

Thoracic Trauma

Often multi-trauma victim with co-existing injuries, thoracic trauma may result in laryngeal injury, tracheo-bronchial tree disruption, chest wall and pulmonary injury, aortic / great vessel disruption and myocardial injury with perioperative mortality associated with hemorrhage, RV failure, air embolism

ANESTHETIC CONSIDERATIONS:

- **Trauma patient:**
 - TBI, c-spine
 - Full stomach, difficult airway
 - Associated injuries
 - Temperature
 - Hemorrhage and hemodynamic instability
 - Intoxicants
- **Pulmonary trauma** with hemodynamic and ventilatory compromise
 - High index of suspicion for TBT disruption or injury
- **Aortic injuries** with hemodynamic implications
- **Cardiac injuries** with hemodynamic compromise
- Associated injuries – high incidence of associated **head injury, C-spine injury, abdominal and pelvic injury**

ANESTHETIC GOALS:

- Resuscitation
- Secure the airway
 - Conflicts: cervical spine injury, a full stomach, an uncertain volume status, a possibly combative patient, and potential hypoxemia, therefore goals include:
 - Secure airway first & then oxygenate to prevent hypoxia
 - Hemodynamic stability
 - C-spine stabilization
- Prevention of secondary spinal cord injury from hypoxemia or hypotension

HISTORY

- Blunt or penetrating trauma to chest
- Mechanism of injury- High velocity injuries, fall from great height, acceleration / deceleration injuries have higher incidence of aortic injuries, TBT disruption
- Mortality at the scene
- Associated injuries – particularly closed head injury, C-spine, abdominal, pelvic
- Time from injury to extraction and arrival at hospital – exposure, temperature
- Intoxicants, stimulants, depressants, etc.
- Usual anesthetic history if possible, allergies, meds, medical conditions
- **Simplified diagnosis / treatment of potential life threatening injuries**
 - **Pneumothorax:** (Simple) Hyper-resonant chest, reduced / absent breath sounds, but neck veins down and trachea central, hypoxemia: Treatment: Chest tube
 - **Tension Pneumothorax:** Neck veins dilated, trachea deviated, absent / reduced breath sounds, hyper-resonant chest, hypoxemia, hypotension: Treatment: immediate needle decompression followed with Chest tube
 - **Tamponade:** Evidence of chest trauma, dilated neck veins, muffled heart sounds, and decreased arterial blood pressure (possibly even pulseless electrical activity) (Beck's triad): Treatment: Needle pericardiocentesis, cardiology / CVT consult for drain / window etc
 - **Massive Hemothorax:** hypoxic, shocky, stony dull chest, absent breath sounds and deviated trachea: Treatment: ensure iv access, chest tube
 - **Flail Chest:** paradoxical chest wall segment motion during spontaneously ventilation: Treatment: if associated with hypoxemia, intubate
 - **Open Chest:** wound finding of simple pneumothorax but open wound + sucking with spontaneous ventilation: Treatment: occlusive dressing + chest tube

PHYSICAL

- ATLS
- Simultaneous diagnosis and treatment
- Primary Survey
 - Oxygen, Vitals, C-spine precautions, IV access
 - Airway
 - Patency, facial injuries
 - Tracheal deviation
 - Hoarseness, stridor, hypersalivation, subcutaneous emphysema
 - Breathing
 - Obvious life threatening chest injuries
 - Airway obstruction
 - Tension pneumothorax
 - Open pneumothorax
 - Massive hemothorax
 - Flail chest
 - Cardiac tamponade
 - Diaphragmatic Rupture
 - Circulation
 - Establish 2 large bore IV's, Fluid resuscitation
 - Vitals and adequacy of peripheral perfusion

- Look for sources of blood loss:
 - Chest , Abdomen, Pelvis, Femurs, Extremities
 - Disability
 - Exposure and Cover
 - Investigations
 - Re-assess primary survey
 - Secondary survey

INVESTIGATIONS

- **Labs**
 - Trauma blood work
 - CBC, lytes, BUN, Creatinine, coagulation factors, LFTs, ABG, lactate, glucose, initial blood cultures
 - Toxicology screen
- **Imaging**
 - X-rays: C-spine series, CXR, Pelvis XR

OPTIMIZATION

- Volume resuscitation, maintain hemodynamics with pressors / inotropes
- Define MAP goals based on age, presence of head injury, ongoing blood loss
- Depending on underlying injuries – ETT + PPV, chest tubes

ANESTHETIC OPTIONS

- Chest injuries going to the OR require a GA, or hemodynamic support, midazolam and muscle paralysis
- Rapid sequence intubation with inline stabilization (C-Spine), place ETT large enough to pass FOB and bronchial blocker, or secure airway, decompress stomach, then replace ETT with DLT over FOB
- Protective ventilatory strategies – high frequency / low volume, PEEP as tolerated

ANESTHETIC SETUP

- **Drugs**
 - O-negative or cross-matched blood in room
 - Infusion pumps, inotropes and vasopressors as infusions (norepinephrine, dobutamine, epinephrine)
 - Medications to rapidly control hemodynamics (phenylephrine, ephedrine, hydralazine, labetalol, nitroglycerine)
- **Equipment**
 - Expert help (anesthesia tech, another anesthesiologist)
 - CAS + 5-lead, Art-line, CVP, Trauma line, large bore IV x 2, TEE or PA catheter, urinary catheter, temperature monitoring
 - Double lumen tube or bronchial blocker with FOB for lung isolation if necessary
 - Cardiopulmonary bypass may be required
 - Level one infuser, cell saver, blood / fluid warmer, warming blanket

MANAGEMENT OF ANESTHESIA

- **Induction**
 - Initial resuscitation and recognition of the above injuries is key
 - Consider underlying thoracic pathology and method of induction:
 - Awake intubation for patients with difficult airway (possible tracheostomy in laryngeal injury)
 - Spontaneous ventilation induction vs. awake: Large BPF, tamponade
 - RSI for others (All above with C-spine control)
 - Etomidate or Ketamine are reasonable choices if patients are hypovolemic
- **Maintenance**
 - Possible need for lung separation (BPF, Aortic reconstruction, repair of mediastinal structure)
 - Vigilance for intra-operative complications:
 - Hypotension
 - Bleeding, tension pneumothorax, neurogenic shock, cardiac injury
 - Citrate toxicity, hypothermia, anaphylaxis, transfusion reaction
 - Pre-existing disease (i.e. CAD and ischemia)
 - Hypothermia
 - Use blood, air warmers and increase room temperature
 - Monitor central temperature
 - Coagulopathy
 - Dilutional, DIC, platelet dysfunction
 - Secondary to hypothermia, acidosis
 - Electrolyte or acid / base disturbance
 - Monitor blood work frequently
- **Emergence**
 - Consider post-op ventilation in major trauma and transfer to ICU setting
 - Patients with minor trauma may be extubatable if ABC stable, awake, warm, comfortable and no further injuries have presented themselves
 - 24 hours of monitoring may be indicated (pulmonary contusion, myocardial contusion, etc)
 - Consider epidural analgesia in a patient with rib fractures, who is unlikely to develop a coagulopathy or further complications secondary to their trauma

DISPOSITION & MONITORING

- High acuity / ICU

- Post-operative ventilation may be required depending on extent of injuries and surgery
- Chest trauma requiring pneumonectomy has mortality nearing 100%, intra-op deaths secondary to uncontrolled hemorrhage, acute RV failure, air embolism
- Analgesia:
 - Epidural often utilized to optimize respiratory function if rib fractures, flail chest, post-thoracotomy
 - Intercostals nerve blocks, intrapleural catheter
 - IV opioids, Tylenol, NSAIDs

COMPLICATIONS

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PATHOPHYSIOLOGY

- Pneumothorax**
 - Chest tube management, to OR only if associated mediastinal injury or blood loss >1500mL in first hours after injury
 - Hemorrhage usually results from injured intercostals arteries, internal mammaries
- Tracheobronchial Injury**
 - Usually evidenced by pneumothorax with massive air leak, often hemodynamic instability
 - Blunt injury usually occurs within 2.5cm of carina, may initially be unrecognized
 - Subcutaneous emphysema, pneumomediastinum, pneumopericardium, pneumoperitoneum without apparent cause should direct to TBT injury
- Traumatic Aortic injury**
 - Most common site distal to left subclavian artery due to shear forces between the mobile heart and aortic arch, and the immobile descending thoracic aorta
 - Surgical repair required due to high risk of rupture (days – hours post injury)
 - Best outcomes associated with partial bypass LA – descending aorta
- Rib Fractures**
 - Therapy directed at decreasing pulmonary morbidity_ pain, splinting, hypoxemia, atelectasis, pneumonia
 - Elderly (>55years) have twice the mortality and morbidity vs. younger patients with similar injuries
 - Epidural analgesia should be used in elderly or in any with severe pain, or if any pre-existing pulmonary disease (decrease M&M by 6% in >55yo population)
 - Flail chest –not all require PPV for internal chest stabilization, use usual ETT / PPV criteria
- Pulmonary Contusions**
 - Can resolve without sequelae, or can evolve into pneumonia or ARDS
 - PEEP as tolerated to manage hypoxemia due to increased shunt
 - Associated pulmonary injury – contusions, laceration, hemopneumothorax and use lung protective ventilatory strategies (high volume, low pressure, permissive hyperCO2)
- Cardiac Injuries**
 - Can EXCLUDE blunt cardiac injury if hemodynamics are stable, no indication of conduction disturbance or tachyarrhythmias on ECG
 - Bruising or edema of the myocardium is functionally indistinguishable from myocardial ischemia
 - Once diagnosed, manage as acute ischemic injury – continue resuscitation, careful use of fluids, coronary vasodilators, symptomatic treatment of rhythm disturbances
 - Consider cardiology consult for angiography / -plasty / stent
 - Rupture of chambers – usually atria (assoc with blunt and penetrating cardiac trauma) have high pre-hospital mortality, exsanguinate into thoracic cavity
 - Surviving patients often present with pericardial tamponade, these are highly unstable, often diagnosed with FAST or during ER thoracotomy
 - Relief of tamponade, suture or x-clamp of laceration / injury to restore vital signs enough to get to OR for hemostasis / chest closure

REFERENCES

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