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Editorial Comment

Assessment of Regional Myocardial Function*

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The recognition that left ventricular regional dysfunction is a more sensitive marker of coronary artery disease than is depression of global ventricular performance has led several investigators (1–4) to develop methods for quantifying normal and abnormal regional wall motion. Although in recent years noninvasive methods utilizing two-dimensional echocardiography and a variety of nuclear imaging techniques have been used to assess regional ventricular function, the contrast left ventriculogram has remained the reference standard by which other clinically applicable techniques are evaluated. In the most widely applied methods, left ventriculography is performed in the right anterior oblique projection, and the ventricle is divided into defined regions by one of two methods. First, lines may be constructed perpendicular to the major axis to divide the major axis into equal segments (1–3). The second method involves construction of lines drawn out in radial fashion from either the midpoint of the major axis or the ventricular "center of gravity" (4). The extent of inward (or outward) motion of individual segments of the endocardial silhouette can then be measured, either manually or with aid of computer techniques, providing quantitative measures of hypokinesia, akinesia and dyskinesia. Although helpful, these techniques may give misleading results. For instance, an area of infarcted myocardium that is pulled inward toward the center of the ventricle by surrounding, normally contracting myocardium may be judged by the two methods mentioned as having normal contractile function.

In the study by Slager et al. (5) published in this issue of the Journal, a new approach to the analysis of regional wall motion is proposed that represents a substantial advance in the analysis of ventricular function. Their work is a technical tour de force, and attacks a critical problem in the study of ventricular function by providing a method of regional wall motion analysis that more closely approximates the visual subjective assessment obtainable by viewing a left ventricular cineangiogram.

Endocardial landmark system to assess regional wall motion. Previous techniques for examining regional wall motion have suffered from the shortcoming that it is exceedingly difficult to be certain that the same area of myocardium is being assessed in sequential time frames. Shortening of myocardial fibers may alter the relation of myocardial segments to arbitrary reference axes, and thus complicate analysis of wall motion. In animal experiments, ultrasonic crystals are used widely to assess function of a clearly defined region of myocardium. In a few human studies, implanted metal markers have been used to define anatomic regions, but this technique obviously has limited applicability. The study by Slager and coworkers (5) takes advantage of the detectable endocardial features on the angiographic silhouette to "track" identified regions of the myocardium throughout the cardiac cycle. Sophisticated computer-assisted analysis is utilized to track these endocardial landmarks, and the investigators have carefully validated their method, comparing their data with those of fixed endocardial markers in animal experiments.

Although this study represents a substantial advance over previously available techniques, there may be special situations that could present unusual difficulties. For instance, in some ventricles (particularly those with extensive subendocardial infarction and scarring), endocardial landmarks may be absent or difficult to identify with precision. In addition, rotational and translational motion of the entire ventricle (6) may alter the angle at which the X-ray beam traverses the ventricular silhouette, and this in turn may alter the appearance of endocardial landmarks. The potential significance of these limitations will need to be established in a large series of patients studied prospectively.

Other methods to analyze regional wall motion. Additional systems for analysis of regional wall motion from left ventricular cineangiograms have been developed by Sasayama et al. (7) and Fujita et al. (8) and Sheehan et al. (9) and Mathey et al. (10). These methods, which utilize computer-assisted analysis of inward motion of multiple areas of the endocardial silhouette, have proved extremely useful in serial analysis of ventricular function in individual patients. In the method of Sasayama et al. (7), end-diastolic and end-systolic ventricular silhouettes are superimposed, and 128 radial grids are drawn from the center of gravity of the end-diastolic silhouette to the endocardial margins of both end-diastolic and end-systolic silhouettes. Measurement of the length of each radial grid between end-diastolic and end-systolic silhouettes serves as a measure of segmental systolic and diastolic function. The approach of Sheehan et al. (9) and Mathey et al. (10) measures wall

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motion along 100 chords constructed as perpendiculars to a centerline drawn midway between the end-diastolic and end-systolic contours.

Clinical application. The analysis of regional wall motion is an important subject, and one that is critical to the assessment of new therapies for limitation of myocardial infarct size. Slager et al. (5) have already applied their endocardial landmark system of regional left ventricular wall motion analysis to assess the efficacy of coronary angioplasty in patients with regional dysfunction at rest. Their finding of improved function after angioplasty supports the concept that chronic myocardial ischemia may cause chronic but reversible myocardial dysfunction. The quantitative assessment of regional myocardial function will undoubtedly continue to have great importance to all those involved in the development of new therapies (for example, angioplasty, thrombolysis) for the patient with ischemic heart disease.

References

1. Sniderman AD, Marpole D, Fallen EL. Regional contraction patterns in the normal and ischemic left ventricle in man. Am J Cardiol 1973;31:484–9.
2. Stewart DK, Dodge HT, Frimer M. Quantitative analysis of regional myocardial performance in coronary artery disease. Cardiovascular Imaging and Image Processing, Theory and Practice 1975;72:217–25.
3. Leighton RF, Wilt SM, Lewis RP. Detection of hypokinesis by a quantitative analysis of left ventricular cineangiograms. Circulation 1974;50:121–7.
4. Cole JS, Holland PA, Glaser DH. A semiautomated technique for the rapid evaluation of left ventricular regional wall motion. Cathet Cardiovasc Diagn 1976;2:185–97.
5. Slager CJ, Hooghoudt TEH, Serruys PW, et al. Quantitative assessment of regional left ventricular motion using endocardial landmarks. J Am Coll Cardiol 1986;7:317–26.
6. Chaitman BR, Bristow JD, Rahimtoola SH. Left ventricular wall motion assessed by using fixed external reference systems. Circulation 1973;48:1043–54.
7. Sasayama S, Nonogi H, Fujita M, et al. Analysis of asynchronous wall motion by regional pressure-length loops in patients with coronary artery disease. J Am Coll Cardiol 1984;4:259–67.
8. Fujita M, Sasayama S, Kawai C, Eiho S, Kuwahara M. Automatic processing of cineventriculograms for analysis of regional myocardial function. Circulation 1981;63:1065–74.
9. Sheehan FH, Dodge HT, Mathey DG, Brown BG, Bolson EL, Mitten S. Application of the centerline method: analysis of change in regional left ventricular wall motion in serial studies. IEEE Comput 1982: 9–12.
10. Mathey DG, Sheehan FH, Schofer J, Dodge HT. Time from onset of symptoms to thrombolytic therapy: a major determinant of myocardial salvage in patients with acute transmural infarction. J Am Coll Cardiol 1985;6:518–25.