

Prevalence of Arrhythmia and Kidney Damage among Patients with Cardiac Catheterization in Saudi Arabia

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Abstract

For diagnosis and treatment, patients with a range of cardiovascular illnesses need cardiac catheterization, a minimally invasive procedure that includes inserting a catheter into the heart or coronary arteries and injecting radio-opaque contrast to identify and perhaps cure a blockage. The purpose of this study is to assess the prevalence of arrhythmia and renal injury among cardiac catheterization patients. This cross-sectional research was conducted in K.S.A from July to November. Demographic information, a history of cardiac catheterization, and whether or not arrhythmia or kidney damage exists were gathered in the survey, as well as the degree of awareness among cardiac patients regarding the severity of these complications. The study included 1194 patients; 54.5% of them were males and 45.5% were females. 28.6% of participants aged between 51- 60 years old. 551 (46.1%) of participants had side effects, 65.3% of them had arrhythmia, 10.2% had renal failure, 12% had nephritis, 29.4% reported that their kidneys were affected, and 6.2% had renal stones. 37.9% of participants had a heart operation following cardiac catheterization, while 13.5% had a kidney operation after cardiac catheterization. In conclusion, the study found a high incidence of arrhythmia and kidney damage among patients with cardiac catheterization in K.S.A. The dangers and consequences related to cardiac catheterization have greatly decreased as a consequence of the introduction of tiny catheters, increasing utilization of the trans-radial method, and better operator technical abilities. However, each patient should be managed depending on general condition along with associated co-morbidities.

Keywords: Arrhythmia, Kidney damage, Cardiac catheterization, Saudi Arabia

INTRODUCTION

Patients with a variety of cardiovascular diseases require cardiac catheterization, a minimally invasive technique that involves inserting a catheter into the heart or coronary arteries and injecting radio-opaque contrast to detect and perhaps cure a blockage for diagnosis and management [1, 2]. It was invented in 1908 by Fritz Bleichroeder, chief resident of the medical department of the Municipal Hospital, Gitschenerstrasse, in Berlin, Germany. He efficiently catheterized the heart of Joseph Portman, a hospital laboratory technician [3]. There are three types of complications: those that are related to the catheter's passage, injection of dyes as part of the operation, and unintentional entry of other undesirable components into the circulatory system [4], and as a result, the complexities of cardiac catheterization are serious and multiple. In 1953, an American Heart Association committee recorded four deaths as a result of catheterization in approximately 5700 procedures performed in eight laboratories [5]. The focus of this study was on both kidney damage and arrhythmia.

In 2013, in Italy, a study was conducted by Paolo Bianchi *et al.* A retrospective analysis of prospectively gathered data. 277 patients aged 12 years received angiography and heart

procedures during the same hospital stay, and angiographic data and other variables were gathered. The findings revealed that (sixty-four percent) of patients had some form of post-operative renal impairment, and (twenty-percent) had A.R.F. (pRIFLE stage Failure) [6].

A cross-sectional study was conducted by Brown *et al.* and was published in 2016. The study assessed 3,633,762 cardiac catheterizations and PCI (Percutaneous Coronary Intervention patients) from the National Inpatient Sample in

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the U.S.A. between 2001 and 2011. Based on those assessments, the study conducted a sharp rise in the development of A.K.I. by almost 3-fold in the designated period [7].

Finally, the recent research published in 2020 by Fatima A. Shaik *et al.* searched Pub-Med and other databases for publications describing various cardiac arrhythmias following common cardiac catheterization procedures, as well as references to full-length articles. Conduct a comprehensive literature study to understand better the frequency of heart arrhythmias observed during cardiac catheterization, their impact on outcomes, and potential ways to reduce this risk. During cardiac catheterization procedures, arrhythmias are a common and potentially life-threatening complication [8].

Despite the great impact that cardiac catheterization has had in treating various heart conditions and considering it a great field for writing several papers related to it and its complications, we found that few studies on Mediterranean populations have been conducted, particularly in Saudi Arabia. Furthermore, the presence of other selection variables, such as resistant hypertension, heart disease, or renal impairment, can skew data interpretation. This makes our research critical because renal failure, arrhythmia, and other major diseases can develop, which are serious and can lead to death. Otherwise, there is little awareness of the seriousness of these complications in K.S.A. the importance of this research lies in determining the prevalence of arrhythmia and kidney damage as convolutions of heart catheterization in K.S.A in order to maximize safety and outcomes, as well as appropriate intervention if it occurs. It will not be fully grasped unless its prevalence is known in the kingdom. This study aims to assess the prevalence of arrhythmia and renal injury among cardiac catheterization patients in K.S.A.

MATERIALS AND METHODS

This cross-sectional research was conducted in Saudi Arabia from July 2022 to May 2023. The data collectors will ask all subjects who volunteer to participate in this research the questions in a structured questionnaire created by the authors. Demographic information, a history of cardiac catheterization, and whether or not arrhythmia or kidney damage exists were gathered in the survey, as well as the degree of awareness among cardiac patients regarding the severity of these complications. Patients with cardiac problems that indicate heart catheterization in K.S.A during 25 years was recruited for our sample. These patients include both genders but are limited to those of 20 years and above.

Sample Size

The sample size was calculated using the Qualtrics calculator with a level of certainty of 97 percent, a margin of error of 3 percent, and a sample size of 1194. The prerequisites for inclusion are as follows: patients (20 years and above) who

agree to participate and with a cardiac problem that indicates cardiac catheterization within ≤ 25 years. The prerequisites for exclusion are as follows: patients who disagree with participation, patients younger than 20 years with a cardiac problem that indicates cardiac catheterization but undergo catheterization within > 25 years.

Tool for Data Collection and Instrument

A questionnaire was employed as a study tool. This tool was developed after consulting relevant studies conducted around the world, and the last version of the questionnaire consisted of 17 questions classified into main 5 sections. Section one will contain questions about whether the patient agrees to participate with us or not; the second section will include demographic data questions as age and gender, when and where the participant is subjected to cardiac catheterization; the third part will ask questions about previous kidney and heart operations or any other complication as an outcome of cardiac catheterization, while the fourth section will ask about if there any chronic diseases, and the last one was about if the patient had any kidney problems before catheterization, and if it increases after it or not .participants was asked these questions face to face in the form of interview.

Data Analysis

Data was entered on the computer using the "Microsoft Office Excel Software" program (2021) for Windows. Data will then be transferred to the Statistical Package of Social Science Software (SPSS) program, version 23 (IBM SPSS Statistics for Windows, Version 23.0. Armonk, NY: I.B.M. Corp.) to be statistically analyzed.

RESULTS AND DISCUSSION

The study included 1194 patients; 54.5% of them were males and 45.5% were females. 28.6% of participants were aged between 51- 60 years old, 26.5% were aged 61- 70 years old, 19.6% were 41- 50 years old, and 13.4% were 71- 80 years old. 90.5% of our sample were Saudi.

Table 1. Sociodemographic characteristics of participants (n=1194)

	Parameter	No.	Percent
Gender	Male	651	54.5
	Female	543	45.5
Age	20 - 30 years old	22	1.8
	31 - 40 years old	64	5.4
	41-50 years old	234	19.6
	51-60 years old	342	28.6
	61 - 70 years old	317	26.5
	71 - 80 years old	160	13.4
Nationality	81 - 90 years old	55	4.6
	Saudi	1080	90.5
	Non-Saudi	114	9.5

Figure 1 illustrates side effects after a cardiac catheterization, as 551 (46.1%) of participants had side effects, 65.3% of them had arrhythmia, 10.2% had renal failure, 12% had nephritis, 29.4% reported that their kidneys were affected, and 6.2% renal stones.

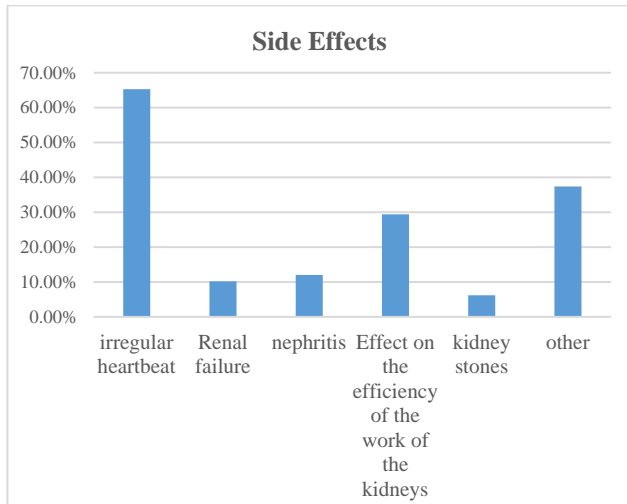


Figure 1. Side effects after a cardiac catheterization among study participants (n=1194)

Table 2 shows that 16% of participants had renal injury ahead of catheterization, and 70.7% of them reported that kidney disease increased after catheterization. 38.6% reported that side effects affected their heart rate, which affected their daily activity.

Table 2. Side effects following cardiac catheterization among study participants (n=1194)

Parameter	No.	Percent
Side effects after cardiac catheterization	Yes	551 46.1
	No	643 53.9
	Arrhythmia	360 65.3
	Renal failure	56 10.2
	Nephritis	66 12.0
If yes, what are the side effects?	Effect on the efficiency of the work of the kidneys	162 29.4
	Kidney stones	34 6.2
	Other	206 37.4
	Kidney problems before the cardiac catheterization	Yes 191 16.0 No 1003 84.0
If yes, does kidney disease increase after cardiac catheterization?	Yes	135 70.7
	No	56 29.3
Side effects affect the heart rate affected the	Yes	461 38.6
	No	192 16.1

daily routine or daily activity.	No side effects related to the kidneys and heart	541	45.3
If yes, to what extent do side effects affect daily activity	A little	149	32.3
	Average	189	41.0
	Much	123	26.7

As shown in **Figure 2**, 84% of participants did not have renal problems before the cardiac catheterization, and only 16% had renal problems.

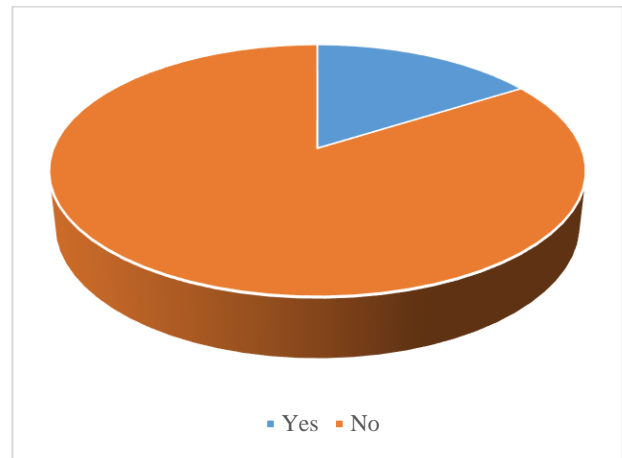


Figure 2. Kidney problems before the cardiac catheterization

As illustrated in **Table 3**, 37.9% of participants had a heart operation following cardiac catheterization, while 13.5% had a kidney operation after cardiac catheterization. As for comorbidities, hypertension was noted in 63.1% of participants, diabetes in 57.5%, and 8.2% for kidney disease. 42.2% of participants who have a family member who had side effects after cardiac catheterization.

Table 3. Operations after heart catheterization and chronic diseases among participants (n=1194)

Parameter	No.	Percent
Had a procedure as a result of complications from a heart catheterization	Yes	452 37.9
	No	742 62.1
Had a kidney procedure due to complications of heart catheterization	Yes	161 13.5
	No	1033 86.5
Where heart catheterization operations in the kingdom	Southern area	80 6.7
	Eastern Province	386 32.3
	The northern area	54 4.5
	Western Region	449 37.6
	Central Region	154 12.9
Outside the Kingdom of Saudi Arabia	71	5.9
	Chronic diseases	Hypertension 754 63.1

	Diabetes	686	57.5
	Kidney disease	98	8.2
	Asthma	102	8.5
	No	230	19.3
Have a family member who had side effects after cardiac catheterization	Yes	504	42.2
	No	690	57.8

As shown in **Table 4**, the study found a significant association between experiencing complications after cardiac catheterization and a history of chronic diseases along with the place of cardiac catheterization occurrences in K.S.A (P= 0.01).

Table 4. Association between experiencing complications after cardiac catheterization with a history of chronic diseases along with the place of cardiac catheterization occurrences in K.S.A

	Experience complications after cardiac catheterization		Total (N=1194)	P value
	Yes	No		
Chronic diseases	Hypertension	409 74.2%	345 53.7%	754 63.1%
	Diabetes	347 63.0%	339 52.7%	686 57.5%
	Kidney disease	74 13.4%	24 3.7%	98 8.2%
	asthma	60 10.9%	42 6.5%	102 8.5%
	NO	48 8.7%	182 28.3%	230 19.3%
Where cardiac catheterization operations in the kingdom	Southern area	48 8.7%	32 5.0%	80 6.7%
	Eastern Province	134 24.3%	252 39.2%	386 32.3%
	The northern area	32 5.8%	22 3.4%	54 4.5%
	Western Region	220 39.9%	229 35.6%	449 37.6%
	Central Region	81 14.7%	73 11.4%	154 12.9%
	Exterior to K.S.A	36 6.5%	35 5.4%	71 5.9%

The incidence of serious complications throughout a diagnostic cardiac catheterization operation is typically less than 1%, with a mortality risk of 0.05% for diagnostic procedures. The complication rate for any patient is determined by a number of factors, including the patient's demographics, vascular anatomy, co-morbid conditions,

patient characteristics, the procedure being performed, and the operator's experience. Complications can range from minor, such as irritation at the catheterization site, to major, such as death [9].

The incidence of ventricular fibrillation or ventricular tachycardia could be attributed to myocardial irritation or ischemia caused by the catheter, contrast material, or occlusive balloons. Such arrhythmias are more common in people who have an acute ST-elevation myocardial infarction. Unless they cause ischemia or hemodynamic instability, these arrhythmias typically do not require immediate treatment. In the modern era, ventricular tachycardia and ventricular fibrillation are caused by catheter irritation of the myocardium. The detection of ventricular ectopy by trained technicians and engaged operators can help to reduce the occurrence of these arrhythmias. Cardioversion and antiarrhythmic drugs are used in treatment, as is restoring flow to the occluded artery [9].

In our study, 65.3% of participants had arrhythmia following cardiac catheterization. According to the most recent data, this complication rate is 0.1 percent. During cardiac catheterization in patients with acute myocardial infarction, ventricular tachycardia occurred in 4.3% of patients with ST-elevation MI in the PAMI trial [10].

Transient bradyarrhythmias are also common. Prolonged episodes of hypotension will necessitate intravenous atropine or transvenous pacing. In patients who already have a right-bundle branch block, developing a left-bundle branch block during right cardiac catheterization may result in total heart block. Minimal catheter manipulation in the right ventricular outflow tract can prevent this [11]. Persistent bradycardia episodes can result in a vagal response, which can cause hypotension, nausea, sweating, and yawning. In one study, this was observed in nearly 3.5% of patients, with 80% developing during access and 16% developing during sheath removal [11].

The incidence of reported contrast nephropathy after cardiac catheterization is quite variable (range 3.3% to 16.5%) among individuals who are having cardiac catheterization, resulting in a transient increase in serum creatinine levels after exposure to contrast material. In our study, 10.2% of participants had renal failure, 12% had nephritis, and 29.4% reported that their kidneys were affected. Also, 16% of participants had renal injury ahead of catheterization, and 70.7% of them reported that kidney disease increased after catheterization. The frequency of dye-induced acute kidney injury among patients undergoing elective and urgent coronary intervention was 7.1% in the Registry of National Cardio-vascular Data [12].

Patient characteristics such as pre-existing chronic kidney disease (CKD), hydration status, age, and co-morbidities such as diabetes, heart failure, peripheral arterial disease, and

Chronic Obstructive Pulmonary Disease (COPD) are examples of pre-procedural risk factors (COPD). Intra-procedural risk factors include the need for transfusions or intraoperative bleeding, hypotension, the use of nephrotoxic contrast media, the route of vascular approach, the use of an Intra-Aortic Balloon Pump (IABP), cardiogenic shock, and ST-elevation myocardial infarction (STEMI) on presentation [4, 12]. Post-procedural factors include post-operative anemia (which is largely due to intraoperative hemorrhage) and duration of ICU stay [13].

This complication can be avoided by using adequate pre-hydration, iso-osmolar agents, and techniques to reduce the amount of dye used. Renal athero-emboli can also cause renal failure and are linked to other embolic symptoms [12].

According to research, contrast use has the possibility to trigger A.R.F., with the dye used for imaging modalities, catheterization, and surgeries accounting for 11% of A.R.F. incidences; this consequence increases the possibility of other hemodynamic issues, as well as the duration of hospital stay and fatalities in affected patients. However, there are risk factors that promote the likelihood of getting A.R.F. after receiving dye [14].

A study with 513 hospitalized patients who underwent cardiac catheterization by Sedhai *et al.* [15]. estimated the prevalence of A.R.F. in 3.7 percent of patients and suggested that these cases were responsible for long hospitalization and higher mortality; it was also noted that A.R.F. was more prevalent in patients with pre-existing A.F., CHF, and CKD. Univariate analysis revealed that the incidence of A.R.F. was 13.8 percent in the A.F. group (0.002), compared to 2.3 percent, 1.9 percent, and 2.4 percent in the absence of pre-existing A.F., CHF, and CKD, respectively. A.R.F. development was significantly correlated with A.F. in additional tests using a multivariate logistic regression model with A.F., CHF, and CKD as independent variables. Singh *et al.* [16]. discovered that using dye for catheterization or radiological modalities was the 2nd cause of A.R.F. in 100 elderly patients in the Nephrology Department, Institute of Medical Sciences, B.H.U., Varanasi, UP, India, from 2014 to 2015. It also revealed mortality in 45 percent of cases, which was related to the elderly already having decreased glomerular filtration, influenced by the aging process, and, in most cases, the presence of chronic diseases, necessitating continuous pharmacological therapies and contributing to renal nephrotoxicity.

This was explained that A.F. could cause hemodynamic disorders due to rapid ventricular rates, irregular heartbeat, loss of atrioventricular synchrony, and atrial contraction, all of which resulted in insufficient cardiac output, putting the patient at risk of A.R.F. despite a normal left ventricle ejection fraction. It was also discovered that patients with A.F. load have higher levels of angiotensin-converting enzyme and angiotensin II receptor expression, implying that

the angiotensin–aldosterone renin cascade is more active. This causes additional kidney damage [17].

CONCLUSION

In conclusion, the study found a high incidence of arrhythmia and kidney damage among patients with cardiac catheterization in K.S.A. The dangers and consequences related to cardiac catheterization have considerably decreased with the introduction of tiny catheters, expanded use of the trans-radial technique, and improved technical expertise of the operators. However, each patient should be managed depending on general condition along with associated comorbidities.

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