



## Animal Emergency & Referral Associates

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## Veterinary Cardiology - More than just an echo...

- Veterinary cardiology is the science, clinical practice, and advancement of the diagnosis and treatment of cardiovascular and cardiovascular-related disease in animals.
- The gold standard of care for veterinary cardiac patients is diagnosis and treatment by a Board-certified veterinary cardiologist.

### Scope of Care delivered by a Veterinary Cardiologist

#### Diagnosics

Patient evaluation  
History  
Cardiovascular examination  
Physiologic recordings  
Noninvasive blood pressure assessment  
Six and ten-lead electrocardiography  
Ambulatory electrocardiography (Holter monitoring, event monitoring)  
Imaging  
Thoracic radiography  
Transthoracic echocardiography  
Transesophageal echocardiography  
Contrast echocardiography  
Cardiac biomarkers  
Cardiac catheterization  
Ventriculography/Angiography  
Fluoroscopy  
CT/MRI

#### Therapy

Interventional (vascular access, transcatheter surgery)  
Device closure of left-to-right shunting PDA  
Balloon valvuloplasty for valvular pulmonic stenosis  
Endocardial/epicardial pacemaker implantation  
Assessment and treatment of other cardiovascular anomalies  
Intratracheal stent placement for tracheal collapse  
Portosystemic shunt assessment, closure  
Chemoembolization of primary neoplastic lesions

Medical Therapeutics

# DIAGNOSTICS

## Patient Evaluation Parameters

### 1. History

- Signalment
- Syncope vs seizure vs... other?
- Acute vs chronic?
- Progressive vs static?
- Appropriate signs?
  - Dog
  - Cat
- Response to previous treatment?
  - Real
  - Apparent

### 2. Cardiovascular examination

- Perfusion parameters
- Auscultation
- Jugular pulse assessment/abdominojugular test
- Likelihood of congestive heart failure

## Physiologic Recording Parameters

### 1. Noninvasive blood pressure assessment

### 2. Six and ten-lead electrocardiography

- Rhythm assessment
- Conduction abnormalities
- Hypertrophy patterns
- S-T segment changes

### 3. Ambulatory electrocardiography (Holter) monitoring

- Establish causation between clinical signs and cardiac dysrhythmias  
*Bradycardia vs tachycardia vs..... Both?*
- Identification of occult disease
- Rate control assessment

## Imaging Parameters

### 1. Thoracic radiography

- Heart failure or no heart failure?  
*“...that is the question...”*
- Severity of disease
- Progression of disease  
*Are we sitting on a powder keg?*
- Response to therapy
- Rule in, rule out
- Extracardiac structures

## 2. Echocardiography

### The cardiologist's test of choice...right? Yes.....and No

#### Echocardiography: limitations

- Unable to diagnose congestive heart failure by itself
- Very dependent on cardiovascular loading conditions
- By comparison to other imaging modalities, relatively poor image resolution
- Limited assessment of non-cardiac intrathoracic structures

#### Echocardiography: Strengths

- Provides information about cardiac chamber sizes and function
  - Presence of disease does not guarantee causation
- Provides information about valve structure and function
- Provides information about direction, nature, and velocity of blood flow into and out of cardiac chambers
  - Allows for estimation of chamber-to-chamber pressure gradients

#### Echocardiography: Clinical utility

Establishing baseline parameters and serial monitoring of progression of disease

- ...any better than a chest radiograph?
  - Determination/confirmation of source of murmur
- More important in some patients than others

Identification of occult HCM in cats

Severity of stenotic or regurgitant flow

Identification of:

- Cardiac neoplasia....most of the time
- Intracardiac thrombi
- Vegetative lesions...sometimes
- Effusions

Complex congenital heart disease

Identification of myocardial dysfunction

- Systolic function
  - Screening for occult DCM
  - Progression of any type of cardiac disease to overt ventricular failure
- Diastolic function
  - Feline myocardial disease
  - Geriatric patients

## 3. Transesophageal Echocardiography

Screening for pulmonary hypertension (PH)

- Pressure gradient =  $4V^2$       V = velocity
- Peak tricuspid regurgitant velocity
  - Normal < ~ 3.0 meters/sec
  - > 3.0 meters/sec supports elevated systolic RV-RA pressure gradient
- Pulmonary insufficiency velocity
  - Peak: provides estimate of mean pulmonary artery pressure
  - End-diastolic: provides estimate of end-diastolic pulmonary artery pressure
- Clinical utility higher in veterinary patients because cardiac catheterization less practical

Pulmonic insufficiency profile:

Mean pulmonary artery pressure ~ 64 mm Hg

End-diastolic pulmonary artery pressure ~ 32 mm Hg

#### 4. Contrast echocardiography

- Identification of small or bidirectional intracardiac shunts
- Identification of right-to-left shunting PDA
- Identification of less common congenital cardiac malformations  
*Ex: Cor triatriatum*
- Assessment of cardiac volume, mass, perfusion

#### 5. Cardiac biomarkers

##### Cardiac Troponin I (cTnI)

- "ALT for the heart..."
- Marker of myocardial inflammation, damage
- Bedside test (i-stat): normal < 0.06 ng/mL
- Marked elevations: infarction, myocarditis
- Mild elevations: primary cardiac arrhythmias

##### Natriuretic peptides

- Body's natural diuretics, also vasodilators
- B-type natriuretic peptide (BNP)  
Released in response to increases in ventricular and atrial stretch, distension
- Atrial natriuretic peptide (ANP)  
Released in response to atrial stretch

##### BNP in veterinary cardiology

BNP molecules:

- Pro-BNP
- BNP
- NT-proBNP (inactive metabolite)  
Currently most thoroughly evaluated

Primary clinical utility:

- Differentiation of cardiac disease from respiratory disease in evaluation of the dyspneic patient
- Value in cats > dogs

BNP in humans: bedside ER, prognosis, response to treatment

Use of BNP in asymptomatic animals

- Not currently a useful screening test in clinically healthy animals unless heart disease is suspected (murmur, gallop, cardiomegaly)  
May aid in deciding if echocardiogram is of higher value, particularly in owners with financial concerns  
Again, value in cats > dogs
- Not useful as a screening test or for assessing severity in asymptomatic dogs with mitral valve disease

#### 6. Cardiac catheterization

Diagnostic:

- Constrictive pericarditis
- Congenital heart disease  
Generally pre- and post-op balloon valvuloplasty

Supportive care-associated:

- Swan-Ganz balloon pulmonary capillary wedge pressure (PCWP) monitoring
- Central venous pressure monitoring

## 7. Angiography

## 8. Fluoroscopy

## 9. CT/MRI

The future...?

# THERAPY

## 1. Interventional therapies

Device closure of left-to-right shunting patent ductus arteriosus (PDA)  
Balloon valvuloplasty for valvular pulmonic stenosis  
Endocardial/epicardial pacemaker implantation for symptomatic bradycardia  
Assessment and treatment of other cardiovascular anomalies

- Atrial septal defect
- Ventricular septal defect
- Systemic-to-pulmonary vascular malformations
- Cor triatriatum dexter, other obstructive caval lesions

Intratracheal stent placement for tracheal collapse  
Portosystemic shunt assessment, closure  
Chemoembolization of primary neoplastic lesions

## 2. Medical therapy for heart disease in dogs and cats

What distinguishes a cardiologist?

- Knowledge of cardiovascular physiology, anatomy
- Understanding of and exposure to:
  - Cardiovascular research and literature
  - Principles of cardiovascular therapy
  - Awareness & adherence to current guidelines for cardiovascular therapy
  - Case volume, experience, variety

Diagnostics and interventional therapies: the separation between cardiologists and non-cardiologists is more tangible

“Tools and toys”

- Training in acquisition and interpretation of various types of imaging
- Access to newer, more advanced technologies in residency setting

With regards to medical therapy, this separation is less tangible

- Minimal gap in access to cardiovascular medications
- All veterinarians received basic training in cardiovascular pharmacology
- Cardiovascular medications are the medical “tools” of a cardiologist, however....

Do cardiac patients treated by cardiologists feel better and/or live longer than those treated by non-cardiologists?

If yes, then why?

- Greater use of guideline-associated therapies among cardiologists
- Greater awareness of and certainty about advances in cardiovascular care by cardiologists
- Cardiologists less likely to prescribe drugs lacking evidence of effectiveness
- Greater use of advanced diagnostic imaging and interventional therapy in patients treated by cardiologists

## **Role of the family practitioner and cardiologist working together**

Primary (family) practitioners are the real eyes, ears and hands of the cardiologist

You will almost invariably:

- First establish the presence of occult cardiac disease
- Be notified of the patient's initial onset of clinical signs by the owner
- Be the recipient of the first visit in crisis!

### **What is the best way for this relationship to function?**

Involvement of the cardiologist may be most beneficial early in the course of disease and in times of clinical crisis

Early involvement enables complete characterization of the initial disease process

- Severity, prognosis
- Presence of concurrent processes (e.g. pulmonary hypertension)
- Serves as baseline if these concurrent processes are not yet present
- Enables cardiologist, primary care veterinarian, and client to develop most appropriate therapeutic plan

#### **Going forward:**

- » Increased compliance
- » Decreased confusion
- » Increased likelihood of benefit from therapies that improve long-term outcome with chronic use

## **Milder forms of clinical decompensation**

### **Role of the primary practitioner is paramount**

- Ability to identify early signs of decompensation, which may be unique to some patients
- Ability to intervene with medication adjustment when necessary to avert complete decompensation

### **Role of cardiologist: availability**

- Aid in determination of whether clinical signs truly are cardiac in origin
- Consultation, recommendations for diagnostics/medication adjustment
- Complete evaluation often not necessary

## **Severe/complete decompensation**

### **Advanced care likely necessary**

Complete cardiac reevaluation to assess for significant changes in cardiac structure, function, physiology

Access to and experience with more intensive forms of treatment and supportive care

- Less commonly used cardiac drugs
- Multiple drug infusions
- Advanced vital sign monitoring
- Intensive care
- Other specialists

*"We cardiologists are engrossed, day in and day out, in the intricacies of cardiovascular care. By our own choice and after years of specialized study, we become experts on the cardiovascular system... Unlike internists and family practitioners, who must maintain more than a working knowledge of multiple human systems, we focus on cardiology..."*

*"...Each month, hundreds of medical journals disperse thousands of articles, many of them revealing findings that are directly relevant to patient care. As overwhelming as this volume can be, we cardiologists have the obligation (and some would say luxury) of selecting...those articles that focus on cardiology. Most of us also read selections from the more general medical journals...so that we remain aware of the noncardiological issues facing our patients. But we do not have to maintain intimate knowledge of all of these areas. The needs of our patients—generally restricted to...cardiovascular disease or risk for it—receive our undivided attention."*

*-Douglas P. Zipes  
President, American College of Cardiology, 2001*

### **Meet Our Cardiologist - Gordon D. Peddle, VMD, DACVIM (Cardiology)**

Dr. Peddle is originally from Long Island, NY. He received a BS in Animal Science from Cornell University and his Veterinariae Medicinae Doctoris (VMD) degree from the University of Pennsylvania, School of Veterinary Medicine. He completed an internship in small animal medicine and surgery at Oradell Animal Hospital in Paramus, NJ before returning to the University of Pennsylvania to complete a residency in veterinary cardiology.

Though fascinated by virtually all aspects of veterinary and human cardiology, Dr. Peddle has a special interest in pericardial disease, pulmonary hypertension, congenital heart disease, infectious endocarditis, heart failure therapy, and catheter-based interventions. He is currently involved in active research investigating alternative diuretic therapies for heart failure and investigation of cardiac biomarkers as indicators of presence and severity of cardiac disease. Dr. Peddle has been published in a variety of veterinary journals on both cardiac and non-cardiac subjects, including original research, review articles and case reports. Dr. Peddle plans to continue active research within veterinary cardiology via pursuit of clinical trials and evaluation of uncommon diseases.

Dr. Peddle enjoys traveling to far off places like Africa, and is an avid New York sports fan. He also enjoys spending free time with his golden retriever, James, who has subaortic stenosis, and is still doing well at the age of five.