

# Eperythrozoonosis in Swine

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**E**PERYTHROZONOSIS means literally an infection with a parasite upon the erythrocytes. This appears to be a very common condition of swine in Kansas as indicated by the relative ease with which eperythrozoa can be recovered from adult hogs. Clinical evidence of this infection, referred to as acute eperythrozoonosis, occurs only sporadically. The acute condition is also known as icteroaemia, anaplasmosis-like disease, or yellow-belly of swine.

Our studies have indicated that the acute disease probably occurs somewhat more frequently than generally recognized. During the past year we encountered nine herd outbreaks of acute eperythrozoonosis within a 25 mile radius of Manhattan. This may, perhaps, give some indication of the disease prevalence one might expect in northeastern Kansas.

In comparison with hog cholera, swine erysipelas, and the enteric diseases of swine, acute eperythrozoonosis is of minor economic importance, however, in certain herds losses may range as high as 40 to 50 percent. The usual number of animals visibly affected in the herd ranges from one to 10 percent. The mortality of clinically affected animals is often quite high.

Detailed observation of all pigs in affected herds will almost always dis-

close a number of subclinical cases as well as those showing clinical symptoms. Under experimental conditions acute eperythrozoonosis may be readily reproduced by injection of infectious blood into splenectomized swine, or by splenectomy of carriers of the parasite. Removal of the spleen reduces the animal's natural resistance to these organisms, and allows intense blood infections to develop. The intensity of Eperythrozoon infections produced in this manner approximates those observed in pre-clinical or very early clinical field cases of acute eperythrozoonosis. We have also succeeded in reproducing the subclinical form of the disease in unoperated pigs by the injection of large amounts of blood containing enormous numbers of parasites.

Two separate species of Eperythrozoon parasites have been found in northeastern Kansas. The first is *E. suis* which was found to be pathogenic, and incriminated as the causative organism of icteroaemia in swine. The second is *E. parvum* which is usually non-pathogenic and has not been observed microscopically in field cases. Recognized authorities in the United States and South Africa have agreed that these blood structures are members of the genus Eperythrozoon.

Quite recently Foote and co-workers (1) of the Oklahoma Veterinary Research Institute reported the recovery of a virus from a pig displaying symptoms of anemia and icterus. They found no eperythrozoa associated with the condition, and were able to transmit the disease to splenectomized swine with blood

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serum and urine filtrates. *E. suis* and *E. parvum* appeared, apparently spontaneously, in some of the pigs inoculated with these filtrates. They concluded that icteric anemia is due to a filtrable virus, and that eperythrozoa are either reactionary bodies or artefacts, or are coincidental with the disease. They have named the condition "virus anemia of swine," the virus being called the "virus of Farley."

The author has demonstrated that the conclusions set forth in the above report are erroneous (2). Acute eperythrozoosis and "virus anemia" of swine are definitely not identical. Blood serum filtrates from acutely affected pigs and carriers of *E. suis* failed to reproduce the disease following inoculation of susceptible, splenectomized pigs.

The complete absence of any infectious agent in the urine has been demonstrated. Filtered and unfiltered urine from carriers or acute cases of eperythrozoosis was found to be innocuous when injected into susceptible, splenectomized pigs.

#### Age and Seasonal Incidence

Acute eperythrozoosis is encountered in the field almost entirely during the warm months of the year. The peak in cases is usually reached in August, September, and October. The majority of these cases occur in young pigs weighing from 50 to 100 pounds, although the size and age may vary from less than eight weeks up to adult, heavy hogs. Experimentally we have reproduced the disease in pigs as young as 7 days and adult hogs weighing 350 to 400 pounds. The majority of cases occur in young pigs probably because of their exposure to older animals in the herd which are carriers. The occurrence of the disease primarily during the summer months suggests that transmission occurs by arthropod vectors, possibly flies or mosquitoes. We have, as yet, been unable to transmit the disease experimentally with hog lice.

#### Symptoms

The outstanding symptom of acute eperythrozoosis is an acute anemia, which in advanced cases may readily be

observed by examination of the mucous membranes of the eye.

Early clinical symptoms include depression, loss of appetite, and usually elevated temperatures of 104 to 107°F. This clinical picture coincides with intense blood infections of *E. suis*. Marked clinical evidence of anemia may not be present at this early stage. These early clinical symptoms may be of very short duration, and not particularly marked in cases in which a sudden spontaneous reduction of the parasites occurs. As the parasites reduce in numbers the body temperature drops to normal or subnormal, and at the same time excessive blood destruction occurs. The pig displays a marked anemia and often icterus of variable intensity. There is often extreme weakness comparable to that observed in hog cholera. Constipation or diarrhea with bile stained feces may also be noted. Talquist readings of the blood hemoglobin are usually 50 percent or less, the blood appearing thin and watery. A spontaneous agglutination of the erythrocytes is often observed during the acute anemic stage.

The clinical course of the disease varies from 24 hours to 7 or 10 days, the average being about four or five days. Pigs may sometimes be found dead, the owner having failed to note any symptoms prior to death.

Subclinical cases are frequent in herds undergoing acute eperythrozoosis, and occur simultaneously with the acute condition. Apparently normal pigs in the herd will be found with elevated temperatures and relatively heavy parasitic infections. A mild anemia develops as the parasites disappear from the blood. Loss of appetite may occur temporarily, perhaps for one or two feedings, but usually is not sufficient to be noted. The majority of animals in the herd will undergo mild Eperythrozoon infections with no ill effects. All of these animals will remain carriers of the parasite, probably permanently.

It should be kept in mind that the production of disease and the severity are dependent entirely upon the number of Eperythrozoon parasites which develop

in the blood stream following infection, and the length of their duration in the blood in great numbers. The disease bears some resemblance to bovine anaplasmosis in this respect.

### Post Mortem Lesions

Lesions on autopsy are usually quite characteristic, and apparently pathogenic if the animal has not succumbed too quickly following the appearance of symptoms. These include thin, watery blood; a yellow discoloration of the body fat and other internal tissues; an enlarged, friable spleen which in some cases may be 3 or 4 times normal size. The stomach and intestinal contents are often discolored with a large amount of orange-yellow bile. The heart, kidneys, and muscles are usually pale in color, and may also show evidence of icterus. The liver may show icteric discoloration and degeneration; the gall bladder contains a thick granular or gelatinous bile. Icterus is not constant, but is usually present in those animals that have lived for three or four days following the appearance of symptoms.

### Differential Diagnosis

Kinsley (3) made the statement a number of years ago that there are at least three conditions of swine in which anemia and icterus are prone to occur. They are baby pig anemia, paratyphoid infection, and the icteroaemia disease entity.

Baby pig anemia or nutritional anemia due to iron and copper deficiency very rarely occurs in pigs over 6 weeks of age. Usually a spontaneous recovery occurs at the age of 6 to 7 weeks. It is particularly prevalent in pigs farrowed in the late fall, winter, or early spring; and because of the weather or other reasons the pigs are confined to floored pens without access to loose soil.

In connection with nutritional anemia of swine, Dr. Frank Breed (4,5) has described an icteroaemic condition of pigs which he believes to be of nutritional origin. It occurs in pigs beginning at about 90 pounds in weight and over. They are usually pigs that were farrowed in

early spring, and had histories of nutritional anemia during the first 5 or 6 weeks of life. Symptoms have usually begun in the month of September, and one or as many as 8 to 10 pigs in the herd may be affected. At no time has a rise in temperature been found. The post mortem lesions are similar to acute eperythrozoonosis, with the exception of liver and bone marrow. The liver shows a great amount of fatty degeneration and connective tissue proliferation; the bone marrow is invariably very pale, and the ribs quite brittle. The bone marrow in acute eperythrozoonosis is usually hyperplastic, as evidenced by the large amount of red bone marrow.

Differentiation of acute eperythrozoonosis from baby pig anemia and the nutritional anemia described by Dr. Breed may be made by careful consideration of the herd history, the season of occurrence, and the age of the animal. Temperatures in acute eperythrozoonosis will usually be elevated early in the disease, and may be normal or subnormal on the 2nd or 3rd day of symptoms. Temperature of the entire herd will usually reveal a number of normal pigs with temperatures elevated up to 107°F.

Kinsley (3) states that the anemia and icterus associated with paratyphoid infection usually affects only a small portion of the herd and is accompanied by an enteritis.

Methods of differentiating acute eperythrozoonosis from "virus anemia" will depend, apparently, upon laboratory examinations. The presence of "virus anemia" in swine cannot be fully accepted, however, until further evidence is presented in which the disease is reproduced consistently and entirely in the absence of eperythrozoa.

It seems probable at this time that the majority of cases of icteroaemia occurring in swine in the Middle West are due to *E. suis*. In the past year the author examined blood smears from 47 acute field cases in 20 herd outbreaks of icteroaemia. *E. suis* was present in all cases with only one exception. States having positive cases were Kansas, Iowa, Missouri, Colorado, and Tennessee. No path-

ogenic virus could be recovered from pigs infected with 12 different strains of *E. suis* obtained in Kansas and Iowa.

Icteric conditions of swine may be observed in obstruction of the bile duct from round worms, or from toxic effects caused by certain poisons and from heavy round worm infestations. The absence of any severe anemia accompanying these conditions should readily serve in differentiating from acute eperythrozoonosis.

Differential diagnosis by blood smear examination will usually serve to distinguish between acute eperythrozoonosis and other similar conditions. Blood smears should be prepared immediately upon drawing blood from the living animal. Smears prepared from dead animals, or from clotted or citrated blood are usually not satisfactory for diagnosis. It is recommended that these smears be examined by laboratories that have had experience in staining and detecting eperythrozoa.

#### Treatment

Neosarsphenamine exerts a specific and almost immediate action upon *E. suis* in both field and experimental cases. A single therapeutic dose will remove all parasites from the blood in as little as two hours following intravenous administration. Following removal of the parasites the temperature returns to normal, usually within 24 hours. If the disease is in the early stage, and anemia is not severe, the pig will be eating and active within 24 hours following therapy. Further blood destruction is prevented by such therapy. Treatment during the incubative stages of the disease will prevent blood destruction entirely in both field and experimental cases.

In field cases specific therapy is probably of little or no value after the third or fourth day of clinical symptoms. Treatment will be of no value in earlier cases if spontaneous reduction of the parasites has already occurred. In the author's observations the specific therapy of some 20 early clinical, subclinical, and pre-clinical cases has given very favorable results.

The recommended dose of neosarsphenamine is one gram per 100 pounds body

weight. Pigs weighing 50 pounds receive 0.5 gram; pigs weighing 150 pounds receive 1.5 grams and so forth. The weight may be estimated. Neosarsphenamine may be given intravenously or intraperitoneally. Intraperitoneal injections are not particularly recommended as the irritating properties of the drug produce localized peritonitis of variable degrees and may precipitate death in weakened animals. Intramuscular injections cause intense pain and temporary lameness, while subcutaneous injections produce marked swelling and possible necrosis. We routinely administer neosarsphenamine via the anterior vena cava. Deposition of the drug outside of the vein in this region will produce swelling and respiratory distress within 24 hours, however reasonably careful technique will prevent this from occurring.

Neosarsphenamine may be purchased in 0.6 gram ampules, a size which is convenient to use, and which reduces the waste in opening the larger 4.5 gram ampule for the treatment of only one or two pigs.

Foote and co-workers (1) state that Aricyl is very beneficial when administered early in the course of the disease. In our experiments we have found that Aricyl is of no value whatever as a specific agent. Experimental infections of *E. suis* progressed as usual following therapy with Aricyl. The disease was controlled immediately following the use of neosarsphenamine.

Aricyl and other arsenicals such as sodium cacodylate and Fowler's solution are apparently of value in stimulating erythrocyte formation, but they do not appear to have any effect upon eperythrozoa.

The mortality of acute cases may be reduced by good nursing procedures. Close confinement to prevent unnecessary exertion is of considerable importance. Nourishing food such as milk or butter milk may serve to maintain the animal during the critical acute anemic stage.

#### Control

The question is sometimes asked whether recovered pigs or all pigs in the

herd should be disposed of since they remain carriers of the disease. In Kansas the answer would be no. In the first place the acute clinical condition does not tend to reappear in herds in following years to any great extent. Secondly, there is no practical method of determining whether or not new animals brought on the farm are carriers. It is likely in this area that if adult hogs are introduced, they are already carriers.

Control in certain problem herds might be effected to some extent by regular spraying with the newer insecticides to eliminate or reduce the number of potential vectors. In some herds the disease may continue to affect pigs over a period of several weeks to a month or more. It is obvious that a call to treat each individual animal would be too time consuming to be practical. Our procedure in these cases is to have the owner bring in any additional pig for treatment just as soon as it is noticed to be off feed. Owners have usually been willing to go to this trouble after seeing the effects of early treatment on the first pig or two.

A drug is needed which might easily be administered to the entire herd, and which would give prophylactic protection and elimination of infection in the incubative stages. There appears to be little or no possibility, at present, for the development of a practical vaccine.

#### References

1. Foote, L. E., Brock, W. E., and Gallaher, B.: Icteroanemia, Eperythrozoonosis, or Anaplasmosis-like Disease of swine proved to be caused by a filtrable virus. *North Amer. Vet.*, 32, (1951):17-23.
2. Splitter, E. J.: Eperythrozoonosis in Swine. Filtration studies. To be published.
3. Kinsley, A. T.: Anemia in suckling pigs. *Vet. Med.*, 34, (1939):239.
4. Breed, F.: Early pig troubles. *Norden news*, 24, (1950):15.
5. Breed, F.: Personal communication. 1950.

That barn owl is your friend. Ninety percent or more of its food is mice and other animal pests. In Australia, laws actually encourage the barn owl and impose a \$25 fine for killing one. One owl was found to catch as many as 80 mice while she was hatching her eggs.

## “Trainee” Examinations

The U.S. Civil Service Commission has announced an examination for Veterinarian (Trainee) to fill positions paying \$3,100 a year in the Bureau of Animal Industry in the United States Department of Agriculture in Washington, D.C., and throughout the United States.

To qualify, applicants must pass a written test and must have completed 4 years of veterinary medicine in an accredited college or university. Applications will be accepted from students who expect to complete the required education by June 30, 1951. The age limits (which will be waived for veterans) are 18 to 35 years.

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## Calorie Requirements

The daily requirement of dogs and cats for calories varies with their breed, size and activity. As a general rule a ten-pound dog will require 50 calories for every pound of body weight, a 20-pound dog about 40 calories per pound of body weight, a 50-pound dog about 35 calories per pound, a 100-pound dog about 28 calories per pound, and a 150-pound dog about 25 calories per pound of body weight. Growing puppies require about twice as many calories as an adult dog, something in the range of about 70 calories per pound of body weight.

Sometimes a dog obviously receiving an adequate amount of essential nutrients still does not do well. This may happen because of abnormalities in the gastrointestinal canal which prevent the digestion of food or prevent its absorption into the system because the tissues fail to utilize the nutrients presented by the blood. Such cases call for diet treatment to suit the individual patient as prescribed by a veterinarian and not the standard prepared dog foods which are, of course, designed for the normally functioning animal.

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Among the parasites, anaplasmosis is most important and costly.