

# Breed Specific Anaesthetic Considerations

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VSA

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VETERINARY SPECIALISTS AOTEAROA  
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# Contents

**Section 1: Greyhounds (Sighthounds)**

**Section 2: Herding Dogs**



# Greyhounds

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# Primary Considerations for Greyhounds

- Unique body shape/composition
- Anaesthetic hyperthermia (stress/malignant)
- Deficiencies in some liver enzymes
- Congenital hyperfibrinolysis
- Anaesthesia related hyperkalaemia
- Clinpath variations
- +/- Temperament



# Unique body shape and composition

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Physical characteristics:

- Low fat-to-muscle ratio
  - 17% vs 35%
- High surface area-to-volume ratio

Increased risk of:

- Hypothermia
- Hyperthermia
- Prolonged recovery post-anaesthesia



# Managing Hypothermia

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- Constant monitoring is paramount
  - Ideal temperature = 36-37.5C
- Options:
  - Active heating
  - Warmed IV fluids
  - Heat and moisture exchanger
  - Use lower doses of Acepromazine
  - Environmental temperature



# Managing Hyperthermia

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## Stress hyperthermia:

- Often during the recovery period (peri-anaesthetic)
- High muscle mass
- Shivering/shaking when waking from anaesthesia
- Stress is also a contributor
- Temperature > 40.5C

## Treatment:

- Active cooling
- Drugs:
  - Acepromazine (low doses)
  - Midazolam
- Pre-visit pharmaceuticals

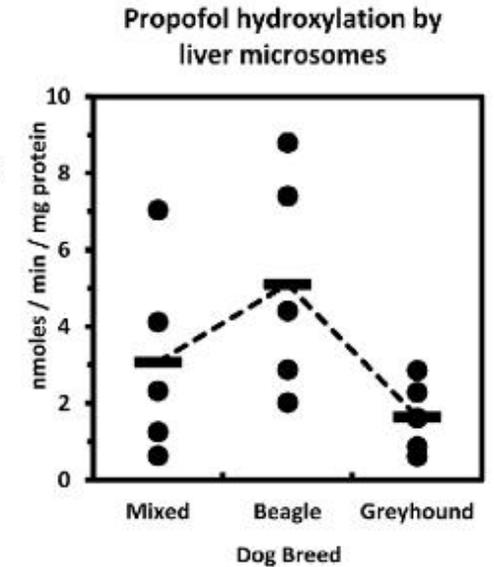
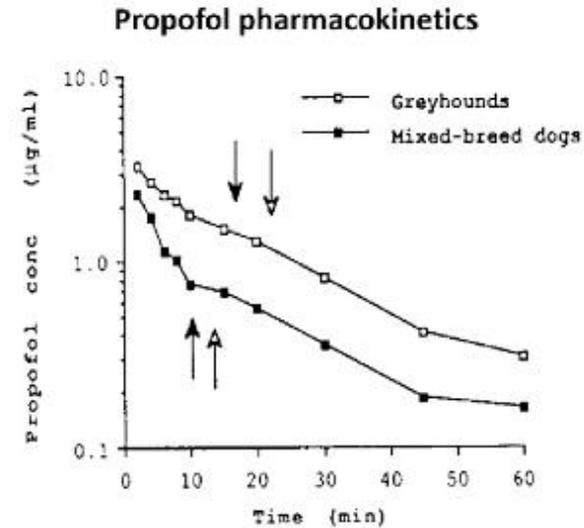
# Malignant Hyperthermia

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- Rare genetic hereditary disorder known in Greyhounds
- Severe hyperthermia in response to inhalant anesthesia
- Clinical signs:
  - Rapid and high temperature increase
  - Tachypnea and tachycardia
  - Cyanotic mucous membranes
  - Trismus (Jaw rigidity)
- Diagnosis = muscle biopsy
- Treatment = Dantrolene

# Liver Enzyme Deficiencies

- Reduced activity of specific cytochrome P450 enzymes
- Important clearance mechanism for certain injectable anesthetics:
  - Thiobarbiturates
  - Propofol
- As a consequence, these drugs are eliminated more slowly in Greyhounds
- Contributes to lengthy recoveries



> [Sci Rep. 2020 Jan 9;10\(1\):69. doi: 10.1038/s41598-019-56660-z.](#)

**Pharmacogenomics of poor drug metabolism in Greyhounds: Cytochrome P450 (CYP) 2B11 genetic variation, breed distribution, and functional characterization**

[Stephanie E Martinez](#)<sup>1</sup>, [Marie C Andresen](#)<sup>2</sup>, [Zhaohui Zhu](#)<sup>2</sup>,

# Prolonged Recoveries

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Important when using lipophilic drugs

- Propofol
- Acepromazine

Important when using p450 metabolized drugs

- Thiopental
- Propofol

**Tips for managing prolonged recoveries:**

- Minimize hypothermia
- Minimize multiple "top ups"
- Support and monitoring

**Example protocol:**

Premedication:

- Medetomidine
- Methadone

Induction:

- Alfaxalone

Maintenance:

- Isoflurane

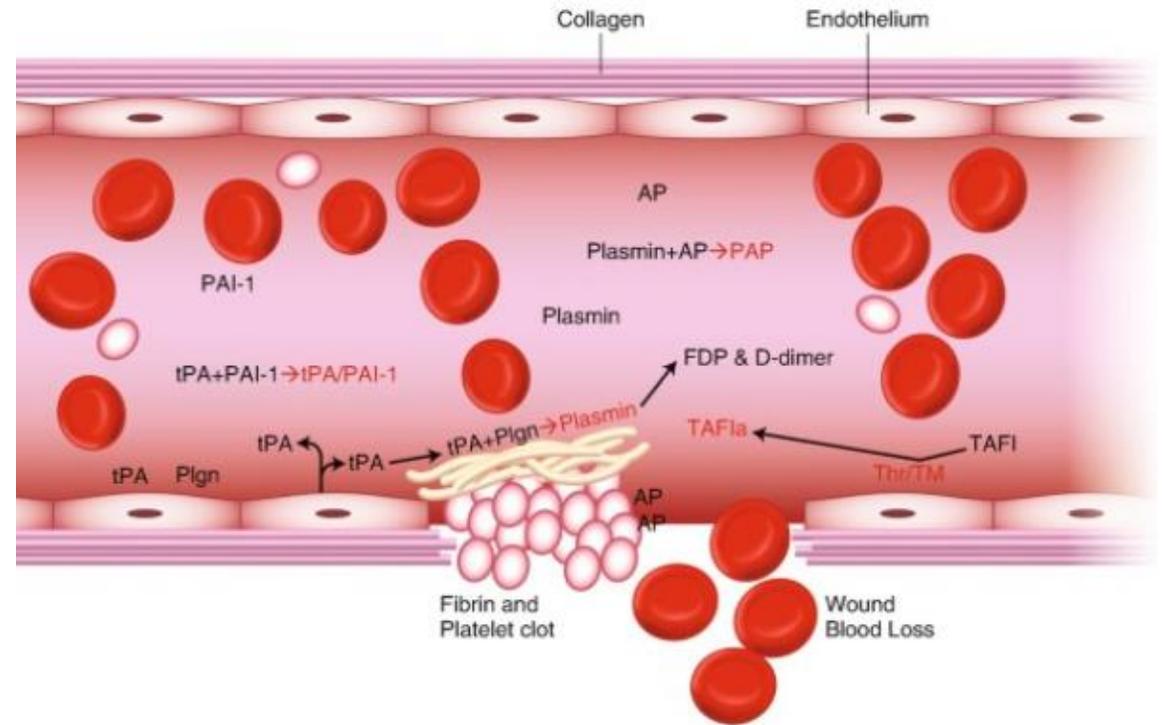
# Congenital Hyperfibrinolysis

## Fibrinolysis:

- Normal body process
- Prevents naturally occurring blood clots from growing and forming thrombi

## Hyperfibrinolysis:

- Excessive removal of fibrin from a clot that can cause significant bleeding



# Congenital Hyperfibrinolysis: Study

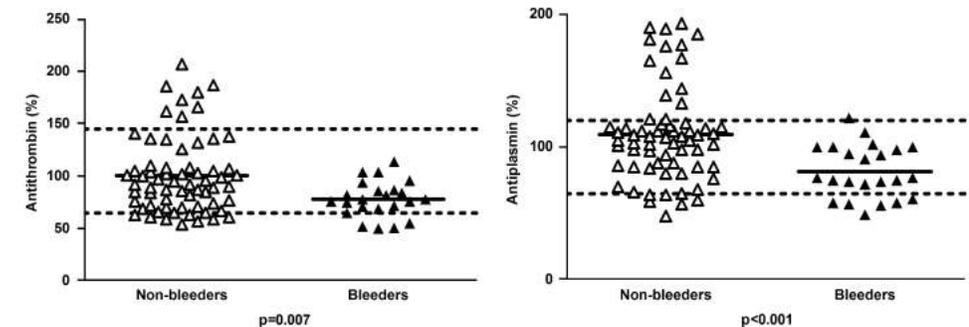
Study investigating Greyhound Hyperfibrinolysis:

*J Vet Intern Med* 2008;22:525–533

## Postoperative Bleeding in Retired Racing Greyhounds

A. Lara-García, C.G. Couto, M.C. Iazbik, and M.B. Brooks

- 88 Greyhounds underwent routine desexing
- 26% of dogs had bleeding 36-48 hours post-surgery
- Antiplasmin and antithrombin were lower pre-operatively in dogs that hemorrhaged
- Platelet count, PT, aPTT and Fibrinogen were not significantly different between bleeders and non-bleeders



# Congenital Hyperfibrinolysis: Treatment

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How can we deal with this?

- Risk assessment based off prior history, physical exam and pre-anesthetic bloodwork
- Prophylactic antifibrinolytic drugs

Tranexamic acid:

- Inhibits plasminogen
- Given prior to surgery (6-8 hours)
- Dose = 10-20mg/kg IV (slowly, over 10-15 minutes)
- Can repeat every 6-8 hours post-surgery

+/- Blood transfusion

# Clinpath Variation

Veterinary Clinical Pathology ISSN 0275-6382

INVITED REVIEW

## Clinical pathology of Greyhounds and other sighthounds

S. Zaldívar-López<sup>1,2</sup>, L.M. Marín<sup>1</sup>, M.C. Iazbik<sup>3</sup>, N. Westendorf-Stingle<sup>1,3</sup>, S. Hensley<sup>1</sup>, C.G. Couto<sup>1,3,4</sup>

<sup>1</sup>Department of Veterinary Clinical Sciences, College of Veterinary Medicine, The Ohio State University, Columbus, OH, USA; <sup>2</sup>Center for Molecular and Human Genetics at The Research Institute at Nationwide Children's Hospital, Columbus, OH, USA; <sup>3</sup>Veterinary Medical Center, College of Veterinary Medicine, The Ohio State University, Columbus, OH, USA; and <sup>4</sup>Ohio State University Comprehensive Cancer Center, The Ohio State University, Columbus, OH, USA

### Greyhound:

- **PCV = 58 – 62%**
- **Platelet count = 80 to 295 x 10000/ $\mu$ L**
- **Total protein = 5.0 to 6.0 is normal**

**Table 1.** Analytes and features characteristic of Greyhound dogs compared with those of other breeds.

| Higher Values                          | Lower Values                         | Unique Features          |
|--|--------------------------------------|--------------------------|
| PCV/HCT                                | WBC count                            | Non-staining             |
| RBC count                              | Neutrophil count                     | eosinophil granules      |
| Hemoglobin concentration               | Platelet count                       |                          |
| MCV*                                   | Fibrinogen                           | Higher frequency         |
| MCHC                                   | TEG values: K-time, angle, MA, and G | of DEA 1.1-negative dogs |
| Hemoglobin affinity for O <sub>2</sub> |                                      |                          |
| Creatinine                             | Potassium                            |                          |
| Glomerular filtration rate             | Phosphate                            |                          |
| Alanine aminotransferase               | Calcium, ionized                     |                          |
| Aspartate aminotransferase             | Magnesium, ionized                   |                          |
| Sodium                                 | Serum total protein                  |                          |
| Chloride                               | Total globulins                      |                          |
| Total CO <sub>2</sub>                  | $\alpha$ - and $\beta$ -globulins    |                          |
| Bicarbonate                            | IgA and IgM                          |                          |
| Cardiac troponin I                     | Haptoglobin                          |                          |
|  | Total T4 and free T4                 |                          |

\*Reported in only one study.<sup>3</sup>

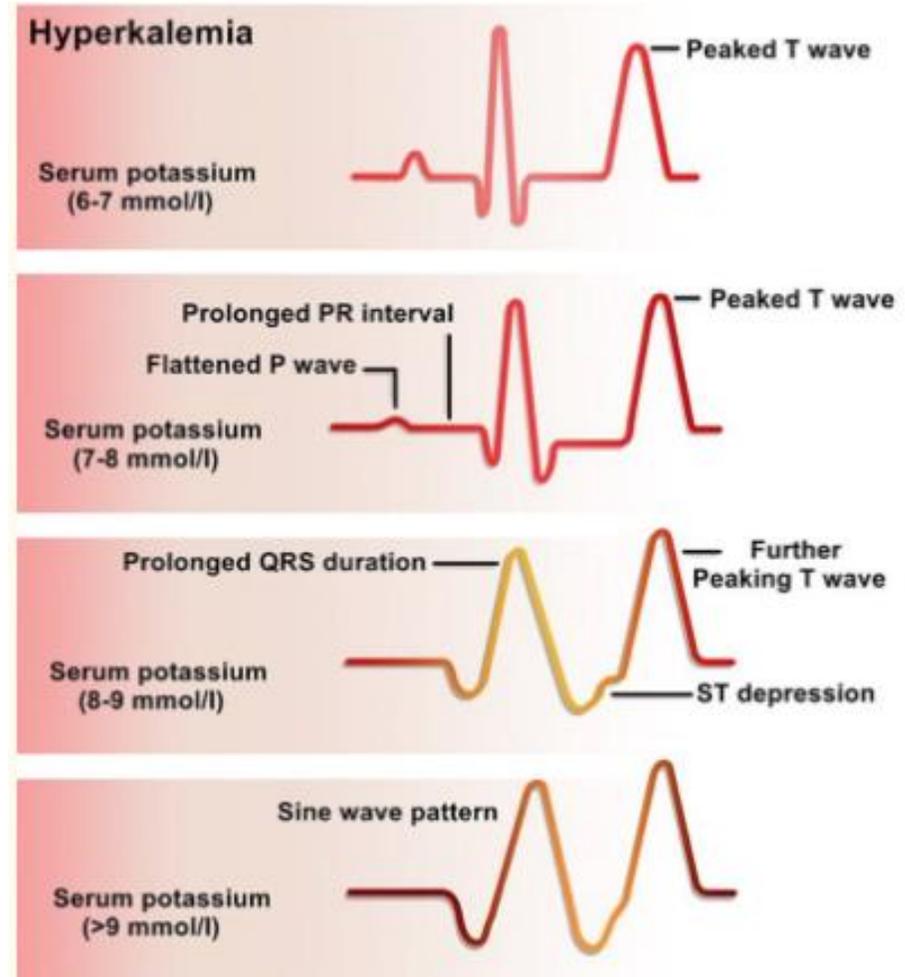
# Hyperkalemia

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Originally recognized in big cats premedicated with alpha-2 adrenergic agonists

Clinically, hyperkalemia in the anesthetized patient will manifest as:

- Heightened T-wave
- Loss of P waves
- Wide and bizarre QRS complexes
- Bradycardia
- Hypotension



# Hyperkalemia:

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- 95 greyhound anesthetic events
- 36/95 (~40%) developed hyperkalemia during the anesthetic → None of these animals were premedicated with an alpha-2
- Hyperkalemia was defined as  $K > 5.6$  mmol/L
- Duration of anesthesia was the strongest risk factor → 80% occurred after 2 hours

## Prevalence of hyperkalemia during general anesthesia in Greyhounds

SJ Jones<sup>1</sup>, KR Mama<sup>2</sup>.

<sup>1</sup>Caring Hands Veterinary Hospital, Thornton, CO, USA; <sup>2</sup>Colorado State University, Fort Collins, CO, USA.

# Hyperkalemia: Treatment

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## STOP CIGAR(S)

STOP =

- Inhalant or TIVA
- Reverse patient if appropriate

C = Calcium gluconate

I = Insulin

G = Glucose (5% dextrose)

A = Albuterol

R = Respiratory acidosis and Renal

- (Hyper) Ventilate the patient to drive down CO<sub>2</sub>
- Furosemide has been shown to be beneficial

## Doses

Calcium Gluconate (10% solution)

- 1-1.5ml/kg 10% solution slow IV over 10-30 minutes

Insulin IV

- Short/Rapid acting
- 0.1U/kg
- Reduces the risk of iatrogenic hypoglycemia
- Can run a CRI

5% Dextrose IV

- 4ml/unit of insulin given
- Diluted 1:1 with sterile saline



# Temperament

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- How does stress/anxiety impact anesthesia?
- Limit premedication routes
- The patient may require higher doses of premedication and induction drugs
- Effect patient/staff wellbeing
- Decrease efficiency
- Increases chance of injury and difficulty handling patients

# Temperament: PVP

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- The official chill protocol:
  - Gabapentin
    - 20-25mg/kg
    - The night before + 1-2 hours before admission
  - Melatonin
    - 0.5-5mg depending on size
    - 1-2hrs prior to admission
  - Acepromazine
    - 0.025-0.05mg/kg - PO
    - 30 minutes prior to arrival

At VSA:

Gabapentin

- 10-20mg/kg PO
- The night before + 1-2hr before admission

Trazodone

- 5-10mg/kg PO
- Prior to arrival to the clinic

# Greyhound Summary

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- Be aware of your patient's temperature and use regular monitoring and early intervention to maintain it within an acceptable range
- Reduced body fat % and lack of specific liver enzymes may result in prolonged recoveries especially when using thiobarbiturates and propofol
- Potential bleeding in Greyhound patients and consider tranexamic acid for prophylaxis
- Hyperkalemia can occur and manifest on your ECG. Have emergency medications ready especially for long procedures
- Be aware of hematological and biochemical differences when pre-anaesthetic screening
- Greyhounds may present stressed. Consider using medications prior to arrival to allow for an easier anesthetic, staff and patient experience



# Herding Dogs

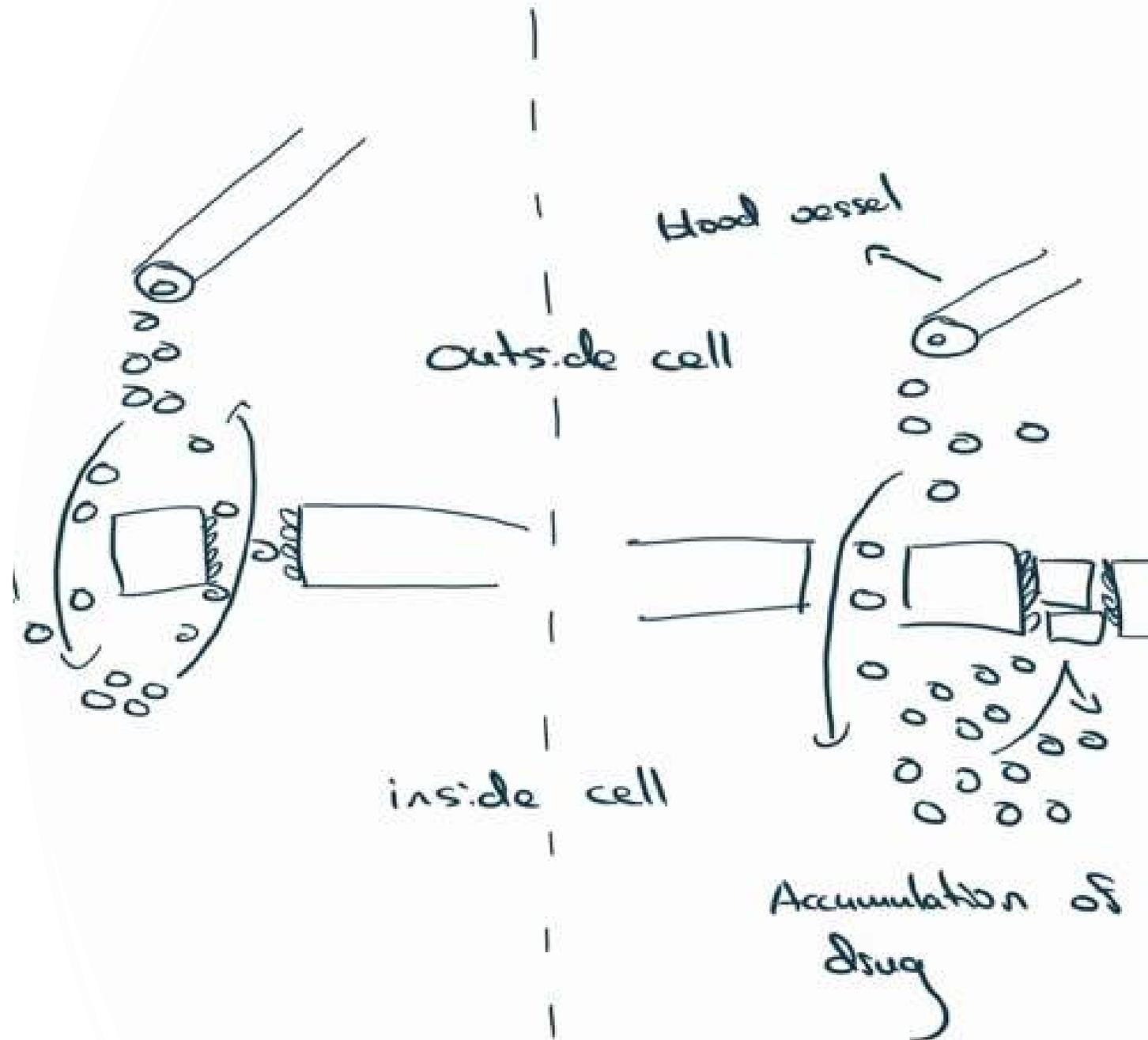
(MDR-1 Gene Mutation)

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# What is the MDR-1 gene?

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- Function = reduces accumulation of dangerous drugs in the CSF
- Dogs with the MDR-1 mutation
  - Alteration in the BBB
  - Change in P-glycoprotein (P-gp)
- Affects transport of certain drugs across the BBB
- Also present in other tissues (intestines, renal tubular cells)



# What dogs are affected?

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- Collie = 70%  
(~50% are homozygous)
- Australian Shepherd (and Mini) = 50%
- Whippet (long-haired) = 50%
- German Shepherd = 10%
- Herding X-Breed = 10%
- Border Collie = 5%
- Mixed Breed = 5%



# What drugs are of concern?

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## Anaesthetic drugs of concern

- Opioids → Morphine, Butorphanol, Buprenorphine
- Phenothiazines → Acepromazine

## Other drugs of concern

- Macrocyclic lactones → Ivermectin, Milbemycin
- Chemotherapeutic drugs → Vinblastine, Doxorubicin
- Apomorphine

## Not of concern

- Alpha-2 adrenergic agonists → Medetomidine, Dexmedetomidine
- NSAIDs → Metacam

# Clinical Signs

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## Toxicity

- Vomiting
- Weakness
- Ataxia
- Tremors
- Seizures
- Blindness
- Death

## Anaesthesia

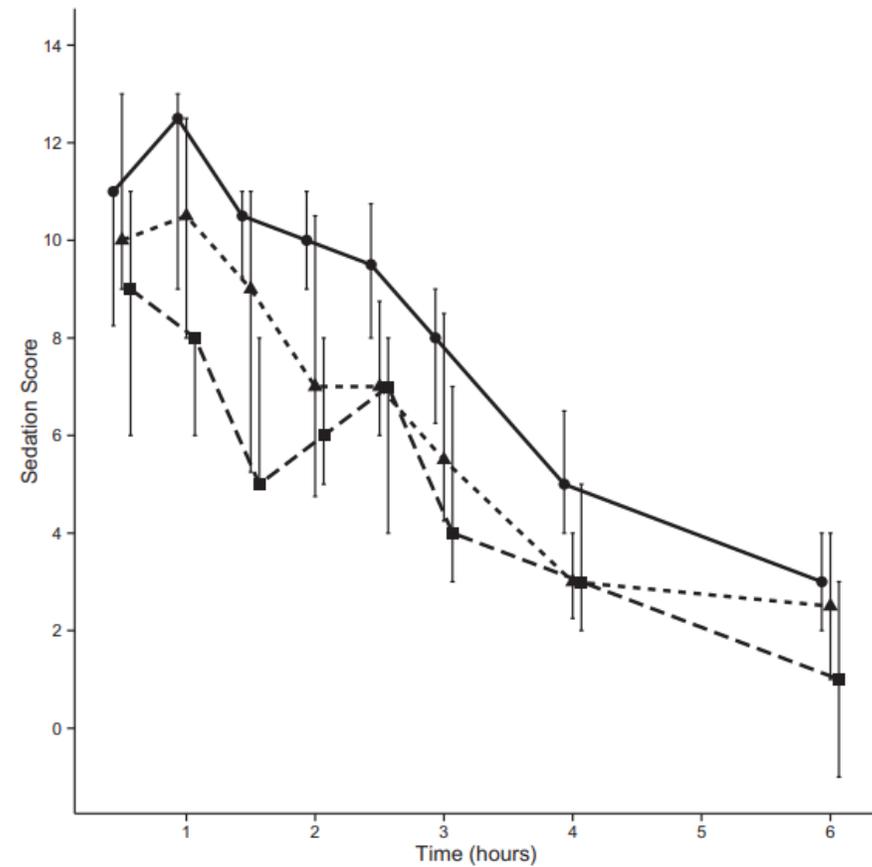
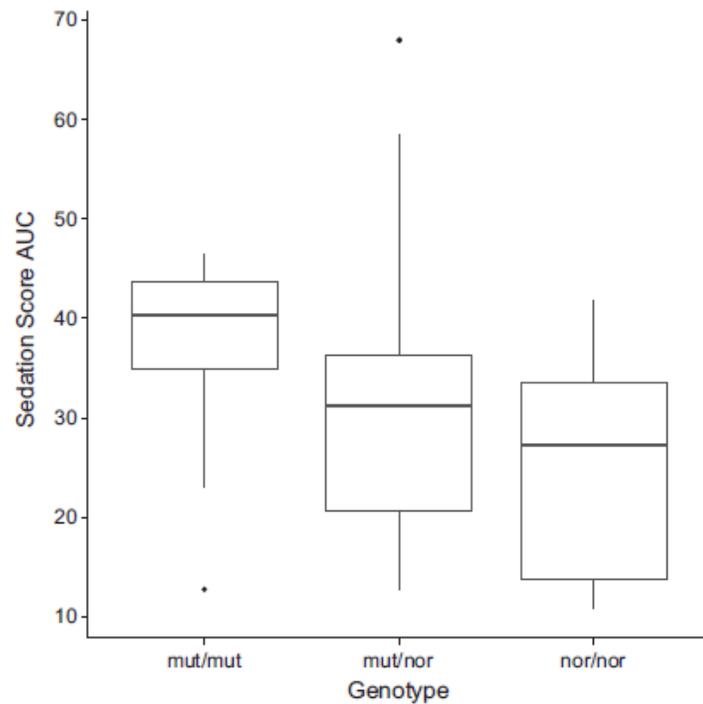
Prolonged and pronounced effects:

- Deeper plane of sedation
- Hypotension
- Prolonged recovery
- Dysphoric wakeup

# Study

## The Effect of the Canine *ABCBI-1Δ* Mutation on Sedation after Intravenous Administration of Acepromazine

D. Deshpande, K.E. Hill, K.L. Mealey, J.P. Chambers, and M.A. Giese



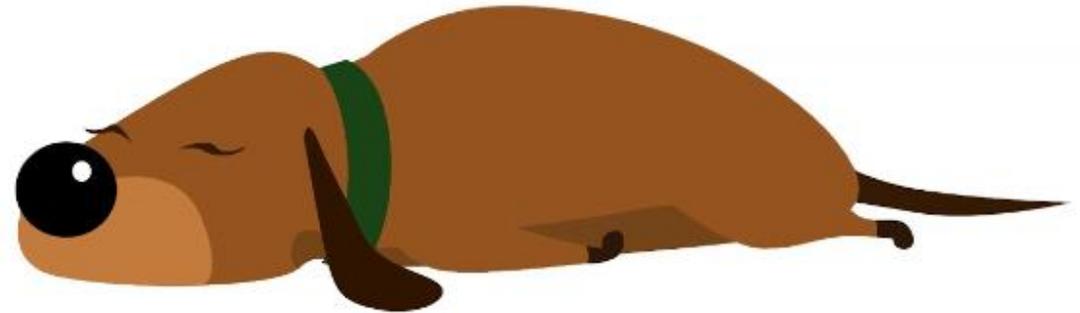
# Treatment

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## Treatment

No specific treatment:

- Make sure to rule out other causes of clinical signs
- Treat supportively and symptomatically



# Prevention

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## Prevention

Develop a safe protocol

- Dose reduction of drugs that are known to cause harmful effects
- Choose alternative options for pre-medication
- Genetic testing

If homozygous → 30-50% dose reduction

If heterozygous → 25% dose reduction

Factor in previous anaesthesia

# Herding Dog Summary

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- Herding dogs are particularly predisposed to having a mutation to the multiple drug resistance-1 gene
- The mutation affects clearance of potential harmful drugs from cells throughout multiple body systems – including the brain
- Potentially toxic drugs include anesthetic premedication and analgesics such as some opioids and acepromazine
- Anesthetic clinical signs include prolonged and increased effects of premedication drugs
- Care must be taken when devising a protocol for these dogs by either picking alternative drugs or decreasing doses

# Special thanks to Joanna Chagas

Thank you for listening :)

# VSA

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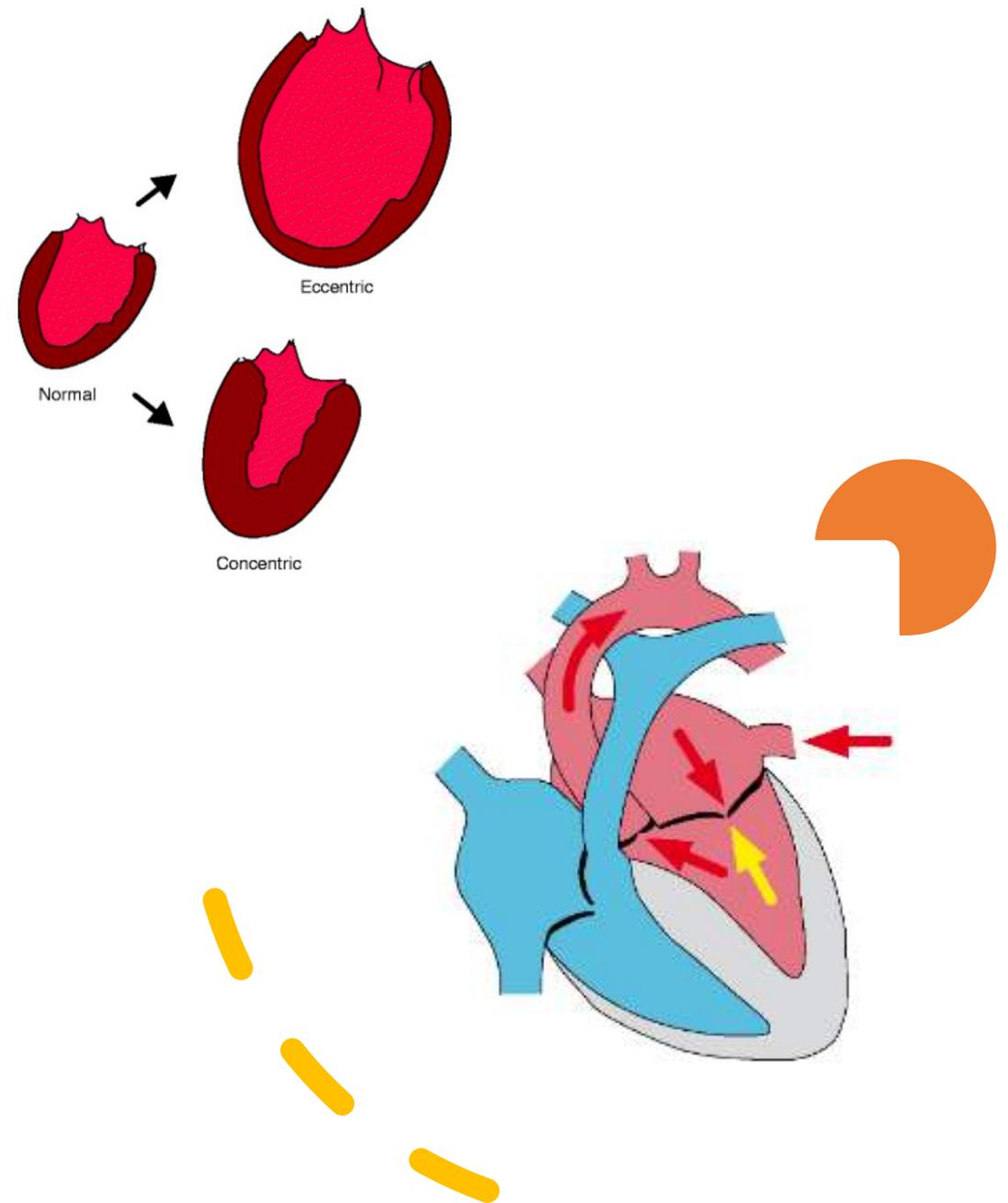
# Cavalier King Charles Spaniels

(Myxomatous mitral valve degeneration)

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# What is MMVD?

- Degeneration of mitral valve
  - Incomplete closure
  - During contraction, blood will flow back through the 'leaky' valve from the left ventricle to left atrium
- The left ventricle and atrium undergo eccentric hypertrophy
  - Atrial dilation
  - Ventricular dysfunction
- In advanced stages, pulmonary and capillary pressures increase
  - Pulmonary oedema and heart failure



# Anesthetic Workup

## Risk Assessment

How serious is the disease? What patients are at more risk?

History and physical exam

- Lethargy, exercise intolerance
- Tachypnea, heart murmur, tachycardia, lung sounds

Imaging

- Echocardiography
- Radiographs

Blood testing

- NT-proBNP
- Cardiac Troponin-1

| Stage | Characteristics   |
|-------|---|
| A     | Dogs with no identifiable structural disorders of the heart but are at increased risk of their development (such as Cavalier King Charles Spaniels) |
| B1    | Dogs with structural heart disease (for example, murmur auscultation) that have no evidence of cardiac remodelling                                  |
| B2    | Dogs with structural heart disease and evidence of cardiac remodelling  |
| C     | Dogs currently in, or with past clinical signs, of congestive heart failure   |
| D     | Dogs in end-stage congestive heart failure with clinical signs refractive to standard treatments  |

Adapted from Keene et al (2019)

- 
- Maintain cardiac output and blood flow around the body
  - Prevent excessive regurgitation (backward flow) from the left ventricle to the left atrium
  - Maintain the heart's ability to contract
  - Avoid bradycardia and severe tachycardia
  - Avoid increases in SVR
  - Avoid hypotension



# Anesthetic goals

# Drug Considerations: Pre-medication

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## Opioids (full mu agonists e.g. Morphine, methadone)

- Great analgesic properties
- Minimal cardiovascular effects
- Bradycardia

## Benzodiazepines (e.g. Midazolam, diazepam)

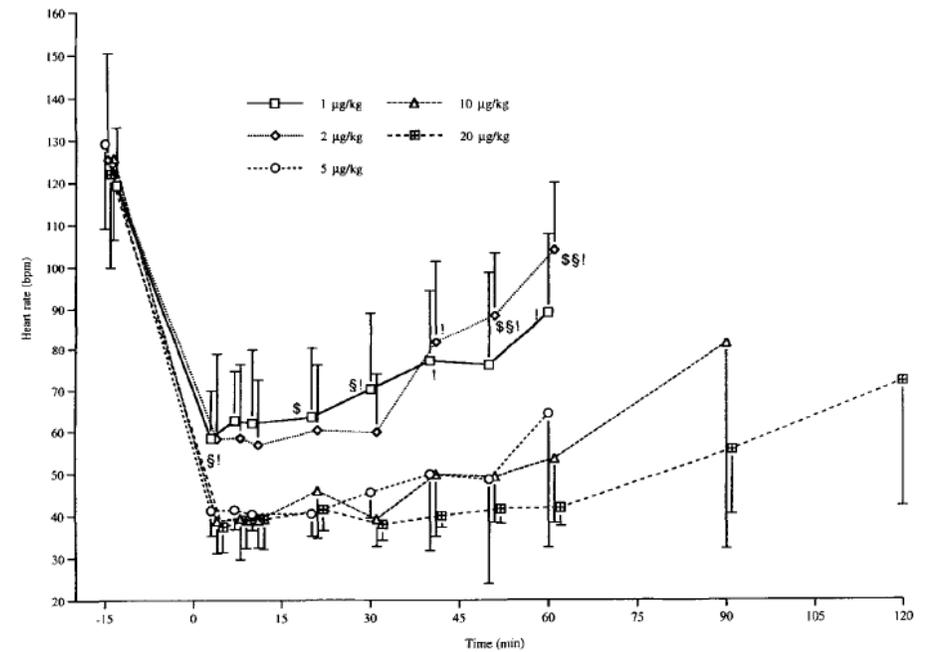
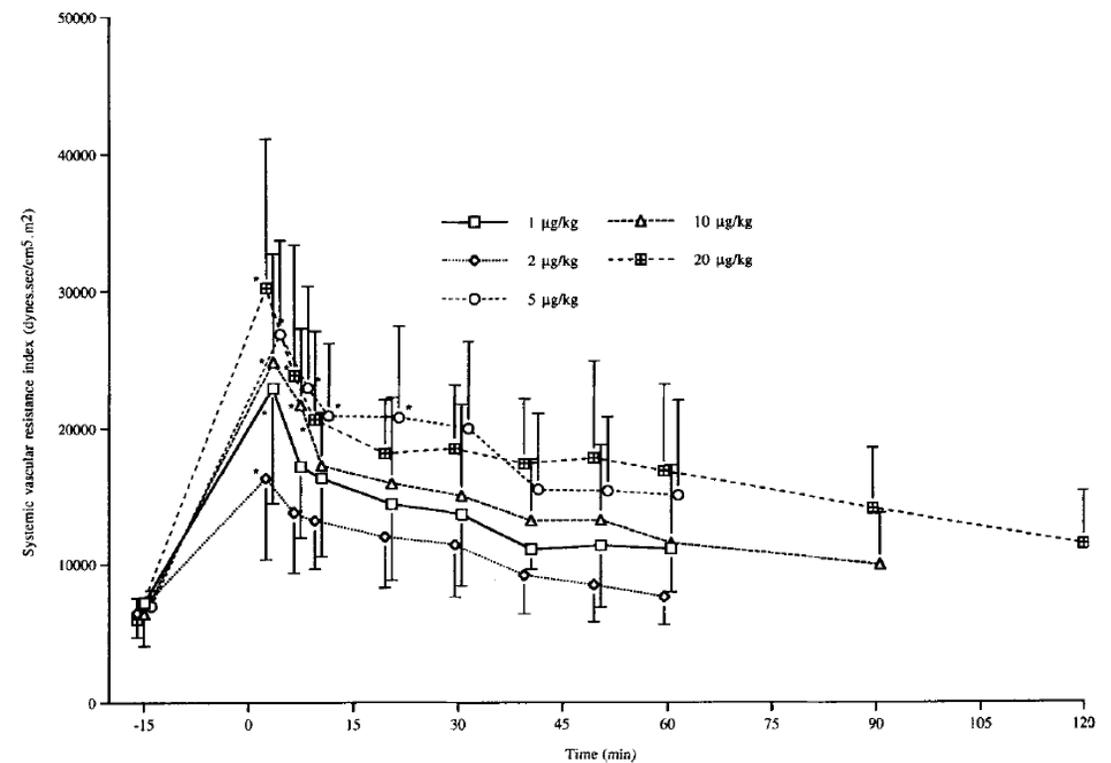
- Good sedation
- Minimal cardiovascular impact
- Can cause excitation in some patients

## Acepromazine

- Calming and sedative effects
- Vasodilation -> Decreased systemic vascular resistance -> Hypotension
- Be careful in advanced MMVD patients

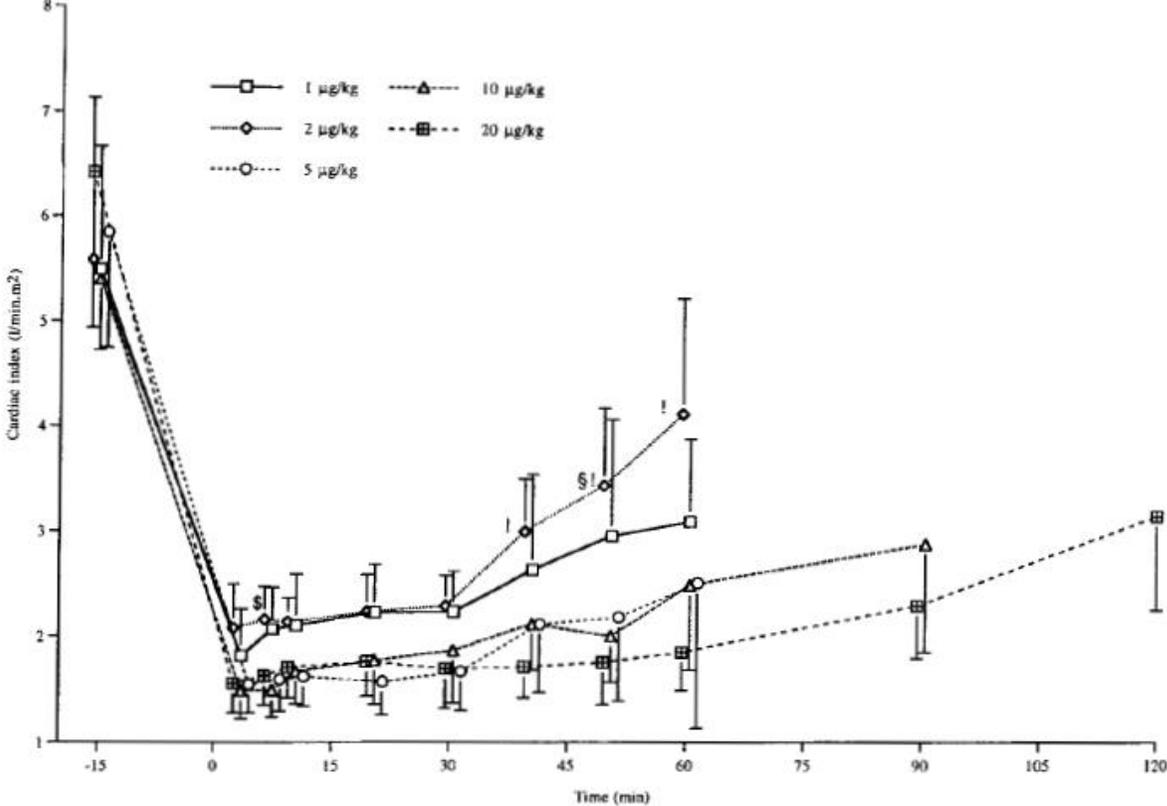
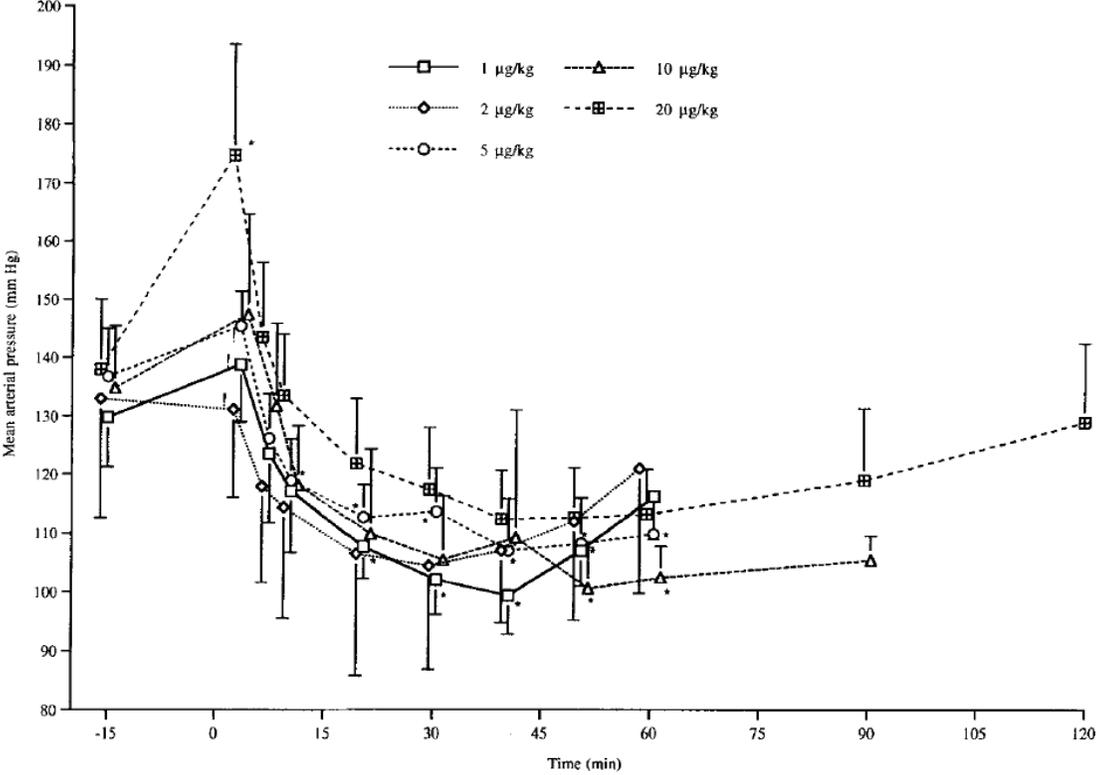
# Drug Considerations: Pre-medication

- Alpha-2 agonists (medetomidine, dexmedetomidine)
- → Reflex bradycardia
  - Increase in systemic vascular resistance
  - Mean arterial pressure increases
  - Heart rate decreases to account for blood pressure increase
  - Systemic vascular resistance normalizes
  - Mean arterial pressure drops -> Hypotension



$MAP = SVR \times CO$

$CO = SV \times HR$



# Drug Considerations: Induction

## Propofol and Alfaxalone

- Similar cardiovascular and respiratory depression
- Alfaxalone causes a responsive increase in heart rate and maintain MAP
- Slowly and to effect -> reduction of dose therefore negative effects of the drug

## Benzodiazepines

- Co-induction agents
- Reduce required dose of induction agents
- Not proven that this has cardiovascular benefits

# Drug Considerations: Maintenance

## Inhalant anesthesia (Isoflurane, Sevoflurane)

- Dose dependent cardiovascular and respiratory depression
- Decrease heart contractility
- Decrease systemic vascular resistance
- Overall result = Hypotension + increased forward flow

## Total Intravenous Anesthesia (Propofol, alfaxalone)

- Practically feasible?
- Can cause similar regurgitant volume (or higher) than inhalant

# Other Considerations

## Adjunctive analgesia:

- Local blocks
- CRI's -> Fentanyl, lidocaine, ketamine

## Fluid therapy:

- Fluid deficits should ideally be corrected prior to surgery
- 3-5ml/kg/hr are adequate in most patients
- Monitor blood pressure and heart rate

## Manage blood pressure

- Anesthetic plane (?)
- Fluid bolus (?)
- Dopamine
- Dobutamine