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ORIGINAL ARTICLE

Role of Inter and Intra Atrial Dyssynchrony to Predict in_Hospital Atrial Fibrillation in Patients With Acute Myocardial Infarction.

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ABSTRACT

Background: Patients who develop new-onset atrial fibrillation (AF) after ST segment elevation myocardial infarction (STEMI) demonstrate an expanded hazard for unfavorable occasions and mortality during follow-up, so we hope to predict it. A new noninvasive echocardiographic method has been approved for AF prediction. It involves estimation of inter-atrial dyssnchrony time utilizing tissue Doppler imaging and was found to be independent predictor for AF [1].

Aim: To study role of intra and inter-atrial dyssynchrony which (calculated by tissue Doppler) in prediction of atrial fibrillation in STEMI patients during hospitalization.

Patients and methods: STEMI patients were subjected to tissue Doppler using Trans Thoracic echocardiography to detect intra and inter-atrial dyssnchrony and detect their association with developing new onset AF.

Results: There was a statistically significant difference between both AF and non AF groups regarding hypertension, p wave dispersion, (PA mitral), (PA septal), (PA tricuspid), left atrial dyssnchrony, inter atrial dyssnchrony and type of revascularization. There was no statistically significant difference between the two groups regarding age, sex, risk factors as Diabetes mellitus (DM) ,Family history to coronary artery disease (CAD), smoking and dyslipidemia, duration of chest pain ,lab parameters including troponin, , C-reactive protein (CRP),HbA1C.

Conclusion: Inter-atrial dyssynchrony and left atrial dyssynchrony can be used as independent predictor for AF development in Anterior STEMI patients during their hospitalization.

Keywords: STEMI (ST segment Elevation Myocardial Infarction),AF(atrial fibrillation) ,tissue Doppler , atrial dyssynchrony.

INTRODUCTION

AF is one of the frequently seen arrhythmia in STEMI cases and has worse prognosis [2], so we aimed at predicting development of AF in STEMI patients hoping to prevent it in the future.

The incidence of new-onset AF after STEMI, defined as the AF that developed during hospitalization after admission with STEMI [3], was accounted to range between 6.5-7.9% in cohorts of patients included in primary PCI or thrombolysis studies. These rates were expanded in patients with LV dysfunction (7.2-19%) [4, 5].

PATIENTS AND METHODS

This was a cohort study performed in Cardiology Department, Faculty of Medicine, Zagazig University, on STEMI patients admitted to Coronary Care Units of Zagazig university hospitals in the period between June 2018 and December 2018.

Patients: Patients with anterior STEMI were classified into two groups based on developing AF during hospitalization:

- **Group (A): Anterior STEMI patients with AF**
- **Group (B): Anterior STEMI patients with no AF**

Other types of MI rather than Anterior were excluded as it has different etiology in developing AF {occluding (Sino-atrial node) supplying artery} [6].

All patients received full explanation of the study, and each patient delivered a written consent. The study was approved by the medical research and ethics committee of Faculty of Medicine, Zagazig University. The work has been performed compatible with The Code of Ethics of the World Medical Association (Declaration of Helsinki) for studies Defend human rights.

Methods:

1. ***Complete history taking***
2. **General and local examination**
3. **Electrocardiographic (ECG):** was done on admission by Comen CM 100 device at a paper speed of 25mm/s and amplification of 10mm/mv. 12-lead ECG with the right leads (V3R and V4R) and posterior leads (V7-V9) as an evidence and localization of STEMI territory.

- Evidence of sinus rhythm and AF development.
- Other ECG predictors of AF: **P wave dispersion** which is defined according to Pérez-**Riera et al.,"** difference between widest and narrowest P. The paper speed must be of 50 mm/s and amplitude at 20 mm/mV for the recording calibration"[7].

4 .**Laboratory*:*** Troponin level, lipid profile, CRP and HbA1c.

5. **ECHO:** Echocardiography was performed just after revascularization either by thrombolytic therapy or primary PCI.

- Standard 2-D and Doppler echocardiogram were performed to all patients involved at this study using a Vivid E9 commercial ultrasound scanner with phased array transducers (M5S-D and 4V-D, equipped with 2.5 MHz transducer. ECG-triggered images of standard parasternal and apical views. Left ventricular ejection fraction (LVEF) was assessed by modified Simpson method. .
- Assessment of left ventricular dimensions (LVESD, LVEDD) wall motion abnormalities and other complications including mitral regurgitation (MR).
- LV diastolic function was evaluated using pulsed-wave Doppler recordings of the mitral valve inflow pattern (E-wave and A-wave) [8].
- LA Volume was assessed by the biplane area-length method.

6. **Tissue Doppler**: **Measurements of intra- and inter-atrial electromechanical delay**

Cui et al., said:" The time from the onset of the P wave on the ECG to the beginning of the A′ wave on TDI (PA′-TDI interval) will be calculated from the lateral (PA′ lateral) and septal (PA′ septal) mitral annuli as well as the lateral tricuspid annulus (PA′ tricuspid) Values for the PA′-TDI interval were averaged over three consecutive beats. The difference between PA′ lateral and PA′ septal was considered as the left atrial (LA) dyssynchrony. The difference between PA′ lateral and PA′ tricuspid was considered as inter-atrial dyssynchrony [9]" as demonstrated in (**figure 1)**.

Statistical analysis

Statistical package for the social sciences (SPSS) version 23 was used for data analysis.

Data were submitted as mean (±) standard deviation for continuous variables and frequencies for categorical variables. Chi-square test was used for differences between groups. Statistics for categorical variables and Student-t test were used to compare means of continuous variables. P-value < 0.05 was expressed as statistically significant, a p-value < 0.001 was considered highly statistically significant and a p-value ≥0.05 was expressed as non-statistically significant.

RESULTS

88 STEMI patients were classified into 2 groups according to development of AF:

- **Group I:** 16 patients developed AF
- **Group II:** 72patients did not develop AF.

The mean age of patients was (56.6 ± 10.5) years, 30 males (34.1%) and 58 females (65.9%). Further descriptive analysis of the demographic data and echo parameters is demonstrated in ***(table 1)***.

Regarding categorical variables, demonstrated in **table (2),(3)** there was no significant difference between the two groups regarding age, sex, DM, smoking,

hyperlipidemia, family history of CAD, troponin levels, CRP, HbA1c, Time of admission after chest pain and certain echo parameters (LVESD,LVEDD,EF) with p-values (>0.05).

However there were some statistically significant factors in between the AF and the non AF groups including hypertension, P wave dispersion, (PA mitral), (PA septal), (PA tricuspid), left atrial dyssnchrony, inter atrial dyssnchrony and type of revascularization with p-values (<0.05).

Receiver operator characteristic (ROC) showed that LA dyssnchrony, inter-atrial dyssnchrony and LA volume are diagnostic markers for AF during hospitalization with cut off values, specificity, sensitivity values are demonstrated in **(table 4).**

Univariate & multivariate logistic regression of potential predictors of In-Hospital AF development showed that inter-atrial dyssnchrony is an independent predictor for AF development as demonstrated in **(table 5)**.

Table (1): clinic demographic data of studied population:

		N	%
Age		**Mean±SD Range**	
		56.6 ± 10.5	
		38-76	
		No.	**%**
Sex	**M**	58	65.9
	F	30	34.1
Diabetic		54	61.4
Hypertensive		41	46.6
Smoker		48	54.5
Dyslipidemia		44	50.0
Family history of CAD		30	34.1
Type of revascularization	**PPCI**	54	61.4
	strept	34	38.6
AF during Hospitalization		16	18.2

Table (2): Comparing AF during hospitalization Vs. Patients' risk factors

	AF or Not During Hospitalization				**p**
	Yes		**No**		
Age	59.1 ± 9.9		56.1 ± 10.6		0.302
Sex	**Male**	**Female**	**MALE**	**Female**	0.750
	10	6	48	24	
	62.5%	37.5%	66.7%	33.3%	
Hypertension	11		30		0.049
	68.8%		41.7%		
Diabetes	8		46		0.302
	50%		63.9%		
Smoking	7		41		0.338
	43.8%		56.9%		
Dyslipidemia	6		38		0.269
	37.5%		52.8%		
Family History for CAD	4		26		0.396
	25%		36.1%		

Table (3): Baseline Laboratory & ECG and Echo values in both groups.

	AF or Not During Hospitalization				P
	Yes		No		
P wave dispersion (ms)	42.5 ± 8.799		26.22 ±6.04		**0.018**
time after chest pain (hours)	7.8 ± 2.8		7.4 ± 3.7		0.713
initial Hs troponin	1140 ± 697.5		1269.8 ± 1023.1		0.631
Max Hs troponin	7713.3 ± 1870.3		7779.6 ± 1567.2		0.883
CRP(mg/L)	32.7 ± 13		27.8 ± 13.2		0.178
HbA1c	6.8 ± 1.6		7.7 ± 2.1		0.126
EF%	49 ± 9.9		52.8±8.4		0.113
LVEDD	58.7 ± 7.6		55.7±5.3		0.15
LVESD	40.6 ± 7.9		38.3 ± 5.3		0.275
PA'(mitral)	128.3 ± 7.6		113.5 ± 4.9		**<0.001**
PA'(septal)	104.3 ± 6.8		95.9 ± 4.9		**<0.001**
PA'(tricuspid)	95.7 ± 4.1		92.2 ± 5.3		**0.017**
LA dyssnchrony	22.9 ± 3.6		18.6 ± 2.7		**<0.001**
inter atrial dyssnchrony	30.5 ± 4.7		23.5 ± 5.2		**<0.001**
LA VOLUME	52 ± 9.2		42.4 ± 5		**<0.001**
MR	6 (37.5%)		10(13.9%)		**0.027**
Type of revascularization	**PPCI**	**Strept**	**PPCI**	**Strept**	**0.030**
	6(37.5%)	10(62.5%)	48(66.7%)	24(33.3%)	

Table (4): The validity of LA dyssnchrony. Inter atrial dyssnchrony and LA volume with area under the ROC curve (AUC) as a diagnostic marker for AF during Hospitalization.

Predictors of AF	Cut-off	Sensitivity %	Specificity %	AUC	SE	95% CI	P
LA dyssnchrony	20.80	75.0%	87.5%	80%	0.06	0.68-0.92	**<0.001**
inter atrial dyssnchrony	23.75	93.8%	68.1%	85%	0.04	0.77-0.94	**<0.001**
LA volume	43.50	81.3%	61.1%	81%	0.07	0.68-0.94	**<0.001**

Table (5): Univariate & multivariate logistic regression of potential predictors of In-Hospital AF development.

	Univariate		Multivariate	
	OR	Sig.	OR	Sig.
Hypertensive (Y Vs. N)	3.08	0.057	10.72	0.030
Type of revascularization(PPCI vs. SK)	0.30	0.036	0.19	0.085
LA Dyssynchrony	9.00	0.001	1.92	0.463
Inter_atrial Dyssynchrony	31.77	<0.001	45.58	0.001
LA Volume	9.11	<0.001	7.47	0.042

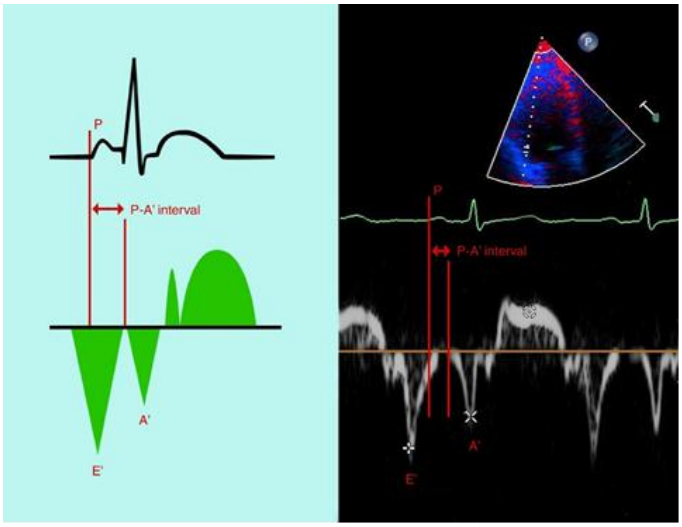

Fig. (1): Measurement of the time from the onset of the P wave on the ECG to the beginning of the A′ wave on tissue Doppler imaging (PA′-TDI interval).

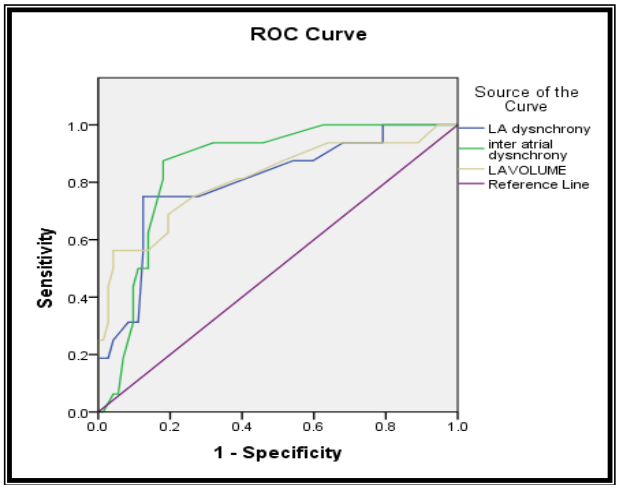

Fig (2): ROC curve of LA dyssnchrony. Inter atrial dyssnchrony and LA volume for diagnosis of AF during Hospitalization

DISCUSSION

Because prevention is better than treatment, we aimed at this study at predicting AF development in STEMI patients hoping to prevent it in the future as AF is one of the frequently seen arrhythmias in the setting of acute STEMI and has a worse prognosis [1].

Regarding **hypertension**, our study showed statistically significant difference between the AF group and the non-AF group **(P= 0.049).** This is explained by the fact that all hypertensive patients have high levels of angiotensin II and through Renin Angiotensin Aldosterone System (RAAS) which promotes AF through direct arrhythmogenic effects, also through the direct effects on ion channel structure and distribution especially potassium channels**[10].**

This result was compatible with ***Podolecki et al.*** who found statistically significant difference between both groups regarding hypertension **(P=0.001) [2].**

However, different results was detected by ***Yesin et al.*** who found no statistically significant difference between the AF group and the non-AF group regarding hypertension **(P=0.50) [11].**

Also **Rhyou et al.** showed no statistically significant difference between the AF group and the non-AF group regarding hypertension **(P=0.33),** However, this study differs from our study in selecting only patients who underwent primary PCI and in following up the patients for one year **[12]**

Regarding **P wave dispersion**, our study showed that the difference between the two groups was statistically significant **(P= 0.018).** The differences in the conduction between the ischemic and the nearing non-ischemic myocardium may lead to electro mechanical delay and so increase P wave dispersion and AF **[13].**

This was in agreement with **Yesin et al.** and **Samadikhah et al.** who showed a highly significant difference between AF group patients and non-AF group patients regarding P wave dispersion **(p<0.001) [11, 13]**.

Regarding **LA Volume**, our study showed that the difference between the two groups was highly statistically significant **(P<0.001).** LA Volume enlargement could predict AF as it cause prolongation of ectopic signals with the easier perpetuation of AF **[14]**.

This is in agreement with **Antoni et al.** who showed a highly statistically significant difference between the AF and non-AF patients regarding LA maximum and minimum Volumes **(P<0,001) [1]**. Also, **Rhyou et al.** showed a statistically significant difference regarding LA Volume Index **(P=0.002) [12]. Modin et al.** showed that the difference between the AF and the non-AF groups was highly statistically significant regarding minimal LA Volume (**P<0.001) [15]**.

Regarding **MR**, current study showed that the difference between the two groups was highly statistically significant **(P=0.027).** MR in acute myocardial infarction can lead to AF as it causes acute overload of LA volume as well as enlargement of LA **[14]**.

This is in accordance with **Antoni et al.** and **Vukmirović et al.** who showed statistically significant difference between the AF and The non AF group regarding MR **[1, 16]**.

Regarding **PA mitral**, our study showed that the difference between the two groups was highly statistically significant **(P<0.001).** Increased electromechanical delay reflects slowing of conduction and dilatation of atrium and may therefore reflect increased possibility for AF development.

This is in agreement with **Antoni et al.** who demonstrated highly statistically significant difference between the AF and the non-AF group regarding PA mitral **(P<0.001) [1].**

Regarding inter-atrial dyssnchrony which is defined the difference between (PA mitral) and (PA tricuspid) our study showed that the difference between the two groups was highly statistically significant **(P<0.001).** This can be explained by electromechanical abnormalities that can promote AF **[1].**

This relationship i.e. (Inter-trial dyssnchrony) between the AF group and non-AF group after STEMI has not been studied yet, however it was studied in other situations such as the study by **Sakabe et al.** who studied inter-atrial dyssynchrony time measured by tissue Doppler imaging to predict progression from paroxysmal to

chronic atrial fibrillation in patients with non-valvular AF and was found to be highly statistically significant **(P<0.001)[17].**

Regarding **PA septal** and **PA tricuspid** our study showed that the difference between the two groups was highly statistically significant **(P<0.001)** and (**P<0.017)** respectively**.** This was also explained by electromechanical delay that predisposes AF**) [1].**

Regarding **type of revascularization**, our study showed that the difference between the two groups was statistically significant **(P=0.03).** Most patients in Group 1 who developed AF received Streptokinase however Group II who did not develop AF underwent primary PCI.

Other factors were statistically non-significant between both groups including age, sex, DM, smoking, hyperlipidemia, family history of CAD, troponin levels, CRP, HbA1c, duration of chest pain and certain echo parameters (LVESD, LVEDD and LVEF).

CONCLUSION

1. Intra and inter- atrial dyssnchrony is a simple and easy tissue Doppler method can be used to predict AF in patients with Anterior STEMI.

2. Predictors for AF development in patients with anterior STEMI include:

- Inter and intra atrial dyssnchrony measured by tissue Doppler.
- Left atrial dyssnchrony measured by tissue Doppler.
- LA Volume.

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