

This Week's Citation Classic

Weissler A M, Harris W S & Schoenfeld C D. Bedside technics for the evaluation of ventricular function in man. *Amer. J. Cardiol.* 23:577-83, 1969. [Dept. Med., Ohio State Univ. Coll. Med., Columbus, OH]

This investigation documented a distinct pattern of change in the systolic time intervals in left ven-tricular decompensation. The ease with which these measures can be obtained prompted their use as quantitative noninvasive measures of cardi-ac performance in man. [The *SCF*[®] indicates that this paper has been cited over 385 times since 1969.]

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"During the 1960s cardiac catheterization emerged as the dominant, and in the minds of many, the only definitive diagnostic modality in cardiovascular medicine. Technology had ad-van-ced to the point that virtually every hemodynamic measure characterizing the perfor-mance of the cardiac chambers could now be determined. So readily available and specific was the physiologic data that few cardiologists raised objection to the inconvenience, discomfort, risk, and expense imposed upon our patients by car-diac catheterization. It was in this setting that I in-troduced the view that valid quantitative physiologic measures of cardiac performance could be derived from recordings of potentials and pulsations at the body's surface. Such an ap-proach could offer many unique clinical advan-tages and could potentially aug-ment and/or replace some cardiac catheterization methods.

"It was at this time that I discovered that of the various measures of cardiac performance the one most often neglected was the determination of the duration of the events of the cardiac cycle. Since the studies of Carl Ludwig, the performance char-acteristics of the heart had been described relative to a constant time base.¹ Time remained the independent variable relative to which measures of pressure, volume, and flow were determined. I hypothesized that in order to main-tain adequate performance through a wide range of heart rate and loading conditions, the heart, a reciprocating pump, must have time to fill and time to empty. Thus, just as alterations in chamber pressure, contractile volume, and blood flow oc-cur in left ventricular decompensation, the time intervals of the contractile cycle might

change as well. That such changes may reflect alterations in cardiac performance was postulated by earlier in-vestigators including Bowen,² Lombard and Cope,³ Katz and Feil,⁴ and Blumberger.⁵ It had not been established, however, that changes in the temporal dynamics of the cardiac cycle paralleled other hemodynamic consequences of left ventric-ular decompensation or retained any quantitative relationship to ventricular performance.

"The present paper was based on our previous studies⁶ documenting that prolongation of the preejection phase (PEP) and shortening of the ejec-tion time (LVET) in cardiac decompensation was closely related to abnormalities in other measures of cardiac performance. In this work my col-leagues Willard S. Harris, Clyde D. Schoenfeld, and I proposed the use of the ratio PEP/LVET, as a convenient quantitative expression of the overall changes in systolic intervals accompanying left ventricular decompensation. This PEP/LVET ratio is now the most commonly applied measure of systolic time intervals for the evaluation of global left ventricular function in man. It was in this paper, too, that we coined the currently popular term 'noninvasive' as a general expression of this diagnostic concept. This paper prompted several later investigations which verified the close rela-tionship between the systolic time intervals and other measures of cardiac chamber performance obtained by cardiac catheterization.

"In perspective, the systolic time intervals con-stituted an initial attempt to quantitate altered ventricular performance in cardiovascular disease by noninvasive technics. Almost simultaneous with their development, the echocardiographic approach to noninvasive diagnosis emerged and, soon thereafter, nuclear methods for defining altered ventricular contractile performance were introduced. These three independent approaches now stand as prototypes for the development of the new discipline of noninvasive cardiovascular medicine, one which promises to add significantly to our knowledge of the physiologic disorders which accompany cardiovascular disease and will lend a more scientific and critical approach to the clinical management of cardiovascular disease. I published a more recent review of the subject in the *New England Journal of Medicine*.⁷

1. Ludwig C. *Arch. Anat. Physiol. Wiss. Med.* 1847:242, 1847.
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4. Katz L N & Fell H S. *Arch. Intern. Med.* 32:672-92, 1923.
5. Blumberger K. *Ergeb. Inn. Med. Kinderheilk.* 62:424-531, 1942.
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