

## A complementary index for quantification of cardiac electrical dispersion: Transmural dispersion of repolarization

To the Editor,

We read the article titled "Influence of the left ventricular types on QT intervals in hypertensive patients" by Kunisek et al. (1) published in the January issue of *Anatol J Cardiol* with great interest. In this well-designed research, the authors investigated the effects of left ventricular hypertrophy (LVH) types on cardiac repolarization parameters and severity of ventricular arrhythmias using 12-lead ECG and ambulatory ECG monitoring in hypertensive subjects. In conclusion, they reported that the repolarization parameters of QT interval (QTI) duration, corrected QT interval (QTc), and QT dispersion (QTd) are not affected by the degree and type of LVH. Meanwhile, they found that QTd was significantly and QTI non-significantly increased in male patients with severe concentric and eccentric hypertrophy. In addition, they revealed that QTI was significantly prolonged in subjects with complex ventricular arrhythmias (Lown III-V) compared with that in subjects with simple ventricular arrhythmias (Lown I-II).

Heterogeneity in the duration of the cardiac repolarization phase causes electrical instability, leading to arrhythmias. As used in this study, QTd is the most frequently used parameter to detect ventricular inhomogeneity. The reproducibility of QTI measurements is low both in manual and automatic measurements, and the inter- and intra-observer variability of QTd is very high.

There are three myocyte types having different electrophysiological properties in the ventricular myocardium: endocardial, epicardial, and midmyocardial M cells. Midmyocardial M cells typically have the longest repolarization phase. The repolarization phase of midmyocardial M cells continues until the end of the T wave. On the other hand, the repolarization phase of epicardial cells ends at the peak of the T wave. The time between the peak and end of the T wave is known as the Tp-e interval, as an index of transmural dispersion of repolarization (TDR) (2). In addition, the Tp-e/QT ratio has also been used as an electrical dispersion index of the myocardium, showing the arrhythmic risk. The role of TDR in evaluation of the arrhythmic risk has been demonstrated in coronary artery disease and in the Brugada, short QT, and long QT syndromes. Previously, we showed that the Tp-e interval was increased in patients with obstructive sleep apnea and chronic arsenic exposure via drinking water (3, 4). Increased TDR has also been demonstrated in subjects with hypertension and ventricular hypertrophy (5). Regarding these observations, increased left ventricular mass causes repolarization heterogeneity, leading to increased TDR. This situation suggests that the thickened layer of the heart is mostly the midmyocardial layer, which leads to prolongation of the Tp-e interval. In their study, Kunisek et al. (1) divided the study population into nine groups according to the severity and type of LVH. Alterations in left ventricular geometry may influence TDR. We believe that if it was measured in this study, TDR may have been found to be increased in some groups. Thus, considering all the data about QTI, QTd, and TDR, the study may have completely illuminated the effects of LVH types on the electrical heterogeneity of the myocardium in many respects.

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### References

1. Kunisek J, Zaputovic L, Cubranic Z, Kunisek L, ZuvicButorac M, Lukin-Eskinja K, et al. Influence of the left ventricular types on QT intervals in hypertensive patients. *Anatol J Cardiol* 2015; 15: 33-9. [CrossRef]
2. Antzelevitch C. T peak-T end interval as an index of transmural dispersion of repolarization. *Eur J Clin Invest* 2001; 31: 555-7. [CrossRef]
3. Kılıçaslan F, Tokatlı A, Özdağ F, Uzun M, Uz O, Işılak Z, et al. Tp-e interval, Tp-e/QT ratio, and Tp-e/QTc ratio are prolonged in patients with moderate and severe obstructive sleep apnea. *Pacing Clin Electrophysiol* 2012; 35: 966-72. [CrossRef]
4. Yıldız A, Karaca M, Biçeroğlu S, Nalbantçılar MT, Coşkun U, Arık F, et al. Effect of chronic arsenic exposure from drinking waters on the QT interval and transmural dispersion of repolarization. *J Int Med Res* 2008; 36: 471-8. [CrossRef]
5. Hlaing T, Guo D, Zhao X, DiMino T, Greenspon L, Kowey PR, et al. The QT and Tp-e intervals in left and right chest leads: comparison between patients with systemic and pulmonary hypertension. *J Electrocardiol* 2005; 38: 154-8. [CrossRef]

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### Author's Reply

To the Editor,

Thank you very much for Yiğiner et al. (1) interest related to the article entitled "Influence of the left ventricular types on QT intervals in hypertensive patients" in this issue. We are very glad that you gave us the opportunity to answer the letter. Here is our response to the letter.

One of the first studies (published in 2001) showed that the Tpeak-Tend interval (Tp-e) was not affected by left ventricular hypertrophy (LVH). The main effect was an increase in QT peak dispersion, resulting from an increase in the maximum QT peak interval (but not in the minimum QT peak interval) (2). Prolonged transmural dispersion of repolarization (TDR) is associated with the induction as well as spontaneous development of ventricular tachycardia in higher risk patients (3). The Tp-e/QT ratio is probably a better predictor of adverse outcomes, particularly after successful primary percutaneous coronary intervention (PCI) in patients with STEMI. In a previous study, patients with a Tp-e/QT ratio of >0.29 showed elevated rates of hospital death, main adverse cardiac events, all-cause death, and cardiac death after discharge (4). We intended to exclude patients who had organic heart disease, hypertrophic cardiomyopathy without hypertension, diabetes, and several other diseases that could influence the occurrence of arrhythmias, as mentioned in the methods section. Only patients with essential hypertension were included in the study. Such rigorous inclusion criteria demand a long period of selection of appropriate patients. Only few published studies have revealed TDR as a marker of proarrhythmic risk

in patients with hypertensive LVH (2, 5). The majority of studies investigating Tp-e and Tp-e/QT ratio as markers of TDR are related to the LQT syndrome, Brugada syndrome, or influence of drugs on TDR.

In our work, LVH in ECG was determined according to two criteria: Sokolow-Lyon and left ventricular strain criterion. The majority of our patients had complex morphology of T waves and it was difficult to determine Tp-e manually, as has been mentioned by other studies (5, 6). The most expressed changes were exactly in the lateral leads that view the electrical field across the ventricular wall. In one study, a close correlation was found between the QT interval and T-wave variables in hypertensive patients (5). Therefore, it is expected that Tp-e is prolonged in patients with LVH, and investigation of TDR parameters would probably result in non-significant results. We did not measure TDR. It can be assumed that Tp-e in our patients would be in correlation with the QT interval and QT dispersion.

Investigation of TDR in hypertensive patients with LVH in relation to the different patterns of LVH can be the topic of some further investigations.

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## References

1. Kunisek J, Zaputovic L, Cubranic Z, Kunisek L, ZuvicButorac M, Lukin-Eskinja K, et al. Influence of the left ventricular types on QT intervals in hypertensive patients. *Anatol J Cardiol* 2015; 15: 33-9. [CrossRef]
2. Wolk R, Mazurek T, Lusawa T, Wasek W, Rezler J. Left ventricular hypertrophy increases transeptal dispersion of repolarization in hypertensive patients: a differential effect on QT peak and QT end dispersion. *Eur J Clin Invest* 2001; 31: 563-9. [CrossRef]
3. Watanabe N, Kobayashi Y, Tanno K, Miyoshi F, Asano T, Kawamura M, et al. Transmural dispersion of repolarization and ventricular tachyarrhythmias. *J Electrocardiol* 2004; 37: 191-200. [CrossRef]
4. Zhao X, Xie Z, Chu Y, Yang L, Xu W, Yang X, et al. Association between Tp-e/QT ratio and prognosis in patients undergoing primary percutaneous coronary intervention for ST-segment elevation myocardial infarction. *Clin Cardiol* 2012; 35: 559-64. [CrossRef]
5. Mozos I, Serban C. The relation between QT interval and T-wave variables in hypertensive patients. *J Pharm Biomed Sci* 2011; 3: 339-44. [CrossRef]
6. Antzelevitch C, Sicouri S, Di Diego JM, Burashnikov A, Viskin S, Shimizu W, et al. Does Tpeak-Tend provide an index of transmural dispersion of repolarization? *Heart Rhythm* 2007; 4: 1114-9. [CrossRef]

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## Heart rate variability can be affected by gender, blood pressure, and insulin resistance

To the Editor,

We really read with a great interest the paper by Durakoğlugil et al. (1) entitled "The effect of irritable bowel syndrome on carotid intima-

media thickness, pulse wave velocity, and heart rate variability" published in the September issue of *Anatol J Cardiol* 2014; 14: 525-30. They purposed to investigate a possible association between irritable bowel syndrome and autonomic dysfunction using heart rate variability (HRV) parameters in their study population. They concluded decreased parasympathetic modulation in patients with constipation-predominant irritable bowel syndrome.

One of the best non-invasive methods to evaluate the autonomic dysfunction is to measure HRV, defined as the RR interval variability beat-by-beat, and provide us quantitative data about the autonomic nervous system (2). However, HRV parameters can be affected by various variables, including age, gender, nutrition, obesity, hyperlipidemia, diabetes mellitus, hypothyroidism, heart failure, hypertension, coronary artery disease, chronic obstructive pulmonary disease, renal failure, chronic liver disease, and drugs (2-5). It is well known that there is a relationship between gender and HRV measurements (3). Recently, Hillebrand et al. (5) reported an association between body fat and HRV and concluded that insulin resistance might be a reason for this relationship. In the study by Durakoglugil et al. (1), I think that it would be more helpful to present whether there was no statistically significant difference between the patients and control subjects in terms of gender, blood pressure, and insulin resistance, because the study population included overweight or obese people and the frequency of diabetes mellitus and hypertension is higher in the control group. We believe that the results of the study will be stronger with these additional data and whether irritable bowel syndrome really has an effect on autonomic dysfunction, which predicts survival, can be more comprehensible.

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## References

1. Durakoğlugil ME, Canga A, Kocaman SA, Akdoğan RA, Durakoğlugil T, Ergül E, et al. The effect of irritable bowel syndrome on carotid intima-media thickness, pulse wave velocity, and heart rate variability. *Anatol J Cardiol* 2014; 14: 525-30. [CrossRef]
2. Fidancı K, Gülgün M, Demirkaya E, Açikel C, Kılıç A, Gök F, et al. Assessment of autonomic functions in children with familial Mediterranean fever by using heart rate variability measurements. *Int J Rheum Dis* 2014 May 4. Epub ahead of print.
3. Vinik AI, Maser RE, Ziegler D. Autonomic imbalance: prophet of doom or scope for hope? *Diabet Med* 2011; 28: 643-51. [CrossRef]
4. Kudaiberdieva G, Görenek B, Timuralp B. Heart rate variability as a predictor of sudden cardiac death. *Anatol J Cardiol* 2007; 7: 68-70.
5. Hillebrand S, Swenne CA, Gast KB, Maan AC, le Cessie S, Jukema JW, et al. The role of insulin resistance in the association between body fat and autonomic function. *Nutr Metab Cardiovasc Dis* 2014 Aug 1. Epub ahead of print.

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