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Post-operative incidences of atrial fibrillation in on-pump versus off-pump coronary artery bypass grafting: A single-center, cross-sectional study

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Abstract--Objectives: Atrial fibrillation (AF) is one of the most common arrhythmias after coronary artery bypass grafting (CABG). Opinions divided regarding which of the two CABG techniques on-pump CABG or off-pump CABG has a lower incidence of post-operative AF. The aim of this study was to measure the incidence of post-operative AF in these techniques and its effect on the patients' morbidity, mortality and hospital stay. Methods: We studied 60 consecutive medical records of patients that underwent on-pump and off-pump CABG. All our study patients underwent A 12-lead electrocardiogram (ECG) in the following situations: immediately after

admission to the ward, after any event of arrhythmia either in the ward or in THE (ICU) and before discharge. We also used the regular monitor ECG cable for continuous, daily recording of patient rhythms. Results: (AF) occurred in two cases (6.25%) in the on-pump CABG group and in two cases (7.1%) in the off-pump CABG group, ($P=0.890$). The mean length of hospital stay had been 6.4 days in the on-pump CABG group and 4.2 days in the off-pump CABG group (P value <0.001). No mortality occurred. Conclusion: The incidence of post-operative (AF) was the same between on-pump and off-pump CABG. The hospital stay days was 1-2 days longer in patients who developed post-operative AF than in patients who remained in sinus rhythm.

Keywords---coronary artery bypass grafting, atrial fibrillation, off-pump coronary.

Background

Arrhythmias are one of the most common complications after cardiac surgery causing a serious morbidity and mortality(1)(2).The most common post-operative arrhythmia is atrial fibrillation (AF),affecting 10%-40% of patients undergoing coronary artery bypass Grafting(CABG)(3).In their comprehensive study ,Banach et al reported that (15%-33%)of patients undergoing CABG were complicated by postoperative (AF)(4)(5),with most the incidences occurring on the second to third post-operative day.(6).Mariscalco et al, reported that AF doubled the overall post-operative mortality rate in CABG patients. It also quadrupled the risk of stroke compared with patients who remained in a sinus rhythm (4). (AF) and its associated complications cause a significant increase in treatment costs, and hospital stay(3). The merits and demerits of On pump vs. off pump CABG have been debated for many years. A classic criticism of off-pump CABG was regarding the completeness of revascularization, this concern is no longer valid as technology to safely perform multi vessel off pump CABG has improved tremendously over the past decade (7). In this study, we focused one incidence of (AF) after on-pump or off-pump CABG surgeries and their relations to patients'morbidity, mortality, and hospital stay.

Methods

A cross sectional study was conducted using 60 consecutive medical records of patients that under gone CABG between August 2019 to August 2021 in the Assuit University Heart Hospital. 32 patients (53.3%) were operated using cardiopulmonary bypass machine (on-pump CABG) and while 28 (46.67%) cases were operated without it (off-pump CABG). All patients undergoing CABG in this study underwent a 12-lead electrocardiogram ECG in the following situations: immediately after admission to the ward, after any event of arrhythmia either in the ward or in the ICU and before discharge. We also used the regular monitor ECG cable for continuous, daily recording of patient rhythms. The decision to perform on pump or Off-pump CABG was influenced by several factors such as the patient's demographic and clinical profiles, including left ventricular ejection

fraction (Table- 1) , site of coronary lesions, or the presence of neurological or renal dysfunction. None of the patients in our study had neurological dysfunction or any renal impairment before the operation (all kidney functions were within the normal range). The decision was ultimately taken at the discretion of the operating surgeon.

Exclusion criteria

Patients with associated valvular heart disease, cases, history of AF and emergency cases, were excluded. The included patients were divided in two groups: those undergoing on-pump CABG and those undergoing off -pump CABG. Data were grouped in pre-operative, intraoperative, and post-operative variables. Subsequently, the variables were evaluated in a comparative way. The technique to perform the operation was based on the surgeon's preference. The preoperative variables were: age, sex, diabetes mellitus, hypertension, dyslipidemia, use of (beta-blockers)(all the patients were under cover of beta-blockers till the day of operation), chronic obstructive pulmonary Disease (COPD), kidney functions, prior percutaneous trans-luminal coronary Angiography (PTCA), ejection fraction.

- The peri-operative variables were: cardiopulmonary bypass machine time (in min), aortic clamping time.
- The postoperative variables were: coronary care unit (CCU) time, hospital stay, and the use of (beta-blockers).
- The primary outcome was the incidence of post-operative atrial fibrillation (AF) in the two -patient groups.
- The secondary outcomes were mortality and hospital stay.

Data were analyzed using the SPSS software package version 20. Descriptive statistics were in the form of frequencies, means, and standard deviations. Statistical analysis, like the chi-squared test or the independent samples t-test, was done according to the type of variable (qualitative or quantitative, normally distributed or not). Multivariable analysis was performed to identify the incidence of AF among on-pump and off-pump. Values were considered significant $P < 0.05$.

Results

In our study all patients from both groups achieved complete revascularization complete revascularization. (AF) was recorded in two cases (6.25%) in the on-pump CABG group and in two cases (7.1%) in the off-pump CABG group ($P = 0.890$, (Table-3). The mean length of hospital stay was 6.4 days in the on-pump CABG group and 4.2 days in the off-pump CABG group ($P < 0.001$), (Table 4). No mortality occurred. AF occurred in the first post-operative day in two cases and on the second post-operative day in the other two cases. In our study AF only affected the hemodynamics of the patients by lowering their cardiac output and blood pressure; it did not cause any thromboembolic manifestations, stroke or the need for re-intubation. AF also increased the length of hospital and ICU stay in affected patients by 1-2 days than those who remained in a sinus rhythm.

We diagnosed AF using with the following protocol: obtained a blood gas test to exclude any electrolyte disturbance, Obtained a 12-lead ECG to confirm the diagnosis of AF. We used amiodarone (Cordarone) a class III anti-arrhythmic drug as a loading and maintenance dose, to effectively control AF in these patients.(8)(9). In our study we did not give warfarin as a prophylactic for thromboembolism because we relied on the patients take aspirin (acetyl salicylic acid) and clopedogril (Plavix) to prevent graft thrombosis.

Table 1
Demographic data

	On Pump (n=32)		Off Pump (n=28)		P. value
	No.	%	No.	%	
Age					
Range	38 - 68		39 - 65		0.601
Mean±SD	56.44±7.63		55.39±7.72		
Sex					
Male	26	81.25	26	92.9	0.187
Female	6	18.75	2	7.1	
Diabetes					
Yes	14	43.75	16	57.1	0.301
No	18	56.25	12	42.9	
Hypertension					
Yes	16	50.0	14	50.0	1.000
No	16	50.0	14	50.0	
COPD					
Yes	17	53.1	22	78.6	0.039*
No	15	46.9	6	21.4	
Dyslipidemia					
Yes	31	96.9	27	96.4	0.923
No	1	3.1	1	3.6	
Pulmonary Hypertension "mmHg"					
Normal	18	56.3	20	71.4	0.469
Moderate	11	34.4	6	21.4	
Mild	3	9.4	2	7.1	
Range	18 - 45		18 - 39		0.163
Mean±SD	28.03±8.81		25.04±7.41		
Ejection Fraction (EF)					
Range	40 - 69		29 - 76		0.340
Mean±SD	58.28±8.05		55.43±14.41		
Creatinine "mg/dL"					
Normal	32	100.0	28	100.0	-
Range	0.5 - 1.2		0.5 - 1.2		0.401
Mean±SD	0.84±0.19		0.88±0.18		
Urea "mg/dL"					
Normal	32	100.0	28	100.0	-
Range	6 - 20		6 - 20		0.452

<i>Mean±SD</i>	15.09±5.01	16.04±4.55
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Table 2
Description of Coronary angiography

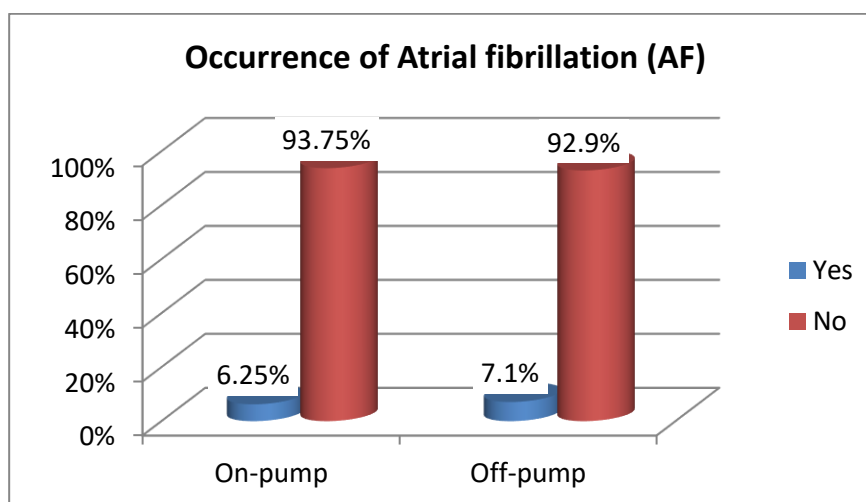
	On Pump (n=32)		Off Pump (n=28)		P. value
	No.	%	No.	%	
LAD					
Total (100% occlusion)	4	12.5	9	32.1	0.171
Subtotal (85-95% occlusion)	15	46.9	11	39.3	
Significant (70-80%)	10	31.3	4	14.3	
Normal	3	9.4	4	14.3	
Range	40 - 100		50 - 100		0.238
Mean±SD	79.19±12.87		83.57±15.63		
RCA					
Total	3	9.4	5	17.9	0.658
Subtotal	15	46.9	12	42.9	
Significant	3	9.4	4	14.3	
Normal	11	34.4	7	25.0	
Range	40 - 100		40 - 100		0.567
Mean±SD	72.47±17.31		75.36±21.51		
LCX					
Total	4	12.5	2	7.1	0.347
Subtotal	14	43.8	9	32.1	
Significant	1	3.1	4	14.3	
Normal	13	40.6	13	46.4	
Range	40 - 100		40 - 100		0.434
Mean±SD	72.97±19.83		69.29±15.79		
D1					
Subtotal	10	31.3	7	25.0	0.159
Significant	0	0.0	3	10.7	
Normal	22	68.8	18	64.3	
Range	50 - 90		40 - 90		0.750
Mean±SD	64.69±15.08		63.39±16.28		
OM					
Total	3	9.4	2	7.1	0.346
Subtotal	7	21.9	9	32.1	
Significant	3	9.4	0	0.0	
Normal	19	59.4	17	60.7	
Range	40 - 100		40 - 100		0.998
Mean±SD	66.41±17.38		66.39±18.54		
PDA					
Subtotal	3	9.4	0	0.0	0.096
Normal	29	90.6	28	100.0	
Range	40 - 90		40 - 60		0.048*
Mean±SD	57.5±11		52.68±6.59		

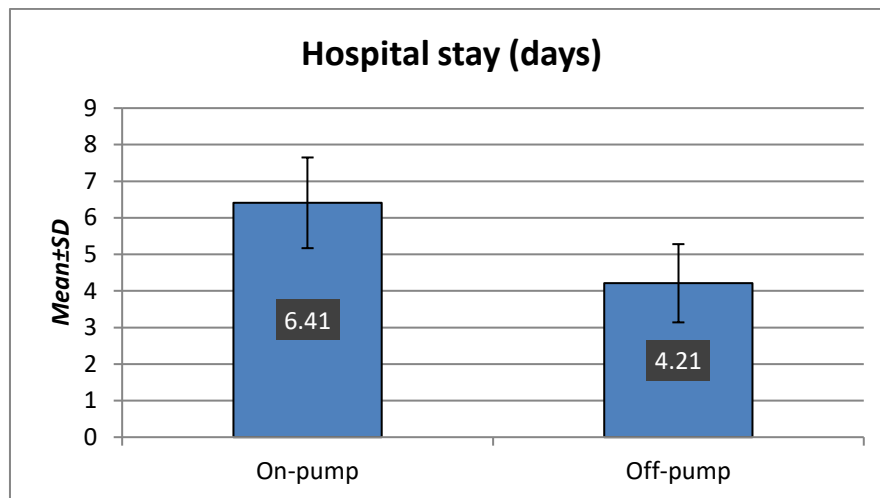
Table 3
Incidence of atrial fibrillation

	On-Pump (n=32)		Off-Pump (n=28)		P. value
	No.	%	No.	%	
Occurrence of post operative Atrial fibrillation (AF)					
Yes	2	6.25	2	7.1	0.890
No	30	93.75	26	92.9	

Table 4
Post- operative hospital stay

	On Pump (n=32)	Off Pump (n=28)	P. value
Post-operative hospital stay (days)			
<i>Range</i>	5 - 10	3 - 6	<0.001**
<i>Mean±SD</i>	6.41±1.24	4.21±1.07	





Discussion

In this study we found no difference in post-operative incidence of AF between the on-pump and off-pump CABG groups (Table 3), which is in agreement with Bohatch Júnior et al(3) and Lewicki et al (4). Arslan et al(10) study showed that incidence of post-operative AF was lower in the off-pump CABG group. In our study AF increased the post-operative hospitalization by 1-2 days compared with patients who maintained sinus rhythm (Table- 4), Bohatch Júnior et al(3) reported an increase in hospital stay by 2-4 days in post-operative patients with AF. Previous studies identified age as a significant risk factor for developing post-operative AF; however, we observed no influence of age because our patients weren't in advanced age were relatively younger, (less than 70 years old). In our study COPD was a significant risk factor for developing post-operative AF. COPD presents a patient related extra-cardiac comorbidity that increases the likelihood of post-operative arrhythmias. Also the risk of AF was high if the posterior descending artery branch of the right coronary artery was affected.

We noticed that post-operative blood transfusion was more in the on-pump CABG group than the off-pump CABG group but this was not associated with the development of AF in those patients Velioglu and Yuksel(6) have previously showed that blood transfusion and post-operative AF were not associated, while some other studies have shown a relation between them. In our study we found no difference in mortality between the two CABG groups. Previous studies have reported the same observation despite the differences in risk profiles such as chronic kidney disease or acute myocardial infarction as in Ho Jin Kim et al(11) study and Saeed Davoodi(12) study but the difference in our study that all patients had normal kidney functions and no myocardial infarctions.

Conclusions

In conclusion, the incidence of AF was equal in both on-pump and off-pump CABG groups. AF patients stayed longer in the hospital stay and ICU by 1-2 days than did patients who remained in sinus rhythm. Also, in the hands of an

experienced and well- trained surgeon, there was no difference in completeness of revascularization between the off-pump and the on-pump CABG techniques.. We recommend the use of both techniques to manage patients with coronary artery disease. We also recommend the use of the Holter method for recording the ECG in these patients because it is easier and more accurate.

List of Abbreviations

AF	Atrial Fibrillation
CABG	Coronary Artery Bypass Grafting
CPB	Cardiopulmonary Bypass Machine
COPD	Chronic Obstructive Pulmonary Disease
LAD	Left Anterior Descending Artery
OM	Obtuse Marginal Branch
PDA	Posterior Descending Artery
LCX	Left Circumflex Branch
RCA	Right Coronary Artery

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