

What Is Cardiopulmonary Resonance – A Theory (Part II)

Recall that we ended the May Newsletter with this discussion.....

“relative to the breathing cycle, blood volume and arterial pressure rise coincident with exhalation and fall coincident with inhalation, but how? If heart rate is not the primary determinant of blood volume and arterial pressure, what is?”

In the 2nd edition of *The New Science of Breathing* I advocate the theory that it is in fact “breathing”. The mechanical action of breathing, in combination with autonomic nervous system regulation, generates a blood wave that rises with exhalation and falls with inhalation – arterial pressure rises and falls with blood volume. Guyton and Hall refer to this phenomenon as the respiratory arterial pressure wave. (See *Medical Physiology Tenth Edition*.) This blood volume wave can actually be observed using a specific type of plethysmograph. (A plethysmograph allows us to observe and measure changes in blood density and volume non-invasively.)

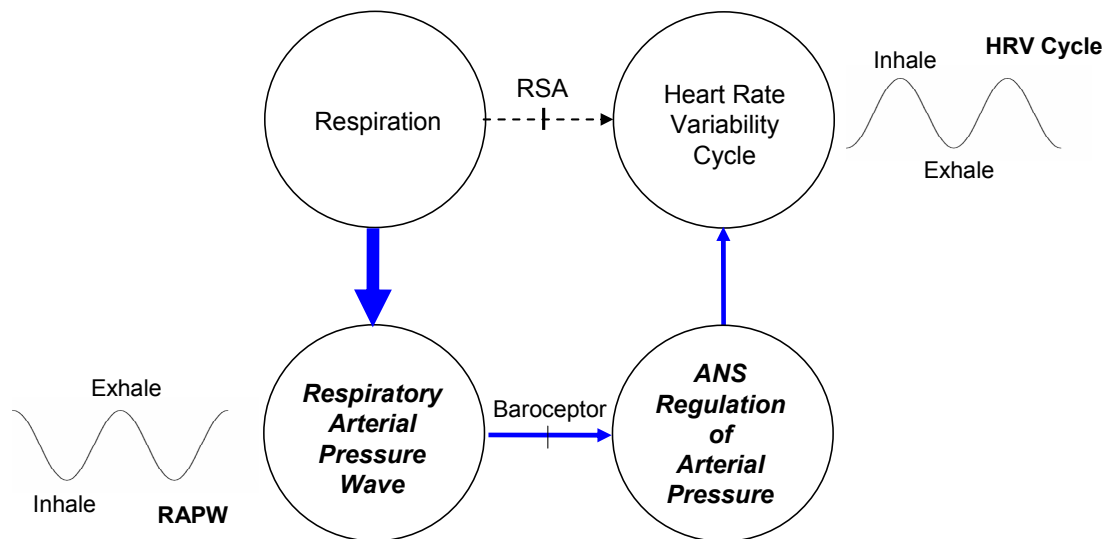


Figure 1: “Breathing” generates the respiratory arterial pressure wave

This wave is generated by a fascinating process that is described in some detail in *The New Science of Breathing* and in the presentation, [New Science of Breathing- Part I, AAPB 2007](http://www.coherence.com/publications_html_production.htm) available at: http://www.coherence.com/publications_html_production.htm. To keep a longer story shorter, the baroreceptor reflex and autonomic nervous system monitor this process working in opposition to the respiratory arterial pressure wave.

When we exhale, arterial blood volume and pressure increase – the autonomic nervous system responds to this increase by facilitating a pressure decrease. This is accomplished by decreasing the heart rate and dilating arteries. When we inhale, arterial blood volume and pressure decrease – the autonomic nervous system facilitates a pressure increase by increasing heart rate and constricting arteries. During diaphragmatic pulmonary resonance, this heart rate increase and decrease is the phenomenon we know as the heart rate variability (HRV) cycle, heart rate increasing with inhalation and decreasing with exhalation, consistent with the relationship we know as respiratory sinus arrhythmia.

The amplitude of the heart rate variability cycle relates strongly to the magnitude of the respiratory arterial pressure wave. And, for this reason, ideal “resonance” results in a heart rate variability cycle of maximal amplitude.

So what is resonance? Resonance is the ideal combination of breathing frequency, breathing depth and relaxation that results in a respiratory arterial pressure wave of maximal magnitude.

The profoundly important thing about this is that blood flow and arterial pressure, to a large extent, govern autonomic status. Or the reverse, governance of blood flow and arterial pressure is a highest priority task for the autonomic nervous system. This is understandable since cell life and death is at stake.

It appears that the autonomic nervous system desires the presence of the respiratory arterial pressure wave. Why?

- a) Because the respiratory arterial pressure wave moves blood in the body, i.e. it insures effective circulation. It is my conjecture that when we breathe “coherently”, 75% of the blood in the body circulates every 60 seconds, even though we are in a state of rest or sedentary activity!
- b) Because it represents the state of optimal efficiency – homeostasis. In this state, the action of the diaphragm and thoracic cavity assume a large part of the burden of generating and sustaining blood flow and pressure, offloading the heart and cardiovascular system of this responsibility. Again, to understand more about this please access the above referenced presentation.

So what happens when the respiratory arterial pressure wave is absent?

We’ll explore this question in the next COHERENCE Newsletter.

Point of Interest: The Calming Power of Coherent Breathing

If one thing can be said about Coherent Breathing, it is that it elicits a deep state of calm and relaxation. It's hard to understand the profundity of this state until you have experienced it. In yoga, this state is referred to as "pratyahara", meaning "withdrawal of the senses", or "sukshma", meaning "subtle awareness". This is the "alpha-theta state" that we often see clients enter during a therapeutic session where alpha brainwaves become prominent, soon followed by prominence of both alpha and theta frequencies. This is a very healing and rejuvenating experience. Once you know how to do it, even 10 minutes will leave you feeling relaxed and refreshed.

I am going to tell you how to access this state quickly and easily. However, I must first advise you that if you are not familiar with meditation or deep relaxation it may seem a little foreign and disconcerting at first. But fear not, it is a perfectly natural experience for all of us to have. I hold that it was a very normal experience for our pre-civilization ancestors.

OK, it's this easy.....

- 1) Position yourself comfortably with your back supported. I suggest either reclining at a 45 degree angle or lying on the floor. The yoga posture Shavasana is fine. It is imperative that abdominal muscles be allowed to relax fully.
- 2) Begin Coherent Breathing. Keep the volume relatively low.
- 3) Relax your eyes, allowing them to gently close. Other than breathing, remain perfectly still. Don't move a finger or bat an eyelid. You may have the impulse to squirm—ignore it and stay focused on breathing.
- 4) Relax consciously with exhalation, especially the chest and diaphragm. If you wish, also consciously relax other "bridges" (from top to bottom).
- 5) Thoughts will come to mind. It's OK to either pay attention to them or not. However, it is not OK to lose your focus on breathing. Therefore, if you do pay attention to your thoughts, you must do so while you continue paying attention to your breathing.

- 6) Typically, within 8-10 minutes you will begin to experience dramatic changes in body sensation. Stay awake and remain focused on synchronizing your breathing with the recording. However, do not strain to stay awake. It is better to fall asleep than to strain.
- 7) Practice this regularly. With practice you will be able to go deeper and deeper, yet remain awake. This is meditation.
- 8) Also, as you become proficient in eliciting this deep parasympathetic state, you can bring it rapidly into your waking daily life whenever and to the degree you wish, simply by taking a few conscious breaths.

Its that easy!

The End