



Indian Veterinary Magazine

a monthly Magazine

of the people, by the people, for the people



Vol 2 Issue 5 May 2026, 447-453

ISSN:3108-1398

Impact of Lead Toxicity on Animal Health: Prevention and Control Strategies

Dr. Karuna P. Bambode* and Dr. Jasanjot Singh**

*Scientist, Division of Animal Physiology, ICAR-NDRI, Karnal-132001 (Haryana)

** Department of Veterinary Physiology, GADVASU Ludhiana (Punjab)

Corresponding author e-mail: karuna2023ars@gmail.com and mrjashan0@gmail.com
doi.org/10.5281/IndianVeterinarymagazine.20347823

Introduction

Lead is a widespread environmental toxin and a major cause of poisoning in domestic and wild animals worldwide. Cases in animals often serve as sentinels, indicating environmental contamination and potential human health risks. In veterinary practice, lead poisoning is most commonly seen in cattle and dogs, while other species are less affected due to selective feeding habits or lower susceptibility. In cattle, many cases are associated with agricultural activities such as seeding and harvesting, during which improper disposal of used oil, batteries, and machinery waste can expose animals to lead. Other important sources include old lead-based paints, grease, linoleum, lead weights, lead shot, and contaminated vegetation near industrial areas, smelters, or roadsides. Although the removal of tetraethyl lead from gasoline has reduced oil-related poisoning, environmental contamination remains a significant risk.

Lead binds strongly to soil particles, accumulating in the upper layers, and can enter water sources through runoff, contaminating forage and drinking water. Grazing animals, particularly cattle, are highly vulnerable due to their indiscriminate feeding behaviour they may lick grease, drink used oil, or chew discarded batteries. In ruminants, ingested lead particles can settle in the reticulum, where stomach acidity gradually converts them into soluble forms such as lead acetate, increasing absorption and toxicity. Among livestock, calves are especially susceptible because of their curiosity, indiscriminate feeding, and higher absorption of lead from milk or milk replacers. Young animals can also be exposed indirectly through contaminated milk. While cattle, dogs, horses, and poultry can all be affected, pigs are relatively resistant. Wildlife, particularly waterfowl, are vulnerable due to ingestion of lead

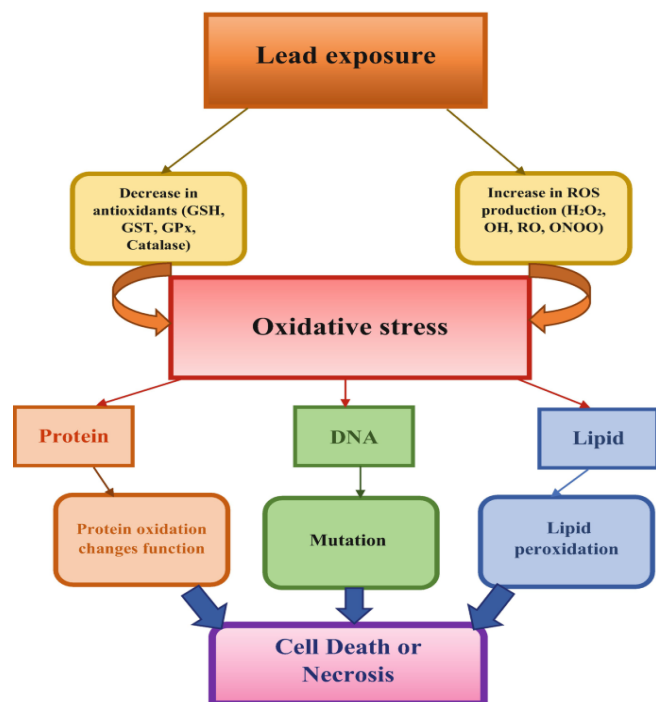
shot and fishing sinkers, while other species may accumulate lead through contaminated ecosystems and the food chain.

Major sources of lead exposure include industrial emissions from mining and smelting operations, lead-based paints, discarded batteries, and contaminated soil and water. Grazing animals ingest lead along with forage and soil, dogs through household exposure, and wildlife through contaminated environments. Lead poisoning remains a critical concern for animal health, food safety, and environmental sustainability, emphasizing the need for proper waste management, monitoring of environmental contaminants, and preventive measures to reduce exposure risk.



Pathogenesis

Lead disrupts normal biological functions in several ways. It binds to sulfhydryl groups in enzymes, inhibiting their activity, reduces the thiol content of red blood cells, and weakens the body’s antioxidant defense system. It particularly affects tissues with high mitochondrial activity, which helps explain the wide range of clinical signs seen in poisoning cases. Neurologically, lead can cause cerebellar hemorrhage and edema due to damage to capillaries. Beyond this, it exerts multiple toxic effects: it suppresses the immune system, interferes with reproduction (gametotoxic), induces developmental abnormalities (teratogenic), damages the kidneys (nephrotoxic), and disrupts blood cell production within the hematopoietic system.



Effects on Animal Health

Acute Lead Poisoning: Acute poisoning is most commonly seen in young animals, with the gastrointestinal and nervous systems primarily affected. In cattle, signs usually develop within 24–48 hours of exposure and include ataxia, blindness, excessive salivation, rapid eyelid twitching, bruxism (teeth grinding), muscle tremors, and convulsions.

Subacute Lead Poisoning: Subacute cases are more frequently observed in sheep and older cattle. Clinical signs include anorexia, rumen stasis, colic, depression, and transient constipation that may later progress to diarrhea. Neurological signs such as blindness, head pressing, bruxism, hyperesthesia, and incoordination may also be present.

Chronic Lead Poisoning: Chronic exposure, occasionally reported in cattle, often presents with signs similar to acute or subacute forms. Dysphagia is a common feature and may result in aspiration pneumonia. Reproductive effects, including embryotoxicity and reduced semen quality, can contribute to infertility.



Advanced stages of lead



Lead Toxicity

Lead Poisoning in Dogs: In dogs, lead toxicity mainly affects the gastrointestinal system, causing anorexia, vomiting, diarrhea, constipation, and abdominal pain. Neurological signs may include anxiety, excessive barking, salivation, jaw clenching, blindness, ataxia, muscle tremors, opisthotonos, and seizures. In some cases, central nervous system depression may occur instead of excitation.

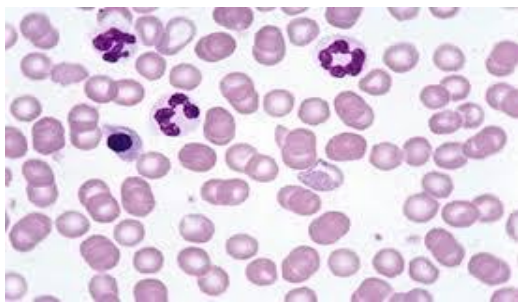
Lead Poisoning in Horses: In horses, lead poisoning generally manifests as a chronic condition. Common signs include weight loss, depression, weakness, colic, diarrhea, and paralysis of the larynx or pharynx, often described as “roaring.” Dysphagia is frequently observed and can lead to aspiration pneumonia.



Lead Poisoning in Birds: Affected birds may show anorexia, poor body condition, ataxia, weakness of wings and legs, and anemia.

Lesions and Pathological Findings

Animals that die from acute lead poisoning often exhibit only subtle changes on gross examination. Occasionally, fragments of paint, oil, or battery materials may be present in the gastrointestinal tract. The corrosive properties of lead salts can lead to inflammation of the stomach and intestines (gastroenteritis). In the brain, typical findings include cerebral edema, congestion of the cortex, and flattening of the cortical gyri. Microscopic examination reveals more detailed damage: swelling of endothelial cells, laminar necrosis of the cerebral cortex, and edema of the white matter. The kidneys may show tubular degeneration, necrosis, and intranuclear acid-fast inclusion bodies. Chronic exposure in lambs has been associated with osteoporosis. Lead can also impair reproduction, as placentitis and accumulation of the metal in the fetus may result in abortion (Osweiler, G.D. et al., 1985).



Blood smear in lead-poisoned dog shows basophilic stippling and nucleated erythrocytes



Post-mortem: lead deposits in reticulum honeycomb

Diagnosis

Lead poisoning is diagnosed based on exposure history, clinical signs, and lab tests. Blood lead levels are the most reliable indicator, while severe cases may show lead accumulation in liver, kidneys, bones, or hair.

- **Blood Lead:** Whole blood is the most reliable sample for assessing lead exposure. Chronic intoxication may show normocytic, normochromic anemia. Normal blood lead in ruminants is 0.05–0.25 ppm; affected animals often exceed 0.35 ppm, with fatalities around 1.0 ppm. Blood levels drop quickly during chelation therapy, so monitoring enzymes like **δ -aminolevulinic acid dehydratase (ALA-D)** can provide additional diagnostic and prognostic value.

- **Milk Lead:** Lead is excreted in milk, though data are limited. Reported levels reach up to 0.13 mg/L, with a half-life of 4.6 days. High milk lead reflects elevated forage contamination (Sheffler et al., 2025).
- **Fecal Lead:** Fecal lead mainly represents unabsorbed or bone-excreted lead. Alone, it has limited diagnostic value and should be interpreted alongside blood levels. Elevated fecal lead indicates ingestion within the past 2–3 weeks (Peter et al., 2017).
- **Urine Lead:** Urinary lead levels are usually low (≤ 0.2 – 0.3 mg/L) and variable. While high urine lead can reflect elevated blood lead, it is not reliable for diagnosis alone (Roegener et al., 2013). δ -Aminolevulinic acid dehydratase (δ -ALA-D), an essential enzyme in heme synthesis, is one of the most sensitive indicators of lead-induced disruption of the heme biosynthetic pathway (Reis et al., 2010).

Differential Diagnosis

Lead poisoning can mimic a range of other conditions, making accurate diagnosis essential. Important differentials include:

1. **Nutritional deficiencies** – such as thiamine or vitamin A deficiency.
2. **Metabolic disorders** – including ketosis and hypoglycemia.
3. **Bacterial infections** – for example, infections caused by *Clostridium* species or listeriosis.
4. **Viral diseases** – such as infectious bovine rhinotracheitis or bovine malignant catarrh.
5. **Other toxicities** – including exposure to mercury, organochlorine compounds, or poisonous plants.

Treatment

Chelation therapy is used to bind lead and enhance its excretion, with commonly used agents such as calcium EDTA and dimercaprol. Supportive therapy, including fluid administration, control of seizures, and proper nutrition, is essential for recovery.

- **Calcium disodium EDTA (Ca-EDTA):** Administer a 1–2% w/v solution in 5% glucose at a dose of 100 mg/kg body weight, twice daily for 2 days. After a 2-day interval, repeat the same treatment for an additional 2 days.
- **Thiamine hydrochloride:** Give at 200 mg/kg/day intramuscularly on alternate days for up to 14 days.
- **Magnesium sulfate (MgSO₄):** Administer orally as a drench to precipitate lead in the gastrointestinal tract and act as a saline purgative.
- **Antibiotics:** Use to prevent or control secondary bacterial infections.

- **Corticosteroids:** Administer to reduce inflammation and alleviate pain.
- **Garlic supplementation:** Feeding garlic at approximately 45 g per animal per day has been reported to prevent clinical signs and help maintain normal appetite.

Prevention and Control Strategies

1. **Proper Waste Management:** Ensure safe disposal of lead-containing materials such as batteries, used oil, paint, and machinery waste to prevent accidental ingestion by animals.
2. **Environmental Monitoring:** Regularly assess soil, water, and forage for lead contamination, especially near industrial areas, highways, and old buildings.
3. **Restrict Access to Hazardous Areas:** Prevent animals from grazing near contaminated sites such as smelters, dumps, construction zones, and areas with peeling lead-based paints.
4. **Safe Storage of Materials:** Store paints, lubricants, batteries, and other hazardous substances securely and out of reach of animals.
5. **Maintain Clean Grazing Areas:** Remove debris, scrap materials, and old machinery parts from pastures to reduce the risk of ingestion.
6. **Nutritional Management:** Provide balanced diets with adequate minerals (e.g., calcium, iron, zinc) to reduce lead absorption in the body.
7. **Regular Health Monitoring:** Conduct routine veterinary check-ups and monitor animals for early signs of toxicity, particularly in high-risk areas.
8. **Public Awareness and Farmer Education:** Educate livestock owners about sources of lead exposure and the importance of preventive measures.
9. **Control of Industrial Emissions:** Implement regulations to limit environmental pollution from industries such as mining and smelting.
10. **Testing and Screening:** Perform blood or tissue testing in suspected cases or in herds located in contaminated regions.
11. **Immediate Removal from Source:** In suspected exposure cases, promptly remove animals from the contaminated environment to prevent further intake.
12. **Proper Carcass Disposal:** Dispose of dead animals safely to prevent environmental contamination and secondary poisoning of other animals.

References:

Osweiler GD, Carson TL, Buck WB, van Gelder (1985): GA. Clinical and Diagnostic Veterinary Toxicology. Iowa: Kendall Hunt Publishing Co.: 107-120.

- Puschne, B. Aleman, M. joy, F. (2010). Lead toxicosis in the horse. *Equine Vet Educ.*22:526.
- Roegner, A., Giannitti, F., Woods, L. W., Mete, A., & Puschner, B. (2013). Public health implications of lead poisoning in backyard chickens and cattle: four cases. *Veterinary Medicine: Research and Reports*, 4, 11–20.
- Reis, LSLS., Pardo, P., Camargos, AS., Oba, E. (2010). Mineral element and heavy metal poisoning in animals. *J Med Medical Sci.*1(12):560.
- Sheffler, R., Reboloso, S., Scott, I., Buchweitz, J. P., & Puschner, B. (2025). Milk and Whole Blood Surveillance Following Lethal and Sublethal Lead Intoxication in a Michigan Dairy Herd. *Toxics*, 13(6), 445.