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Incidence and Demographic Characteristics of Patients with Post Cardiac Surgery Arrhythmias: A Single Center Retrospective Study

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ABSTRACT

Objectives: Arrhythmias are a common complication following cardiac surgery, and can significantly affect patients' outcomes. In some cases, post-operative arrhythmias may lead to hemodynamic instability, congestive heart failure, or even sudden cardiac death. Various types of cardiac surgery result in varying rates of post-operative arrhythmias, with more complex procedures causing higher rates. Risk factors for post-operative arrhythmias include advanced age, pre-existing cardiovascular disease, electrolyte imbalances, and the type of cardiac surgery. In this study, we aim to determine the incidence and demographic characteristics of patients who underwent cardiac surgery from November 15, 2020, till November 30, 2021, in a tertiary center in the Kingdom of Bahrain.

Material and Methods: All adult patients (18 years or older) who were booked for cardiac surgery during the study period were included. Patients with pre-existing documented arrhythmias were excluded from the study. Data was collected from patients' clinical notes including demographic information (age, sex, and nationality), medical history, comorbidities, type of cardiac surgery, laboratory investigations, and mortality. Descriptive statistics was used to analyze the data, including frequency distributions, means, and standard deviations. Data was collected from patients' clinical notes including demographic information (age, sex, and nationality), medical history, comorbidities, type of cardiac surgery, laboratory investigations, length of hospital stay, and mortality. Data was collected from patients' clinical notes including demographic information (age, sex, and nationality), medical history, comorbidities, type of cardiac surgery, laboratory investigations, length of hospital stay, and mortality.

Results: A total of 161 patients were enrolled in the study with a mean age of 56.75 ± 1.68 years. Among the total enrolled population, 68.32% were male and 31.68% were female. The majority of patients (61.49%) had undergone urgent surgery. Approximately, half (49.07%) of the patients had coronary artery bypass surgery. Premature ventricular complexes (PVC), atrial fibrillation (AF), junctional rhythm, heart block, and atrial flutter were reported in 30.43%, 29.19%, 11.18%, 9.31%, and 8.07% of patient populations respectively. Pleural effusion (50.31%) and bleeding (19.25%) were common post-surgery complications observed among the patients. The mean oxygen saturation (sO_2) of the patients on the day of arrhythmia was 95.67 ± 2.05%. Epinephrine/norepinephrine (71.43%) was the most used inotropic agent used after cardiac surgery.

Conclusion: Cardiac surgery is associated with various arrhythmias. The two most common arrhythmias observed in patients after cardiac surgery are premature ventricular contractions and atrial fibrillation.

Keywords: Arrhythmia, Atrial fibrillation, Premature ventricular complexes

INTRODUCTION

Cardiovascular disease is a global burden accounting for the highest number of deaths (17.5 million) every year worldwide.[1] Arrhythmias are a common complication following cardiac

surgery and a major cause of death, longer hospital stays, and increased medical costs.[2] The clinical importance of an arrhythmia is determined by a variety of factors, including the medical and cardiac history of the patient, the duration of the arrhythmia, and the underlying left ventricular ejection fraction.[3] Thus, some patients can tolerate arrhythmia post-surgery, while others may experience high morbidity or mortality following arrhythmia due to comorbid conditions.[4,5] Arrhythmias which are self-terminating without any severe cardiac distress can be left untreated. However, in patients in whom arrhythmias lead to hemodynamic instability, medical interventions are required to stabilize the clinical status.[2]

Atrial fibrillation (AF) is observed to be the most common arrhythmia occurring post-cardiac surgery with an estimated incidence in a range of 20%–50%.[6–8] Based on the type of cardiac surgery AF usually occurs within the first 48h of the surgery.[8] Several risk factors such as obesity, chronic renal failure, history of paroxysmal AF, chronic obstructive pulmonary disease, and male gender along with several echocardiographic predictors like increased left atrial volume, left ventricular hypertrophy and left ventricular diastolic and systolic function, attributes to the occurrence of post-cardiac surgery AF.[9] Premature ventricular complexes (PVCs) are reported to be ubiquitous and one of the most common arrhythmia.[10] Higher incidences of PVCs can significantly hike the risk of PVC-induced cardiomyopathy.[10]

This retrospective study was thereby designed to evaluate the incidences of different types of arrhythmias after cardiac surgery along with demographic characteristics of patients with arrhythmias in a single tertiary center in Bahrain and if there were any specific factor(s) that triggered them.

MATERIAL AND METHODS

This is a retrospective observational study where electronic medical records of all adult patients (18 years or older) who were booked for cardiac surgery during the study period (November 15, 2020 till November 30, 2021) were reviewed. Data was collected from patients' electronic clinical records including demographic information (age, sex, and nationality), medical history, comorbidities, type of cardiac surgery, types of arrhythmias, laboratory investigations, complications, length of hospital stay, and mortality. Patients with known pre-existing arrhythmias including atrial fibrillation and/or atrial flutter were excluded from the study. Also, the presence of PVCs, junctional rhythm, AV nodal conduction abnormalities, the presence of right or left bundle branch blocks on admission's electrocardiograms (ECG) or preoperative Holter were also excluded. Since the study was conducted during the peak period of COVID-19 pandemic all patients were screened pre-operatively with polymerase chain reaction (PCR) for COVID-19 and the study included patients who were negative for COVID-19. All ECGs and rhythm strips showing arrhythmias were verified by an electrophysiologist. Routinely, all patients underwent daily 12-lead ECG. Further 12-lead ECGs are performed if there are any obvious arrhythmias detected while the patient is connected to the telemetry or at the discretion of the treating surgeons or the consulted electrophysiologist. For this study all non-sinus rhythm or non-sinus tachycardia were included. Furthermore, any new conduction disturbance involving the AV node or bundle branches were considered abnormal and were included.

Surgical technique

All procedures were approached through a median sternotomy incision. Most coronary artery bypass grafting (CABG) patients were done on pump beating heart (on cardiopulmonary bypass (CPB) but without cross-clamping the ascending aorta). Two CABG cases were done off-pump. All valvular and aortic surgeries were done under CPB and cardioplegic arrest. For mitral valve surgeries, bicaval venous cannulation was undertaken. The mitral valve was either approached through Waterson's groove or trans-septally. The cardioplegia used was cold blood cardioplegia that was composed of blood, potassium chloride, magnesium sulfate, calcium chloride, lidocaine, and sodium bicarbonate (blood to crystalloid ratio 4:1). Ablation of AF was performed using Medtronic bipolar radiofrequency ablation clamp. Closure of the left atrial appendage was done through an intracardiac approach.

Statistical method

Data were analyzed using the Statistical Package for Social Sciences (SPSS Inc., and Chicago, IL, USA). Numerical data were expressed as mean ± SD. Binary logistic regression was performed using Hosmer and Lemeshow test, and two-sided p values < 0.05 were considered statistically significant.

RESULTS

A total of 173 patients underwent cardiac surgery during the study period, of whom 12 were excluded due to pre-existing arrhythmias (mostly atrial fibrillation and ventricular bigeminy) and two had COVID-19. The study included 161 participants who met the inclusion criteria. The mean age of patients was 56.75 ± 1.68 years. A total of 68.32% of the enrolled population was male, while 31.68% was female. The patients had a mean Body Mass Index (BMI) of 29.04 ± 5.68. Bahrainis constituted 77.64% and non-Bahrainians 22.36% of the study population. The demographics of the patients are presented in Table 1.

Table 1: Patient demographic and clinical manifestation at presentation.

Demographic characteristics, (n = 161)	
Age, mean ± SD	56.75 ± 1.68
Gender, n (%)	
Male	110 (68.32)
Female	51 (31.68)
BMI, mean ± SD	29.04 ± 5.68
Weight, mean ± SD	77.56 ± 15.67
Height, mean ± SD	163.67 ± 9.61
Nationality, n (%)	
Bahraini	125 (77.64)
Non-Bahraini	36 (22.36)
Presentation of patient, n (%)	
Angina	36 (22.36)
Congestive heart failure	71 (44.1)
NSTEMI	30 (18.63)
STEMI	13 (8.07)
Others	11 (6.83)

NSTEMI: Non-ST-elevation myocardial infarction; STEMI: ST-elevation myocardial infarction; BMI: Body Mass Index; SD: Standard Deviation; n:number of patients

Table 2: Medical history of the patients.

Medical history, n (%)	
Diabetes mellitus	90 (55.90)
Hypertension	98 (60.87)
Dyslipidemia	86 (53.42)
Connective tissue disease	1 (0.62)
Asthma/COPD	3 (1.86)
Heart Failure	37 (22.98)
Valvular heart disease	65 (40.37)
Coronary artery disease	32 (19.88)
Previous stroke/TIA	6 (3.73)
Peripheral arterial disease	7 (4.35)
Renal impairment	
a. Stage I	52 (32.30)
b. Stage II	51 (31.68)
c. Stage III	40 (24.84)
d. Stage IV	14 (8.70)
e. Stage V (with or without dialysis)	4 (2.48)
Smoking	35 (21.74)
Alcohol	1 (0.62)

COPD: Chronic obstructive pulmonary disease; TIA: Transient ischemic attack; n:number of patients

Patients with diabetes mellitus, hypertension, dyslipidemia, valvular heart disease, and coronary artery disease accounted for 55.90%, 60.87%, 53.42%, 40.37% and 19.88% of the enrolled population, respectively. It is estimated that 65.2% of the enrolled patients have renal impairment of stage II or more, and 44.1% of them have congestive heart failure. None of the patients studied had a history of cardiac device implantation. A smoking history was reported by 21.74% of patients. The patients' detailed medical histories are presented in Table 2.

Based on baseline ECG readings, heart rates averaged 79.99 ± 21.55 beats per minute. A right bundle branch block was observed in 7.45% of patients. The baseline ECHO demonstrated a mean LVEF of 51.42 ± 10.87% with mean left atrial size of 3.99 ± 0.8 cm. Table 3 shows the baseline ECG and two-dimensional (2D) ECHO characteristics of patients.

The majority of patients (61.49%) had undergone urgent surgery. CABG was the most common surgical procedure (40.37%). In terms of valvesurgery, 12.42% had an aortic valve replacement and 19.25% had mitral valve replacement or repair [Table 4].

Cardioplegia was reported in 39.75% of patients and 58.39% of patients had a history of blood transfusion. Overall, 56.52% of patients had one or more of the arrhythmias reported in Table 5. PVCs, AF, junctional rhythm, heart block, and atrial flutter (AFL) were reported in 30.43%, 29.19%, 11.18%, 9.31%, and 8.07%, patient population respectively. Approximately 67% of people with arrhythmias other than LBBB, RBBB,

Table 3: Baseline ECG and 2D ECHO.

Baseline ECG	
Heart rate	79.99 ± 21.55
cQT interval (ms)	443.56 ± 42.12
Baseline ECHO, (n = 161)	
LVEF (%)	51.42 ± 10.87
LA size (cm)	3.99 ± 0.8
LVH–IVS (cm)	1.09 ± 0.21
LVH–PW (cm)	1.02 ± 0.19
RVH	12 (7.45)

ECG: Electrocardiogram; 2D: two-dimensional; ECHO: Echocardiogram; LA: Left atrium; LVEF: Left-ventricular ejection fraction; LVH-IVS: Left-ventricular hypertrophy-interventricular septum; LVH-PW: Left-ventricular hypertrophy-posterior wall; RVH: Right-ventricular hypertrophy

Intraventricular conduction defects (IVCD) or junctional rhythm received rate control strategies, most commonly beta-blockers. Of the group receiving rhythm strategy (33%), approximately 66.67% received amiodarone, while 33.33% had either electrical cardioversion or defibrillation. A permanent pacemaker was implanted in four patients (2.48%) before discharge. Pleural effusion (50.31%) is common post-surgery complications observed among the patients. We defined post-operative bleeding using the bleeding academic research consortium (BARC) classification, which classifies bleeding types from 0 to 5. It is estimated that 6% of patients had type 3 BARC bleeding. Renal failure was also observed in 17.39% of patients. The mean sO_2 of the patients on the day

Table 4: Surgical history of the patients.

Surgical history, n (%)	
Surgical status:	
1. Elective	57 (35.4)
2. Emergent	5 (3.11)
3. Urgent	99 (61.49)
Type of surgery	
1. Aortic valve replacement	20 (12.42)
2. Aortic aneurysm repair	1 (0.62)
3. Aortic dissection	4 (2.48)
4. Mitral valve repair/replacement	31 (19.25)
5. CABG	65 (40.37)
6. AVR+MVR	8 (4.97)
7. CABG+AVR	7 (4.37)
8. CABG+MVR	7 (4.37)
Surgical AF ablation done	17 (10.55)
Surgical AF ablation technique	
I. Left atrial lesion	5 (3.11)
II. Pulmonary vein isolation only	12 (7.45)
Surgical LAA closure done	51 (31.68)
Type of cardioplegia	
1. Antegrade	30 (18.63)
2. Retrograde	1 (0.62)
3. Both	64 (39.75)
Blood transfusions given	29 (18%)
Number of blood transfusions units	2.62 ± 10.87
Off-pump CABG	2 (1.24)
Infective endocarditis	11 (6.83)
Cross-clamp time (min)	92 (57.14)
9. Other	18 (11.18)

AF: Atrial fibrillation; AVR: Aortic valve replacement; CABG: Coronary artery bypass graft; LAA: Left atrial appendage; MVR: Mitral valve replacement; n: number of patients

Table 5: Post-surgery arrhythmia and other complications.

Arrhythmias post-surgery, n (%)	n = 161
No arrhythmias	70 (43.48)
Any form of arrhythmias	91 (56.52)
New PVCs	49 (30.43)
Morphology of PVCs	
Multifocal	6 (3.73)
Unifocal	38 (23.6)
Both	1 (0.62)
NSVT	6 (3.73)
VT	1 (0.62)
Morphology of VT Polymorphic	1 (0.62)
VF	6 (3.73)
New onset AF	47 (29.19)
New onset AFL	13 (8.07)
Heart block	15 (9.31)
1st degree	8 (4.97)
2nd degree	3 (1.86)
3rd degree	3 (1.86)
combination of 1 and/or 2 and/or 3rd	1 (0.62)
Asystole	4 (2.48)
PEA	2 (1.24)
New LBBB	3 (1.86)
New RBBB	1 (0.62)
New IVCD	0 (0)
SVT	2 (1.24)
Junctional rhythm	18 (11.18)
Atrial tachycardia	1 (0.62)
Complications post-surgery	
Pneumothorax	3 (1.86)
Pericarditis	4 (2.48)
Pericardial effusion/tamponade	14 (8.7)
Sternal wound dehiscence	1 (0.62)
MI	0 (0)
Stroke/TIA	1 (0.62)
Bleeding (BARC classification)	31 (19.25)
Type 0	130 (80.75)
Type 1	2 (1.24)
Type 2	17 (10.56)
Type 3	10 (6.21)
Type 4	2 (1.24)
Type 5	0
Temporary pacemaker	5 (3.1)
Pleural effusion	81 (50.31)
Death	9 (5.59)

PVCs: Premature ventricular complexes; NSVT: Non-sustained ventricular tachycardia; VT: Ventricular tachycardia; VF: Ventricular fibrillation; AF: Atrial fibrillation; AFL: Atrial flutter; PEA: Pulseless electrical activity; LBBB: Left bundle branch block; RBBB: Right bundle branch block; SVT: Supraventricular tachycardia; MI: Myocardial infarction; TIA: Transient ischemic attack; IVCD: Intraventricular conduction defects; BARC: Bleeding academic research consortium; n:number of patients

of arrhythmia was 95.67 ± 2.05%. Details of the findings of the investigation on the day of arrhythmia are presented in Table 6.

The post-surgery laboratory parameters of the patients are presented in Table 7. The mean creatinine and blood sugar level of the patients post-surgery were found to be high, 102.89 ± 119.11 umol/L and 7.92 ± 3.2 mmol/L, respectively. The mean glycated hemoglobin level was also found to be high (7.12 ± 4.58 mmol/L). The pre-operative medications received by the patients are reported in Table 8. Epinephrine/norepinephrine (71.43%) was the most used inotropic agent following cardiac surgery. The majority of patients were taking beta-blockers (75.78%) prior to surgery.

Binary logistic regression for the occurrence of post-surgery arrhythmia were for each unit increase in diabetes as "yes" then individuals or cases belonging to the "yes" category have approximately 1.92 times higher odds of experiencing arrhythmias. For each unit increase in valvular heart disease as "yes" then individuals or cases belonging to the "yes" category have approximately 4.82 times higher odds of experiencing arrhythmias. For each unit increase in previous stroke/Transient ischemic attack (TIA) as "yes" then individuals or

Table 6: Results of the investigations on the day of arrhythmia.

Investigation on the day of arrhythmia	
sO_2 (mean ± SD, %)	95.67 ± 2.05
O_2% therapy (L)	2.57 ± 1.12
PaO_2 (10.5–13.5 kPa)	12.58 ± 1.54
$PaCO_2$ (5.1–5.6 kPa)	5.54 ± 1.22
HCO_3 (22–26 meq/L)	23.9 ± 3.71

sO_2: Sulfur dioxide; O_2: Oxygen; PaO_2: Partial pressure of oxygen in arterial blood; $PaCO_2$: Partial pressure of carbon dioxide in arterial blood; HCO_2: Bicarbonate ion; SD: Standard Deviation

Table 7: Laboratory parameters.

Lab investigations, mean ± SD	
Hb (120.0–160.0 g/L)	77.64 ± 56.2
WBC (4.0–11.0 ×10^9/L)	10.01 ± 10.22
Platelets (150.0–450.0 ×10^9/L)	243.84 ± 102.14
Sodium (Na) (136.0–145.0 mmol/L)	137.14 ± 4.08
Potassium (K) (3.5–5.10 mmol/L)	4.27 ± 0.4
Creatinine (44.0–80.0 umol/L)	102.89 ± 119.11
Urea (2.76–8.07 mmol/L)	8.39 ± 8.01
Calcium (Ca) (2.15–2.5 mmol/L)	2.23 ± 0.18
Magnesium (Mg) (0.66–1.07 mmol/L)	1.48 ± 6.58
Liver function tests	
Bilirubin (0.0–24.0 umol/L)	13.82 ± 32.56
Albumin (35.0–52.0 G/L)	39.27 ± 5.58
ALT (0.0–33.0 IU/L)	33.66 ± 101.82
AST (0.0–32.0 IU/L)	49.36 ± 211.94
ALP (35.0–105.0 IU/L)	91.91 ± 93.46
GGT (5.0–36.0 IU/L)	61.91 ± 166.3
Thyroid function tests	
TSH (0.27–4.20 uIU/ml)	2.31 ± 1.59
free T4 (12.0–22.0 pmol/l)	16.17 ± 2.84
free T3 (3.10–6.8 pmol/l)	5.95 ± 24.05
Lipids	
Cholesterol (3.8–5.2 mmol/L)	4.17 ± 1.29
TG (0.10–1.70 mmol/L)	1.51 ± 0.75
LDL (0.0–2.59 mmol/L)	2.59 ± 1.07
HDL (0.0–1.68 mmol/L)	1.1 ± 0.32
Blood sugar (BS) (4.11–5.89 mmol/L)	7.92 ± 3.2
HbA1C (4.5–5.6%)	7.12 ± 4.58

Hb: Hemoglobin; WBC: White blood cells; ALT: Alanine transaminase; AST: Aspartate aminotransferase; ALP: Alkaline phosphatase; GGT: Gammaglutamyl-transferase; TSH: Thyroid stimulating hormone; T4: Thyroxine4; T3: Thyroxine 3; TG: Triglycerides; LDL: Low-density lipoprotein; HDL: High-density lipoprotein; HbA1C: Glycated hemoglobin; SD: Standard Deviation

cases belonging to the "yes" category have approximately 3.48 times higher odds of experiencing arrhythmias [Table 9].

DISCUSSION

In the present study, we found that the most common arrhythmias among patients who had undergone cardiac surgery was PVCs (30.43%). In line with previously reported

Table 8: Pre- and post-operation medications.

Inotropes used before arrhythmia onset, n (%)	
Dopamine	45 (27.95)
Dobutamine	83 (51.55)
Epinephrine/Norepinephrine	115 (71.43)
Milrinone	6 (3.73)
Pre-op medications	
Beta-blockers	122 (75.78)
Calcium channel blockers	26 (16.15)
ACEI/ARB	89 (55.28)
Diuretics	48 (29.81)
Ivabradine	4 (2.48)
Antiplatelets	108 (67.08)
1. Aspirin	57 (35.4)
2. Aspirin and Clopidogrel	43 (26.71)
3. Aspirin and Ticagrelor	9 (5.59)
4. Clopidogrel	1 (0.62)
Statins	109 (67.7)
Steroids	2 (1.24)
Management of post-op arrhythmias	
Rate control	61 (67)
Rhythm control	30 (33)
Rate control, medications used	
1. Beta-blockers	90 (98.36)
2. Calcium channel blockers	1 (1.64)
Rhythm control strategy	
1. Amiodarone	20 (66.67)
2. Electrical cardioversion/defibrillation	10 (33.33)
Permanent pacemaker implant	4 (4.39)
ICD implant	0 (0)

ACEI: Angiotensin-converting enzyme inhibitors; ARB: Angiotensin receptor blockers; ICD: Implantable cardioverter-defibrillators

findings, the rate of atrial fibrillation among patients falls within the established range at 29.19%. In comparison with other post-operative non-arrhythmic complications, pleural effusions (50.31%) have been reported as the most common complications, followed by bleeding (19.25%). In the context of the surgical procedures, a few of the laboratory parameters were found to be above normal following the surgery.

The mean creatinine level and blood sugar level was found to be 102.89 ± 119.11 umol/L and 7.92 ± 3.2 mmol/L, respectively in the study population. We found that our sample population had remarkably high rates of diabetes and hypertension. Our study found that 54% of patients had diabetes and 59% had hypertension. These two risk factors may contribute to arrhythmia development following cardiac surgery. In spite of higher rates of these risk factors, there were very low rates of sternal wound dehiscence (0.6%) and stroke (0.6%).

Although the surgical techniques have improved, the incidence of AF after cardiac surgery have increased significantly.[11]

Table 9: Coefficient significance tests for post-surgery arrhythmia.

Independent Variable X	Regression Coefficient b(i)	Standard Error Sb(i)	Wald Z-Value H0: β=0	Wald P-Value	Exp(b(i))
Intercept	−2.18142	1.24787	−1.748	0.08044	0.11288
Age	0.02334	0.02259	1.033	0.3014	1.02362
(Valvular_heart_disease="Yes")	1.57309	0.54262	2.899	0.00374	4.82154
(Diabetes="Yes")	0.65396	0.62733	1.042	0.29721	1.92314
(Dyslipidemia="Yes")	−1.00171	0.62116	−1.613	0.10682	0.36725
(Previous_stroke_TIA="Yes")	1.24713	1.01218	1.232	0.2179	3.48036

b(i): The regression coefficient for the independent variable; Sb(i): The standard error of the regression coefficient for the independent variable; Z-Value: The Wald test statistic is calculated as the ratio of the estimated coefficient to its standard error; H0:β=0: The parameter (coefficient) of interest is equal to a specified value (often zero, it indicates no effects); P-Value: The probability of obtaining a test statistic as extreme or more extreme than the observed one, assuming the null hypothesis is true; Exp(b(i)): The exponentiation of the B coefficient, which is an odds ratio.

Various patient-related risk factors have been documented to be associated with post-operative arrhythmia such as the age of the patients, history of structural heart disease, and presence of several cardiovascular comorbidities. Published literature suggests that at an increasing age leads to a hike in the development of atrial substrate which, in turn, elevates the risk of post-operative AF.[12] Patients with structural heart disease also have a higher risk of developing post-operative arrhythmia.[2,3] Any structural abnormalities in the atria or the ventricle lead to triggered activity, re-entry, or abnormal automaticity thereby increasing the risk of developing arrhythmias.[3] Cardiac surgeries are often associated with atrial enlargement or an increase of atrial pressure which may provide a substrate for post-operative arrhythmias.[3] A recent systemic review and meta-analysis revealed that isolated CABG was associated with a high incidence of new-onset atrial fibrillation post-surgery.[13] A combination of valvular surgery and CABG, on the other hand, may have a higher risk of developing AF than either procedure alone. Another study reported 264,000 patients will develop new-onset atrial fibrillation out of approximately 800,000 undergoing CABG worldwide.[14] Local inflammation is reported to be a risk factor for post-operative AF. Previous studies have shown that inflammatory biomarkers like interleukin-2,[15] C-reactive protein,[16] and interleukin-6[17] have some connections with the incidences of post-operative AF. Atrial stimulation, electrolyte imbalances, prolonged mechanical ventilation, and pulmonary infections are also reported to be triggering factors for post-operative AF which complicates the condition of patients after cardiac surgery.[16]

The rates of ventricular tachycardia and ventricular fibrillation were low in the present study and were reported to be 0.62% and 3.73%, respectively. Similarly, Mouws *et al.* reported that though ventricular dysrhythmias (VA) were reported commonly among their study population, there were no incidences of VTs and VFs. In this study, the incidence of new LBBB was documented in 1.86% of patients and 0.68% with RBBB.[18] Doshi *et al.* reported that new LBBB was recorded in 8.9% of patients and the absence of new RBBB.[19] The small sample size could explain the lower rate of LBBB in our study. Furthermore, aortic valve surgery is more commonly associated with a higher risk of developing LBBB. Only 12.42% of the patients in our study underwent an aortic valve replacement while 9% underwent AVR along with CABG or mitral valve repair or replacement.

Pleural effusion is a common risk associated with post cardiac surgeries. A recent study by Brookes *et al* reported that post CABG, 14.4% of the enrolled patients (n = 409) required drainage of pleural effusion.[20] Similarly in our study, 49.07% had a history of CABG and post-cardiac surgery, pleural effusion was observed in 50.31% of patients.

Post cardiac surgery, bradyarrhythmias, and conduction abnormalities are relatively common. In the present study, 2.48% of the study population needed a permanent pacemaker implantation after cardiac surgery. Ghamdi *et al.* have reported that 1.6% patients in their study required pacemaker implantation after cardiac surgery.[21]

In the present study, the mean post-operative glucose level was reported to be high (7.92 ± 3.2 mmol/L) in the study population. Hyperglycemia after cardiac surgery can worsen the clinical outcome.[22] Moorthy *et al.*[23] reported in their study that post-operative hyperglycemia increases the risk of post-operative arrhythmias. In their study, 26.9% of patients with hyperglycemia were reported to have post-operative arrhythmia. Several factors like increased levels of inflammatory biomarkers, poor ventricular function, and larger size of infarcts which triggers the development of arrhythmia, are found to have connections with hyperglycemia.[24] Hyperglycemia can also prolongate QT-interval [25] leading to development of ventricular tachycardia in patients who have underlying coronary artery disease.[24]

In addition, our study also revealed that the mean hemoglobin level was very low (77.64 ± 56.2 g/L) in the study population. A recent nationwide population-based study reported that low or high Hb levels increase the risk of AF.[26] anemic patients may experience repeated incidences of AF.[27] anemic can trigger chamber dilatation and myocardial hypertrophy leading to AF and heart failure.[28]

The updated American College of Cardiology Foundation/ American Heart Association (ACCF/AHA) 2011 guideline recommends prescribing beta blocker therapy before or after the surgery to prevent atrial fibrillation (AF) after CABG. A meta-analysis reported that beta blockers can significantly reduce the incidences of AF after CABG.[29] Beta blockers reduce the blood pressure which may prevent the occurrence of any risks post-surgery.[30] Also, alternative antiarrhythmic drugs, such as calcium channel blockers are useful in the treatment of certain arrhythmias, such as supraventricular tachyarrhythmias.[31] In the present study, approximately 98% and 2% of the patients with post-op arrhythmias were given beta blockers and calcium channel blockers as a rate control strategy respectively. Peretto *et al.* reported that therapeutic management including beta blockers and calcium channel blockers of early post-operative arrhythmias.[32] In this study, amiodarone (66.67%) was the only anti-arrhythmic drugs used in the management. A previous study found that perioperative amiodarone reduced the incidence of post-operative atrial arrhythmias both safely and effectively.[33] The incidence of post-operative atrial fibrillation is reduced by about 40% to 50% with amiodarone.[32] In the PAPABEAR study, it has been shown that prophylactic treatment with amiodarone was associated with a reduction in post-operative atrial fibrillation and flutter.[34]

The Cochrane review by Arsenault *et al*, found that a variety of strategies were used in order to reduce the incidence of atrial fibrillation after cardiac surgery. These strategies included the use of amiodarone postoperatively, beta blockers, magnesium sulfate, sotalol, atrial pacing, and posterior pericardiotomy. In spite of the fact that all of the interventions that were previously mentioned were able to reduce the incidence of post-operative atrial fibrillation by half, this difference did not translate into a reduction in post-operative stroke, all-cause mortality or cardiac mortality.[35]

There are three main goals of the management of post-operative AF. These goals include stabilizing the hemodynamic status of the patient, preventing thromboembolic complications, and controlling the symptoms and the likelihood of AF recurrence.[7]

In order to achieve the most favorable outcome, it is recommended that patients be managed individually. Various measures must also be implemented to prevent complications such as optimizing and correcting electrolytes imbalance and hypoxia.[7]

Study limitation

It is possible that the findings of this study are limited in generalizability since only 161 patients were included from a single center.Since this is a retrospective study, data are collected from medical records, which may introduce bias or errors.Because those who underwent cardiac surgery during the COVID-19 pandemic may have differed in important ways from those who didn't, the study may have been subject to selection bias.Due to the absence of a control group, causal inferences about the relationship between COVID-19 and cardiac surgery outcomes are limited. A final limitation is that the study did not control for other possible factors, such as comorbidities, age, or other medical treatments that might have influenced the outcomes.

CONCLUSION

In our study, PVCs and AF were found to be the two most common arrhythmias observed in patients following cardiac surgery. In order to determine the clinical significance of any arrhythmia, a number of factors must be taken into account, including comorbidities and other cardiovascular risk factors, the duration of the arrhythmias, the left ventricular ejection fraction of the patient, and other hemodynamic parameters. Our study highlights the importance of identifying and managing cardiac risk factors in patients undergoing cardiac surgery to reduce the incidence of post-operative arrhythmias and improve overall patients outcomes. Further research is needed to explore the mechanisms underlying the associations between these risk factors and post-operative arrhythmias, and to develop effective prevention and management strategies.

LIST OF ABBREVIATIONS

AAR: Aortic aneurysm repair

AF: Atrial fibrillation

AFL: Atrial flutter

AVR: Aortic valve replacement

BMI: Body Mass Index

CABG: Coronary artery bypass surgery

COVID-19: Coronavirus disease 2019

CPB: Cardiopulmonary bypass

ECGs: Electrocardiogram

LBBB: Left bundle branch block

MVR: Mitral valve replacement

PCR: Polymerase chain reaction

PVCs: Premature ventricular complexes

RBBB: Right bundle branch block

SD: Standard Deviation

SPSS: Statistical Package for Social Sciences

Availability of data and materials

Data may be available on request.

Authors' contributions

AKH contributed to the conception or design of the work. TSC, AJA, BI, KAY, and MAS contributed to the acquisition of the data. AKH contributed to the analysis, interpretation of data for the work. AKH drafted the manuscript. All authors critically reviewed the manuscript. All authors gave final approval and agreed to be accountable for all aspects of the work ensuring integrity and accuracy. All authors read and approved the final manuscript.

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Ethical approval

The research/study complied with the Helsinki Declaration of 1964.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

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There are no conflicts of interest.

Use of artificial intelligence (AI)-assisted technology for manuscript preparation

The authors confirm that there was no use of artificial intelligence (AI)-assisted technology for assisting in the writing or editing of the manuscript and no images were manipulated using AI.

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