

Case Report on Feline Polycythemia Vera

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Abstract

Polycythemia vera has been reported as a known condition in cats as early as 1966. This condition manifests as an increased mass in red blood cells and elevated hematocrit and is defined as an idiopathic chronic myeloproliferative disorder. The patient described in this paper presented with hyperemic gums and pinna and an acute onset of progressive ataxia and lethargy. Several possible underlying primary conditions such as cardiac disease and renal malignancy were excluded by running basic blood work and radiographic imaging. Initial blood work revealed a significantly elevated packed cell volume (88%). After diagnosis, treatment with phlebotomy and chemotherapy lead to a reduction in hematocrit and elimination of neurologic signs. This case study represents the diagnosis and successful management of this disease in a private practice setting. Polycythemia vera is relatively uncommon in dogs and cats, but should still be considered in cases of neurologic disorders, especially with the presence of bright red ears, paws, or gums.

Keywords

Polycythemia Vera, Feline, Phlebotomy, Hydroxyurea

1. Introduction

Feline hematology is something that private practitioners commonly review as part of their daily clinical practice. A decreased red blood cell count, otherwise noted as anemia, is by far the most commonly noted red blood cell count abnormality or irregularity seen on feline hematology. The list of potential rule outs for anemia is widespread and includes diseases, disorders, and infections of nearly every body system. Conversely, an increased red blood cell count, otherwise noted as polycythemia vera is significantly less common. Known causes of this condition are exceptionally limited. Rule outs for polycythemia vera include primary polycythemia (aka idiopathic) and secondary polycythemia caused by heart disease or erythropoietin (EPO) producing renal tumor. The limited lists

of causes for this disorder make the diagnosis relatively simple. While an absolute cure for this disease has yet to be discovered, management and treatment of this condition has a rewardingly high success rate.

2. Case Presentation

A four-year-old, 4.4 kg, neutered, male, indoor-only, domestic-short-hair cat presented to the Revere Pet Clinic with a progressive six-day history of lethargy, ataxia, and inappropriate mentation.

Three days prior to arriving at the Revere Pet Clinic the patient had been seen at a local emergency hospital for lethargy and ataxia. The patient had a history of two urinary tract infections, was not up-to-date on vaccines, was FIV/FelV negative as a kitten, and the owner had one other healthy cat at home.

Physiologic parameters (heart rate, temperature, respiratory rate, and capillary refill time) were all within normal limits. A neurologic consult revealed tetra-ataxia (most pronounced in the hind limbs), lack of menace, and otherwise normal reflexes and proprioception. Due to financial constraints the owner could not afford a further work-up at the referral hospital. In the absence of further consent to diagnostics, the neurologist prescribed Clindamycin to rule out infectious causes (toxoplasmosis) and recommended starting steroids if no improvement was seen on this medication.

On arrival at the Revere Pet Clinic, the cat's tetra-ataxia was still present and had progressed to partial paresis in the hind legs. The patient was twitching occasionally and acting lethargic with no appetite. A thorough physical exam was performed. In addition to the neurological signs, pertinent findings on physical exam included hyperemic gums, and erythema on ears and paw pads. All other physical exam findings were unremarkable. Initial diagnostics included an in-house blood glucose (49), in-house FIV-FelV test (both negative), and a complete blood count (CBC) and biochemistry panel was sent to Idexx Laboratories, Inc. (North Grafton, MA). The patient was sent home to wait for blood work diagnostics with a guarded prognosis.

The CBC revealed a polycythemia with a mild leucopenia (**Table 1**). Total protein and albumin were within normal limits. The biochemistry panel reflected normal total protein and albumin with a slight elevation in GGT (**Table 2**). A cytology review confirmed the polycythemia and found no significant abnormalities in the erythrocytes, white blood cells (WBC), or platelets. Radiographs were recommended to check for evidence of secondary causes of polycythemia such as hypoxia secondary to heart or lung disease, or an erythropoietin producing renal tumor. Twenty-four hours after initial presentation to the clinic, a three-view series of full body radiographs revealed no abnormalities in the thorax or abdomen.

Overnight the cat's neurological state continued to deteriorate. The patient had two seizures, five hours apart. His neurological signs had progressed to complete hind limb paralysis/weakness, and constant facial and limb twitching were noted. He had not eaten anything and the owner had syringed some water

into his mouth in an attempt to hydrate him. An in-house packed cell volume (PCV) was 88%.

The cat was immediately prepped for phlebotomy. The skin over the cephalic and left jugular veins was shaved and sterilely prepped. A standard intravenous (IV) catheter was placed in the cephalic vein. A twenty-one-gauge butterfly catheter was flushed with heparin and saline solution and placed in the jugular vein. 82 mls were removed via a 25 cc syringe and three-way stop cock. Immediately following the phlebotomy, 120 mls of lactated ringer's solution (LRS) was given through the cephalic IV catheter over a one-hour period.

An hour after phlebotomy and immediately after administering IV fluids, the patient's PCV had dropped to 71%. The cat's mentation had already improved and he was sitting up and looking around. No tremors or twitching were noted. He was able to stand and walk back into his carrier although marked hind-leg weakness was noted. The cat was sent home with instructions on how to give subcutaneous fluids daily (150 mls LRS/day).

The cat spent a week on daily subcutaneous fluids. One week after the initial phlebotomy occasional twitching was noted and a second phlebotomy was performed (starting PCV 77%, 75 mls of blood extracted and replaced with saline.

Table 1. Comprehensive Complete Blood Count.

	Test Result	Reference Range	Low/High
WBC ($\times 10^3/\mu\text{L}$)	3.8	4.2 - 15.6	Low
RBC ($\times 10^6/\mu\text{L}$)	14.45	6.0 - 10.0	High
HGB (g/dL)	21.5	9.5 - 15	High
HCT (Manually spun HCT) (%)	67.5	29 - 45	High
MCV (fL)	46	41 - 58	Normal
MCH (pg)	14.9	11.0 - 17.5	Normal
MCHC (g/dL)	31.6	29 - 36	Normal
Neutrophil Seg (%)	53	35 - 75	Normal
Lymphocyte (%)	41	20 - 55	Normal
Monocyte (%)	3	1 - 4	Normal
Eosinophil (%)	3	2 - 12	Normal
Basophil (%)	0	0 - 1	Normal
Absolute Neutrophil (/uL)	2014	2500 - 12,500	Low
Absolute Lymphocyte (/uL)	1558	1500 - 7000	Normal
Absolute Monocyte (/uL)	114	0 - 850	Normal
Absolute Eosinophil (/uL)	114	0 - 1500	Normal
Absolute Basophil (/uL)	0	0 - 100	Normal

WBC (White Blood Cell); RBC (Red Blood Cell); HGB (Hemoglobin); HCT (Hematocrit); MCV (Mean Corpuscular Volume); MCH (Mean Corpuscular hemoglobin); MCHC (Mean Corpuscular Hemoglobin Concentrations). **Platelet Comments:** Scanning of the blood smear revealed adequate platelet numbers. Due to clumping and/or large platelets the automated platelet number cannot be accurately determined. **Remarks:** Slide reviewed microscopically. WBC and RBC morphology appears normal.

Table 2. Blood Chemistry Analysis.

	Test Result	Reference Range	Low/High
ALP (U/L)	12	0 - 62	Normal
ALT (U/L)	32	28 - 100	Normal
AST (U/L)	51	5 - 55	Normal
Creatinine Kinase (U/L)	156	64 - 440	Normal
GGT (U/L)	12	0 - 6	High
Albumin (g/dL)	3.6	2.3 - 3.9	Normal
Total Protein (g/dL)	8.1	0.0 - 0.4	Normal
Globulin (g/dL)	4.5	3.0 - 5.6	Normal
Total Bilirubin (mg/dL)	0.2	0.0 - 0.4	Normal
Direct Bilirubin (mg/dL)	0.1	0.0 - 0.2	Normal
BUN (mg/dL)	22	15 - 34	Normal
Creatinine (mg/dL)	1.5	0.8 - 2.3	Normal
Cholesterol (mg/dL)	161	82 - 218	Low
Glucose (mg/dL)	94	70 - 150	Normal
Calcium (mg/dL)	10.5	8.2 - 11.8	Normal
Phosphorus (mg/dL)	5.7	3.0 - 7.0	Normal
ALB/GLOB Ratio	0.8	0.4 - 0.8	Normal
BUN/Creatinine Ratio	14.7		
Indirect Bilirubin	0.1	0 - 0.3	Normal
Hemolysis Index	Normal		
Lipemia Index	Normal		

Test Result Reference Range Low Normal Hig: ALP (Alkaline Phosphatase); ALT (Alanine Transaminase); AST (Aspartate Aminotransferase); GGT (Gamma-Glutamyl Transpeptidase); BUN (Blood Urea Nitrogen).

Post phlebotomy PCV was 62%). The cat was started on hydroxyurea at 125 mg every other day for two weeks. One-week post treatment the PCV was 65%. The hydroxyurea was continued at every other day for an additional week and re-check PCV a week later was 61% with no clinical signs (no twitching, seizures, or other neurologic signs with a normal appetite and disposition). The cat was then weaned onto a maintenance dose of hydroxyurea at 250 mg twice weekly. The hydroxyurea was compounded and given by mouth as a liquid. The cat seemed lethargic after the recommended 250 mg dose, so the owner elected to give 160 mg 3 times per week as maintenance. No lethargy was noted at this dose and frequency.

Long term treatment plan consisted of weekly PCV checks, and CBC and biochemistry panels run every three months to monitor WBC count for myelosuppression and recurrence of polycythemia. After three months of stabilization, CBC and chemistry checks were run 3 - 4 times a year to monitor. Two years later the cat continued to do well with no episodes of twitching or seizure. The cat still had occasional minor hind leg weakness, and retained the hyperemic mucus membranes, and erythematous pinnae and paws. Anecdotally, he is one of the

nicest cats the prescribing veterinarian has encountered.

3. Discussion

Polycythemia vera is relatively uncommon in small animal practice [1], but should still be considered in cases of neurologic disorders, especially with the presence of bright red ears, paws, or gums [2]. Due to the vascular effects of the disease such as decreased oxygen transport and obstructed blood flow, atypical cases may present first with secondary symptoms such as uveitis [3]. It has been reported as a known condition in cats as early as 1966 [3]. Once treated, this disease has a relatively good prognosis [4]. This case study represents successful management of this disease in a private practice setting.

True or absolute polycythemia is suspected when there is an elevated PCV in the absence of dehydration. If dehydration is present, then a relative polycythemia must be considered. Breed specific elevations in PCV (e.g., Greyhounds) must also be considered [4].

Diagnosing of primary vs. secondary polycythemia vera can be slightly challenging. Radiographs, ultrasound, and blood gases can be used to rule-out secondary polycythemia due to underlying heart disease [5], or erythropoietin (EPO)-producing kidney tumor. Checking EPO blood levels has limited diagnostic use since the concentrations in polycythemic patients may overlap with normal levels and there is a lack of species specific assays in the dog and cat [6].

Primary polycythemia or polycythemia vera manifests as an overproduction of normal red blood cells within the bone marrow. This malignant clone of red blood cells exists despite normal or even low levels of erythropoietin. Some alternative theories behind the etiology of this disorder suggest that the condition exists due to a hypersensitivity to EPO rather than a malignant cell population within the marrow [7].

In most cases of polycythemia vera, the condition is not diagnosed until clinical signs have become severe. The increasing number of clinics with in-house blood screening abilities has made general health screening of blood work both more affordable and more common. Regular blood screening tests at wellness visits will likely increase the incidence of diagnosing this disease earlier before clinical signs become evident. The clinical signs most commonly noted by owners and veterinarians are due to the hyperviscosity of the blood which causes a decreased cerebral perfusion and leads to such symptoms as blindness, ataxia, or seizures. Phlebotomy is the fastest and most effective way to decrease the PCV and resolve the patient's neurological signs [7]. Several different calculators can be used to determine how much blood to remove. In the example case, the following formula was used [8]:

$$\text{Blood Volume} = \text{BW} * \text{k} * 1000 * \left\{ \frac{(\text{HCTA} - \text{HCTD})}{\text{HCTA}} \right\}.$$

BW = Body wt in kg, K = 0.09 for dogs, 0.07 for cats, HCTA = actual HCT, and HCTD = desired HCT.

No more than 20 mL/kg per day with a goal of a PCV of less than 60%.

In the case example, heart disease or a malignant kidney tumor could not be completely ruled out based on radiographs and clinical signs alone. However, the blood work and radiographic evidence were presumed significant enough to proceed with treatment options for polycythemia vera considering the owner's financial constraints and limited ability to pursue further diagnostic workup. If money were no concern, additional diagnostics may have included an arterial blood gas, abdominal ultrasound, and possible EPO level (less diagnostically valuable, *i.e.* results will be inconclusive). Notably, bone marrow biopsy cannot distinguish primary from secondary polycythemia and is not considered a useful test for this condition [7].

4. Conclusion

This case represents the successful diagnosis and treatment of a polycythemic cat in a general practice setting. In rare cases, polycythemia patients may spontaneously regress so a follow up is important [9]. Side effects of long term use of the chemotherapeutic agent hydroxyurea are usually reversible and can include bone marrow suppression, hair loss, and gastrointestinal upset [7]. If a patient has an adverse reaction to the hydroxyurea, alternative methods of treatment include serial phlebotomies, other chemotherapy drugs or the less conventional medical grade leeches [10]. Since evidence of this disorder can be seen on basic blood work, this disease represents one example of the potential benefits for regular blood work screenings at annual appointments [11].

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