Canine Leptospirosis

Kenneth R. Harkin, DVM, Diplomate ACVIM (Small Animal Internal Medicine), Kansas State University

Profile

**DEFINITION**
Worldwide zoonotic disease caused by spirochete bacteria of the genus *Leptospira*

**SIGNALMENT**
Dogs of any age, sex, breed, or activity are susceptible to infection, but infection may be more prevalent in the following groups:
- Dogs 4 to 10 years of age
- Intact males
- Herding dogs, hounds, working dogs, and mixed-breeds
- German shepherds

**CAUSES**
Several serovars have been identified in dogs with leptospirosis, which are listed along with their reservoir hosts:
- *L. grippotyphosa*: raccoons, skunks, opossums; this is the most prevalent serovar in the United States
- *L. pomona*: cows, pigs, skunks, and opossums
- *L. icterohaemorrhagiae*: rats and possibly raccoons
- *L. canicola*: dogs
- *L. bratislava*: rats, pigs, and horses

**RISK FACTORS**
Transmission occurs through contamination of water, food, soil, and bedding with infected urine; ingestion of infected tissue; and bites of infected animals. Risk factors that may increase transmission include:
- Living within a kilometer of a rural area
- Recent urbanization
- Frequent flooding and higher-than-average rainfall
- Season; peak prevalence in the late summer and fall

**PATHOPHYSIOLOGY**
- Organism enters through mucous membranes, abraded skin, ingestion, inoculation.
- Rapid spread to various organ systems, including liver, kidneys, central nervous system.
- Replication in target organs before significant leptospiremia.
- Leptospiremia results in vasculitis and endothelial damage with consequential hemorrhage, hypovolemia, hemolysis.
- Acute renal failure develops from acute interstitial nephritis and parenchymal swelling, which may impair renal blood flow. Renal ischemia results from decreased renal blood flow, vasculitis, dehydration, hemorrhage.

**SIGNS**
- Lethargy, anorexia, vomiting, fever, abdominal/lumbar pain, myalgia/arthralgia, ocular discharge, polyuria/polydipsia, dyspnea, cough, diarrhea.
- Additional findings include renomegaly, icterus (Figure 1), petechiae, dehydration.
- Renal disease is associated with lethargy, anorexia, vomiting. PU/PD may be present but is less common. Tongue tip necrosis (Figure 2) associated with uremia may develop in cases of severe disease.
- Acute hepatic disease may occur, with or without acute renal failure, resulting in jaundice. Chronic hepatitis can result in clinical signs suggestive of long-standing liver disease (icterus, ascites, hepatic encephalopathy).

(Figure 1) Severe icterus in a dog with acute leptospirosis

(Figure 2) Tongue tip necrosis from uremia in a dog with leptospirosis

continues
**POSTMORTEM FINDINGS**

- Gross necropsy findings may be minimal or can include diffuse icterus, multiple petechiae, gastrointestinal hemorrhage, intussusception, pulmonary hemorrhage, acute necrotizing pancreatitis, uremic pneumonitis.
- Histologic examination of renal tissue reveals lymphoplasmacytic and neutrophilic tubulointerstitial nephritis.
- Other histologic findings are suggestive of vasculitis, disseminated intravascular coagulation (microvascular thrombi, parenchymal infarcts, and hemorrhages in various organs), uremia (uremic gastritis, uremic pneumonitis).

**DIFFERENTIAL DIAGNOSIS**

- Differential diagnoses for dogs with acute renal failure can include bacterial pyelonephritis, Lyme nephritis, toxicity (ethylene glycol, raisins, NSAIDs).
- Differential diagnoses for dogs with renal and hepatic involvement include acute necrotizing pancreatitis, sepsis.
- Puppies may be misdiagnosed as having parvovirus or canine distemper.
- Myalgia/arthralgia can be misdiagnosed as degenerative joint disease, immune-mediated polyarthritis, Lyme disease.
- PU/PD in the absence of azotemia is frequently misdiagnosed as central diabetes insipidus or psychogenic polydipsia.
- Vomiting and diarrhea can be misdiagnosed as parasitic enteritis, nonspecific acute gastroenteritis, pancreatitis.

**LABORATORY FINDINGS/IMAGING**

**Clinician alert:** Dogs that present with myalgia/arthralgia, lethargy, or fever of unspecified origin as the initial presenting sign may have normal laboratory results but develop severe renal failure with or without cholestasis 24 to 48 hours later.

- Mild-to-moderate leukocytosis occurs in approximately 50% of cases and a left shift is uncommon (total white blood cell count ranging from 17,000 to 45,000 cells/ml).
- Mild nonregenerative anemia may be found in up to 30% of cases and can result in misdiagnosis of chronic renal failure.
- Thrombocytopenia is seen in up to 50% of cases and typically is mild to moderate (platelet counts > 75,000 platelets/µl), although some dogs may have severe thrombocytopenia (< 20,000 platelets/µl).
- Azotemia is the most common finding and can range from mild (BUN 40 to 60 mg/dl; creatinine 3 to 4 mg/dl) to severe (BUN 175 to 250 mg/dl; creatinine 10 to 15 mg/dl).
- Serum alkaline phosphatase is the most frequently elevated liver enzyme, often more than 4 times the upper limit of normal. Serum alanine transaminase is typically less than 2 times the upper limit of normal when elevated.
- Hyperbilirubinemia is seen in typically fewer than 30% of cases; however, levels can exceed 15 mg/dl in some cases.
- Urinalysis shows isosthenuria, but hematuria, pyuria, significant proteinuria, and casts are found in fewer than 25% of cases.
- Abdominal radiographs may document hepatomegaly, splenomegaly, or renomegaly (Figure 3) (all seen in < 50% of cases).
- Thoracic radiographs are not routinely indicated but may show an interstitial or bronchiointerstitial pattern or evidence of pulmonary hemorrhage.
- Abdominal ultrasonography may document renomegaly, increased renal cortical density, or dilatation of the renal pelvis; however, ultrasonography is normal in 50% to 75% of cases.

BUN = blood urea nitrogen; CVP = central venous pressure; ELISA = enzyme-linked immunosorbent assay; NSAIDs = nonsteroidal antiinflammatory drugs; PU/PD = polyuria/polydipsia.
Treatment

INPATIENT OR OUTPATIENT
• Outpatient therapy is reserved for patients with atypical leptospirosis (nonazotemic PU/PD, fever with normal laboratory work) or dogs that have mild hepatic or renal involvement and are still eating and drinking. In these cases, doxycycline therapy is initiated at 5 mg/kg PO Q 12 H for 3 weeks.
• Hospitalization is indicated for any patient with renal failure that is vomiting, dehydrated, and not eating or drinking adequately.

ACTIVITY
No restrictions after recovery from acute disease.

CLIENT EDUCATION
• Leptospirosis is a zoonotic disease and may manifest in humans as a flulike syndrome, ocular pain, headaches, fever, or a more severe syndrome of renal failure.
• Wash hands thoroughly after contact with the dog; gloves should be worn to clean up urine.
• Children, pregnant women, or anyone developing an acute illness who has a pet with leptospirosis should see their doctor. Measurement of acute and convalescent titers is recommended for pregnant women to determine the need for therapy.

Medications

DRUGS/FLUIDS
IV fluid therapy with crystalloids intended for replacement therapy (lactated Ringer’s solution, 0.9% sodium chloride) is appropriate for initial fluid therapy. Potassium is added as needed. Hyperkalemia may develop in the oliguric or anuric phase of acute renal failure, and hypokalemia may develop during the polyuric recovery phase. Initial fluid therapy rate (ml/hr) is calculated as follows:

\[
\text{Initial fluid therapy rate (ml/hr)} = \left( \frac{\% \text{ dehydrated} \times \text{body weight (kg) \times 10}}{\text{number of hours for rehydration (usually 8 to 12)}} \right) + (\text{hourly maintenance fluid rate}) + (\text{anticipated hourly rate of other ongoing losses}).
\]

Although the standard for monitoring fluid therapy in a patient with renal failure includes placement of a closed urinary collection system for measurement of urine production and measurement of CVP (which involves placement of a jugular catheter), in clinic situations that make these steps impractical, frequent weighing of the dog (every 6 hours) can provide valuable information. After rehydration, the weight of a dog assumed to be 10% dehydrated at admission should not exceed kg/0.9 the weight at admission. A 1% to 5% gain over the predicted weight after rehydration is acceptable, but additional weight gain could signal fluid overload from oliguria or anuria. Continued weight loss after admission or during recovery indicates inadequate IV fluid rate.

Ampicillin therapy (25 to 40 mg/kg IV Q 6 to 8 H) is indicated as first-line therapy for dogs unable to take oral medications. Ampicillin therapy should be initiated in any dog with acute renal failure in which leptospirosis is suspected before confirmation of the diagnosis (obtain urine culture first).

Doxycycline therapy (5 mg/kg PO Q 12 H for 3 weeks) is initiated as soon as the patient can tolerate oral medications. IV doxycycline is expensive and not routinely used.

CONTRAINDICATIONS/INTERACTIONS/PRECAUTIONS
There are no contraindications or interactions of significant concern. Precautions include fluid overload in an oliguric or anuric patient.

ALTERNATIVE THERAPY
Other antibiotics are effective (ciprofloxacin, enrofloxacin, ceftriaxone) but are substantially more expensive and no more effective than ampicillin or doxycycline. First-generation cephalosporins are not effective.

NUTRITIONAL ASPECTS
Low-protein diets are not indicated in patients with acute renal failure. Hospitalized patients that remain anorexic for prolonged periods may need nutritional support, either enteral or parenteral.

Follow-up

PATIENT MONITORING
During hospitalization, laboratory values can be monitored Q 24 to 48 H or less frequently, depending on the patient’s status. Changes in electrolytes should be monitored during fluid therapy.
PREVENTION
Annual vaccination with an approved vaccine is indicated to prevent disease. A vaccine that includes *L. grippotyphosa* and *L. pomona* is recommended in areas where these serovars predominate. Vaccination is strongly recommended for dogs in high-risk categories.

COMPLICATIONS
Acute leptospirosis typically has a reasonably good prognosis for recovery (70% to 85%); however, the following complications can occur that may affect morbidity and mortality:
- Disseminated intravascular coagulation
- Intussusception
- Severe necrosis of the tongue
- Chronic renal failure

COURSE
Resolution of azotemia usually takes 2 to 5 days.

AT-HOME TREATMENT & MONITORING
- Minimal care, other than continued administration of oral doxycycline, is typically required at home after hospitalization.
- Measuring convalescent titers is important, especially if acute titers were negative or low.
- Weekly monitoring of BUN/creatinine should initially be done in patients that remained azotemic at discharge.

RELATIVE COST
Outpatient costs for cases only requiring doxycycline is very low ($).

Inpatient costs for dogs with acute renal failure can be very high ($$$-$$$$$), depending on response time.

**Cost Key**

<table>
<thead>
<tr>
<th>Cost Symbol</th>
<th>Cost Range</th>
</tr>
</thead>
<tbody>
<tr>
<td>$</td>
<td>&lt; $100</td>
</tr>
<tr>
<td>$$</td>
<td>$100-250</td>
</tr>
<tr>
<td>$$$</td>
<td>$250-500</td>
</tr>
<tr>
<td>$$$$</td>
<td>$500-1000</td>
</tr>
<tr>
<td>$$$$$</td>
<td>&gt; $1000</td>
</tr>
</tbody>
</table>

PROGNOSIS
Prognosis for complete recovery is usually good.

In General

**In General**

Public Contact with Animals: Standardized Zoonotic Recommendations

Guidelines to reduce risks for transmission of disease to humans from animals in public settings such as fairs, farm tours, petting zoos, circuses, and pet shops have been released in a report from the National Association of State Public Health Veterinarians. The report—which is endorsed by the Centers for Disease Control and Prevention, the Council of State and Territorial Epidemiologists, and the AVMA—indicates that the single most important preventive step is hand washing. Other key strategies include separating animal areas from areas where food is sold; proper care/management of animals; and educating venue operators, staff, and visitors about the risks.—Press release, 4/1/05

Thyroid Treatment Centers

Radiocat Centers for the Treatment of Feline Hyperthyroidism (800-323-9729; www.radiocat.com) offer single-injection treatment to destroy thyroid tumors and hospitalization during reduction of radiation to safe and legal levels before returning home. Centers are located in Arizona, California, Connecticut, Delaware, Georgia, Illinois, Indiana, Maryland, Massachusetts, New York, Pennsylvania, South Carolina, and Virginia.