

The Origin of Disease and Health

Heart Waves

The Single Solution to Heart Rate Variability and Ischemic Preconditioning

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In the world of medicine are two extraordinary experimental mysteries that intuition at first suggests are totally unrelated. The first mystery, which comes from the field of cardiology, is: Why does a decrease in heart rate variability (HRV) emerge as a single common risk factor for virtually all chronic diseases at all ages? The second mystery, which comes from the field of cardiovascular surgery, is: Why should the process of cyclically clamping and declamping the coronary arteries—called ischemic preconditioning—just prior to clamping them for a prolonged period during coronary surgery protect the myocardium from cellular death?

The first mystery is associated with disease and death, whereas the second promotes survival and life. However, rather than representing opposed phenomena, the two are actually sides of the same coin. Researchers are looking for answers in the same place, within molecular biology. But there is, in fact, another place to look. Moreover, they look for two different answers where, in truth, there is only one.

As a vascular surgeon dealing with life threatening situations, and then as Founding Chairman of the United States Olympic Sports Medicine Council dealing with elite athletes, I had the unique opportunity to consider the behavior of the heart in both

worst-case circumstances of acute distress and intervention in the operating room and in best-case circumstances of sports performance and fitness training on the playing field. By stepping outside of the constraints of each specialty, I was able to discover a completely new understanding of how the heart behaves as a wave - *Heart Waves™*, which further led to a new understanding of how waves truly behave in Nature.

This new understanding of wave behavior explains how the seemingly complex, disparate information of the body's behaviors, molecular biology, and genes is organized into a single coherent picture. I call this the *Wave Theory*.^{1,2}

The theory's implications are vast. It not only solves the two mysteries but also explains the underlying origin of chronic disease; at the same time, it provides the means for prevention and reversal of those diseases and the means for optimizing health, performance, and longevity. This paper presents the *Wave Theory*, previously described in the context of universal law^{1,2}, as it relates to the function of the human heart in biology and medicine.

Mystery No. 1: Why is Low Heart Rate Variability (HRV) Associated With So Many Health and Behavior Disorders?

HRV is a simple measure of the beat-to-beat degree of evenness of consecutive heartbeats. A decrease in HRV means the beat-to-beat time interval is more and more the same. The more even (metronome-like) the frequency changes, the lower the HRV.

Conversely, the more uneven the frequency changes, the greater the HRV.

HRV is easily determined mathematically by measuring the time between successive beat-to-beat R-R intervals of QRS complexes as recorded on an electrocardiographic strip (Figure 1a,b). To measure HRV and heart rates over linear time, each heart-beat cycle of systole and diastole is treated as a dimensionless point. Medicine ignores Nature's cycles of systole and diastole in favor of idealizing and then analyzing the cycles as serial points in a straight line to mathematically measure beat-to-beat heart rate variability. The patterns of natural heart beats are converted into numbers, points, and lines (as if there were gaps from point to point with nothing going on in between). What is lost in this dematerialization of the cyclic heart pattern into abstractions is the natural continuum of the heart beating as a wave (see Figure 1c,d).

Over the last thirty years a decrease in HRV has received increasing attention as a prognostic indicator of risk associated with a variety of chronic diseases, behavioral disorders, mortality, and even aging. The finding of one single risk factor for such a wide variety of problems is unexpected. Historically medicine has searched for a single causal agent—such as a molecular abnormality, a virus, or a defect in a gene—as the etiology of any particular disease. Similarly we tend to think of a specific risk factor as being associated with a particular disease. Consequently the discovery of a single risk factor associated with the widest spectrum of disorders is strong evidence of some underlying connecting phenomenon of disease and health that we have not yet understood.

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