By Stuart Williamson BVSC MRCVS

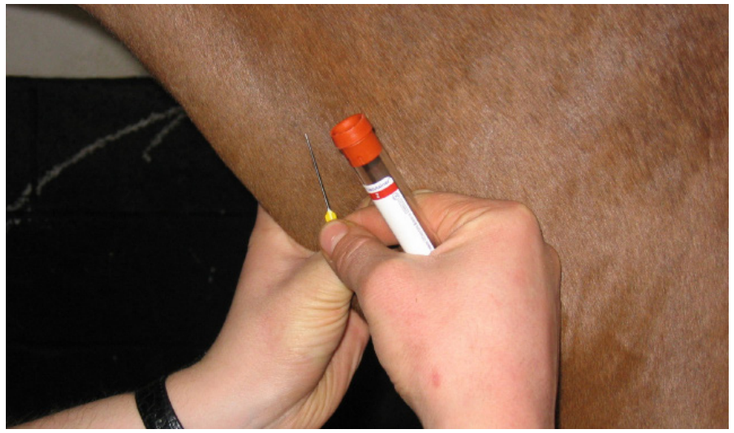
Blood sample analysis in the racehorse in training

Haematology and blood biochemistry analysis in the racing thoroughbred are an integral part of equine clinical practice. When performed at key points in the horse's training programme, they can help to establish the normal haematological and biochemical values for an individual horse, as well as detect important subclinical and potentially performance-limiting conditions.

Blood sample analysis does not replace the need for a thorough veterinary examination in the case of an ailing horse, but in cases where overt clinical signs are lacking, then the results of blood tests may provide important information to help identify underlying problems. While some trainers make it an integral part of the assessment of their horses' fitness, others have not embraced it and place more reliance on other veterinary techniques.

Blood is a body fluid that delivers the necessary substances including nutrients and oxygen to the body's cells, as well as transporting metabolic waste products away from those same cells. It is composed of blood cells suspended in plasma. Individual blood samples can be tested as whole blood or can be split to separate either the serum (the liquid part of blood that contains no cells) or the plasma (this is serum plus the proteins that are involved in the clotting of blood) from cells. Testing requirements will differ according to the blood parameter being measured.

Elective blood samples are typically taken from the resting horse so that the transient and clinically irrelevant excitation effects of exercise are not present to confuse the interpretation. The left and right jugular veins in the neck are the veins of choice for blood collection, given their ease of access and lack of resentment from most patients. The requirement to bleed from a site other than the jugular vein is rare.



Many trainers make blood sample analysis an integral part of their regime

Once the sample has been processed and analysed by either the haematology or the biochemistry machine, patient results are displayed and compared with the 'normal reference ranges' available for each parameter. Abnormal results can then be examined further, in combination with other parameters and in the context of the condition necessitating blood sampling.

Figure 1 *Some of the vacutainers available for blood collection and storage. The coloured labelling indicates the additive present within each tube that stabilises or preserves the blood sample before laboratory analysis*

What can we look for in blood samples?

Below are some of the main haematological and biochemical parameters that we routinely analyse in the racehorse in training. The list is not exhaustive and there are many other tests that can be run if there is concern regarding a particular organ system or clinical condition.

Red blood cells or erythrocytes

The most common cell type and the principal means of delivering oxygen from the lungs to the body's tissues. Red blood cells contain haemoglobin and it is this pigment that not only confers the red blood cell's colour but also permits them to transport both oxygen to, and carbon dioxide away from, the body's cells. The haemoglobin level can be measured separately.

Packed cell volume (PCV)

The PCV measures the volume percentage of red blood cells within blood. Thoroughbreds will normally have a high PCV of between 35% and 45% as they are designed to be athletes and therefore require a lot of oxygen-carrying cells to deliver oxygen to the body's cells.

An increased PCV is noted when the number of red blood cells increases, such as in excitement, or when the total blood volume is reduced, such as in dehydration.

A decreased PCV indicates anaemia and is encountered when the body either decreases its production of red blood cells or increases its destruction of red blood cells.

Figure 2 *A haematology machine. This analyses the cells within blood, including red blood cells, white blood cells and platelets*

White blood cells or leucocytes

Whilst accounting only for approximately 1% of the total cells within blood, white blood cells, also called leucocytes, are vital in the body's fight against illness and disease. These immunity cells are produced in the bone marrow and are present in the bloodstream to fight viruses, bacteria and other foreign invaders.

There are various types of white blood cells, including neutrophils, lymphocytes, monocytes and eosinophils, that can all be measured separately. Neutrophils are the most numerous type of white blood cell, accounting for 50%-70% of total numbers. They are the first line of defence when infection strikes and kill and digest both bacteria and fungi. Lymphocytes manufacture antibodies to fight against bacteria and viruses. Monocytes help to break down bacteria. Eosinophils attack parasites and are also involved in allergic responses.

An increase in the number of circulating total white blood cells is known as leucocytosis and can be seen in times of stress, excitement, following exercise, and in the face of an infectious or inflammatory process. Understanding variations in each of these particular types of white cell can help to unravel the particular disease process affecting a horse. A decreased white cell count, known as leucopenia, is also usually a sign of infection as the white blood cells are taken out of the bloodstream and to the area of infection. A lack of production of white blood cells must also be considered in cases of leucopenia, though this is rare in the horse. Subtle changes from 'normal' levels must not be over-interpreted in an outwardly healthy horse that trains well.

Platelets

Small blood cells that are formed in the bone marrow, the platelets are involved in the coagulation process. Platelet disorders in the horse are rare.

Fibrinogen and serum amyloid A (SAA)

Both fibrinogen and SAA are markers of infection or inflammation. When an infectious or inflammatory insult occurs, SAA increases rapidly and then decreases rapidly in response to resolving infection or inflammation. Fibrinogen, however, is slower to increase and slower to decrease. The combined interpretation of these two parameters can therefore provide more of an insight into the onset and duration of the infectious or inflammatory disease process. SAA is used most frequently to monitor response to treatment and clearing of infection as the fibrinogen value may remain raised for a number of weeks after resolution.

Red Blood Cells	7.5	10^6/ul	(6.0 - 11.0)
Haemoglobin	12.7	g/dl	(12.0 - 16.0)
PCV	35.8	%	(30.0 - 49.0)
MCV	48.1	fl	(37 - 50)
MCH	17.0	pg	(13 - 18)
MCHC	35.5	g/dl	(34 - 37)
White Cell Count	9.3	x10^9/l	(5.5 - 11.0)
Neutrophils	77	%	(45 - 65)
Lymphocytes	15	%	(36 - 48)
Monocytes	6	%	(0 - 6)
Eosinophils	2	%	(0 - 3)
Fibrinogen	4.1	g/l	(1 - 4)
Serum amyloid A	650.0	ug/ml	(0 - 20)

Figure 4 *A set of results for a typical 'horse in training' blood profile analysis. The patient's results are those in the second column from the left. Normal reference ranges are in the brackets on the right. This horse has an inflammatory blood result with a borderline fibrinogen and a marked increase in serum amyloid A, in addition to a relative increase in neutrophils and a relative decrease in lymphocytes; this is referred to as a 'wide split'*

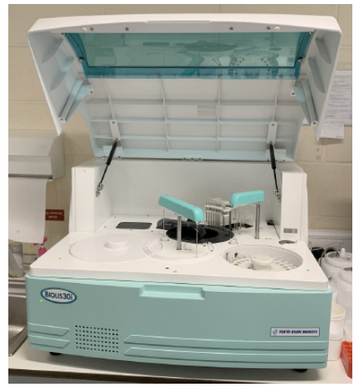


Figure 3 *A biochemistry machine. This analyses the liquid portion of blood that contains many proteins, enzymes and electrolytes. Information regarding organ-specific disease processes may also be obtained from this portion of the blood*

Creatinine phosphokinase (CPK) and aspartate aminotransferase (AST)

These two muscle enzymes are analysed to look for muscle damage in cases of equine exertional rhabdomyolysis, or 'tying-up'. CPK will usually peak within six hours after muscle injury and decrease quickly. In most cases it will normalise within 24-48 hours, assuming there are no further episodes of tying-up. AST is slower to rise, peaking 12-24 hours following the tying-up episode.

It will also decrease to normal slowly, sometimes taking two to three weeks, again providing there is no ongoing muscle damage. The combination of these two muscle enzymes can help to monitor a condition likely to affect many racehorses at some stage of their training.

Conclusion

Abnormalities in any of the described parameters may prompt a call for further testing in order to understand the relevance of any detected abnormality. Further testing may include kidney, liver or cardiac function, protein levels, electrolyte levels and hormone levels.

Whilst blood analysis is not all-encompassing and cannot answer many training or performance issues, it can certainly help us to understand more fully the general health of the horse and direct treatment, if required.