Changes in QT Dispersion Magnitude During Respiratory Phases: Role of Maximum Inspiration and Expiration

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ÖZET

SOLUNUM FAZLARINDA DİSPERSİYON DEĞİŞİMLERİ: MAKSİMUM İNSPİRASYON VE EKSPİRASYONUN ROLÜ

QT interval dispersiyonunun güvenilirliği ve prognostik değeri hakkında gözlemciler arası değişiklikten kaynaklanan tartışmalar mevcuttur. Bu çalışma sağlıklı erişkinlerde QT intervalinin ve QT dispersiyonunun solunum fazlarından etkilendiği hipotezini öne sürmektedir. Sağlık personelinden oluşan 60 gönüllü erişkin (38 erkek, 22 kadın, ortalama yaş=25) çalışma grubunu oluşturdu. Elektrokardiyogramlar aynı tekniker tarafından 50 mm/s hızında normal solunum, zorlu inspiriyum ve zorlu ekspiriyum sırasında çekildi. QT interval 12 derivasyonda ölçülen maksimum ve minimum QT intervalleri arasındaki fark olarak tanımlandı. Düzeltilmiş QT intervali (QTc) Bazzet formulüne göre hesaplandı. Normal solunumla karşılaştırıldığında zorlu inspiriyum ve ekspiriyum sırasındaki QTc maximum intervalleri arasında farklılık yoktu (sırasıyla 409±22ms vs 417±26 ms, P>0.05 ve 412± 18ms vs 417± 26ms, P>0.05). Zorlu inspiriyum ve ekspiriyum sırasındaki QTc dispersiyonu normal solunumdakinden daha düşüktü (sırasıyla 36±8 ms vs 44± 9 ms, P<0.001 ve 32±7 vs 44±9 ms , P< 0.001). Zorlu ekspiriyumdaki QTc dispersiyonu zorlu inspiriyumdakinden daha düşüktü (p<0.01). Sağlıklı erişkinlerde QT dispersiyonu solunum fazlarından etkilenmektedir ve normal solunumla karşılaştırıldığında hem zorlu inspiriyumda hem de zorlu ekspiriyumda QT dispersiyonu azalmaktadır.

Anahtar kelimeler: *QT dispersiyonu, solunum fazları*

QT dispersion defined as interlead QT variability in a 12 lead electrocardiogram (ECG) was proposed by Day et al[1] as a simple method to evaluate the repolarization heterogenicity of the ventricular myocardium[2,3]. Due to its great potential clinical usefullness[4-5] it has gained much importance during recent years. However there is still controversy about the reliability and its prognostic value because of inter- and intraobserver variability[7]. The present study hypothesis that QT interval duration and QT dispersion are effected by the respiratory phases in healthy subjects.

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PATIENTS and METHODS

Sixty healthy volunteers (38 men, 22 women, mean age =25±3) from the medical staff comprised the study group. All subjects had normal ECG tracing. 12 lead ECG were recorded by the same technician at a rate of 50 mm/s during normal respiration, maximum inspiration and maximum expiration. ECGs were coded and all annotations were masked. QT interval was measured from the onset of the QRS complex to the end of the T wave,defined as its return to the T-P isoelectric baseline. QT interval measurement in individual leads of a single heart beat were performed by a blinded observer using a standart electrocardiographic lineal. After completion of the measurements all ECGs were decoded. QT dispersion was defined as the difference between the maximal and minimal QT interval measurements occuring among any of the 12 leads. Corrected QT interval (QTc) was calculated according to Bazett's formula[8] as follows; QTc = QT/ square root of the R-R interval. QTc dispersion was calculated in a similiar manner used for QT dispersion. QTc dispersion for normal breathing , maximum inspiration and maximum expiration were calculated. Results are expressed as mean ± SD. And for comparison Wilcoxon matched pairs test was used. A p value of $p<0.05$ was considered as significant.

RESULTS

Table 1 represents the maximum QTc interval and QT dispersion measurement during normal breathing, maximum inspiration, and maximum expiration. There were no significant differences QTcmax interval measurement during maximum inspiration and expiration compared to that in normal breathing (409±22 ms vs 417±26 ms , p>0.05 and 412±18 ms vs 417±26 ms, p>0.05 respectively). QTc dispersion magnitude during both maximum inspiration and maximum expiration were significantly lower

Table 1. Maximum and minimum corrected QT intervals and QTc dispersion values during

	Normal Respiration	Maximum Inspiration	Maximum Respiration
QTcmax (ms)	417±26	409±22	412±18
QTcmin (ms)	373±18	373±14	380±13
QTdc (ms)	44±9	36±8* #	32±7**

** P< 0.003 vs during normal respiration, ** P< 0.003 vs during normal respiration, # P< 0.01 vs maximum expiration., QTcmax =Maximum corrected QT interval duration, QTcmin =Minimum corrected QT interval duration, QTdc = Corrected QT dispersion. All values are given as mean±SD.*

than that during normal breathing(36±8ms vs 44±9 ms, $p<0.001$ and 32±7 ms vs 44±9ms $p<0.001$). There were also significant difference between the QTc dispersion during maximum inspiration and expiration ($p<0.01$).

DISCUSSION

The present data demonstrated two main findings. First the QTc dispersion during both maximum inspiration and maximum expiration are lower than that of normal breathing. Second, QTc dispersion during maximum expiration is lower than that during maximum inspiration. Krautzner et al[7] has found significant intra- and interobserver variability regarding the QT dispersion in healthy individuals and has suggested that QT dispersion may be a consequence of inaccuracies of QT interval measurement or of a different orientation of individual leads to a single repolarization vector. Commonly used electrocardiographic machines record simultaneously 3 or 6 leads only ; thus QT interval used for QT dispersion measurement are evaluated in 2 or 4 heart beats possibly from different phases of respiratory cycle. In our study both maximum inspiration and maximum expiration decrease QT dispersion value by about 18% and 25% respectively. The result of this study may contribute to the intra- and interobserver variability documented by Krautzner et al[7]. Krupienicz et.al[9] has reported similiar QT dispersion decrease during both maximum inspiration and expiration . But there were not statistically significant difference between maximum inspiration and expiration. In our study we have also showed that the QT dispersion during maximum expiration is significantly lower than that during maximum inspiration. The change in QT dispersion magnitude may be related to the anatomic location of the heart in the chest cage. Such a relation was found to be responsible for the "P pulmonale" appearance in electrocardiogram by Maeda et al[10]. Considering the heart in a more stationary position during maximum inspiration and expiration than that during normal respiration may be an explanation of the lower QT dispersion magnitude. According to this hypothesis , lower QT dispersion value during maximum expiration may also be related to the close proximity of the heart to the chest wall. Nevertheless, it is hard to say that the change in QT dispersion magnitude is completely due to the position of the heart during respiration. The partial alveolar O_2 and CO_2 pressures, body habitus may also play a role in QT dispersion. Kiely et.al[11] has found that hypercapnia significantly increased both QTc interval and QTc dispersion . The documented phenomenon of the relation between QT dispersion magnitude and respiratory phases adds an other question mark to the value of QT dispersion as a marker of regional inhomogeneity of ventricular repolarization in humans.

In conclusion, QT dispersion magnitude is effected by the respiratory phases in healthy subjects and decrease during both maximum inspiration and expiration compared to normal respiration. And the decrease is more evident during maximum expiration.

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