Diseases of the Myocardium

Winter 2009
Lisa Miller
Idiopathic or Inherited Primary Myocardial Disease

Primary Myocardial Diseases
Primary Cardiomyopathy

• Definition
  - Acute, subacute, or chronic generalized disease of heart muscle. An intrinsic disease of the myocardial fiber.

• Arrhythmogenic cardiomyopathy (ACM)
  - Clinical term arrhythmia with normal ejection fraction.
  - May precede pathological changes.
Idiopathic Primary Myocardial Disease (IPMD)

Primary Cardiomyopathy

- Pathological Terms
  - Primary cardiomyopathy is diagnosed with gross or histopathological changes in the myocardium without apparent cause.

- Cause/Etiology
  - Inherited
  - Obscure or not known.
    - Viruses, Immune mediated disease, Toxins
      - All have been implicated
Primary Cardiomyopathy
Generalities

• Classification based on cardiac wall thickness
  - Pathologically Speaking
• Hypertrophic (HCM)
• Congestive or Dilative (DCM)
  - Taurine deficiency in cats, foxes and dogs
    • Taurine Deficiency Myocardial Failure (TDMF)
  - L-carnitine deficiency
    • Dilative cardiomyopathy in dogs (Boxer)
    • Used in treatment protocols
• Restrictive Cardiomyopathy
• Other
  - Arrhythmogenic Right Ventricular Cardiomyopathy
  - Excessive Moderator Bands
Primary Cardiomyopathy
Species Affected

- **Dogs**
  - Great Dane - DCM
  - Newfoundland - DCM
  - English Cocker
  - Irish Wolfhound - DCM
  - German shepherd - HCM
  - St Bernard - DCM
  - Boxer (ACM)
  - English bull dogs (ACM)
  - Doberman Pinschers (2 forms)
  - American Cocker Spaniel
  - Bull Mastiff
  - Dalmatians
  - Boston terriers (HCM)
  - Springer Spaniels - Atrial standstill
  - Portuguese water Dogs
  - Golden Retriever
- **Males and Middle Aged**
- **0.5% admission to VTH**

- **Cats**
  - Maine Coon Cat
  - Rag Doll
  - British and American Shorthair
  - Rex, Persians, DSH

- **Cattle**
  - Holstein, Simmental, Herefords, etc

- **Birds**
  - Turkeys
    - Round Heart Disease
  - Chickens
  - Ducklings

- **Syrian Hamsters** - Inherited MD

- **Human beings**
  - Autosomal dominant HCM
Hypertrophic Cardiomyopathy

- **Gross**
  - Resembles concentric hypertrophy
  - Increase in Heart weight

- **Species**
  - Cat
    - 10-20% present with posterior paresis
    - Most common form of heart disease in the cat
  - Breeds
    - Maine Coon (AD)
    - Rag Doll
    - British & American Short Hair (AD)
    - Rex
  - Dog, rat, pig

Heart from cat with HCOM
Thrombus in distal aorta
Hypertrophic Cardiomyopathy
HCOM

Histo
- Large, hypertrophied fibers - irregular size
- Myofibre disarray
- Variable numbers of inflammatory cells and fibrosis

Physiology ➔ Diastolic Dysfunction
- ↓ ventricular filling
- ↓ compliance
- Sometimes only see hypertrophy of septum
Hypertrophic Cardiomyopathy

Outflow obstruction
- Acquired Subaortic Stenosis
  Caused by HCOM
  Endomyocardial fibrosis
  Mitral valve irritant?

Feline HCOM Myocardial fibrosis
Masson's trichrome stain
Congestive Cardiomyopathy
Dilative, Dilated, Dilatative, DCM

- **Species**
  - Dog
  - Cat, hamster, turkey, pig, cow, fox

- **Gross**
  - Resembles eccentric hypertrophy
    - Dilated chamber, thin walls, valves may be open due to cardiac muscle dilation
  - ↑ ♥ Wt

12-year-old doberman, m/c with congestive cardiomyopathy
Congestive Cardiomyopathy

Physiology:

- Progressive cardiac dilation and contractile dysfunction
- ↓ contractile force
- ↑ End Diastolic Volume

• Histo
  - Thin, wavy, myofibres
  - Variable fibrosis

Normal myocardium

Feline Congestive Cardiomyopathy Myocardium H&E
Congestive Cardiomyopathy

Gross Appearance:
- ventricular chambers increased in size
- thin walls
- attenuated papillary muscles
Restrictive Cardiomyopathy

• Less common and probably not a “true cardiomyopathy”

• ↓ ventricular compliance
  - Due to restriction of ventricular filling

• Cats
  - Endocardial fibroelastosis
    • Burmese
  - Inflammation
    • Fibrosis
    • Endomyocarditis
Other Primary Cardiomyopathies

• Arrhythmogenic Right Ventricular Cardiomyopathy (Fibrofatty Dysplasia)
  – Adipose cells and fibroblasts infiltrate and replace normal right ventricular myocardium
  • Boxers

http://www.bcm.edu/web/pediatrics/images/ARVD_C_Heart_Cap.gif
Other Primary Cardiomyopathies

- Excessive Moderator Bands
  - Reported in Adult Cats
  - May be a Congenital Anomalie
# Cardiomyopathies

<table>
<thead>
<tr>
<th>Hypertrophic</th>
<th>Congestive</th>
<th>Restrictive</th>
<th>Other</th>
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<tbody>
<tr>
<td>↑ ♥ wt/body</td>
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<td>Replaced with fibroblasts and adipose tissue</td>
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<th>Cats</th>
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<td>middle aged males</td>
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<tr>
<td>10-20% posterior paralysis</td>
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<td>Persians, Maine coon</td>
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</tbody>
</table>

| Dog, Rat, Pig, Cattle |

| Dog, Cat, Hamster, Turkey, Pig, Cattle |

| Cat, Human beings, Dogs? subaortic stenosis? |

| Dog, Boxer, Human Beings |
Secondary Myocardial Disease
Secondary Cardiomyopathy

• Definition: Disease of cardiac muscle resulting from metabolic, toxic, infectious, or neoplastic disease

• Not
  - NOT "INTRINSIC DISEASE of myofibres"
  - NOT PRIMARY CARDIOMYOPATHY
  - NOT Inflammatory Disease

See page 585 - Box 10-3
- Pathologic Basis of Veterinary Disease
Catecholamine Toxicity

• “Brain-Heart Syndrome”

• Causes:
  - Chemical agents
  - Brain/spinal cord trauma
  - Functional tumor of adrenal medulla

• Lesions:
  - Multifocal myocardial necrosis (LV,P)

• Species
  - Dogs
  - Many other species
Hyperthyroidism

- **Causes**
  - Cats with functional thyroid masses

- **Lesions**
  - Concentric hypertrophy
  - LV

- **Reversible**
Conduction Disorders

- Unexpected death in Doberman pinscher dogs
  - Focal degeneration of the bundle of His
- Syncope in pug dogs
  - Degeneration of the bundle of His
- Intermittent sinus arrest in deaf dalmation dogs
  - Sinus Node lesions
- Sinoatrial syncope (sick sinus syndrome)
  - Miniature Schnauzers, West Highland White terriers
  - Dachshunds, Springer Spaniels
- Arrhythmias - dogs and horses
- Atrial fibrillation
- Heart block
  - associated with myocardial lesions

Few pathological evaluations or reports on conduction disorders...
Nutritional Deficiencies

Vitamin E/Selenium deficiency

Synonyms
“White Muscle Disease”
“Mulberry Heart Disease”

Incidence
Areas deficient in VitE/Se
Many species

Etiology
Low Vit E/Se, low Sulphur
High [polyunsaturated fats]
Exposure to pro-oxidant compounds
Intake of selenium antagonists
silver salts, Hg, Cu, Co, Cd, Zn, Sn
Vitamin E/Selenium deficiency

Pathogenesis

Vit E = antioxidant works with glutathione peroxidase to prevent oxidation of membranes

Lesions

Pale areas of necrosis and mineralization lambs and calves, pigs have widespread haemorrhages (microangiopathy)
Taurine Deficiency
Taurine Deficiency Myocardial Failure

Essential Amino Acid for Cats

Modulates Tissue Calcium

Dilated left and right ventricles with thin myocardial - indistinguishable from DCM.
Poisonous plants & Animals

Avocados Leaves
Cardiac Glycosides
- Oleander
- Foxglove
- Lily of the Valley
- Dogbane
- Toad Poisoning “Bufo toxicosis”

• No lesions - sudden death
• Inhibit sodium and potassium ATPase pumps

http://www.ivis.org/advances/Beasley/cpt14b/chapter_frm.asp?LA=1
Cardiotoxins

- Myocardial depressants
- Direct Injury to Myofibre
  - Electrical Defibrillation
  - Hemorrhagic Shock
- Hypersensitivity
Chemotherapeutic Agents producing myocardial disease

- Doxorubicin (Adriamycin)
  - Dose related cardiotoxicity - CHF
  - Sarcoplasmic vacuolization and necrosis

- Monensin
  - Horses, cattle, sheep, pigs, dogs & poultry
  - Myocardial necrosis
Infectious Agents

Myocarditis

- **Viral**
  - Encephalomyocarditis virus of swine
    - Picornavirus - cardioivirus
    - Elephants, primates, swine
    - Rodents are carriers
Infectious Agents

Viral Myocarditis

• **Parvovirus** in the dog
  - Lesions in pups <10 weeks of age

• **West Nile Virus**

• **Pseudorabies**

• **Canine distemper**
  - in very young puppies

• **Bluetongue** in sheep

• **Coxsackie virus**
  - Man and mouse
Viral Agents - Myocarditis

- **Foot and Mouth Disease**
  - Tiger Heart
- Avian Encephalomyelitis
- Newcastle Disease
- Eastern & Western Encephalitis
- Human Viruses
  - Influenza
  - HIV
  - Cytomegalovirus

**NOTE:**
- Viral agents may produce acute necrosis with little inflammatory response.
Bacterial Agents

Myocarditis

• Direct extension of pericarditis
  - (eg. "hardware disease")

• Direct extension of endocarditis
  - (eg. Bacterial infection of mitral valves)

• Septicemias
Bacterial Agents - Myocarditis

• Any septicemia
  - *Borrelia burgdorferi* - Lyme Disease
  - *Histophilus somni*
    • feedlot cattle
  - *Clostridium chauvei*
    • Blackleg
  - *Listeria monocytogenes*
    • especially in sheep
  - *Actinobacillus equuli & Streptococcus equi*
    • horses
  - *A. pyogenes*
    • Cattle and sheep
  - *Staph aureus*
    • Sheep and goats
  - *Corynebacterium kutscheri*
    • Rodents
  - *Psudomonas aeruginosa*
  - Tyzzer's Disease
  - Necrobacillosis

Lamb - Staphylococcal myocarditis, multifocal

Bovine - Heart Histo Blackleg - Clostridial myocarditis
Parasites - Myocarditis

• Neosporum caninum
  - Fatal fetal myocarditis and encephalitis
  - Abortion or weak calves

• Toxoplasma gondii
  - Occurs in any species in contact with cat faeces
  - Public health hazard
  - Fatal fetal myocarditis can occur if infected during pregnancy
Parasites - Myocarditis

- **Trypanosoma cruzi** (Chaga's disease)
  - Reported in dogs in Texas and Louisiana
  - Fatal infection in young dogs (6-8 months)
  - "Assassin" bug inoculates organism while feeding
## Causes of Myocardial Dysfunction - Summary

<table>
<thead>
<tr>
<th>Category</th>
<th>Causes</th>
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<tbody>
<tr>
<td><strong>Idiopathic and Inherited</strong></td>
<td>Cardiomyopathies – Dilative, Hypertrophic, Restrictive, Arrhythmogenic</td>
</tr>
<tr>
<td><strong>Endocrine/Metabolic</strong></td>
<td>Hyperthyroidism, Catecholamine toxicity, Hypokalemia</td>
</tr>
<tr>
<td><strong>Nutritional</strong></td>
<td>Vitamin E/Selenium, Taurine, Copper</td>
</tr>
<tr>
<td><strong>Toxic Agents</strong></td>
<td>Gossypol, Poisonous Plants – oleander, foxglove, others, Ionophotes – monensin, salinomycin, maduramicin, Doxorubicin/daunorubicin, Iron, Thallium, toads and blister beetle, Furazolidone, fluoroacetate, and more…</td>
</tr>
<tr>
<td><strong>Infectious agents</strong></td>
<td>Viral, Bacterial, Parasitic</td>
</tr>
<tr>
<td><strong>Genetic</strong></td>
<td>Cardiomyopathies, Porcine Stress Syndrome, Storage Diseases</td>
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</tbody>
</table>
Miscellaneous Myocardial Disease

- Porcine stress syndrome
- Sudden death in cattle
- Canine gastric/dilation – volvulus
- Acute necrotizing pancreatitis
- Sepsis – peritonitis