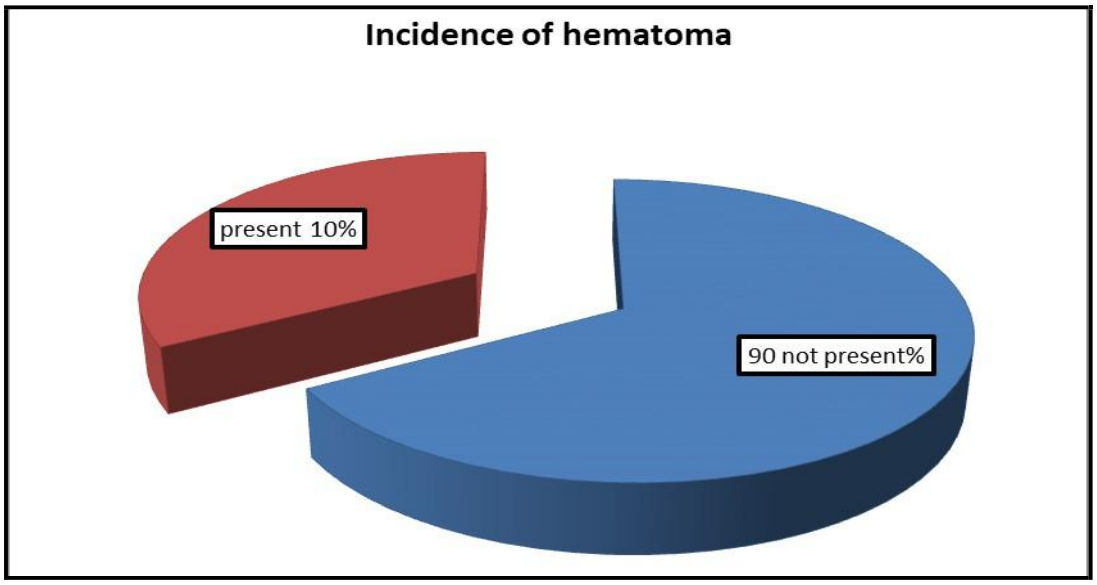

Table 4: Reported that modifiable risk factors among the studied patients included; obesity29 (14.5%), As well as hypertension was found among 25(12.5%), renal dysfunction was found among 19(9.5%). A small number of patients 17(8.5%)use anticoagulation's that may participate in hematoma formation in the groin area, and that could be a modified factors which may be the cause ofhematoma formation among the large sheath 17(8.5%), also early ambulation among27(13.5) of the studied patients, puncture below the femoral bifurcation among19(9.5%), method of compression among 17(8.5%), 20(10%) taking steroids, position change during compression among 31(15.5), number of artery puncture among 25(12.5%), compression time 30-45 minutes among 25(12.5%), taken dose of heparin among 22(11%), perform previous catheterization among 21(10.5%), low platelet count wasamong19(9.5%), lower bodysurface area among 19(9.5%), low body Wight was among 19(9.5%), incidence of hematoma was among 22(11%).

Modifiable risk factors	Total	Hematoma				P.value
		Not present		**Present**		
		N.	**%**	**N.**	**%**	
-Obesity	29	11	5.5%	18	9.0%	0.001
-Hypertension	25	11	5.5%	14	7.0%	0.001
-Renaldysfunction	19	8	4.0%	11	5.5%	0.001
-Low body weigh	19	10	5.0%	9	4.5%	0.001
-Lower BMI	19	10	5.0%	9	4.5%	0.001
-Use of anticoagulant	17	8	4.0%	9	4.5%	0.001
-Heparindose	22	10	5.0%	12	6.0%	0.001
-Steroids	20	8	4.0%	12	6.0%	0.001
-Low plate letcount	19	10	5.0%	9	4.5%	0.001
-Large sheaths	17	8	4.0%	9	4.5%	0.001
-Sheath time	18	9	4.5%	9	4.5%	0.001
-Puncturing below the femoral bifurcation	19	9	4.5%	10	5.0%	0.001
-Number of artery puncture	25	13	6.5%	12	6.0%	0.001
-Method of compression	17	8	4.0%	9	4.5%	0.001
-Position change during compression	31	14	7.0%	17	8.5%	0.001
-Time compression	25	12	6.0%	13	6.5%	0.001
-Previous catheterization at the same sit	21	10	5.0%	11	5.5%	0.001
-Early ambulation	27	11	5.5%	16	8.0%	0.001

Table 5: Showed that the non-modifiable risk factors were found among 29(14.5%) of the studied patients, who were advanced in age and gender 27(12.5%). As The percentage of male gender was 27(13.5%) and had risk factors of hematoma formation more than the female gender.

Non modifiable risk factors	Total	Hematoma				P.value
		Notpresent		**Present**		
		N.	**%**	**N.**	**%**	

-Advanced age	29	14	7.0%	15	7.5%	0.001
-Gender	27	12	6.0%	15	7.5%	0.001

Table 6: Reported that appositive correlation between the incidence of hematoma occurrence with both the modifiable and the non-modifiable risk factors.

Risk factors	Hematoma	N.	Mean	Std.Deviation	
Modifiable risk factors	No present	180	.8944	3.44388	T:-9.160
	Present	20	9.2000	6.51799	Sig.0.001**
-Non modifiable	No present	180	.2500	.90853	T:-10.785
	present	20	2.7500	1.51744	Sig.0.001**

Table 7: Showed that the increased number of trails puncture, presence of diabetes millets, hypertension, previous hospitalization, and number of artery puncture had a positive correlation with hematoma formation.

Variables	Correlation hematomas	
	R	P
-Diabetes mellitus	.140	.048*
-Hypertension	.161	.023*
-Chronic obstructive pulmonary disease	.053	.453ns
-Dyslipidemia	.115	.105ns
-Previous hospitalization	.153	.030*
-Number of artery puncture	.445	.001**

DISCUSSION

After cardiac catheterization, hematoma development at the femoral access site is a frequent consequence. Hemostases and the patient group under study have different incidence rates. Careful patient selection, suitable procedural technique, and timely identification and management of problems could reduce the chance of hematoma formation**(Kurt &Kaşıkçı, 2019).**

This study aims to assess the incidence and risk factors of hematoma formation at femoral access site among patients post cardiac catheterization.

Regarding the demographic characteristics of patients with cardiac catheterization who underwent cardiac catheterization in this particular study. The majority of them were males. The mean ageof the patients was 52.58 years, with a standard deviation of 6.91 years.

This is in the same line with the finding of a study done by **Baljepally et al., (2021)** who had shown that men are more likely than women to undergo cardiac catheterization procedures. Also, the finding of a study done by **Brida et al., (2021)** suggested that the patient population was relatively young and may not be representative of older patient populations who are more likely to develop cardiovascular disease.

Also the finding of a study done by **Vincent et al., (2021)** suggested that men are more likely than women to undergo cardiac catheterization procedures, and that the average age of patients undergoing the procedure is typically in the mid-of 60 years old.

However, women were less likely than males to have cardiac catheterization procedures, and they were also less likely to obtain the right care for their cardiovascular issues, according to a study by Steenblik et al. (2021).

Interms of occupation,the current study revealed that the largest group of patients were skilled workers in fields such as construction, carpentry, and while around half of them were housewives. As well the majority of patients came from rural areas. It's importantto note that these demographics may not be representative of the general population due to the specific characteristics of the study population.

The finding of a study done by **Yujeong, (2022)** who investigated the demographics data of the patients undergoing cardiac catheterization procedures and found that the majority of patients undergoing cardiac catheterization procedures were employed, with a significant percentage working in manual labor jobs.

In the current study more than half of the studied patients undergoing cardiac catheterization had hypertension, while less than half of them werehaving diabetes mellitus and fewer percentage were having dyslipidemia. The researcher opinion, people with diabetes are more likely to get high blood pressure, high cholesterol, and obesity, all of which are a majorrisk factorsfor cardiovascular diseases. Additionally, diabetes could cause damage to the blood vessels and nerves that control the heart and blood vessels, which can lead to complications suchasheartattack,stroke,andperipheralarterydiseaseas mentioned in study of done by **Otvos et al., (2023)**.

In this line, the finding of a study done by **Stein etal., (2022)** found that hypertension, or high blood pressure, is a majorrisk factorfor cardiovascular diseases and is a common comorbidity in patients undergoing cardiac catheterization.

Besides, the finding of a study done by **Huang et al., (2022) who** found other risk factors, such as obesity, smoking, high cholesterol, and asedentary lifestyle, which could also contribute to the development of

cardiovascular diseases and may require further evaluation and management.

In terms of the purpose of the catheterization, the majority of procedures were diagnostic that match with the purpose of the catheterization, diagnostic proceduresaremorecommonthantherapeutic procedures.The finding of a study done by **Yoshihara, (2023)** confirmed that purpose of the diagnostic catheterizationwhich involves, evaluation the structure and function of the heart and blood vessels while therapeutic catheterization, need a specialized instrument, such as balloons or stents, to treat blockages or other abnormalities in the coronary arteries.

Regarding hospitalization history, the finding of a studydone by **Bonanadet al., (2020)** who found that it is not uncommon for patients with a history of cardiovascular diseases or related comorbidities to require hospitalization for management of their condition. Also the finding of a study done by **Nielsen et al., (2021)** reported that hospitalization maybenecessaryforavarietyofreasons,suchas fordiagnosticevaluation,treatmentof acute symptoms, or for surgical or interventional procedures. While the finding of a study done by **Curigliano et al., (2020)** reported that patients witha history of hospitalization for cardiovascular disease may had a higher risk ofadverse outcomesand may require closer monitoring and follow-up care.

Additionally, the result of the present study showed that a large percentage of the studied patients undergoing cardiac catheterization were smokers. From the researcher pointed of view smoking is a well-established risk factor for cardiovascular diseases, and it is not surprising that a significant proportion of patients undergoing cardiac catheterization were smokers.

This confirmed by the finding of a study done by **Malakar et al., (2019)** who found cigarette smoking could contribute to the development of atherosclerosis, a buildup of plaque in the arteries that can lead to heartattack, stroke,or other cardiovascular complications.

A large portion of patients in the present study underwent cardiac catheterization with a normal site of puncture with no hematoma formation, which is typically the femoral artery in the groin area. A small proportion of patients had a low puncture site or a high puncture site, which may be used in special circumstances such as in patients with peripheral artery disease or in those requiring access to a specific coronary artery. The researcher view that due to that all patients in the present study underwent cardiac catheterization, the size of the sheath varied among patients, with a range of 6French. The number of trials, or attempts to gain access to the artery, also varied among patients, with large number of patients requiring two trials and the majority had a mild pain. This match with the finding of a study done by Annetta et al., (2022) who registered that low incidence of hematoma occurrence was related to a low puncture site, typically in the distal femoral artery, may be used in patients with peripheral artery disease or other conditions that make the femoral artery in the groin area inaccessible.

According to the researcher view gaining access tothe artery can sometimes be challenging and may require multiple attempts. This is not uncommon in cardiac catheterization, as the procedure requires a high level of skill and experience to navigate the complex anatomy of the heart and blood vessels.

The finding of a study done by **Cho et al., (2023)** showed that multiple attempts to gain access to the arterycouldincreasetheriskofcomplications,such as bleeding orhematoma formation, and could also prolong the duration of the cardiac catheterization. However, the finding of a study done by **Mangieri et al., (2023)** who mentioned that it is important for the healthcare provider to obtain safe and successful access to the artery in order to perform the necessary diagnostic ortherapeutic interventions. Also the finding of a study done by of **Besli et al., (2021)** supported this and found that the majority of patients experienced mild pain or discomfort during the procedure, and thatpain scoreswere generally low at 24 hours after the cardiac catheterization.

Regarding the modifiable risk factors of hematoma formation, the present study found that the majorityof patients with hematoma were obese, use of anticoagulant medications, had large sheaths and did not ambulate early after the procedure.

The researcher institute that it is important to notethat while these factors were found to be associated with an increased risk of hematoma and added that identifying and addressing modifiable risk factors could help reduce the risk of hematoma and other complications after cardiac catheterization.

However, the finding of a study done by **Sasaki etal., (2023)** who recommended that healthcare providers may take steps such as using smaller sheaths, avoiding multiple punctures, using appropriate compression devices, and encouraging early ambulation to reduce the risk of hematoma formation.Careful monitoringandfollow-upafterthe procedure can help detect and manage any complications that may arise.

While the finding of a study done by **Cheng et al., (2022)**whostatedthatthestrategiestoreducetherisk of hematoma include using smaller sheaths, avoiding multiple punctures, using appropriate compression devices, and encouraging early ambulation.

Based on the data presented, regarding modifiableriskfactorsforhematomaaftercardiaccatheterization the majority of patients with hematoma had renal dysfunction, and hypertension. The researcheropinion that advanced age may be associated with thinning of the skin and reduced tissue elasticity, which could increase the risk of bleeding orhematoma formation after acardiac catheterization. While the finding of a study done by **Mangieri et al., (2023) who** reported that non modifiable factors cannot be directly modified, so, healthcare

providers can take appropriate measures to monitor and manage these risks, such as adjusting medication dosages or using different approaches to reduce the risk of bleeding or hematoma formation. Close monitoring and follow-up after the procedure can also help detect and manage any complications that may arise.

In this regard, the finding of a study done by **Jones- Muhammad, & Warrington, (2019)** who reported that hypertension - high blood pressure can cause damage to blood vessels which makes them more prone to leaking and bleeding.

This is an important consideration in cardiac catheterization,asprolongedpressureholdscould increase the risk of complications such as bleeding or hematoma formation **(Bangalore et al., 2021).**

This match with the finding of a study done by **Ahmed et al., (2023)** who reported that hematoma isa known complication of cardiac catheterization. The researcher views that the presence of a hematoma could increase the risk of bleeding and other complications and may require additional monitoring or treatment.

However, the finding of a studydone by **Naiduetal., (2021)** who recommended that patients should be advised to report any unusual bleeding or bruising after the procedure, as prompt evaluation and treatment may be necessaryto prevent complications. **Relation:**

The existing study referencing found a significant correlation between hematoma formation and both modifiable and non-modifiable risk factors, as well as body mass index. Overall, as the researcher opinion, it is important for healthcare providers to consider both modifiable and non-modifiable risk factors, as well as body mass index, when assessing a patient's risk of hematoma formation after femoral access, and take appropriate measures to minimize this risk, such as using appropriate hemostasis techniques and monitoring the patient closely after the cardiac catheterization

Regarding the finding of a study done by Ali et al., (2018) who investigated the risk factors associated with hematoma formation after femoral artery access for cardiac catheterization.

While the finding of a study done by Slogoff et al., (2020) who found a non-significant results associated between certain risk factors and hematoma formation after femoral access.

The present study found that, diabetes millets, hypertension, previous hospitalization and number of arterypunctures increase incidence ofhematoma. and showed appositive correlation between incidence of hematoma occurrence and those variables.

While the finding of a study done by Sasaki et al., (2023) who reported that 1,207 patients undergoing percutaneous coronary intervention found that hypertension and diabetes mellitus were significant predictors of hematoma formation after femoral access. The authors recommended that these risk factors should be considered when assessing a patient's risk of hematoma formation after percutaneous coronary intervention.

However, it is possible that some studies may had conflicting results. For example, the finding of a study done by Slogoff et al. (2020) who did not find a significant association between age, gender, hypertension, diabetes mellitus and obesity with hematoma formation after femoral access.

CONCLUSION

From the results of the present study, it could be concluded that **t**he incidence of femoral access hematoma formation after cardiac catheterization atMakkah hospital over six months less common. Moreover, a statistical significant difference was found between hematoma formation with both modifiable and non-modifiable risk factors. Apositive correlation was found between hematoma formation and diabetes mellitus, hypertension, previous hospitalization, and number of artery puncture.

Recommendations

1. Simple illustrated guidelines about cardiac catheterization and prevention of hematoma formation should be available for patients.
2. Evaluating the effectiveness of different hemostasis techniques in preventing hematoma formation. This could include comparing manual compression with the use of closure devices.
3. Developing and implementing quality improvement initiatives aimed at reducing the incidence of hematoma formation at the femoral access site among patients post cardiac catheterization.
4. Conductinglarge prospective studies to determine the incidence of hematoma formation at the femoral access site in patients post cardiac catheterization and to identify the risk factors associated with this complication.

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