P-Wave Duration and Dispersion Analysis: Methodological Considerations

To the Editor:

With great interest, we have read the article of Fan and colleagues on the effects of biatrial pacing in the prevention of postoperative atrial fibrillation after coronary artery bypass surgery. By measuring P-wave duration from 12-lead surface ECGs and calculating P-wave dispersion, they found that biatrial pacing resulted in a more significant reduction in P-wave dispersion when compared with single-site atrial pacing. Although these results are interesting, we believe that they should be considered cautiously because of the limited accuracy of electrocardiographic measurements performed manually on paper-printed ECGs obtained at a standard signal size and paper speed.

Our research group has introduced P-wave dispersion as a simple electrocardiographic predictor of paroxysmal lone atrial fibrillation. Although acceptable intraobserver and interobserver errors in the measurement of P-wave duration in 12-lead ECGs have been reported, well-known difficulties in defining P-wave onset and offset may restrict the accuracy and reproducibility of the measurements. To overcome some of these restrictions, we introduced a more advanced technology-assisted method that enables us to measure P-wave duration from digitally recorded and stored ECG data. A computer-based ECG system is used, which records all 12 ECG leads simultaneously at a sampling rate of 1200 Hz and with 12-bit analog-to-digital conversion. A sufficient sampling rate and amplitude resolution are necessary for high-resolution ECG analysis. For each lead, the average complex is calculated, and P-wave duration is measured manually from the average complexes displayed on a high-resolution computer screen. To compare the different methods for manual P-wave duration measurement in 12-lead ECGs, another study was conducted. The conclusion reached was that manual measurement of P-wave duration in standard 12-lead ECGs is feasible and more stable and reliable when performed on the high-resolution screen of a digital ECG system than with more conventional methods involving paper-printed ECGs. Therefore, manual measurement of P-wave duration performed on standard paper-printed ECGs is of limited accuracy. To achieve greater precision in measuring P-wave duration from 12-lead ECGs obtained and stored on paper, we believe that scanning and digitizing ECG signals from paper records in order to display them on a high-resolution computer screen is a feasible alternative, but such hardware is not widely commercially available. In fact, Dr Dilaveris and colleagues have shown that different manual methods of P-wave analysis (using digitally stored ECGs displayed on a high-resolution computer screen, paper ECGs, or a high-resolution digitizing board with a specialized software package) are mutually consistent and acceptable. The intraobserver and interobserver errors of measuring surface P-wave duration have been acceptable in other studies. Other methods used for assessing electrocardiographic markers to identify areas of delayed atrial conduction, such as signal-averaged ECG for predicting increased risk of atrial fibrillation after coronary bypass surgery, have been compared, but results are not conclusive. Therefore, further evaluation of these electrocardiographic markers as predictors in clinical studies is required before using them to assess an individual patient.

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Response

In response to Dr Dilaveris and colleagues, we used P-wave analysis from the standard surface ECG because these measurements were readily available in hospitals, simple to operate, and less expensive than other methods of measurement. We agree that scanning and digitizing ECG signals from paper records in order to display them on a high-resolution computer screen is a feasible alternative, but such hardware is not widely commercially available. In fact, Dr Dilaveris and colleagues have shown that different manual methods of P-wave analysis (using digitally stored ECGs displayed on a high-resolution computer screen, paper ECGs, or a high-resolution digitizing board with a specialized software package) are mutually consistent and acceptable. The intraobserver and interobserver errors of measuring surface P-wave duration have been acceptable in other studies. Other methods used for assessing electrocardiographic markers to identify areas of delayed atrial conduction, such as signal-averaged ECG for predicting increased risk of atrial fibrillation after coronary bypass surgery, have been compared, but results are not conclusive. Therefore, further evaluation of these electrocardiographic markers as predictors in clinical studies is required before using them to assess an individual patient.

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