



**College of Veterinary Medicine**  
Department of Pathology

**Case number #228201**

**Presenter:** Justin Farris, DVM

**Contributors:** Melinda Camus, DVM, DACVP

**Signalment:** 9 year old female spayed Keeshond

**Clinical history:** The patient was previously diagnosed with stage 5A multicentric B cell lymphoma. The initial diagnosis of lymphoma from a cutaneous neck lesion was made via histopathology with positive immunohistochemical staining for CD20. A mandibular lymph node was later aspirated and diagnosed as lymphoma via cytology. She presented to the University of Georgia Oncology Service for a complete blood count and a dose of chemotherapy (if no CBC contraindication) as part of her CHOP (cyclophosphamide, vincristine, L-asparaginase, doxorubicin, and prednisone) protocol. She was reportedly feeling well at home with good energy and appetite. No clinical complaints were expressed at this visit.

**Physical exam findings:** At presentation, the patient was bright, alert and responsive. Peripheral lymph nodes were normal in size. No abnormalities were noted.

**Complete Blood Count Data:**

| Test                  | Result   | Reference Interval | Units                     |
|-----------------------|----------|--------------------|---------------------------|
| RBC                   | 5.21 (L) | 5.90 – 8.66        | $\times 10^6/\mu\text{L}$ |
| HGB                   | 10.6 (L) | 13.7 – 20.7        | g/dL                      |
| HCT                   | 34.0 (L) | 42.2 – 59.8        | %                         |
| MCV                   | 65.2     | 63.9 – 75.4        | fL                        |
| MCHC                  | 31.3 (L) | 33.0 – 35.0        | g/dL                      |
| RDW                   | 18.1 (H) | 11.2 – 13.2        | %                         |
| Platelets             | 872 (H)  | 226-424            | $\times 10^6/\mu\text{L}$ |
| PCT                   | 1.05 (H) | 0.15 – 0.45        | %                         |
| WBC                   | 9.0      | 4.2 – 12.9         | $\times 10^3/\mu\text{L}$ |
| Segmented Neutrophils | 8.1      | 2.7 – 8.5          | $\times 10^3/\mu\text{L}$ |
| Lymphocytes           | 0.9      | 0.5 – 4.1          | $\times 10^3/\mu\text{L}$ |

**A blood smear is provided for your evaluation.**



**College of Veterinary Medicine**  
Department of Pathology

**Case #228201 (Farris)**

**Blood smear review:** The erythrocyte mass is slightly decreased, consistent with a mild anemia. Moderate anisocytosis and mild polychromasia are seen, rarely with evidence for basophilic stippling. Moderate numbers of Howell-Jolly bodies and siderocytes containing small, blue, focal, aggregated material within the erythrocyte cytoplasm (Pappenheimer bodies) are present. Rare hemoglobin crystals are noted and slight rouleaux is observed. Platelets are increased. The leukon appears microscopically unremarkable.

**Diagnosis:** Anemia with moderate numbers of siderocytes

**Discussion:** Siderocytes are erythrocytes which contain aggregates of basophilic granules, termed siderotic granules<sup>1,2</sup>. Siderotic granules are iron accumulations within the cytoplasm (as ferritin) or mitochondria (also referred to as Pappenheimer bodies). Siderotic granules must be distinguished from basophilic stippling, as these findings suggest different pathologic processes. Cytologically, siderotic granules appear as loosely organized aggregates or clusters of basophilic inclusions within erythrocytes, whereas basophilic stippling is found dispersed throughout the erythrocyte. Basophilic stippling represents accumulations of ribosomes and can be found most commonly in regenerative anemias and with lead poisoning<sup>3</sup>. Positive staining with Prussian blue is confirmatory for siderotic granules.

The presence of siderocytes in a peripheral blood smear is uncommon in dogs but is thought to be related to abnormal heme synthesis and iron metabolism disorders<sup>1,2</sup>. Siderocytes have been associated with medication administration (such as chloramphenicol and hydroxazine), immune-mediated hemolytic anemia, lead poisoning, myeloid neoplasms, and experimentally in pigs with pyridoxine or copper deficiencies. This finding may be accompanied by dyserythropoiesis with morphologically abnormal erythroid cells in peripheral blood<sup>3,4</sup>. Hemoglobin crystals have also been documented concurrently with siderotic inclusions in a dog with dyserythropoiesis<sup>3</sup>. Findings consistent with dyserythropoiesis have also been associated with patients following vincristine administration<sup>4</sup>. Although not seen in the current case, other abnormalities that have been linked with vincristine-related dyserythropoiesis include multiple and/or abnormal nuclear fragments, bizarre nuclei within metarubricytes, abnormal mitotic figures, and binucleation.

The presence of Pappenheimer bodies in this patient was thought to be secondary to dyserythropoiesis, potentially from bone marrow disease related to her neoplasia. Medication or chemotherapy-associated dyserythropoiesis would also be considered.

**References:**

1. Stockham, Steven L., and Michael A. Scott. *Fundamentals of Veterinary Clinical Pathology*. John Wiley & Sons, 2013. 138-142.
2. Harvey, John W. *Veterinary Hematology*. St. Louis: WB Saunders, 2012. 80.
3. Canfield, P. J., A. D. J. Watson, and R. C. C. Ratcliffe. "Dyserythropoiesis, sideroblasts/siderocytes and hemoglobin crystallization in a dog." *Veterinary Clinical Pathology* 16.1 (1987): 21-28.
4. Collicutt, Nancy B., and Bridget Garner. "Erythrocyte dysplasia in peripheral blood smears from 5 thrombocytopenic dogs treated with vincristine sulfate." *Veterinary Clinical Pathology* 42.4 (2013): 458-464.
5. Mackin, Andrew J., D. G. Allen, and I. B. Johnston. "Effects of vincristine and prednisone on platelet numbers and function in clinically normal dogs." *American Journal of Veterinary Research* 56.1 (1995): 100-108.