Assessment of left ventricular function

William C. Sheldon, M.D.

Cleveland, Ohio

In planning a cardiac operation, the key objective should be to accomplish the best possible benefit for the myocardium with the least possible stress. The ultimate objective for most cardiac operations is to preserve and protect myocardial function through correction of the mechanical burden, such as a septal defect, malfunctioning valve, or obstructed coronary artery. In the preoperative evaluation of the cardiac patient, the anesthesiologist wishes to know the basis for the existing burden on the myocardium, its current state of compensation and, if possible, its margin of functional reserve. This information will influence all phases of surgical management: preoperative, intraoperative, and postoperative. There is no single examination or parameter that will provide the anesthesiologist with all that he needs to know.

The simplest and most cost-effective means of evaluating the cardiac patient is a careful review of the history and physical examination by the anesthesiologist who will be responsible for his management. Much can be learned about the state of the myocardium by observing such simple signs as the persistent, nonproductive cough, cold clammy skin, pulsus alternans, among many others. The chest roentgenogram and electrocardiogram should be systematically evaluated rather than the mere ac-

ceptance of the officially recorded interpretations.

A number of "noninvasive methods" are available, which may help supplement the simple clinical observations. The echocardiogram may demonstrate abnormal dilatation of one or more chambers, diminished wall motion, or paradoxical motion of the interventricular septum. The interpretation should be made with caution, however, for the M-mode echocardiogram provides only a pinhole view of the heart. A two-dimensional echocardiogram provides a slightly broader window through which cardiac function can be viewed.

Isotope perfusion studies of the myocardium may demonstrate varying degrees of ischemia if performed during exercise, or myocardial fibrosis if done at rest after sufficient time for equilibration. Gated blood pool radionuclide cine angiography may provide helpful information with regard to transit time for the radionuclide bolus, ejection fraction, and regional wall motion abnormalities, depending upon the number of projections obtained. Interpretation of isotopic studies requires an understanding of the importance of the density of radioactive counts, appropriate correction for background radioactivity, and integration of multiple projections.

Even information regarding myocardial function obtained from cardiac catheterization and angiography requires critical interpretation. Left ventricular end-diastolic pressure is but a crude indicator of the state of compensation of the myocardium. It may be elevated in acute fluid overload, or in the hypertrophied compensated heart, low in the acutely failing myocardium or hypovolemic states, or increased in the ischemic but compensated heart. The arterial-venous oxygen difference may be influenced by noncardiac conditions; and cardiac output, cardiac index, and ejection fraction reflect global myocardial performance. Regional wall motion analysis is less quantitative and may be influenced by localized ischemia or fibrosis, this distinction being of greater importance to the surgeon in planning a bypass graft operation than perhaps the anesthesiologist who is more concerned with total cardiac performance.

Although a comprehensive quantitative evaluation of left ventricular performance may be desirable, overreliance upon quantitative data may be misleading in failing to consider dynamics of left ventricular performance and the varying influence of forces affecting its performance. Even qualitative information permits some estimation regarding the state of the myocardium and its functional reserve. Although the approach to the preoperative analysis of cardiac function and functional reserve may vary among institutions, even the most sophisticated of computerized analyses do not diminish the importance of basic clinical observations. Whatever the state of myocardial function, optimal anesthetic technic should offer optimal protection for the myocardium with minimal risk from manipulation.