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ANESTHESIA FOR PATIENTS WITH CARDIOVASCULAR, RESPIRATORY & GASTROINTESTINAL DISEASES

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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 (DO_2) meets or exceeds the consumption of oxygen (VO_2) 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
  - phophodiesterase 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

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

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

    - Propofol
    - Etomidate
    - 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.
    - It diffuses into gaseous pocket and worsens symptoms such as pneumothorax
    - It reduces the inspiratory fraction of oxygen
- Monitoring:
    - ECG
    - Pulse oximetry
    - BP
    - Capnography
    - Serial blood gas analysis
    - Tidal volume and peak airway pressure (thoracic compliance)
    - Temperature
- Recovery
    - Maintain ET tube *in situ* as long as possible
    - Post-operative pulse oximetry
    - Support ventilation as long as possible
    - Consider post anesthetic oxygen supplementation
        - mask
        - nasal catheter
        - oxygen cage
    - Minimize stress, judicious use of tranquilizers/sedatives if needed
    - If acute respiratory obstruction occurs post extubation, be prepared to reinduce anesthesia & reintubate rapidly
    - 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 dilitation/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