Beyond the EKG, to a Hypersensitive Heart Monitor

By ANNE EISENBERG

The familiar electrocardiograms of yearly medical checkups are the routine way to record electrical activity of the heart and detect disorders in its rhythms. But the test is relatively insensitive at pinpointing small areas where there may be problems, since a standard EKG machine samples electrical potential only at a handful of points on the body's surface.

But a new computer-based method developed by a researcher seeks to deliver far more detailed information about the electrical activity of the heart. Instead of a dozen or so electrodes, the technique uses 224 of them, all woven into a chain mail-like vest worn by the patient. The electrode-based recordings are then combined with computerized X-rays taken at the same time.

Algorithms process the data to map the electrical impulses of the heart as they travel through the muscle, revealing the places where cardiac rhythms go awry.

The technique, called electrocardiographic imaging, provides a close approximation of the electrical measurements obtained when doctors thread catheters through the body to the heart and assess electrical activity there directly.

Yoram Rudy, a professor of biomedical engineering at Case Western Reserve University, has developed the method over 20 years. Using the imaging system, he said, "we have noninvasively reconstructed and located initiation sites of arrhythmic activity in the heart with an accuracy of 10 millimeters or better." Normally, he said, detailed information on such activity could be obtained only by putting electrodes in direct contact with the heart.

In the technique, the patient slips on the vest for simultaneous recording. Multiple X-rays are also taken by computer tomography or CT, a technique used to construct three-dimensional images of the heart. Mathematical programs then reconstruct the heart's electrical activities by using the information from the X-rays and the electrocardiograms.

The new method is still in need of validation; the vest used by Dr. Rudy is a prototype, and much clinical testing lies ahead. But when it becomes available, it may offer many advantages. "Dr. Rudy's technique is able to determine the electrical activation of the heart from signals on the body surface," said Dr. William Gregory Stevenson, who directs the clinical cardiac electrophysiology program at Brigham and Women's Hospital in Boston. It is much more accurate than the typical EKG, he said, and yields more information about what's going on in the heart.

"Dr. Rudy and his group recently reported their first use of the method on human subjects in this month's issue of the journal Nature Medicine.

The procedure may one day be useful in helping to identify patients at high risk of life-threatening arrhythmias before a catastrophic incident. Sudden death is the most serious consequence of such arrhythmias, said David A. Lathrop, who leads the arrhythmia and ischemia group at the National Heart, Lung and Blood Institute, which has financed Dr. Rudy's research.

There are about 250,000 cases of sudden cardiac death in the United States each year, Dr. Lathrop said, about 70 percent of them from disturbances in the lower chambers of the heart, the ventricles.

"There's not much warning," he said. Sudden cardiac death occurs within an hour of symptoms like tightness of the chest. Sometimes there are no warning signs at all.

Dr. Rudy's method may one day permit improved images of the electrical status of the heart, Dr. Lathrop said, and identify individuals at risk well before the event occurs. "The problem of sudden death is very real," said Dr. Douglas P. Zipes, head of the division of cardiology at Indiana University School of Medicine and a past president of the American College of Cardiology. "Prob...