INDICATORS OF FITNESS AND PERFORMANCE

**Erythrocytes**

Oxygen carriage to skeletal muscle is an important factor in overall fitness, and in horses there is a clear association between total red cell volume and performance. As horses enter training, red cell parameters are expected to increase for a couple of months before reaching a plateau and they may therefore be used as an indicator of how well the animal is responding to training. The same trend should be observed each season, with a slight year-on-year increase in total red cell volumes through the first few years of competition.

Fit thoroughbreds would be expected to have red cell numbers, packed cell volumes (PCVs) and haemoglobin concentrations toward the top end of, or exceeding, published reference ranges for the general horse population. Factors that affect hydration status and degree of splenic contraction (such as excitement, stress, time since exercise and time since feeding) all influence the distribution of red cells within the circulatory system, resulting in individual horses demonstrating significant intra-day variation and potentially confounding monitoring.

As a result of excitement, PCV may increase by up to 10L/L and remain elevated for up to two hours. One means of eliminating these variables is to measure maximal haematocrit levels within a minute of the cessation of hard exercise. This approach is not widely utilised as it poses logistical difficulties and exercise will serve to confound the measurement of other haematological and biochemical variables that may be of interest. If samples are to be collected at rest, it is best to standardise collection; the optimal time being early morning before feeding, exercise or turn-out on a day following a rest day or a following a day of light work.

Declining PCVs in performance horses are a concern as they may be an indication of subclinical or clinical disease. It is hypothesised that subclinical or clinical disease may result in reduced sympathetic tone and hence an increase in splenic sequestration of erythrocytes. Primary anaemia is rarely identified in performance horses and investigations of apparent reductions in red cell volumes should initially focus on other conditions that commonly affect performance horses, such as infectious respiratory disease and equine gastric ulcer syndrome.

**Leucocytes**

Measurement of absolute and relative leucocyte numbers is of no value in the assessment of fitness per se; however, they are important in the detection of clinical and subclinical disease that will have a bearing on performance. In young performance horses, assessment of the leucogram a few days before competition is a popular and useful tool that is used to detect animals that may have faced infectious challenge and may therefore be likely to under-perform.

The relative concentrations of leucocytes within the circulating and peripheral pools will be influenced by factors such as stress and excitement and the conditions of sampling must therefore be considered when interpreting results. Sample collection should be avoided within six hours after exercise or stressful incidents. If this is not possible, the results should be interpreted cautiously. The typical glucocorticoid-mediated response that accompanies the stress of exercise and competition (as well as Cushing’s disease and exogenous glucocorticoid administration) results in neutrophilia, lymphopenia and eosinopenia and an overall increase in leucocyte numbers. However, this effect may be balanced during high-intensity exercise or short-term excitement (such as during venepuncture) by increased blood volume and lymphocyte release secondary to splenic contraction.

In performance horses, relative neutropaenia or a ‘reversed differential’ (i.e. neutrophils present in similar or lower numbers than lymphocytes) is commonly observed in animals that are performing poorly or showing signs of lethargy. Whilst this presentation is well-recognised it is not well explained. It is generally assumed to be a result of viral infection or an equine post-viral fatigue syndrome and may be associated with overtraining. Horses with poor performance and relative neutropaenia are often identified, with elevations in muscle enzymes that might be due to viral myositis or to post-viral fatigue syndrome. Horses presenting in such a manner may take many months to recover and it is generally recommended that they are rested until the leucocyte differential returns to normal. Supplements and immune stimulants such as interferon are commonly administered, but there is little evidence that they make a notable clinical difference. Fatigue and related symptoms may persist for months or even years.
Muscle Enzymes

Increases in creatine kinase (CK) and aspartate aminotransferase (AST) may indicate various myopathies such as recurrent exertional rhabdomyolysis, polysaccharide storage myopathy or viral myositis. Increases may also be observed in response to initiation of training or overtraining which may or may not indicate underlying myopathy. Though not likely to be relevant to performance horses muscle enzymes may also be increased in horses that are catabolic. Confusion surrounds what constitutes normal and abnormal values for AST and CK and the degree of increase that should be expected after exercise. Exertion is expected to result in an increase in circulating AST and CK but post-exercise values may still remain within published reference ranges if the baseline is low. Sequential samples from the same horse may be more helpful than relying on published reference ranges, which are inevitably wide. Measurements performed before and after exercise (4 and 24 hours) are also a useful means of determining whether myopathy is present; a significant increase post exercise is an indication of underlying pathology (See later chapter on investigating myopathies).

Liver Enzymes

Gamma-glutamyl transferase (GGT) has been investigated as a measure of performance in addition to being a marker of hepatic disease. In response to training, GGT appears to increase in a linear manner and has been associated with poor performance; it is unclear whether this is due merely to overtraining or to subclinical liver disease. High GGT may be observed on routine blood samples in the absence of clinical signs and in cases that have recovered from hepatic disease. An increase in GGT is not totally specific for hepatic disease or overtraining therefore and more research needs to be performed into its significance in the performance horse.

Electrolytes

Abnormal electrolyte levels have been associated with poor performance and with exertional rhabdomyolysis. As most performance horses receive a plethora of supplements, deficiencies are uncommon. Furthermore, circulating electrolyte levels provide a very poor assessment of whole-body status and detection of excesses or deficiencies should be performed by calculating renal clearances from simultaneously collected urine and blood samples rather than by simply measuring blood levels.

Conclusion

Attempting to determine fitness from resting blood samples remains fraught with difficulty and there is little evidence to suggest that it may be done reliably. Assessments of lactate and erythrocyte levels at and immediately after exercise are probably the most helpful but require veterinary attendance at exercise. The main value of clinical pathology lies in detecting underlying conditions, such as muscular or infectious disease, that may have a considerable bearing on performance, especially at the top level.