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Glyphosate Surfactant Herbicide Toxicosis in a Dog with Hindlimb Paresis and Urinary Incontinence

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Abstract : A 4-year-old Yorkshire terrier was presented with hindlimb paresis and urinary incontinence after accidental ingestion of an herbicide. Based on neurologic examinations, decreased hindlimb proprioception with flaccid paresis were revealed. Other possible causes of the clinical signs were excluded. The clinical signs gradually improved after administration of anti-inflammatory and antioxidant therapy. This case report is the first to describe the long-term outcome of hindlimb paresis and urinary incontinence induced by glyphosate surfactant herbicide (GPSH) poisoning in a dog.

Key words **:** Canine, glyphosate surfactant herbicide, hindlimb paresis, toxicosis.

Introduction

Glyphosate is a non-selective herbicide widely used worldwide (7,9). Glyphosate inhibits plant growth by interfering with the enzyme enolpyruvylshikimate phosphate (EPSP) synthase, which is required to produce essential aromatic amino acids necessary for plant growth (3). Glyphosate is known to have relatively low toxicity in mammals due to its high herbal selectivity (3,4,9). The most widely used surfactant in glyphosate surfactant herbicide (GPSH) products is polyoxyethylene amine (5).

Glyphosate is one of the most commonly involved herbicides in cases of animal poisoning (2) and life-threatening toxicity can occur following large amounts of glyphosate ingestions (3,4). Serious symptoms such as central nervous system depression, acute kidney injury, hepatic dysfunction, gastrointestinal mucosal damage, pancreatitis, acute respiratory distress syndrome, hypotension, cardiovascular collapse, shock, and death caused by excess ingestion of glyphosate have been reported in humans (3-5). GPSH toxicosis can cause neurologic problems, and a study has demonstrated tremors and muscle fasciculations in 8 dogs exposed to glyphosate-containing herbicides (2).

This report describes the long-term management of a dog with hindlimb paresis and urinary incontinence caused by GPSH poisoning. To the author's knowledge, persistent hindlimb paresis and urinary incontinence due to GPSH intoxication in a dog has not been reported previously.

Case

A 4-year-old spayed female Yorkshire terrier presented with acute hindlimb paresis and urinary incontinence. The dog was accidently exposed to GPSH, then hindlimb paresis and urinary incontinence were exhibited after intoxication.

Physical examination revealed hindlimb paresis and urinary incontinence. There was no remarkable finding in the complete blood count, and the serum biochemistry profile revealed elevated lipase (1854 U/L; reference interval, 100–1400 U/L), indicating acute pancreatitis (Table 1). Neurologic examination revealed decreased hindlimb proprioception with flaccid paresis and the complete absence of hindlimb posture reaction. These results indicated a lower motor neuron (LMN) lesion that was localized to the L4-S3 spinal segment. There were no abnormalities detected in other neurological examinations. Blood pressure and electrocardiographic findings were normal. Based on the history, the blood and neurologic examination results, neurologic problems caused by inflammatory or toxic disorders were highly suspected.

Table 1. Complete blood count and serum biochemical results in a dog with GPSH (glyphosate surfactant herbicide) poisoning

Parameters	D 0	D7	Reference interval
WBC (10^9/L)	5.93	-	2.87-17.02
RBC (10^{12}/L)	6.76	-	6. 54-12.2
HCT (%)	45.8	-	30.3-52.3
ALT (U/dL)	49	48	10-100
AST (U/dL)	34	30	0-50
ALP (U/dL)	56	168	23-212
CK (U/L)	45	-	100-200
Lipase (U/L)	1854	1101	200-1800

D, days after first examination; WBC, white blood cells; RBC, red blood cells; HCT, hematocrit; ALT, alanine transaminase; AST, aspartate transaminase; ALP, alkaline phosphatase; CK, creatine kinase.

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To rule out inflammatory diseases of the spinal cord, magnetic resonance imaging (MRI) was performed. No specific abnormalities along the spinal cord were observed in the lumbosacral region in the MRI findings, so inflammatory diseases including inter-vertebral disc disease and fibrocartilaginous embolism were ruled out. Based on patient history and clinical examinations, including neurologic examinations, GPSH poisoning-induced hindlimb paresis and urinary incontinence were highly suspected in this dog.

Upon presentation, symptomatic treatment including fluid therapy and hepatic protectants were initiated to prevent acute kidney injury, hepatic failure, acid–base imbalance, and gastrointestinal disorders for a week. However, neurologic signs such as hindlimb paresis and urinary incontinence were not remarkably improved. Thus, the treatment plan was changed considering GPSH toxic properties.

Anti-inflammatory therapy was initiated with prednisolone (0.5 mg/kg, SC, bid; Daesung, Korea). Vitamin E (400 IU, PO, sid; Yuhan, Korea), misoprostol (5 μg/kg, PO, bid; Nelson, Korea), famotidine (0.5 mg/kg, PO, bid; Nelson, Korea), and N-acetylcysteine (20 mg/kg, PO, bid; Wooridulpharm, Korea) were administered together. Vitamin E and N-acetylcysteine were administered for the adjunctive treatment due to their antioxidant properties. Seven days after changing medications, hindlimb paresis and urinary incontinence gradually began improving. The dog was followed up for 5 months and urinary incontinence was completely resolved. Until recently, mild hindlimb paresis existed, but this was well-tolerated, and the dog remained healthy without any significant clinical adverse effects.

Discussion

This report describes a dog with hindlimb paresis and urinary incontinence caused by GPSH poisoning. There are other toxicants that can cause paresis in dogs, such as snake toxins (venom), lead, organic alkyl mercury, and ionophores, and these need special detoxification with antidotes, like specific antidotes or chelating agents (9). Further questioning of the owner revealed that there was no possibility of ingesting those toxins mentioned above. In this case, the dog presented with chronic non-progressive paresis after GPSH exposure in a neighbor's yard; other toxins that can cause paresis were ruled out through history and clinical examinations.

Even though mild signs like pancreatic, hepatic, and gastrointestinal signs were noted following exposure of GPSH, neurologic signs existed for 5 months in this case. As described earlier (3,10), damage to cellular components including mitochondrial cell membranes, protein synthesis mechanisms, and cellular DNA is described, but the precise mechanism of toxicity of GPSH ingestion is still unclear. However, it has been postulated that the mechanism of toxicity in humans and animals is related to the uncoupling of mitochondrial oxidative phosphorylation (3,10). With respect to the treatment, there is no specific antidote for GPSH toxicants (7). However, administering antioxidants was effective in this case, which supports the hypothesis that GPSH toxicosis is related to the uncoupling of mitochondrial oxidative phosphorylation.

GPSH toxicosis reveals a favorable prognosis because of its wide safety margin (9), but prognosis generally depends on the amount of product ingested, severity of signs, and overall health of the animal involved (1). In humans, it is reported that older age (8), elongated corrected QT interval (6,8), increased lactic acid levels, and hyperkalemia (1) are related to poor prognosis in GPSH poisoning.

Conclusions

In conclusion, this case is the first to describe the diagnosis and long-term management following GPSH poisoning in a dog. In addition, cases of GPSH-poisoned dogs, particularly dogs with neurologic disorders, can be manageable with anti-inflammatory and antioxidant therapy for a long period.

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