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Haemato-biochemical changes and therapeutic management of snake envenomation in dogs

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Abstract
Seven dogs (five females, and two males) were presented to the Veterinary Clinical Complex (VCC), Veterinary College, Kamdhenu University, Anand, with snakebite injuries. The dogs exhibited signs of recent confrontation with snakes, including localized swelling at the bite site and, in some cases, persistent bleeding. Clinical examinations identified swelling on the lips, forehead, and legs, along with symptoms such as dullness, depression, frothy salivation, abnormal gait, and recumbency. Based on these findings and the history provided, the dogs were diagnosed with snake envenomation. Haematological tests showed reduced haemoglobin and packed cell volume, accompanied by an elevated total leukocyte count. Biochemical analyses revealed increased alanine aminotransferase and creatinine levels. Of the seven dogs, one succumbed to envenomation, while six were successfully treated over five days with polyvalent anti-snake venom, 5% dextrose normal saline (DNS), tetanus toxoid, dexamethasone, frusemide, and broad-spectrum antibiotics.

Keywords: Snakebite, envenomation, dog treatment, haematology, biochemistry

Introduction
In the Indian subcontinent, approximately 216 snake species have been documented, with 52 classifieds as venomous. The most commonly encountered venomous species include the King Cobra, Russell's viper, Saw-scaled viper, and Common Krait (Vijayakumar *et al.*, 2019) [11]. Snake envenomation presents a significant concern in both human and veterinary medicine, with snake bites being more frequent in dogs and horses than in livestock such as cattle, buffalo, sheep, and goats (Yogeshpriya *et al.*, 2020) [12]. In animals, snake bites typically occur during grazing, hunting, or while exploring in outdoor areas. Diagnosing snake envenomation can be challenging when the bite goes unwitnessed, making prompt identification crucial to manage this medical emergency effectively. If untreated, snake envenomation can lead to severe injury or death. In veterinary practice, immediate intervention is essential to enhance an affected animal's chances of survival and recovery. Clinical symptoms vary widely, influenced by the snake species involved, the age and size of the animal, the number of bites, and venom type and volume. In dogs, common symptoms include extensive swelling, severe pain, skin discolouration, cardiopulmonary issues, tissue damage, blood coagulation defects, and ataxia, with effects typically noticeable within hours of the bite (Ananda *et al.*, 2009; Bhardwaj, 2011; Konjeti *et al.*, 2024) [1, 3, 6]. This paper outlines the haemato-biochemical change and effective treatment of snake envenomation in dogs, utilizing a combination of polyvalent anti-snake venom, 5% DNS, tetanus toxoid, dexamethasone, frusemide, and a broad-spectrum antibiotic for successful management.

Case history and clinical observation
History of Snakebite: Most cases involve owners witnessing the snakebite but being unsure of the snake species. In one case, a fight with a Russel Viper is specifically reported, while another case had no witness (Table 1).

Breed, Age, and Sex: The cases involve various breeds, ages ranging from 9 months to 6 years, and a mix of both male and female dogs (Table 1).

Rectal Temperature and Pulse Rate: Rectal temperatures vary slightly, generally remaining close to the normal range for dogs (about 101-102.5 °F). Pulse rates per minute vary, with some dogs having a notably low rate (e.g., 31 bpm), which could suggest a physiological response to the envenomation (Table 1).

Location of Bites: Snakebites are noted on different parts of the body, including the paw (Fig. 1), nostril (Fig. 2), jaw (Figs. 3 and 4), and head/throat area (Fig. 5 and 6). The location seems to vary possibly based on where the snake bite occurred or the dog's reaction to the snake's proximity.

Symptoms and Severity

Swelling: The most common reaction across cases is swelling, ranging from localized (jaw) to extensive (head and throat). Severe oedematous swelling (Fig. 5) likely indicates a more severe inflammatory response.

Bleeding: In some instances, the bite resulted in bleeding (near nostrils in Fig. 2, mouth in Fig. 5). This may indicate puncture wounds from the snake's fangs or local tissue damage at the bite site.

Blood Clotting Time: Increased clotting time is noted in some cases, indicating possible coagulopathy, which can be a complication of venomous snakebites.

This suggests consistent signs of snake envenomation, with notable variations in symptoms and vitals across the cases, potentially due to differences in venom types, bite locations, and individual responses among the dogs.

Table 1: Detailed case reports of seven dog snakebite Envenomation.

	Case No.1	Case No.2	Case No.3	Case No.4	Case No.5	Case No.6	Case No.7
History	Snakebite witnessed by owner but don't know species of snake.	No witness of a snake bite.	Snakebite witnessed by owner but don't know species of snake.	Snakebite witnessed by owner but don't know species of snake.	History of snake bite before 2 hours but don't know species of snake.	The owner reported fighting with a Russel Viper	Snakebite witnessed by owner but don't know species of snake.
Breed	Non-descript	Golden retriever	German shepherd	Rottweiler	Labrador	Rottweiler	Doberman
Age	1 year	1 year	9 months	6 year	10 months	2 year	3 year
Sex	Female	Female	Female	Male	Male	Female	Female
Rectal Temperature	102.0 °F	103.1˚ F	100.9˚ F	101.0˚ F	102.5 °F	101.2 °F	102.2 °F
Pulse rate per minute	48	52	44	38	47	31	45
Dog bite lesion	Swelling on the lower jaw.	Bite and swelling on the right hind leg	Bleeding from snake bite near nostril	Swelling on the face	Swelling on the right upper and lower lips	Swelling on the face	Swelling on the face
Blood clotting time		Increased	Increased			Increased	

Fig 1: Snakebite at the paw of the right hind leg in a female golden retriever dog.

Fig 2: Bleeding from snake bite near nostril in a female German shepherd dog

Fig 3: Swelling on the upper and lower jaw in a male rottweiler dog

Fig 4: Swelling on the jaw in a male Labrador dog

Fig 5: Sever oedematous swelling on the head & throat region and bleeding from the mouth in a female rottweiler dog

Fig 6: Swelling on the upper jaw, lower jaw and throat in a female Doberman dog

The blood sample was collected in an ethylene diamine tetra acetic acid (EDTA)- containing tube for complete blood count (CBC) using an automatic whole blood analyser (Abacus Junior Vet-5) and in a clot activator tube for serum biochemical parameters like total protein, aspartate aminotransferase (AST), alanine aminotransferase (ALT), blood urea nitrogen (BUN), and creatinine using a clinical serum biochemistry auto-analyzer (CKK 300) (Table 1). The haemato-biochemical parameters revealed decreased Haemoglobin (g/dl), Packed Cell Volume (%), Total Erythrocytic Count ($\times 10^6$/ µL), Lymphocytes (%), and Platelets ($\times 10^3$/ µL) and increased values of Leucocyte Count ($\times 10^3$/ µL), Neutrophils (%), BUN, Serum Creatinine and SGPT in all dogs (Table 2).

The cases were diagnosed as snake envenomation based on history, clinical examination, and laboratory examination.

Table 2: Hematobiochemical changes in snake envenomated dogs

Haematological Parameters	Reference Range (Fielder, 2023)	Affected Dog
Haemoglobin (g/dL)	11.9-18.9	7.96 ± 1.66
Packed Cell Volume (%)	35-57	25.76 ± 4.31
Total Erythrocytic Count ($\times 10^6$/ µL)	4.95-7.87	3.66 ± 1.03
Red cell distribution width (%)	10.6-14.3	14.55 ± 0.28
Total Leucocyte Count ($\times 10^3$/ µL)	5.0-14.1	34.43 ± 2.24
Lymphocyte (%)	8-21	5.3 ± 2.15
Monocytes (%)	2-10	5.5 ± 1.03
Neutrophils (%)	58-85	88.72 ± 2.77
Eosinophils (%)	0-9	0.4 ± 0.10
Basophils (%)	0-1	0.05 ± 0.02
Platelets ($\times 10^3$/ µL)	211-621	140 ± 15.96
BUN (mg/dL)	8-28	38.34 ± 3.50
Serum Creatinine (mg/dL)	0.5-1.7	2.17 ± 0.30
Total Protein (g/dL))	5.4-7.5	6.24 ± 0.12
SGPT (IU/dL)	10-109	150.19 ± 38.94

Treatment

All seven dogs received lyophilized polyvalent anti-snake venom, containing standardized doses of venom from Cobra (Naja naja, 0.6 mg), Common Krait (Bungarus caeruleus, 0.45 mg), Russell's Viper (Viper russell, 0.6 mg), and Saw-scaled Viper (0.45 mg), sourced from the Serum Institute of India Ltd. Each vial of anti-venom was reconstituted with 10 ml of sterile water for injection, producing a clear solution that was then slowly administered intravenously in 500 ml of 5% Dextrose Normal Saline (DNS) over 2 hours. Additional supportive treatments included Ceftriaxone + Sulbactam (20 mg/kg body weight, once daily, IV), Metronidazole (10 mg/kg body weight, IV), Dexamethasone sodium phosphate (0.2 mg/kg body weight, IV), Tetanus toxoid (1 ml, IM), and Furosemide (2 mg/kg body weight, IM). The bite wound was thoroughly cleaned with soap and water and dressed with Povidone Iodine as a local antiseptic. Each dog was closely monitored. After 5 hours, each dog showed marked improvement, remaining active without relapse of symptoms. From the second day onward, treatment with 5% DNS, antibiotics, dexamethasone, and furosemide continued daily for five days. A second and third dose of anti-venom was administered as needed, based on individual recovery. Of the seven dogs, one female rottweiler dog succumbed to envenomation, while six were successfully treated. By the end of the week, the dogs began eating normally and showed no signs of complications. After a week of treatment, each dog made a complete, uneventful recovery.

Results and Discussion

Snake venom is a complex mixture of proteins and peptides, composed of both enzymatic and non-enzymatic compounds, as well as glycoproteins, lipids, and biogenic amines, including histamine, serotonin, and neurotransmitters such as catecholamines and acetylcholine (Klaassen, 2008) [5]. In this study, a physical examination of the dog revealed swollen areas, suggesting a pronounced inflammatory response driven by the enzyme hyaluronidase, which promotes venom spread. Dog bites from venomous snakes typically occur on the head, face, or neck; while bites on the body are rarer, they often involve more severe envenomation (Anoop *et al.,* 2016) [2]. Evidence of puncture wounds, prolonged clotting time, and bleeding indicates the haemato-toxic effects of snake venom, including local tissue damage at the bite site. Clinical signs observed in this case, such as frothy salivation, lethargy, muscular weakness, and an abnormal gait, align with findings from Konjeti *et al.* (2024) [6].

Haematological analysis showing decreased haemoglobin (Hb), total erythrocyte count (TEC), and packed cell volume (PCV), suggests anaemia, likely due to the haemolytic effects of venom (Ananda *et al.,* 2009; Anoop *et al.,* 2016) [1, 2]. Studies by Vigneswari, (2020) [10] and Konjeti *et al.* (2024) [6] show that elevated blood urea nitrogen (BUN) and creatinine levels indicate potential kidney impairment from nephrotoxic venom effects, while high serum glutamic-pyruvic transaminase (SGPT) levels indicate possible liver damage from hepatotoxic venom effects. An elevated white blood cell (WBC) count suggests an inflammatory or immune response triggered by venom-induced tissue damage and potential infection, given that snake fangs and oral cavities harbour bacterial contaminants (Blaylock *et al.,* 2001) [4]. Lymphopenia may reflect a stress response or immune suppression, while increased neutrophils (neutrophilia) indicate an acute inflammatory response. Thrombocytopenia (low platelet count) points to coagulation issues, a common result of snake envenomation.

For treatment, polyvalent snake antivenom was chosen due to its protection against venom from the “Big Four” snakes: the common cobra, common krait, saw-scaled viper, and Russell's viper (Suchitra *et al.,* 2010; Vigneswari, 2020) [9, 10]. Since anaphylactic reactions can occur with lyophilized polyvalent antivenom (Sai *et al.,* 2008) [7], dexamethasone was administered to counteract potential adverse effects. In this case, corticosteroids were preferred over antihistamines, as antihistamines may exacerbate venom toxicity. A tetanus toxoid was also provided to guard against possible tetanus from contaminated snake fangs (Shukla, 2009) [8]. Lastly, broad-spectrum antibiotics were given prophylactically due to the bacterial contamination commonly associated with snake fangs.

Conclusion

In this study, a detailed clinical and haematological examination of a dog with a venomous snakebite revealed characteristic signs of snake envenomation, including local tissue damage, inflammatory responses, and systemic effects. The venom’s complex composition contributed to a range of clinical symptoms such as swelling, frothy salivation, lethargy, and muscular weakness. Haematological findings, including anaemia, elevated white blood cell count, and thrombocytopenia, along with nephrotoxic, and hepatotoxic effects from the venom. The elevated levels of blood urea nitrogen (BUN), creatinine, and serum glutamic-pyruvic transaminase (SGPT) suggest kidney and liver dysfunction. The use of polyvalent snake antivenom, combined with corticosteroids to prevent anaphylactic reactions, tetanus toxoid, and broad-spectrum antibiotics, effectively addressed the immediate clinical needs. This therapeutic approach not only neutralized the venom's effects but also provided supportive care to manage potential secondary infections and complications. The present study concluded that the snake bite in animals is more dangerous when the diagnosis is not in proper time.

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Conflict of Interest

Not available

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