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CASE REPORT

Battling Giants: A Case of Canine Dioctophymiasis

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Abstract

This case report outlines the history, diagnosis, and treatment of a 9-month-old Labrador retriever infected with giant kidney worms (*Dioctophyme renale*). The case highlights the importance of appropriate diagnostic methods and effective client communication in detecting and preventing parasitic infections with zoonotic potential.

Take-Home Points

- The giant kidney worm (*Dioctophyme renale*) can be contracted through the ingestion of contaminated water or undercooked frogs and fish.
- Microscopic urine sediment evaluations can detect the presence of *D renale* ova and are an essential component of a complete urinalysis.
- Diagnostic imaging should be used to confirm the location of adult kidney worms prior to treatment as *D renale* larvae can migrate to ectopic locations throughout the body.
- Surgical removal of adult worms is currently the only effective treatment option for *D renale* infections.

While the majority of dog and cat owners recognize the risks posed to their pets by gastrointestinal parasites and biting insects or arthropods, they are typically unaware of parasites obtained through predation or of the zoonotic potential most parasites possess. *Dioctophyme renale*, the giant kidney worm, is a lesser-known parasite that is contracted through the ingestion of undercooked frogs and fish or contaminated drinking water; it can wreak devastating, long-lasting effects on both humans and their pets if left untreated.

HISTORY AND PRESENTATION

Maverick is a 9-month-old intact male black Labrador retriever that was presented to a general practice veterinary clinic in Ontario, Canada, for a 3-day history of intermittent hematuria. Although Maverick's physical examination was unremarkable, a CBC revealed elevated neutrophil, lymphocyte, eosinophil, and basophil counts, indicating an underlying infection with suspected parasitic involvement (**TABLE 1**). Elevated creatinine values on a mini serum biochemical profile and the presence of white blood cells (WBCs), red blood cells (RBCs), and protein on a urinalysis of a free-catch urine sample implied ongoing inflammation, hemorrhage, tissue damage, and decreased function in the kidneys and/or urinary bladder. A microscopic evaluation of the urine sediment revealed several dark, cylindrical objects resembling *D renale* ova. Maverick was referred to the closest advanced specialty veterinary hospital, located in Michigan, for additional diagnostic confirmation of a parasitic infection.

Two weeks later, Maverick presented to the specialty hospital's small animal primary care service for an initial evaluation. Maverick remained highly active with normal eating and drinking habits but continued to exhibit hematuria at least once a day with a normal urine stream. The owner added that Maverick was currently an outside dog with full access to 40 acres of property and 3 ponds and had been found numerous times with dead frogs in his mouth. Maverick was up-to-date on the core canine vaccines (including leptospirosis) and was administered monthly parasite control for heartworm disease, intestinal parasites, ticks, and fleas during the summer months.

INITIAL ASSESSMENT AND DIAGNOSTIC TESTS

Upon physical examination, Maverick was bright, alert, and responsive with a sweet temperament and no sign of physical discomfort. Initial findings included the following normal vital signs:

- Rectal temperature of 37.8 °C (100 °F) (reference range, 37.5 °C to 39.2 °C [99.5 °F to 102.6 °F])
- Heart rate of 100 beats per minute (bpm; reference range, 60 to 160 bpm)
- Respiratory rate of 30 breaths/min (reference range, 10 to 30 breaths/min) with no effort

His body weight was 30 kg (66 lb), and he had a body condition score of 5/9. His mucous membranes were pink, with a capillary refill time of < 2 seconds. On palpation, his abdomen was soft and nonpainful (0/4 on the Colorado State University Canine Acute Pain Scale [CSU CAPS]), and no abnormalities were discovered during a cursory urogenital exam.

A recheck CBC and serum biochemical profile performed by the hospital's clinical pathology laboratory showed slight improvements in the high WBC counts and elevated creatinine values. However, additional findings of increased blood urea nitrogen, hyperphosphatemia, and hypoalbuminemia indicated

TABLE 1 The Patient's Abnormal Diagnostic Test Values

BLOOD/URINE COMPONENT *Normal reference interval*	RDVM (3/6/23)	1 DAY PREOP (3/22/23)	1 DAY POSTOP (3/24/23)	2 DAYS POSTOP (3/25/23)	3 DAYS POSTOP (3/26/23)
CBC					
White blood cells *4.6–10.7 K/µL*	28.44 **H**	15.7 **H**			
Neutrophils *2.7–7.8 K/µL*	12.46 **H**	5.8 (Bands = 0.3 **H**)			
Lymphocytes *0.6–5 K/µL*	6.44 **H**	5.7 **H**			
Eosinophils *0–1.3 K/µL*	8.33 **H**	3.3 **H**			
Basophils *0–0.1 K/µL*	0.43 **H**	0.2 **H**			
SERUM BIOCHEMICAL PROFILE					
Creatinine *0.6–1.4 mg/dL*	1.43 **H**	1.1	1	1.2	1.1
Blood urea nitrogen *12–27 mg/dL*		38 **H**	10 **L**	13	12
Phosphorus *2.7–5.4 mg/dL*		6.4 **H**	4.4	5.6 **H**	5.6 **H**
Albumin *2.8–3.6 g/dL*		2.7 **L**	2.7 **L**	2.5 **L**	2.5 **L**
Globulin *2.3–3.7 g/dL*		3.9 **H**		3.4	3.4
URINALYSIS					
Collection method	Free catch	Cystocentesis			
Color	Red	Dark yellow			
Specific gravity *1.025–1.050 (canine)*	1.030	1.039			
Leukocytes *Negative (chemical analysis)*	+2 (125 cells/µL) **H**				
Blood *Negative (chemical analysis)*	+2 (80 cell/µL) **H**				
Protein *Negative (chemical analysis)*	+2 (100 mg/dL) **H**	+1 (30 mg/dL) **H**			
Red blood cells *≤5/hpf (sediment evaluation)*		>50/hpf **H**			
White blood cells *≤3/hpf (sediment evaluation)*		>50/hpf **H**			
***Dioctophyme renale* ova** *None (sediment evaluation)*	Present (value unknown) **H**	Present (5–15 per 10× magnification field) **H**			

H = high; hpf = high-power field; L = low; RDVM = referring veterinarian

worsening kidney damage and a correlating drop in kidney filtering abilities. A concurrent rise in globulin levels reinforced the suspicion of an ongoing infection.

Abdominal ultrasonography performed by the diagnostic imaging service revealed a tubular, undulating, layered object surrounded by mildly echoic fluid in the right kidney as well as severe loss of peripheral renal parenchyma (**FIGURE 1**). Because the urinary bladder contained a small amount of suspended hyperechoic debris, a sterile urine sample was obtained via cystocentesis and submitted to both the clinical pathology laboratory for a complete urinalysis and the bacteriology section for a urine culture and sensitivity

test. The urinalysis results echoed the previous finding of protein in the urine, and numerous WBCs and RBCs were visualized on microscopic sediment evaluation in addition to multiple yellowish-brown, thick-walled oval objects consistent in appearance with *D renale* ova (**FIGURE 2**).

Combined with the ultrasonographic findings, the confirmed presence of *D renale* ova led to a definitive diagnosis of dioctophymiasis. Because giant kidney worms are insusceptible to currently available anthelmintics, surgical removal of the parasites was required to prevent further organ damage. Despite the high risk of intraoperative (44.9%) and postoperative (44%) complications associated with removing a kidney, a nephrectomy to remove the destroyed right kidney and its adult worm occupants was recommended as the only viable treatment method to eradicate the parasitic infection.[1] Maverick was admitted to the hospital for overnight IV fluid administration and NPO (nil per os/nothing by mouth) restrictions before transfer to the soft tissue surgery service in the morning.

TREATMENT

Since the kidneys receive approximately 20% of total cardiac output, nephrectomies can result in excessive hemorrhage, severe hypotension, and subsequent cardiac arrest.[1] Removing half the body's available nephrons also increases the risk of acute kidney injury if the remaining kidney is damaged or unable to compensate.[1]

To address these concerns, the anesthesia service developed an anesthetic protocol that minimized the risk of additional damage to the left kidney from hypertension, dehydration, or excessive drug metabolism. Maverick was premedicated with a pure μ-agonist opioid for analgesia (methadone 10 mg IV) and induced with a cardiovascular-sparing γ-aminobutyric acid agonist (alfaxalone 3 mg/kg IV to effect) and a facility-available benzodiazepine for muscle relaxation (midazolam 0.2 mg/kg IV). Intubation was achieved with a 12-mm internal-diameter endotracheal tube. Anesthesia was maintained by administering 2% isoflurane mixed with oxygen at a flow rate of 2 L/min, and a left dorsal pedal arterial catheter was placed for direct blood pressure measurement. Precautions for the risk of intraoperative hemorrhage included a blood type test (dog erythrocyte antigen 1.1 positive) and placement of an additional IV catheter in the left cephalic vein for blood product administration. Appropriate blood pressure and kidney perfusion levels were maintained with lactated Ringer's solution given 160 mL/hr IV.

FIGURE 1. Ultrasonographic image of the patient's right kidney containing multiple hyperechoic rings indicative of an adult kidney worm.

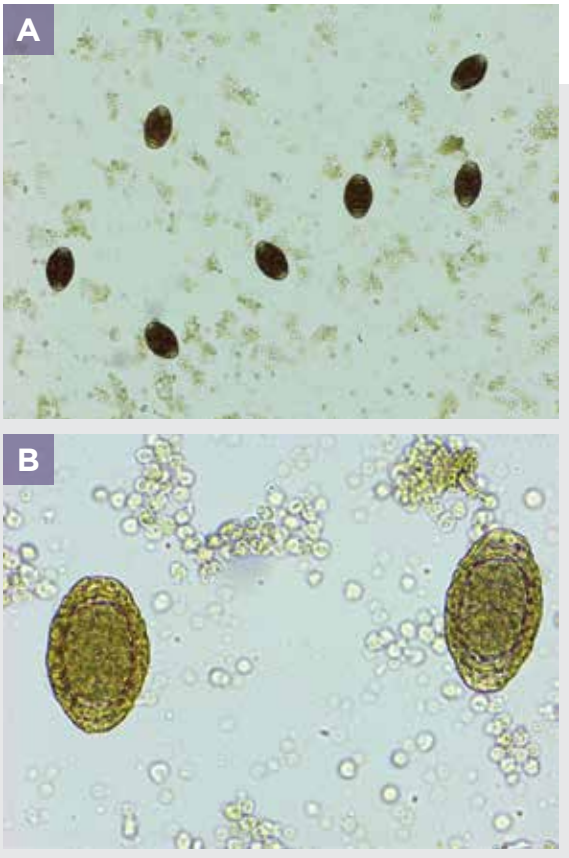

FIGURE 2. *Dioctophyme renale* ova in urine sediment, shown at **(A)** 10× magnification and **(B)** 40× magnification.

After Maverick was placed in dorsal recumbency and sterilely prepped, a ventral midline incision was created to access the abdominal cavity. Maverick responded physiologically to the painful stimuli with significant elevations in heart rate, respiratory rate, and blood pressure values. Adequate anesthesia and analgesia were regained with alfaxalone (1 mg/kg IV) and a fentanyl constant-rate infusion (CRI) of 5 µg/kg/hr IV. Abdominal exploration uncovered a markedly enlarged and inflamed right kidney surrounded by a brown pigmented, mildly inflamed omentum and mesentery. The right kidney was removed and dissected to reveal a complete lack of functional kidney tissue as well as 2 highly motile adult kidney worms (**FIGURES 3 TO 5**). No evidence of ectopic worms was discovered, and the abdomen was lavaged and surgically closed. Maverick received prophylactic antibiotics (cephazolin 27 mg/kg IV) intraoperatively and a local anesthetic (bupivacaine liposome 3.5 mg/kg SC) at the surgical site during closing. Anesthetic recovery was smooth and uneventful.

OUTCOME

Immediately following the surgery, Maverick remained under close observation in the intensive care unit for signs of pain or hemorrhage. Surgical site discomfort (3/4 on the CSU CAPS) was initially managed with methadone (0.2 mg/kg IV q6h), a fentanyl CRI (4 µg/kg/hr IV), and a ketamine CRI (3 g/kg/min IV). An improvement in pain scores (0/4 to 1/4 on the CSU CAPS) and appetite 2 days postoperation facilitated a switch to oral pain medications (acetaminophen 10 mg/kg q8h and codeine 2 mg/kg PO q8h). Blood pressure levels were carefully monitored via q4h blood pressure measurements and adequately maintained with continual IV fluid administration (lactated Ringer's solution 100 to 120 mL/hr). Daily serum biochemical tests evaluating renal values indicated adequate compensation by the left kidney, and the urine culture and sensitivity results reported no bacterial growth. Three days postoperation, Maverick was discharged with oral pain medication (acetaminophen 10 mg/kg q8h and codeine 2 mg/kg PO q8h) and a sedative (trazodone 150 mg PO q8h to q12h) to be used as needed during the 2-week recovery period prior to recheck of the surgical incision at the owner's local general practice veterinary clinic.

While Maverick's current prognosis is good due to the left kidney's high level of function, his future renal health depends on careful, lifelong management and

FIGURE 3. Dissected right kidney exhibiting severe loss of peripheral renal parenchyma.

FIGURE 4. Adult kidney worms (male, top; female, bottom) surgically removed from the right kidney.

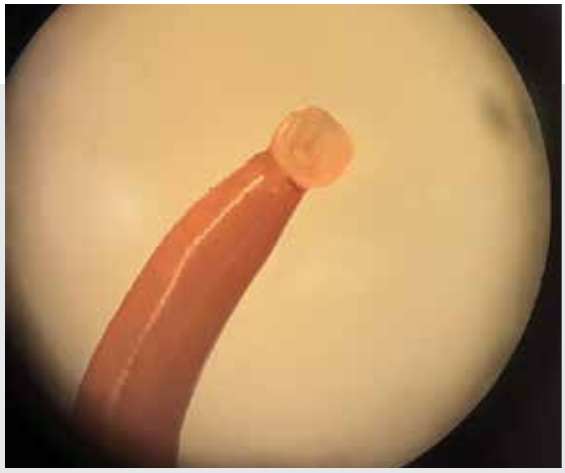

FIGURE 5. Copulatory bursa of an adult male kidney worm (4× magnification).

monitoring of the remaining healthy nephrons. Precautionary measures include:

- Preventing further ingestion of raw frogs or fish to reduce reinfection risk
- Avoiding exposure to renal toxins or pathogens (e.g., raisins, leptospirosis)
- Minimizing the use of drugs with renal adverse effects or metabolism (e.g., NSAIDs)
- Encouraging adequate hydration through freely available filtered water
- Switching to a low-protein diet that decreases the kidney's workload in metabolizing protein by-products

DISCUSSION

D renale, commonly called the giant kidney worm, is the largest nematode that infects terrestrial mammals, with female adult worms reaching up to 100 cm in length.[2,3] *D renale* has a global distribution and has been found in 49 separate mammal species, including humans, dogs, and cats, while its ova have been discovered in fossilized dog and human feces dating as far back as 4500 BC.[4]

The *D renale* life cycle starts when a female adult worm excretes ova into the urinary tract to be expelled into an aquatic environment, where they are subsequently ingested by freshwater oligochaete annelids ("mud worms") and develop into infective-stage larvae.[2] Occasionally, frogs, fish, or turtles will ingest an infected annelid, and the larvae will migrate to the muscle tissue and form dormant cysts.[4,5] Mammals contract the parasite when they drink water contaminated with infected annelids or consume vertebrate tissue containing encysted larvae.[2] The infective larvae then typically take 3.5 to 6 months to travel through the duodenum and peritoneal cavity to a kidney, commonly the right one due to its proximity to the gastrointestinal tract, and develop into sexually mature adults.[2,5,6]

Clinical signs are related to the gradual destruction of the right kidney and can include hematuria; abdominal pain; hypertrophy of the left kidney; dysuria; fever; anorexia; cachexia; death; and, in humans, renal carcinoma.[3,5,7-10] Ectopic activity has been noted in the testicles, uterus, abdominal cavity, thoracic cavity, subcutaneous tissue, and spinal cord and may result in additional clinical signs.[3,11-13]

Into Practice

- ☑ Complete a microscopic sediment evaluation with every urinalysis.
- ☑ Advocate for additional diagnostic imaging in patients with hematuria or abdominal discomfort.
- ☑ Educate clients on the risk of parasitic diseases associated with the consumption of unfiltered water or raw meat.

Urine sediment evaluation can detect *D renale* ova; however, false negatives may occur if only immature, male, or ectopic worms are present.[3-5,14] Abdominal ultrasonography, computed tomography, or magnetic resonance imaging are considered the gold diagnostic standard for both confirming a *D renale* infection and pinpointing the worms' locations.[2,14-16] Recently developed serologic antibody assays and *D renale* antigen ELISA tests are in the early stages of testing and may prove to be a reliable early diagnostic indicator of infection.[2,3,10]

There is currently no oral dewormer effective against *D renale,* and the most common treatment is surgical removal of the adult worms along with the affected kidney.[5,7] However, recent experimentation with laparoscopic and nephroscopic techniques has proven highly successful and may provide a nephron-sparing alternative to nephrectomy.[17,18] Unconventional methods under study include chemotherapy drugs, nematophagous fungi, and extract from the Brazilian medicinal "wolf fruit" plant.[3] Control measures include filtering drinking water and thoroughly cooking frog or fish meat before consumption.[3]

Veterinary nurses from multiple departments were heavily involved in Maverick's diagnosis and treatment. Their contributions included:

- Obtaining a thorough history and accurate diagnostic test results
- Developing and implementing patient-tailored anesthetic protocols
- Setting up and scrubbing in on a complex surgery
- Providing empathetic critical nursing care
- Communicating effectively with other team members and the client

The integration of advanced skills and knowledge throughout the case highlights the vital role of

veterinary nurses in successful patient outcomes and underscores their value as essential members of the veterinary team. TVN

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Isabel is a licensed veterinary technician with experience in general practice, university, and private specialty referral hospital settings. Her passion for internal medicine began at Tufts University and later led to the pursuit of a VTS certification while working at a private practice in New Jersey. Isabel is currently a faculty member of the Michigan State University veterinary nursing program where she enjoys teaching, and learning from, the next generation of veterinary professionals.

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