Feline Aortic Thromboembolism

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**Profile**

**DEFINITION**
Feline aortic thromboembolism (FATE) is a clinical syndrome associated with systemic embolization of cardiac thrombi (it is strongly suspected, but not proven, that peripheral thrombosis is secondary to embolization, rather than a localized thrombotic process). Any part of the systemic vasculature can be embolized. Most TE occlude the aortoiliac bifurcation (aortic saddle; Figure 1). Ischemic necrosis of the embolized organ or tissue results. Most FATE occurs secondary to HCM, UCM, and occasionally DCM (rare these days). Cases of FATE can occur without identifiable underlying disease, in conjunction with noncardiac hypercoagulable states (eg, proteinuric nephropathy, neoplasia), or may be secondary to hyperthyroidism.

**GENETIC IMPLICATIONS**
- HCM is considered to have a genetic basis in humans and many cats.
- Genetic mutation has only been identified in Maine coons (www.vetmed.wsu.edu/deptsVCGL); testing is available for this breed.
- No specific genetic predisposition has been suspected for FATE.

**INCIDENCE/PREVALENCE**
No published articles have accurately determined the incidence or prevalence of FATE.

**RISK FACTORS**
- Specific risk factors in FATE have not been critically examined.
- Suspected risk factors include severe HCM, DCM or UCM:
  - With left atrial thrombus—a reasonable hypothesis, because the patient is displaying evidence of thrombogenic potential and a nidus for TE
  - With spontaneous left atrial echogenic contrast (ie, “smoke”)—evidence of blood stasis, providing an environment for thrombosis
- Less specific risk factors include severe HCM, DCM, or UCM with severe left atrial enlargement (One recent study suggests left atrial size may not be an independent risk factor.).
- In noncardiac FATE, proteinuria and loss of ATIII are risk factors.

**CAUSES**
- Severe HCM, UCM, or DCM predisposes to FATE.
- Hyperthyroidism
- Disorders resulting in hypercoagulability (eg, proteinuric nephropathy, neoplasia)

**SIGNALMENT**
- Breeds at risk for HCM are at risk for FATE: Maine coons, Persians, Burmese, Siamese, American shorthairs, ragdolls, Norwegian forest cats, Scottish folds, Turkish vans, British shorthairs, Abyssinians, Birmans.
- Adult
- No gender predisposition

**GEOGRAPHIC DISTRIBUTION**
Worldwide

**CAUSES**
- Severe HCM, UCM, or DCM predisposes to FATE.
- Hyperthyroidism

While some articles have suggested that the incidence is as high as 35% to 50% of HCM cases, anecdotal evidence and my experience suggest that fewer than 10% of cats with HCM develop FATE.

A postmortem dissection of a saddle thrombus at the bifurcation of the iliac arteries

ATIII = antithrombin III; DCM = dilated cardiomyopathy; HCM = feline hypertrophic cardiomyopathy; TE = thromboemboli; UCM = unclassified cardiomyopathy

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• Severe malaise can occur with renal or intestinal ischemia.

**PHYSICAL EXAMINATION**
• Specific findings depend on the affected organ or tissue and severity of vascular compromise.
• Presentation is usually acute.
• Signs of CHF may be present.
• Tachypnea is common (pain-, stress-, or CHF-related).
• Hypothermia (due to lack of rectal blood flow)
• Pain will be present if TE is acute (ie, < 24 hrs).
• Embolization of limbs results in loss of motor and sensory function (paresis or paralysis), depending on degree of vascular compromise.
• Muscles distal to TE become hard and swollen.
• Affected distal extremities may be cool.
• Footpads may be cyanotic.
• Claws in affected limbs may fail to bleed if clipped. This test can be done if deep pain is absent—otherwise, it is a painful diagnostic procedure.
• Pulses in affected limbs may be undetectable with Doppler flow probes or digital palpation.
• Heart murmurs, arrhythmias, gallop sounds may be ausculted, confirming presence of heart disease; most but not all cats have detectable signs of heart disease.

**PAIN INDEX**
• Often severe with acute embolization and ischemic myopathy
• Subsides with time because of associated ischemic sensory neuropathy
• May increase with acute reperfusion

**Diagnosis**

**DEFINITIVE DIAGNOSIS**
• Largely based on physical examination findings (see above)
• Imaging studies can help in some cases.

**DIFFERENTIAL DIAGNOSIS**
• Other causes of acute limb dysfunction should be ruled out.
• Motor vehicle or other trauma resulting in spinal or limb fracture can have similar presentation.

**LABORATORY FINDINGS/IMAGING**
• Stress hyperglycemia
• Elevations in muscle enzymes:
  - Marked elevations in creatine kinase (sometimes > 100,000 mg/dl)
  - Elevations in aspartate aminotransferase and lactate dehydrogenase
• Hyperkalemia may be present if reperfusion has occurred before sampling and can be life-threatening.
• Azotemia may be present if renal arteries are obstructed or if cat is dehydrated.
• Ultrasonography (color-flow Doppler) of affected vasculature may reveal thrombus or lack of blood flow.
• Contrast angiography can demonstrate vascular occlusion; however, this is a high-risk procedure and is not recommended.
• Echocardiography can confirm the presence of substantial cardiac disease and potentially intracardiac thrombi.

**POSTMORTEM FINDINGS**
• Thromboembolism can occasionally be found if necropsy is done immediately (Figure 1).
• Heart disease is often identifiable, with a large left atrium.
• Atrial thrombosis can occasionally be found (the thrombus is commonly lodged in the left auricle).
• Affected ischemic muscles may appear blanched or different from unaffected muscles.

ATIII = antithrombin III; CHF = congestive heart failure; DCM = dilated cardiomyopathy; HCM = feline hypertrophic cardiomyopathy; LMWH = low-molecular-weight heparin; TE = thromboemboli

*Lateral thoracic radiograph of a cat with dyspnea. A heavy pulmonary interstitial pattern and marked cardiomegaly, consistent with CHF, are apparent. Gas in the stomach is suggestive of aerophagia associated with dyspnea.*
TREATMENT

FATE requires hospitalization in virtually all cases, especially those with CHF, paralysis, and pain. Patients can be discharged once clinical signs are controlled and pain has been alleviated.

ACTIVITY

Should be confined during recovery. Physical therapy may be attempted for affected limbs.

CLIENT EDUCATION

Clients should be advised of the severity of the condition, the often prolonged and incomplete recovery, and the high probability of recurrence or death from cardiac causes.

SURGERY

- Surgical TE removal has been attempted in the past with uniformly dismal results and should not be undertaken.
- Amputation or wound management of ischemic and necrotic tissue may be necessary during long-term management.

ACUTE THERAPY

- Pain relief is essential in acute FATE. Narcotic analgesia is advised, by epidural, transdermal, or parenteral methods.
- Reperfusion hyperkalemia can be life-threatening with rapid reperfusion and should be carefully monitored. Glucose/insulin and calcium gluconate administration may be required to control hyperkalemia.
- CHF (Figure 2) should be treated when necessary by diuresis with furosemide. Other cardiac medications have little utility in acute management of CHF in cats. Pleurocentesis may be necessary if pleural effusion is present.
- Oxygen therapy may be necessary if CHF is present.
- Fluid therapy should be administered cautiously; most cats have substantial cardiac disease and cannot tolerate fluid loading.
- Thrombolytic therapy is currently not recommended because of high mortality with reperfusion injury. No studies demonstrate clinical benefit of streptokinase infusions. Two studies demonstrated 50% acute mortality from reperfusion injury with tissue plasminogen activator infusion or streptokinase administration due to rapid thrombolysis. A recent study using rheolytic thrombectomy also showed a 50% acute mortality.
- Vasodilator therapy does not appear to be effective in promoting collateral circulation. Acepromazine fails to promote collateral circulation and can tranquilize the patient excessively. Hydralazine also is of little value. Serotonin antagonists (eg, cyproheptadine) prevent collateral vasoconstriction only if administered before—not after—thromboembolism.
- CHF should be treated as necessary—furosemide (1–4 mg/kg Q 8–24 H) and angiotensin-converting enzyme inhibitors (0.5 mg/kg Q 12–24 H) should be administered.
- Hyperthyroidism should be treated by radioiodine therapy or methimazole.
- Antithrombotics should not be combined other medications—its use is not recommended for this and other reasons.
- Warfarin has many interactions with other medications—its use is not recommended for this and other reasons.
- Clopidogrel (18.75 mg Q 24 H PO) is a platelet-activation inhibitor that blocks the ADP receptor on unactivated platelets, preventing ADP-mediated activation. Few clinical side effects have been documented. A clinical trial examining the efficacy of clopidogrel in preventing recurrence of FATE (FAT CAT) is currently ongoing and recruiting cases (www.vin.com/fatcat/). Aspirin can be given safely with clopidogrel.

CONTRAINDICATIONS

Thrombolytic therapies are generally contraindicated in acute management of FATE.

PRECAUTIONS

- Animals receiving antithrombotics should be monitored for hemorrhage.
- Warfarin has many interactions with other medications—its use is not recommended for this and other reasons.

INTERACTIONS

- Antithrombotics should not be combined (other than with aspirin).
- Warfarin has many interactions with other medications—its use is not recommended for this and other reasons.

Alternative Therapy

Physiotherapy of affected limbs can be attempted—massage and joint manipulation may stimulate collateral circulation once pain has subsided.

NUTRITIONAL ASPECTS

- Nasogastric feeding may be required during acute management if patients are anorexic. Food administered by nasogastric tubes should be included in daily fluid balance calculations.
- If DCM is identified, plasma taurine concentrations should be measured and taurine should be supplemented if necessary; however, taurine-deficient DCM is rare.

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Follow-up

INPATIENT MONITORING
- Respiratory rate and effort should be monitored for CHF resolution or development.
- Serum potassium concentrations should be monitored for evidence of reperfusion hyperkalemia, especially if sudden return of limb function occurs.

OUTPATIENT
- Newer antithrombotics do not require coagulation monitoring.
- Affected limbs should be monitored for return of function and tissue necrosis.

PREVENTION
No therapies have been shown to prevent FATE or HCM. Many cardiologists administer antithrombotics prophylactically to “at-risk” cats, but this practice has no clinical basis.

COMPLICATIONS
- Recurrence of FATE is common. Subsequent episodes are often milder, but can be life-threatening.
- Hemorrhagic complications can occur with heparin or warfarin therapy, but have not been reported with LMWH or clopidogrel at this time.

COURSE
- Recovery of limb function can occur in hours, but can take several weeks.
- In most cats that regain function, substantial return of blood flow and partial return of function is evident within 2 weeks.
- Recovery may never be complete, or may be unilateral.

AT-HOME TREATMENT
- Administration of medications for chronic management
- Physical therapy during convalescence

In General

RELATIVE COST
- $$$–$$$$ for acute management
- $–$$ for monthly antithrombotic medication

Cost Key
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\begin{array}{cc}
S &= < $100 \\
S$ &= $100-250 \\
SS$ &= $250-500 \\
SSS$ &= $500-1000 \\
\end{array}
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PROGNOSIS
- Approximately 50% of cats survive to discharge (with or without CHF).
- Cats with hypothermia at presentation have worse prognosis.
- Long-term survival is poor—50% of cats discharged die or have rethrombosis within 4 months; recurrence can occur within 2.5 months in cats with CHF at presentation. A total of 90% of cats that survived to discharge in one study had rethrombosis or died within 6 months.
- No critical survival data are available for cats treated with LMWH or clopidogrel. In one study, 50% of cats treated with LMWH survived for 6 months, but no control group was included. Another study by the same authors found the same survival rate in cats not treated with LMWH.

FUTURE CONSIDERATIONS
- Studies of clinical outcomes with most chronic therapies are lacking for FATE. FAT CAT is the first randomized trial to examine efficacy of antithrombotic agents in preventing recurrence of FATE. Participation is strongly encouraged. Practitioners retain management of their patients.
- Rheolytic thrombectomy, which requires arterial access, has been recently performed successfully in 5 of 6 cats, but only 3 survived to discharge.
- Estimates of left atrial appendage (left auricle) flow by Doppler echocardiography may help identify cats at risk for left atrial thrombosis and stratify patients for appropriate therapy.

See Aids & Resources, back page, for references, contacts, and appendices.