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Main interests: After graduating from the Royal Veterinary College London in 1986, I won a Rotary Foundation scholarship and spent 2 years studying at University of California, Davis, where I obtained a Masters degree in equine pathology. I returned to England to join Rosssdales in 1988, working in stud and laboratory medicine. Married to Rosssdales partner Fred, and with two teenage children, I now work exclusively in the practice's busy equine laboratory. My job involves interpreting blood sample results, and examining samples of cytology (cells in fluid) and tissue under the microscope. Our team of 8 technicians prepare the samples and perform all the tests. The results are then given to me to make an interpretation of the findings, which is then included on the report to the veterinary surgeon who took the sample. The family are all keen riders and taking care of our horses and a menagerie of other animals takes up most of my spare time. When we can get away, I enjoy sailing, skiing and travelling.

What can a **blood sample** tell us?

Blood sampling can be a very useful diagnostic tool in many situations. Last year our laboratory received over 36,000 samples, and cases can vary from the routine to the very obscure. In addition to servicing the needs of our own veterinary surgeons, Beaufort Cottage Laboratories is also the largest specialist equine clinical laboratory in Europe.

Blood samples may be taken for routine health screening reasons, or for diagnostic purposes when a horse is showing abnormal clinical signs. For example, we recommend performing routine blood sampling in day-old foals to check that they have received sufficient antibodies from the mare's colostrum (first milk), and it is useful to screen older horses to detect risk factors for laminitis. Other situations where blood sampling is useful are the investigation of poor performance, weight loss or low grade colic.

Examining a blood sample does not replace the need for a thorough veterinary examination and history-taking, but in some cases signs of overt clinical problems are lacking and the results of blood analyses may provide important information to help find the underlying problems.

Normal ranges

To detect and interpret changes, the results obtained from blood testing a particular horse must be compared with 'normal' ranges established from horses of similar age and type tested within a specific laboratory. Individual blood tests are often grouped into profiles appropriate to the desired investigation; for example, a basic performance horse profile would include complete blood count, inflammatory proteins and muscle enzymes. Whilst routine blood profiles cannot be used to assess the fitness of a horse, or to predict performance in competition, laboratory results can be used to identify horses that are of suboptimal health status and may not perform to their maximum potential.

Looking at blood cells

Haematology is the study of the cells in the blood. Red cells are the oxygen-carrying cells and are quantified by their number (red cell count), size and the amount of haemoglobin they contain. Another useful index is the Packed Cell Volume (PCV or

haematocrit); this is a measure of the percentage of the blood occupied by cells when they have been packed together by centrifugation (separation of the cells from the liquid component by spinning the sample). In general, red cell numbers (red cell count and PCV) will increase as a horse becomes fitter. However, the horse's spleen holds a large store of red blood cells, which can be recruited into the circulation when the horse needs extra oxygen-carrying capacity. Splenic contraction occurs in anticipation of and during exercise, or indeed any situation that induces excitement or fear. Samples should be collected quietly and with minimal restraint.



Annalisa Barrelet examining a tissue sample under the microscope

Anaemia, defined as reduced red blood cell numbers (below the normal range for the age and type of horse), results in reduced oxygen-carrying capacity of the blood. Most anaemia cases occur as secondary to other conditions such as infection, long-standing inflammation, internal parasites or, less commonly, liver or kidney disease. Further testing is warranted in these cases. Genuine elevations in the red cell count and PCV (not as a result of fear or excitement) are most commonly seen in horses with reduced blood volume due to fluid loss or dehydration. In these horses, plasma proteins generally will be higher than normal.

White blood cell changes

Blood cells are generally made up from 3 categories: red blood cells (RBC) (known as erythrocytes), white blood cells (WBC) (leukocytes), and platelets (thrombocytes).

Table 1 - The cellular components of blood and their different functions

Cell	Function	Relative numbers
Erythrocytes (RBC)	RBC contain haemoglobin (a transport of oxygen and iron chloride)	Varies somewhat with breed/type and type of work
Neutrophil (PMN)	WBC involved in fighting infection with micro-organisms e.g. bacteria/viruses	Most common white blood cell - average 55% of total white cell count
Lymphocyte	WBC involved in fighting infections, particularly via immune response and production of antibodies	Average 40% of total white cell count
Monocyte	WBC involved in digestion of foreign proteins, invading microorganisms and dead cells	5-10% of total white cells
Eosinophil	WBC involved in allergic conditions and antibody responses to parasites	Absent or low numbers - 5% of total white cell count
Basophil	Involved in allergic responses	Absent or very low numbers - 0.5% of total white cell count
Platelets	Involved in blood clotting	Very small cell fragments

There are 5 types of white blood cells recognised in horse blood (see Table 1 above).

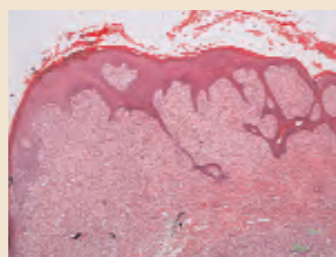
An increase in the white cell count and number of neutrophils most commonly indicates a response to infection. However, when a severe infection occurs, the white cells may be used and destroyed more quickly than they can be produced, and the total number of white cells and neutrophils

falls precipitously. Inevitably there will be clinical signs to support severe infection or 'blood poisoning' (endotoxaemia) in these cases. A modest reduction in the white blood count and neutrophil count may be seen when a horse is challenged by a viral infection. In this situation, the horse is unlikely to perform to its best potential, recovery after exertion may be prolonged and if the horse is asked to overexert itself there may be secondary complications.

A week in brief...

Monday

One of the tissue samples for microscopic examination today is from a lump on the girth of area of a horse. This was found at a pre-purchase examination. The tissue is processed and stained for examination which reveals that the lump is a sarcoid. This is a skin tumour which does not metastasise (spread internally), but it often causes problems by regrowing at the site of removal or development of more sarcoids on the skin. The veterinary surgeon who carried out the pre-purchase examination will have to discuss this result and its possible implications with the potential purchaser. The surgeons at our hospital have achieved good results with surgical removal of sarcoids using laser surgery.



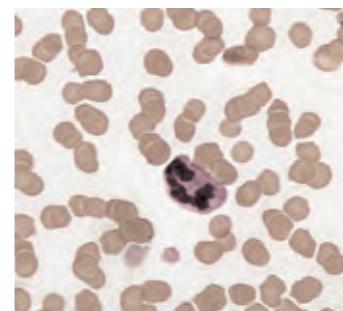
A tissue sample confirms the diagnosis of a sarcoid

Tuesday

Blood and faecal samples from 5 emaciated horses were delivered by courier from a veterinary surgeon working on behalf of the RSPCA. Blood sample results from welfare cases provide important court evidence where there is a prosecution, and we have to ensure that strict continuity is guaranteed for legal purposes. The samples showed mild anaemia, signs of mild infection/inflammation, loss of blood protein (albumin), and numerous parasite eggs in the faecal sample. This type of picture seems to be typical in cases of neglect where there is inadequate provision of fodder and lack of parasite control. It is important to rule out the possibility of underlying organ disease as a cause of emaciation.

Wednesday

A horse was in the hospital last night having colic surgery and the surgeons found a solid blockage in the small colon. This was cleared but the intestine was moving very poorly and the surgeons wanted to find out if grass sickness was involved. A biopsy was taken from the ileum (small intestine) and the tissue was processed and prepared for microscopic examination (histology). There is extensive degeneration of the nerves which control the co-ordinated movement of the bowel and this



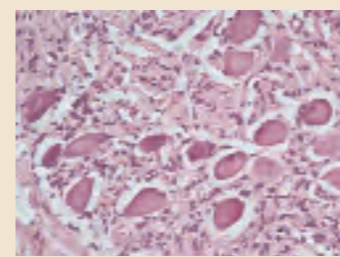
Neutrophils (centre) are the most common white blood cells and are involved in fighting infection. Described as polymorphonuclear, due to the multilobed shape of the nucleus

Blood biochemistry

The liquid part of the blood contains proteins, enzymes, electrolytes and other substances that can be measured and give us useful information about disease processes.

Proteins

Blood proteins, albumin and globulin, are essential in maintaining fluid volume in circulation, transporting of other substances around the body, and in responses to infectious challenge. Increased quantities of inflammatory proteins (SAA, fibrinogen) are produced in response to infection and



Degenerative nerve cells viewed under a microscope confirm a diagnosis of grass sickness

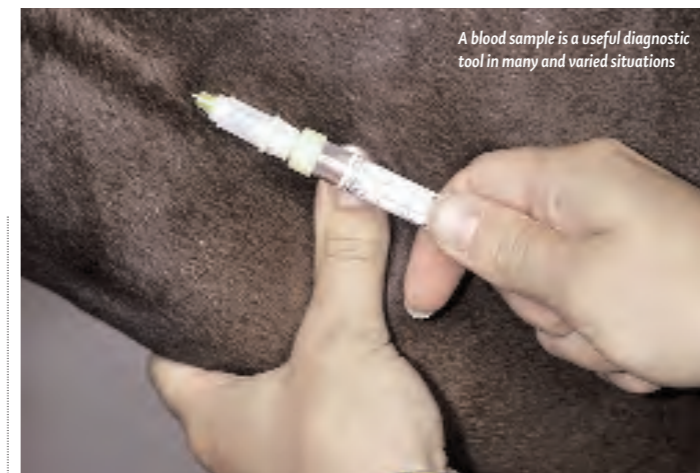
confirms a diagnosis of grass sickness. Unfortunately the chances of this horse recovering are almost nil, and the owner will be advised that it would be kinder to put the horse to sleep.

Thursday

A 24-year-old retired showjumper has been gradually losing weight over the past 3 months and is now extremely thin. A blood film shows abnormal lymphocytes, a low blood albumin (protein) and raised globulin (protein). A scan of the globulin detected an abnormal 'spike', which strongly suggests a blood cell tumour, lymphoma. We suggested that the referring veterinary surgeon sends a sample of abdominal fluid (peritoneal fluid) so that we can look for abnormal cells in that.

Friday

The peritoneal fluid from yesterday's weight



inflammatory processes. Measurement of these can be useful to diagnose an infectious process and to monitor response to treatment and recovery. Certain diseases cause reduction in the blood protein albumin (particularly intestinal parasite damage, liver or kidney disease). This can be very serious as albumin is essential to maintenance of the normal circulation.

Enzymes

All cells within the body contain enzymes that are involved in cell function. Conditions that cause increased permeability or damage to the cell membrane allow enzymes to leak into the bloodstream in increased quantities. When muscle cells are damaged muscle enzymes (called AST and CK) leak in to the circulation and can be measured in increased quantities in a blood sample. The most dramatic example of this

is in the case of a horse which 'ties up' (exertional myopathy); muscle cells are damaged and large quantities of muscle enzymes are released into the bloodstream. Similarly, when liver cells are damaged, enzymes specific to the liver are released into the blood and can be detected biochemically. Not all enzymes are specific to an organ system, and often a panel of biochemical tests must be performed to formulate a diagnosis.



State of the art laboratory equipment enables accurate and fast turnaround of results.



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