Effect of deep inspiration and expiration on (QT and JT dispersion) in normal subjects.

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Abstract:
This study was carried out on 20 normal healthy male volunteers, aged 18-36 years to study QT-dispersion and JT-dispersion in responses to control, deep inspiration and deep expiration by using non-invasive technique Electrocardiography for measurement of QT-dispersion and JT-dispersion studying the QT-dispersion and JT-dispersion shows: There are no significant changes in QT-dispersion between control and deep inspiration and also no significant changes between control and deep expiration. The JT-dispersion shows no significant difference between control and deep inspiration but there is significant increase in JT-dispersion in deep expiration in comparison with the control expiration. On comparison between deep inspiration and deep expiration, there are no significant difference in both QT-Dispersion and JT-Dispersion.

Introduction
Normal adult 12-lead ECG
The diagnosis of the normal electrocardiogram is made by excluding any recognized abnormality. It's description is therefore quite lengthy (Dean Jenkins, 1996). Normal sinus rhythm: each p-wave is followed by a QRS complex. P-waves normal for the subject. P-wave rate 60-100 beat per minute (bpm) with < 10% variation.
2- Normal QRS axis.
3- Normal P-waves:
.height < 2.5 mm in lead II.width < 0.11 s in lead II.
4- Normal PR interval: 0.12 to 0.20 s (3-5 small squares).
5- Normal QRS complex: <0.12 s duration (3 small squares).
6- No pathological Q waves. No evidence of left or right ventricular hypertrophy.
7- Normal ST segment: No elevation or depression.
8- Normal T wave. (Dean Jenkins, 1996).
The ECG complex, P = P wave, PR = PR segment, QRS = QRS complex, QT = QT interval, ST = ST segment, T = T wave.

**QT interval**
The QT interval is measured from the beginning of the QRS complex to the end of the T wave. The QT interval as well as the corrected QT interval is important in the diagnosis of long QT syndrome and short QT syndrome. The QT interval varies based on the heart rate.

**QT dispersion**
Currently the most routinely used noninvasive method to assess ventricular recovery time is the QT interval measurement made from the 12-lead electrocardiogram. The QT interval measurement is usually made from a single lead, with very little standardization in dealing with measurement complications such as low amplitude T waves, U waves, P waves and small biphasic T waves. This lack of a standard measurement technique has lead to poor sensitivity and specificity in using the isolated QT interval measurement for predicting susceptibility to life threatening ventricular arrhythmias. (Mirvis, 1985).

Dispersion, defined as the difference between the lead with the maximum QT interval and the lead with the minimum QT interval as measured from the 12 lead electrocardiogram has been suggested to give information about the spatial differences in myocardial recovery time. Although there is evidence to the benefit of looking at QT interval dispersion from the 12 lead electrocardiogram little has been done to standardize and automate the making of these measurements. Manual measurements of QT dispersion can be significantly affected by the speed and gain used to plot the electrocardiogram, and also suffer from both intra and inter observer variability. (Zarebw, et. al., 1994)

Research has indicated that accurate and consistent QT dispersion measurements are essential when attempting to identify small yet perhaps clinically significant changes in the 12-lead electrocardiogram. This is of particular importance when attempting to identify QT dispersion measurements as an independent and predictive value for defining and assessing risk. Automated measurement algorithms should offer consistency and reproducibility of these measurements. Additionally, automated analysis algorithms should allow the physician to inspect, modify and possibly eliminate measurements at their discretion, and be able to
provide trending of measurements made on large numbers of electrocardiogram. Studies have shown the benefit of QT associated measurements made on all 12 leads versus only the precordial leads. Thus, automated algorithms need to provide measurements based on all twelve leads termed "global" dispersion measurements, along with measurements based on the leads V1 through V6 often referred to as "precardial" dispersion measurements. It is also beneficial to indicate which leads were used to determine the minimum and maximum QT measurements and to graphically portray the range of dispersion on the 12 lead ECG. (Cin VG. et. al., 1997). The benefit of automated analysis and trending of these QT measurements may be magnified when comparing serial changes of these values on repeat electrocardiograms during assessment of disease progression, regression, or when evaluating the effects of drug treatment. Validation of the automated measurement algorithms is critical in establishing credibility and faith in the measurements themselves and should help to promote the use of the measurements in more varied clinical studies. (Murray A.M, Laughlin, 1994).

\[ JT\text{-}dispersion \]
This can be calculated by subtraction of largest value of QT-dispersion in 12 lead ECG from the lowest value.
The J point is the point were the ventricles complete their depolarization ,it is zero point where no current passes into the ventricular mass (Gyton Physiology, 2007).
JT-interval = QT-interval – QRS complex
JT-dispersion = JT max. – JT min

Subjects, Materials and Methods:
Subjects: This study was carried out on 20 normal healthy male volunteers. During control, deep inspiration and deep expiration.

Materials:
Electrocardiography The 12 lead electrocardiography device (ECG), MAKC (1200, Japan) used to detect electrical cardiac changes during study made in Japan using limb leads and chest leads according to protocol of the study.
Standard mercury sphygmomanometer and stethoscope
The sphygmomanometer is the standard and the most widely used non-invasive method used for recording arterial BP in the clinical practice (Tein et. al., 1982). The auscultatory method is the most popular method for BP measurement today (Simpson and Wicks, 1988) by using phase one of Korotkoff sound to point out the SBP and phase five for DBP reading (Hoffler and Robert, 2001).

Method:
A full clinical history and anthropometric data were taken prior to the test. Blood pressure and heart rate calculated during control, deep inspiration and deep expiration. Then 12-lead ECG performed to control then during deep inspiration and deep expiration. For all measurement of 12-lead QT and JT dispersion then measuring the mean of these value.
The Results:
Electrocardiographic changes (QT and JT dispersion) responses to control and deep inspiration and response to control and deep expiration in supine position:
There are no significant changes in QT-dispersion between control and deep inspiration and also no significant changes between control and deep expiration.
The JT-dispersion shows no significant difference between control and deep inspiration but there is significant increase in JT-dispersion in deep expiration in comparison with the control expiration, as shown in table (1), figures (1, 2).

Table (1): Electrocardiographic reflex responses to normal control breathing and deep breathing maneuver:

<table>
<thead>
<tr>
<th>Parameters mean ±SD</th>
<th>Changes during inspiration</th>
<th>Changes during expiration</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Control breathing</td>
<td>Deep inspiration</td>
</tr>
<tr>
<td>QT-D</td>
<td>0.06±0.03</td>
<td>0.07±.02</td>
</tr>
<tr>
<td>JT-D</td>
<td>0.06±0.02</td>
<td>0.08±0.03</td>
</tr>
</tbody>
</table>

QT-D = QT-dispersion.
JT-D = JT-dispersion.

Figure (1): QT-dispersion (QTD) in control inspiration (CI) with deep inspiration (DI) and control expiration (CE) with deep expiration (DE).
Electrocardiographic changes (QT and JT dispersion) responses - to deep inspiration and deep expiration in supine position:

On comparison between deep inspiration and deep expiration, there are no significant difference in both QT-Dispersion and JT-Dispersion as shown in table(2), figure (3).

Table(2): Electrocardiographic changes (QT and JT dispersion) in responses to deep inspiration and expiration.

<table>
<thead>
<tr>
<th>Parameters ±SD</th>
<th>deep inspiration</th>
<th>deep expiration</th>
<th>difference</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>QT-dispersion</td>
<td>0.07±0.002</td>
<td>0.06±0.03</td>
<td>0.003±0.03</td>
<td>&gt;0.05</td>
</tr>
<tr>
<td>JT-dispersion</td>
<td>0.08±0.03</td>
<td>0.08±0.02</td>
<td>-0.003±0.03</td>
<td>&gt;0.05</td>
</tr>
</tbody>
</table>
Discussion:
I-1-Table (1 Electrocardiographic changes concerning QT and JT dispersion in control and deep inspiration and expiration(Figures 1,2)
Comparing control and deep inspiration with control and deep expiration, the QT dispersion during deep inspiration is slightly higher than control value but it does not reach the significant level. Where as the QT dispersion during deep expiration shows no any changes, which may be due to the fact that the QT dispersion like most other ECG variables is independent of heart rate(Zabel M. et, al., 2000), while the QT-interval known to be rate dependent, that is to say, increasing heart rate resulting in decreasing QT- interval(Goldberger A.L. et, al., 2000).
There is no significant change in comparing control JT-dispersion with deep inspiration, but the JT-dispersion is significantly increase in deep expiration comparing with control.
II-2-Table (2) Electrocardiographic changes concerning QT and JT dispersion in deep inspiration and deep expiration(Figure 3).
There are no significant changes in both QT and JT dispersion in comparing deep inspiration and deep expiration as they are independent on heart rate (Zabel M. et, al., 2000)
References:
Markus Zabel and Franz; The electrophysiological basis of QT-dispersion: Global or local repolarization; Circ. (2000); 101:235.