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Relationship among respiratory activity, cardiovascular variables and their variability in health and disease: a focus on the neural autonomic control of cardiovascular system as assessed by power spectrum analysis methodologies and muscle sympathetic nerve activity direct recording.

Abstract

From the functional standpoint, the cardiovascular neural control can be modeled as a dual feed-back system. Excitatory positive feed-back mechanisms depend on sympathetic afferents projecting to the neural cord and efferent fibers innervating, among the different organs, the heart and vessels. Inhibitory negative feed-back mechanisms rely on baroreceptors and vagal afferents and efferent neural fibers connecting the bulbar structures with the heart. A further crucial modulation is exerted by cortical structures and respiratory activity. As a result of the instantaneous relationship between excitatory sympathetic and inhibitory vagal influences on the sinoatrial node activity, the heart period oscillates on a beat by beat basis. Similarly, arterial pressure is characterized by spontaneous, neurally mediated, oscillations with a periodicity of 10 seconds.

1. The differential control of the mean value of heart rate, blood pressure and muscle sympathetic nerve activity (MSNA) and the frequency content of their spontaneous variability. Physiological conditions characterized by a sympathetic excitation such as the morning wake up or the gravitational stimulation, mimicked by the lower body negative pressure, will be considered. Neurally mediated syncope, baroreceptor failure and Parkinson's disease will be the examples showing that an alteration of the oscillatory pattern of the cardiovascular variables may precede the changes of the mean values of such variables. This peculiar pattern may result in valuable clinical information. Univariate and bivariate power spectrum analyses of RR interval, arterial pressure, MSNA and respiratory activity will provide a useful tool to explore such a complexity.
2. The study of the laterality of the post-ganglionic sympathetic nerve discharge activity at rest will emphasize the crucial role played by res-

piratory activity in modulating the efferent sympathetic vasomotor control. Concomitant right and left MSNA recordings, obtained from the peroneal nerves of healthy volunteers by microneurography technique, enabled to highlight a right prevalence of the normalized amplitude of sympathetic burst. Interestingly enough, this was observed in spite of similarities in the bursts rate of right and left MSNA recordings. In order to avoid the confounding effects of different breathing frequencies on MSNA, we paced respiratory frequency at 0.25 Hz and referred all experimental conditions to controlled breathing. Finally, given the crucial role played by arterial carotid baroreceptors in modulating neural sympathetic discharge activity and its variability, we also evaluated whether a unilateral stimulation of these structures might result in any sided prevalence of MSNA. To this aim, single-sided and bilateral 0.1 Hz sinusoidal neck suction procedures were used to rhythmically unload carotid baroreceptors.