PRI and Equine Biomechanics/Neuorology/Respiration - Part I

Locomotor Respiratory Coupling

I continue to dive deeper into the physiology, anatomy, and biomechanics of both horse and rider, in a passionate effort to understand how 2 asymmetrical beings come together to produce fluid, balanced, floating movement in the world of equestrian disciplines. This is a rather lofty goal I have set for myself, because this type of movement is rarely achieved, EVEN at the elite levels of Dressage.

All 4 experiences of 1) becoming PRT certified, 2) being a PRI Vision and PT patient, 3) retraining myself to run with proper alternating, reciprocating movement, and 4) taking Vaulting and Dressage lessons, have been invaluable in terms of my understanding what the rider needs to do with her body to effectively communicate with the horse. I am still learning, as I have been told and am starting to realize, that this process is a journey. There are innumerable nuances to riding "in lightness". I have found riding Dressage both intellectually and physically stimulating, which is probably why I am becoming addicted.

So, as I am much less schooled in everything "horse", I've been studying since I began this endeavor. I am starting to integrate some pieces of information now (of course one question answered always lead to another question) ☺ However, I've found much of what I have learned thus far very interesting with respect to PRI and thought the PRI community would also find it so.

Locomotor-Respiratory Coupling in the Horse (Doesn't this sound familiar? "walking is breathing and breathing is walking")

The following excerpts are quoted from *"Conditioning Sport Horses"* by Hilary M. Clayton, BVMS, PhD, MRCVS (world-renowned Equine Vet)

> "Both inspiration and expiration are biphasic in horses, comprising passive and active components."
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> "At a walk and, to a certain extent at a trot and pace, the horse selects an appropriate respiratory rate for the intensity of exercise…1:2, 1:3 or 2:3. In the canter and gallop, however, the respiratory rate is usually coupled to the stride rate with a 1:1 ratio. " (one complete breath : one complete stride)
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> "The energy used to drive respiration increases markedly with the intensity of the exercise. **In energetic terms the most economical breathing strategy minimizes the**

muscular effort of respiration. **Horses accomplish this using a phenomenon called locomotor-respiratory coupling (LRC), in which respiration is driven by the locomotor forces associated with weight-bearing on the front limbs, the pressure of the abdominal organs against the diaphragm, and changes in the orientation of the body axis."**

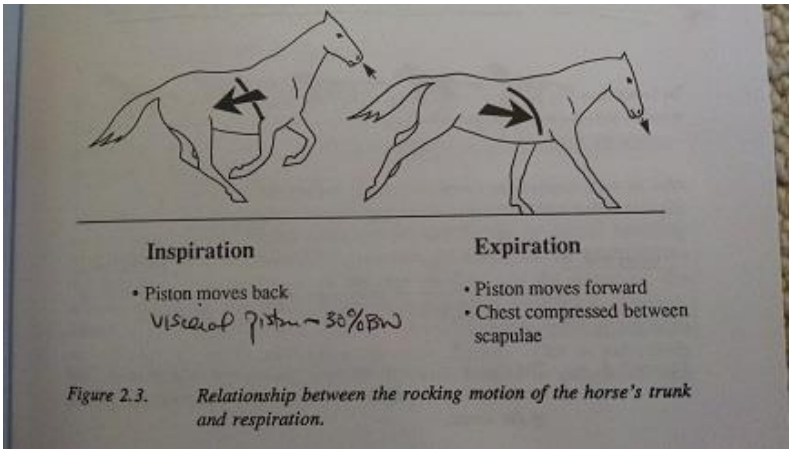

Figure 1. LRC in the Canter

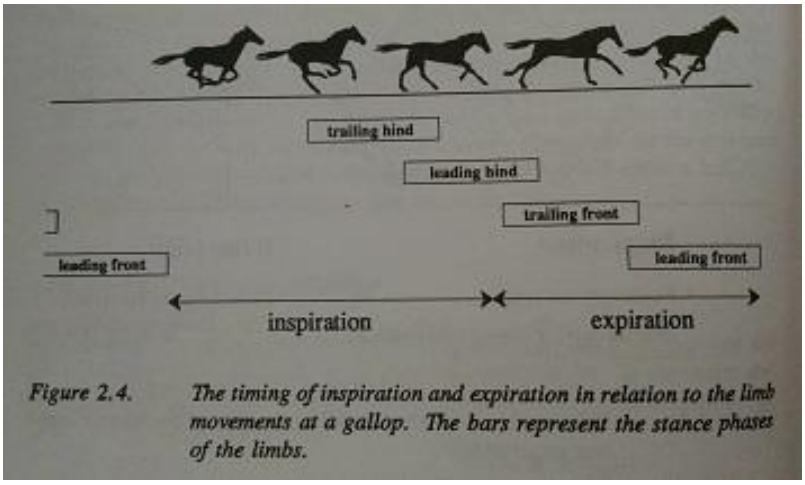

Figure 2. LRC in the Gallop

"**One of the major contributors to LRC is compression of the chest between the 2 scapulae as the front legs bear weight. In the canter and gallop, the 2 front legs are on the ground simultaneously, which maximizes the effect of thoracic compression. LRC augments the muscular action of the diaphragm through the movements of the abdominal organs…the visceral piston**. The visceral piston is heavy… equivalent to almost 30% fo the body weight. The organs comprising the visceral piston are attached to the body wall in the pelvic region and to the diaphragm, which allows them considerable freedom of movement within the abdominal cavity."

"At the canter and gallop, the speed of body movement changs within each stride. The body decelerates when the trailing front leg makes impact with the ground, then accelerates as the leading front leg pushes off into the suspension. Due to its large mass

the visceral piston has considerable inertia, so it tends to maintain a more constant speed throughout the stride. **As the body decelerates, the piston continues its forward motion pushing the diaphragm forward into the chest and forcing air out of the lungs. As the body accelerates into the suspension, the inertia of the visceral piston causes it to lag behind the rest of the body, pulling the diaphragm back into the abdomen and enlarging thoracic volume, which stimulates inspiration**."

"If 2 horses with different stride lengths gallop at the same speed, the horse with the longer stride length has a slower stride rate, allowing more time for each respiration."

This horse will win the race because he uses his energy system more efficiently!

The trot and pace, by contrast to the canter and gallop, are symmetrical gaits. The 4 legs work in diagonal pairs: R hind and L front alternate with L hind and R front. To clarify, this is more like the alternating, reciprocating walk for humans. Since the 2 front legs hit the ground at separate times, "loading of the front legs is less effective in compressing the chest. Also the body moves at a more consistent speed throughout the stride, so the visceral piston does not oscillate back and forth against the diaphragm, and the body axis does not tend to pitch up and down." The horse usually adapts to a 1:2, 1:3, or 2:3 respiratory rate to stride rate in this case.

Coming soon, Part II: TMCC in the Horse