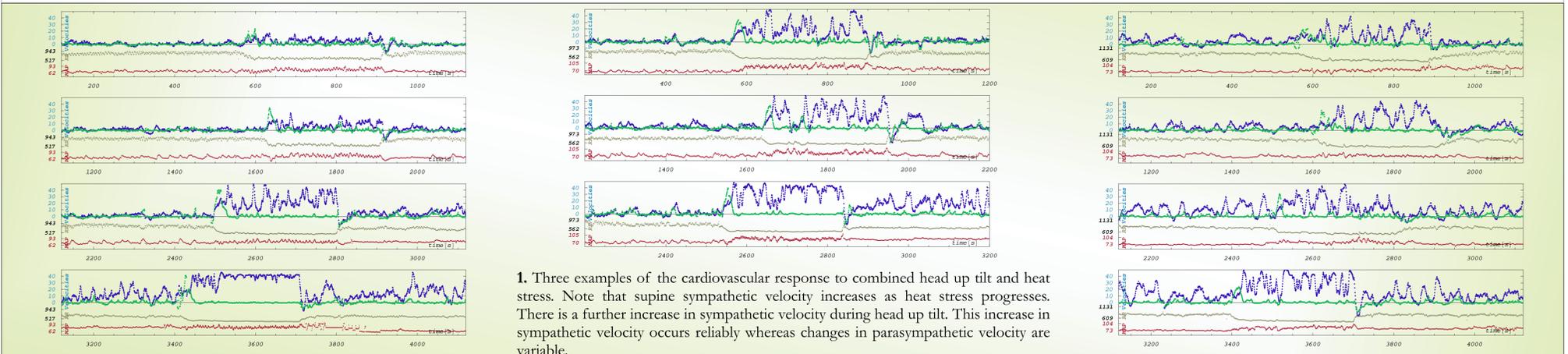
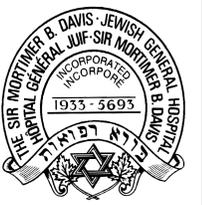


Evaluation of a Novel Non Model Driven Assessment of Cardiac Autonomic Activity:

Response to Combined Graded Orthostatic and Heat Stress

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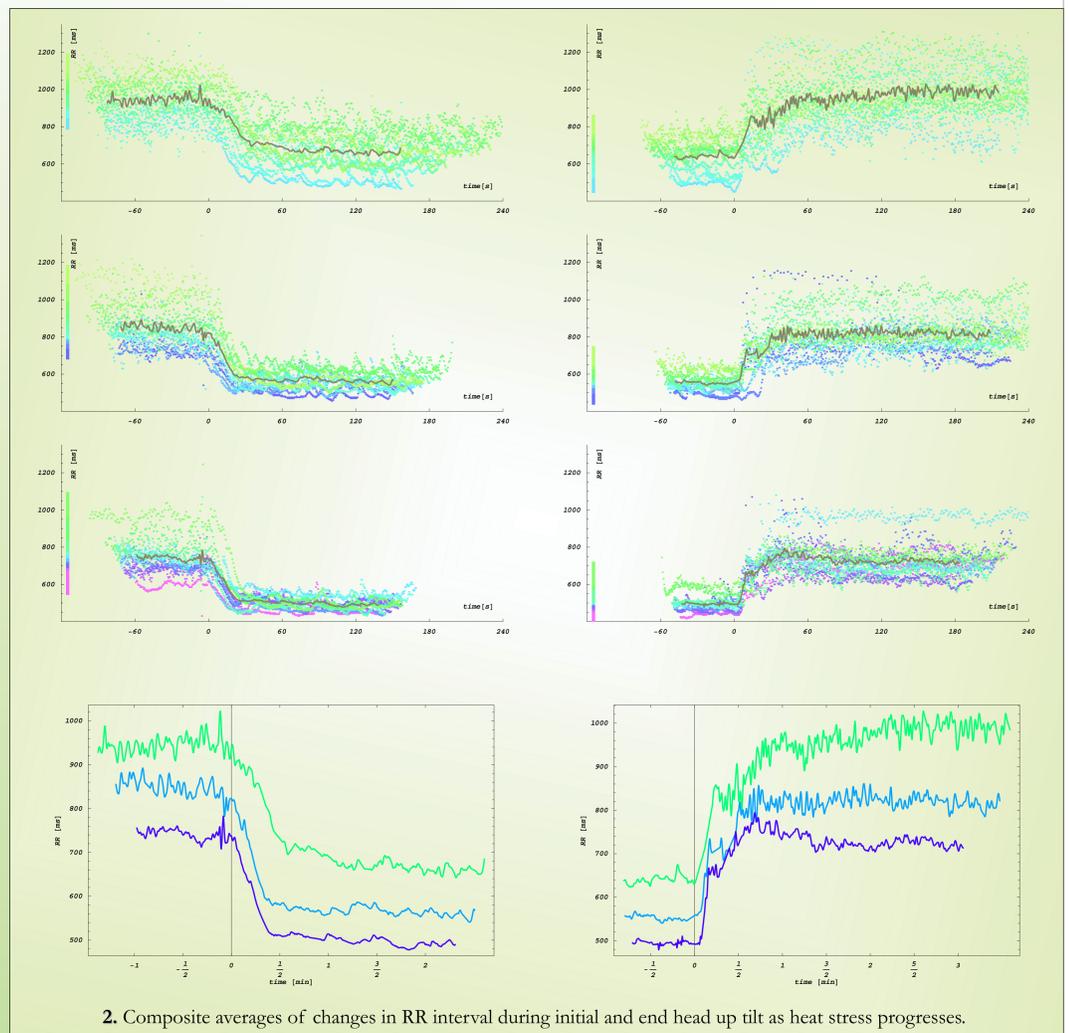
1. Three examples of the cardiovascular response to combined head up tilt and heat stress. Note that supine sympathetic velocity increases as heat stress progresses. There is a further increase in sympathetic velocity during head up tilt. This increase in sympathetic velocity occurs reliably whereas changes in parasympathetic velocity are variable.

Objective: To determine the ability of a novel methodology to measure cardiac sympathetic modulation under relevant physiologic conditions.

Background: We have previously reported results using a novel time domain method that decomposes beat-to-beat changes in R-R intervals (RRI) into 2 continuous sets of causal activities that reflect the parasympathetic and sympathetic components of cardiac autonomic activity. We have found that our measure of cardiac vagal activity is robust. However our measure of sympathetic activity is critically dependent on the presence of cardiovagal activity and if this activity is eliminated, baseline sympathetic velocity shifts upward and fluctuations in sympathetic velocity are attenuated.

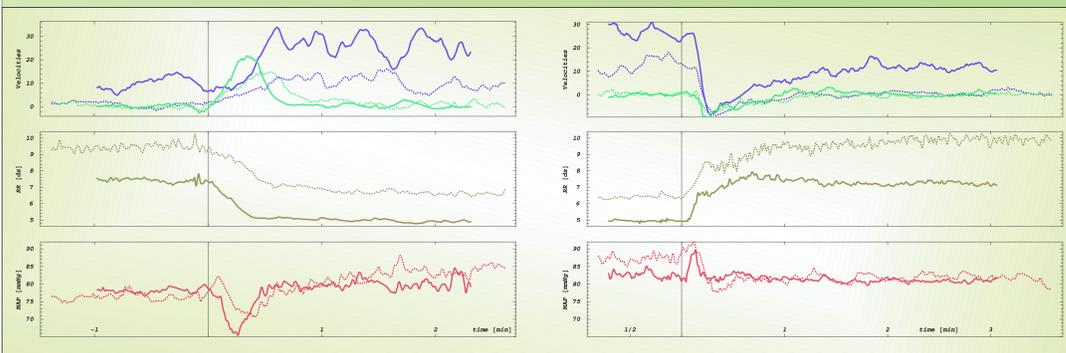
Design/Methods: We reanalyzed data from 13 normal subjects during 5 minutes of head-up tilt (HUT) alone or in combination with heat stress achieved by perfusing a tube-lined suit with warm water. The RRI response to HUT alone and during HUT combined with moderate or severe heat stress was measured.

Results: HUT alone or following heat stress incrementally decreased RRI. During HUT alone, sympathetic velocity increased without substantial reduction in parasympathetic velocity. During heat stress, RRI incrementally decreased. Baseline sympathetic velocity increased to levels approximately equivalent to that obtained during HUT without heat stress again without substantial change in parasympathetic velocity. During combined HUT and heat stress, sympathetic velocity substantially increased to a level approximately threefold that obtained during HUT alone.



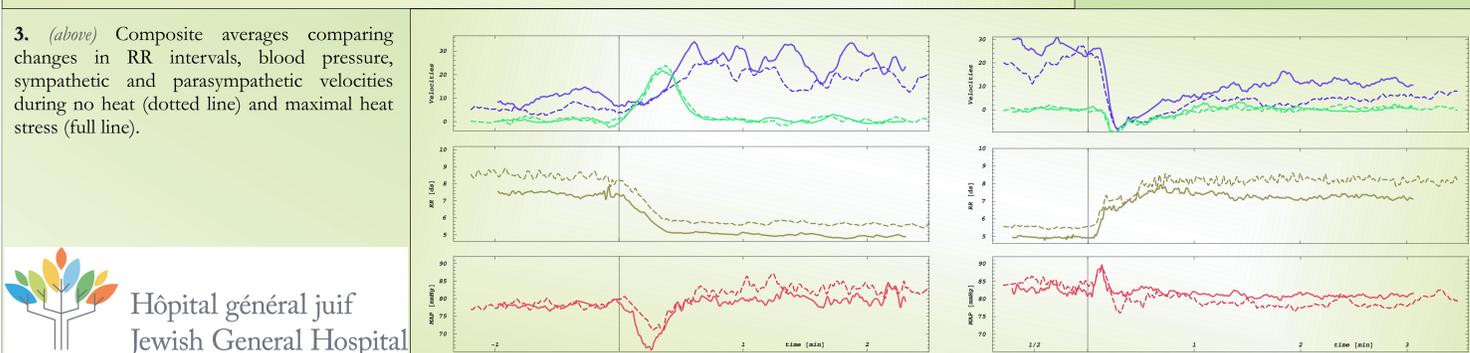
2. Composite averages of changes in RR interval during initial and end head up tilt as heat stress progresses.

There was no change in parasympathetic velocity between moderate and severe heat stress although sympathetic velocity continued to increase. In all 3 conditions coactivation of parasympathetic and sympathetic velocity was observed during the transition to full HUT.



3. (above) Composite averages comparing changes in RR intervals, blood pressure, sympathetic and parasympathetic velocities during no heat (dotted line) and maximal heat stress (full line).

Conclusions/Relevance: These observations provide confirmation of the method's ability to rapidly detect changes in spontaneous cardiac sympathetic activity under physiologically relevant increases in orthostatic stress. Our measure of this activity is limited only when cardiovagal activity is absent.



4. (left) Composite averages comparing changes in RR intervals, blood pressure, sympathetic and parasympathetic velocities during moderate (dashed line) and maximal heat stress (full line).