

- Society. Endorsed by the International Society for Computerized Electrocardiology. *J Am Coll Cardiol* 2009;53:1003–11.
8. George A, Arumugham PS, Figueredo VM. aVR - the forgotten lead. *Exp Clin Cardiol* 2010;15:e36–44.
  9. Das MK, Saha C, El Masry H, Peng J, Dandamudi G, Mahenthiran J, et al. Fragmented QRS on a 12-lead ECG: a predictor of mortality and cardiac events in patients with coronary artery disease. *Heart Rhythm* 2007;4:1385–92.
  10. Das MK, Maskoun W, Shen C, Michael MA, Suradi H, Desai M, et al. Fragmented QRS on twelve-lead electrocardiogram predicts arrhythmic events in patients with ischemic and nonischemic cardiomyopathy. *Heart Rhythm* 2010;7:74–80.

### Authors reply

Dear Editor,

We would like to thank our colleagues who read our study<sup>[1]</sup> with such attention. The axis of the lead aVR is opposed to the left ventricular (LV) apical region, which provides unique information about global ischemia of this region.<sup>[2]</sup> In our study, T-wave positivity at the lead aVR was shown to be closely related to LV thrombus formation after acute anterior myocardial infarction.<sup>[1]</sup> Although Cetin et al. proposed that T-wave positivity in the lead aVR might reflect the presence of T-wave negativity at the inferolateral leads, only 1 patient in our study (Fig. 1b) demonstrated T-wave negativity at the inferolateral leads, which was found coincidentally. Consistent with previous studies,<sup>[3,4]</sup> we also reported that the lead aVR might provide indirect information about reciprocal ischemic changes in the LV apical region. However, no association between T-wave positivity at the lead aVR and T-wave negativity at the inferolateral leads as a reciprocal change was found in our study. In addition, fragmented QRS (fQRS) on a surface electrocardiogram (ECG) reflects delayed ventricular depolarization time, most likely due to ventricular myocardial scarring, and has been shown to be a marker of adverse cardiovascular outcomes in several cardiovascular diseases.<sup>[5,6]</sup> Although there are studies showing a significant association between fQRS and reperfusion failure and adverse in-hospital and long-term outcomes,<sup>[7]</sup> none of our patients demonstrated a fQRS on the 48-hour ECG, though this might be due to ECG assessment without magnification. Long-term follow-up data is lacking in our study because of the cross-sectional design; fQRS might develop over time due to LV scarring and remodeling.

11. Pietrasik G, Goldenberg I, Zdzienicka J, Moss AJ, Zareba W. Prognostic significance of fragmented QRS complex for predicting the risk of recurrent cardiac events in patients with Q-wave myocardial infarction. *Am J Cardiol* 2007;100:583–6.
12. Ratheendran AC, Subramanian M, Bhanu DK, Prabhu MA, Kannan R, Natarajan KU, et al. Fragmented QRS on electrocardiography as a predictor of myocardial scar in patients with hypertrophic cardiomyopathy. *Acta Cardiol* 2019;1–5.
13. Bayramoğlu A, Taşolar H, Bektaş O, Kaya A, Günaydin ZY. Association between fragmented QRS complexes and left ventricular dysfunction in healthy smokers. *Echocardiography* 2019;36:292–6.

Yahya Kemal İçen, M.D., Abdullah Orhan Demirtaş, M.D., Hasan Koca, M.D., Mevlut Koç, M.D.

Department of Cardiology, Health Sciences University, Adana Health Practices and Research Center, Adana, Turkey

e-mail: dryahyakemalicen@gmail.com

doi: 10.5543/tkda.2019.44903

Conflict of interest: None declared.



### References

1. İçen YK, Dönmez Y, Demirtaş AO, Koca H, Ardiç ML, Koç AS, et al. Ischemic changes in lead aVR is associated with left ventricular thrombus or high-grade spontaneous echocontrast in patients with acute anterior myocardial infarction. *Türk Kardiyol Dern Ars* 2019;47:168–76. [CrossRef]
2. Warner RA, Hill NE, Mookherjee S, Smulyan H. Diagnostic significance for coronary artery disease of abnormal Q waves in the “lateral” electrocardiographic leads. *Am J Cardiol* 1986;58:431–5. [CrossRef]
3. Al-Zaiti SS, Fallavollita JA, Canty JM, Carey MG. The prognostic value of discordant T waves in lead aVR: A simple risk marker of sudden cardiac arrest in ischemic cardiomyopathy. *J Electrocardiol* 2015;48:887–92. [CrossRef]
4. Tanaka Y, Konno T, Tamura Y, Tsuda T, Furusho H, Takamura M, et al. Impact of T wave amplitude in lead aVR on predicting cardiac events in ischemic and nonischemic cardiomyopathy patients with an implantable cardioverter defibrillator. *Ann Noninvasive Electrocardiol* 2017;22. [CrossRef]
5. Ratheendran AC, Subramanian M, Bhanu DK, Prabhu MA, Kannan R, Natarajan KU, et al. Fragmented QRS on electrocardiography as a predictor of myocardial scar in patients with hypertrophic cardiomyopathy. *Acta Cardiol* 2019;1–5. [CrossRef]
6. Das MK, Saha C, El Masry H, Peng J, Dandamudi G, Mahenthiran J, et al. Fragmented QRS on a 12-lead ECG: a predictor of mortality and cardiac events in patients with coronary artery disease. *Heart Rhythm* 2007;4:1385–92. [CrossRef]
7. Ozcan F, Turak O, Canpolat U, Kadife I, Avci S, İşleyen A, et al. Myocardial tissue perfusion predicts the evolution of fragmented QRS in patients with ST-segment elevation myocardial infarction undergoing primary percutaneous coronary intervention. *Ann Noninvasive Electrocardiol* 2014;19:454–61. [CrossRef]