CLINICAL AND MORPHOPATHOLOGICAL ASPECTS IN ANTI-FREEZE INTOXICATION OF DOGS

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Abstract

Anti-freeze intoxication is most frequently encountered in dogs and cats after accidental consumption of the liquid emptied from car radiators. In ruminants, the intoxication can appear as a consequence of erratic contamination of grazing fields with the liquid from tractor tires. Other cases have been reported, due to erronate treatments applied to silage, when ethilenglicole is mistaken taken for formic acid, or after contaminated water consumption. Ethylen glycol is oxidized by alcohol dehydrogenase in the liver to glycoaldehide, wich is in turn oxidized to glycolic acid, glyoxalate, and finally, oxalate. Calcium oxalates crystals may be found in tubular lamina, tubular cells and the interstitium; they are light yellow, arranged in rosettes or prisms, and are birefringent in polarized light. Tubular lesions range from fat degeneration to necrosis. Large numbers of crystals in tubules are pathognomonic for ethylene glycol poisoning.

Key words: *anti-freeze, dog, intoxication.*

INTRODUCTION

Antifreeze poisoning is most commonly observed in pet carnivores (dogs, cats). It is a toxicosis with nonspecific clinical symptoms, acute evolving as digestive disorders, cardio-respiratory and nervous and subacute form by nephrotoxic syndrome and renal failure.

Species frequently exposed are dog and cat, but intoxication was reported in cattle, dwarf goats and poultry (Solcan, 2001; Jubb et al., 2007).

Antifreeze is a syrupy, sweet liquid containing 95% ethylene glycol.

Poisonings are more common in autumn and spring, coinciding with the period of handling antifreeze for winter maintenance vehicles (Jubb et al, 2007).

Poisoning is more frequent in dogs than in cats, but the latter is more sensitive (Goicoa et al., 2003).

Following ingestion, the toxic is rapidly absorbed from the gastrointestinal tract and metabolized in the liver, where the action of alcohol

dehydrogenase and liver oxidase will turn it into oxalic acid (Paul, 2000). Intermediate compounds of metabolism: aldehyde glycol, glycolic acid and oxalic acid have neurotoxic and nephrotoxic action (Solcan, 2001).
Clinically, intoxication develops two forms: acute and subacute.
Acute form onset 30 'to 12h, manifested by nervous disorders, digestive and cardiovascular (5).
Acute form begins to 2^{nd}-7^{th} days with nephrotoxic syndrome and renal failure.
The accurate diagnosis consist in corroboration of toxicological, clinical and histopathological dates, the latter giving the most important data for diagnosis(Jubb et al, 2007).
Specific antidote is ethanol, which competes with ethylene glycol in using alcohol dehydrogenase. The enzyme has a higher affinity for ethanol than for ethylene, the latter being eliminated unchanged (Popescu and Enache, 1996; Solcan, 2001).

MATERIALS AND METHODS

Clinical and pathological investigations were performed on 6 dogs brought to the Faculty of Veterinary Medecine Iasi. The dogs were treated in the Internal Medecine and Toxicology Units; morphopathological investigations were performed in the Pathology Unit.
After necropsic examination, organ samples for histopathological investigations. Each case was prelevated kidney fragments, as well as fragments of different organs, physiologically closely related (heart, brain, liver, lung, stomach, intestine, spleen, etc.) were prelevated.
Organ samples were fixed in formaldehyde 10%, then paraffin - imbeded. The histological sections of 5 μm were stained Haematoxilin - Eosin - Methyl Blue (Tricromic - Masson) and Haematoxilin - Eosin.

RESULTS AND DISSCUTIONS

On clinical examination, the patients developed progressive nervous disorders, consisting in agitation, walking drunk, then progressive cortical depression, which occur periodically due to seizures or epileptiform manifestations type, digestive disorders (vomiting and diarrhea), signs of toxic shock (trend to hypothermia, tachycardia, cardiac arrhythmias or rhythmical heart, weak pulse, tachypnea, cyanosis mucosal and acute pulmonary congestion).

Subsequently, acute renal failure was installed with oliguria and anuria, and at biochemical examination of the blood was found hypercreatininemia (above 8 mg / dl) and increased uremia (above 300, reaching even 800 mg / dl). In this phase signs of uremic gastroenteritis (bloody vomiting, diarrhea) and secondary nervous disorders (muscle tremors, seizures and coma) were observed.
Ultrasound examination of the kidneys showed a diffuse hyperechogenic cortical with small shadow cones, suggestive for nephrocalcinosis (Figure 1). Ultrasound examination of the stomach revealed a secondary uremic gastritis (Figure 2).

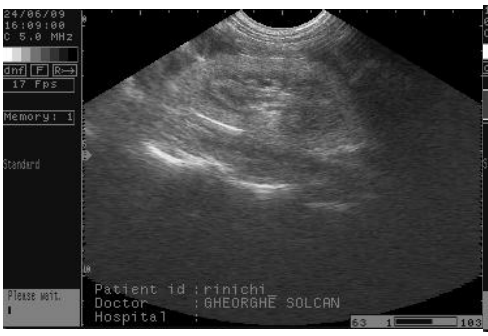

Figure 1. Diffuse renal calcinosis. Hyperechogenic cortical and medullar.

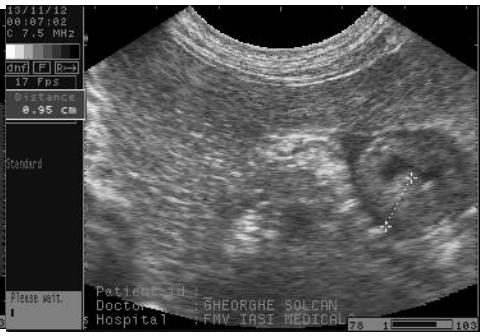

Figure 2. Secondary uremic gastritis. Thick pylorus.

Death occurred within the first 12-36 hours in most cases, due to nervous depression or convulsions, (2 from 8 were euthanized), and 2 cases 4-5 days later due to acute renal failure.
Necropsy. After the death of patients, necropsy was performed, stating the gross lesions observed.
The kidneys were pale, globular, wrinkled surface and showed discrete cortical petechiae (Figure 3).
Heart was distended with a discolored and soft myocardium and the left ventricle was very dilated (Figure 4, Figure 5).

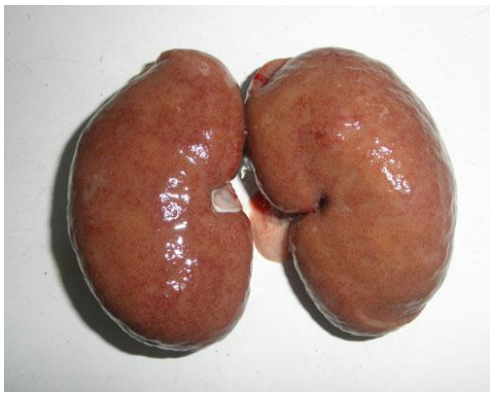

Figure 3. Dog. Discolored and wavy kidney.
Antifreeze poisoning.

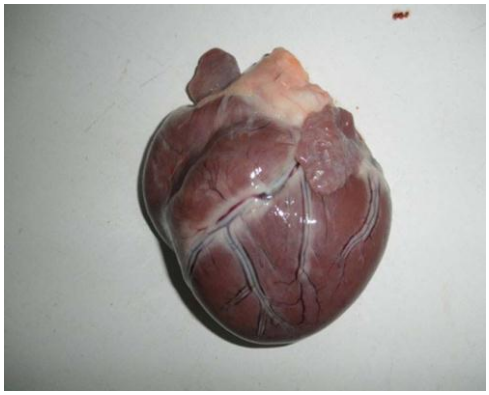

Figure 4. Dog. Discolored and soft heart.
Antifreeze poisoning.

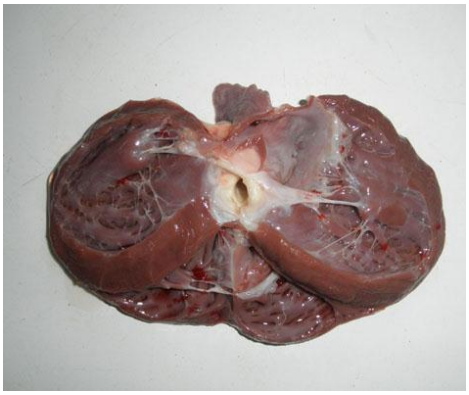

Figure 5. Dog. Left ventricle distension.
Antifreeze poisoning.

Lungs were expanded, pale or slightly reddish. They expressed on the section surface an aerated sparkling reddish liquid, also observed in the lumen of the trachea and the main bronchi (Figure 6, Figure 7).
Constantly in our cases, the spleen was enlarged in volume and weight, red and blackish, asphyxic blood being observed on the surface of section (Figure 8).
The gastric wall was much thickened with accented pleats, a lot of mucus and small hemorrhages on the mucosa. Stomach content was fluid, looking like "coffee grounds" (Figure 9).
In the duodenum were observed macroscopic changes which corresponded to a severe diffuse hemorrhagic inflammation (Figure 10).

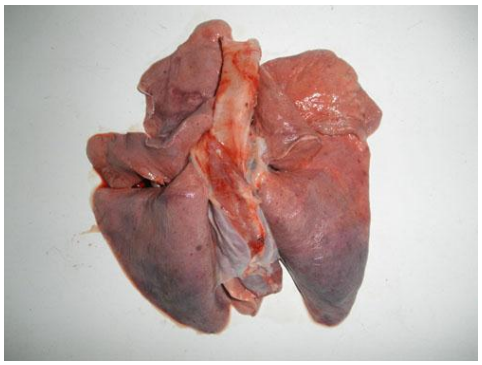

Figure 6. Dog. Pulmonary edema. Antifreeze poisoning.

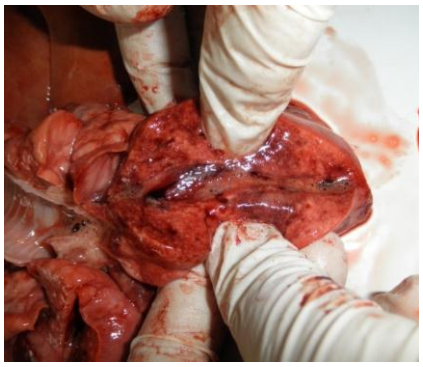

Figure 7. Dog. Pulmonary congestion and edema. Congestie și edem pulmonar. Antifreeze poisoning.

Figure 8. Dog. Spleen stasis. Antifreeze poisoning.

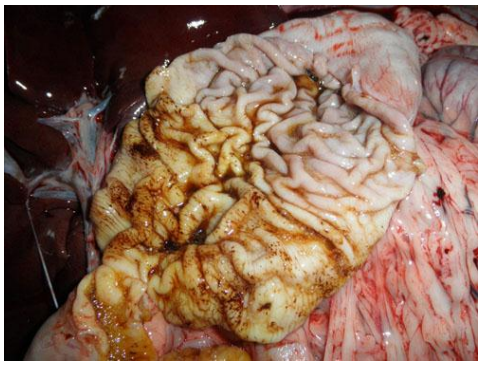

Figure 9. Dog. Focalised hemorrhagic gastritis. Antifreeze poisoning.

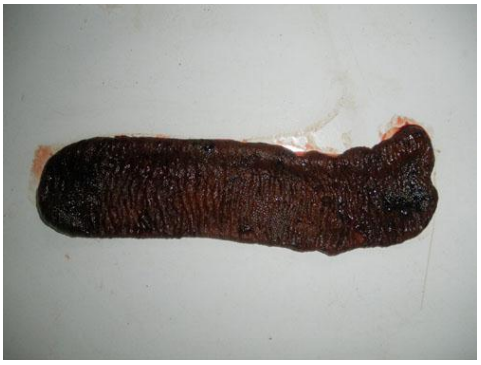

Figure 10. Dog. Hemorrhagic duodenitis. Antifreeze poisoning.

On histopathology, the lesions observed was located kidney, heart, lung, digestive tract and nervous, were characteristic for antifreeze poisoning.
Histopathological examination of the kidneys established the cause of dogs death.
In all cases were noted severe tubular degenerative lesions. Lipid and granular dystrophies, as well as hyaline cylinders were observed in tubular epithelium.
The presence of calcium oxalate crystals induced necrosis of tubular epithelium and its detachment from the basal membrane and also lymphohystiocytare and fibrous proliferation.
In convoluted renal tubules were identified radiar, yellowish calcium oxalate crystal deposits (Figure 11, Figure 12, Figure 13). The nephrocytes showed cloudy/granular cytoplasm and pyknotic nuclei.
On histological exam, the hearts showed a severe granular dystrophy, and in 2 cases subepicardic edema was observed(Figure 14, Figure 15).
Histologically, circulatory lungs disorders were represented by congestion and edema. The interstitial capillary were dilatated and filled with blood. Also, transsudat and hemosiderocytes in alveolar spaces were observed(Figure 16, Figure 17). In subacute form of posoning pulmonary emphysema was observed.
Hemorrhagic and catarrhal-haemorrhagic inflammation was observed in stomach and duodenum (Figure 18, Figure 19).
Cerebral edema was observed consistently in the cases, pointing out also the presence of calcium oxalate crystals in meningeal vessels (Figure 20, Figure 21).
Microscopically, the splenic sinuses were represented by uniformly colored lakes filled with red blood cells, rare lymphocytes and the capsule and trabecules were thickened. Hemosiderocytes were seen in large numbers (Figure 22).
In the liver, the overload of centrolobular vein and sinusoid capillaries was observed (Figure 23).

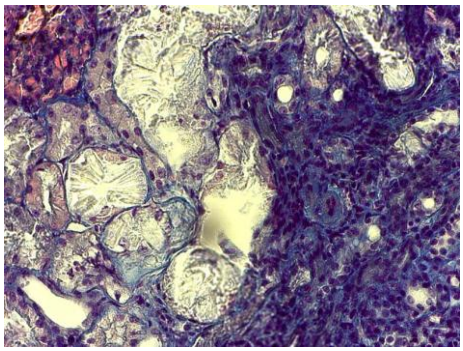

Figure 11. Dog. Oxalic nephrosis. Antifreeze poisoning. Col. HEA, x1000;

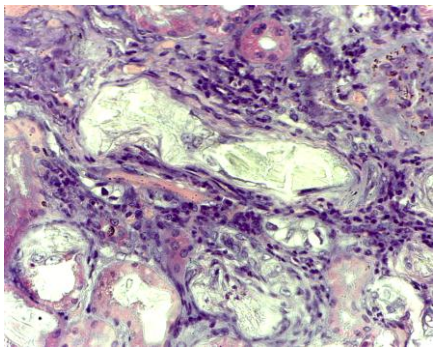

Figure 12. Dog. Tubular epithelium degeneration. Lymphohistiocytic interstitial inflammation. Col. HEA, x1000;

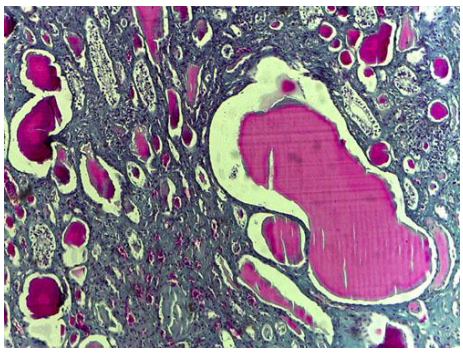

Figure 13. Dog. Hyaline cylinders. Kidney. Col. HEA, x200;

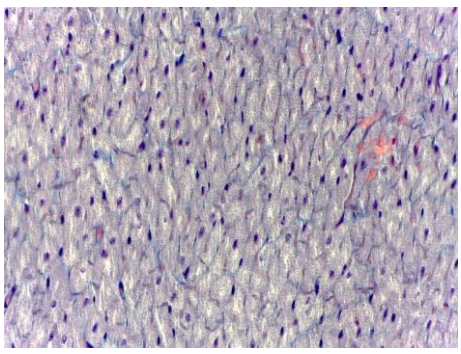

Figure 14. Dog. Granular myocardosis.Col. HEA, x200;

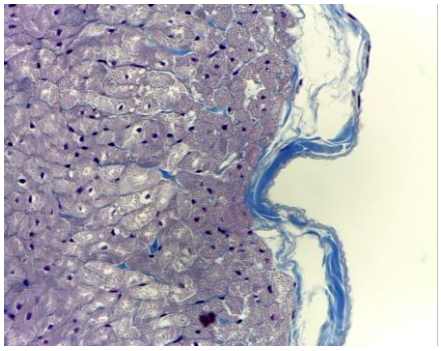

Figure 15. Dog. Subepicardic edema. Antifreeze poisoning. Col. HEA, x200;

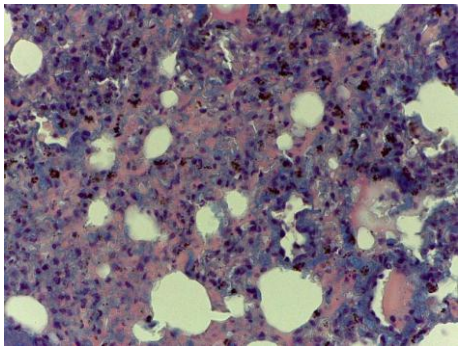

Figure 16. Dog. Pulmonary congestion and edema. Antifreeze poisoning. Col. HEA, x400;

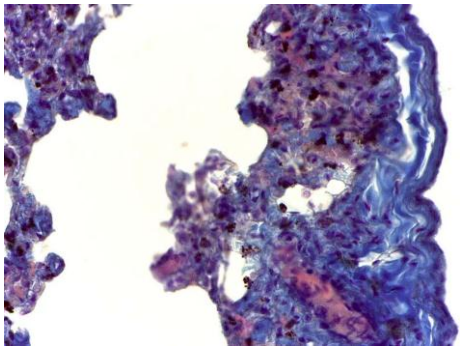

Figure 17. Dog. Pulmonary emphysema. Antifreeze poisoning.

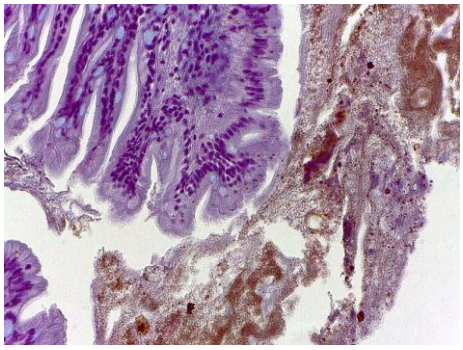

Figure 18. Dog. Haemorrhagic gastritis. Antifreeze poisoning. Col. HEA, x400;

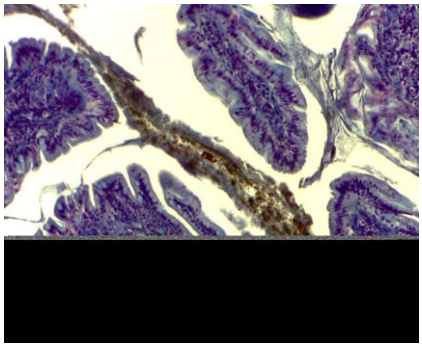

Figure 19. Dog. Catarrhal-haemorrhagic duodenitis. Antifreeze poisoning. Col. HEA, x200;

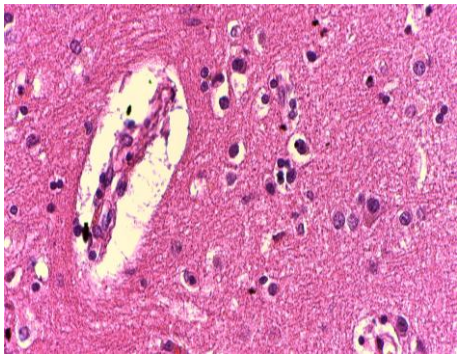

Figure 20. Dog. Cerebral acute edema. Virchow-Robin spaces dilatated. Antifreeze poisoning. Col. HE, x1000

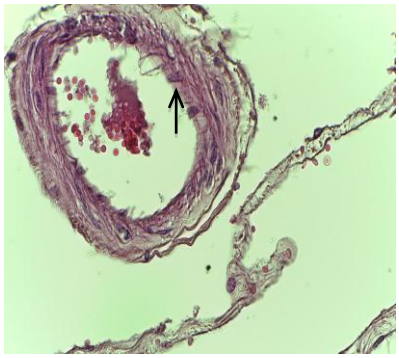

Figure 21. Dog. Cerebral acute edema. Oxalate cristals in meningeal artery. Antifreeze poisoning. Col. HE, x1000

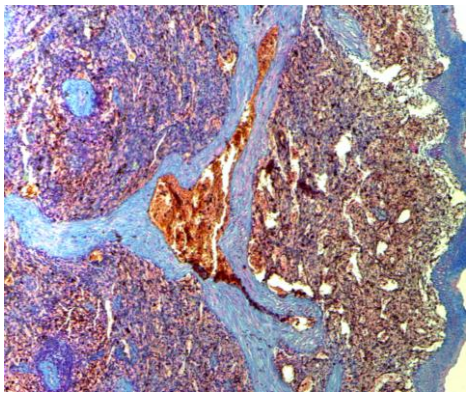

Figure 22. Dog. Spleen stasis. Antifreeze poisoning. Col. HEA, x200;

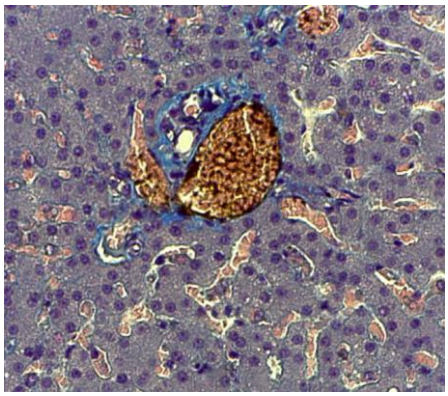

Figure 23. Dog. Liver stasis. Antifreeze poisoning. Col. HEA, x400;

CONCLUSIONS

Clinical signs in all investigated cases consisted in nervous signs (restlessness, walking drunk, progressive cortical depression, seizures or epileptiform), digestive disorders (vomiting and diarrhea), toxic shock signs (hypothermia, tachycardia, cardiac arrhythmias, weak pulse, tachypnea, cyanosis mucosal and acute pulmonary congestion) and acute renal failure.
Necropsy revealed pulmonary and splenic congestion lesions and severe dystrophic and inflammatory lesions of the digestive tract and kidneys.
Microscopic examination revealed hemorrhagic gastritis specific in uraemic poisoning outbreaks and severe degenerative kidney damage induced by the presence of calcium oxalate crystals.
The presence of a large number of calcium oxalate crystals in uriniferous tubules confirmed ethylene glycol poisoning.

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