EDITORIAL

Dynamic Electromechanical Remodeling of the Left Ventricle

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Epidemiological studies and randomized clinical trials are used to identify the predictive power of risk factors and benefits of interventions among a broad range of conditions that affect public health. In most designs, a marker of risk is measured at a point close in time to the initiation of counting of events or randomization of therapy, and not repeated during the course of the study. This strategy is effective for setting an incident marker of risk from a point in time. However, the single-point, static estimate of risk does not take into consideration the modification of risk over time due to dynamic changes in pathophysiology.

Acute and healing myocardial infarction (MI) is a condition that is uniquely suited to studies of dynamic risk. This disorder is common with public health impact, has well-characterized anatomical, mechanical, and electrophysiological markers, and has a pathophysiology that changes over time. Given its incidence and clinical impact, strategies that will improve individual risk prediction have both patient care and health economic importance.

The major findings related to risk profiling for sudden and nonsudden cardiac death and recurrent MI after an MI emerged from studies carried out in the 1980s.^{1,2} These early studies suggested that markers of risk that occurred during the acute phase of MI (the first 48 hours) were largely predictive of outcomes during the initial hospitalization, perhaps extending through the early convalescent phase of MI. This prognostication occurred in a scientific environment that did not yet recognize the occurrence or impact of remodeling over time, or the possibility that measures made after what

was assumed to be the healing phase might change over a longer time horizon. The patient population that comprised the long-term follow-up groups at that time was also limited by the fact that early intervention strategies for acute MI still resulted in mortality risks as high as 15%, considerably higher than risks in the current era. An additional consequence of this risk is the fact that survivors from what would have been fatal events based on MI size in an earlier era went on to populate what became a larger chronic high-risk population.

The current population of MI survivors might be subject to previously unrecognized dynamic changes in risk over time, based upon longer survivorships and more complex clinical issues, and reflected in changes in markers and their predictive impact. Thus, the notion that single static measures of risk markers, reflecting the extent of damage or electrophysiological instability, are not likely to pertain to the current cohorts of survivors. The fact of remodeling risk, combined with the potential for remodeling intervention, creates a much more complex patient profile that is more likely to be defined by serial measures of appropriate risk markers over time, a strategy that is better suited to the modern concepts of the evolving pathophysiology of the MI survivor. An example of this concept can be derived from the implantable defibrillator data for primary prevention strategies in which it is evident that benefit is time-dependent.³ It appears now that there is a second phase of high risk that would time well with the remodeling process and suggests that delayed measures, perhaps in conjunction with early measures, might provide a better profile of

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risk over time. This concept leads to the strategy of dynamic risk profiling, based on the generally accepted notion that remodeling, whether anatomical, mechanical, or electrical, is an active, time-dependent process and its occurrence (or failure to occur) will affect estimated risks. The benefits of better dynamic risk profiling should result in more specific applications of targeted therapeutic interventions to reduce time-dependent dysfunctional cardiac remodeling and its morbidity and mortality consequences.

Postinfarction dynamic risk involvement can involve anatomic, mechanical, and electrophysiologic risk evaluation early after the acute infarction, and then again at 3 months and 1 year following the index event. Cardiac magnetic resonance imaging is useful in defining the extent of the core infarction and the vulnerable peri-infarct zone. Echocardiography and tissue Doppler imaging provide invaluable information about ventricular chamber size and shape as well as localization of dysfunction and dyssynchrony. There is substantial evidence for postinfarction changes in numerous ECG parameters that can be documented by modern noninvasive electrocardiology techniques including state-of-the-art high-resolution Holter recordings or specialized ECG recordings.⁴ Modern ECG monitoring⁵ utilizes a comprehensive tool for investigat-

ing electrical and neuroendocrine factors that might contribute to cardiac dysfunction and death.

Importantly, using currently available techniques, sequential assessments of the heart after MI can identify emerging signs of early, evolving, and potentially remediable changes in mechanical and/or electrical cardiac performance. More clinical research is needed in this area.

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