ORIGINAL RESEARCH PAPER

Cardiology

KEY WORDS: Ventricular premature complex, coupling interval ratio, VPC burden, coupling interval.

A CORRELATIONAL STUDY BETWEEN COUPLING INTERVAL RATIO AND SYMPTOMS IN PATIENTS WITH IDIOPATHIC VENTRICULAR PREMATURE COMPLEXES IN 24 HRS HOLTER MONITORING

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ABSTRACT

Background and objective: Ventricular premature complexes (VPCs) are the most common arrhythmia encountered in cardiology OPD. Patients with frequent VPCs are often symptomatic. Our study aims to identify the ECG predictors of symptoms in patients with idiopathic VPCs in 24 hours Holter monitoring.

Subjects and methods: This study was conducted on 102 patients with VPCs during the period of February 2019 to December 2019 in cardiology OPD of our centre. All the patients were screened with transthoracic echocardiography.24 hours Holter monitoring was done, the measured parameters were QRS width (Both in sinus beat & VPC), coupling interval (CI), CI ratio (CL/sinus cycle length) and VPC burden (Number and percentage of VPCs per day).

Results: Both group had similar categorical age group and gender. ORS width of both sinus beat (P = 0.389) and VPCs (P = 0.035), VPC CI (P=0.487) and VPC burden (P = 0.458) did not correlate with symptoms but VPC CI ratio were significantly higher in Group B (symptomatic) than in group A (P = 0.004)

Conclusion: There is a relationship between VPC related symptoms and VPC CI ratio.

INTRODUCTION:

Ventricular premature complexes (VPCs) are the most common arrhythmia encountered in cardiology OPD. Patients with frequent VPCs are often symptomatic. Our study aims to identify the ECG predictors of symptoms in patients with idiopathic VPCs in 24 hours Holter monitoring.

Subjects and Methods

We enrolled 102 patients with VPCs during the period of February 2019 to December 2019 in cardiology OPD of our centre. All the patients were screened with transthoracic echocardiography. Those with structurally normal heart and normal ejection fraction were included in the study . This group had totally 60 patients (39 males and 21 females). They were divided into Group A (without VPC related symptoms like palpitations, dizziness and syncope; n= 25) and Group B (with VPC related symptoms; n=35). 24 hours Holter monitoring was done in our hospital. The measured parameters in Holter monitoring were QRS width (Both in sinus beat & VPC), coupling interval (CI), CI ratio (CI/sinus cycle length) and VPC burden (Number and percentage of VPCs per day).

Inclusion Criteria:

Age between 15 to 70 years,
Frequent VPCs (>10% VPC burden per 24 hours) according to 24-hr Holter ECG monitoring.
Structurally normal heart.
Normal EF> 55.
Unifocal VPC alone is included

Exclusion Criteria:

Evidence for any of the following arrhythmias by 12-lead ECG or Holter ECG monitoring like atrial fibrillation, atrial flutter, atrial tachycardia, nonsustained ventricular tachycardia, sustained ventricular tachycardia;

History of myocardial infarction, structural heart disease, or heart valve replacement/repair;

Any evidence of ischemic/structural heart disease based on information obtained from the echocardiogram;

Patients were divided into two subgroups (symptomatic or asymptomatic) according to the presence or absence of typical VPC-related symptoms;

Full description of symptoms in the medical records including questionnaire and Holter monitoring, and baseline echocardiography and Holter monitoring at enrollment

If the patient did not feel any palpitations, dizziness related to VPCs observed on an ECG, the patient was assigned to Group A;

If a patient felt palpitations, dizziness when VPCs appeared on an ECG or Holter monitoring, this was defined as a typical VPC-related symptom, and the patient was assigned to Group B;

Electrocardiography measurements

Baseline sinus cycle length (ms): from the R peak of one sinus beat to the R peak of the next sinus beat;

VPC QRS width (ms): from the onset of the VPC to the terminal S wave;

Sinus QRS width (ms): from the onset of the R wave to the terminal S wave;

VPC CI (ms): from the onset of the R wave of the previous sinus beat to the onset of the VPC

VPC CI ratio (%): VPC CI/sinus cycle length×100;

Statistical Analysis:

Pearson's product moment correlation coefficient was calculated to quantify inter-rater variability in the measurement of both VPC QRS duration and VPC coupling interval. Continuous data are expressed as mean ± standard deviation unless otherwise specified.

Between-groups comparisons were performed using Student's t-tests, whereas within-group comparisons were performed using paired t-tests. For comparisons of non-continuous variables, chi-square tests were used. For all tests, $p<0.05$ was considered statistically significant

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Table: 1 ECG Analysis And Comparison Of Symptomatic And Asymptomatic Patients. Mean And Standard Deviation

Statistics	Group	N	Mean	Std. Deviation
QRS - SINUS	Asymtomatic	25	96.04	18.831
	Symtomatic	35	100.94	23.346
VPC -QRS	Asymtomatic	25	146.64	18.692
	Symtomatic	35	151.69	20.592
SCL	Asymtomatic	25	823.56	81.344
	Symtomatic	35	865.97	134.396
CI	Asymtomatic	25	479.92	89.212
	Symtomatic	35	500.06	122.564
CI Ratio	Asymtomatic	25	41.12	27.417
	Symtomatic	35	59.20	14.624
VPC burden, n	Asymtomatic	25	15789.987	12677.897
	Symtomatic	35	18678.679	14786.387
VPC burden, %	Asymtomatic	25	18.465	13.6509
	Symtomatic	35	24.456	17.098

Table: 2 Analysis By Levenes Test And t-test

Independent Samples Test		Levene's Test for Equality of Variances		t-test for Equality of Means		
		F	Sig.	t	df	Sig. (2-tailed)
QRS –SINUS	Equal variances assumed	1.788	.186	-.867	58	.389
	Equal variances not assumed			-.899	57.070	.373
VPC –QRS	Equal variances assumed	.171	.681	-.972	58	.335
	Equal variances not assumed			-.988	54.654	.328
SCL	Equal variances assumed	.571	.453	-.719	58	.475
	Equal variances not assumed			-.732	54.825	.467
CI	Equal variances assumed	.371	.545	-.699	58	.487
	Equal variances not assumed			-.737	57.965	.464
CI Ratio	Equal variances assumed	1.017	.318	.308	58	.004
	Equal variances not assumed			.300	46.655	.002
VPC burden, n	Equal variances assumed	.889	.149	.712	58	.458
	Equal variances not assumed			.778	36.081	.428
VPC burden, %	Equal variances assumed	.588	.879	.949	58	.334
	Equal variances not assumed			.967	49.218	.318

Table: 3 Age Group Cross tabulation

Age * Group Crosstabulation		Group		Total
		Asymtomatic	Symtomatic	
Age	15-25	2	2	4
	26-25	3	5	8
	36-45	3	9	12
	46-55	9	12	21
	56-68	8	7	15
Total		25	35	60

Fig: 1 Age Group Cross tabulation

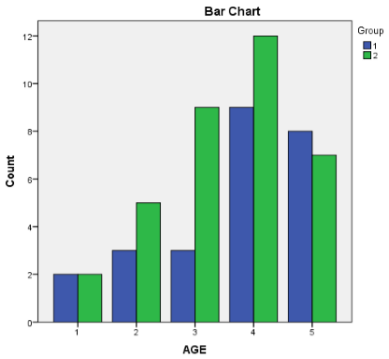

TABLE :4

Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	2.395a	4	.664
Likelihood Ratio	2.467	4	.651
Linear-by-Linear Association	.558	1	.455
N of Valid Cases	60		
a. 4 cells (40.0%) have expected count less than 5. The minimum expected count is 1.67.			

Table:5 Sex Group Cross tabulation

Sex * Group Crosstabulation		Group		Total
		Asymtomatic	Symtomatic	
Sex	Female	12	9	21
	Male	13	26	39
Total		25	35	60

Fig: 2 Sex Group Cross tabulation

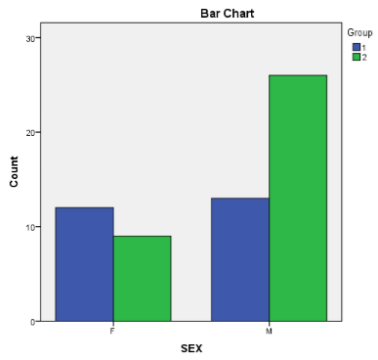

TABLE 6

Chi-Square Tests	Value	df	Asymptotic Significance (2-sided)
Pearson Chi-Square	3.184a	1	.074
Continuity Correctionb	2.279	1	.131
Likelihood Ratio	3.173	1	.075
Fisher's Exact Test			
N of Valid Cases	60		
a. 0 cells (0.0%) have expected count less than 5. The minimum expected count is 8.75.			

Table: 7 ECG parameter, P-Value measurements for Group A and Group B patients.

	Group A (n=25)	Group B (n=35)	P - Value
Sinus QRS (ms)	96.04 ± 18.831	100.94 ± 23.346	0.389
VPC –QRS Width (ms)	146.64 ± 18.692	151.69 ± 20.592	0.035

Sinus cycle length (ms)	823.56 ± 81.344	865.97 ± 134.396	0.475
VPC CI (ms)	479.92 ± 89.212	500.06 ± 122.564	0.487
CI Ratio	41.12 ± 27.417	59.20 ± 14.624	0.004
VPC burden, n	15789.987± 12677.897	18678.679 ± 14786.387	0.458
VPC burden, %	18.465±13.6509	24.456 ± 17.098	0.334
Age			0.664
Sex			0.074
b. Computed only for a 2x2 table			

RESULTS:

A total of 102 patients with frequent VPCs were prospectively enrolled. Among these, forty two patients were excluded according to the exclusion criteria. Thus, 60 patients (39 males, 21 female) with VPCs were enrolled. Group A included 25 patients and Group B included 35patients (Table 1). Both group had similar categorical age group and gender.

QRS width of both sinus beat (P=0.389) and VPCs (P=0.035) and VPC burden (P = 0.458) did not correlate with symptoms .VPC CI ratio were significantly higher in Group B than in group A (P = 0.004)

Discussion:

In this study, we tried to identify predictors of typical VPC-related symptoms by analyzing ECG characteristics. Several studies have reported that hemodynamic differences are related to the VPC site of origin, CI, and myocardial status. CI itself was not an important factor for the occurrence of typical VPC related symptoms. Rather CI ratio was significantly higher in patients with typical VPC related symptoms.

Several previous studies have reported that hemodynamic differences are related to the VPC site of origin, CI between the sinus beat and VPC, and myocardial status.

The CI between the previous sinus beat and VPC is also an important parameter contributing to different hemodynamic effects. A shorter CI may have greater hemodynamic significance than a longer CI.

If Out flow tract (OT) VPCs occur after a short CI, there may be an inadequate time for LV filling, thus reducing the stroke volume, in accordance with the Frank-Starling's law. However, when the OT VPC occurs after a long CI, this will provide more time for ventricular filling, and the patient may feel the increased blood flow

The results suggest that VPC-related symptoms occur because of an increased VPC CI ratio. The Physiologic and Pathologic basis for the noted VPC CI ratio differences associated with the VPC-related symptoms deserves further prospective study.

Limitations:

Correlating the symptoms to VPCs was a difficult aspect of the study. VPC-related symptoms due to other factors like ANS abnormality, emotional stress couldn't be ruled out. We didn't specifically select the site of origin of VPCs.

In spite of taking the mean of five ECG measurements, due to variations in the sinus cycle length, the chances of error could not be eliminated. Interpolated and multifocal VPCs are not included.

CONCLUSION:

VPC related symptoms are significantly more common in patients with high VPC CI ratio (P =0.004) and QRS width of VPC (P=0.035). These results suggest that there is a relationship between VPC related symptoms and VPC CI ratio. The hemodynamic effect of this correlation needs further evaluation.

REFERENCES;

1. Gaita F, Giustetto C, Di Donna, et al. Long-term follow-up of right ventricular monomorphic extrasystoles. J Am Coll Cardiol 2001;38:364-
2. Conti CR. Ventricular arrhythmias: a general cardiologist's assessment of therapies in 2005. Clin Cardiol 2005;28:314-6.
3. Ghanbari H, Schmidt M, Machado C, Daccarett M. Catheter ablation of ventricular tachycardia in structurally normal hearts. Expert Rev Cardiovasc Ther 2010;8:651-61.
4. Wilber DJ. Ventricular ectopic beats: not so benign. Heart 2009;95: 1209-10.
5. Baman TS, Lange DC, Ilg KJ, et al. Relationship between burden of premature ventricular complexes and left ventricular function. Heart Rhythm 2010;7:865-9.
6. Sarrazin JF, Labounty T, Kuhne M, et al. Impact of radiofrequency ablation of frequent post-infarction premature ventricular complexes on left ventricular ejection fraction. Heart Rhythm 2009;6:1543-9.
7. Yarlagadda RK, Iwai S, Stein KM, et al. Reversal of cardiomyopathy in patients with repetitive monomorphic ventricular ectopy originating from the right ventricular outflow tract. Circulation 2005;112:1092-7.
8. Bogun F, Crawford T, Reich S, et al. Radiofrequency ablation of frequent, idiopathic premature ventricular complexes: comparison with a control group without intervention. Heart Rhythm 2007;4:863-7.
9. Takemoto M, Yoshimura H, Ohba Y, et al. Radiofrequency catheter ablation of premature ventricular complexes from right ventricular outflow tract improves left ventricular dilation and clinical status in patients without structural heart disease. J Am Coll Cardiol 2005;45:1259-65.
10. Oh HL, Choue CW, Cho JM, et al. Clinical characteristics of ventricular premature beats originating from right ventricular outflow tract. Korean Circ J 2003;33:1118-25.
11. Rolfe SJ, Rasor T, Shaffer PA, Sanitate PA, Bashore TM. Relation between premature ventricular contraction site of origin (defined by radionuclide phase analysis) and subsequent left ventricular function. Am J Cardiol 1984;53:1028-33.
12. Migliore F, Folino AF, Bilato C, et al. Origin of recurrent syncope in patient with right ventricular outflow tract arrhythmias: evidence of autonomic modulation of the ectopic foci. J Cardiovasc Med 2011;12:598-600.
13. Chen JY, Tsai WC, Lee YL, et al. Association of premature ventricular complexes with central aortic pressure indices and pulse wave velocity. Am Heart J 2008;155:e1-6.
14. Huizar JF, Kaszala K, Potfay J, et al. Left ventricular systolic dysfunction induced by ventricular ectopy: a novel model for premature ventricular contraction-induced cardiomyopathy. Circ Arrhythm Electrophysiol 2011;4:543-9.
15. Ban JE, Lee HS, Lee DI, et al. Electrophysiological characteristics related to outcome after catheter ablation of idiopathic ventricular arrhythmia originating from the papillary muscle in the left ventricle. Korean Circ J 2013;43:811-8.
16. Sun Y, Blom NA, Yu Y, et al. The influence of premature ventricular contractions on left ventricular function in asymptomatic children without structural heart disease: an echocardiographic evaluation. Int J Cardiovasc Imaging 2003;19:295-9.
17. Komatsu T, Ikeda K, Tomoike H. Assessment of the variability in coupling intervals of ventricular premature contractions. Jpn Circ J 1993;57:781-8.
18. Thanavaro S, Kleiger RE, Miller JP, Province MA, Friedman E, Oliver GC. Coupling interval and types of ventricular ectopic activity associated with ventricular runs. Am Heart J 1983;106:484-91.
19. Jakopin J, Horvat M, Brucan A, Rode P. The relation of heart rhythm to postextrasystolic potentiation. Bibl Cardiol 1979;164-8.
20. Otsuji Y, Kisanuki A, Toda H, et al. Influence of left ventricular filling profile during preceding control beats on the occurrence of pulse deficit caused by ventricular premature contractions. Eur Heart J 1993;14:1044-9.
21. Yellin EL, Kennish A, Yoran C, Laniado S, Buckley NM, Frater RW. The influence of left ventricular filling on postextrasystolic potentiation in the dog heart. Circ Res 1979;44:712-22.
22. Eber LM, Berkovits BV, Matloff JM, Gorlin R. Dynamic characterization of premature ventricular beats and ventricular tachycardias. Am J Cardiol 1974;33:378-83.
23. Millar K, Eich RH, Abildskov JA. Relation of variations in activation order to intraventricular pressures during premature beats. Circ Res 1966;19:481-8.
24. Baman TS, Lange DC, Ilg KJ, et al. Relationship between burden of premature ventricular complexes and left ventricular function. Heart Rhythm 2010;7:865-9.
25. Sarrazin JF, Labounty T, Kuhne M, et al. Impact of radiofrequency ablation of frequent post-infarction premature ventricular complexes on left ventricular ejection fraction. Heart Rhythm 2009;6:1543-9.
26. Efremidis M, Letsas KP, Sideris A, Kardaras F. Reversal of premature ventricular complex-induced cardiomyopathy following successful radio-frequency catheter ablation. Europace 2008;10:769-70.
27. Mountantonakis SE, Frankel DS, Gerstenfeld EP, et al. Reversal of outflow tract ventricular premature depolarization-
induced cardiomyopathy with ablation: effect of residual arrhythmia burden and preexisting cardiomyopathy on outcome.
Heart Rhythm
28. Kyoung –Min park, MD et al.Coupling Intrval Ratio is associated with Ventricular Premature Complex related symptoms.Korean Circ J 2015;45(4)294-300