EDITORIAL

Assessment of Cardiac Autonomic Regulation

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Ann Noninvasive Electrocardiol 2011;16(4):319–320

This comment considers experimental design and data processing technologies suitable to studies investigating cardiac autonomic status and its changes. The aim of the editorial is to explain that physiologic studies of cardiac autonomic regulation, and autonomic cardiac risk stratification benefit from both different experimental protocols and distinct data processing techniques.

The autonomic system plays an important role in maintaining the homeostasis of the organism. In man, the situation is complicated by the interaction between the autonomic system and psychological and psychosocial reactions. The autonomic system thus responds to a broad array of physiologic conditions and to variety of pathologies.

Compared to other organs, cardiac autonomic regulation is more easily studied. This is because of the oscillatory nature of the cardiovascular physiology and the practicality of obtaining accurate beat-to-beat sequences of blood pressure readings and electrocardiographic measurements. The interest in studying cardiac autonomic regulation has been further advanced by observations relating cardiac autonomic reflexes to risk stratification of cardiac patients.

The two facets of studying cardiac autonomic regulation, i.e., the physiologic investigations and the cardiac risk assessment studies, have also been reflected in the development of investigative methodologies. Seminal animal and human studies linked the oscillations of cardiac periodicity to the autonomic nervous system. These initial physiologic investigations utilized standard spectral analysis of the series of cardiac cycle durations and

led to the development of the concept of high- and low-frequency components of heart rate variability.¹ In addition, physiologic studies utilized other analytical techniques frequently developed out of the necessity of processing heart period signals not suitable for the standard spectral analysis.² Still, spectral analysis of cardiac tachograms obtained under standardized conditions seems to remain a reasonable technology for the purposes of physiologic studies.

Cardiac risk stratification studies utilizing autonomic manifestations appeared simultaneously with the physiologic investigations. Although attempts were made to use the cardiac cycle spectral analysis for risk stratification,³ the majority of cardiac risk stratification studies aimed not only at the quantification of essential autonomic reflexes but also at capturing the autonomic responsiveness to provocations. Indeed, the power of autonomic system based cardiac risk stratification is increased with methodologies developed particularly for this purpose.^{4,5}

While the autonomic risk indices are influenced by drugs, physiologic circumstances, and pathologies,⁴ these indices are not necessarily particularly suited for physiologic studies of conditions influencing cardiac autonomic regulation. While the integration of intrinsic reflexes and external provocations provides characterization of the overall cardiac autonomic status and thus reasonably predicts outcome, the interplay between the different reflexes and provocations makes the details physiologic interpretation difficult.

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In this issue of the Journal, Celik et al. report on the autonomic influence of hypothyroidism both before and after treatment.⁶ They compared hypothyroid patients with healthy controls. Similar differences between the two groups were found both before and after thyroid replacement therapy. Celik et al. conclude that hypothyroidism may cause abnormalities in cardiac autonomic function.

While these observations are of interest, it is rather unfortunate that risk stratification markers were investigated instead of focused indices allowing detailed physiologic interpretation. Long-term Holters that Celik et al. used can only be obtained without strict standardization of the surrounding conditions and circumstances. For example, it is not obvious whether systemic differences between hypothyroid patients and healthy subjects make them to perceive the external stimuli differently, whether the disease has any subclinical mental influence, whether the sleep quality matched in both groups, etc. Hence, the practical implications of the report by Celik et al. are limited to the fact that when risk stratifying cardiac patients, those with thyroid abnormalities, should be considered separately.

In terms of physiologic interpretation, the study by Celik et al. does not seem to be the best model for future investigations. If hypothyroid patients (and matching healthy subjects) were subjected to focused investigations, e.g., spectral analysis of cardiac tachograms obtained during staged head-up

tilt or strictly controlled postural tests, the results would have been easier to interpret and also more focused and detailed. The simplest of these possibilities is perhaps the controlled postural testing.

Future studies of the cardiac autonomic status and regulation should carefully consider whether their primary goals are enhanced physiologic understanding or cardiac risk assessment. The research techniques and data processing methods should be selected accordingly.

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