LETTERS TO THE EDITOR

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Relationship of Surface Electrogram Recordings to Activity in the Underlying Specialized Conducting Tissue

To the Editor:

A recent article by Myerburg et al. (Circulation 45: 420, 1972) indicates a discrepancy between the time of local depolarization, as judged from extracellular electrograms, and the instant of intracellular depolarization in action potentials, both recorded from strands of Purkinje tissue. The paper concludes that extracellular records taken by catheter electrodes within the heart, purportedly showing the time of activity of the atrioventricular conduction system, may likewise be in error in indicating the time of activity in the conduction system.

One may envisage a similar experimental result. Suppose that in open-heart surgery, when an intracellular electrode is placed into a ventricular cell, its potential is similarly found to differ in its timing from the QRS complex. One might interpret such data as indicating that the QRS complex did not arise from ventricular depolarization.

A recent paper by Dr. Myerburg, with other co-workers, in Circulation Research is a valuable contribution to the literature about ventricular activation. The present paper, however, is characterized by a lack of understanding of elementary potential theory. Further, conclusions in the paper are based on the assumption that if a recording from a single cell indicates that activity occurs at one time, while the average activity of many cells in the electrogram indicated that activity occurs at another time, the single cell must be right.

Certainly there are many problems with the catheter recording procedure for timing and understanding the function of the conduction system. Possibly the greatest of these is the inability to determine accurately which cells are being recorded from. Myerburg's paper, however, raises a false issue and contributes nothing to our understanding of the nature of ventricular conduction.

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The author replies:

To the Editor:

In replying to the comments of Drs. Scher and Spach, I would like first to place their comments in the context of the manuscript. Four major points are made in the paper: (1) loss of electrogram voltage during early premature activity; (2) potentially misleading reversal of polarity during early premature propagation; (3) the depth to which surface electrograms might reflect activity within specialized conducting tissue; and (4) the time relationships between propagating wavefronts and surface recordings as analyzed from surface electrograms and transmembrane action potentials. From the comments contained in their letter, it appears that Drs. Scher and Spach are primarily concerned only about the last of these four points.

In the first paragraph of their letter, Drs. Scher and Spach accurately paraphrase our results and conclusions on the time relationships, but later challenge these points. In response, I cite data from the manuscript (page 426), as well as subsequent studies from our laboratory, which demonstrate that very premature impulses are often characterized by propagating wavefronts which are nonuniform across the transverse plane of the conducting tissue, that is, the plane perpendicular to the longitudinal axis of propagation. We have shown in many experiments (e.g., our fig. 6) that the surface electrogram could coincide with any one of several transmembrane potentials which are temporally dissociated from one another. Since electrograms recorded with close bipolar surface electrodes register primarily local events over short distances, the position of the electrodes across the transverse axis will influence the time of inscription of the electrogram when nonuniform propagation is occurring.
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Circulation. 1972;46:206
doi: 10.1161/01.CIR.46.1.206

Circulation is published by the American Heart Association, 7272 Greenville Avenue, Dallas, TX 75231
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Print ISSN: 0009-7322. Online ISSN: 1524-4539

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http://circ.ahajournals.org/content/46/1/206.1.citation

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