

Association Between Echocardiographic Indices and Post Coronary Artery Bypass Graft Surgery Atrial Fibrillation

Mehrnoush Toufan, MD^{1,*}; Fariborz Akbarzadeh, MD¹; Mehdi Arabmaleki, MD¹

¹Cardiovascular Research Center, Shahid Madani Heart Center, Tabriz University of Medical Science, Tabriz, IR Iran

*Corresponding author: Mehrnoush Toufan, Cardiovascular Research Center, Shahid Madani Heart Center, Tabriz University of Medical sciences, Tabriz, IR Iran. Tel: +98-411335771, Fax: +98-4113374324, E-mail: mtoufan@gmail.com.

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Background: Atrial fibrillation (AF) was recognized as a major cause of morbidity and mortality after coronary artery bypass graft surgery (CABGS). Finding an accurate method to identify patients with increased risk may prevent or lower the occurrence of the related complications.

Objectives: This study aimed to evaluate the association between interval of P-wave initiation in surface electrocardiogram, a-wave initiation in doppler study of mitral valve, MV annular velocity by TDI and compare them with conventional echocardiographic findings to investigate the associated factors related to the occurrence of AF in the first 72 hours after the CABGS.

Patients and Methods: Four hundred and four patients with sinus rhythm, who were candidate for CABGS between June 2010 and July 2012 were examined before the surgery by conventional echocardiography and Tissue Velocity Imaging Methods and were monitored for 72 hours after surgery. Data collection and analysis were done by SPSS statistical software.

Results: The mean age of patients was 60 ± 9.9 years. Statistically significant relationship between the occurrence of AF with Mitral valve annulus, LA Volume Index (LAVI), Right ventricle function, and type of surgery (off pump or on pump) were detected in our study ($P < 0.05$). There was no statistically significant relationship between the occurrence of AF and time interval of P wave to A wave onset in conventional Doppler echocardiographic study (P-A), P-A' onset and P-A' peak in TDI examination ($P > 0.05$).

Conclusions: Based on our findings, MV annulus, LAVI, RV function and on pump CABGS were independent factors related to the occurrence of AF post CABGS. Echocardiographic study associated with clinical data could be helpful for risk stratification of occurrence of post-operative AF.

Keywords: CABGS; AF rhythm; Tissue Doppler study

1. Background

Atrial fibrillation was recognized as a major cause of morbidity and mortality after CABGS (1-3). The incidence of AF depends on several factors like clinical factors (duration of arrhythmia and co morbid diseases), type of postoperative monitoring (intermittent or continuous) and changing profile of patients undergoing CABGS (4-6). The post-operation AF will increase the incidence of Cerebrovascular accidents (CVA), patients' disability, hospital stay, drug consumption, and treatment expenditure. Also post-operative AF increases patients' mortality up to 29% (7, 8). Maintenance of sinus rhythm could be effective in improving the quality of life and heart performance in patients with congestive heart failure (CHF), and also, could decrease the risk of thromboembolism and the side effects of long term anti coagulation therapy (9, 10). By continuous electrocardiographic monitoring, the incidence of postoperative AF was 25%-40% after CABGS and 62% in combined surgeries of CABGS and valvular proce-

dures. Therefore, more attention has been focused to define the predictors of post-operative AF and find high risk patients. Procedures like electrophysiological study (EPS) (11, 12) and Signal Average study of P waves (13, 14) were used to predict the incidence of post-operative AF, but their use were limited because of their invasiveness and cost. Patients with post-operative AF usually are older, have larger LA dimension, and electromechanical delay in atria. Also they have lower LV ejection fraction (LVEF) and longer P-wave duration. They have smaller A-wave in Doppler Echocardiography. It has been shown that the atrial electromechanical delay is the best independent factor for predicting the incidence of post-operative AF (15).

2. Objectives

This study aimed to evaluate the association between the Time Interval of P-Wave initiation in the surface electrocardiogram and A-Wave Initiation in Doppler Study

Implication for health policy/practice/research/medical education:

The findings of present study demonstrated that advanced age, LAVI, MV annulus, RV systolic function, type of surgery (On Pump), History of HTN, and urgent surgery were the independent predictors of AF after CABGS. These findings could apparently detect high risk patients before the operation and be an important step to cut in costs, shorten hospital stay, and improve their outcomes.

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of mitral valve flow and MV annular velocity by TDI and compare those findings with conventional echocardiographic findings to predict the incidence of atrial fibrillation during 72 hours after the CABG surgery.

3. Patients and Methods

Between August 2010 and August 2012, a prospective observational study was done to find the new predictors of AF after CABGS, 404 patients who underwent CABGS included in the study in Madani heart center of Tabriz. Study was approved by ethical committee of Tabriz University of medical sciences. Data were collected from hospital records and patient information remained confidential. Echocardiographic study before surgery and control of rhythm after surgery were included in the usual care of patients who were candidate for surgery so there were no additional cost for all patients. All patients who were candidate for doing CABGS and had sinus rhythm were examined before surgery with echocardiography by conventional and tissue Doppler methods and they were monitored for 72 hours after the surgery for incidence of AF rhythm. Patients with previous history of AF, use of antiarrhythmic drugs except for B-Blocker, presence of PPM and associated significant valvular problems tended to mix operation were excluded. Patients who died during or within 72 hours after the surgery were excluded from this study (with or without occurring AF). Study variables were: Rhythm of AF, P-wave duration, interval between onset of P-wave in surface ECG and A-wave onset in Doppler profile of MV flow (P-A onset) has been shown in Figure 1. Interval between P-wave onset in surface ECG and septal corner of MV A' onset in TVI (P-A' Onset) has been shown in Figure 2. Interval between P-wave initiation in surface ECG and septal corner A' peak (P-A' Peak), left atrial volume index (LA volume/BSA, based on prolate formula $(A^1_x A^2_x 0.85 / L / BSA .A^1 = \text{Max. planimetered LA area in A4C view, } A^2 = \text{Max. Planimeterd LA area in A2C view, } L = \text{Length measured from back wall of LA to line across mitral valve hinge point})$, right atrial area, right ventricular function (based on Tricuspid annular plane systolic excursion, TAPSE), Mitral annulus measured in parasternal long axis and apical four-chamber view at zoom mode, and type of surgery (on or off-pump). Measurements are expressed as mean (SD), frequency (percentage). T-test, Fisher's Exact Test, Pearson Chi-Square were used in order to compare study data. The obtained data were analyzed using SPSS 16 for Windows (SPSS Inc., Chicago, Illinois). Mean (SD) of continuous variables and frequency of qualitative variables were reported. Student T-test was used for comparing continuous variables. The P value less than or equal to 0.05 was reported as significant difference.

4. Results

A total of 404 patients enrolled. Included patients were 228 male (56.4%) and 176 female (43.6%). The overall incidence of AF occurred in 16.1% of patients, post-operatively. The basic data relating to characteristics are summarized in Table 1, Mean age of patients was 60.8 ± 9.9 (35-80 years) years, and 51.3% of patients were hypertensive (AF developed in 39 patients with history of hypertension). The surgery was emergent in 22.8% of patients. In 74.5% of patients, the surgery was done with On-pump method. The frequency of patients with three, two and one vessel involvement was 61.6%, 26.7% and 6.9%, respectively. Moreover, the Left main involvement was found in 16.1% of patients (obstruction more than 50%). Based on pre-operative echocardiographic study, the mean EF was 48.6% (10% to 65%, Table 1). Significant relationship was detected between Mitral annulus, LAVI, Right ventricle function, urgency and type of surgery (off or on pump) with occurrence of AF after surgery ($P < 0.05$, Table 2). There were no statistically significant relationship between occurring of AF and P-A onset in conventional Doppler study, P-A' onset in TDI examination, P- A' peak in TDI , P-wave duration in surface ECG, and Right atrial area in echocardiographic examination ($P < 0.05$, Table 2).

Table 1. The Information About Cardiac Status

	No.	mean (SD)	Max - Min
Age, y		60 (9.9)	80-35
EF ^a	399	48 (8.4)	65-10
P-A Onset duration, ms	402	73 (14.5)	134-27
P-A' Onset, ms	404	132 (23)	216-11
P-A' Peak, ms	404	79 (20)	140-20
La volume index, cc/m ²	404	26 (7.4)	74-11
Mitral valve ring, mm	296	29 (4.2)	40-19
RA area, cm ²	296	13 (2.2)	19-5.8
P wave duration	370	0.07 (0.02)	0.12-0.04

^a Abbreviations: EF, Ejection Fraction; RA, Right Atrium

5. Discussion

Our study examined the prognostic impact of several clinical, Echocardiographic, and Electromechanical variables for occurrence of post-operative AF after CABG surgery. Advanced age was strongly associated with post op AF, Mean age was 72 and 49 years in patients with and without AF after surgery, respectively. In this study, there was significant association between Mitral annulus, LAVI, Right ventricle function, urgency and type of surgery (off pump or on pump) and occurrence of AF after CABGS. There was no significant association between time inter-

val of P-A onset in conventional Doppler, P-A' onset in TDI examination, P-A' peak in TDI, P-wave duration in surface ECG", and right atrial area in echocardiography examination and occurrence of AF after CABGS. The value of LV

electromechanical delay in patients with postoperative AF was examined in one study (16), it was concluded that Left-ventricular electromechanical delay is prolonged in patients with postoperative AF.

Table 2. Association Between Different Factors in Two Groups With and Without AF

	With AF ^a (n=65)	Without AF (n=339)	P value
P-A Onset, m/sec (conventional Doppler)			0.63
mean (SD)	73.97 (12.85)	73.01 (14.90)	
P-A' Onset, m/sec (TDI time interval)			0.223
mean (SD)	82.42 (17.85)	79.02 (20.99)	
P-A Peak, m/se (TDI time interval)			0.37
mean (SD)	134.49 (24.8)	131.62 (23.4)	
Mitral annulus, ml			< 0.001
mean (SD)	32 (3.6)	28.52 (4.1)	
Relation of P-wave duration in surface ECG second			0.47
mean (SD)	0.072 (0.022)	0.074 (0.019)	
LAVI			< 0.001
mean (SD)	32.09 (7.98)	24.99 (6.71)	
Right atrial surface area (RAA, cm²)			0.29
mean (SD)	13.4 (2.54)	12.9 (3.08)	
Right ventricle systolic function (TAPSE < 17 mm), No. (%)			0.017
Normal	45 (11)	236 (58)	
Reduced	6 (1.4)	9 (2.2)	
Urgency of surgery, No. (%)			0.002
Elective	38 (9)	262 (64)	
Emergent	24 (5)	68 (16)	
Type of surgery, No. (%)			0.04
on pump	55	246	
off pump	10	93	

^a Abbreviations: AF, atrial fibrillation; ECG, electrocardiogram; LAVI, left atrial volume index; RAA, right atrial area; TAPSE, tricuspid annular plane systolic excursion; TDI, tissue doppler imaging

In the study of Predictors of recurrence of AF after AF-ablation with cryoballoon, it was concluded that the incidence of AF increased by intra-left atrial electromechanical delay, PA-lateral, and higher age which confirmed the importance of substrate material in the mechanism of developing AF. Early recurrence was the strongest predictor of late recurrence of AF (17); such findings did not meet in our study by time interval. Chao T-F et al. in their study about the relationships between the atrial electromechanical interval, atrial remodeling, and outcome of catheter ablation in paroxysmal AF, concluded that the atrial electromechanical interval can reflect the process of left atrial remodeling, such as a left atrial enlargement, prolonged activation time and decreased voltage of P-wave. It was a convenient parameter for predicting the recurrence after catheter ablation of paroxysmal AF (18); although, our findings were similar in aspect of LAVI, they did not find such an association between electromechanical

aspects. Cui QQ concluded that the atrial electromechanical coupling was significantly longer and the dispersion of P-A at left lateral mitral annulus was greater in PAF patients (19); also, this is different from the results of our study, though it is similar in the aspect of LAVI. Additionally in another investigation by Park S-M, it was concluded that LA electromechanical conduction time (EMT) was significantly prolonged in patients with recurring AF, indicating significantly depressed atrial conduction in enlarged LA. In a study by Efremidis M and colleagues, it was found that the LA diameter and A-wave velocity were independent predictors of AF recurrence (15, 20); in this regard, our findings were in conformity with their results. Moreover, in conformity with our study, Beaulieu Y et al. reported that in patients undergoing cardiac valvular surgery, a method of using intravenous amiodarone for 48 hours was not efficacious in reducing the risk of AF during cardiac valvular surgery (21). The high sample

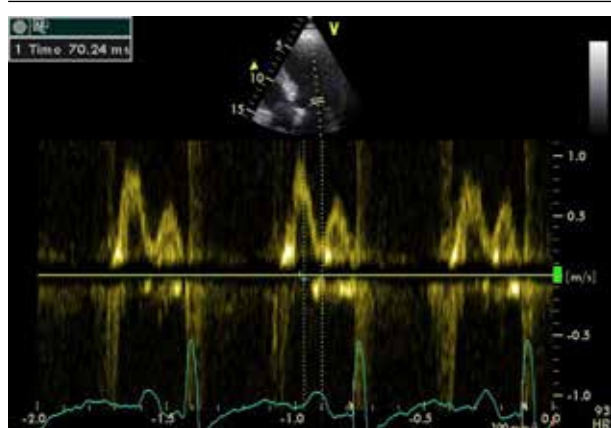


Figure 1. Interval Between Onset of P-Wave in Surface ECG and A-Wave Onset in Doppler Profile of MV Flow (P-A' Onset)

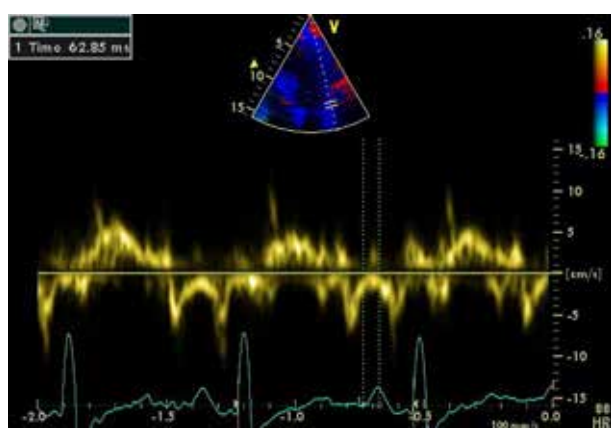


Figure 2. Interval Between P-Wave Onset in Surface ECG and Septal Corner of MV A' Onset in TVI (P-A' Onset)

volume of patients in our study is a robust point for our results. Also in this study, the relationship between new variables such as RV function, mitral annulus, LAVI with occurrence of AF rhythm has been clarified. The main limitation of our study was the method used to record arrhythmia, rhythm monitored continuously by nurses and using the history of bed side monitoring system, and some episodes of AF could be overlooked. The findings of present study demonstrated that higher age, LAVI, MV annulus, RV systolic function, type of surgery (On Pump), History of HTN, and urgent surgery were the predictors of occurrence of AF after CABGS. These findings could be used apparently to detect high risk patients before the operation and could be an important step to cut in costs, shorten hospital stay, and improve their outcomes.

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Authors' Contributions

Contribution was in order of their name presented in the authors' list.

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