true for the sheath technique, which is more vulnerable to burring and buckling of the sheath if there is significant sigmoidal tunneling through fibrotic tissue or if there was puncture of the costoclavicular ligament. In this case, the lead-splitting technique may provide a better option if the wire can be accommodated or, if possible, dissection along the lead nearer to the insertion to the vein could be carefully performed. It should be recognized that in some cases such as this, however, with a nonideal entry path into the vein or with significant "hinge points" or kinking, it may be useful to reevaluate and obtain de novo access if at all possible, as any forces that caused one lead failure may persist and lead to another.

Vascular access is simultaneously mundane and challenging; like a fractal, the closer one looks, the more nuance one can keep on finding in the decisions and techniques required to maximize lead longevity and minimize associated morbidity. These principles are increasingly referred to as "lead management." Close attention to all forces that act on any inserted lead, and having an abundance of techniques at our disposal for access and replacement, will only lead to improved outcomes for our patients.

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Letter to the Editor— Average T-wave alternans in ambulatory electrocardiogram recordings in patients with heart failure

I read with joy the contribution of Monasterio et al,[1] published ahead of print in Heart*Rhythm* on October 21, 2011, in which the authors report on the long-term average T-wave alternans (TWA) activity from 24-hour ambulatory Holter electrocardiograms (ECGs) recorded in 650 patients with heart failure. They found that after a median follow-up of 48 months, the survival rate was significantly higher in the group of patients who reached a value of $<3.7\ \mu V$ in their averaged TWA. Using an averaged metric for TWA is refreshing. Indeed, this reader has expressed for sometime concern about reports using one TWA metric, reflecting the maximum TWA value from Holter ECG recordings, while it is obvious to readers of such tests that there is a large range in the amplitude of T waves over the course of 24 hours. There must be a way to evaluate the contribution of this range of T-wave amplitudes or to be exact the amplitude of the JT intervals, since this was used by the authors for their calculations, and the TWA (eg, the voltage-time integral). In other words, is there a relationship of the series of values of TWA and the JT integral obtained during the 24 hours in Holter ECG recordings in the individual patients? Another thought that arises from the authors' decision to use an integration of X, Y, and Z ECG leads for generating the TWA is whether that way they have lost information deriving from the "regionality" of TWA displayed by different regions of the heart in patients with ischemic cardiomyopathy and previous myocardial infarction, as shown previously.

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Letter to the Editor– Average T-wave alternans activity in ambulatory electrocardiogram records: Commentary on the relationship with T-wave amplitude and T-wave alternans regionality

We thank Dr Madias for his kind comments[1] and the interest in our paper,[2] and we would like to comment on the points raised.

Dr Madias' first question was about the relationship between T-wave alternans (TWA) and the amplitude of the JT segment. We agree that when studying local TWA amplitudes, the question of whether TWA depends on the T-wave amplitude could be of interest, as it might indicate that adjusting local TWA values to T-wave amplitudes could improve the value of TWA clinical indices. With the approach proposed in our work, however, the effect of T-wave amplitudes on TWA indices is no longer a one-to-one relationship. The indices proposed in our paper depend not only on local TWA amplitudes but also on the percentage of time with TWA in a 24-hour period. This means, for example, that the index of average alternans would be low for electrocardiograms presenting high-amplitude TWA during a small percentage of time. This particular framework, therefore, is not appropriate to determine the exact influence of JT amplitudes on TWA indices.

Dr Madias also raised the question of whether the use of a multilead combination produces a loss of information on the "regionality" of TWA. We would like to clarify that it is not the case. As we explain in the paper, the way of combining X, Y, Z electrocardiographic leads is not predefined, but is specifically computed for each segment in order to maximize the visibility of TWA in the resulting lead. The combined lead can thus be interpreted as a derived lead whose direction depends on the region where TWA is better observed. Therefore, the information on the "regionality" of TWA is not lost and lies on the linear combination of the leads obtained by periodic component analysis. In fact, for each signal segment, it is possible to transform back the measured TWA to quantify the magnitude of TWA in the original leads. The discussion of this property was out of the scope of the paper, but the interested reader can refer to a recent work[3] in which a modified version of the multilead-TWA algorithm was applied to the study of the spatial distribution of TWA induced by artery occlusion in animal models. In Ref. 3, the results of the spatial analysis were coherent with the regional nature of TWA and were in consonance with results obtained in humans during coronary angioplasty.

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