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Dispersion of QT interval in premature ventricular beats is not an independent marker for inducible sustained ventricular tachycardia

Ventriküler prematüre atımların QT interval dispersiyonu indüklenebilir sürekli ventriküler takikardi için bağımsız bir gösterge değildir

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Aim: Variability in QT interval duration on the different leads of the 12-lead ECG has been proposed as an indicator of risk for ventricular arrhythmias in different clinical settings, but the value of QTd-V is not clear yet. The aim of this study was to estimate the value of QT dispersion in ventricular premature beats (QTd-V) in identifying patients susceptible to reentrant ventricular tachyarrhythmias (VT).
Materials and Methods: We compared the performance of precordial QTd-V, late potentials on the signal-averaged electrocardiogram and reduced left ventricular ejection fraction for identification of inducible ventricular tachycardia in 34 patients undergoing electrophysiologic study.
Results: QTd-V in 12 patients with inducible VT (110±50 msec) was found to be greater than that in 22 patients without inducible VT (65±38 msec, p=0.006). Multivariate analysis including ejection fraction and presence of late potentials showed that QTd-V was not an independent factor in identifying the susceptible patients to ventricular tachyarrhythmias.
Conclusion: Increased QTd-V is related to susceptibility to reentrant ventricular tachyarrhythmias, however does not appear to provide additional diagnostic information to that provided by late potentials and left ventricular ejection fraction.

Key words: ***QT dispersion, ventricular premature beat, electrophysiologic study***

Amaç: 12 derivasyonlu EKG nin farklı derivasyonları arasında QT interval süresinde değişkenlik birçok klinik durumda ventriküler aritmiler için bir risk göstergesi olarak öngörülürken, QTd-V nin değeri henüz açık değildir. Çalışmanın amacı reentran ventriküler takiaritmilere (VT) duyarlılığı olan hastaları belirlemede ventriküler prematüre atımlarda QT dispersiyonu'nun (QTd-V) değerini araştırmaktır.
Gereç ve Yöntem: Elektrofizyolojik çalışma yapılmış 34 hastada indüklenebilir VT nin tahmini için prekordiyal QTd-V, sinyal ortalamalı EKG de geç potansiyeller ve azalmış sol ventrikül ejeksiyon fraksiyonu karşılaştırıldı.
Bulgular: İndüklenebilir VT li 12 hastadaki QTd-V (110±50 msec) VT nin indüklenemediği 22 hastadaki QTd-V den (65±38 msec, p=0.006) daha büyük bulundu. Ejeksiyon fraksiyonu ve geç potansiyel varlığının dahil edildiği çok değişkenli analiz QTd-V nin ventriküler takiaritmilere duyarlı hastaları belirlemede bağımsız bir faktör olmadığını gösterdi.
Sonuç: Artmış QTd-V tek başına reentran ventriküler takiaritmilere duyarlılıkla ilintili olsa da, geç potansiyeller ve sol ventrikül ejeksiyon fraksiyonu hesaba katıldığında ilave tanısal bilgi sağlamadığı gözükmektedir.

Anahtar sözcükler: ***QT dispersiyon, ventriküler prematüre atım, elektrofizyolojik çalışma***

Experimental studies have provided powerful evidence of the dispersion of myocardial recovery times for the occurence ventricular arrhytmias (1-4). Measurement of the variability in QT interval duration among the different leads of the standard 12-lead electrocardiogram (ECG) (i.e., QT dispersion) has been proposed as a noninvasive method for detecting the inhomogenity of ventricular recovery times (5-9).

Observations have related an increase in QT dispersion on the surface ECG to increased risk of clinically important ventricular arrhythmias (10-14). Useful

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prognostic value of abnormally increased QT dispersion has been found in patients with acute myocardial infarction (10), cardiomyopathy (11), the long QT syndrome (10,15), drug induced torsades de pointes (16) and sudden cardiac death (17).

The presence of late potentials on the signal-averaged ECG (6,18,19,20,21,22) and abnormal left ventricular ejection fraction (LVEF) (23) also have been associated with an anatomic substrate for reentrant ventricular arrhythmias and inducible ventricular tachycardia (VT) at electrophsiologic study (EPS).

There are only several reports studying the clinical significance of QT interval dispersion measured in spontaneous ventricular beats (QTd-V) (24-26) showing significant relationship between QTd-V and the risk of arrhytmic events.

The present study was designed to examine relation of measures of precordial QT dispersion in premature ventricular beats and inducible ventricular arrhytmias and the independence of these findings from late potentials and ventricular function.

Materials and Methods

Patients who underwent electrophysiologic testing because of symptomatic ventricular arrhythmia at our center were enrolled into the study. The study group consisted of 34 patients (21men, 13 women) who had premature ventricular beats on a 12-lead standard ECG and signal averaged ECG's before electrophsiologic study. The mean age of the patients was 54 years.

Electrocardiography

Standard ECG's were recorded with a 12-channel ECG recorder at a paper speed of 25mm/sec. QT interval, QT dispersion, QRS complex duration, QTd-V and duration of the QRS complex of ventricular extrasystole measured manually. The QT intervals were measured from the onset of the QRS complex to the end of the T wave by means of tangential method. When U waves were present, the QT interval was measured to the nadir of the curve between T and U waves, also with the aid of tangential method. The QRS complex duration of normal and ventricular premature beats were measured from the begining of the QRS complex to its end. QTd-V was defined as difference between the maximum and minimum QT interval measured in ventricular premature beats across the 12-lead ECG. A minimum 10-leads was required for QTd-V to be calculated. Index of prematurity of VPBs was obtained by dividing the coupling interval time of ventricular premature beat (VPB) by the QT interval duration of preceeding normal beat.

Signal averaged ECG

After careful preperation of the skin and with the patient lying quietly in the supine position, three orthogonal X,Y and Z leads were acquired with an operator selected template at a frequency of 2000 Hz. Digital filtering was performed on avereged, orthogonal-lead complexes with a fourth-order 40 to 250 Hz bandpass bidirectional digital filter. Late potentials were defined as present when the filtered vector QRS duration was >114 msec and either the root-mean square voltage of the terminal 40 msec of the vector QRS was < 20 muV or the low-amplitude signal was > 38 msec.

Electrophysiologic study

Electrophysiologic testing included programmed ventricular stimulation using up to three extrastimuli and two basic drive cycle lenghts (600 and 400 ms) from the right ventricular apex and outflow tract. Ventricular tachycardia was defined as 1) sustained when its duration was >30s or if defibrillation was required for its termination; and 2) as non-sustained if it lasted >5 beats but <30s.

Statistical analysis

Data are expressed as mean value and standard deviation. Paired and unpaired t tests were used for quantitative data where applicable. The Pearson correlation coefficient was used to estimate univariate correlations between the variables. Logistic multible regression analysis was used to evaluate the independent values of the different variables in differentiating the patient groups with and without susceptibility to ventriclar tachyarrhyhtmias. Differences were considered significant when $p < 0.05$.

Results

Group characteristics

Clinical characteristics of the study population groups relevant to the inducibility of VT at EPS are summarized and compared in Table 1. Patients with positive EPS were slightly older than those with negative EPS (57± 15 vs 52±15 years, p=0.37). There were no significant sex differences among the groups. Patients with inducible VT were more likely to have coronary artery disease or cardiomyopathy than those with negative EPS. There were significant difference between the patient groups in terms of the left ventricular ejection fraction (%59±12 vs % 45±14 respectively, p=0.005).

QT measurement comparisons:

Table 2 summarizes and compares the resting electrocardiographic findings in two groups. QRS duration of the patients with positive EPS was significantly greater than that of the patients with negative EPS, but the QRS duration of ventricular premature beat was not significantly

different between the groups. Patients with inducible ventricular arrhythmias had a longer QT dispersion of normal QRS complexes and ventricular premature beats (p=0.001 and p=0.006 respectively). The prematurity index did not differ between the groups.

Signal averaged electrocardiogram measurements:

Table 3 summarizes and compares the signal averaged ECG findings in the groups. The QRS duration of the patients with inducible ventricular arrythmias was significantly longer (p=0.003). The presence of ventricular late potentials were much more common in EPS positive patients than EPS negative patients (20% vs 88%, p=0.002).

Regression analysis:

There were no significant correlation between EF and QTd-V in EPS negative patients (r=0.13, p=0.9) or in EPS positive patients (r=0.12, p=0.7). A correlation was found between QTd-V and QTd in EPS positive patients (r=0.7, p=0.01) but no correlation was found in negative EPS patients (r=0.3, p=0.1). The relationship of QT-V dispersion to the presence of late potentials and an abnormal LVEF who underwent EPS is examined by logistic regression analysis. Among these patients, QTd-V, late potentials (p=0.07) and ejection fraction (p=0.3) were not independently associated with susceptibility to ventricular tachyarrhythmias.

Discussion

The identification of patients who are at high risk for ventricular tachycardia and sudden death is of great importance. The strategies such as ventricular ectopic activity and spontaneous arrhythmias can not effectively identify subjects at high risk (27). The newer noninvasive methods such as signal-averaged electrocardiography, heart rate variability and baroreceptor reflex sensitivity offer improved risk stratification (28). However, the positive predictive accuracy of each of these methods is still limited with regard to identifying individual patients for therapeutic interventions; it is possible that the combination of noninvasive methods may result in better accuracy (29).

The present study demonstrates that prolonged QT dispersion of normal and ventricular premature beats on the standard resting ECG can identify patients with inducible VT. These findings confirm the previous report of Dabrowski that demostrate a sigificant relationship between QTd-V and risk of arrhyhmic events (24-26). These observations are consistent with the hypothesis that QT dispersion on the standard ECG is a marker of underlying regional inhomogenity of ventricular repolarization that can be associated with reentrant VT.

Difference from the previous studies from Dabrowski (24-26) showing QT dispersion of ventricular premature beat is an independent risk for arryhthmic events, the present study demonstrates that QTd-V had a similiar accuracy compared with that of other noninvasive methods used in previous studies for discriminating between patients with different susceptibilities to ventricular tachyarrhythmias and does not provide

Table 1. Clinical characteristics of the study patients

	Negative EPS patients (n=22)	*Positive EPS patients (n=12)*
Age (yr)	52±15	57±15
Sex (male/female)	14/8	7/5
LVEF	59±12 %	45±14
CAD	2 (9.1%)	4 (33.3%)
HT	6 (27.3%)	None
DCMP	3 (13.6%)	3 (25%)
VHD	4 (18.2%)	None
ICMP	1 (4.5%)	5 (41.7%)
none	6 (27.3%)	none

*Data are expressed as mean ± SD
CAD: coronary artery disease; **DCMP: dilated cardiomyopathy; **ICMP:** ischemic cardiomyopathy; EPS electrophysiologic study; **HT:** hypertension; **LVEF:** left ventricular ejection fraction; **VHD:** valvular heart disease;

Table 2. Summary of electrocardiographic measurements

	Negative EPS patients (n=22)	*Positive EPS patients (n=12)*	*p*
QRS duration	99±6	147±32	0.001
QT dispersion	41±15	75±37	0.001
QTd-V	67±38	110±50	0.006
QRS-V	157±36	163±30	NS
Prematurity index	1.8±0.9	1.2±0.9	NS

***QTd-V, QT:** dispersion of ventricular premature beat; **QRS-V, QRS:** complex duration of ventricular premature beat; **NS:** non significant

Table 3. Signal avereaged ECG findings in patient groups

	Negative EPS patients (n=22)	*Positive EPS patients (n=12)*	*p*
LAS	32.7±17.8	65±25	0.006
QRS duration	112±37	164±22	0.003
RMS	43.9±27.8	14.2±13	0.01
Late potentials	20%	88%	0.002

***LAS:** low amplitude signal duration; **RMS:** root mean square voltage

additional independent diagnostic information. However, measurament of QT dispersion is easy, inexpensive and noninvasive but because measurement of QT interval and its dispersion are subject to introbserver and interobserver variability (28,29) and the problems with identification of the end of the T wave and as QTd-V is a dependent risk factor, the measurement of QTd-V should not be included in the noninvasive evaluation of arrhythmic risk.

Limitations

Our major limitations were small size of study population and the inhomogenity of the study groups. Prospective studies of larger and homogeneous groups of patients are therefore needed to confirm the present data.

Conclusion

Our findings demonstrate that precordial dispersion of ventricular premature beat on the resting ECG is associated with the presence of inducible reentrant VT in symptomatic patients undergoing EPS, however QT dispersion of ventricular premature beat does not appear to provide additional independent diagnostic information to that provided by late potentials and left ventricular ejection fraction.

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