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### Heartworms, Recognizing Caval Syndrome - The What?

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## Heartworms—Caval Syndrome

- I. Background
  - A. Multiple mosquitos
  - B. Moderate to large number of worms
    - 1. Pulmonary arteries
      - a. Marked decrease in blood flow allows them to fall into right ventricle
      - b. Move back into pulmonary arteries unless
        - 1) Entwine in tricuspid valve
        - 2) Large mass
    - 2. Right heart—wrapped around tricuspid valve
      - a. Acute, severe tricuspid regurgitation causes the right heart failure
        - 1) Jugular vein distension
        - 2) Hepatomegaly, maybe ascites
      - b. No occlusion of tricuspid valve
      - c. Volume under loaded left ventricle
      - d. If large enough mass, may be pushed into the vena cava
    - 3. Combination of large worm burden and moderate to severe pulmonary hypertension results in this problem
  - C. Intravascular red cell lysis
    - 1. Cause uncertain
      - a. Related to the shear stresses caused by flowing around the heartworms at a high velocity
      - b. Red cells are more fragile in these dogs
      - c. Hemoglobinemia
      - d. Hemoglobinuria
- II. Diagnosis
  - A. Clinical signs
    - 1. Weak, depressed, lethargic
    - 2. Pale mucus membranes, thread pulses, shocky
    - 3. Tachypnea, dyspnea in some
    - 4. Murmur of tricuspid regurgitation
    - 5. Jugular veins distended
    - 6. Ascites may be present
  - B. Laboratory findings
    - 1. Microfilaremia
    - 2. Moderate regenerative anemia with hemoglobinemia
    - 3. Increases in serum AST, ALT, ALP, bilirubin, BUN
    - 4. Hemoglobinuria and bilirubinuria
    - 5. Changes due to hemolysis, acute hepatic congestion, and hypoperfusion
    - 6. DIC may occur

- C. Thoracic radiographs—typical of severe heartworm disease
  - D. Echocardiogram
    - 1. Mass of heartworms in right atrium, right ventricle, and entwined in tricuspid valve
    - 2. Right ventricle is dilated
    - 3. Left ventricle is small
- III. Treatment
- A. Without treatment animals die in 12-72 hours due to necrosis of liver and renal failure (hypoperfusion)
    - 1. Even with treatment, mortality rate is 30-40%
    - 2. Complications are common and include DIC and organ failure
  - B. Supportive care
    - 1. Fluids
      - a. For hypoperfusion—increase cardiac output
      - b. To treat DIC
      - c. To prevent hemoglobin nephropathy
      - d. To reverse lactic acidosis due to decreased tissue perfusion
      - e. Carefully before heartworms removed, more aggressive afterwards
    - 2. Other supportive care can include steroids, heparin, and antibiotics
  - C. Removal of heartworms imperative!
    - 1. No sedation if moribund
    - 2. Sedation if tractable
    - 3. Anesthesia with intensive monitoring
      - a. No acepromazine—lasts too long and can get more hypotensive with it
      - b. Constant blood pressure monitoring
      - c. Pulse oximetry
      - d. All anesthesia causes pulmonary vasoconstriction which can be a problem with oxygenation in these patients.
      - e. Recommends short acting anesthetics and premeds
      - f. Remember that as worms are removed, some may break apart and cause pulmonary embolism or DIC or both.
      - g. Be ready for any crisis!
    - 4. Clip and prep right lateral neck
    - 5. Cut down to jugular and isolate it with blunt dissection
    - 6. Place umbilical tape around both ends of it
    - 7. Incise jugular with incision running parallel to blood flow.
    - 8. Instruments to remove heartworms:
      - a. Long alligator forceps (20-40 cm long)—small diameter
        - 1) Easy to grasp worms
        - 2) Easy to perforate vessels
        - 3) Easy to tear tricuspid valve
        - 4) Easy to macerate heartworms
      - b. Jackson forceps made for heartworm removal—cumbersome in small patients

- c. Endoscopic baskets
- d. Horsehair type brush (Tayma String brush)
- e. Flexible alligator forceps (Ishihara alligator forceps)
- f. Advance whatever instrument used slowly. Ideally fluoroscopy can be used or echocardiography. Careful as can go down the wrong vessel at the thoracic inlet
- g. Keep repeating procedure until no worms are brought out in 5-6 successive attempts (or only a few worms remain on echo).

D. Complications

- 1. Macerating worms causes massive antigen release resulting in :
  - a. Pulmonary vasoconstriction
  - b. DIC
  - c. If this occurs, give anti-inflammatory doses of corticosteroids and heparin (100-500 U/kg q. 8 hrs.).
- 2. Monitoring
  - a. Urine color, BUN, and hematocrit
  - b. May need oxygen therapy in some

E. Once stable

- 1. Can go home
- 2. Send home on doxycycline or minocycline
- 3. Treat remaining adults with Immiticide starting in 2-4 weeks after dog goes home as takes time for right heart to return to normal.