

# Neonatal & Pediatric Anesthesia

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# Introduction

- Neonatal and pediatric patients present a unique challenge under anesthesia
- Consider life stage and physical status of the patient when designing appropriate anesthetic protocol



# Life Stages

Stage	Canine	Feline
Neonate	First 4-6 weeks	First 4-6 weeks
Pediatric	Neonate to 6 months*	Neonate to 6 months
Junior	Reproductive mature, still growing	Up until 2 years
Adult	Structurally mature, finish growing	3-6 years
Mature	From middle up to approximately last 25% of expected lifespan (around half life expectancy for breed)	7-10 years
Senior	From mature to life expectancy (around last 25% of expected lifespan)	11-14 years
Geriatric	At life expectancy and beyond	>15 years

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# Physiology

## OVERALL

- Hypoalbuminemia → increased fraction of active drug
- Increased body water content → altered volume of distribution
  - Normal adult: 60% total body water
  - Neonate and pediatric: 80% total body water
- Centralized circulating fluid volume → more susceptible to hypovolemia

# Physiology

## OVERALL

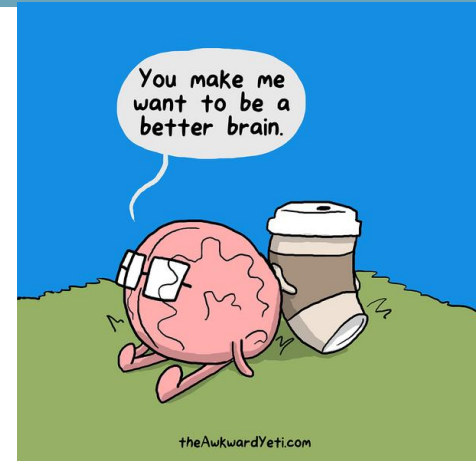
- Decreased body fat percentage → decreased drug redistribution
- Immature thermoregulation, high body surface to mass ratio → more susceptible to hypothermia
- Decreased production of erythropoietin → decreased hematocrit

# Physiology

## NERVOUS SYSTEM

- Increased permeability of blood brain barrier  
→ increased percentage of drug dose to brain
- Immature sympathetic nervous system

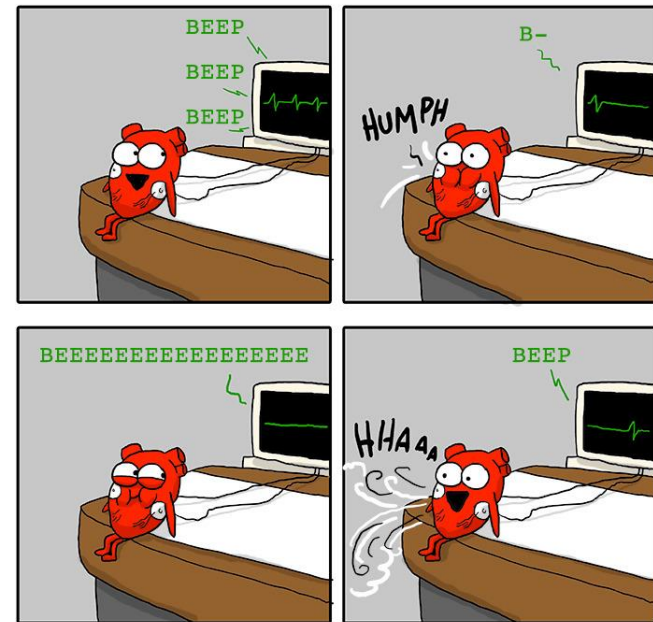
**Use reduced drug levels to produce effective general and local anesthesia, and neuromuscular blockade**



# Physiology

## CARDIOVASCULAR SYSTEM

- Less contractile tissue per gram of myocardial tissue → decreased contractility
- Limited cardiac reserve
- Decreased ventricular compliance
- Poor vasomotor control
- Reduced baroreceptor reflexes
- **Cardiac output is HR dependent!!!**
- Potential for intracardiac shunt



theAwkwardYeti.com



# Cardiovascular Physiology

$$CO = HR * SV$$

Neonates rely on high heart rate to maintain adequate cardiac output due to immature autonomic tone

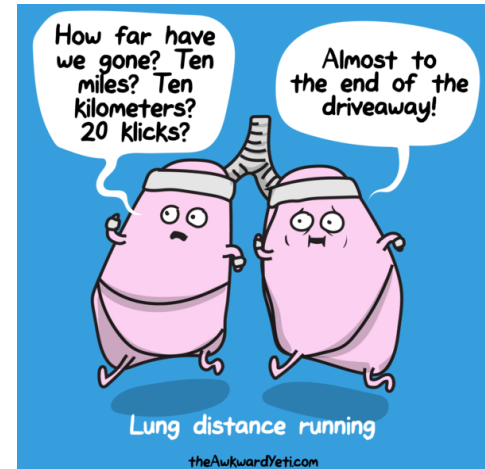


<https://animallova.com/>

# Physiology

## RESPIRATORY SYSTEM

- High metabolic rate → increased oxygen demand
- High minute ventilation
- Limited pulmonary reserve → increased risk of hypoxia
- Compliant rib cage + weaker intercostal muscles → less efficient ventilation and greater work of breathing → increased risk of hypoxia and respiratory fatigue



# Physiology

Neonatal and pediatric animals have higher heart rates, higher respiratory rates, and lower blood pressure than adults

Conscious neonatal dogs and cats:

- Heart rate: 200-220 beats per minute
- Respiratory rate: 15-40 breaths per minute
- Mean arterial blood pressure in 1 month old puppies: 50 mmHg

# Physiology

## HEPATIC SYSTEM

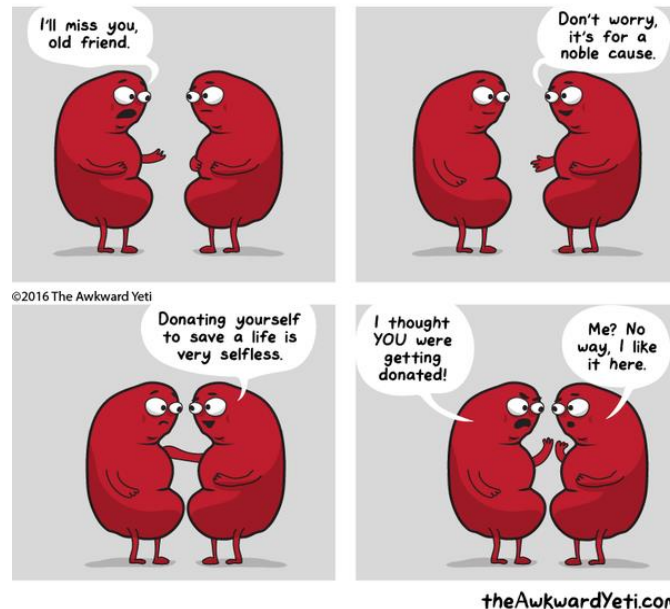
- Limited organ reserve
- Immature cytochrome P450 system → decreased drug metabolism → prolonged drug elimination
- Low glycogen levels → prone to hypoglycemia



# Physiology

## RENAL SYSTEM

- Limited organ reserve
- Lower glomerular filtration rate → prolonged duration



# What Does All Of This Mean?

- Exaggerated effect from using standard adult drug dosing → use decreased drug dosage
- Prolonged duration of action = prolonged recovery
- Fluid requirements are greater in neonates
  - Caution with overhydration
- Support cardiovascular system with IV fluids and positive chronotropy
- Mask induction occurs extremely quickly
- Provide oxygen and ventilatory support

# Anesthetic Considerations

- First case of the day
- Obtain accurate weight
- Fasting
  - If less than 8 weeks of age, do not fast for more than 1-2 hours
  - Consider monitoring blood glucose
- Careful auscultation of heart
- Maintain high heart rate

# Anesthetic Considerations

- Use lower drug dosages
- Consider reversible drugs
- Anticipate difficult IV catheter placement and intubation
- Pre-oxygenate
- Prewarming
- Use 1 mL flushes



# Analgesia

- Neonatal and pediatric humans experience pain
  - Pain experienced at extremely young age may lead to changes in nociceptive processes, which can result in chronic pain conditions later in life

## **Appropriate analgesia reduces dose of drugs needed to maintain general anesthesia**

- Consider local or regional blockade
- NSAIDs?

# Premedication

- Advantages:
  - Minimize stress in anxious patients
  - Decrease dose requirements for induction and maintenance
- Good to use:
  - Opioids
  - Benzodiazepines
- Caution use with:
  - Alpha<sub>2</sub> agonists
  - Acepromazine



<https://commons.wikimedia.org>  
<http://acesurgical.com>

# Induction

- Good to use:
  - Propofol
  - Alfaxalone
- Caution use with:
  - Mask induction
  - Ketamine
- Smooth and quick induction and intubation
- Pre-oxygenate



<https://pennvet.com/>  
<https://jurox.com>

# Maintenance

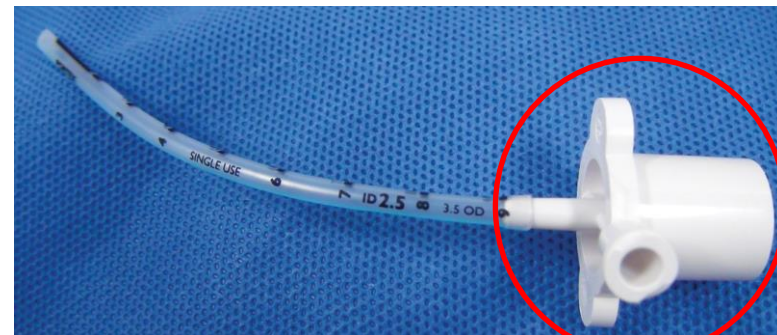
- Good to use:
  - Inhalants
- Consider MAC sparing techniques
- Minimize anesthesia time
- Monitor blood glucose intra-op
- Maintain normothermia
- Provide adequate IV fluids
- Judicious use of anticholinergics to support heart rate

# Airway Equipment

- Stylet
- Short laryngoscope blade
- Small endotracheal tubes
  - Consider uncuffed endotracheal tubes
- Non-rebreathing circuit if <3 kg
  - Alternatives: pediatric F circuit or pediatric Y rebreathing circuits
- Minimize mechanical dead space
- Consider IPPV (do not exceed 15-20 cmH<sub>2</sub>O)

# Monitoring

- ECG
- Blood pressure
- SpO<sub>2</sub>
- RR
- ETCO<sub>2</sub>
  - Mainstream vs sidestream
- Temperature



<https://todaysveterinarynurse.com/>

# Recovery

- Provide analgesia
- Maintain normothermia
- Maintain normal blood glucose concentrations
- Normal feeding should resume as soon as possible

# Conclusion

- Neonate and pediatric patients have limited organ reserve
- Use decreased drug dosage
- Maintain high heart rate
- Monitor temperature and blood glucose concentrations
- Provide appropriate analgesia