Pulmonary Complications after General Anesthesia

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Pulmonary complications following surgery can have significant morbidity and mortality

Can be associated with reintubation and an ICU stay

Prolonged intubation is associated with increased risk of developing an infectious process such as ventilator associated pneumonia


Atelectasis

Patients undergoing general anesthesia have many changes that can lead to post operative hypoxia

Major cause of post operative hypoxia is atelectasis

– Atelectasis occurs in 90% of all anesthetized patients

– Atelectasis can lead to increased work of breathing which increases the risk of reintubation


Atelectasis

During anesthesia there is a 16-20% decrease in functional residual capacity (FRC) immediately following induction

As the FRC decreases there is airway closure, reduced compliance and ventilation perfusion mismatching

Atelectasis

Post operative atelectasis leads to post operative hypoxemia

This is a major concern with morbidly obese patients

Atelectasis combined with partial neuromuscular blockade and opioids can lead to acute respiratory failure


Hypoxemia

Causes:

– Atelectasis

– Hypoventilation

– Fluid overload

– Exacerbation of COPD
Hypoxemia

Associated with delirium
  – May occur in 65% of post operative patients

Wound infection
  – Neutrophil function depends on oxygen tension

Association with ECG changes


Pneumonia

Occurs in up to 9% of high risk surgery patients

Mortality between 20%-45%

Extended ventilatory support patients are at risk for ventilator associated pneumonia

Pneumonia

There may be an association with developing pneumonia and atelectasis

Noninvasive mechanical ventilation may help reduce the risk of pneumonia


Local Inflammatory Response

Atelectasis leads to hyperinflation next to atelectatic areas and hyperoxemia in these areas. This can lead to the release of inflammatory mediators and mild lung injury.

Ventilator Induced Lung Injury


Negative Pressure Pulmonary Edema

A condition where pulmonary edema develops immediately after upper airway obstruction

– Type 1 associated with inspiratory effort

– Type 2 occurs after relief of partial airway obstruction
Negative Pressure Pulmonary Edema

Type 1
- Laryngospasm
- Epiglottitis
- Endotracheal Tube Obstruction

Type 2
- After tonsillectomy
- After laryngeal mass excision

Incidence may be as high as 1 in every 1000 anesthetics in healthy individuals

During emergent intubation it may possibly be as high as 11%

Rarely seen in MICU populations
**Negative Pressure Pulmonary Edema**

Common sign is respiratory distress following extubation

Can be delayed up to 24 hours

Chest film will show bilateral changes consistent with pulmonary edema

Treatment:

- Supportive care
- Usually PEEP or CPAP can lead to rapid resolution
- Severe case may require mechanical ventilation
- Diuretics can exacerbate hypovolemia in post operative patients

Transfusion Related Lung Injury

Syndrome of non cardiac pulmonary edema that occurs a few hours after transfusion of a blood product

Incidence is 1-5 in 10,000 transfusion

Exact mechanism unknown, possibly related to antibodies in donor blood

Transfusion Related Lung Injury

Hypoxia

Hypovolemia

Hypotension

Fever
Transfusion Related Lung Injury

Care is supportive
- Blood pressure support
- Possibly mechanical ventilation
- Avoid diuretics because associated with hypovolemia

Mortality as high as 5%

 Usually resolves in 24-48 hours

If patient survives usually no sequelae


Transfusion Associated Circulatory Overload

Pulmonary edema associated with transfusion

Associated with:
- Dyspnea
- Tachypnea
- Usually Hypertensive
Transfusion Associated Circulatory Overload

Diuresis is the common treatment

Patients may need mechanical ventilation

Mortality rates of 5-15% have been reported


Pneumothorax

Presence of air in the pleural cavity leading to lung collapse

Small pneumothorax can be asymptomatic

If air is unable to escape may be lead to a tension pneumothorax
Pneumothorax

Risk Factors:

– Central Line Placement
– Emphysema (Blebs)
– Laproscopic Surgery
– Trauma
– Bronchoscopy

Pneumothorax

Presentation:

– Decreased SpO2
– Tachycardia
– Distention of neck veins
– Possible subcutaneous emphysema
– Decreased breath sounds on the affected side
– Hypotension (especially with a tension pneumothorax)
Pneumothorax

Increase FiO2 to 100%

Notify surgical team

Needle decompression with a large bore needle midclavicular line 2nd intercostal space

Place a chest tube

Diagnosis of Pneumothorax with Ultrasound

Krishnan, S. et al. Anesthesiology. 2013:118(3); 715-21.
Surgical patients are at increased risk for pulmonary embolus (PE)

Factors that increase risk of PE include activation of clotting cascade, acute inflammatory reaction, immobilization

Virchow’s Triad: venous stasis, hypercoagulable state, and endothelial damage

Classic Findings include:

- Dyspnea
- Tachycardia
- Hypotension

If a patient is still unconscious hypotension and tachycardia may be the only presenting findings
Pulmonary Embolus

Respiratory dysfunction and hypoxia are some of the first changes seen in anesthetized patients

- Hypoxia
- Increased airway pressures
- Decrease in dead space
  - (decreased End tidal CO2 with large gradient when compared to arterial blood gas)

Pulmonary Embolus

Supportive therapy should be instituted before diagnosis is made

- Increase FiO2
- Vasopressors / Inotropes
- Pulmonary artery dilators
Pulmonary Embolus

Norepinephrine may be very beneficial

– Alpha 1 vasoconstriction increases blood pressure
– Beta 1 increases contractility and cardiac output
– Can also use norepinephrine combined with dobutamine

Pulmonary Embolus

Nitric Oxide may also be considered

– Can decrease pulmonary artery pressures
– Increase cardiac output
– Does not decrease systemic blood pressure significantly
**Pulmonary Embolus**

Treatment includes anticoagulation therapy

- Warfarin requires monitoring
- Heparin requires monitoring
- Unfractionated low molecular weight heparin requires no monitoring

**Pulmonary Embolus**

Thrombolysis therapy

- High risk of bleeding
- Should be used in patient that are unstable despite supportive care
- Should also be used if not a high risk of bleeding
Pulmonary Embolus

Pulmonary embolectomy

– Surgical and catheter directed

– Should be used in patients who have failed thrombolysis with severe hemodynamic compromise

– High mortality rate (6%-27%)


Strategies to Decrease Pulmonary Complications

Low FiO2

PEEP

Recruitment Maneuvers

Post operative Noninvasive Mechanical Ventilation

NIV has been shown to prevent ventilation in surgical patients

Major problems are patient intolerance which can lead to stress and increased work of breathing

Summary

We have talked about several different pulmonary complications we can encounter during general anesthesia.

They can lead to a prolonged hospital stay.

They can and will happen.

Summary

Pulmonary complications occur often after surgery.

There are many risk factors that can lead to pulmonary complications.

Ventilatory strategies, fluid strategies, and transfusion strategies can decrease the risk.