Chemical poisoning in animals. 2. Lead

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II.-LEAD

LEAD is the most frequent cause of poisoning in farm animals, especially of cattle. All animals and man are susceptible to large doses, but small repeated doses may accumulate to toxic proportions in the body. Cattle and sheep are more susceptible to poisoning and are more likely to have access to sources of lead.

SOURCES

The paint colouring compounds, of which lead is often the base, are one of its most important sources and include red lead, white lead and lead chromate. Red lead and sheet lead are also used extensively in the plumbing trade. Lead arsenate, a common insecticide used to spray fruit, is also capable of poisoning stock; but usually through its arsenic content rather than through the lead it contains.

Lead acetate, or sweet sugar of lead, is a common constituent of some animal liniments and lotions and is more dangerous due to its insolubility. Access to old tins or packages which have contained any of these compounds may lead to lead poisoning.

The accumulator plates and cases of discarded car batteries provide the most common source of metallic lead, and the depraved appetite often seen in young calves or in adult cattle suffering under the effects of phosphorus deficiency can lead to poisoning through eating these.

Lead shot has also been the cause of poisoning in poultry and ducks. However, metallic lead is not quite as toxic as the more soluble lead salts.

ABSORPTION

Almost all instances of lead poisoning result from ingestion of the poison with feed or by access to discarded insecticide tins, battery plates, etc. It seems unlikely that poisoning could arise from lead shot or bullets which have lodged in the tissues. Cattle grazing phosphate deficient pasture take to chewing strange objects such as stones, bones and tins which are of no or little nutritional value, but may lead to poisoning.

Absorption from the alimentary tract is not great and most of the ingested lead is passed in the droppings. However, even the insoluble compounds are attacked by the digestive juices so that a proportion is rendered slightly soluble. Thus, the amount absorbed is much the same whether the form eaten is soluble (such as lead acetate) or insoluble (such as
metallic lead or lead carbonate). The amount absorbed is approximately 1 to 2 per cent. of that ingested. The rate at which absorption takes place, however, is higher with the more soluble forms.

Once absorbed, the lead is passed to the liver by the bloodstreams, where the majority is taken up and excreted into the gut with the bile. The small amount which passes on from the liver is excreted in urine, milk and saliva. Enough lead may be present in the milk of a poisoned cow to render it unfit for human consumption.

After continuous ingestion of small amounts of lead (i.e. chronic poisoning), most of it is found stored in bone, with smaller amounts in the liver and kidneys. With acute poisoning by ingestion of a lot of lead over a short period of time, less is found in the bones, and the majority is distributed in the liver and kidney.

Lead is retained in the organs a long time and abnormally high levels may be found in the blood and liver some months after eating a small dose. This can result in symptoms of poisoning after a number of small doses of lead over a period of time.

SYMPTOMS

Acute Poisoning.—The main and probably the only danger with sheep and cattle is acute poisoning—by the ingestion of a lot of lead in a short period of time. Symptoms are not seen for a few days but when they do appear, they are basically those of derangement of the nervous system.

In calves, bellowing, staggering, rolling of the eyes and frothing at the mouth are first seen. This progresses to intermittent periods of mania and convulsions, interspersed with quiet periods. During convulsions, the animal may appear quite blind and try to climb up or push against the walls of its stall or pen. Convulsive muscle spasms and champing of the jaws occur with increasing frequency to end in death, often as early as one hour from the onset of symptoms. Thus, perhaps the only signs seen are the dead calf or one taking a fit.

In less severe cases of acutely poisoned calves, dullness and loss of appetite occur over several days accompanied by signs of abdominal pain, such as groaning, an arched back, or licking and glancing at the flank. Constipation occurs, but this is often followed by diarrhoea and the calves slobber and tend to choke back.

Symptoms are less marked in adult cattle and are seen as salivation with slobbering, choking and lack of appetite followed by a drop in, or termination of, milk production in cows. There are intermittent attacks of abdominal pain with staggering and convulsions.

Dullness and loss of appetite are also seen in pigs and sheep, but sheep never show muscle spasms even in the terminal stages. In pigs, the droppings become grey-white to grey and may be blood tinged. They become frenzied, champ their jaws and may go blind. These symptoms lead to convulsions, coma and death. Mature pigs may not show convulsions, only an inco-ordination leading to paralysis and death.

Acute poisoning in horses shows less marked symptoms. There may be a depression, stupor and partial paralysis with knuckling over of the pastern-joints, but droppings are normal in colour and there may be no signs of colicky pain.

Dogs also show inconstant signs, with listlessness, loss of appetite and marked emaciation being most common. Muscle tremors, frothing at the mouth, vomiting and continuous barking precede any convulsions which may occur. These signs eventually terminate in blindness, coma and death.

Acutely poisoned poultry show depression, lack of appetite, emaciation with excessive thirst. Muscle weakness is seen with the wings drooping to the ground and the bird may be unable to stand. Droppings are often discoloured green. Young birds may die within 36 hours of ingestion of lead.

Chronic Poisoning.—This is the result of accumulation of lead in the body from repeated ingestion of small amounts of lead over a relatively long period of time. It rarely occurs in sheep and cattle as they are remarkably tolerant to small amounts of lead; it is however, often encountered in dogs and cats and was once frequent in horses. There is evidence that pregnant ewes are more susceptible, and continued ingestion may lead to abortion. Lead piping was a common source of contamination of water supplies, but it is
not used in modern water reticulation systems.

The principal signs of chronic poisoning are wasting with joint swellings, reduction or termination of lactation and abortion ending in convulsions and paralysis.

Horses suffering from chronic poisoning show a marked loss of weight, swellings at the carpal or "knee" joint of the forelegs and a gradual paralysis of the hind legs. There is a characteristic shortness of breath which may lead to "roaring" due to paralysis of the nerves supplying the vocal cords. In the horse, as with dogs, cumulative poisoning may occasionally produce a blue-black discolouration of the gums similar to the classical "lead line" of lead poisoning in man. However, this is comparatively rare.

**POST-MORTEM SIGNS**

In the acute form of poisoning in all animals, there is inflammation of the lining of the stomach and small intestine with areas of ulceration. The intestinal wall may be covered with a grey or black film of lead sulphide, due to a chemical reaction between the lead and the intestinal contents.

The liver shows degenerative changes and has a soft putty-like consistency. In fresh carcasses, the kidneys are pale, with small blood spots on their surfaces. Similar blood spots may be seen on the outer and inner surfaces of the heart muscle, or in any part of the body. Poisoned poultry may show necrosis of the liver even after very small doses of lead.

In chronic lead poisoning, the body is very emaciated and there is a general lack of fat beneath the skin, along the omentum and around the kidneys. The internal organs, especially the kidney, are shrunken. The liver is pale and fibrotic and shows haemorrhages through its substance.

**DIAGNOSIS**

Diagnosis is based essentially on symptoms of convulsive or maniacal behaviour with confirmation of gastro-enteritis and other changes at post-mortem. History of ingestion or access to lead or lead compounds aids diagnosis, but often lead may be available from a forgotten or unknown source.

**TREATMENT**

There is usually a lapse of a few days between ingestion of the lead and exhibition of symptoms. Therefore, acute cases in farm animals are usually encountered at too late a stage for treatment to be of value. Veterinary assistance should be sought where it is available.

However, precipitation of the lead should be attempted by the use of chemical antidotes such as the proteins of egg and milk. Subsequent purging should be used to get rid of the lead remaining in the intestine. Epsom salts or Glauber's salts have a dual action in that they have both a precipitating action, forming the insoluble lead sulphate, and a non-irritant purging action.

The dose of Epsom salts to be given varies with age and weight, but adult horses, sheep, goats and pigs should be given a quarter pound dissolved in approximately a pint of water, while adult cattle may be given up to a pound dissolved in a few pints. The dose rate of Glauber's salts is a little higher. These quantities should be reduced for young animals and those in poor condition.

In chronic poisoning, calcium supplements should be given to hasten the deposition of lead in the bones from soft tissue, so that the danger of its accumulation to toxic proportions is reduced. These may be administered in the form of ground limestone or bone meal at a level of 1 to 2 ounces daily. Injections of calcium borogluconate subcutaneously at a rate of 50 cc of solution per 100 lb. live-weight may be used instead of or supplementary to this form of treatment.

**PREVENTION**

Prevention is basically a matter of common sense and care. Calves should be kept penned away from surfaces where lead containing paints have been applied. Containers which have held lead compounds, as well as old batteries and sheet lead should be disposed of in a safe place. The soluble lead compounds—especially the sweet sugar of lead—should be kept in places which are inaccessible to all animals and children.
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