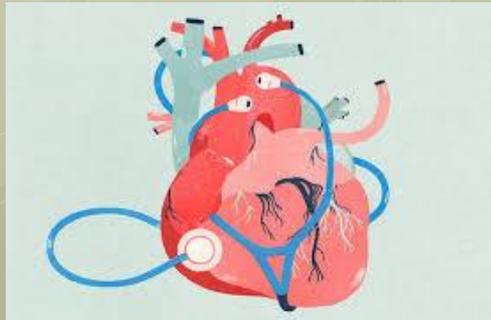


# ANESTHESIA FOR PATIENTS WITH CARDIAC DISEASE



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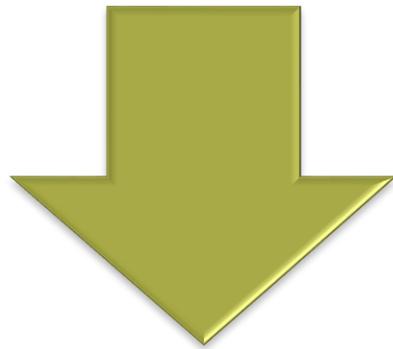
AMERICAN COLLEGE OF  
VETERINARY ANESTHESIA  
AND ANALGESIA



# OUTLINES

- General considerations
- Pathophysiology and anesthetic management of DMVD in dogs and HCM cats

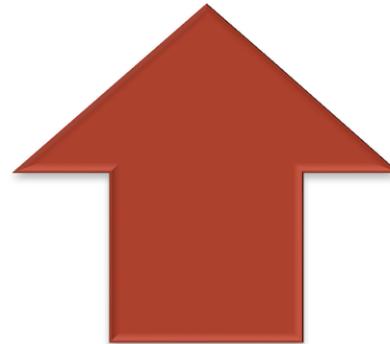
# ANESTHETIC CHALLENGE



**Pathophysiology  
of the disease**



**CV effects of  
anesthetic drugs**



# CARDIAC DISEASES

## Electrical problem:

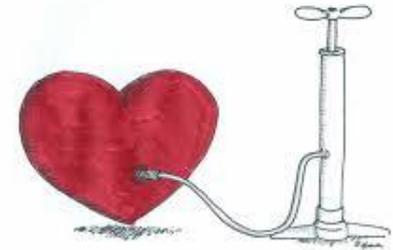
- Sinus bradycardia
- AV conduction disturbances
- Supraventricular tachycardia
- Atrial fibrillation
- Ventricular ectopic activity



# CARDIAC DISEASES

## **Mechanical problem:**

- Mitral or tricuspid insufficiency
- Pulmonic or aortic stenosis
- Hypertrophic cardiomyopathy
- Dilated cardiomyopathy



# ANESTHESIA AND THE HEART



# INCREASED ANESTHETIC RISK?



≠





INCREASED ANESTHETIC RISK?

**Magnitude of the disease**

Understand the pathophysiology

Understand the CV effects of anesthetics

Each disease is different

Understand the interactions between cardiac medications and anesthetics

**POSITIVE  
OUTCOME**

```
graph TD; A[Understand the pathophysiology] --> D((POSITIVE OUTCOME)); B[Understand the CV effects of anesthetics] --> D; C[Each disease is different] --> D; E[Understand the interactions between cardiac medications and anesthetics] --> D;
```

# EACH DISEASE IS DIFFERENT

- Choice of sedatives/anesthetics
- Asymptomatic vs symptomatic patients
- Presence of arrhythmias
- Cardiac medications used



# UNDERSTANDING THE PATHOPHYSIOLOGY

- Are valves affected?
- Are chambers enlarged or thicker?
- Is pulmonary circulation compromised?
- Is there a restriction to forward blood flow?
- Is there an arrhythmia?
- Is contractility preserved?

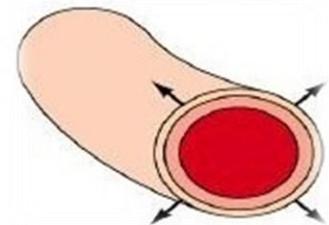
Drug	Heart rate	Cardiac output	Contractility	Blood pressure
Phenothiazines	↑	↑	↓	↓
Benzodiazepines	NC	NC	NC	NC
α <sub>2</sub> - agonists	↓	↓	NC or ↓	↑
Opioids	↓	↓	NC or ↓	NC or ↓
Propofol	NC or ↑	↓	↓	↓
Etomidate	NC or ↑	NC or ↓	NC or ↓	NC or ↓
Inhalation anesthetics	↓	↓	↓	↓

# CARDIAC MEDICATIONS AND ANESTHESIA

- Understanding how they interact with anesthetics
  - Calcium channel blockers and beta-blockers: reduction of heart rate and cardiac output
  - ACE-inhibitors, amlodipine and furosemide: decrease in blood pressure

# CARDIAC MEDICATIONS AND ANESTHESIA

- Continue until the morning of the procedure
- **CAUTION**: amlodipine and furosemide



# KEYPOINTS



# KEYPOINTS

- It is not just about anesthetic drugs!

*“Far more important than “smart” drug choices is to use the chosen drugs in a smart way”*

# Oxygen delivery ( $DO_2$ )

Cardiac output

Arterial  $O_2$  content

Heart rate

Stroke volume

Saturation  $O_2$

Hemoglobin

Preload

Contractility

Afterload

# OPTIMIZE OXYGEN DELIVERY

- Changes in cardiac output affect the oxygen delivery
- **Maximize  $DO_2$**  before induction of anesthesia:
  - Pre-oxygenation
  - Correction of blood pressure, Hb concentration and cardiac output before administration of anesthetic drugs

# OXYGEN DELIVERY AND CONSUMPTION

## Factors decreasing $DO_2$

- Volume depletion
- Septic shock
- Severe anemia
- Severe hypoxemia
- Sedatives/analgesics

## Factors increasing $VO_2$

- Surgery
- Trauma
- Sepsis
- Inflammation
- Seizures
- Anxiety/pain
- Adrenergic drugs

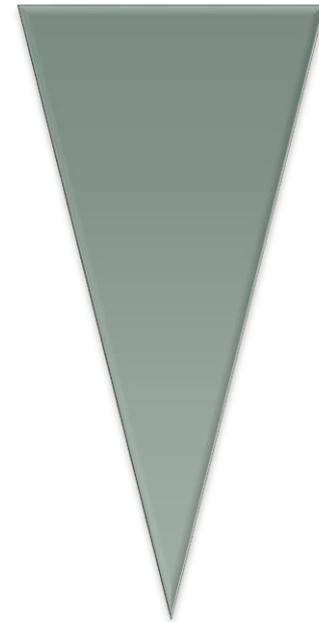


# PREANESTHETIC ASSESSMENT

- Current medications and any recent changes
- Any symptoms related to the disease
- Thoracic radiographs
- ECG and BP
- Echocardiogram findings

# PREMEDICATION AGENTS

- Stable patients: **MORE** choices
- Advanced stage or unstable patients : **LESS** choices



# PREMEDICATION AT HOME

## **TRAZODONE** 1 hour before arrival

- < 10 kg dog: 7 mg/kg
- > 10 kg dog: 5 mg/kg

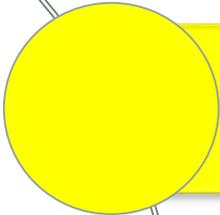


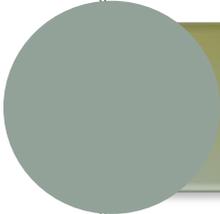
## **GABAPENTIN** 2-3 hours before arrival

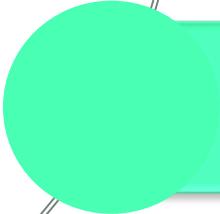
- 50-100 mg/cat
- 150 mg/big cat
- 50 mg petite or geriatric cats



# PREMEDICATION AGENTS

 Acepromazine

 Opioids 

 Dexmedetomidine??

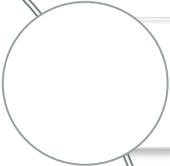
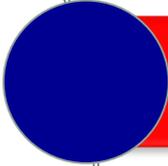
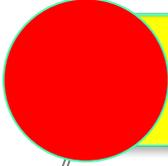
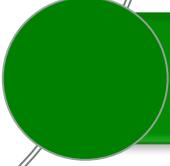
# PREMEDICATION AGENTS



**MIDAZOLAM  
=  
DISINHIBITION**



# INDUCTION AGENTS

-  Propofol
-  Alfaxalone
-  Ketamine
-  Midazolam

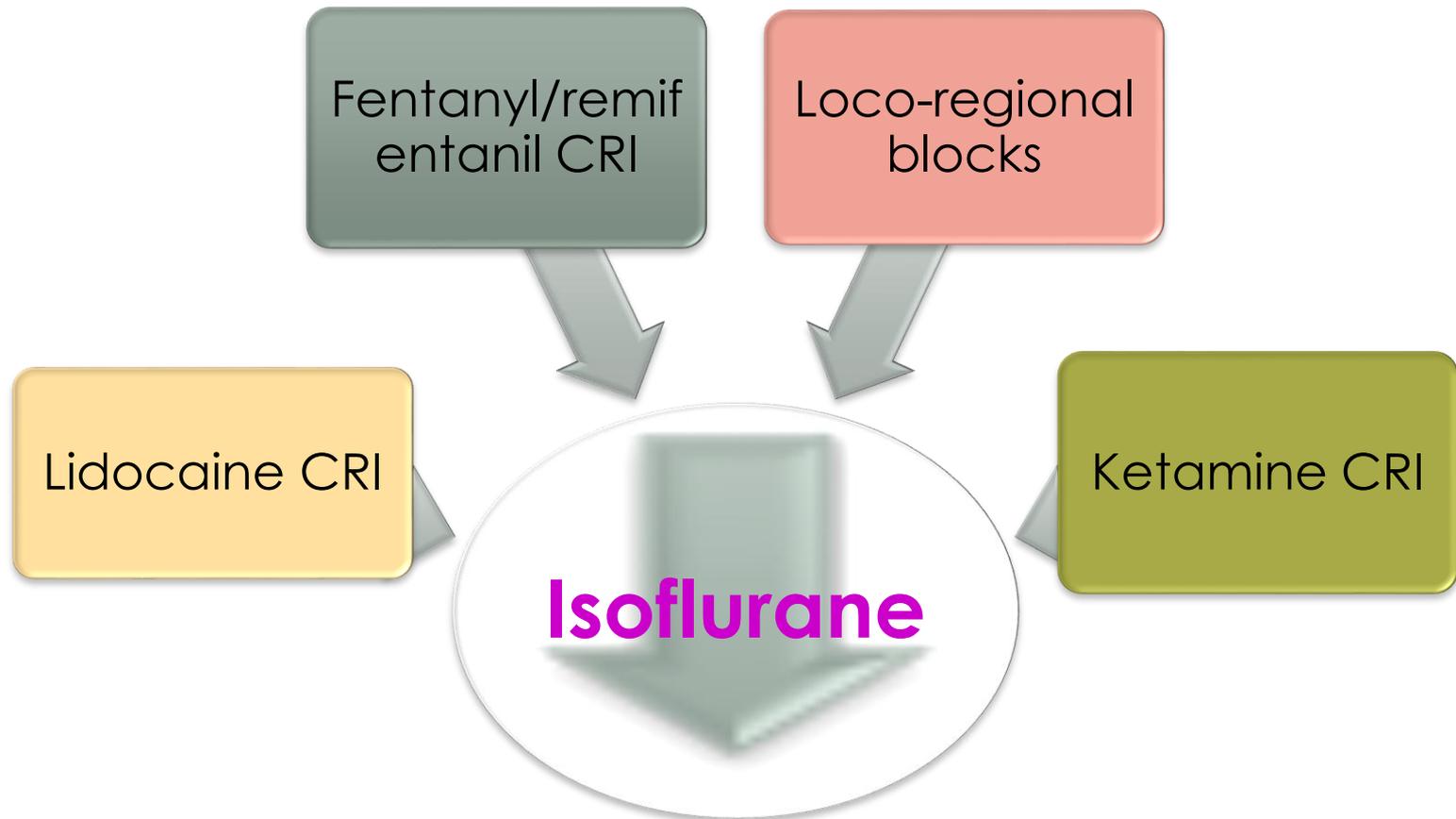
# WHAT IS PRIMING?

$\frac{1}{4}$  of the dose  
of induction  
agent

Benzodiazepine  
(0.2 mg/kg)

Additional  
induction  
agent

# MAINTENANCE



WHAT ELSE AFTER DRUGS?!?!



# WHY TO PREOXYGENATE

**Comparison of time to desaturation between preoxygenated and nonpreoxygenated dogs following sedation with acepromazine maleate and morphine and induction of anesthesia with propofol**

Erin M. McNally, DVM; Sheilah A. Robertson, BVMS, PhD; Luisito S. Pablo, DVM, MS

Time to desaturation:  
1-1.5 min vs 4-6 min

Am J Vet Res, 2009

# PREOXYGENATION IN CATS

Cats may not tolerate face masks unless well sedated



# PREOXYGENATION IN CATS

Use of an induction box to preoxygenate



# FLUIDOTHERAPY

## MY APPROACH

- Stable and mild disease:
  - 5 ml/kg/hr for 1 hour and 3 ml/kg/hr thereafter
- Stable and moderate/severe disease:
  - 3 ml/kg/hr
  - if > 3 hours decrease to 2 ml/kg/hr

# FLUIDOTHERAPY

## **FLUID BOLUSES?**

**Only if patient is dehydrated**

- Stable and mild disease:
  - Start with 5 ml/kg over 15-20 min
- Stable and moderate/severe disease:
  - More cautious, try to avoid

# PATIENT MONITORING



Start before induction

# PATIENT MONITORING

- **ECG**

- Pre-existent arrhythmias

- **SpO<sub>2</sub>**

- Detection of pulse deficit

- **Arterial blood pressure**

- Invasive monitoring for advanced disease

# VENTILATION

Careful with positive pressure ventilation





# HOW TO MANAGE HYPOTENSION

- Ephedrine (0.05-0.1 mg/kg IV)
- Dobutamine CRI (2-7 mcg/kg/min)
- Dopamine CRI (2-5 mcg/kg/min)
- Anticholinergic if bradycardia

# SEDATION VS GA

Sedation MAY NOT be safer than GA or feasible for cardiac patients

- No airway control
- Less attention to monitoring
- Dexmedetomidine/ketamine may not be indicated

# DEGENERATIVE MITRAL VALVE DISEASE

Nodular distortion of the  
valve leaflets



Incompetent valve



Increase LA pressure and LA  
dilation



High end-diastolic pressure  
and volume LV leading to  
dilation

# DEGENERATIVE MITRAL VALVE DISEASE

- Dexmedetomidine/medetomidine contraindicated
- Acepromazine can be used as promotes forward blood flow



DOs



DON'Ts

# DEGENERATIVE MITRAL VALVE DISEASE

- Opioids are good choice
- Propofol/alfaxalone + benzodiazepine/ketamine
- Fluid therapy: 3-5 ml/kg/hr
- Loco-regional and CRIs

# DEGENERATIVE MITRAL VALVE DISEASE

## **STABLE AND COMPENSATED MILD DISEASE**

Little adjustments to anesthetic management and not intensive management

- Maintain normal-high normal HR
- Avoid hypothermia (induce bradycardia)

# DEGENERATIVE MITRAL VALVE DISEASE

## UNSTABLE PATIENTS

- Previous hx of heart failure
- Presence of arrhythmias

## STABLE PATIENTS ON MULTIPLE MEDICATIONS (MODERATE/SEVERE)

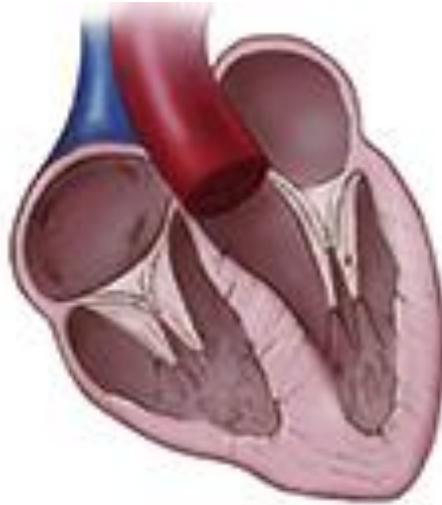


# DEGENERATIVE MITRAL VALVE DISEASE

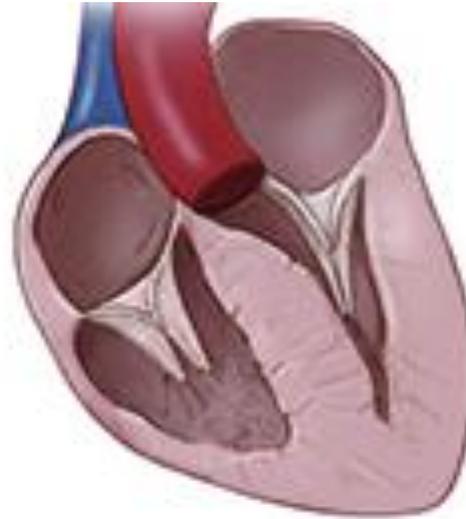
- **All efforts made to decrease inhaled anesthetics**
- Induction: propofol/alfaxalone + midazolam +fentanyl
- Close monitoring of ABP and rhythm



# HYPERTROPHIC CARDIOMYOPATHY



Normal heart



Heart with  
HCM

Thickening of  
LV muscle

Abnormal  
relaxation

Decreased  
volume LV

Impaired  
diastolic filling

# HYPERTROPHIC CARDIOMYOPATHY

Reduced ventricular compliance and perfusion



- Myocardial ischemia and necrosis

- Myocardial fibrosis

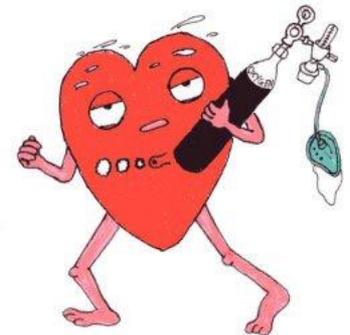
- Ventricular arrhythmias

# ANESTHETIC MANAGEMENT

Based on severity of disease

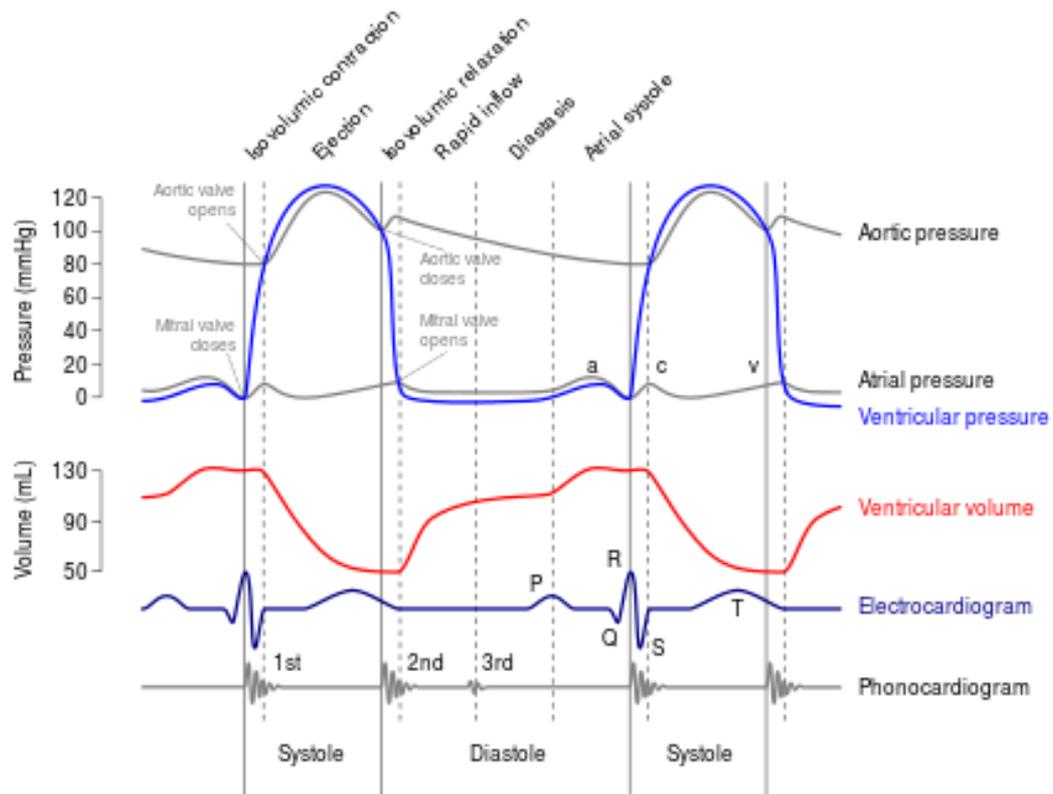
**MINIMIZE MYOCARDIAL OXYGEN DEMAND**

**Prevent tachycardia**



# ANESTHETIC MANAGEMENT

## Prevent tachycardia



# ANESTHETIC MANAGEMENT



DOs



DON'Ts

## DOs

- Tranquillization at home with **gabapentin** (100 or 150 mg) or **trazodone** (50 mg)
- **Opioids** (butorphanol, hydromorphone, methadone, fentanyl)

# ANESTHETIC MANAGEMENT



DOs



DON'Ts

## DOs

- Propofol or alfaxalone +/- midazolam or ketamine
- Fentanyl/midazolam in very sick patients

# ANESTHETIC MANAGEMENT



DOs



DON'Ts

## **DON'Ts**

- Dexmedetomidine/medetomidine (controversial in HOCCM)
- Acepromazine
- Benzodiazepines unless combined with stronger sedatives (paradoxical excitement)

# ANESTHETIC MANAGEMENT



DOs



DON'Ts

## **DON'Ts**

- “Box induction” with inhaled anesthetics
- High IV fluids rates (unless dehydration), boluses and colloids
- Dobutamine CRI controversial to treat hypotension

# KETAMINE AND HCM

## **Contraindicated in moderate-severe stages**

- Increase in HR, contractility, sympathetic tone



- Increase myocardial work and oxygen demand

CRI for pain management might be used

# ALFAXALONE IM

- Use **ALWAYS** in combination with other sedatives/tranquilizers
- Dose: **1-2 mg/kg**
- Monitoring and oxygen supplementation (pending on degree of sedation)

# ALFAXALONE IM

## **Alfaxalone 1-2 mg/kg**

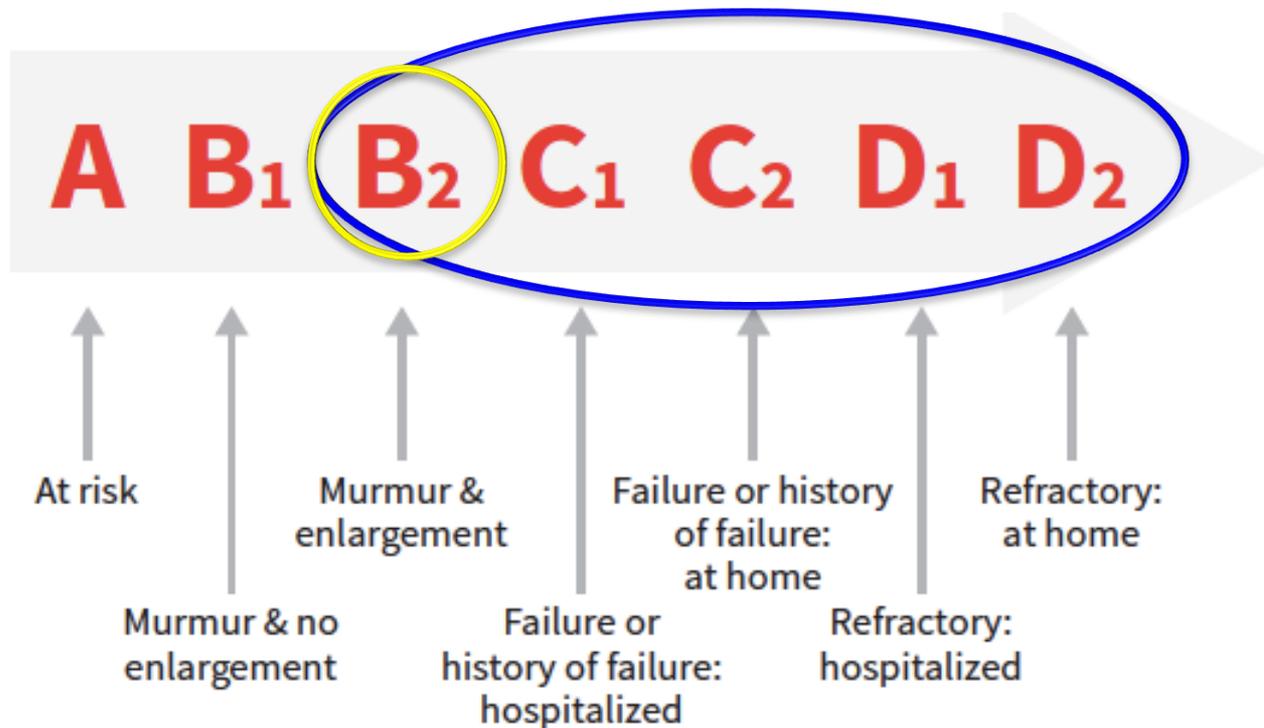
- + midazolam 0.2 mg/kg
- + butorphanol 0.2 mg/kg
- + midazolam 0.2 mg/kg + butorphanol 0.2 mg/kg



# WHEN TO REFER or CONSULT WITH ANESTHESIOLOGIST

- Owner concern
- Level of comfort with anesthetizing the patient
- Advanced stage of the disease
- Lack of monitoring equipment
- Lack of dedicated staff to anesthesia
- Lack of or unfamiliarity with medications (fentanyl, vasopressors)

# WHEN TO REFER or CONSULT WITH ANESTHESIOLOGIST



▲ **FIGURE 1** Schematic version of the ACVIM classification for MMVD in the dog. The ACVIM consensus statement lists therapeutic recommendations based on stage of disease.<sup>3</sup> Figure courtesy of Clarke E. Atkins, DVM, DACVIM

**THANK YOU!**



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[www.anesthesiavet.org](http://www.anesthesiavet.org)