

B Vitamin Deficiencies and Equine Anaemia in Horses

B vitamin deficiencies (specifically, B-12 and folate) are certainly capable of causing an anaemia. However, they have never been documented as a cause of anemia in horses. Without confirming normal blood levels of these vitamins (tests that are not routinely available), it would be very difficult to completely rule them out as at least a contributing cause for an anemia. This is because B-12 and/or folate deficiency anemia cause a macrocytic (large red cells) and normochromic (normal level of hemoglobin in cells) anemia.

The same picture is seen in the blood of a horse that is recovering from anaemia, regardless of the cause. In that case, the larger red cells are immature cells being released earlier than normal from the bone marrow. B-12 is a cobalt containing vitamin. It is synthesized in the intestinal tract by the bacterial populations there. Carnivores also get B-12 by consuming meat.

A specialized protein called “intrinsic factor” is released by cells in the stomach and activated by stomach acid. In other species, intrinsic factor is required for the absorption of B-12. Whether this is the case in horses or not is unknown. In any case, horses on long

term acid suppression for ulcers, or those with intestinal tract upset or poor appetite might be candidates for B-12 supplementation by injection for support of recovery in the event of anemia. Dosages of 1000 to 2000 mcg are commonly used, once or twice weekly.

Folate is both synthesized by the intestinal bacteria and ingested from green plants. It has been documented that horses stabled and fed hay have lower folate levels than horses maintained on pastures. Whether this represents a true deficiency or an overabundance when grazing high quality pastures is not clear. Pyrimethazine, a drug sometimes used to treat EPM, and the sulphur class of antibiotics cause severe folate deficiency:

[J Am Vet Med Assoc](#). 1998 Mar 1;212(5):697-701.

Congenital defects in newborn foals of mares treated for equine protozoal myeloencephalitis during pregnancy.

[Toribio RE](#)¹, [Bain FT](#), [Mrad DR](#), [Messer NT](#) 4th, [Sellers RS](#), [Hinchcliff KW](#).

⊕ Author information

Abstract

Three weak, recumbent neonatal foals with skin lesions, including a thin wooly coat, were born to mares being treated for equine protozoal myeloencephalitis. Mares received sulfadiazine or sulfamethoxazole-trimethoprim, pyrimethamine, folic acid, and vitamin E orally. Foals were anemic, leukopenic, azotemic, hyponatremic, and hyperkalemic. Serum folate concentrations in the 3 foals and 2 mares were lower than those reported in the literature for clinically normal brood mares. Treatment was unsuccessful. For each foal, necropsy revealed lobulated kidneys with thin cortices and a pale medulla, and the spleen and thymus were small. Histologic examination revealed marked epidermal necrosis without inflammatory cells, thin renal cortices, renal tubular nephrosis, lymphoid aplasia, and bone marrow aplasia and hypoplasia. These observations indicate that oral administration of sulfonamides, 2,4-diaminopyrimidines (pyrimethamine with or without trimethoprim), and folic acid to mares during pregnancy is related to congenital defects in newborn foals.

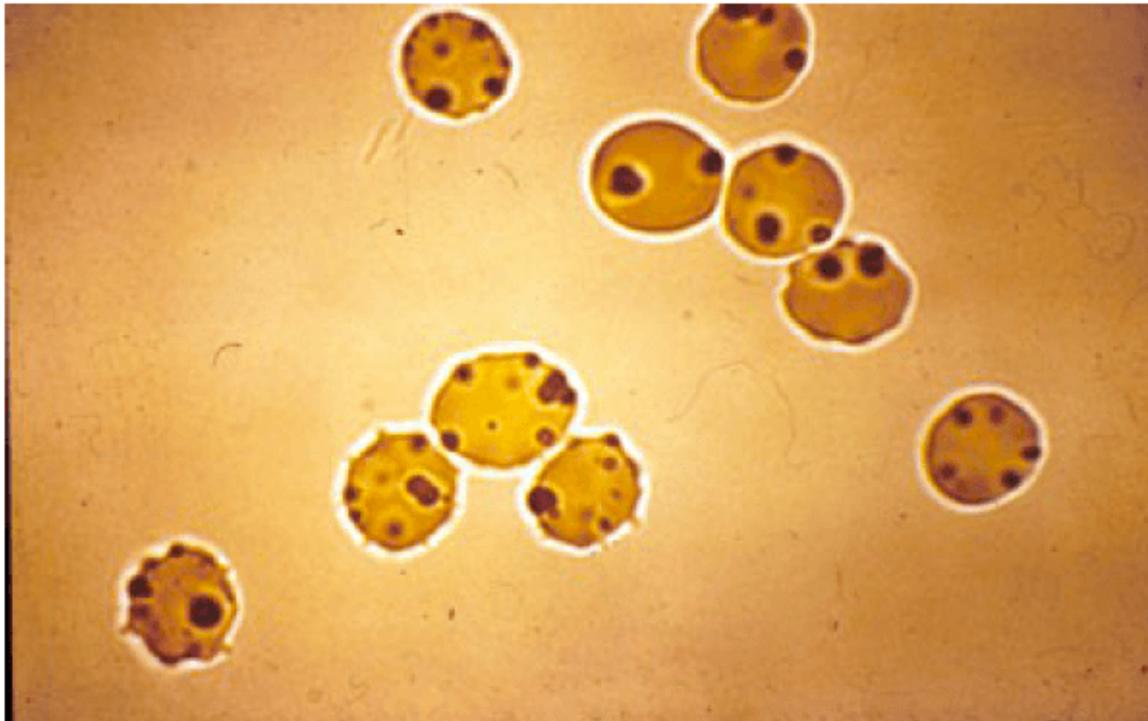
This occurs despite the horses being supplemented with oral folic acid (the synthetic form of folate) and several other studies have confirmed that folic acid is poorly bioavailable in horses.

This is the opposite of what has been observed in people. Folate in foods is present in its biologically active form of tetrahydrofolate. When we ingest folic acid, the liver converts it to tetrahydrofolate which is an important cofactor in many enzymatic reactions. Since folic acid appears to be poorly absorbed by horses, the injectible route is preferred or foods high in folate such as red beet powder or yeast could be used. Dosage recommendations are not available, but a few ounces of beetroot powder or juice or yeast in addition to a quality hay of a good green quality should be adequate.

Plant Toxicities which can cause Equine Anaemia in Horses

There are some plant toxicities which can cause anaemia. Both onion and garlic can

induce a hemolytic anemia in horses, characterized by finding Heinz bodies on the red blood cells. Heinz bodies are little “bubbles” containing hemoglobin damaged by thiosulfates (organic sulfur containing substances).



Red blood cells covered by Heinz bodies

In this study, as little as 3.5 ounces (100 grams)/day of freeze-dried garlic for a 500 kg horse produced Heinz body anemia:

Am J Vet Res. 2005 Mar;66(3):457-65. Association of maximum voluntary dietary intake of freeze-dried garlic with Heinz body anaemia in horses.

Pearson W, Boermans HJ, Bettger WJ, McBride BW, Lindinger MI.

Department of Animal and Poultry Science, University of Guelph, Guelph, ON, N1G 2W1 Canada. Abstract

OBJECTIVE: To characterize hematologic and clinical consequences of chronic dietary consumption of freeze-dried garlic at maximum voluntary intake in horses.

ANIMALS: 4 healthy sex- and age-matched horses.

PROCEDURE: An initial garlic dose (0.05 g/kg, twice daily) was fed to 2 horses in a molasses carrier as part of their normal ration and was gradually increased to maximum voluntary intake (0.25 g/kg, twice daily) over 41 days. Dietary supplementation then continued for a total of 71 days. Two control horses were fed molasses with no garlic with their ration. Blood samples were collected weekly and analyzed for hematologic and biochemical changes, including the presence of Heinz bodies. Recovery of affected blood values was followed for 5 weeks after termination of dietary supplementation with garlic.

RESULTS: At a daily dose of > 0.2 g/kg, horses fed garlic developed hematologic and biochemical indications of Heinz body anemia, as characterized by increases in Heinz body score (HBS), mean corpuscular volume (MCV), mean corpuscular hemoglobin, platelet count, and serum unconjugated and total bilirubin concentrations and decreases in RBC count, blood hemoglobin concentration, mean corpuscular hemoglobin concentration, and serum haptoglobin concentration. Recovery from anemia was largely complete within 5 weeks after termination of dietary supplementation with garlic. Heinz body score and MCV remained high at the end of the 5-week recovery period.

CONCLUSIONS AND CLINICAL RELEVANCE: Horses will voluntarily consume sufficient quantities of garlic to cause Heinz body anaemia. The potential for garlic toxicosis exists when horses are chronically fed garlic. Further study is required to determine the safe dietary dose of garlic in horses.

Grazing onion grass in the spring (onion grass comes up sooner than other grasses) can also cause Heinz body anaemia.

Another toxicity that can cause Heinz body formation is red maple. Red maple leaves contain an unidentified toxin that oxidizes/damages the hemoglobin, or can change the charge on the iron in hemoglobin and prevent it from binding oxygen. This produces the chocolate brown colored blood typical of red maple poisoning. The medical term is methemoglobin.

As little as 3.5 ounces (100 grams)/day of freeze-dried garlic for a 500 kg horse produced Heinz body anemia: [Click To Tweet](#)

Both of these toxicities can cause hemolytic anemia which simply means that the damaged cells lyse/"burst". The released hemoglobin will cause red to dark brown urine. If severe, this can cause death.

Molds which can causes Equine Anaemia in Horses

Mold on sweet clover or sweet clover hay can produce a substance called dicoumarol. Dicoumarol interferes with the metabolism of vitamin K, resulting in impaired clotting. This causes hemorrhaging into the joints, body cavities and under the skin, in the subcutaneous tissues. Nosebleeds may occur. This particular poisoning is reported more often in cattle than horses, but this probably only reflects the fact that clover hay is more commonly fed to cows. It is diagnosed by history, examination and finding abnormal clotting on blood tests. Fortunately, treatment with injectable vitamin K and transfusions is usually successful.

Infections as a cause of Equine Anaemia in Horses

Infections are the most common cause of anaemia in otherwise healthy adult horses. Chronic infections that do not directly involve the red blood cells themselves can trigger "anaemia of chronic disease", which will be discussed below. This would include things like pigeon fever, Lyme disease, abdominal abscesses from Strep equi (Strangles).

Equine Infectious Anaemia (EIA)

Equine infectious anaemia (EIA) is a chronic viral infection with periods of acute flare in which red cells are destroyed. The red cells become coated with the virus, blood proteins

called complements and antibodies to the viral-complement complex. This triggers their destruction. The familiar Coggins test is the test for EIA.

Once infected with this virus, the horse remains infected for life. The virus is spread by biting flies.

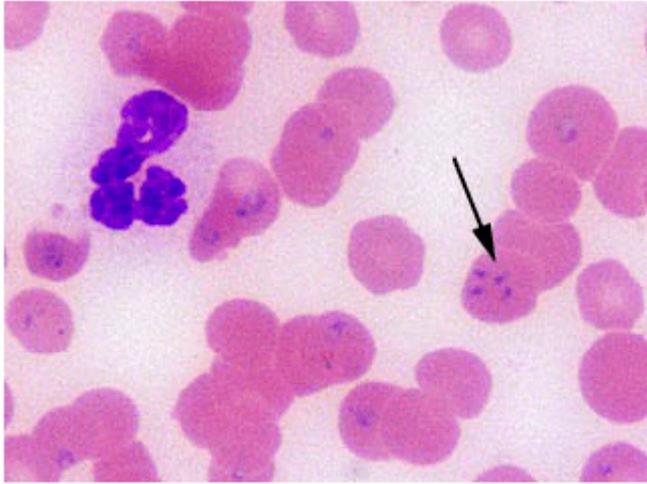
Seven to 30 days after initial infection, virus load in the blood peaks and a fly feeding on this horse can infect many others. The large flies with painful bites are believed to be the most efficient in transmitting the disease because a bitten horse reacts aggressively, forcing the fly to move on to another horse.

The virus and horse often coexist for many years without any serious effects to the horse, but any challenge to the horse's immune system can allow the virus to multiply unchecked. As the horse ages and immune function wanes, these episodes can become more frequent and the horse develops a syndrome of weight loss, anaemia, intermittent fevers.

Because the horse and virus can coexist for many years with no problems, the current policy of euthanasia or extreme isolation of any Coggins positive horse has drawn a lot of opposition. However, if you look at the history of EIA and how it influences herds, from death of very young horses to eventual extreme debilitation of older horses, it's difficult to argue against the idea that this disease needs to be eliminated.

Protozoa which causes Equine Anaemia in Horses

Babesia (aka Theileria) and Trypanosoma are protozoa that can parasitize red blood cells and cause anemia in horses. Both are transmitted by ticks. They are found in more tropical and subtropical areas but is as close as South America and the species of ticks involved with transmission of this protozoa do occur in North America.



Arrow pointing to Babesia organisms inside a red blood cell

Babesia was introduced into Florida in the 1950s with the importation of horses from Cuba and is considered endemic (established as a local disease) in some areas of the Southeast.

Foals born of infected dams have passive immunity from the colostrum and typically do not develop severe signs of infection when exposed to the organism but do become carriers. Horses infected for the first time as adults show fever and depression within about a week, jaundice, tiny hemorrhages on gums, discolored urine and anemia.

Treatment with the antiprotozoal drug Imidocarb and transfusion is often successful but must be continued long enough to eliminate the protozoa or the horse will develop into a carrier. Long term carriers are more difficult to treat.

Bacteria as a cause of Equine Anaemia in Horses

The bacterial strains Haemobartonella and Eperythrozoon have recently been reclassified as Mycoplasma species. These attach to the exterior of red blood cells, deforming and eventually destroying them. They cause symptoms ranging from an acute severe anemia with fever to a chronic anemia with "ill thrift".

When attempting to characterize an anaemia, microscopic examination of the cells is very important for detecting changes like Heinz bodies, parasites and variations in cell size. For best results, the microscopic slide (called a blood smear) should be prepared using freshly drawn blood.

After the blood has been sitting in the tube, cells become distorted. If you don't see your vet making a slide after taking your horse's blood, request it.

These bacteria have been found in virtually every species and were recently also described in the horse:

Vet Microbiol. 2010 Apr 24. [Epub ahead of print] Haemotrophic Mycoplasma infection in horses. Dieckmann SM, Winkler M, Groebel K, Dieckmann MP, Hofmann-Lehmann R, Hoelzle K, Wittenbrink MM, Hoelzle LE. Institute of Veterinary Bacteriology, Vetsuisse Faculty, University of Zurich, Winterthurerstrasse 270, CH-8057 Zurich, Switzerland.

Abstract

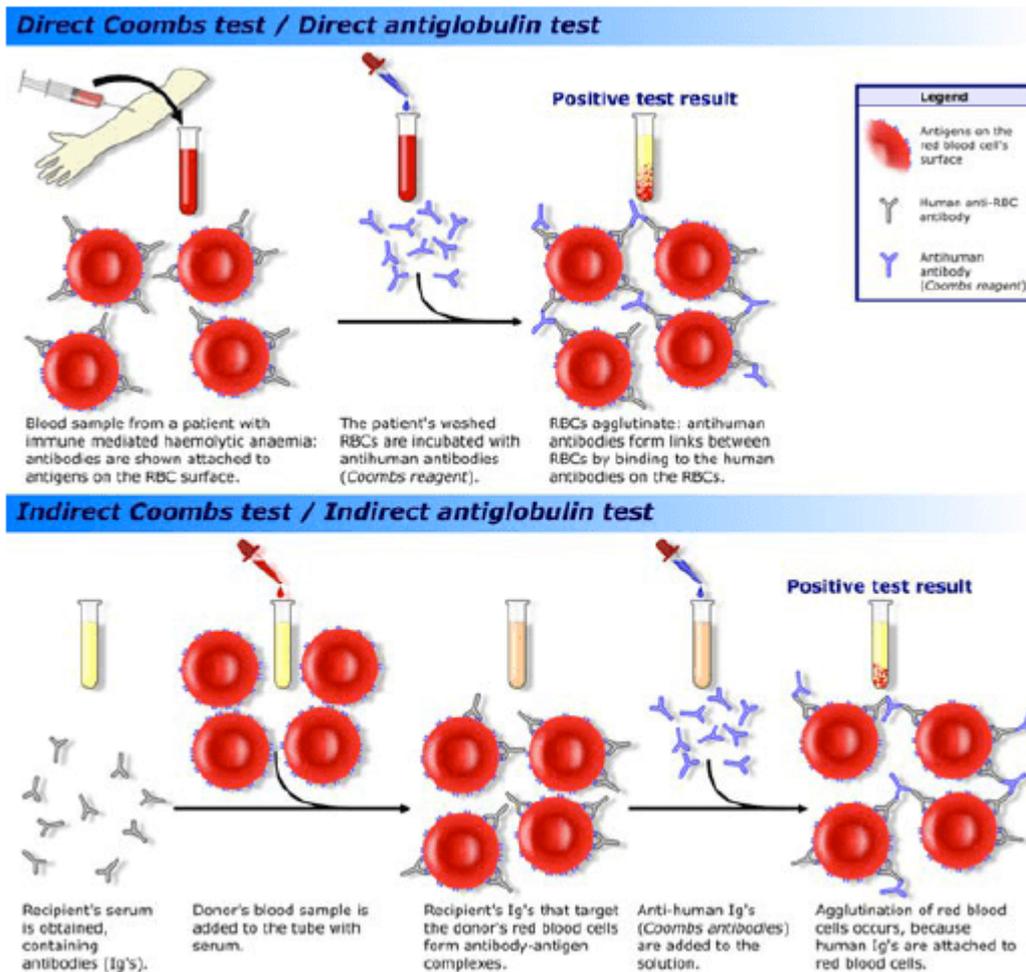
Haemotrophic mycoplasmas (HM) are parasites on the surface of red blood cells and known to infect a wide range of animals. However, there are no previous evidences of HM infections in horses. In this study HM were detected for the first time in the blood of two horses suffering from poor performance, apathy, weight loss, and anaemia. Using a HM specific PCR assay and subsequent sequencing the infective agents isolated from the blood of said horses were confirmed as closely related to the HM species *Mycoplasma haemofelis* and 'Candidatus *Mycoplasma haemobos*'. ["haemotrophic" means attracted to red cells]

These organisms cannot be recovered on culture and are only diagnosed by testing for their DNA (PCR testing). They are easily killed by tetracycline.

Autoimmune Mediated Anaemia in Horses

Although not recognized very often, autoimmune-mediated anaemia has been described in horses, where antibody and/or complement bind to the surface of the red blood cell causing it to be removed by the reticuloendothelial system in the spleen. In many cases, the cause is not confirmed but the most commonly identified trigger is drugs - penicillin, trimethoprim-sulfa, phenylbutazone and other NSAIDs have been identified.

It is believed these drugs alter the red blood cell membrane configuration, making it appear “foreign” to the immune system or triggering complement activation.



This is diagnosed by a blood test called a Coombs test (above), where the blood is washed

to remove the horse's own plasma, then mixed with a globulin protein specific for the equine red blood cells. If antibody or complement are coating the red cells, they will agglutinate/clump. This type of anemia is probably underdiagnosed simply because no one thinks to check for it and because the horse may already have one or more things wrong with him.

The timing for the development of the anaemia would be about two weeks after starting the drug if it's a first time exposure, or within a few days to a week if this is not the first exposure to the drug.

It is also underdiagnosed because the Coombs test is not a routine lab test. Samples usually have to be sent either to a university lab whose Immunology Department is equipped to do the testing, or to a specialised outside lab.

The cases reported in the veterinary literature were all quite severe with extensive destruction of red cells, profound weakness, even death. However, it is known from species where this is better studied that the anemia may also be mild. Those are the cases most likely to be missed. Stopping the offending drug may be all the treatment that is needed. If anemia persists, a course of corticosteroids is used.

Amaemia of chronic disease in Horses

Anaemia of chronic disease (AOCD) is probably the most common form of anaemia in horses. It is caused by a suppression of red blood cell production, rather than by any defect or inability of the bone marrow to produce red cells.

As already mentioned, kidney failure leads to decreased levels of EPO hormone, but chronic kidney disease is uncommon in horses. However, the inflammatory processes that underlie anaemia of chronic disease also suppress production of EPO.

AOCD is characterized by marked suppression in iron metabolism. Because iron fuels inflammation, and is required in large amounts by many infectious organisms as well as malignancies, any disease associated with an inflammatory state triggers decreased iron absorption, decreased TIBC/transferrin, decreased transferrin saturation and increased ferritin to secure iron out of the circulation. At the same time, inflammatory cytokines stimulate the liver to produce a protein called hepcidin. Hepcidin prevents the intestinal

cells and iron storage sites from releasing their iron. AOCD in the horse is a normocytic, normochromic anaemia.

Anaemia of chronic disease can look like iron deficiency anaemia but Dr Kellon has not seen this, probably because iron stores in domestic horses are higher than they would need for a lifetime. [Click To Tweet](#)

Although the effect on iron metabolism can lead to AOCD eventually looking like iron deficiency anaemia, I have never seen this happen with a horse – probably because iron stores in domestic horses are typically many times higher than what they would need for a lifetime.

The inflammatory state induced by insulin resistance can lead to a mild AOCD in these horses. AOCD is typically more marked in horses with Cushing's disease/PPID (pituitary pars intermedia dysfunction). This is because cortisol can block the effect of EPO in the bone marrow so these horses are taking a double whammy. The typical complete blood count (CBC) of a poorly controlled PPID horse will show:

normocytic, normochromic anemia with hematocrit in the mid 20s to low 30s
elevated neutrophil:lymphocyte ratio

The change in the neutrophil:lymphocyte ratio is a classical cortisol effect. In healthy adult horses, the ratio should be close to 1:1.

Anaemia in Older Horses

Finally, anaemia is a common finding in older horses, even if they do not have PPID or any obvious disease. Low grade anaemia in older horses is multifactorial. Inactivity, muscle wasting and an overall decrease in metabolic rate result in a lower requirement for oxygen. Many older horses will run hematocrits in the high 20s to low 30s and be perfectly normal.

That said, a new finding of anaemia should always trigger a physical exam and blood chemistry screen to look for possible underlying disease. If nothing else is found, a mild anaemia in an older horse is likely physiological and no cause for concern – or treatment.

Forageplus Talk is a free access website sponsored by Forageplus Ltd Intelligent Nutrition for your Horse.