

Response to Letter from Barra et al Based on “Association of Early Repolarization and Sudden Cardiac Death During an Acute Coronary Event” by Tikkanen et al

We thank Dr Barra and his colleagues for their interest and comments about our study,¹ which presented an association between early repolarization pattern (ERP) and sudden cardiac death during an acute coronary event. We concur with the authors on several topics with minor viewpoint divergences.

First, the authors of the letter point out the differences between the studied groups. This is obviously a regrettable downside of the nature of our observational cross-sectional study. We did recognize this limitation, and therefore performed additional analyses with subjects without documented coronary artery disease or prior coronary event. Within these subjects, the results remained essentially the same. However, as the authors of the letter state, it is true that a reliable comparison would require less preventive treatment in the control group.

In their letter, Barra and colleagues next discuss the possibility of peri-infarction block and remote myocardial scarring underlying the ERP. As we discussed in the referred publication¹ and in another letter to editor,² several underlying mechanisms are very likely to be present in early repolarization ECG pattern, especially within older populations as the ones studied. These underlying cardiac conditions unfortunately cannot be ruled out from planar ECG, which is an obvious limitation of observational ECG studies. Overlapping of fragmented QRS and ERP is possible in many cases of terminal QRS notching as the variant of ERP. However, it should be noted that majority of ERPs in this study were slurring of the terminal QRS. In fact, the presence of fragmented QRS was also studied here, but it was not related to the presence of ERP.

As the authors of the letter discuss, our study did not include ERP in anterior precordial leads. This is a natural consequence to several previous studies including our previous publication,³ which excluded anterior manifestations of early repolarization and from which the primary hypothesis aroused. In that study,³ inferolateral ERP (ie, J waves) increased fatal arrhythmias at relatively old age, in which age group the most common trigger of sudden cardiac death is an acute coronary event.⁴ Thus, we wanted to investigate whether the presence of J waves in inferolateral leads would associate with sudden cardiac death in patients with acute coronary event. This speculation was also presented by others elsewhere.⁵ These results also concur with other studies, which have demonstrated a higher risk of ventricular fibrillation at the time of acute myocardial infarction in patients with J waves on premonitory ECG.^{6,7}

Barra and colleagues also point out another interesting issue of the malignancy of J waves in the absence, but not presence, of ST-segment elevation. There are growing data available that it is the J waves with no ST-segment elevation that are associated with arrhythmias and increased mortality rates.^{8–11} A speculation of a very steep localized repolarization gradient in those with J waves and absence of ST elevation have been discussed elsewhere,⁹ but as mentioned above, there might be several pathophysiological mechanisms underlying J waves and thus several possibilities might exist in the triggering of arrhythmias in ERP.

The authors of the letters finally discuss the possibilities in statistical analyses. The proposed analyses were not performed, but these issues are highly acknowledged. In future analyses, the studied

variants should be compared with traditional risk factors and investigated as to whether the screening of the variant influences the clinical outcome, that is, does the variant actually add value to risk-reducing therapies.¹² A prospective observational study design in a large cohort should be performed for this purpose.

We strongly agree with the conclusions drawn by Barra and colleagues that further studies are required before any aggressive preventive therapy strategies can be considered for asymptomatic subjects with J waves. As an observational and cross-sectional study with its limitations, our study does not apply to current clinical practice, but it does support the possible association of J waves with arrhythmias during ischemic events and supports the need for further investigation.

Disclosures

None.

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References

1. Tikkanen JT, Wichmann V, Junttila MJ, Rainio M, Hookana E, Lappi OP, Kortelainen ML, Anttonen O, Huikuri HV. Association of early repolarization and sudden cardiac death during an acute coronary event. *Circ Arrhythm Electrophysiol*. 2012;5:714–718.
2. Bastiaenen R, Behr ER. Letter by Bastiaenen and Behr regarding article, “Early repolarization: electrocardiographic phenotypes associated with favorable long-term outcome”. *Circulation*. 2011;124:e899; author reply e900.
3. Tikkanen JT, Anttonen O, Junttila MJ, Aro AL, Kerola T, Rissanen HA, Reunanen A, Huikuri HV. Long-term outcome associated with early repolarization on electrocardiography. *N Engl J Med*. 2009;361:2529–2537.
4. Hookana E, Junttila MJ, Puurunen VP, Tikkanen JT, Kaikkonen KS, Kortelainen ML, Myerburg RJ, Huikuri HV. Causes of nonischemic sudden cardiac death in the current era. *Heart Rhythm*. 2011;8:1570–1575.
5. Rosso R, Halkin A, Viskin S. J waves and early repolarization: Do not confuse me with the facts! *Heart Rhythm*. 2012;9:1603–1604.
6. Naruse Y, Tada H, Harimura Y, Hayashi M, Noguchi Y, Sato A, Yoshida K, Sekiguchi Y, Aonuma K. Early repolarization is an independent predictor of occurrences of ventricular fibrillation in the very early phase of acute myocardial infarction. *Circ Arrhythm Electrophysiol*. 2012;5:506–513.
7. Rudic B, Veltmann C, Kuntz E, Behnes M, Elmas E, Konrad T, Kuschyk J, Weiss C, Borggreffe M, Schimpf R. Early repolarization pattern is

- associated with ventricular fibrillation in patients with acute myocardial infarction. *Heart Rhythm*. 2012;9:1295–1300.
8. Rosso R, Adler A, Halkin A, Viskin S. Risk of sudden death among young individuals with J waves and early repolarization: putting the evidence into perspective. *Heart Rhythm*. 2011;8:923–929.
 9. Rosso R, Glikson E, Belhassen B, Katz A, Halkin A, Steinvil A, Viskin S. Distinguishing “benign” from “malignant early repolarization”: the value of the ST-segment morphology. *Heart Rhythm*. 2012;9:225–229.
 10. Tikkanen JT, Junttila MJ, Anttonen O, Aro AL, Luttinen S, Kerola T, Sager SJ, Rissanen HA, Myerburg RJ, Reunanen A, Huikuri HV. Early repolarization: electrocardiographic phenotypes associated with favorable long-term outcome. *Circulation*. 2011;123:2666–2673.
 11. Rollin A, Maury P, Bongard V, Sacher F, Delay M, Duparc A, Mondoly P, Carrié D, Ferrières J, Ruidavets JB. Prevalence, prognosis, and identification of the malignant form of early repolarization pattern in a population-based study. *Am J Cardiol*. 2012;110:1302–1308.
 12. Chou R, Arora B, Dana T, Fu R, Walker M, Humphrey L. Screening asymptomatic adults with resting or exercise electrocardiography: a review of the evidence for the U.S. Preventive Services Task Force. *Ann Intern Med*. 2011;155:375–385.

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