**Every Breath you Take**

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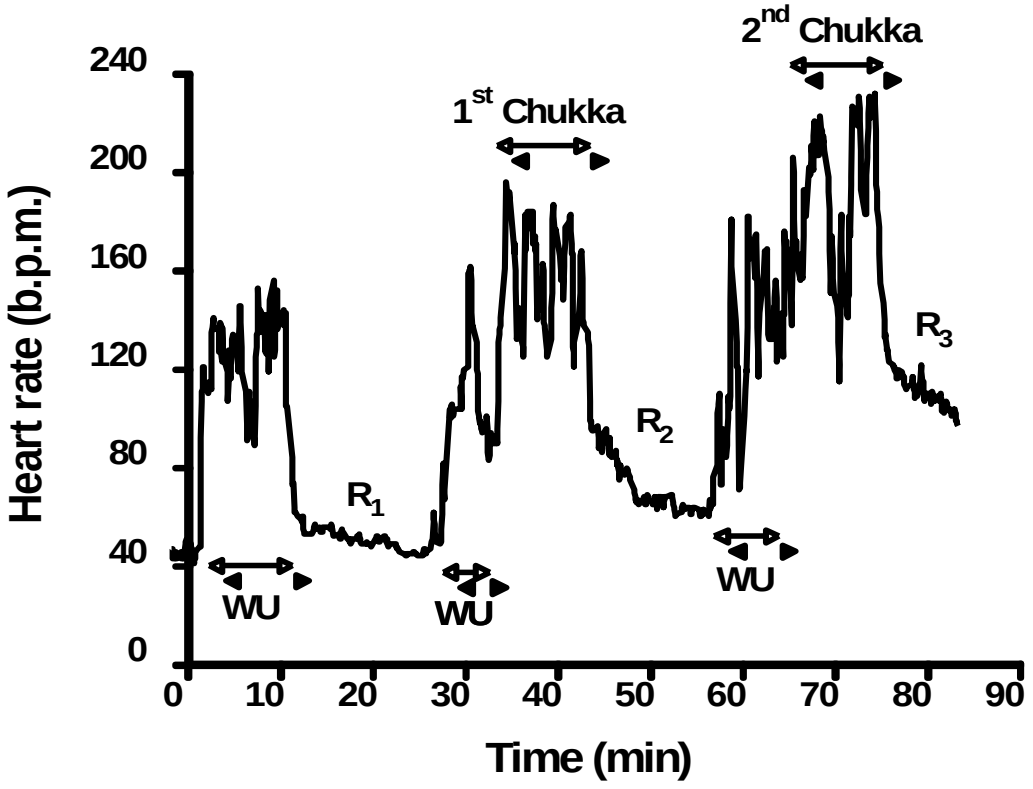
What characteristics would one be looking for in a good polo pony? Rapid acceleration, good top speed, ability to make tight turns, good temperament, ability to stay sound? These abilities generally relate to the muscles, bones, ligaments and tendons and the nervous system, of which the brain is of course part. Some might be looking for a good strong heart. However, I wonder how many players would put a good respiratory system near the top of their list? Probably not many. Of course, we want a healthy respiratory system. A pony with an upper airway obstruction or lower airway (lung) disease, such as broken wind (referred to as equine COPD or Recurrent Airway Obstruction), is clearly unlikely to perform to its full potential. But few people still realise that, in equestrian sports that involve short periods of exercise, even a healthy respiratory system can be a limiting factor. In this article I'll explain why.

Of course to understand what role the respiratory system plays, we need to understand what it does. The first function is one that everyone knows: to bring oxygen in air into the lungs so that it can be taken up by the blood and delivered to the living cells in the body. It is also important for removing carbon dioxide from the body. The respiratory system also serves as a very important filter, removing clots and gas bubbles from the circulation. It is also important in the control of body temperature, hence why horses blow and pant when they are hot to get rid of heat. One problem with the respiratory system, it that the horses upper airway has a slight "design fault". The skin each side of the head just above each nostril is thin and poorly supported. When a horse breathes in this skin is sucked in, narrowing the air passage and the horse must put in extra effort to get sufficient air in. This does not matter in the wild as the horse rarely exercises for long periods and will usually put in short sprints to get away from danger.

From a scientific perspective polo is a sport which involves short bouts of intense, maximal exercise interspersed with periods of lower intensity of exercise which allow the horse to partially recover, for example following a goal, when a penalty is awarded or when the ball goes out of play. We can clearly see the nature of the sport from a spectator's angle but we can also get an interesting insight from measuring a polo pony's heart rate during a chukka. The harder a pony is working the higher its heart rate will be. The **figure** below shows the heart rate of a low goal polo pony during warm-up and two chukkas. There is a tremendous amount that we can learn from this trace. The figure is from work that I carried out with Newmarket veterinarian and polo enthusiast Jeremy Allen back in the 1990's and was published in the *Equine Veterinary Journal* in 1999.

The heart has the ability to respond almost immediately to changes in activity, for example in the first stride the horse takes in a chase for the ball. The heart rate can also rise rapidly in response to anticipation even when the horse is standing still. But generally when the heart rate is up above 180 beats per minute, the main thing controlling the heart rate is the effort the horse is putting in. At the end of a sprint, as the horse is pulled up, the heart rate will also begin to drop rapidly. However, at the end of a chukka, the heart rate may stay high for a considerable amount of time. The hotter the horse, the longer it will take the heart rate to drop back to resting (around 30 beats per minute). But even in cool weather and when a pony has been washed off, it may take several hours for the heart rate to reach the same rate as before the chukka.

Now back to the heart rate trace in the **figure**. The first thing we notice is that when the pony was tied-up in the lines (on the far left of the graph), it had a close to resting heart rate of around 40 beats per minute. During the warm-up before the 1st chukka, the heart rate ranged from around 80 to 150 beats per minute. We can also see that at the end of the warm-up (around 11 minutes) the heart rate drops rapidly back to around 50 beats per minute and then as the horse stands in the lines, by around 28 minutes it's close to 40 beats per minute again. But we see that during the 1st chukka this pony is played in, its heart rate is much higher and ranges from 120 beats per minute to as high as 180 beats per minute. Now notice what happens at the end of this chukka. The heart rate drops rapidly as it did after the warm-up, but this fast drop settles out at around 85 beats per minute, whereas before it went nearly to 40 beats per minute. This slower heart rate recovery is a good indicator of how hard the pony has worked and how hot it is. We can see that the heart rate continues to fall and settles out around 55 beats per minute just before the pony is mounted and warmed up to play in it's 2nd chukka of the match. We can see in the 2nd chukka that the heart rates reach around 220 beats per minute. This is likely to be this pony's maximum heart rate; that is, it's now working flat out. We can also see that at the end of this 2nd chukka, the heart rate only drops rapidly to around 120 beats per minute. So with each piece of exercise, the heart rate recovery becomes slower. We can see from this trace that whilst fit, this pony has done more than enough for one day. We can also see that the pony was ridden much harder in the 2nd chukka.




Heart rate trace from a pony playing in a low-goal match. WU = warm-up; R1 = recovery period 1; R2 = recovery period 2; R3 = recovery period 3.

This actually gives us a clue to one of the many ways in which we can use a simple tool such as heart rate measurements to understand what is going on inside a pony. A pony that seems to be struggling or unwilling or slow when pushed hard but has a heart rate of only 170 beats per minute could be

suspected of being lazy. A pony with a heart rate of 230 beats per minute on the other hand when only being ridden moderately may have an issue with temperament, undiagnosed pain or lack of fitness. This is just a simplified example to illustrate how we can use something as simple as heart rate.

The horse's heart rate increases with increasing effort primarily to power the locomotory muscles.. The faster the heart beats, the more blood that is pumped around the body. During exercise, most of the body's blood flow needs are for the muscles. This is for a number of reasons. Firstly, to deliver oxygen. Secondly, to remove waste products from the muscles, such as lactic acid; Thirdly, to remove heat from the muscles (the muscles produce 4 units of heat for every unit of energy they convert into movement). Finally, the increased blood flow delivers energy to the muscles in the form of sugars and fats.

So let's consider how this applies to polo.

**Oxygen delivery.** Because polo is a sport involving repeated near maximal sprints, the energy for the muscles comes mainly from anaerobic metabolism. This is the rapid breakdown of sugars stored within the muscle cells joined together in chains and known as glycogen. The important points about anaerobic metabolism are that it is a very fast way to get energy for muscle contraction, it's not very efficient (we don't get much energy for each sugar molecule used up) and most important of all, it does not need oxygen. So during a chukka when a pony is accelerating or sprinting, oxygen contributes very little to this. And therefore we might then deduce that the respiratory system is of little importance. This would be a mistake for several reasons. When a pony is cantering or galloping, the breathing and stride are linked one to one. The pony will take one breath exactly in time with each stride (Some ponies will hold their breath for several strides as they accelerate but they then must get into this locked rhythm). This relationship between breathing and stride means that even during a short burst any limitation of breathing has the potential to limit stride length and stride frequency, or in simple terms, performance! This happens even though the pony does not need oxygen for short bursts.

The respiratory system and breathing also becomes critical when it comes to recovery. When the pace slows in a chukka, for example after a penalty has been awarded, the ponies have perhaps 30 seconds to partially recover. At this time, breathing is central to this recovery process. The breathing and heart rate both stay elevated and help to remove lactic acid, heat and supply oxygen; all essential for muscular recovery and to prepare the muscles for the next burst of exercise. In low-goal polo where ponies can play two chukka's in a four chukka match, the heart and respiratory system are central to recovery before the next chukka is played.

**Delivery of energy to the muscles in the form of sugars and fats.** The one aspect of increased heart rate and blood flow to the muscles that is irrelevant in polo is the supply of energy in the form of fats and sugars in the blood. All the energy that is used by a polo pony during a chukka comes from the sugars stored within the muscle cells as glycogen.

So we should consider the horses' respiratory system as being of major importance in polo. It can limit stride and it aids recovery within, and in low-goal between, chukkas. However, there are some aspects of the respiratory system that we should consider from a performance point of view. Firstly, the respiratory system does not improve with training. There is a widespread myth that the lungs

move more air in and out after training. This is entirely false. Secondly, high intensity exercise, including polo, results in rupture of blood vessels in the lung. Even if blood is not seen at the nostrils, which is fortunately rare, training and matches result in bleeding deep in the lung which leads to cumulative lung damage. This will occur to some extent in all ponies, ranging from mild to severe. The greater the damage, the poorer the function of the lungs.

Interestingly, one factor that we believe does not directly impact the respiratory system is over-tight girths. Over-tight girths have been shown in studies in Australia to make horses tire earlier in races. This was widely believed to be due to limiting the expansion of the chest. However, it is now known that the negative effect of an over-tight girth is actually due to "crushing" of the muscles under the girth which are used to move the leg forward and back and not to limiting breathing.

There is good evidence that the respiratory system is a weak point when it comes to performance. It is working at it limits, it is delicate and easily damaged, it's not designed for medium to long periods of exercise, its common to find structural abnormalities (e.g. roaring and gurgling) and allergic and infectious respiratory disease are common. So, what steps can we take to ensure that the respiratory system does not limit performance in polo? Many apparently healthy horses will frequently show some signs of respiratory disease when 'scoped (i.e. when we look into the windpipe with an endoscope) so 'scoping even healthy well performing ponies periodically during the season is advisable. Any abnormal respiratory noise warrants investigation and if indicated, surgical treatment. Whereas this used to require training and examination on a treadmill there are now field endoscopes that can be used to examine the upper airway under natural conditions. One easy step to take is to give some help to the upper airways. FLAIR® Equine Nasal Strips support the skin over each nasal passage to reduce collapse of the nasal passage which occurs in all horses during breathing in. This has been scientifically proven to reduce the effort needed to breathe, reduce the amount of lung bleeding and to speed recovery leading to better performance.