Airway Management in the Multiply Traumatized Patient

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Airway Management in Trauma

• Can be extremely challenging and anxiety provoking
• Trauma patients considered “difficult airways”
• Additional factors can make them extremely difficult (blood in airway/airway trauma...)
• Multiple injuries, $\downarrow O_2$, $\downarrow BP$, $\uparrow ICP$
• Requires rapid assessment and decision making
• Ill advised decisions can have dire consequences
Airway Management in Trauma

• **Principles** = similar to elective situation
  
  – Pt assessment incl airway assessment; airway plan*/rescue plan(s) +++nb in emerg/trauma

• Most everything else isn’t
  
  – C-spine stabilization
  
  – Need to assess, decide and act quickly
  
  – Often without all info you’d like (ltd a/w assess)

*Technique, medications, airway tool(s), tube...
Keys for success

• No formula
• Organized approach
• Evaluation for indications of a difficult airway
• Careful selection of pharmacologic agents
• Back up plans and equipment
• Early use of a videolaryngoscope or other alternative airway tools when necessary
• Ability to perform surgical airway when necessary**
Outline

• Issues to consider
• Indications and Decision-making
• Methods of airway management
  – C-spine
• Preoxygenation
• Pharmacologic decisions
  – Induction agents/Muscle relaxants/Pre-treatment
• Special Situations (time permitting)
  – Combative patients/Increased ICP
ISSUES TO CONSIDER WHEN MANAGING THE AIRWAY OF THE TRAUMA PATIENT
Airway Management Considerations in Elective Patients

- Comorbidities?
- Aspiration risk?
- Difficult airway?
  - Mask ventilation, SGA insertion and ventilation, Laryngoscopy, videolaryngoscopy, intubation, surgical airway
Airway Management Considerations in Emergency Situations (Non Trauma)

- Difficult Airway (with limited time to assess)
- Aspiration Risk
- Comorbidities
- ↓O₂/↑CO₂
- ↓BP – hypovolemia/cardiac/sepsis...
- Decreased LOC/Increased ICP
- Intoxication
- Uncooperative
Airway Management Considerations in Trauma Patients

- Limited time to assess
- Full stomach
- Difficult airway
- Awkward intubation
- Facial trauma
- Airway injury
- Uncleared C-spine
- C-Spine Injury (CSI)

- Spinal cord injury
- ↓O₂/↑CO₂
- ↓BP/hypovolemia
- LOC/↑ICP
- Intoxication
- Uncooperative
- Comorbidities
Airway Management Considerations in Trauma Patients

- Limited time to assess
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- Spinal cord injury
- $\downarrow O_2/\uparrow CO_2$
- $\downarrow$BP/hypovolemia
- ICP
- Intoxication
- Uncooperative
- Comorbidities
Airway Management Considerations in Trauma Patients

• Need to (rapidly) consider all the issues and decide on “best” plan + rescue plans
Trauma patients needing airway management require...

- Rapid airway evaluation
- Development of an airway management plan
- Including rescue techniques in the event of failure
- Willingness to act quickly with incomplete information.
Indications for intubation in the trauma patient
Indications for Intubation/Decision Making

• Traditional Indications for Intubation
  ➢ Airway Patency
  ➢ Airway Protection (from aspiration)
  ➢ Oxygenation
  ➢ Ventilation
  ➢ Secretions*

• In trauma, indications are same but...
Indications for Intubation/Decision Making in Trauma

..... also need to consider the patient’s expected course/likelihood of deterioration:

• Any injuries that are likely to progress?

• Does/will the patient need to be intubated for surgery/investigations and will intubation/sedation help facilitate this?
Indications for Intubation/Decision Making in Trauma

• Ask 3 questions:

1. Is there a failure to maintain or protect airway?
2. Is there a failure of oxygenation or ventilation?
3. Is there a need for intubation based on the anticipated clinical course?
Decision Making/Indications for Intubation in Trauma – 1. **Airway Patency and Protection**

- **Gag reflex:**
  - Weak/absent in 25%
  - Not useful for assessment of protection (not sens or spec)
  - Potentially dangerous (vomiting)
Decision Making/Indications for Intubation in Trauma – 1. **Airway Patency and Protection**

- Phonation and Ability to Swallow and handle Secretions are best
  - **Phonation** - requires unobstructed airway
  - **Secretions/Swallowing** – ability to sense secretions in oropharynx and swallow indicate ability to protect airway
Decision Making/Indications for Intubation in Trauma –

2. Oxygenation/Ventilation

• Clinical assessment with support from SaO$_2$ form bulk of decision
• Decisions rarely made by ABGs
• High flow O2 via reservoir mask for all
• If ↓O2, any reversible causes?
  – i.e. PTX/HTX
• If not, intubate (**many conditions progress)
Decision Making/Indications for Intubation in Trauma:
3. Anticipated Clinical Course

• Injuries:
  – Airway (laryngeal) trauma; Inhalation injuries
  – May not met usual criteria for intubation
  – Swelling can progress, sometimes rapidly
  – Beware if hoarse (= v.cord(s) edema, injury, hematoma...)
  – If uncertain, intubate early
Decision Making/Indications for Intubation in Trauma:
3. Anticipated Clinical Course

- Need for analgesia/investigations/surgery
  - Need for ++ opioids
  - Need for transport for imaging
  - Ultimate need for surgery
  - Better to err on side of early intubation in ED if uncertain rather than risk deterioration in CT
Decisions re: Airway Management in Trauma Based on:

• Patient’s current condition
• **Likelihood of deterioration**
• Planned diagnostic and therapeutic interventions (including transport)
• Preinjury comorbidity
• Resources and expertise available in the resuscitation area.
Once decision is made, what technique(s) should be used to intubate?
Options

- Orotracheal, nasotracheal, cricothyroidotomy, tracheostomy, submental

- **Orotracheal**: Direct laryngoscopy, Videolaryngoscopy, FOB, LMA, ILMA, retrograde

- **Nasotracheal**: Blind, Laryngoscopy, FOB

- **Cricothyroidotomy**: Open, Seldinger, Bougie-assisted, needle (Transtracheal Jet Ventilation)
Options

• Awake intubation vs. induction

• Preservation vs. ablation of spontaneous ventilation

• Non-invasive technique vs. invasive techniques for the initial approach to intubation
Choice of technique

• Have to take into account:

  – Predicted airway difficulty
  – Urgency of airway management
  – Physiologic status of pt
  – Patient’s injuries
  – Equipment/personnel available
  – Ability to perform surgical airway
Choosing Technique

• RSI is standard/default method of securing airway in trauma patient
• Dependent on confidence in ability to see cords (and pass ETT) and to ventilate (oxygenate) pt
• Therefore, a rapid but detailed airway evaluation MUST be done before making decision to give NMBs (laryngoscopy, VL, BMV, SGA, surgical airway)
• Laryngoscopy (+) of trauma patients considered difficult
Methods of Securing Airway

- If airway looks ok, can perform RSI (BUT, **MUST** always have backup plans/equipment)

- If don’t think you can intubate OR ventilate, don’t paralyze patient
Urgency

• Urgency of situation affects decision
• Can determine based on status of A and B (and C)
• If A patent and not immediately threatened and O2 satn ok and C stable, have a bit of time
• If airway NOT patent and/or is threatened and/OR O2 sat low….don’t have luxury of time
<table>
<thead>
<tr>
<th>Airway Difficulty</th>
<th>Time</th>
<th>No/Min Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Airway not overly difficult (think you can intubate and ventilate)</td>
<td>Traditional RSI</td>
<td>Traditional RSI</td>
</tr>
<tr>
<td>Airway looks difficult (ventilate and/or intubate)</td>
<td>Awake intubation</td>
<td>Awake Intubation vs RSI with Double Set-Up (Neck prepped,</td>
</tr>
</tbody>
</table>
Failed airway criteria → Call for assistance

LMA or Combitube may be attempted while preparing for cricothyrotomy

BMV maintains SpO₂ ≥90%?

- Yes → Contraindicated
- No → Cricothyrotomy

Consider:
- Fiberoptic method
- LMA
- Lighted stylet
- Supraglottic airway

Time allows and successful?

- Yes → Cuffed ETT placed?
  - Yes → Postintubation management
  - No → Arrange for definitive airway management
- No → Cuffed ETT placed?
Rapid Sequence Induction
RSI

- Preoxygenation
- Cricoid Pressure
- Medications (induction, NMB, pre-treatment)
- Inline Stabilization
- C-spine movement
RSI - Preoxygenation

• Goals = SaO2 ~ 100%; Denitrogenate
• Many trauma patients hypoxemic
• Some uncooperative
• Unable to preoxygenate (adequately)
• Often, bite the bullet → RSI → ↓↓↓O2
• O2 satn < 70% → risk of dysrhythmias, HD decompensation, hypoxic brain injury, death
Preoxygenation

• “Nonrebreather” @ 15 L/min → ~ 65-80% O2 (if tight seal on face)
  Can increase to > 90% with 30-60 L/min flow

• Resuscitation bags (self inflating, BMV, Ambu):
  – Deliver O2 if: squeeze bag/pt generates enough force to overcome one-way valves (3-5 cm H2O)
  – Need tight seal on face
Preoxygenation

- Need 3-5 minutes
- Should have exhaled FIO2 ≥ 90%
- If physiologic shunt, O2 will not ↑ SaO2
- If pre-induction SaO2 < 93-95%, rapid desat
- Can attempt maneuvers to ↓ shunt/↑O2 sat:
  - ↑ Mean airway pressure (CPAP, NIV, PEEP valve on resusc bag)
Preoxygenation

• **Apneic Oxygenation** (must have patent airway**):  
  - Nasal cannulae at high flow (15 L/min)  
  - Facemasks (preferably with one-way valves)  
  - Resuscitation bags unhelpful  
  - CPAP; NIV

• Can mask ventilate pt if required (despite RSI)  
  – PEEP valve  
  – Use cricoid to prevent gastric distention
<table>
<thead>
<tr>
<th>Risk Category, Based on Pulse Oximetry While Receiving High-Flow Oxygen</th>
<th>Preoxygenation Period (3 Minutes)</th>
<th>Onset of Muscle Relaxation (≈60 Seconds)</th>
<th>Apneic Period During Tracheal Intubation (Variable Duration, Depending on Airway Difficulty; Ideally &lt;30 Seconds)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low risk, SpO₂ 96%–100%</td>
<td>Nonrebreather mask with maximal oxygen flow rate</td>
<td>Nonrebreather mask and nasal oxygen at 15 L/min</td>
<td>Nasal oxygen at 15 L/min</td>
</tr>
<tr>
<td>High risk, SpO₂ 91%–95%</td>
<td>Nonrebreather mask or CPAP or bag-valve-mask device with PEEP</td>
<td>Nonrebreather mask, CPAP, or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min</td>
<td>Nasal oxygen at 15 L/min</td>
</tr>
<tr>
<td>Hypoxemic, SpO₂ 90% or less</td>
<td>CPAP or bag-valve-mask device with PEEP</td>
<td>CPAP or bag-valve-mask device with PEEP and nasal oxygen at 15 L/min</td>
<td>Nasal oxygen at 15 L/min</td>
</tr>
</tbody>
</table>
Sequence of Preoxygenation and Prevention of Desaturation

(Assuming 2 oxygen regulators*)

Preoxygenation Period

- Position the patient in a semi-recumbent position (~20°) or in reverse Trendelenberg. Position the patient’s head in the ear-to-ster nal-notch position using padding if necessary.
- Place a nasal cannula in the patient’s nares. Do not hook the nasal cannula to oxygen regulator.
- Place patient on a non-rebreather mask at the maximal flow allowed by the oxygen regulator (at least 15 lpm, but many allow a much greater uncalibrated flow).
- If patient is not saturating > 90%, remove face mask and switch to non-invasive CPAP by using ventilator, non-invasive ventilation machine, commercial CPAP device, or BVM with PEEP valve attached. Titrate between 5-15 cm H₂O of PEEP to achieve an oxygen saturation > 98%. Consider this step in patients saturating 91-95%.
- Allow patient to breath at tidal volume for 3 minutes or ask the patient to perform 8 maximal exhalations and inhalations.
- Attach a BVM to oxygen regulator and set it to maximal flow (at least 15 lpm). If the patient required CPAP for preoxygenation, attach a PEEP valve to the BVM set at the patient’s current CPAP level.

Apneic Period

- Push sedative and paralytic (preferably rocuronium, if the patient is at risk for rapid desaturation).
- Detach face mask from the oxygen regulator and attach the nasal cannula. Drop the flow rate to 15 lpm.
- Remove the face mask from the patient.
- Perform a jaw thrust to maintain pharyngeal patency.
- If the patient is high risk (required CPAP for preoxygenation), consider leaving on the CPAP during the apneic period or providing 4-6 ventilations with the BVM with a PEEP valve attached. Maintain a two-hand mask seal during the entire apneic period to maintain the CPAP.

Intubation Period

- Leave the nasal cannula on throughout the airway management period to maintain apneic oxygenation.

* If 3 regulators are available, attach reservoir face mask, BVM, and nasal cannula to them. If only one regulator is available, consider using a standalone oxygen tank to offer a second source of oxygen.
Inline Stabilization

- C-spine immobilization when moving pt/airway maneuvers (ANY)
- NOT traction
- Beside thorax vs at head
- Don’t impede mouth opening
- **Always remove anterior collar**
- No RCTs but neuro deterioration less
- Worsens view at laryngoscopy
- Ease up as necessary
C-spine movement with airway maneuvers

• Studies done in healthy pts or cadavers with injury created post mortem
• All airway maneuvers cause some C-sp mvmt (but within limits of normal physiologic mvmt)
• Most movement in upper C-spine
• FOB and Trachlight seem to cause least movement (but coughing from topicalization occurs – inline stabilization)
C-spine movement with airway maneuvers

• Videolaryngosopes may cause less C-spine movement cw direct laryngoscopy

• All methods seem safe if appropriate precautions taken

• Reports of neuro worsening with A/W mgmt occurred without approp precautions taken

• Don’t need to see entire cords – use enough force to expose enough of cords to intubate
Cricoid Pressure

- Effectiveness is debated
- Often recommended for BMV
- Can distort airway anatomy and decrease effectiveness of BMV/make laryngoscopic view worse
- LMA: Prior to insertion – sits too high
- After insertion –
  - decreased gastric insufflation
  - decreased mean exp volume
Cricoid Pressure

• Therefore, reduce pressure/release if necessary

• Cricoid pressure and C-spine:
  • Intuitively, should avoid in case CSI
  • Studies: movement within physiologic limits
  • No evidence it causes harm
  • No evidence to encourage/discourage
Cricoid Pressure

- Reasonable to use it if believe in it
- Reasonable not to use it if don’t believe in it
- Probably use it if need to BMV
- Release if BMV ineffective/suboptimal
- Release if poor view at laryngoscopy
Medications for RSI (decrease doses to 1/2 to 1/3 (IBW) in hypotensive)

<table>
<thead>
<tr>
<th>Drug</th>
<th>Positives</th>
<th>Negatives</th>
</tr>
</thead>
<tbody>
<tr>
<td>Propofol</td>
<td>Beneficial ICP</td>
<td>↓BP/↓CPP</td>
</tr>
<tr>
<td>Ketamine</td>
<td>Sedation/Induction</td>
<td>↑ICP</td>
</tr>
<tr>
<td></td>
<td>Hemod stable/↑BP</td>
<td>Myoc depression</td>
</tr>
<tr>
<td>Etomidate</td>
<td>Hemod stable</td>
<td>Adrenal suppr’n</td>
</tr>
<tr>
<td></td>
<td>Beneficial ICP</td>
<td>?↑Pneumonia</td>
</tr>
<tr>
<td></td>
<td></td>
<td>?↑Death</td>
</tr>
</tbody>
</table>
Medications for RSI

• Succinylcholine generally recommended over rocuronium b/o shorter duration

• Pretreatment to prevent ↑ICP:
  – Fentanyl 3-5 ug/kg
  – Remifentanil ~1 ug/kg (reduce propofol dose)
  – Esmolol 0.2 – 1.5 ug/kg (0.5-1 ug/kg)
  – Lidocaine 1.5 mg/kg (less effective)
That’s all we have time for...
Challenges

• Need to act quickly with limited/incomplete info
• Limited time for incomplete airway assessment
• Airway management outside the OR
• Rescue plan(s) crucial
• Must consider risk of deterioration – need to secure airway early even if ok now i.e. swelling hematoma sc emphysema
Thank you very much