

## Section 1

# Mammalian Hematology Case Studies

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## A 6-Year-Old Otter Undergoing a Routine Physical Examination

### Signalment

A 6-year-old intact North American male river otter (*Lontra canadensis*) was examined as part of a routine physical examination.

### History

The patient was housed with two other male otters of the same age. No significant health problems had been observed in any of the otters. The otters were weighed weekly, and there had been no change in the appetite, behavior, or weight.

### Physical Examination Findings

The 10 kg otter appeared healthy on physical examination (Figs. 1.1–1.4 and Tables 1.1 and 1.2).



**Fig. 1.1.** The North American river otter in an exhibit with his cage mate.

### Other Diagnostic Information

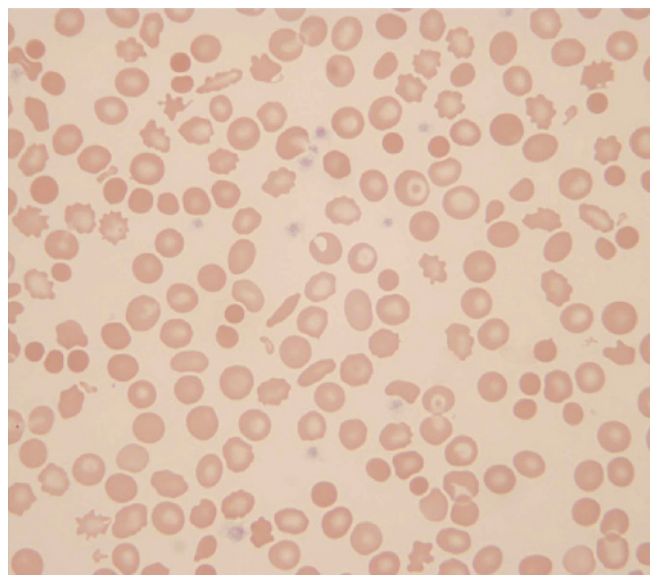
A fecal occult blood was positive; however, no red blood cells or other abnormalities were seen on a fecal cytology.

Whole body ventral–dorsal and lateral radiographs revealed no abnormalities in the abdominal organs. The T14–L1 intervertebral disk space was narrowed with sclerotic end plates and was indicative of spondylosis deformans.

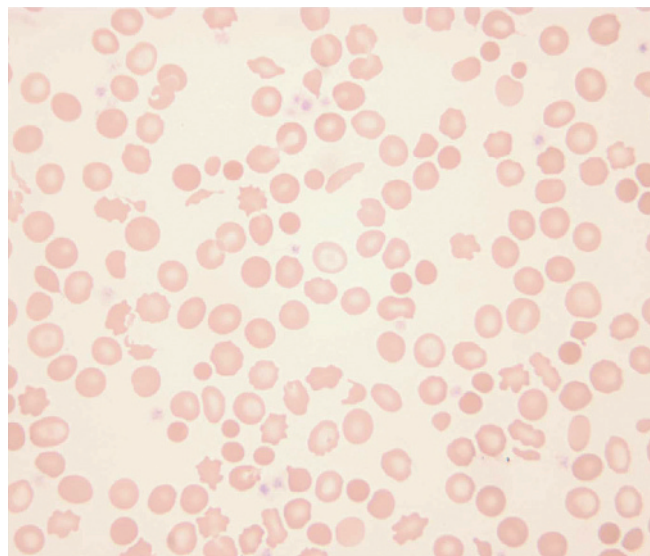
Endoscopic examination revealed evidence of fresh blood in the stomach and small punctate ulcers. Some shrimp tails remained in the stomach several hours after the last meal. The gastric mucosa was irregular, suggesting a possible infection associated with *Helicobacter* sp. The duodenum appeared normal. The esophagus was very long and the pylorus was open and easy to enter. Histopathologic examination of biopsies



**Fig. 1.2.** The otter under anesthesia for physical examination and blood collection.



(a)



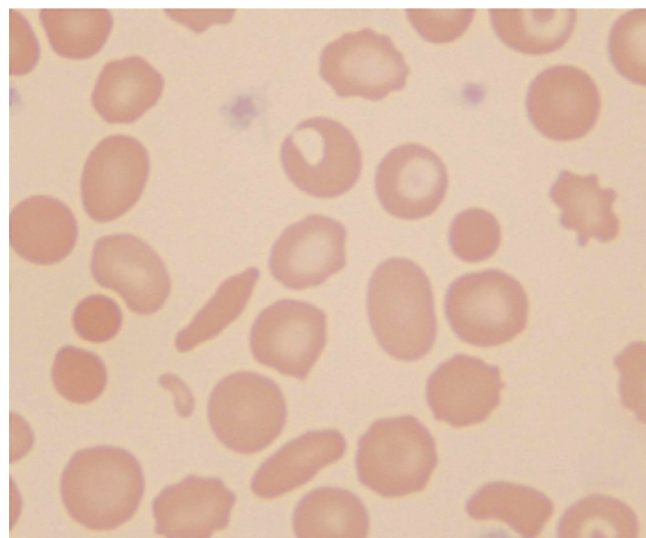
(b)

**Fig. 1.3.** (a and b) Blood films from an otter (Wright–Giemsa stain, 50 $\times$ ).

taken during the endoscopic examination revealed no abnormalities.

### Interpretive Discussion

Figures 1.3 and 1.4 reveal erythrocyte abnormalities. Many of the erythrocytes are hypochromatic as indicated by extended central pallor and thin rim of hemoglobin. There are many keratocytes and schistocytes present. The erythrocytes (blister cells) appear to be developing vacuoles or blisters that enlarge. These blisters eventually break open to form “apple stem cells” and keratocytes. Spiculated erythrocytes (those



**Fig. 1.4.** A blood film from an otter (Wright–Giemsa stain, 100 $\times$ ).

with more than two pointed projections) are also seen. The projections fragment from the cells to form the schistocytes.

The packed cell volume (PCV), hemoglobin concentration (Hb), mean cell volume (MCV), and

**Table 1.1.** Hematology results.

	Day 1	Ranges for otters at aquarium
WBC ( $10^3/\mu\text{L}$ )	7.1	2.7–5.3 (3.8)
Neutrophils ( $10^3/\mu\text{L}$ )	4.4	1.6–3.9 (2.4)
Neutrophils (%)	62	38–73 (61)
Lymphocytes ( $10^3/\mu\text{L}$ )	2.4	0.7–1.6 (1.1)
Lymphocytes (%)	34	16–48 (31)
Monocytes ( $10^3/\mu\text{L}$ )	0.2	0–0.2 (0.1)
Monocytes (%)	3	1–5 (2)
Eosinophils ( $10^3/\mu\text{L}$ )	0.1	0–0.4 (0.2)
Eosinophils (%)	1	1–8 (4)
Basophils ( $10^3/\mu\text{L}$ )	0	0
Basophils (%)	0	0
Plasma protein (g/dL)	7.4	7.4–8.1 (7.7)
RBC ( $10^6/\mu\text{L}$ )	11.5	10.9–14.6 (12.3)
Hb (g/dL)	9.9	16.0–19.6 (17.0)
PCV (%)	38	48–60 (52)
MCV (fL)	33.0	39–45 (42)
MCHC (g/dL)	26.0	32–34 (33)
Reticulocytes per microliter		10,910–14,620 (12,673)
Reticulocytes (%)		0.1
RDW	8.8	13.6–18.0 (15.1)
Platelets ( $10^3/\mu\text{L}$ )	762	311–474 (371)
MPV (fL)	5.9	6.0–6.9 (6.6)
Clumped platelets	0	0
Keratocytes	Moderate	0
Echinocytes	Few	0 to few
Hypochromasia	Slight	0
Reactive lymphs	Few	0

**Table 1.2.** Plasma biochemical results.

	Day 1	Ranges for otters at aquarium
Glucose (g/dL)	109	91–136 (114)
BUN (mg/dL)	38	27–43 (36)
Creatinine (mg/dL)	0.4	0.4–0.7 (0.5)
Phosphorus (mg/dL)	4.6	2.2–4.8 (3.6)
Calcium (mg/dL)	8.9	8.5–9.4 (9.0)
Total protein (g/dL)	7.0	6.6–7.4 (7.0)
Albumin (g/dL)	2.9	2.6–3.2 (3.0)
Globulin (g/dL)	4.1	3.6–4.2 (4.0)
A/G ratio	0.7	0.7–0.9 (0.8)
Cholesterol (mg/dL)	177	88–235 (175)
Total bilirubin (mg/dL)	0.1	0.1–0.2 (0.2)
CK (IU/L)	149	148–588 (375)
ALP (IU/L)	61	60–118 (82)
ALT (IU/L)	104	91–127 (112)
AST (IU/L)	122	88–174 (125)
GGT (IU/L)	9	7–14 (10)
Sodium (mg/dL)	147	143–149 (146)
Potassium (mg/dL)	3.7	3.7–4.0 (3.9)
Chloride (mg/dL)	114	107–115 (112)
Bicarbonate (mg/dL)	20.8	17–25 (21)
Anion gap	15	10–20 (16)
Calculated osmolality	300	291–303 (297)
Lipemia (mg/dL)	9	—
Hemolysis (mg/dL)	9	—
Icterus (mg/dL)	0	—

mean cell hemoglobin concentration (MCHC) on the hemogram are decreased, which is indicative of an iron-deficiency anemia. The appearance of microcytic, hypochromic erythrocytes on the blood film is also indicative of an iron-deficiency anemia, a condition that is nearly always caused by chronic blood loss in an adult animal. The positive fecal occult blood is suggestive of gastrointestinal blood loss in this patient; however, the two healthy otters that share his habitat also exhibited positive fecal occult blood tests. Thus, it is likely that the results of the fecal occult blood testing are false-positive owing to the meat diet of the otters. The endoscopic examination suggested the possibility of blood being lost from the upper gastrointestinal tract as would be seen

**Table 1.3.** Plasma iron profile results.

	Day 1	Ranges for otters at aquarium
Iron (µg/dL)	35	112–160 (135)
TIBC (µg/dL)	434	286–409 (320)
Saturation (%)	8	27–58 (44)
UIBC (µg/dL)	399	116–297 (186)

with *Helicobacter* involvement; however, histologic examination of biopsy samples failed to confirm pathology associated with that area (Table 1.3).

Variability in the normal serum iron, total iron-binding capacity (TIBC), and percent saturation of transferrin occurs among mammalian species; however, in general, healthy animals have an average serum iron concentration of 100 µg/dL, a TIBC of 300 µg/dL, and transferrin saturation of 33%. Using these values, this otter patient has a confirmed iron deficiency based on reduced serum iron concentration and transferrin saturation with an increased TIBC.

The platelet count is greater than expected. This is a common finding associated with iron-deficiency anemia in other mammalian species. The exact cause of this is unknown.

The otter had a mild leukocytosis, mature neutrophilia, and lymphocytosis, which are suggestive of a physiological leukocytosis. This is not surprising owing to the nature of capture and delivery of a chemical restraint needed in order to obtain the blood sample.

### Summary

The otter underwent a 4-month treatment for a presumed chronic blood loss anemia resulting in the loss of iron from the gastrointestinal tract in association with a *Helicobacter* sp. infection. He was also treated with injectable supplemental iron. Because the otter never appeared weak or ill from his anemia, a reevaluation examination was performed 4 months following the initial examination. The erythrocyte parameters had returned to normal by that time.

