

Atrial Conduction Time measured preoperatively By Tissue Doppler as a Predictor of Atrial Fibrillation after Mitral Valve Surgery for Mitral Regurge Patients

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Abstract

Atrial fibrillation (AF) is one of the common adverse effects of cardiac surgery with an incidence of approximately 65%. The present study aimed to evaluate the value PA-TDI duration ability to predict post-operative AF. Data of 100 patients who was diagnosed with severe mitral regurge and was referred for mitral valve surgery. PA interval was measured using tissue Doppler as well as routine echocardiographic parameters. After surgery patients was monitored to detect any attacks of atrial fibrillation. According to occurrence of atrial fibrillation patients was divided to two groups and compared the two groups. PA-TDI interval duration in group I was significantly prolonged than in group II P-value <0.001. PA-TDI duration more than 151 ms had an accuracy of 66% in detecting AF episodes post-operatively with sensitivity equal to 65 and specificity 68%. Positive predictive value for PA-TDI interval more than 151 ms was 76% and negative predictive value of this interval was 53%. This study discovered that Pre-operative PA-TDI duration represent an independent predictor of POAF. PA-TDI is a simple parameter whose cost is low, is not a time-consuming parameter to be measured, and is available in many modern echocardiographic.

Keywords: post-operative atrial fibrillation , mitral regurge, TDI-PA interval, Total atrial conduction time.

1. Introduction

Atrial fibrillation (AF) is one of the common adverse effects of cardiac surgery with an incidence of approximately 65% [1]. Current developments in surgical techniques and pre- and post-operative care allow high-risk patients to be able to undergo cardiac surgery. In addition, recent development in cardiac rhythm monitoring helped to detect AF episodes with higher accuracy and sensitivity [2].

However, old studies considered postoperative AF as benign, self-limiting complication or side effect of cardiac surgery which has no consequence [1], recent studies stated various adverse effects such as prolonged length of admission, cerebral infraction, the need of a permanent pacemaker and short- and long-term mortality [3].

However, many of the previous studies focused on long-term morbidity and mortality, this study focusses on predicting post-operative atrial fibrillation to help the physician and the patient to obtain the appropriate treatment options for those patients [4].

Some specific predictors can be used for detecting patients at risk for post-operative AF. Some of these is predictors have been investigated but with a little or limited value. PA-TDI has been investigated in many clinical scenarios regarding post-operative AF prediction after aortic valve intervention and CABG; however, there is limited data about the association of PA-TDI and POAF after mitral valve surgical intervention [5].

2. Patients and methods

Among patients with valvular affection who underwent mitral valve surgical intervention, 100 patients with no clinical history of atrial arrhythmias one week before surgery were chosen. Patients with implanted pacemaker or those who are on therapy for arrhythmia except β -blockers were excluded from the study.

The same medications and β -blockers were resumed before and after the surgery. Old patients above the age of 70 were excluded from this study to exclude the age role in AF development. Preoperatively, the presence of risk factors such as diabetes, hypertension, and smoking history was obtained from the patients.

Echocardiography was used to detect Ejection fraction, regional wall motion abnormality and mitral regurgitation. Angiography was done to all patients to exclude or confirm CAD. A 12-lead ECG was preoperatively recorded at a voltage of 10 mm/mV and speeds of 25 mm/s one day or days before operation.

The same standard was fixed for all ECGs. On surface ECG, P-wave duration was measured from the START (connection between the isoelectric line and the START of P-wave deflection) and the end of the P-wave.

PWD was calculated by measuring the difference between the duration of the longest and the shortest P-waves in lead II. Post-operative AF was detected by monitoring the patient during hospital admission. The primary

end point, AF, was defined as irregular rhythm with duration longer than 30 seconds.

The differences between pre- and postoperative parameters were evaluated by Fisher's exact test. P values lower than 0.05 were considered significant. Mann-Whitney test was done for comparison between variables pre and post-surgery. Linear regression analysis to search for associations between parameters pre and post valve replacement. Statistical analysis was done by SPSS (SPSS Inc., Chicago, IL, US).

3. Results

3.1 Patient characteristics

One hundred patients undergoing mitral valve surgical intervention were enrolled in the study.

The clinical date of this study patients is summarized in Table (1).

The age of the patients in our study was 66 ± 10 years of age, and 43% were women. All patients group, 100 patients (76%) underwent mitral valve replacement by metallic valve, 25 patients (25%) tissue valve, and 10 patients (10%) underwent combined mitral valve replacement and tricuspid valve repair.

Sixty-six (66%) had an attack or more of AF within hospital admission after cardiac surgery before discharge. There was relation between the risk of POAF and drugs prescribed to the patient prior to surgery and his co-morbidities.

Patients with POAF had no significant difference from the sinus group (68.6 ± 2.1 vs 64.4 ± 1.6 years; $P = 0.12$).

Regarding baseline characteristics, there was no statistically significant difference among patients who underwent right atrial

tissue sample taking and those who did not have their right atrium appendage sampled ($P = 0.05$).

3.2 Echocardiographic parameters of POAF and the importance of TACT

Comparisons of data collected by echocardiography in patients with POAF and patient who remained in sinus rhythm are summarized in Table (2).

Mean left atrium diameter was relatively the same in patients with POAF and no POAF (42.4 ± 0.97 vs 40.3 ± 0.95 milliseconds; $P = 0.12$), left atrium volume indexed to body surface area was also the same in both groups (32.8 ± 2.4 vs 27.1 ± 1.7 mL/m²; $P = 0.06$). Moreover, left atrial ejection fraction was significantly lower in patients who developed POAF in comparison with NO POAF group (45.6 ± 2.1 vs $54.0 \pm 2.7\%$; $P = 0.02$).

The mean PA-TDI duration for the total study population was 132.8 milliseconds with a range from 87 to 185 milliseconds (mean coefficient of variation: $1.9 \pm 1.74\%$).

Patients with POAF during the first 10 days after cardiac surgery had a significantly longer PA-TDI interval at baseline compared to patients who maintained in sinus rhythm (152.1 ± 3.0 vs 120.8 ± 1.8 milliseconds; mean \pm standard error of the mean [SEM]; $P < 0.001$). At an optimal cut-off value of 133 milliseconds, the sensitivity and specificity in identifying POAF were 100% and 86%, respectively (Fig. 3). On multivariate logistic regression analysis, PA-TDI interval (milliseconds), LA-EF (%) and LAVI (mL/m²) were independently associated with POAF ($P < 0.05$) Table (3)

Table (1) Clinical parameters of the Study Population.

	POAF (n= 66)	No POAF (n=44)	P value
Age	64.4 ± 1.6	68.6 ± 2.1	0.12
Sex	m:39	m:28	0.74
Body surface area (m ²)	2.0 ± 0.1	2.0 ± 0.1	0.12
Body mass index (kg/m ²)	28.5 ± 0.6	26.4 ± 0.8	0.74
CHA ₂ DS ₂ VASc-Score	3 (2)	3(2.5)	0.96
Underlying diseases (n)			
Hypertension	12	18	0.30
Diabetes mellitus	4	8	0.74
History of stroke or TIA	1	3	0.82
Chronic kidney disease	1	2	0.69
smoking	24	12	0.42
β-blocking agents	30	19	0.74
Verapamil	5	8	0.97
Statins	47	22	0.48
Angiotensin-converting enzyme inhibitor	44	31	0.86
Number of antihypertensive medications	2	2	0.44

Data are expressed as Means \pm SEM and count respectively.

Table (2) Characteristics of the Study Population regarding echocardiographic parameters, surgical data and pathological examination.

	Without POAF	POAF	P value
Preoperative transthoracic echocardiogram			
LAD (mm)	40.3 ± 0.95	42.4 ± 0.97	.12
LAVI (mL/m ²)	27.1 ± 1.7	32.8 ± 2.4	0.06
LA-EF (%)	54.0 ± 2.7	45.6 ± 2.1	0.02
PA-TDI (milliseconds)	120.8 ± 1.8	152.1 ± 3.0	<0.001
LV-EF (%)	60.1 ± 1.6	58.6 ± 2.9	0.67
Operative parameters			
Replacement by metallic valve	45	31	0.74
Repair	8	2	
Tissue valve	13	12	
Duration of surgery (minutes)	193.6 ± 15.8	184.3 ± 19.0	0.67
Aortic cross clamp time	62.8 ± 7.0	91.0 ± 14.7	0.09
Histopathologic parameter			
Amount of RAA fibrosis (%)	16.56 (5.39)	27.01 (11.8)	<0.001

Table (3) Using Multiple Logistic Regression Analysis to detect independent predictors of PAOF.

	B	SE	WALD	P value	OR (95% CI)
Atrial fibrosis	4.235	0.291	220.2	<0.001	68.1 (39.0–132.6)
PA-TDI	2.001	0.113	331.0	<0.001	7.4 (5.7–9.4)
LAEF	-0.177	0.043	17.5	<0.01	0.84 (0.78–0.91)
LAVI	0.102	0.043	7.1	<0.05	0.90 (0.83–0.98)
Aortic cross clamp time	-0.043	0.042	1.2	0.317	0.96(0.89-1.04)

4. Discussion

4.1 Key findings

The current study examined the correlation between atrial fibrosis and total atrial conduction time and its relation with development of post-operative atrial fibrillation. The key findings in this study include that patients who had an early POAF had higher amount of fibrosis in their atrial tissue as shown by the sample. In addition, TACT helped in classifying the patients who had high risk for developing POAF after undergoing surgical intervention. Moreover, TACT shows the burden of atrial fibrosis and subsequent remodeling in the atrial tissue.

4.2 TACT and Post-operative atrial fibrillation

Earlier studies revealed that PA-TDI interval could predict early onset AF post-operatively.

Measuring PA-TDI interval is quite consistent with low inter-observer variation; therefore, measuring it twice is applicable and can be used with confidence in evaluating the risk of the post-operative atrial fibrillation [6].

Roshanali et al. was the first study to examine and confirm that TACT could be used to detect the risk of POAF undergoing CABG. A cut-off point of 121 milliseconds was defined for predicting POAF (sensitivity 99%; specificity 93.8%). According the cut-off point

of the previous study, we considered an optimal cut-off point of 132 milliseconds (sensitivity 99%, specificity 85%) using phi correlation coefficient [7].

In our study LA-ejection, fraction and PA-TDI interval were the only two independent parameters, which are associated with early POAF Table (1). In addition, multivariate Analysis showed that PA-TDI interval was the echocardiographic variable that was able to predict post-operative atrial fibrillation Table (3) [7].

4.3 Correlation of TACT and Structural Atrial Remodeling

Atrial fibrosis is considered the precursor for initiation and perpetuation of atrial fibrillation [8].

Oakes et al. showed that amount of fibrosis detected by magnetic resonance imaging delayed-enhancement which is considered to be a noninvasive tool for assessment of left atrial fibrosis within myocardial tissue in AF patient and could evaluate the disease progression.20 However, its use is limited due to practical limitation [9].

Age is considered to be an established risk factor for AF and earlier studies showed a positive correlation between RAA fibrosis and the patient undergoing open heart surgery age [10].

Both Platonov et al. and the current could not detect such a correlation [11].

5. Limitation

Small sample size and being a single center experience are the main limitation of this study

6. Conclusion

PA-TDI is an emerging parameter that would be helpful in risk stratification of patients undergoing mitral valve replacement and further investigation of this novel parameter in different population would be beneficial in assessing its ability of predicting POAF.

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