Case Report

DELAYED ONSET NEUROPATHY ALONG WITH LARYNGEAL PARALYSIS -POLYNEUROPATHY COMPLEX DUE TO ORGANOPHOSPHATE POISONING – NEUROLOGICAL CASE REPORT IN A DOG

P.K. Ramkumar[1*], M. Saravanan[2], R. Lakshmi[1], K. Karthika[2], D.T. Kaarthick[1] and G. Manojkumar[3]

Veterinary Clinical Complex
Veterinary College and Research Institute
Tamil Nadu Veterinary and Animal Sciences University
Orathanadu- 614 625

ABSTRACT

Organophosphates (OP) and carbamates are widely utilized insecticides, but they also pose significant risks as sources of intoxication for both humans and animals. A male non-descript dog, seven years old was presented with a chronic respiratory distress, dysphonia, exercise intolerance, and neurologic signs to Veterinary Clinical Complex, VCRI, Orathanadu on April 2023. Physical examination revealed elevated rectal temperature and congested mucous membrane with elevated heart beat and respiratory rate. Thoracic auscultation revealed muffled heart sound. The dog's medical history indicated a potential case of organophosphate poisoning. Treatment involved administering atropine sulfate, normal saline, ceftriaxone, and furosemide. However, throughout the treatment process, the dog continued to experience upper respiratory stridor and dyspnoea. Clinical examination and radiographic observations confirmed the diagnosis of laryngeal paralysis. This case highlights the occurrence of laryngeal paralysis polyneuropathy complex in a canine affected by organophosphate poisoning.

Keywords: Organophosphate poisoning, laryngeal paralysis, dog, acetylcholine esterase, atropine

Received : 30.01.2024 Revised : 08.05.2024 Accepted : 13.09.2024

INTRODUCTION

Organophosphates (OP) and carbamates are commonly used pesticides and are significant sources of poisoning in animals (Vale and Lotti, 2015; Klainbart *et al*., 2019; Eddleston, 2020). OPs are derivatives of phosphoric acid or thiophosphoric acid,

[1]. Assistant Professor**,** Corresponding author Email id: ramkumar.vet@gmail.com

[2]. Assistant Professor and Head, Department of Veterinary Medicine, Veterinary College and Research Institute, Orathanadu **-** 614 625

[3]. Undergraduate Student, Veterinary College and Research Institute, Orathanadu **-** 614 625

while carbamates are primarily phosphorous free derivatives of carbamic acid. Both types of insecticides competitively bind to the anionic and esteric sites of acetylcholine esterase, effectively inhibiting their function. Acetylcholine is a neurotransmitter found in cholinergic nerve endings and neuromuscular junctions and it is hydrolyzed by acetylcholinesterase. On the other hand butyrylcholinesterase present mainly in the plasma but also in the liver, pancreas, brain, and intestinal mucosa, is synthesized by the liver and breaks down various esteric compounds, including butyrylcholine and acetylcholine (Lockridge, 2015). Exposure to OPs or carbamates results in the removal of a hydroxyl ion from serine in the active site of acetylcholine esterase leading to the inhibition of acetylcholine hydrolysis.

Consequently, acetylcholine accumulates in the synapses, causing overstimulation of muscarinic and nicotinic post-synaptic receptors and disrupting signal transmission within the central and peripheral nervous systems (Berny *et al*., 2010). The typical clinical symptoms of OPC poisoning include muscular tremors, excessive salivation, constriction of the pupils (miosis), weakness, vomiting, and diarrhea (Klainbart *et al*., 2019). OP-induced delayed neurotoxicity (OPIDN) leads to sensory-motor distal axonopathy, characterized by the degeneration of peripheral and central nervous system axons, including the pyramidal tract and posterior column (Luiz Felipe *et al*., 2002). Poisoning cases affects liver which may lead to hepatobiliary disorders, hepatic encephalopathy (Saravanan *et al*., 2014) and acute renal failure (Zafar *et al*., 2017). In cases of laryngeal paralysis caused by chronic organophosphate exposure, dogs may exhibit changes in their bark, such as a muted or hoarse sound (dysphonia) (Indudharan *et al*., 1998).

Organo phosphates and carbamates intoxications are typically diagnosed based on a combination of factors, including a history of exposure, characteristic clinical signs, and positive response to atropine-sulfate and pralidoxime therapy (Mohammadi *et al*., 2018). Additionally, decreased red blood cell acetylcholineesterase activity can serve as indicator and the toxic compound can be identified in gastric contents. Various methods are available for measuring cholinesterase activity. Measuring whole blood RBC acetylcolin esterase can be done and if it decreases to less than 50% of the lower limit of the reference interval, it raises suspicion of intoxication. If the activity drops to less than 25% of the lower limit of the reference interval, it becomes confirmatory of intoxication (Bajgar, 2005).

Despite the importance of understanding OP and carbamates intoxication in dogs, there is a lack of published large scale studies on the topic. Hence, the objective of this retrospective study is to provide a comprehensive description of clinical, neurological, and laboratory findings as well as the treatment and outcome of acute cholinergic crisis resulting from such intoxications in a dog.

CASE HISTORY AND OBSERVATION

A seven year old male non-descript female dog was presented to small animal medicine Teaching Veterinary Clinical Complex, Veterinary College and Research Institute, Orathanadu with the history of chronic respiratory distress, dysphonia and exercise intolerance accompanied by neurologic signs and was reported for organophosphate poisoning. Physical examination revealed elevated rectal temperature and congested mucous membrane with elevated heart beat and respiratory rate.

Thoracic auscultation revealed muffled heart sound. In the course of treatment, the animal showed vomiting and hyper-salivation. Upper respiratory stridor and dyspnoea was evident and the presence of laryngeal paralysis was confirmed on further radiographic examination.

DIAGNOSIS

Confirmation of organophosphate poisoning was indicated by the presence of muscarinic symptoms along with a notable decrease in blood acetylcholine esterase (AChE) levels measured by semiautomatic analyser. The estimation of acetylcholine esterase enzyme revealed a substantial decline in its concentration (Table 1). On analyzing the serum biochemical and hematological values there was marked leucocytosis with neutrophilia. Serum phosphorus was also increased (Table 2). Further Laryngeal paralysis was predicted with examination of larynx and chest and neck x-rays (Fig 1).

TREATMENT

The administration of an antimuscarinic drug as soon as possible is critically important in all cases. Atropine was the first drug of choice, 0.5 mg/kg b.wt of atropine was administered through I/V and along with it fluid therapy was given simultaneously. Furosemide was also given at 4 mg/kg b.wt; additionally Inj. ceftriaxone was also added at 15 mg/kg b.wt through I/V. Unfortunately the animal had collapsed third day of the course of treatment.

DISCUSSION

In dogs, two common causes of upper airway obstruction are laryngeal paralysis (LP) and brachycephalic airway obstruction (Millard and Tobias, 2009). LP occurs due to dysfunction of the recurrent laryngeal nerves, specifically the caudal laryngeal nerves. This dysfunction prevents the active contraction of the cricoarytenoideus dorsal is muscle, leading to the inability to control the glottis and vocal folds, as well as the disappearance of arytenoid abduction (Griffiths *et al*., 2001).

Laryngeal paralysis-polyneuropathy complexes have been observed in certain dog breeds such as Dalmatians and Rottweilers (Griffiths *et al*., 2001). Acquired laryngeal paralysis can result from damage to the recurrent laryngeal nerve or intrinsic laryngeal muscles due to polyneuropathy, polymyopathy, trauma, or intrathoracic surgery. Common clinical symptoms include noisy inspiratory respiration, exercise intolerance, alterations in voice, coughing, and gagging. In later stages, serious airway obstruction may manifest as

Table 1. Cholinesterase value of the dog

Cholinesterase value of the dog	Reference Range
2235 U/L	3405 -6561 U/L

Table 2. Laboratory investigations

Analytes	Values	Reference interval (Units)
Hemoglobin	13.5 (g/L)	12.9-18.4 (g/L)
Erythrocytes	7.5 x (10^6 /µL)	5.6-8.7 x (10^6 /µL)
PCV	39%	37-55.0 (%)
Leukocytes	14.6 x10^3 /µL	5.2-13.9 (x10^3 /µL)
Neutrophils	8.9 x10^3 /µL	3.9-8.0 (x10^3 /µL)
Lymphocytes	2.4 x10^3 /µL	1.3-4.1 (x10^3 /µL)
Monocytes	0.6 x10^3 /µL	0.2-1.1 (x10^3 /µL)
Total Protein	6.4 g/dL	5.5-7.7 (g/dL)
Total Bilirubin	0.1 mg/dL	0.0-0.2 (mg/dL)
Alkaline Phosphatase	85 U/L	21-170 (U/L)
Alanine Transaminase	34 U/L	19-67 (U/L)
Glucose	79 mg/dL	64-123 (mg/dL)
Potassium	3.1mEq/L	3.6-5.3 (mEq/L)
Calcium (total)	10.3 mg/dL	9.7-11.5 (mg/dL)
Phosphorus	7.4 mg/dL	3.0-6.2 (mg/dL)
Sodium	124mEq/L	145-154 (mEq/L)
BUN	28 mg/dl.	25 to 30 mg/dl.

cyanosis, sudden collapse, and respiratory distress.

Diagnosis of laryngeal paralysis involves physical examination, blood tests, urinalysis, thyroid function screening, thoracic radiography, and laryngeal examination. An esophagram may be necessary to rule out esophageal dysfunction or megaesophagus, particularly in cases of dysphagia or vomiting. Visual examination of the larynx is crucial for a definitive diagnosis, and intravenous thiopental is considered the optimal method to assess laryngeal function (Jackson *et al*., 2004). Doxapram Hydrochloride (1 mg/kg IV) can be administered to improve respiratory effort and laryngeal motion during laryngoscopy (Miller *et al*., 2002; Tobias *et al*., 2004).

Surgical intervention is considered for dogs with bilateral laryngeal paralysis, taking into account the dog's quality of life, severity of symptoms, and season. Unilateral laryngeal dysfunction does not typically warrant surgery. Conservative care options for laryngeal paralysis include environmental modifications, owner education, weight loss, and anti-inflammatory medications to reduce laryngeal edema. Supplemental thyroid treatment may be initiated for concurrent hypothyroidism but usually does not alleviate the clinical symptoms of laryngeal paralysis.

Various surgical techniques exist to address laryngeal paralysis, one of which involves suturing the caudodorsal portion of the thyroid cartilage to the muscular process of the arytenoid cartilage (King *et al*., 2015; Vimalraj *et al*., 2022). This procedure enlarges the rima glottis to a lesser extent compared to cricoarytenoid suture and laterally moves the arytenoid cartilage (Griffiths *et al*., 2001). It is worth noting that laryngeal paralysis can be a recognized complication of delayed organophosphate poisoning, as demonstrated in the aforementioned case report.

Fig. 1. Laryngeal paralysis was predicted with examination of larynx, chest and neck x-rays.

CONCLUSION

In this comprehensive retrospective study on delayed organophosphate intoxication in a dog, describes the common clinical and laboratory findings at presentation and has discussed about various diagnostic and treatment options.

REFERENCES

Bajgar, J. (2005). Laboratory diagnosis of organophosphates/nerve agent poisoning. *Klinick Biochemiea Metabolismus*, **13**: 40 – 47.

Berny, P., Caloni, F., Croubels, S., Sachana, M., Vandenbroucke, V., Davanzo, F. and Guitart, R. (2010). Animal poisoning in Europe. Part 2: companion animals. *The Veterinary Journal,* **183**: 255 – 259.

Eddleston, M. (2020). Poisoning by pesticides. *Medicine,* **48**: 214 - 217.

Griffiths, L.G., Sullivan, M. and Reid, S.W. (2001). A comparison of the effects of unilateral thyroarytenoid lateralization versus cricoarytenoid laryngoplasty on the area of the rima glottides and clinical outcome in dogs with laryngeal paralysis. *Veterinary Surgery,* **30**: 359 - 65.

Indudharan, R., Win, M.N. and Noor, A.R. (1998). Laryngeal paralysis in organophosphorous poisoning, *Journal of Laryngology and Otology,* **112:** 81 - 2.

Jackson, A.M., Tobias, K. and Long, C. (2004). Effects of various anaesthetic agents on laryngeal motion during laryngoscopy in normal dogs. *Veterinary Surgery,* **33**: 102 – 106.

King, A.M., Cynthia, K. and Aaron, C.K. (2015). Organophosphate and carbamate poisoning. *Emergency Medicine Clinics of North America*, **33**: 133 – 51.

Klainbart, S., Grabernik, M., Kelmer, E., Chai, O., Cuneah, O., Segev, G. and Aroch. (2019). Clinical manifestations, laboratory findings, treatment and outcome of acute organophosphate or carbamate intoxication in 102 dogs: A retrospective study. *Veterinary Journal*, **251**: 105 – 349.

Lockridge, O. (2015). Review of human butyrylcholinesterase structure, function, genetic variants, history of use in the clinic, and potential therapeutic uses. *Pharmacology and Therapeutics*, **148**: 34 – 46.

Luiz Felipe, R., Vasconcellos, Leite1, A.C., Osvaldo, J.M. and Nascimento. (2002). Organophosphate induced delayed neuropathy. *Arquivos de Neuro-Psiquiatria*, **60**: 1003 -1007.

Millard, R. and Tobias, K. (2009). Laryngeal Paralysis in Dogs., DVM, MS, DACVS Compendium continuing education for veterinarians, **31:** 212 – 9.

Miller, C.J., McKiernan, B.C., Pace, J. and Fettman, M.J. (2002). The effects of doxapram hydrochloride (Dopram-V) on laryngeal function in healthy dogs. *Journal of Veterinary Internal Medicine*, **16**: 524 - 2002.

Mohammadi, A.B., Nahandi, M.Z., Raad, N., Javani, S. and Gharekhani, A. (2018). Evaluation of Pralidoxime use in an Iranian teaching referral hospital. *Pharmaceutical Science*, **24:** 79 - 82.

Saravanan, M., Montal, D.B., Sarma, K., Mahendran, K., Vijayakumar, H. and Sasikala, V. (2014). Comprehensive study of haemato-biochemical, ascetic fluid analysis and ultrasonography in the diagnosis of ascites due to hepatobiliary disorders in dog. *Indian Journal of Animal Sciences*, **84**: 503 – 506.

Tobias, K., Jackson, A.M. and Harvey, R.C. (2004). Effects of doxapram HCl on laryngeal function of normal dogs and dogs with naturally occurring laryngeal paralysis. *Veterinary Anaesthesia and Analgesia,* **31**: 258 – 263.

Vale, A. and Lotti, M. (2015). Organophosphorus and carbamate insecticide poisoning. *Handbook of Clinical Neurology*, **131:** 149 - 68.

Vimalraj, E., Bhuvaneswari, T. and Arulkumar, S. (2022). Organophosphorus compound poisoning postmortem findings in a dog and its veterolegal approach. *The Pharma Innovation*, **11**: 830 - 832.

Zafar, R., Munawar, K., Nasrullah, A., Haq, S., Ghazanfar, H., Sheikh, A.B. and Khan, A.Y. (2017). Acute renal failure due to organophosphate poisoning: a case report. *Cureus*, **9**: e1523.