



ISSN: 2456-2912
NAAS Rating (2026): 4.61
VET 2025; SP-11(6): 121-125
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www.veterinarypaper.com
Received: 24-04-2026
Accepted: 28-05-2026

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Etiological classification of anemia in canines: A retrospective study in Hisar, Haryana, India

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DOI: <https://www.doi.org/10.22271/veterinary.2026.v11.i6Sb.3536>

Abstract

We did this retrospective study at the Teaching Veterinary Clinical Complex at the College of Veterinary Sciences, part of Lala Lajpat Rai University of Veterinary and Animal Sciences in Hisar, India. The goal was to figure out the main causes of anemia in dogs. We randomly picked 300 dogs that came into the clinic and checked them for anemia, which is defined as a hemoglobin level under 12 g/dL. Out of those, we pinpointed the cause in over 80% of the cases—that's 241 dogs with anemia, while 59 turned out not to be anemic at all. Among the anemic ones, most had it pretty bad: severe anemia (under 8 g/dL) affected about 31.95%, moderate cases were around 42.74%, and mild ones just 25.31%.

The top culprit was hemorrhagic gastroenteritis, causing about 21% of the cases. Next up were hemoprotozoan diseases at 16%, heavy worm loads at 12%, and kidney failure at 11%. Other common issues included canine distemper (8%), tick fever (7%), blood poisoning or toxemia (7%), liver inflammation (7%), urinary tract infections (5%), and a mix of other things (7%).

Overall, this shows there's a wide range of reasons dogs get anemia in the Hisar area, and it really stresses how crucial it is to do thorough check-ups to treat them properly. The study highlights the diverse etiological spectrum of canemia in the Hisar region and emphasizes the importance of comprehensive diagnostic evaluation for effective clinical management.

Keywords: Canine anemia, etiological classification, hemorrhagic gastroenteritis, hemoprotozoan diseases, Hisar, retrospective study

1. Introduction

Anemia is characterized by a reduction in red blood cell count, hemoglobin concentration, or packed cell volume below the established reference ranges for the species, representing one of the most frequently encountered hematological disorders in veterinary medicine. In dogs, anemia does not constitute a primary disease but rather serves as a clinical sign indicative of diverse underlying pathologies that impair erythrocyte production, accelerate erythrocyte destruction, or lead to blood loss (Weiss and Wardrop, 2010) ^[12].

The etiological classification of anemia is essential for elucidating its pathophysiology and informing targeted therapeutic strategies. Broadly, canine anemia can be divided into three primary categories: hemorrhagic anemia (resulting from blood loss), hemolytic anemia (involving heightened erythrocyte destruction), and non-regenerative anemia (stemming from diminished or faulty erythrocyte production). Each category includes a variety of specific etiologies, each with unique clinical features, diagnostic requirements, and management approaches (Thrall *et al.*, 2012) ^[11].

Hemorrhagic anemia may arise from acute or chronic blood loss secondary to trauma, surgical interventions, gastrointestinal erosions, coagulation disorders, or parasitic burdens. Hemolytic anemias encompass immune-mediated processes, infectious etiologies (e.g., those caused by Babesia, Ehrlichia, or Mycoplasma spp.), or conditions involving oxidative stress, mechanical fragmentation, or congenital erythrocyte anomalies. Non-regenerative anemias are commonly linked to bone marrow suppression, chronic renal insufficiency, endocrine dysfunctions, nutritional inadequacies, or systemic inflammatory and infectious states (Chervier *et al.*, 2012) ^[3].

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The semi-arid environment of the Hisar region in Haryana, India, fosters the propagation of tick species and other disease vectors, thereby influencing the local epidemiology of canine illnesses. Prior investigations in this area have reported notable incidences of tick-borne pathogens, such as a 30% positivity rate for canine monocytic ehrlichiosis via nested PCR, alongside various hemoprotozoan infections (Bai *et al.*, 2016; Bai *et al.* 2019) ^[1, 2]. Nevertheless, detailed insights into the comprehensive etiological profile of anemia in local canine populations remain scarce.

A thorough grasp of regional etiological patterns is vital for clinicians to refine differential diagnoses and expedite appropriate interventions. Accordingly, this retrospective study was conducted to examine the etiological classification of anemia in dogs presented to the Teaching Veterinary Clinical Complex at Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar. The specific aims were to assess the prevalence of anemia, delineate the predominant etiological contributors, and stratify anemia severity according to hemoglobin levels.

2. Materials and Methods

2.1 Study Design and Location

This retrospective study was conducted at the Teaching Veterinary Clinical Complex (TVCC), College of Veterinary Sciences (COVS), Lala Lajpat Rai University of Veterinary and Animal Sciences (LUVAS), Hisar, Haryana, India. LUVAS is a premier veterinary institution in northern India, and the TVCC serves as a referral center for companion animals from Hisar city and surrounding districts.

2.2 Sample Selection

A total of 300 dogs presenting to the veterinary clinic were randomly selected for inclusion in this study. The selection criteria included dogs of all ages, breeds, and both sexes that presented with clinical signs suggestive of various disease conditions. Dogs were excluded if they had received blood transfusion within the preceding two weeks or if they were on medications known to affect hematological parameters.

2.3 Clinical Examination and History

A detailed clinical history was obtained from pet owners, including information regarding duration of illness, appetite, water intake, urination, defecation patterns, presence of vomiting or diarrhea, previous medications, vaccination status, and tick/flea infestation history. Complete physical examination was performed on each animal, including assessment of body condition score, rectal temperature, heart rate, respiratory rate, capillary refill time, mucous membrane color, lymph node palpation, and abdominal palpation.

2.4 Sample Collection and Hematological Analysis

Blood samples (approximately 2-3 mL) were collected aseptically from the cephalic or saphenous vein into EDTA-coated vacutainers for hematological examination. Complete blood count (CBC) including hemoglobin concentration, packed cell volume (PCV), total erythrocyte count (TEC), total leukocyte count (TLC), differential leukocyte count (DLC), and platelet count was performed using an automated hematology analyzer. Thin blood smears were prepared for microscopic examination to detect blood parasites and

evaluate red blood cell morphology.

2.5 Definition and Classification of Anemia

Anemia was defined as a hemoglobin concentration below 12 g/dL, which is the lower limit of the normal reference range for dogs. The severity of anemia was classified as follows:

- Mild anemia: Hemoglobin 10-12 g/dL (PCV 30-37%)
- Moderate anemia: Hemoglobin 8-9.8 g/dL (PCV 20-30%)
- Severe anemia: Hemoglobin <8 g/dL (PCV <20%)

2.6 Etiological Diagnosis

The underlying cause of anemia was determined based on clinical history, physical examination findings, hematological parameters, blood smear examination for parasites, serum biochemistry (where indicated), and response to specific therapeutic interventions. Additional diagnostic tests including fecal examination for parasites, urinalysis, abdominal ultrasonography, and specific serological/molecular tests were performed as deemed necessary by the attending clinician.

2.7 Statistical Analysis

Data were compiled and analyzed using descriptive statistics. Prevalence rates were calculated as percentages, and results are presented in tabular format.

3. Results

3.1 General Prevalence of Anemia

Of the 300 dogs randomly selected and evaluated, 241 dogs (80.33%) were found to be anemic based on hemoglobin concentration below 12 g/dL. The remaining 59 dogs (19.67%) had hemoglobin concentrations within the normal reference range and were classified as non-anemic. This high prevalence of anemia indicates the significant burden of anemia-causing conditions in the canine population of the Hisar region.

3.2 Severity Distribution of Anemia

Moderate anemia was the most prevalent category, accounting for 103 cases (42.74%), followed by severe anemia with 77 cases (31.95%), and mild anemia with 61 cases (25.31%). The predominance of moderate anemia cases suggests varied presentation stages in the canine population of the Hisar region.

Table 1: Severity Distribution of Anemia in Dogs (n=241)

Severity of	Number of	Percentage	Hemoglobin
Mild Anemia	61	25.31	10-12 g/dL
Moderate Anemia	103	42.74	8-9.8 g/dL
Severe Anemia	77	31.95	<8 g/dL
Total	241	100.00	-

3.3 Etiological Classification of Anemia

The etiological distribution of anemia among the 241 anemic dogs is presented in Table 2. A wide spectrum of underlying causes was identified, with hemorrhagic gastroenteritis being the most common etiology (51 cases, 21.16%), followed by hemoprotozoan diseases (38 cases, 15.77%), endoparasites/worm load (29 cases, 12.03%), and renal failure (26 cases, 10.79%).

Table 2: Etiological Distribution of Anemia in Dogs (n=241)

S. No.	Cause of Anemia	Number of Cases	Percentage (%)
1	Hemorrhagic Gastroenteritis	51	21.16
2	Hemoprotozoan Disease	38	15.77
3	Endoparasites/Worm Load	29	12.03
4	Renal Failure	26	10.79
5	Canine Distemper	20	8.30
6	Tick Fever	16	6.64
7	Septicemia/Toxemia	16	6.64
8	Hepatitis	16	6.64
9	Urinary Tract Infection	12	4.98
10	Other Causes	17	7.05
	Total	241	100.00

3.4 Etiological Classification by Mechanism

Based on the mechanism of anemia development, the

etiologies were further classified into three major categories as shown in Table 3:

Table 3: Classification of Anemia by Pathophysiological Mechanism

Classification	Etiologies Included	Cases	Percentage (%)
Blood Loss Anemia (Hemorrhagic)	HGE, Endoparasites, UTI	92	38.17
Hemolytic Anemia	Hemoprotozoan Disease, Tick Fever	54	22.41
Anemia of Chronic/Inflammatory Disease	Renal Failure, Hepatitis, CD, Septicemia	78	32.37
Other/Mixed Etiology	Other Causes	17	7.05
	Total	241	100.00

4. Discussion

The present retrospective study provides valuable insights into the etiological spectrum of anemia in canines in the Hisar region of Haryana, India. The overall prevalence of anemia (80.33%) observed in this study is consistent with previous reports from different parts of India, where prevalence rates ranging from 47% to 75% have been documented (Moninder, 2003; Singh *et al.*, 2012; Tandel *et al.*, 2016; Meshram *et al.*, 2019; Swami *et al.*, 2024) [6, 8, 10, 5, 9].

The distribution of anemia severity in our study population showed moderate anemia as the most common category (42.74%), followed by severe (31.95%) and mild (25.31%) cases. This distribution pattern differs from previous reports and may be attributed to varied presentation times, with pet owners seeking veterinary care at different stages of disease progression. The significant proportion of moderate and severe cases (74.69% combined) underscores the need for early disease detection and owner education regarding warning signs of anemia.

4.1 Hemorrhagic Gastroenteritis as Leading Cause

Hemorrhagic gastroenteritis (HGE) emerged as the most common cause of anemia in our study, accounting for 21.16% of cases. This finding aligns with reports from Anand, Gujarat, where gastrointestinal hemorrhage was identified as the leading cause of anemia (22.05%) in dogs (Acspublisher, 2022) [13]. HGE can result in significant blood loss leading to acute hemorrhagic anemia. The high prevalence may be attributed to dietary indiscretion, infectious enteritis (particularly parvoviral enteritis in young dogs), and stress-related gastric ulceration. The regenerative nature of blood loss anemia typically allows for recovery with appropriate supportive care, including fluid therapy, blood transfusion in severe cases, and treatment of the underlying cause.

4.2 Hemoprotozoan Diseases and Tick-borne Infections

Hemoprotozoan diseases constituted the second most common cause of anemia (15.77%), while tick fever accounted for an additional 6.64% of cases. Combined, these vector-borne diseases contributed to 22.41% of anemia cases.

This is consistent with the endemic nature of tick-borne diseases in the Hisar region, as documented by Bai *et al.* (2016) [1], who reported 30% positivity for *Ehrlichia canis* by nested PCR in dogs from this area. The prevalence of haemoparasites including *Babesia canis* (0.95%), *Hepatozoon canis* (2.85%), and *Trypanosoma* species (0.95%) has been previously documented from TVCC, LUVAS, Hisar (Bai *et al.*, 2019) [2].

Hemoprotozoan infections cause anemia through multiple mechanisms including direct erythrocyte parasitization and lysis, immune-mediated destruction of infected and bystander red blood cells, and bone marrow suppression. The characteristic thrombocytopenia observed in ehrlichiosis further complicates the clinical picture. Early diagnosis through blood smear examination and molecular techniques, coupled with appropriate antimicrobial therapy, is essential for successful management.

4.3 Endoparasitic Infestations

Endoparasites/worm load contributed to 12.03% of anemia cases in this study. Hookworm (*Ancylostoma caninum*) infestation is particularly significant as it causes blood loss through intestinal attachment and feeding. In young puppies with heavy worm burdens, the blood loss can be severe enough to cause life-threatening anemia. Iron deficiency anemia may develop in chronic cases due to continuous blood loss exceeding the body's ability to replenish iron stores. Regular deworming programs and fecal examinations are essential preventive measures.

4.4 Renal Failure and Chronic Disease

Renal failure accounted for 10.79% of anemia cases, consistent with findings from Ludhiana, India, where renal failure was the most common cause of anemia (20%) (Shah *et al.*, 2020) [7]. The anemia of chronic kidney disease is primarily due to decreased erythropoietin production by the failing kidneys, leading to inadequate stimulation of erythropoiesis in the bone marrow. Additionally, uremic toxins may suppress bone marrow function and decrease red blood cell survival. Management includes addressing the

underlying renal disease, supportive care, and in some cases, erythropoietin-stimulating agents.

4.5 Infectious Diseases

Canine distemper (8.30%), septicemia/toxemia (6.64%), and hepatitis (6.64%) together accounted for 21.58% of anemia cases. These conditions cause anemia through various mechanisms including bone marrow suppression by viral infections, anemia of inflammation mediated by cytokines, and direct effects of toxins on erythrocytes or erythroid precursors. The inflammatory cytokines (IL-1, IL-6, TNF- α) associated with infectious diseases inhibit erythropoietin production, decrease iron availability by increasing hepcidin synthesis, and directly suppress erythroid progenitor proliferation.

4.6 Pathophysiological Classification

When classified by the primary mechanism of anemia development, blood loss anemia (hemorrhagic) was the most common category (38.17%), followed by anemia of chronic/inflammatory disease (32.37%) and hemolytic anemia (22.41%). This distribution reflects the diverse pathophysiological processes contributing to anemia in the canine population and emphasizes the importance of a systematic diagnostic approach to identify the underlying cause.

The classification of anemia based on regenerative response (reticulocyte count) and red blood cell morphology (MCV and MCHC) further aids in determining the underlying cause. Blood loss and hemolytic anemias are typically regenerative with reticulocytosis evident within 3-5 days, while anemias due to chronic disease, renal failure, or bone marrow disorders are usually non-regenerative or inadequately

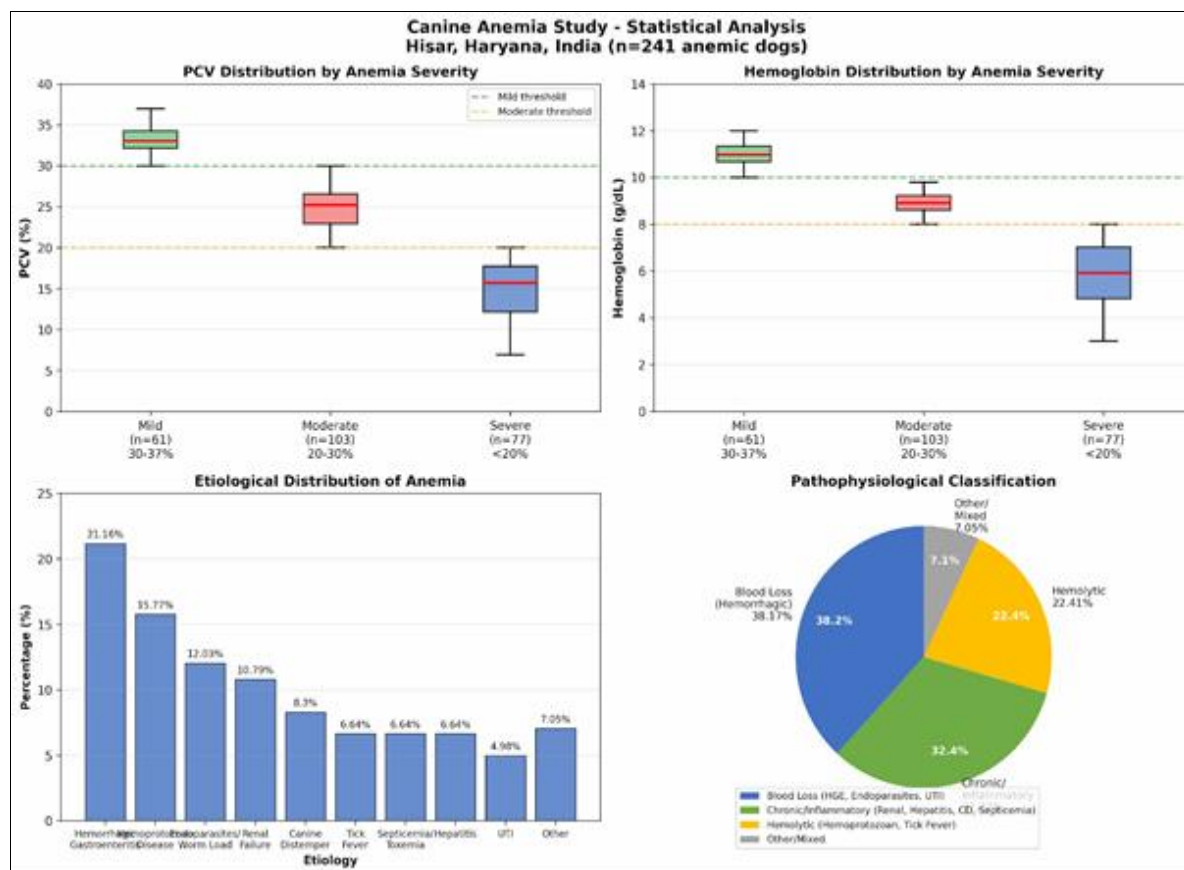
regenerative.

5. Conclusion

This retrospective study demonstrates a high prevalence of anemia (80.33%) among dogs presented to TVCC, LUVAS, Hisar, with a diverse etiological spectrum. The key findings are:

1. Moderate anemia was the most common presentation (42.74%), followed by severe anemia (31.95%) and mild anemia (25.31%), indicating varied stages of disease presentation.
2. Hemorrhagic gastroenteritis was the leading cause of anemia (21.16%), followed by hemoprotozoan diseases (15.77%), endoparasites (12.03%), and renal failure (10.79%).
3. Blood loss anemia was the predominant pathophysiological category (38.17%), followed by anemia of chronic/inflammatory disease (32.37%) and hemolytic anemia (22.41%).
4. Vector-borne diseases (hemoprotozoan diseases and tick fever combined) contributed significantly (22.41%) to the anemia burden, reflecting the endemic nature of these infections in the Hisar region.

These findings underscore the importance of comprehensive diagnostic evaluation in anemic dogs, including history, physical examination, complete blood count with reticulocyte count, blood smear examination, and additional tests as indicated. Early detection and treatment of underlying conditions are essential for successful clinical outcomes. Regular deworming, tick prevention, and owner education regarding warning signs of illness can help reduce the burden of anemia-causing conditions in the canine population.



(A) PCV Distribution by Severity | (B) Hemoglobin Distribution by Severity | (C) Etiological Distribution | (D) Pathophysiological Classification

Fig 1: Box Whisker Plot Analysis of Canine Anemia Data

6. Recommendations

Based on the findings of this study, the following recommendations are made:

1. Implementation of regular health screening programs for early detection of anemia in the canine population.
2. Year-round tick and parasite prevention to reduce the incidence of vector-borne and parasitic causes of anemia.
3. Owner education programs regarding proper nutrition, hygiene, and recognition of early signs of illness.
4. Development of region-specific diagnostic protocols prioritizing common etiologies.
5. Further prospective studies to correlate specific etiologies with hematological profiles and clinical outcomes.

Acknowledgements

The authors gratefully acknowledge the facilities provided by the Teaching Veterinary Clinical Complex, College of Veterinary Sciences, LUVAS, Hisar for conducting this study.

Conflict of Interest

The authors declare no conflict of interest.

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How to Cite This Article

Risabh. Etiological classification of anemia in canines: A retrospective study in Hisar, Haryana, India. *International Journal of Veterinary Sciences and Animal Husbandry*. 2026;SP-11(6):121-125.

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