Hello all,

Welcome to the March 2010 ***COHERENCE Newsletter***. This month I'm pleased to discuss the final outcome of *Blood Pressure vs. Heart Rate Variability,* a study that Dee Edmonson and I conducted over the last several years. The study has 2 goals. Part I of the effort is to characterize the relationship between blood pressure and heart rate variability. Part II is to assess the impact of 8-12 minutes of Coherent Breathing with HRV biofeedback on blood pressure. In this newsletter we'll focus on Part I. The entire Part I report is available in Powerpoint format as an Adobe .pdf for the low price of $4.95 here. Part II will be published a bit later. The theoretical basis of the study is this...

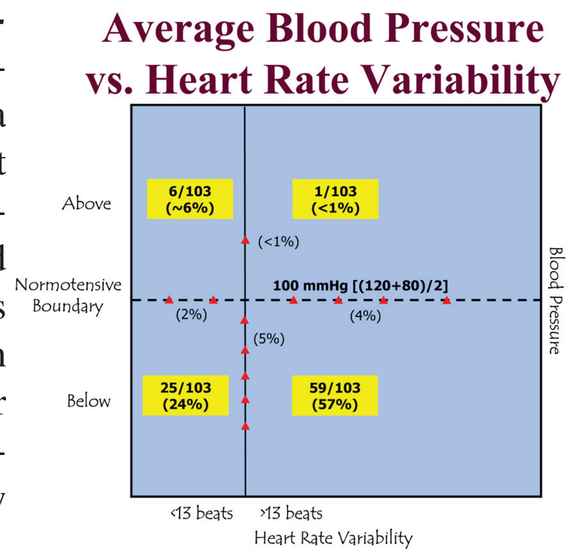

Figure 1 - The Data
Average blood pressure = [systolic+diastolic]/2

Resonant breathing results in the phenomenon of the respiratory arterial pressure wave (or more completely the arterio-venous "Valsalva Wave") which is known to rise and fall by 20mmHg. (*Medical Physiology*, Guyton & Hall, 2002). The respiratory wave is depicted in the first and second red graphs at the top of Figure 2. (Zoom in.)

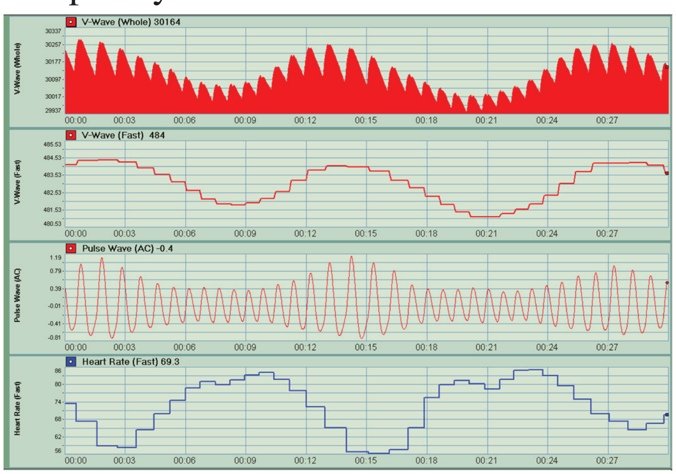

Figure 2 - Valsalva Wave (top), HRV (bottom)

This respiratory arterio-venous wave is believed to be the physiological impetus for "breathing induced heart rate variability", the bottom blue graph. Changes in blood flow and pressure resulting principally from respiration are detected by baroreceptors, specialized neurons distributed throughout major arteries. The autonomic nervous system uses baroreceptor input to coordinate both heart rate and vascular capacity to facilitate the respiratory wave. It is noted that other factors, e.g. stretch receptors in the chest, heart, etc. are also involved in this autonomic sensing and regulation.

When the arterio-venous wave is low, heart rate variability is low; when the arterio-venous wave is high, HRV is high. Neither the respiratory wave or its result, HRV, can be high if arteries are not relaxed during the exhalation phase of breathing. If arteries are relaxed during the exhalation phase of breathing, blood pressure cannot be high. Therefore, if correct, there should be an inverse correlation between HRV and blood pressure, i.e. high blood pressure and high HRV should be mutually exclusive, this being our Part I hypothesis.

The study consists of 103 instances of data collected from 42 clients after each engaged in 8-12 minutes of Coherent Breathing with HRV biofeedback. Because the Part I goal is simply to understand the real time relationship between blood pressure and HRV, both of which are considered variables, each assessment can be considered unique. It should be noted that 15/23 or 65% of hypertensives no longer demonstrated hypertensive pressures after the 8-12 period.

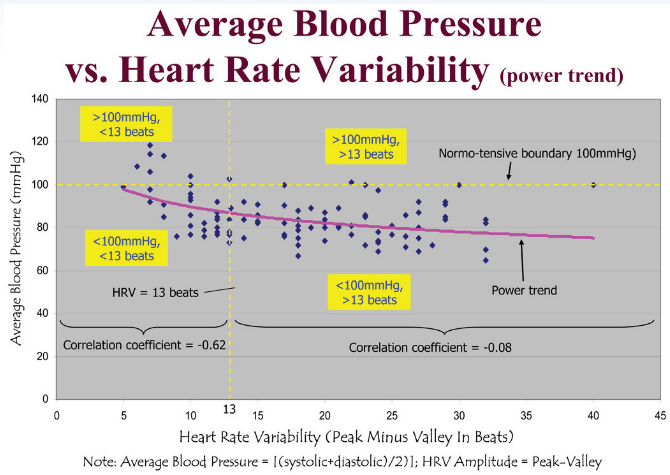

Figure 3 - Correlation above and below 13 beats

We can see from either Figure 1 or Figure 3 to the right, that all of the data instances fall into the upper left, lower left, or lower right quadrants. There is one instance in the upper right but it is extremely close to the normo-tensive boundary of 100 mmHg. From this we can conclude that there are virtually no instances where average blood pressure is above normotensive and heart rate variability is above 13 beats. (HRV is measured in beats difference between the peak heart rate and the valley heart rate - see the blue graph of Figure 2 for an example.)

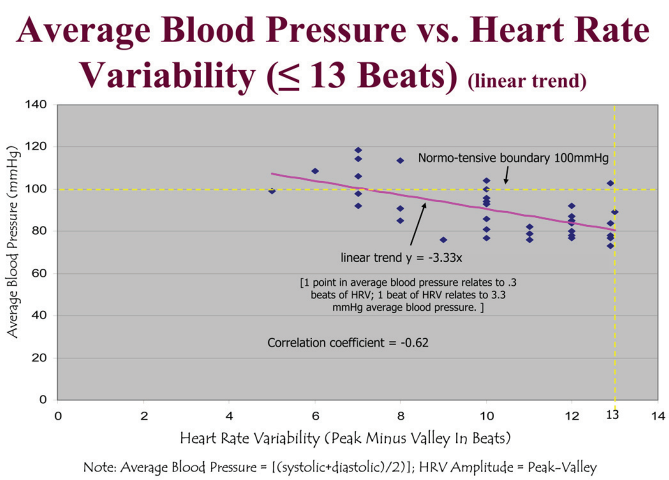

Figure 4 - Linear trend ≤13 beats

The power trend line of Figure 3 curves gently upward as we move to the left, demonstrating stronger effect and nonlinearity in the relationship. In fact, if segmented there is a very dramatic difference in the correlation between blood pressure and HRV to the left and right of 13 beats, the correlation coefficient ≤13 beats being -0.62 and the correlation coefficient >13 beats being -0.05.

The linear trendline of Figure 4 demonstrates the strength of the effect ≤13 where we see that 1mmHg in average blood pressure relates to .3 beats of HRV; conversely, 1 beat of HRV relates to 3.3 mmHg average blood pressure. Again, please zoom in to see the graphic more clearly.

The large difference in correlation below vs. above 13 beats suggests that the physiological mechanisms of blood pressure and HRV are closely linked in lower HRV ranges and less so in higher HRV ranges. Additional research to confirm these results and further characterize this “range” is warranted. The data is reasonably supportive of the Part I hypothesis that high blood pressure and high HRV are mutually exclusive as there are no instances where blood pressure is above normotensive and HRV is above 20 beats (our “hi” HRV boundary). The full report also presents systolic and diastolic pressures and their correlation with HRV.

Thank you for your consideration,

Stephen Elliott & Dee Edmonson