

Article

<https://doi.org/10.61900/SPJVS.2023.03.01>**ETIOLOGY OF REGENERATIVE ANEMIA IN DOGS AND CATS****Razvan MALANCUS¹**

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Abstract

The study was conducted between March 2020 – December 2022 on 129 dogs and 63 cats, different breeds and age, both males and females, clinically diagnosed with anemia. All individuals were subjected to a full hematology test including blood analysis and blood smear assessment where regenerative reaction was confirmed in 22 dogs and 9 cats. To understand the ability of the hematogenous bone marrow to respond and develop new red blood cells (RBCs) and the effectiveness of the therapy is important to recognize the main causes of anemia that lead to the destruction, loss or deficit in production. The research highlighted post-hemorrhagic anemia as the most important cause of regenerative reaction in dogs (68,2%) while in cats, hemolytic anemia was the primary reason of reticulocytosis (55,6%). Correctly identifying the type of anemia in terms of hematogenous bone marrow responsiveness is of utmost importance in tailoring the treatment, preventing complications or monitoring the progress of the patient and one of main tools used to assess and differentiate between the RBCs disorders

Key words: anemia, reticulocytes, dogs, cats, hemolysis

Regenerative anemia, characterized by a reduction in red blood cell mass with a concurrent increase in the production of immature erythrocytes, represents a common hematologic disorder in domesticated dogs and cats (Glogowska E. and Gallagher P.G., 2015). This condition, often associated with a range of underlying pathologies, poses a significant clinical challenge to veterinary practitioners and warrants comprehensive investigation to enhance diagnostic accuracy and refine therapeutic approaches. Despite its prevalence, a precise understanding of the multifactorial causes and contributing factors that drive regenerative anemia in these companion animals remains incomplete.

The pathogenesis of regenerative anemia is intricately linked to a dynamic interplay of factors encompassing both intrinsic and extrinsic components of erythropoiesis (Weiss D.J. *et al.*, 2019). Intrinsic factors pertain to disruptions within the erythroid lineage itself, while extrinsic factors involve various diseases, toxins, or conditions affecting the bone marrow microenvironment or triggering anemia-inducing systemic responses (Glogowska E. and Gallagher P.G., 2015). Although several studies have endeavored to elucidate the mechanisms governing regenerative anemia in dogs and cats, there exists a need for a comprehensive synthesis of current

knowledge and a critical evaluation of emerging research findings.

This article aims to address this knowledge gap by systematically reviewing and analyzing the main causes of regenerative anemia in dogs and cats. Furthermore, a nuanced understanding of these etiological factors is imperative for the development of targeted diagnostic protocols and therapeutic interventions, ultimately improving the clinical management of regenerative anemia in canine and feline populations

MATERIAL AND METHOD

The study was conducted over a 2-year period between March 2020-December 2022 at the Faculty of Veterinary Medicine in Iasi. The study was performed on 129 dogs and 63 cats, different breeds and age, both males and females. Clinical examination preceded hematological investigation for all cases and specifically diagnosed the included subjects with anemia. Hematology was performed using Abaxis Vetscan HM5 automated hematological analyzer. Blood samples were collected either from the external saphenous vein or the jugular vein. The vacutainers contained EDTA as anticoagulant substance and the samples were analyzed immediately after collecting them. For each case have been determined the following parameters: red blood cells (RBCs), packed cell

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volume (PCV), hemoglobin, mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH) and mean corpuscular hemoglobin concentration (MCHC). All parameters provide full assessment on red blood elements integrity.

For all the subjects a May Grunwald Giemsa stained blood smear was prepared to assess qualitative changes of the RBCs. Also, another blood smear stained by Brilliant Cresyl Blue method to quantitatively determine the reticulocytes within the smear.

RESULTS AND DISCUSSIONS

Regenerative anemia is a common hematologic disorder in domesticated dogs and cats, and understanding its etiology is crucial for effective diagnosis and treatment. The results of our study shed light on the primary causes of regenerative anemia in these two species.

Infectious diseases and immune-mediated processes represent significant contributors to regenerative anemia in both dogs and cats. The study revealed that infections, especially those caused by hemotropic pathogens like *Mycoplasma* spp. and feline leukemia virus (FeLV), played a substantial role in the etiology of regenerative anemia in cats (Hartmann K., 2011).

Hemolytic anemia emerged as the primary cause of regenerative anemia in cats, accounting

for 55.6% of cases (table 1). Hemolytic anemia in cats can result from various underlying etiologies, including immune-mediated hemolysis, infectious diseases, and genetic predispositions (Giger U., 2020). The high proportion of hemolytic anemia in cats aligns with the feline predisposition to immune-mediated disorders, particularly immune-mediated hemolytic anemia (IMHA) (Weinkle T.K. *et al.*, 2008). IMHA is characterized by the destruction of RBCs by the immune system, leading to a regenerative response as the bone marrow attempts to replace the lost RBCs.

Feline leukemia virus (FeLV) and feline immunodeficiency virus (FIV) infections can also contribute to hemolytic anemia in cats (Hartmann, 2011). These retroviral infections can lead to immune suppression and associated opportunistic infections, as well as direct bone marrow suppression, impairing erythropoiesis and promoting the development of regenerative anemia.

Furthermore, certain breeds of cats may be genetically predisposed to hemolytic anemias. For example, Abyssinian cats have been reported to have a higher incidence of pyruvate kinase deficiency, an inherited enzyme deficiency that can lead to hemolytic anemia (Giger U., 2020). Understanding these genetic predispositions is vital for early diagnosis and management in affected breeds.

Table 1

Main causes of regenerative anemia in dogs and cats

Cause	Dogs		Cats	
	No. of cases	%	No. of cases	%
Acute post-hemorrhagic anemia	9	40.9%	2	22.2
Chronic post-hemorrhagic anemia	6	27.3	2	22.2
Hemolytic anemia	6	27.3	5	54.6
Unknown origin	1	0.5	0	0.0
Total subjects	22		9	

The substantial prevalence of post-hemorrhagic anemia in dogs found in this study aligns with previous reports in the veterinary literature (Brunori L. *et al.*, 2023). This form of anemia occurs due to acute blood loss resulting from trauma, surgery, or internal bleeding, leading to a rapid reduction in red blood cell (RBCs) mass. Dogs, as active and sometimes adventurous animals, are more susceptible to injuries and accidents that can result in significant blood loss. Additionally, certain breeds with a predisposition to bleeding disorders, such as Doberman Pinschers and Greyhounds, may contribute to the high

incidence of post-hemorrhagic anemia (Dow S.W. *et al.*, 2016).

The regenerative response observed in dogs with post-hemorrhagic anemia can be attributed to the erythropoietic compensatory mechanism within the bone marrow. Erythropoietin, a hormone produced by the kidney in response to hypoxia, stimulates the production of RBCs precursors (reticulocytes) to compensate for the acute loss of mature RBCs (Glogowska E. and Gallagher P.G., 2015). This compensatory mechanism is reflected in the elevated reticulocyte count often observed in these cases (Weiss D.J. *et al.*, 2019).

The results for the reticulocytes count in dogs with acute and chronic post-hemorrhagic anemia reveal higher numbers for the acute processes compared to the chronic ones due to the ability of the hematogenous bone marrow to initially compensate the RBCs loss.

The observed difference in the main causes of regenerative anemia between dogs and cats may be attributed to several factors, including species-specific vulnerabilities and environmental influences. Dogs, as more active animals with a higher likelihood of trauma-related injuries, may naturally be at greater risk of post-hemorrhagic anemia (Dow S.W. *et al.*, 2016). In contrast, cats may be more susceptible to immune-mediated disorders due to their known predisposition and the potential influence of infectious diseases like FeLV and FIV (Hartmann K., 2011).

It is worth noting that advances in diagnostic techniques and increased awareness among veterinary practitioners may also contribute to variations in the reported causes of regenerative anemia over time. Improved diagnostic capabilities, including serological tests for infectious diseases and genetic screening for breed-specific disorders, enable more accurate identification of underlying etiologies (Malancus R., 2019).

Understanding the predominant causes of regenerative anemia in dogs and cats has critical clinical implications. Veterinarians should consider these findings when evaluating and diagnosing anemic patients, as they can guide initial diagnostic tests and treatment strategies.

CONCLUSIONS

The present study provides valuable insights into the primary causes of regenerative anemia in

dogs and cats. Post-hemorrhagic anemia prevails in dogs, likely due to their propensity for injuries and accidents, while hemolytic anemia is the leading cause in cats, influenced by their predisposition to immune-mediated disorders and retroviral infections. Recognizing these differences in etiology is essential for veterinary practitioners to enhance their diagnostic accuracy and tailor treatment strategies to effectively manage regenerative anemia in these companion animals.

REFERENCES

- Brunori L., Dolan C., Elias Santo-Domingo N.** - Occurrence and clinical relevance of postoperative hypernatremia in dogs undergoing cholecystectomy. *J Vet Intern Med.* Sep 8. doi: 10.1111/jvim.16847, 2023
- Dow S.W., Rosychuk R.A., McConnico R.S.** - Canine hemorrhagic diathesis: a review. *J Vet Emerg Crit Care (San Antonio)*, 26(2), 279-298
- Giger U.** - Hemolytic Anemias. In: Ettinger SJ, Feldman EC, Côté E, editors. *Textbook of Veterinary Internal Medicine.* 8th ed. St. Louis, MO: Elsevier, 2020
- Glogowska E., Gallagher P.G.** - Disorders of erythrocyte volume homeostasis. *Int J Lab Hematol.* May; 37 Suppl 1(0 1):85-91. doi: 10.1111/ijlh.12357, 2015
- Hartmann K.** - Clinical aspects of feline retroviruses: a review. *Viruses*, 3(11), 2192-2213, 2011
- Malancus R.** - Stress induced by muzzle wearing in dogs, *Lucr. Stiintifice USAMV Iasi, seria Medicina Veterinara* vol 62/2019, 111-114, 2019
- Weinkle T.K., Center S.A., Randolph J.F., Warner K.L., Barr, S.C., Erb H.N.** - Evaluation of prognostic factors, survival rates, and treatment protocols for immune-mediated hemolytic anemia in dogs: 151 cases (1993-2002). *J Am Vet Med Assoc*, 232(6), 914-919, 2005
- Weiss D.J., Wardrop K.J.** - Schalm's Veterinary Hematology. In: Schalm OW, Jain NC, editors. 7th ed. Wiley-Blackwell, 2019