ASSOCIATION OF VENTRICULAR LATE POTENTIALS WITH MITRAL REGURGITATION IN PATIENTS WITH MITRAL VALVE PROLAPSE

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ABSTRACT

Objective: To determine association of ventricular late potentials with mitral valve regurgitation in patients with mitral valve prolapse.

Study Design: Descriptive cross sectional study.

Place and Duration of Study: Armed Forces Institute of Cardiology / National Institute of Heart Diseases, Rawalpindi from May 2006 to February 2007.

Methodology: Thirty Seven Patients with confirmed diagnosis of mitral valve prolapse on 2 dimensional echo echocardiography were selected for the study. Patients having myocardial infarction, ischemic heart disease, hypertension and diabetes mellitus were excluded. Signal Averaged ECG of every patient was recorded using 1200 EPX High Resolution Electrocardiograph and was analyzed for the presence or otherwise of ventricular late potentials.

Results: Male to female ratio of study patients was 23:14 with mean age of 26.27 ± 6.18 years. Twelve patients out of 37 had mitral valve regurgitation. Out of these, 8 (67%) patients had ventricular late potentials on signal averaged ECG. Only 1 (4%) patient without mitral valve regurgitation showed ventricular late potentials. Association between ventricular late potentials and mitral regurgitation was found statistically significant (p = 0.001).

Conclusion: Ventricular late potentials are highly associated with mitral valve regurgitation in patients with mitral valve prolapse. These can act as noninvasive predictors of ventricular tachyarrhythmias and sudden cardiac death in these patients.

Keywords: Mitral valve prolapse, Mitral regurgitation, Ventricular late potentials, SAECG

INTRODUCTION

Ventricular late potentials (VLPs) are low amplitude but high frequency cardiac signals present in the terminal part of QRS complex[1]. These signals may extend for a variable length into the ST segment. They are labelled as "late potentials" because they arise late in ventricular activation process[1]. They are symbolic of myocardial ischemia, which provides an ideal substrate for the development of ventricular arrhythmias through re-entry mechanism. Ventricular late potentials are therefore considered non-invasive markers for the development of ventricular tachyarrhythmias[2]. They typically arise in peri-infarct zone, an area of myocardium where the conduction velocity of cardiac impulse is sluggish leading ultimately to heterogeneity of refractoriness[3]. This leads to generation of abnormal, low voltage, fractionated signals towards the end of QRS complex[4]. VLPs are detected only on high resolution electrocardiography like signal averaged ECG (SAECG). They cannot be identified by standard ECG as they are obscured by high level background skeletal muscle noise (8-10μv)[5].

Mitral valve prolapse syndrome (MVP) is a relatively common valvular heart disease[6]. Although most cases take a benign clinical course, a subset of patients develop severe clinical symptoms such as arrhythmias, insufficiency of the mitral valve or infective endocarditis[7]. MVP is considered the most common cause of primary mitral valve regurgitation[8]. One of the major fatal events associated with mitral valve prolapse is sudden

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Received: 26 May 2014; Accepted: 25 Jul 2014

cardiac death, presumably due to ventricular tachyarrhythmias[9]. It has been observed that ventricular arrhythmias in mitral valve prolapse are more frequent in patients with associated mitral regurgitation as compared to those without regurgitation[10]. It has been postulated that in MVP, arrhythmias are the likely consequence of mitral regurgitation and depressed left ventricular function, rather than mitral valve prolapse alone[11].

Several mechanisms have been postulated explaining arrhythmogenic features of mitral valve prolapse. Reentry phenomenon, altered myocardial refractoriness and heterogeneity of repolarization become more significant in mitral valve prolapse associated with mitral regurgitation[12]. The debilitated myocardium in mitral valve prolapse provides an ideal substrate for generation of ventricular late potentials, leading to ventricular tachyarrhythmias with subsequent increased risk of sudden cardiac death. It has also been suggested that the enlarged prolapsing mitral valve may induce abnormal stress on the papillary muscles leading to stretch induced arrhythmias by mechanoelectrical feedback mechanism[13]. The risk of sudden death in these patients is 0.1% per year, hardly any different to that of the rest of the general adult population (0.2%), however, the risk may rise to 0.9 to 2% in cases with mitralregurgitation[11]. This subset of MVP patients with mitral regurgitation are at potential risk of having sudden death and need to be screened out and monitored.

Ventricular late potentials are non-invasive electrocardiographic markers predicting the chances of developing ventricular arrhythmias which may lead to sudden cardiac death[14]. It, therefore, follows that MVP patients with mitral regurgitation showing ventricular late potentials on SAECG form a high risk group[10]. These are the patients who may suffer from sudden arrhythmic death, therefore need to be put on prophylactic antiarrhythmic therapy. Mitral regurgitation alone puts MVP patients at high risk of developing complications but amongst them, a subset having VLPs, are at even greater risk especially of sudden death[15]. The present study was planned to determine association of ventricular late potentials with mitral valve regurgitation in patients with mitral valve prolapse. It is pertinent to mention that no local study is available on the current topic.

METHODOLOGY

This cross sectional study was conducted from May 2007 to March 2008 at Armed Forces Institute of Cardiology / National Institute of Heart Diseases, Rawalpindi. A formal approval was acquired from medical ethics committee before commencement of the study. Written and informed consents were attained from all the patients. Diagnosis of mitral valve prolapse and mitral regurgitation was confirmed on 2 dimensional echocardiography according to the standard criteria[16]. Blood sugar and blood pressure profiles were checked to rule out diabetes mellitus and hypertension. All the patients underwent standard ECG and exercise tolerance test to exclude ischemic heart disease. Patients with acute or old myocardial infarction were also excluded from the study. A total of 37 patients, aging 15 to 38 years, were finally selected to be included in the study.

Signal averaged ECG of every patient was recorded using SAECG recording machine '1200 EPX High Resolution Electrocardiograph' by 'Arrhythmia research technology incorporation, Austin, Texas'. SAECG recordings were obtained for about one thousand heart beats. The three bipolar leads were recorded, averaged, filtered and combined into a QRS vector magnitude, called filtered QRS complex (fQRS). These filtered QRS complexes were analyzed for the presence or otherwise of ventricular late potentials. SAECG was considered to be positive (showing presence of VLPs) when at least two out of the following three criteria were fulfilled[17].

- Duration of total filtered QRS complex (fQRS) > 114 ms
- Low amplitude signal under 40 μv (LAS 40) > 38 ms

- Root mean square voltage of last 40 ms of fQRS (RMS 40) < 20 μv.

Statistical analysis was performed by using IBM SPSS version 21. Descriptive statistics were used to describe the results. Chi square test was applied to determine association between ventricular late potentials and mitral valve regurgitation. Alpha value was set at < 0.05 for significance.

RESULTS

The mean age of patients was 26.27 ± 6.18 years with male to female ratio of 1.6 : 1. Out of total 37 patients, mitral regurgitation was present in 12 (32%) whereas 25 patients (68%) were without the regurgitation. Signal average ECG was positive showing ventricular late potentials in 9 (24%) patients whereas in remaining 28 patients (76%), the ECG was negative showing absence of ventricular late potentials.

Cross tabulation in SPSS showed that out of 12 patients with mitral regurgitation, 8 had ventricular late potentials whereas only 1 patient without mitral regurgitation showed the late potentials. Chi Square test showed that association between ventricular late potentials and mitral regurgitation was statistically significant (p = 0.001) (Table-1).

DISCUSSION

In our study, ventricular late potentials were recorded in 9 patients (24%). Out of these, one patient did not have mitral valve regurgitation leaving 8 patients with mitral valve prolapse having mitral valve regurgitation and ventricular late potentials. This is the actual subset of patients at high risk of going into ventricular arrhythmias and sudden death. The association between mitral regurgitation and ventricular late potentials gives an inkling regarding the probable mechanism of sudden arrhythmic death in such patients.

Turker Y et al, carried out a study to find out predictors of ventricular arrhythmias in patients with mitral valve prolapse[18]. They studied 58 patients who underwent echocardiography and holter monitoring for 24 hours to record mitral regurgitation and arrhythmic events respectively. Turker et al found that 34% of their patients had ventricular arrhythmias. Further analysis through multivariable logistic regression showed that mitral regurgitation was significantly associated with ventricular arrhythmias (relative risk 8.42, 95% confidence interval 1.49-47.64, p-value 0.01). They reported that the only independent predictor of ventricular arrhythmias in patients with mitral valve prolapse was the occurrence of moderate to severe mitral regurgitation. In our study, instead of recording ventricular arrhythmias, we, recorded ventricular late potentials which are indirect reflection of

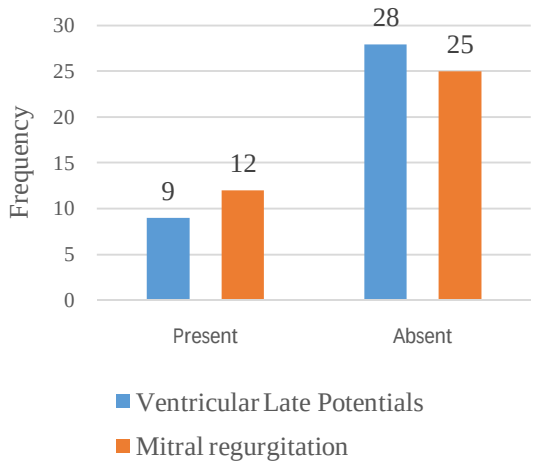

Figure-1: Frequency of mitral regurgitation and ventricular late potentials.

ventricular arrhythmias. We also found out strong association between ventricular late potentials and mitral valve regurgitation. Results of the two studies confirm that patients with mitral valve prolapse may be at risk of developing ventricular arrhythmias.

Fauchier et al conducted a study to find out the relation between mitral valve prolapse, arrhythmias and sudden death[11]. They reported that atrial and complex ventricular arrhythmias were more common in mitral valve prolapse as compared to the control group. Their study showed that arrhythmias were strongly associated with mitral valve regurgitation. They reported that the risk of sudden cardiac death

increased from about 0.1% to nearly 2% in cases with mitral regurgitation. This shows the impact of mitral regurgitation on development of ventricular arrhythmias which may lead to sudden cardiac death. Our study also supported the same finding through ventricular late potentials.

Table-1: Association of ventricular late potentials with mitral regurgitation.

Mitral regurgitation	Ventricular late potentials		*p*-value
	Absent	Present	
No	24 (96%)	1 (4%)	0.001*
Yes	4 (33%)	8 (67%)	

**p*-value significant

Vohra et al studied seven patients with mitral valve prolapse[19]. All their patients had mild to moderate mitral valve regurgitation. They followed their patients for a mean follow up period of 2.5 years (from 6 months to 5 years) to record adverse outcomes. Two patients (28%) died suddenly during the follow up period, despite the fact that they were on antiarrhythmic drug therapy. Our study showed 22% patients had ventricular late potentials along with mitral valve regurgitation. The percentage of total patients having ventricular late potentials was even higher (24%). As we could not do follow up of our patients, data regarding mortality in our study population could not be gathered. However, ventricular late potentials combined with mitral regurgitation give us an indirect clue about the adverse outcomes in the form of sudden death[20]. Considering this, results of our study are comparable to that conducted by Vohra et al. In fact combined results of the two studies point towards some arrhythmogenic mechanism underlying both, ventricular late potentials and mitral valve regurgitation. Our study indirectly confirmed that, by showing statistically significant association between ventricular late potentials and mitral valve regurgitation.

Sniezek-Maciejewska et al carried out a study on 20 patients with mitral valve prolapse to evaluate ventricular arrhythmias[21]. All their patients underwent holter ECG monitoring for 24 hours. They evaluated ventricular arrhythmias according to Lown classification. Severe ventricular arrhythmias (class IV and V) were present in 5 patients (25%). Our study showed 24% patients had ventricular late potentials and Vohra et al reported sudden death in 28% of their patients. Results of all the three studies are comparable showing some relation between severe ventricular arrhythmias, ventricular late potentials and sudden death.

Kligfield et al carried out a study on 31 patients to see the effect of mitral valve regurgitation on complex ventricular arrhythmias in patients with mitral valve prolapse[10]. Their study included two groups of patients; with and without mitral regurgitation. Thirty five percent of their patients with mitral regurgitation had complex ventricular arrhythmias whereas only 4% had such arrhythmias in the control group (*p*-value 0.005). They reported significant difference in arrhythmogenesis in patients with and without mitral regurgitation. This implies that association exists between arrhythmogenesis which may be evident in the form of ventricular late potentials and mitral regurgitation in patients with mitral valve prolapse. Results of our study confirmed the association between ventricular late potentials and mitral regurgitation.

CONCLUSION

There is a strong association between ventricular late potentials and mitral valve regurgitation. It therefore follows that patients showing mitral regurgitation at the time of diagnosis of mitral valve prolapse on echo echocardiography, may be considered for further scrutiny for the assessment of ventricular arrhythmias and sudden death.

Conflict of Interest

This study has no conflict of interest to declare by any author.

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