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Original Article

Right coronary artery severe stenosis as a predictor of new onset atrial fibrillation after coronary artery bypass surgery

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Abstract

Background: post-operative Atrial fibrillation (POAF) commonly occurs in patients undergoing cardiac surgeries including Coronary artery bypass grafting (CABG). Role of right coronary artery (RCA) stenosis in developing POAF after CABG is not settled yet. This retrospective study aimed to assess severe RCA stenotic lesion (70% or more narrowing) as a predisposing factor for POAF, in patients undergoing on-pump CABG, whether the RCA was grafted or not.

Methods: A total of 100 patients who underwent on-pump CABG in Kasr Al-Ainy and Fayoum University Hospitals between January 2022 and June 2022 were divided into two groups: Group (A) had severe right coronary artery disease, and Group (B) did not have severe right coronary artery disease. Following the operation, all patients were examined daily for electrocardiogram (ECG) alterations until they were discharged.

Results: The mean age of the included patients was 52.6 (± 3), and 55 % of them were females. The mean Left ventricular ejection fraction was 56 (± 5). Incidence of atrial fibrillation was significantly higher in patients with severe RCA stenosis compared to those without severe RCA stenosis; p= 0.001 (68% vs 34%) denoting positive correlation between significant RCA stenosis and POAF; r=0.340, p=0.001.

Conclusion: Severe RCA stenosis is one of the predictors of developing AF after CABG.

KEYWORDS

Post-operative; On-pump; Coronary artery bypass graft; Right coronary artery; Atrial fibrillation

Article History

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Introduction

Post-operative atrial fibrillation (POAF) occurs in up to 40% of coronary artery bypass grafting (CABG) patients [1,2] with subsequent higher post-operative morbidity and mortality [3,4]. Thus, full awareness regarding risk factors for such serious complication is crucial before initiating CABG operations.

Many Peri-operative risk factors including old age, poor left ventricular function, inadequate myocardial protection, hypoxia, incomplete myocardial revascularization and post-operative prolonged mechanical ventilation, hypovolemia and anemia have been implicated in developing POAF following CABG operations [5-7].

Hypothetically, right coronary artery (RCA) stenosis, by altering atrial perfusion and ante-grade cardioplegic solution from reaching post-stenotic areas, has also been accused of

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developing POAF. However, its role remains debatable [8].

This retrospective study aimed to evaluate the role of severe right coronary artery disease as a predictor of POAF in patients undergoing on-pump coronary artery bypass graft (CABG) surgery whether the RCA was grafted or not.

Patients and Methods

50 of the 100 included patients had significant RCA proximal lesion as evident by preoperative coronary angiography imaging. All patients were closely observed for POAF till discharge.

Inclusion criteria: Patients with ischemic heart disease and preoperative sinus rhythm undergoing isolated CABG operation.

Exclusion criteria: Patients with a previous history of atrial fibrillation (AF) and patients demanding any cardiac procedure rather than CABG.

Definitions:

Severe right coronary artery disease was defined as narrowing of 70% or more of the proximal lumen diameter [9,10]. According to the 2020 ESC guidelines, clinical AF was defined as Symptomatic or asymptomatic AF that is documented by surface ECG. The minimum duration of an ECG tracing of AF required to establish the diagnosis of clinical AF is at least 30 seconds or entire 12-lead ECG. Preoperative, operative, and postoperative data were collected and compared in both groups, including preoperative demographic data, comorbidities, Echocardiography, coronary angiography and ECG, intraoperative and postoperative rate and rhythm, ICU (Intensive Care Unit) stay and hospital stay.

Ethical approval:

The ethical committee of Kasr Al-Ainy University hospitals approved the study protocol. Ethical Approval Number: ms-378-2021. Every patient signed an informed written consent for acceptance of the operation. This work has been carried out in accordance with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies involving humans [11].

Surgical technique:

Anesthesia and Cardiopulmonary bypass (CPB):

Under general anesthesia, in a supine position, a conventional sternotomy incision was used to approach the heart and the internal mammary artery, and then aorto-atrial cannulation was used to settle CPB with full heparinization. Cardiac arrest was achieved using an antegrade warm cardioplegic solution after the start of CPB and clamping of the ascending aorta.

CABG Technique:

Distal anastomoses were done using continuous polyproline 7/0 or 8/0 suture and after declamping of the aorta, aortic side-occluder is used at the proximal anastomosis site (if needed) and anastomosis was done with a continuous 6/0 polypropylene suture. All patients with significant right coronary artery disease underwent bypass. No patient underwent endarterectomy of the proximal right coronary artery.

At the end of the operation, protamine sulfate is used to reverse the process of heparinization, chest drains were inserted avoiding retrocardiac position not to irritate the heart, pericardium is left open and sternotomy incision is closed in layers.

Post-operative care and monitoring:

All patients were transferred to the ICU on mechanical ventilation. Daily monitoring of ECG until discharge for all patients was done, in addition to continuous blood pressure monitoring through an arterial line. A 12-lead ECG was used to validate any atrial fibrillation detected by the monitor. The arrhythmia's onset and use of beta-blockers' treatment before that day were documented.

After weaning of ventilator, any inotropic support and proper rate and rhythm control, patient is transferred to the ward to complete the process of wound care and medication adjustment.

Patients were discharged when meeting the following criteria: hemodynamic stability, free septic profile, stable sternum, clean wounds, free

chest, cardiovascular, and neurological examinations.

Management of AF:

We managed POAF according to the 2020 European Society of Cardiology (ESC) and the European Association for Cardio-Thoracic Surgery (EACTS) guidelines which discussed the ABC approach for managing AF including POAF [12]. It comprises "A" for anticoagulation avoiding stroke, "B" for better symptom control, and "C" for cardiovascular risk factors and concomitant disease detection and management. This approach was associated with better outcomes and lower mortality incidence, hospitalization period and costs.

Statistical analysis:

Sampling Method:

A convenient sample was used. The sample size detected was 100 patients. This number of cases was adopted using the Medcalc 19 program by setting an alpha error of 5%, 95% confidence level, and 80% power sample. The sample size for this study was calculated from the prevalence of atrial fibrillation postoperatively in cases with proximal or mid-right coronary artery stenosis (43%), according to a previous study by Lisa Mendes et al. (1995) [13]. Equations are described by Machin D et al. (2009) [14].

Data Analysis:

Data from the included patients were collected and processed using SPSS for Windows (version 23). Patients were grouped according to the presence or absence of right coronary artery stenosis and the development of postoperative atrial fibrillation.

Results were expressed as mean ± standard deviation or number (%). Comparison between categorical data [number (%)] was performed using the Chi-square test or Fisher exact test if the cell count is less than 5. The test of normality, the Kolmogorov-Smirnov test, was used to measure the distribution of data. Accordingly, a comparison between variables in the two groups was performed using the unpaired t-test or the Mann-Whitney test whenever appropriate. P value ≤ 0.05 was considered significant.

Results

A total of 100 (55 female) patients were included in two groups; 50 patients with RCA stenosis and 50 patients without RCA stenosis. The mean age of our sample was 52.6 (± 3) years old. There was no significant difference between both groups regarding all demographic and clinical baseline characteristics; p>0.05 (Table 1).

As shown in Table 2, there was no significant difference between both groups regarding intraoperative characteristics (p>0.05). All patients with significant right coronary artery disease underwent bypass.

As shown in Table 3, AF occurred in 51 (51%) patients of our study population. The incidence of atrial fibrillation was significantly higher in patients with RCA stenosis compared to those without RCA stenosis; p= 0.001. Atrial fibrillation occurred in 34 (68%) patients with RCA stenosis. On the other hand, it occurred only in 17 patients (34%) without RCA stenosis.

Table 1: Preoperative demographic and clinical characteristics of patients

Parameter		Total (n=100)	Group A (n=50)	Group B (n=50)	*p*-value
Age		52.6 (± 3)	55.3 (± 7.3)	54.4 (± 7.9)	0.3
Sex	**Males**	45 (45%)	25 (50%)	20 (40%)	0.3
	Females	55 (55%)	25 (50%)	30 (60%)	
Smokers		54 (54%)	23 (46%)	31 (62%)	0.1
DM		47 (47%)	23 (46%)	24 (48%)	0.8
HTN		49 (49%)	21 (42%)	28 (56%)	0.2
LVEF		56 (±5)	56.4973 (± 5)	55.3850 (± 5.04)	0.3

RCA= Right coronary artery, DM= Diabetes mellitus. HTN= Hypertension, LVEF = Left ventricular ejection fraction

Table 2: Intraoperative variables

Parameter		Total	Group A (n=50)	Group B (n=50)	*p*-value
Graft count	2	36 (36%)	21 (42%)	15 (30%)	0.3
	3	27 (27%)	14 (28%)	13 (26%)	
	4	37 (37%)	15 (30%)	22 (44%)	
CPB time		77 (± 13)	76 (± 13.3)	78 (± 12.2)	0.4
ACC time		39.4 (± 8.7)	40.4 (± 9.3)	38.4 (± 8)	0.3

RCA= Right coronary artery. CPB= Cardiopulmonary bypass; ACC= Aortic cross-clamping

Electrolyte disturbances occurred in 49 (49%) patients with no significant difference between patients with RCA stenosis and those without RCA stenosis; p= 0.5. Post operative bleeding and wound infection occurred in 3 patients each, with no significant difference between patients with RCA stenosis and those without it; p=0.6. There was no significant difference between patients with RCA stenosis and those without RCA stenosis regarding postoperative use of inotropes and beta-blockers; p= 0.7 and 0.1 respectively. Similarly, there was no significant difference between both groups regarding the duration of hospital and ICU stay; p= 0.3 and 0.08 respectively.

Post-operative follow-up:

The mean postoperative follow up duration was 1.15+0.58 years for all patients. At every out-patient visit, patients were examined regarding heart rate and rhythm both clinically and using ECG and the rate-control medications are modified accordingly as prescribed by a specialized cardiologist.

Discussion

POAF is a hazardous complication that commonly follows cardiac surgery including CABG. Understanding of the underlying mechanism and the precipitating factors of this problem allows the managing team to lower its incidence and hazards.

A total of 100 matched patients were included (half of them were diagnosed with RCA stenosis) in this study aiming mainly to correlate between the degree of RCA stenosis and POAF in candidates of on-pump CABG. Regarding the preoperative risk factors, RCA Occlusion, Regarding our results, 51 patients developed POAF. It developed in 34 patients (68%) with RCA stenosis and 17 (34%) patients without RCA stenosis. This incidence was significantly higher in the RCA stenosis group; p= 0.001. With another statistical evidence, we found a positive correlation between them; p =0.001.

Our incidence, however, was higher than that previously reported by Ismail et al. [15], Banach et al. [16] and several other investigations, which varied from 17 to 33% [17-20]. This might be explained by the smaller sample size in our study and dependence on oscilloscopic monitors in the other publications which leads to the missing of shorter episodes of AF. Furthermore, AF episodes may be missed due to the administration of postoperative beta blockers [13,21].

Table 3: Post-operative variables

Parameter	Total	Group A (n=50)	Group B (n=50)	*p*-value
Postoperative Atrial Fibrillation	51 (51%)	34 (68%)	17 (34%)	0.001
Post-operative bleeding	3 (3%)	1 (2%)	2 (4%)	0.6
Post operative Electrolyte imbalance	49 (49%)	23 (46%)	26 (52%)	0.5
Post-operative Use of inotropes	48 (48%)	23 (46%)	25 (50%)	0.7
Post operative Use of beta blockers	87 (87%)	46 (92%)	41 (82%)	0.1
MV	4.4 (± 2.04)	4.6 (± 2.2)	4.2 (± 1.8)	0.3
Duration of ICU Stay	3.4 (± 1.13)	3.3 (± 1.1)	3.5 (± 1.2)	0.3
Duration of hospital stay	6 (± 3.8)	6.3 (± 4)	5.8 (± 3.2)	0.08

MV= Mechanical Ventilation

In 1995, Mendes et al. were the first to implicate RCA stenosis in developing POAF by studying 170 patients, of whom 104 suffered significant preoperative RCA stenosis. They reported a 2.4-fold increase in POAF in patients with significant RCA stenosis [13]. Similarly, Pehkonen et al. [21] disclosed higher incidences of POAF in presence of high-grade RCA lesions and 34 (odds ratio (OR)= 3.75 (95% CI =1.22 -11.5).

Old Age is associated with degenerative changes such as fibrosis and senile amyloidosis in the atrial chambers leading to atrophy of cardiac muscle, atrial dilatation, and subsequent impaired conduction of the cardiac cells [22,23]. Lee and Jang [17] found that, patients who developed POAF were significantly older than those who did not develop AF; with a mean age of 68.5 ± 7.6 and 62.7 ± 9.7 years old respectively; p=0.001. Similar results reported by Filardo et al [20] and by Banach et al, [16]. In contrary, we found no significant correlation between the age of participants and the development of AF, this may be explained by insignificant difference in mean age of both groups in our study (55.3 (± 7.3) and 54.4 (± 8)).

Regarding the intra and post-operative findings, it has been reported that the longer the duration of ICU stay the higher the incidence of POAF [21]. We found a prolonged ICU stay in patients with POAF compared to those without POAF; 3.5 vs 3.3 days respectively; p= 0.01.

Similarly, the duration of hospitalization was longer in the positive POAF group compared to the other group; 6.3 vs 5.5 days respectively. However, this difference was statistically insignificant; p= 1. Also, we could not establish a relationship between the hospital or ICU stay duration and the probability of developing POAF. These findings point to the sequelae of longer hospitalization period and ICU stay duration in POAF patients which lead to increased cost burden and susceptibility to develop hospital-acquired infections with the probability of worsening the condition.

Conclusion

Our findings support the importance of significant RCA stenosis in patients undergoing on-pump CABG. However, to acquire more solid results, we advocate undertaking a larger multi-center trial on patients receiving various types of cardiac operations. Aggressive postoperative management protocol for new onset AF should be used.

Conflict of interest: Authors declare no conflict of interest.

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