COHERENT BREATHING®

VOLUME 1, ISSUE 3 - OCTOBER 2018

Hello all,

Welcome to Volume 1, Issue 3 of COHERENT BREATHING, the new YouTube channel dedicated to the art and science of Coherent Breathing. Issue 3 begins where Issue 2, ***Coherent Breathing & Exercise*** ended. There we observed the heart rate variability (HRV cycle) fall into phase alignment with the Valsalva Wave as exercise ramped up and it remained aligned for the duration of exercise.

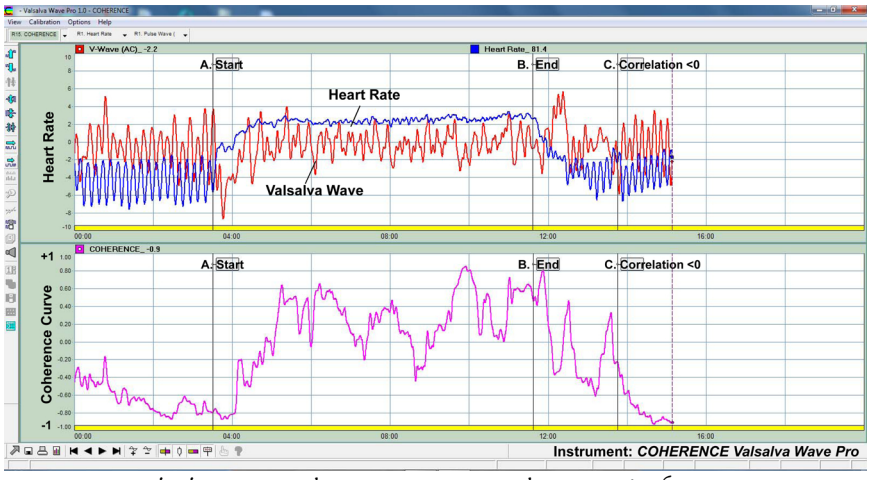

Figure 1: Valsalva Wave, heart rate, and coherence before and during and after exercise (observed at ear lobe).

Relating to Issue 2, Figure 1 of this issue demonstrates the entire period: ~3.5 minutes of Coherent Breathing, followed by ~8 minutes of exercise, followed by ~3.5 minutes of cool down, where we see the HRV cycle demonstrate 180 degree synchrony with the Valsalva Wave, followed by the HRV cycle approaching zero degree phase alignment between the two during exercise, and then the relationship returning to near 180 degree phase alignment during cool down, respectively. The Coherence Curve (Resonance) tells the story where -1 indicates 180 degree phase alignment and +1 indicates 0 degree phase alignment. During exercise we see the Coherence Curve dithering in the positive range with peaks hitting +.8. In short, this indicates that the HRV cycle is approaching phase alignment with the Valsalva Wave. When exercise ends the phase alignment returns to near 180 degrees, indicative of Coherent Breathing and resonance while at rest or semi-activity.

I posit that the purpose of this alignment during exercise is to increase fluid flow throughout the body, particularly to working muscles, but that this wave action hydrates, nourishes, and cleanses all of the cells of the body, one of its results being perspiration, a sign that subtle fluid pressures and flows are making their way across the capillary membrane and through the interstitium, ultimately arriving at the surface of the skin. We tend not to give perspiration much thought – if its hot, we sweat. If we work out we sweat. So, why sweat it? *Exercise is generally considered to be the single thing that we can do that aids all health conditions, given that we are able to perform the exercise of interest safely.* (Of course, if we're recovering from a sprained ankle, the ankle may need rest and healing time before we begin exercising it.)

Many health benefits are attributed to exercise including healthy metabolism, lower adipose tissue, stronger bones, reduced risk of cardiovascular disease, improved mental acuity, and improved mood. Exercise is also found to improve vagal tone, lower average heart rate, and "vascular remodeling", enlargement of blood vessels[1]. To me, the interesting question is why? Researching this question, we find many answers, *all except one* – this being that *exercise requires the diaphragm to move*, i.e. it requires us to *breathe* whether we are intent on it, conscious of it or not – this is the automagical governance of the autonomic nervous system at work. The mechanics of it are: a) subject the body to "work", b) the autonomic nervous system (looking after the totality

of bodily functioning including energy production and preserving the viability of the cellular environment) asserts motor control of the diaphragm via the phrenic nerve, causing the diaphragm to flex (inhalation) and relax (exhalation). I estimate the movement of the diaphragm with range doubles the rate of blood flow in the body by adding the additional motive force of the thoracic pump, generating wave action in the circulation, where without diaphragm movement there is no wave action. There are 5L of blood in the average adult body. It is generally accepted that this 5L makes its way through the circulatory system 1 time per minute. When we exercise the rate of blood flow must increase to service working tissues and respective cells, hence both heart rate and breathing rate increase. We tend to think that the breathing rate increases simply to facilitate an increase in gas exchange, carbon dioxide for oxygen. However I argue that *breathing is principally a circulatory function during which gas exchange occurs*. The fundamental reason that breathing rate increases during exercise is to facilitate increased blood flow and a resultant increase in fluid exchange throughout the body. Of course gas is exchanged during the process.

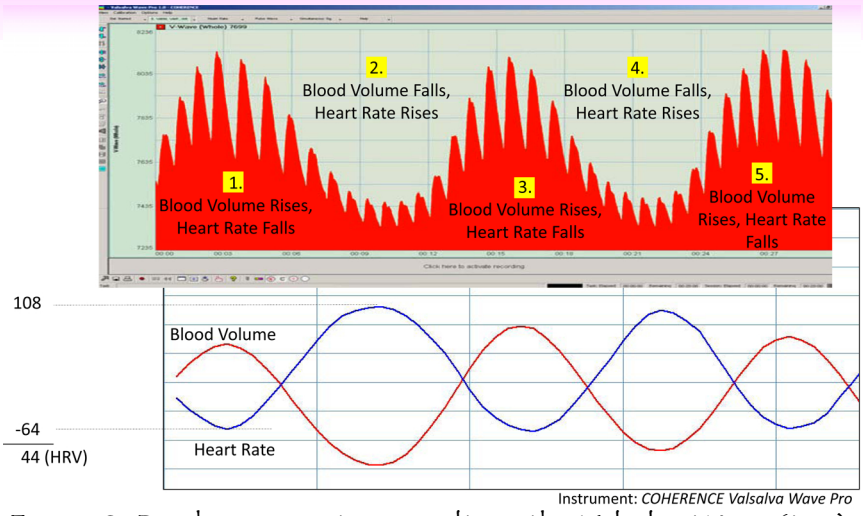

Figure 2: Diaphragm motion results in the Valsalva Wave (top). The heart rate synchronizes with diaphragm motion = HRV.

Using the diaphragm with viable range, e.g. 50% or more, generates the wave and facilitates increased circulation even when we are at rest or semi-activity, as I am now while writing this article. I have argued that the human diaphragm and the conscious control we have thereof was an evolutionary necessity because we, humans, the genus *homo*, are upright beings. Because we are upright, our circulatory systems must overcome the force of gravity acting on the blood and all fluids in the body, totaling 42 liters. The wave generated by diaphragm movement is necessary to move blood upward to the head and brain which occurs with exhalation, and is equally necessary to move blood upward from the legs and feet during inhalation. In this regard we are no different than the giraffe – the extreme case of land dwelling mammalian verticality.

This proposed doubling of the rate of blood flow happens when we move the diaphragm with range, whether we are actively exercising the arms and legs or not! Remember that the diaphragm itself is a large powerful muscle, by moving it consciously we are exercising, even if the arms and legs are still. Recognition of the "thoracic pump" and its contribution to circulation remain largely unknown to western medicine as well as in the sports field – where hydration is recognized as being super critical to performance but the mechanism by which hydration is distributed in the body is not.

Thank you for your interest,

Stephen Elliott, President, COHERENCE LLC

[1] Beere, Glogov, Zarins, 1992, *Arteriosclerosis, Thrombosis, and Vascular Biology,* 12 (11), 1245-53.

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