Anesthetic management of Diaphragmatic Hernia
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Summary
Describe the various types of diaphragmatic hernias
Identify our anesthetic concerns for the most common surgical patients using the
delivery of oxygen equation
Make an anesthetic plan based on our anesthetic concerns

Types of diaphragmatic hernias
Traumatic
   Acute
   Subacute
   Chronic
Congenital
   Pleuroperitoneal
   Peritoneopericardial (aka PPDH)

Our most common surgical patients are found within the traumatic variety of diaphragmatic
hernias. We must consider at least 3 different scenarios for the various anesthetic concerns we
can encounter. In each case, we should consider how the condition affects the delivery of
oxygen.

Consider the equation DO2 = CaO2 (content of arterial oxygen) x CO (cardiac output). Please
recall that CaO2 takes into consideration the amount of hemoglobin (Hb) present, the
percentage of hemoglobin oxygen saturation (SaO2), and the partial pressure of oxygen
dissolved in plasma (PaO2). CO include heart rate multiplied by stroke volume (preload,
afterload, and cardiac contractility).

Acute Diaphragmatic Hernia Anesthetic Concerns

Hypoventilation (PaO2 and SaO2)
   Pain from fractured ribs
   Pneumothorax
   Atelectasis
   Hemothorax
   Abdominal organs invading the chest
Anemia (Hb)
   Hemothorax
   Other internal bleeding (liver, spleen, kidney)
Shock (Preload, Afterload)
   Hemorrhage
   Autonomic disturbances
Arrhythmias (Heart rate)
Concussive cardiac damage
Aspiration of gastric contents (Pa O2)

Acute Diaphragmatic Hernia Anesthetic protocol

First stabilize prior to any anesthetic administration

If patient is experiencing tachycardia check for evidence of hemorrhage (CBC, PCV, ultrasound). Place IV catheter for fluid therapy. Provide a quarter to a third shock dose (80-90 mL/kg, dog) (50-60 mL/kg, cat) crystalloids while determining Hb concentration.

Provide flow-by oxygen support.

Flow-by oxygen is sufficient when the patient is breathing comfortably and the pulse oximeter is reporting 93-95% saturation of hemoglobin. This should be continued until the patient has been induced for surgical intervention.

If patient is experiencing paradoxical breathing pattern and/or pulse oximetry doesn’t improve to 93% or better with flow-by oxygen consider emergency induction and rapid intubation. In this case, a neuroleptic induction may be necessary, meaning a high dose opioid (15 mcg/kg Fentanyl) and high dose benzodiazepine (0.5 mg/kg Midazolam). This combination is mixed in the same syringe and given as a third of the milliliter dose every 30 seconds until the patient can be intubated.

Provide analgesia

Assuming the patient has no evidence of altered mentation secondary to traumatic brain injury a full mu agonist such as: hydromorphone, methadone, fentanyl (along with a continuous rate infusion), or morphine can be used to treat pain and can be used as a pre-emptive analgesic/premedication before anesthesia.

Be prepared to assist in patient ventilation after anesthetic induction

Reverse Trendelenburg position
Hand ventilate or mechanical ventilation

Try to improve atelectasis

Recruitment maneuvers
Positive-end expiratory pressure
Ventilate at the lowest effective peak inspiratory pressure
Be prepared to treat arrhythmias from traumatic injury

  Treat when arrhythmias causing deleterious effects on cardiac output
  Lidocaine bolus 2 mg/kg up to 8 mg/kg along with lidocaine cri 50 mcg/kg/min
  Avoid inducing with Ketamine if arrhythmias are present as you may increase the severity of the arrhythmia.

Be prepared to treat autonomic disturbances secondary to trauma and anesthesia

  Dobutamine 1-5 mcg/kg/min as a CRI
  Dopamine 5-20 mcg/kg/min as CRI
  Norepinephrine 0.05-2 mcg/kg/min as CRI

Consider pre-treating the patient for post anesthetic nausea

  Cerenia 1 mg/kg
  H2 blocker or proton pump inhibitor

Consider arterial catheter for direct blood pressure measurement and arterial blood gas sampling

Don’t forget post-operative considerations

  Analgesia
    Pure mu agonist such as fentanyl CRI
  Oxygen supplementation during recovery
    Post op atelectasis
  More intensive post op monitoring
    Heart rate
    Blood pressure
    Respiratory rate
    Pulse oximetry/blood gas monitoring
    Temperature
    Pain and anxiety checks

Subacute and chronic diaphragmatic hernia anesthetic concerns

  Hypoventilation (PaO2 and SaO2)
  Hydrothorax
  Atelectasis
  Abdominal organs invading the chest

  Aspiration of gastric contents
Bleeding
Adhesions

Re-expansion pulmonary edema
   Chronic atelectasis
   Shearing forces
   Lack of surfactant
   Inflammatory response

Provide flow-by oxygen support.
   Flow-by oxygen is sufficient when the patient is breathing comfortably and the pulse oximeter is reporting 93-95% saturation of hemoglobin. This should be continued until the patient has been induced for surgical intervention.

Provide analgesia
   A full mu agonist such as: hydromorphone, methadone, fentanyl (along with a continuous rate infusion), or morphine can be used to treat pain and can be used as a pre-emptive analgesic/premedication before anesthesia.

Be prepared to assist in patient ventilation after anesthetic induction
   Reverse Trendelenburg position
   Hand ventilate or mechanical ventilation

Try to improve atelectasis gradually as re-expansion pulmonary edema may result from over aggressive recruitment
   Recruitment maneuvers
   Positive-end expiratory pressure
   Ventilate at the lowest effective peak inspiratory pressure

Be prepared to treat autonomic disturbances anesthesia
   Dobutamine 1-5 mcg/kg/min as a CRI
   Dopamine 5-20 mcg/kg/min as CRI
   Norepinephrine 0.05-2 mcg/kg/min as CRI

Consider pre-treating the patient for post anesthetic nausea
   Cerenia 1 mg/kg
   H2 blocker or proton pump inhibitor
Consider arterial catheter for direct blood pressure measurement and arterial blood gas sampling

Don’t forget post-operative considerations

Analgesia
   - Pure mu agonist such as fentanyl CRI
Oxygen supplementation during recovery
   - Post op atelectasis
More intensive post op monitoring
   - Heart rate
   - Blood pressure
   - Respiratory rate
   - Pulse oximetry/blood gas monitoring
   - Temperature
   - Pain and anxiety checks