Patients with Cardiovascular Diseases

General considerations

- Most anesthetics produce some degree of cardiovascular depression
- The patient with preexisting cardiovascular disease often has reduced cardiac reserve - less ability to compensate for anesthetic-induced depression
- Usually patients with compensated cardiovascular disease (that is, not exhibiting any clinical symptoms of their disease) tolerate anesthesia fairly well
- The cardiopulmonary system functions to ensure that the rate of delivery of oxygen (DO2) meets or exceeds the consumption of oxygen (VO2) in the whole body (review Cardiopulmonary Physiology lecture)
- Effects of anesthetics on the cardiovascular system are
  - impairment of calcium utilization (inhalants, barbiturates)
  - alteration of systemic vascular resistance, heart rate, blood pressure
  - development of intracellular acidosis (secondary to respiratory depression)
- Many different types of cardiovascular disease may be encountered
  - congenital heart disease
  - acquired valvular disease
  - significant preexisting arrhythmias
  - hypotension/hypovolemia
  - dilated cardiomyopathy
  - anemia
- Primary goals of anesthetic management in these patient groups are to
  - avoid wide swings in heart rate
  - minimize changes in preload and afterload
  - prevent hypovolemia or overhydration
  - minimize changes in inotropy (myocardial contractility)
Ways to support the cardiovascularly challenged patients

- Stabilize heart rate & rhythm prior to anesthesia if possible
- Optimize cardiac function prior to anesthesia if possible
- Physical examination: observe jugular distension, pulsation, palpate peripheral arterial pulse quality, auscultate heart for assessing characters of pulsation
- Thorough cardiac evaluation prior to anesthesia - ECG, Doppler echocardiograph, thoracic radiographs, blood pressure measurement, ultrasonography, cardiac catheterization
- Laboratory evaluation - PCV, TP, hemoglobin content, arterial blood gases, electrolytes
- Choose anesthetic agents that produce minimal cardiovascular changes and preferably have drugs of short duration of action or that are reversible
- Preanesthetics: rely mostly on opioids +/- benzodiazepines: neuroleptanalgesic combination
- Anticholinergics are used judiciously
- Employ local anesthetic technique under sedation or even general anesthesia
- Induction: propofol, etomidate, ketamine, mask with inhalant
- Maintenance: usually isoflurane or sevoflurane (rapid recovery and less cardiovascular depression than halothane)
- Monitor cardiovascular performance
  - ECG: rate and rhythm
  - arterial blood pressure (BP = CO x SVR)
  - central venous pressure (preload)
- Treat arrhythmias if they develop
  - significant VPC – lidocaine, beta-blockers
  - significant bradycardia or bradyarrhythmias – glycopyrrolate, atropine, isoproterenol or temporary pace maker implant if medically nonresponsive
- Support inotropy with
  - adrenergic agonists
    - dobutamine
    - dopamine
    - doepxamine
    - ephedrine
    - norepinephrine
    - epinephrine
  - phosphodiesterase inhibitor
    - milrinone
    - amrinone
    - enoximone
    - theophylline
    - pentoxyfylline
  - calcium channel sensitizer
    - levosimendan
    - pimobendan
  - digoxin
  - calcium
  - glucagon
Case example

- “Taylor”
- Signalment: 6 month old intact male Maltese of 2kg in bwt
- History: presented for evaluation of inappetence, ataxia, weakness and exercise intolerance
- Significant physical exam findings: ataxia, muscle weakness, heart murmur
- Laboratory finding: no abnormalities noted
- Thoracic radiographs: enlarged heart shadow
- Echocardiographic findings: patent ductus arteriosus
- Presented for PDA surgical ligation

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<tr>
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<th>Goal &amp; Plan</th>
<th>Action</th>
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<tbody>
<tr>
<td><strong>Preanesthetic</strong></td>
<td>Maintain diastolic blood pressure, avoid alpha blockers (phenothiazine)</td>
<td>Neuroleptanalgeisa: midazolam 0.2 mg/kg IM, oxymorphone 0.1 mg/kg IM; glycopyrrolate 0.01 mg/kg IM</td>
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<tr>
<td><strong>medication</strong></td>
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<tr>
<td><strong>Anesthetic</strong></td>
<td>Little change of blood pressure, myocardial contractility</td>
<td>Diazepam 0.1 mg IV + Etomidate 3 mg/kg IV to effect</td>
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<td><strong>induction</strong></td>
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<td><strong>Maintenance of</strong></td>
<td>Avoid deep plane of anesthesia, Little change of blood pressure,</td>
<td>Sevoflurane endtidal 2.0 – 2.4 %, fluids 10 ml/kg/hr,</td>
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<tr>
<td><strong>anesthesia</strong></td>
<td>myocardial contractility, support ventilation</td>
<td>dopamine 1- 5 mcg/kg/min PRN, controlled ventilation (IPPV)</td>
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<td><strong>Monitoring</strong></td>
<td>Oxygenation, circulation, ventilation, temperature</td>
<td>ECG, pulse oximetry, capnography, invasive ABP, CVP, temp, ABG</td>
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<td><strong>Postoperative</strong></td>
<td>Patent airway, avoid hypothermia, pain control</td>
<td>Leave the ET tube as long as possible, Forced warm air blanket, pulse oximetry, oxymorphone 0.05 mg/kg IV</td>
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<tr>
<td><strong>care</strong></td>
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Patients with Respiratory Diseases

General considerations

- Many anesthetics produce some degree of respiratory depression
- The respiratory depression in combination with cardiovascular depression induced by most anesthetics, decreases oxygen availability in the tissues
- Avoid heavy sedation that may induce excessive respiratory depression
- May have impairments of ventilation, oxygenation, or both
- Ventilatory impairment affects acid/base balance
- Oxygenation impairment affects oxygen delivery to tissues
- Respiratory disease may be divided into upper or lower airway disease
  - With upper airway disease, the key is to bypass the upper airway obstruction as quickly as possible
  - With lower airway disease, our ability to correct/manage the problem may be more limited
- Patient with poor compliance of the lung (restrictive disease such as pulmonary edema, fibrosis or effusion) tend to adopt rapid shallow ventilatory pattern
- Patients with obstructive disease (laryngeal paralysis, collapsing trachea, small airway disease) tend to adopt a slower pattern with increased respiratory effort
- Inspiratory dyspnea is usually associated with extrathoracic and expiratory dyspnea with intrathoracic lesion in origin.
- If pneumonic that can be treated with antibiotics and other supportive therapy, delay the surgery as long as possible until the symptom gets fully resolved

Preoperative evaluations

- Thorough physical exam and ancillary investigation
- Does the patient exhibit dyspnea at rest? with exercise/stress?
- Is there stridor present?
- Thorough auscultation of the lungs and trachea
- Radiographs/ultrasonography
- ECG
- Pulse oximetry
- Wright’s respirometer and tight fitting face mask to assess respiratory volume (tidal volume and minute ventilation)
- Blood gas analysis

Keys to anesthetic management

- Preoxygenate, if possible
- Thoracocentesis if needed (remove air, fluid, blood, etc...)
- Minimize stress
- Tranquilization/sedation with short acting or reversible drugs
  - Opioids (resp. Depression)
  - Benzodiazepines
  - Phenothiazines?
  - Avoid excessive doses so as to prevent resp depression
- Rapid induction with short acting anesthetic agents
  - Thiobarbiturates
o Propofol
o Etomidate
o Ketamine

• minimize oxygen deficit period by allowing rapid intubation and ventilation
• Control airway as quickly as possible, begin positive pressure ventilation (esp. with lower airway disease)
• Nitrous oxide may be better avoided.
  o It diffuses into gaseous pocket and worsens symptoms such as pneumothorax
  o It reduces the inspiratory fraction of oxygen
• Monitoring:
  o ECG
  o Pulse oximetry
  o BP
  o Capnography
  o Serial blood gas analysis
  o Tidal volume and peak airway pressure (thoracic compliance)
  o Temperature
• Recovery
  o Maintain ET tube in situ as long as possible
  o Post-operative pulse oximetry
  o Support ventilation as long as possible
  o Consider post anesthetic oxygen supplementation
    ▪ mask
    ▪ nasal catheter
    ▪ oxygen cage
  o Minimize stress, judicious use of tranquilizers/sedatives if needed
  o If acute respiratory obstruction occurs post extubation, be prepared to reinduce anesthesia & reintubate rapidly
  o Treat chest pain so as to facilitate better use of respiratory muscle

Case example 1

• "Jake"
• Signalment: 1 year old intact male Labrador retriever
• History: presented for evaluation anorexia, listlessness of one week's duration
• Significant physical exam findings: tachypnea, fever
• Laboratory finding: elevated white blood cell count
• Thoracic radiographs: pleural fluid, lung lobe collapse (suspect lung lobe torsion)
• Presented for anesthesia 3/27 for thoracic exploratory

Preanesthetic management?

Anesthetic induction?

Maintenance of anesthesia?

Monitoring?

Postoperative care?
Case example 2

- "Miss Genuines"
- Signalment: 1 week old Quarter Horse filly
- History: presented for choanal atresia
- Significant physical exam findings: normal neonatal foal except for nasal obstruction
- Laboratory finding: normal
- Referring DVM had performed a tracheostomy shortly after birth
- Presented for anesthesia 4/6 for laser surgical correction of choanal atresia

Preanesthetic management?

Anesthetic induction?

Maintenance of anesthesia?

Monitoring?

Postoperative care?
Patients with Gastrointestinal Diseases

General considerations

- Variety of disease processes...
- Malabsorption
- Derangement of electrolytes, acid-base status
- hypovolemia
- Preoperative stabilization of fluid balance, electrolyte balance important, if possible...

Gastric dilatation/volvulus (GDV)

- Surgical emergency
- Present with:
  - Respiratory compromise
  - Cardiovascular compromise
  - Cardiac dysrhythmias (VPCs, V tach, tachycardia)
  - Hypotension
  - Hypoxemia
  - Acid/base disturbances
- If possible, decompress stomach prior to anesthesia
- Large volumes of IV fluids rapidly (multiple large bore catheters) at 40-90 ml/kg
- Acid/base evaluation helpful
- Monitor & treat cardiac dysrhythmias as they present - lidocaine usually first line of defense
- Anesthetic management
  - Preanesthetic: opioids +/- benzodiazepines
  - Induction:
    - rapid induction to gain control of airway quickly is preferable, initiate positive pressure ventilation
    - may be able to intubate w/ neuroleptanalgesic combination (eg oxymorphone + diazepam)
    - propofol preferred
    - low dose thiopental may be used - but cautiously - potential for aggravating arrhythmias
    - mask induction w/ isoflurane/sevoflurane may be used - but it is still slower
  - Maintenance
    - isoflurane/sevoflurane
    - supplemental opioids (eg oxymorphone, hydromorphone, fentanyl) IV to reduce inhalant concentration
  - IPPV usually needed
  - Monitor cardiovascular system closely
    - ECG
    - Blood pressure
Equine Colic

- One of our most common emergency surgical procedures
- Patients present in a variety of conditions, from minimally to severely compromised
  - Respiratory compromise
  - Cardiovascular compromise
  - Dehydration
  - Hypotension
  - Hypoxemia
  - Electrolyte imbalances
  - Acid/Base disturbances

- Again, stabilize if possible
  - Large volumes of fluids IV rapidly (multiple large bore catheters)
  - Bicarbonate if acidotic
  - Pain management (usually w/ alpha-2, NSAID such as Flunixin meglumine)

- Our current anesthetic protocol
  - Premedicate with xylazine + butorphanol or xylazine
  - Induce with diazepam + ketamine or GGE + ketamine
  - Maintain with sevoflurane
  - Monitor
    - invasive blood pressure
    - ECG
    - capnography
    - serial blood gases and electrolytes
  - Controlled ventilation (IPPV)
  - Multiple IV lines for rapid fluid administration
  - Dobutamine or other positive inotropes to support BP and CO
  - Calcium supplementation if hypocalcemic
  - Colloids if TP < 4 g/dl

- Recovery often slow - postoperative pain management should be considered