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Journal of Dairy, Veterinary & Animal Research

Research Article

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# Importance of pre-operative complete blood count in elective surgical procedures in dogs and cats - retrospective study

## Abstract

The complete blood count (CBC) is a test commonly carried out in the preoperative period of surgical procedures in dogs and cats. Blood cells are analyzed for information that reflects the patient's systemic condition, and it is possible to identify some alterations and diseases, even in asymptomatic patients. This study evaluated the preoperative blood count of 119 animals from elective surgeries performed between 2016 and 2021. The most common alteration found was hyperproteinemia with 31.63% (31), followed by thrombocytopenia with 20.41% (20), erythrocytosis 18.37% (18), thrombocytosis 11.22% (11), leukocytosis 8.16% (8) and anemia with 7.14% (7). The least frequent alteration found was leukopenia, with 3.06% (3). In general, 54,17% of the animals had some laboratory alteration, even though they were clinically healthy. Thus, it was possible to confirm the importance of the preoperative blood count in dogs and cats, highlighting the need for this complementary test to minimize surgical risks to the patient.

**Keywords:** animals, blood cells, cbc, hemogram, veterinary surgery

Volume 13 Issue 1 - 2024

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**Received:** February 02, 2024 | **Published:** February 12, 2024

## Introduction

The blood is made up of different elements: erythrocytes or red blood cells (RBC), leukocytes or white blood cells (WBC) and thrombocytes or platelets. Red blood cells carry hemoglobin, a globular protein responsible for transporting oxygen and carbon dioxide between tissues, acting as an acid-base buffer. Leukocytes are responsible for defending the body against antigens and differentiate into neutrophils, eosinophils, lymphocytes, basophils and monocytes. Platelets act in the coagulation, forming a buffer in cases of bleeding.[1]

The blood count is a test commonly performed in the preoperative period of elective or therapeutic surgeries in dogs and cats. Blood cells are assessed through qualitative and quantitative analysis, and it is possible to observe some organic, morphological, structural and quantitative changes in the blood fractions.[2]

In view of the wide variety of alterations possible in the evaluation of a blood count, allowing the identification of clinical and subclinical alterations in dogs and cats that could be interfered with during and after surgery, the following retrospective study was carried out with the hematological findings of animals undergoing elective surgical procedures, with the aim of showing the importance of the blood count as a preoperative examination.

## Materials and methods

The research was approved by the Ethics Committee for the Use of Animals of the Ingá University Center - Uningá, under protocol number 107/2021. Hematology reports from 2016 to 2021 were analyzed from the database of the UNINGÁ Veterinary Clinic. During this period, 119 clinically healthy animals, 111 dogs and 8 cats, underwent elective surgical procedures (ovariohysterectomy and orchiectomy) and had their data evaluated. Patients with concomitant diseases or an indication for a therapeutic surgical procedure were excluded from the study.

The blood count of the 119 animals selected was evaluated based on their erythrocyte, leukocyte and platelet fractions, as well as serum protein. All the blood counts were taken on a Mindray BC-2800 Vet hematology analyzer and then ratified manually using a blood smear, microhematocrit and refractometer.

The erythrogram looked for the presence of anemia and erythrocytosis. The leukogram considered leukopenia and leukocytosis based on the absolute value. The total platelet count was assessed, characterizing possible cases of thrombocytopenia and thrombocytosis. Total plasma proteins, when altered, were classified as hypoproteinemia and hyperproteinemia.

Blood counts were analyzed individually according to the reference value for each age group, as determined by Weiss and Wardrop.[3] Young dogs were considered to be those under 1 year old; adults, animals between 1 and 8 years old and the elderly over 8 years old. In cats, young people up to 1 year old; adults from 1 to 10 years old and the elderly over 11 years old.[4] The data was analyzed using descriptive statistics with the Microsoft Power BI application and discussed according to the findings in question.

The clinical-surgical approach adopted and noteworthy changes in the trans-operative and post-operative periods were taken into account, in an attempt to correlate them with the changes present in the complete blood counts.

## Results and discussion

Most of the animals that underwent elective ovariohysterectomy and orchiectomy had alterations in their blood counts, 54.17% (65 animals), even though they were clinically healthy. This result was similar to that found by Carmo et al.,[5] who evaluated the blood counts of 50 healthy animals undergoing castration, where 60% of these animals showed alterations in their blood counts.

The majority of the sample was made up of dogs, 93.33% (111 specimens), with only 6.67% (8 specimens) of cats. Of the dogs, 54.46% (61) had alterations and of the cats, 50% (4). The animals' ages ranged from 4 months to 16 years. Therefore, for a better descriptive analysis, the sample was divided by age group. Of the 119

animals, 23.33% (28) were categorized as young, with 67.86% (19) of them showing alterations in their tests. Adults accounted for 71.67% (86) of the sample, and 50% (43) of them had alterations. Finally, only 5% (6) of the animals were elderly, of which 50% (3) had alterations in their blood counts. Young animals showed a higher percentage of alterations, which can be explained by the fact that the immune system of these animals is not capable of developing an efficient response in some situations. Thus, some diseases may occur more frequently in these animals. Examples include parvovirus and parasitic diseases such as giardiasis.[6,7]

Among the complete blood counts with alterations, 7.14% (7) showed anemia, which is characterized by a decrease in the mass of circulating erythrocytes. It is identified by a decrease in globular volume (VG), hematocrit, hemoglobin content and erythrocyte count.[8] Therefore, animals with these values lower than the reference value for age were classified as anemic.

Compensatory physiological mechanisms are present in anemic patients, seeking to provide homeostasis: an increase in cardiac output, which aims to maintain tissue oxygen supply, and an increase in plasma volume, providing a lower viscosity, so that erythrocytes circulate more quickly. In cases where anemia is critical, compensatory mechanisms are insufficient, causing tissue hypoxia.[9] However, no clinical alterations were reported in the patients analyzed here. Even so, the anemic patients were not submitted to surgery and a new medical investigation was carried out to identify the cause of the alteration, because according to the classification of physical state and anesthetic risk recommended by the American Society of Anesthesiologists (ASA), anemic animals are classified as ASA III, due to severe systemic disease, increasing the anesthetic risk, as well as a higher surgical risk. Anemic patients have few reserves in case of bleeding or complications during the procedure, so this disorder can make the patient less tolerant of the depression caused by anesthesia.[9,10]

Erythrocytosis is the opposite of anemia, with an increase in VG, hematocrit and erythrocyte mass. In this study, erythrocytosis accounted for 18.37% (18) of the alterations. This disorder can be classified as relative or absolute. In cases where the increase in red blood cell mass is transient, it is considered relative and is found mainly in animals that are excited or in pain, as epinephrine is released and consequently splenic contraction occurs. In addition, dehydration is a process that causes relative erythrocytosis due to hemoconcentration. In the latter case, an increase in total plasma proteins is also present. Absolute erythrocytosis develops due to increased production of erythropoietin, myeloproliferative disorders or tissue hypoxia. Absolute erythrocytosis develops due to increased production of erythropoietin, myeloproliferative disorders or tissue hypoxia. In the patients studied here, erythrocytosis was associated with an increase in total plasma proteins in 50% (9) of the animals with this alteration, suggesting relative erythrocytosis secondary to hemoconcentration. In the remaining animals, it may be related to stress during blood collection. In surgical procedures, erythrocytosis can compromise blood flow and tissue oxygen perfusion, as well as causing thrombosis and hemorrhage due to increased blood viscosity. In surgical procedures, erythrocytosis can compromise blood flow and tissue oxygen perfusion, as well as causing thrombosis and hemorrhage due to increased blood viscosity.[11–13] However, nothing was observed in the patients in this study.

Leukocytosis was identified in 8.16% (8) of all alterations, with neutrophilia being the most frequent cause of leukocytosis, corresponding to 75% (6) of the 8 animals with leukocytosis, followed by eosinophilia with 62.5% (5) and lymphocytosis, representing only 12.5% (1) of the animals with leukocytosis. No cases of basophilia or monocytosis were found.

Leukocytosis was not a prevalent alteration in the sample, in contrast to what was found by Fischer et al.[14] in their study that evaluated 100 blood counts of healthy animals, where leukocytosis was identified as the most frequent alteration, suggesting subclinical inflammation. Leukocytosis can occur physiologically due to the response to excitation, where leukocytes from the marginal compartment are directed towards the circulatory compartment, being noticed by lymphocytes and neutrophils, which do not deviate to the left, since only segmented neutrophils should be present.[15] Leukocytosis can also occur in inflammatory processes, where inflammatory mediators stimulate mechanisms for greater blood supply to the inflamed tissue, and depending on the level of inflammation, it can stimulate the release of young leukocytes at the medullary level, causing a left shift, especially in infectious processes.[11,12]

Leukopenia was identified in only 3.06% (3) of the animals and is associated with increased consumption of peripheral leukocytes due to infections or lower bone marrow production. Lymphopenia was determined as the most frequent cause of leukopenia, with 66.67% (2) of the leukopenic animals being identified. Eosinopenia and neutropenia were each present in 33.33% (1), basopenia and monocytopenia were not found. Pre-surgical leukopenia should be investigated, and other complementary tests are needed for a definitive diagnosis, so the animal should be treated and stabilized before the surgical procedure, thus avoiding surgical complications secondary to immunosuppression.[11]

Of the 111 dogs evaluated, thrombocytopenia was present in 19.57% (18), while in cats it was found in 33.33% (2). Thrombocytopenia can be secondary to parasitic and infectious diseases; systemic alterations; medullary and immune-mediated alterations. These pathologies can remain without clinical alterations. Platelets are part of the coagulation cascade and are essential for hemostasis, initially stopping bleeding by aggregating in the vascular bed. Therefore, when they are reduced, they have the potential to cause bleeding in the transoperative period, especially when they are lower than 50,000/ µℓ.[11,16] According to Nagrebetshy,[17] other associated hematological alterations such as anemia can alter the risk of bleeding. In the cats in the study, thrombocytopenia was the most common alteration and, in the dogs, it was the second most common. In the patients in the study, the cause of thrombocytopenia was blamed on pseudothrombocytopenia and subclinical infectious diseases.[11,16]

Thrombocytosis was identified in only 11.22% (11) of the sample. According to Rocha,[18] thrombocytosis is a non-specific abnormality that may be related to iron deficiency, splenic contraction, neoplasms and gastrointestinal diseases, with a predisposition to hypercoagulability and thrombus formation. Complementary tests are needed to rule out other causes of this alteration. However, the thrombocytosis found may be related to stress during collection, which causes splenic contraction.[11,16]

Hyperproteinemia was the most frequently identified alteration, corresponding to 31.63% (31) of the blood counts. Total plasma proteins (TPP) are found in the plasma fraction, and their value is easily altered, recognizing that their elevation occurs in inflammatory processes, which stimulate the production of globulins by hepatocytes, in addition to dehydration, leading to hemoconcentration. In this study, hyperproteinemia was the biggest alteration seen, which corroborates the result found by Carmo et al.[5] This finding reiterates the importance of determining hematocrit and total plasma proteins as necessary laboratory tests for healthy animals.[2,19] No blood counts with

hypoproteinemia were identified, but this alteration can be relevant in anesthesia, increasing the risk of hypotension, tissue edema and sensitivity to drugs with high protein binding.[10,20]

## Conclusion

Based on the results obtained in this study, the hematological alterations found in the preoperative examinations of healthy animals were, in descending order, hyperproteinemia, thrombocytopenia, erythrocytosis, thrombocytosis, leukocytosis, anemia and leukopenia. Thus, it can be concluded that the blood count is a necessary test in the preoperative period, since even clinically healthy animals can show alterations in their blood counts, directly influencing the patient's pre-, trans- and post-surgical risks.

## Acknowledgments

None.

## Conflicts of interest

Author declares there are no conflicts of interests.

## Funding

None.

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