MONTANA TRAUMA TREATMENT MANUAL

Guidelines for the Treatment of Trauma

MONTANA DPHHS
Healthy People. Healthy Communities.
Department of Public Health & Human Services

Montana EMS
EMS & Trauma Systems

ACKNOWLEDGEMENT

We would like to thank Steven Briggs, MD from Sanford Medical Center-Fargo and Amy Eberle RN, former North Dakota State Trauma Program Manager for allowing us to use the North Dakota Trauma Treatment Manual as basis for this trauma care guide.

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Traumatic injury remains a leading healthcare problem within the State of Montana. The problem is compounded by a scare population spread over a large geographic area. As a consequence, delivery of appropriate trauma care does not fit into the highly refined urban trauma center model that is used by much of the country. In 1995 the foundations for development of a voluntary inclusive statewide trauma system were put in place. Designation of facilities as trauma centers that provide emergency care for injured patients, is a key component of the Montana Trauma System. Participating hospitals/clinics are designated by the State Trauma Care Committee, Performance Improvement subcommittee, through standardized reviews of the facilities' qualifications by our State review team, which consists of our RN contracted trauma coordinator reviewer and a rural trauma surgeon. There are 63 hospitals/clinics in the State that can meet the requirements of trauma designation. Of these 63 facilities, 42 are Critical Access Hospitals and 2 are rural clinics with limited resources and experience in the care of severely injured trauma patients. Healthcare at these facilities is provided primarily by mid-level (PA-C or NP) practitioners and primary care physicians.

All designated trauma facilities are expected to maintain a basic level of preparedness and ability to deal with traumatic injury. Implicit in the development of an inclusive trauma system is the standardization of trauma care across the state. It is reasonable to expect that a traumatic injury occurring in one region of the state will be cared for in an appropriate and similar fashion as an injury occurring in another part of the state. To establish a framework around which care can be standardized and monitored, the Montana State Trauma Treatment Guidelines were developed by members of the State Trauma Care Committee's Education Sub-Committee.

These guidelines are not meant to substitute for appropriate clinical evaluation. The authors and contributors to this manual are not responsible for the actions of providers utilizing this manual. This manual will be posted on line on the Montana EMS and Trauma Website (www.dphhs.mt.gov/ems/), listed under Montana Trauma Treatment Manual, and it can be used for; patient care guideline, orientation of new EMS and facility staff, medical providers, orientation of locums providers and traveler staff, and as a continuing education template, as a guideline for reviewing cases for the purpose of Performance Improvement.

This manual was created with reference to the Advanced Trauma Life Support® Course for the purpose of serving as a guide for providers in Hospitals to help guide them through the initial resuscitation and stabilization of the severely injured patient. The manual assumes providers have a working knowledge of ATLS®, but recognizes they see very few critically injured patients over the course of time. The content of this manual is based on the needs and assessments of the Montana Trauma Systems and will be subject to change as new literature and research is published regarding standards of care for the trauma patient.

Airway Assessment

Airway should be established/maintained while maintaining C-spine immobilization

Priorities

- Airway open and breathing on own
- Apply O2 15L/NRB mask
- O2 SAT Monitor
- Suction airway as needed;
  Airway obstruction with secretions, blood, teeth
- Sonorous respirations/reposition
- GCS <8

If airway problems persist, intubate or use rescue airway

If no problems, go to **Breathing** chapter

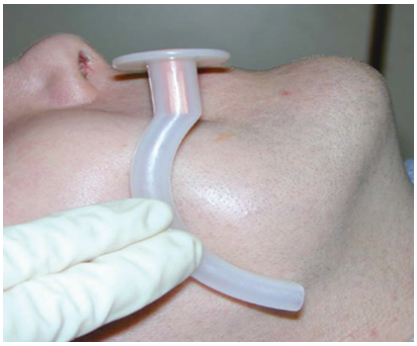
Use Length-based/Broselow ™ Tape for PEDIATRIC patients

Oropharyngeal Airway

- Noninvasive; follows curve of palate, follows curve to maintain open airway
- Indicated in patients with NO gag reflex
- Facilitates suctioning
- Can be used as a bite block to protect an endotracheal tube
- Does NOT protect from aspiration

Oropharyngeal Airway

1. Measure



2. Place

3. Assess

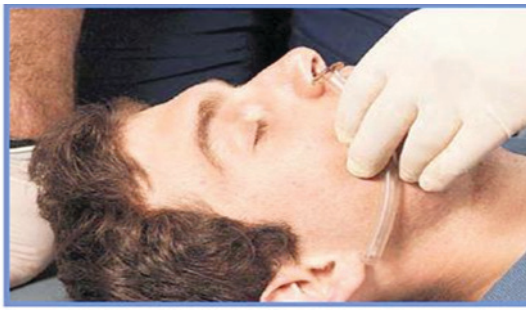
Check that the tongue was not inadvertently pushed back blocking the airway

Nasopharyngeal Airway

- Soft nasal tube; follows curve of nasopharynx to just below base of tongue
- Indicated for upper airway obstruction
- Tolerated by patients with and without gag reflex or clenched teeth
- Not recommended for facial or head trauma
- Can cause more trauma during placement

Nasopharyngeal Airway

1. Measure



2. Placement

Pull up on tip of nose for ease of insertion

Nasopharyngeal Airway (continued...)

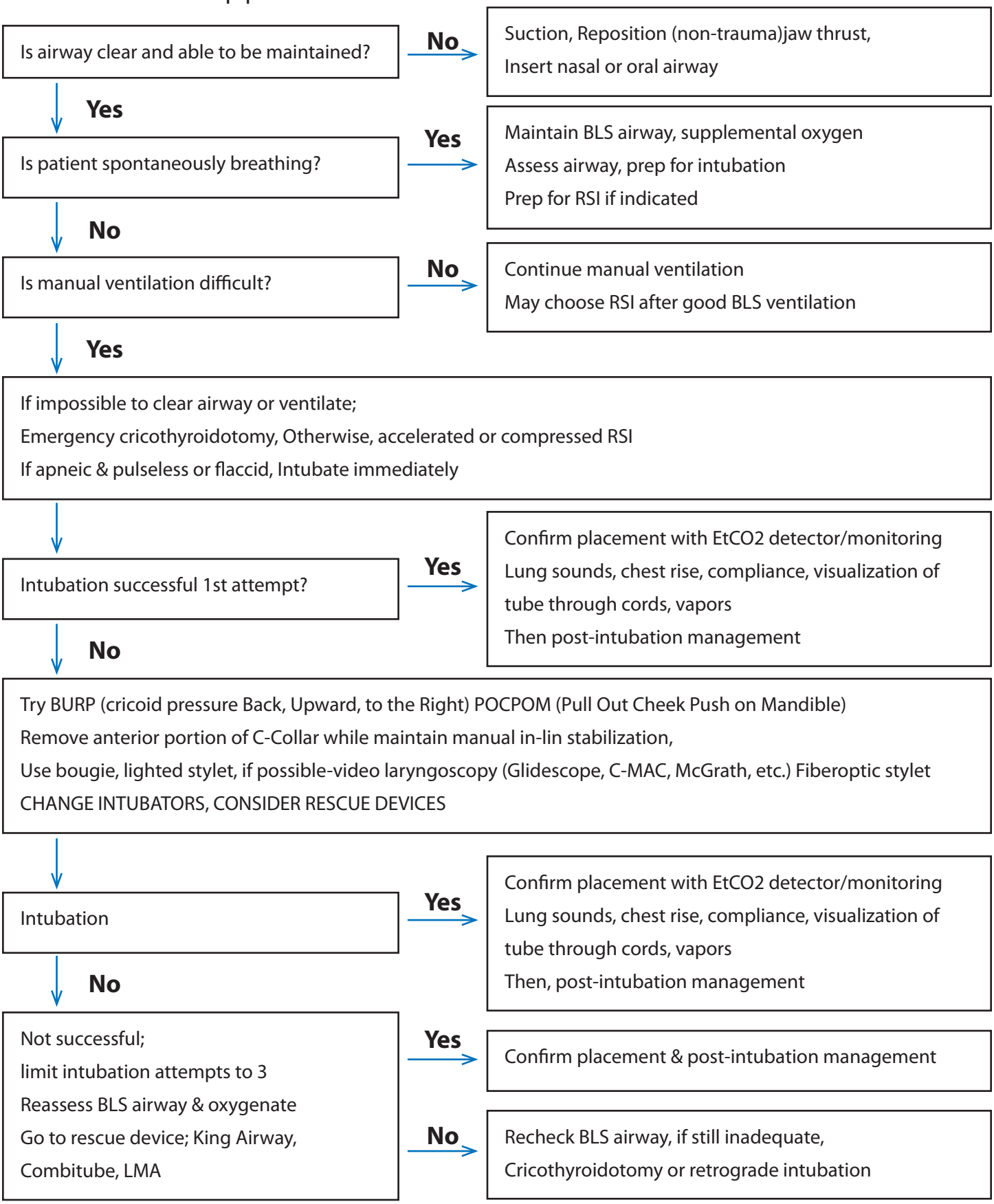
3. Assess

Nasopharyngeal Airway

- LUBRICATE, to minimize bleeding
- Inserted bevel side toward the septum
- Right nares; slides in
- Left nares; starts upside down (bevel to the septum) and rotated into position

Decision Tree for patient needing intubation

Call for assistance
Anticipate difficult airway
Have backup plan at bedside



Rapid Sequence Intubation

7 P's of RSI

1. Preparation
2. Preoxygenation
3. Pretreatment
4. Paralysis with induction
5. Protection w/positioning
6. Placement of tube with proof
7. Postintubation management

RSI Sequence Timelines

Rapid Sequence Intubation

Time	Action (seven Ps)
Zero minus 10 minutes	Preparation: *Assemble all necessary equipment, drugs, etc.*
Zero minus 5 minutes	Preoxygenation
Zero minus 3 minutes	Pretreatment
Zero	Paralysis with induction: *Administer induction agent by intravenuous (IV) push, followed immediately by paralytic agent by IV push*
Zero plus 20-30 seconds	Positioning: *Position patient for optimal laryngoscopy; Sellick's maneu if desired, is applied now*
Zero plus 45 seconds	Placement with proof: *Assess mandible for flaccidity; perform intubation; confirm placement*
Zero plus 1 minute	Postintubation management: *Longterm sedation/paralysis as indicated*

Prepare to intubate

Rapid Sequence Intubation Algorithm/Rescue Airways

1. Prepare: Equipment, meds, team, patient (basic airway management, positioning)

2. Preoxygenate: 100% O2, 3 to 5 minutes

3. Premedicate:
   Atropine (0.02 mg/kg IV; PEDS minimum 0.1 mg in children < 8 years)
   Lidocaine 1.5 mg/kg IV (head injury, asthma)

4. Push the sedative (Use one):
   Etomidate 0.3 mg/kg IV: Use with caution in septic shock.
   Midazolam Adult/Peds: 0.1- 0.3 mg/kg IV:
   Suggested maximum single dose 10 mg;
   reduce dose or consider alternative in hypotension or elderly
   Ketamine 1 to 2 mg/kg IV (bronchodilator)
   Propofol (Diprivan) 2mg/kg/IV

5. Paralyze (Use one): *See appendix
   Succinycholine 1-1.5mg/kg IV Avoid in hyperkalemia, neuromuscular disease, or ocular trauma Vecuronium 0.1 mg/kg IV OR Rocuronium 1 mg/kg IV
   After administering, wait for relaxation (45-60 sec).
   Do not bag unless hypoxic.

6. Position airway: Head/neck position; laryngeal manipulation, BURP (backward, upward, and rightward pressure on larynx), cricoid pressure as needed

7. Pass the tube: Maintain in-line cervical immobilization in head/neck trauma

8. Patent airway assessment: check breath sounds bilaterally, CO2 detector (yellow is good), ETCO2, wave form capnography if available and chest x-ray

9. Postintubation plan: Drugs and dosages depend on medications used during intubation

Sedation: Midazolam 0.05 to 0.3 mg/kg IV.
Suggested maximum single dose 10 mg; reduce dose or consider alternative in hypotension or elderly

Paralysis: Vecuronium 0.1 mg/kg IV (if not used for intubation)
Analgesia: Fentanyl 1 to 2 MICROgrams/kg IV
Morphine 0.05 to 0.15mg/kg/IV
Repeat as needed to maintain sedation, paralysis and analgesia

Secure tube
Draw ABGs
OG/NG placement

RSI checklist

Assemble equipment and supplies

- ET tubes, 2 sizes above and below size for patient, syringe/test balloon
- Working suction
- Laryngoscope blades, straight/curved, test light, extra batteries available
- 2 IV lines, preferably (no saline lock)
- Cardiac monitor, plus oximetry
- Crash cart, OPEN
- BVM 100% oxygen, end-tidal CO2 detector, wave-form capnography, if available
- RSI medications and rescue airways available
- Tube securing device

Assemble staff

- ERP/PA/NP
- 2 ED RN's if possible, assign medication /assistive roles
- Respiratory Therapy if available
- EMS staff if available
- Anesthesia if available
- Communicate procedure plan to department and other staff

Patient

- Assess airway, respiratory status, full VS including GCS, temperature and pain level
- Allergies/medications/pertinent history/advance directives
- Explain procedure to patient if possible, obtain written consent as patient condition allows
- 2 patent IVs if possible with IV fluid hanging for RSI medication
- Attach patient to cardiac monitor, pulse oximetry, wave form capnography if available, and continue monitoring

RSI checklist (continued...)

Pre-oxygenate

- Apply 02 per NRB15L/min x 5 minutes to maximize oxygenation, assure nitrogen "washout" and prevent desaturation during intubation
- Alternate technique if time is short; patient to take 8 deep breaths on high flow O2

Pre-Treatment

- Administer loading mediations as ordered
  If possible, wait 3 minutes for full effect
  Premedications add time and complexity to procedure so may be deferred

Paralysis with induction

- DO NOT ventilate by BVM until patient intubated or re-oxygenation required (desaturation <90%)
- Assist with patient positioning, utilize spinal precautions with suspected c-spine injury
- Verify medication and dosage ordered by verbal call-back
- Draw up medications as ordered (LABEL or tape medication vial to syringe)
- Administer paralytic agent as ordered
- Provide Sellick/BURP as requested to assist in visualization of epiglottis during intubation
- Ventilate w/BVM, 100%oxygen if patient desaturates during intubation attempt

Prove Placement

- Confirm tube placement once intubated, balloon inflated
  Color change on CO2 detector (yellow is good), wave form capnography if available
  5 point auscultation (both anterior lung fields, both lateral lung fields, both lung fields/axillae, and over epigastrim

RSI checklist (continued...)

Postintubation management

- Secure ET tube, note tube depth, initiate BVM/mechanical ventilation
- Adminster Sedation & Analgesia (may do simultaneously w/RSI meds if ordered)
- Obtain ABG's and CXR
- Place NG/OG
- Document procedure by ; whom, time, preparations, tube size/ depth, medications administered/time, number of attempts, BVM rate, breath sounds auscultated/CO2 detector color change, wave form capnography if available, lab/CXR obtained and ventilator setting
- Maintain rigorous/on-going in-room nursing oversight of:
  Continued ventilatory effectiveness
  Analgesia/sedation/paralysis
  Hemodynamic stability; VS every 5-15 min, cardiac rhythm/SPO2, temperature, prevention of further heat loss, initiate warming measures as needed
- If ventilator alarms or patient becomes hemodynamically more unstable, notifiy ERP/NP/PA and RT, if available
  Remove patient from ventilator and initiate BVM ventialtions
  Remember DOPE for trouble shooting:
  Displaced ET tube
  Obstruction
  Pneumothorax
  Equipment problem

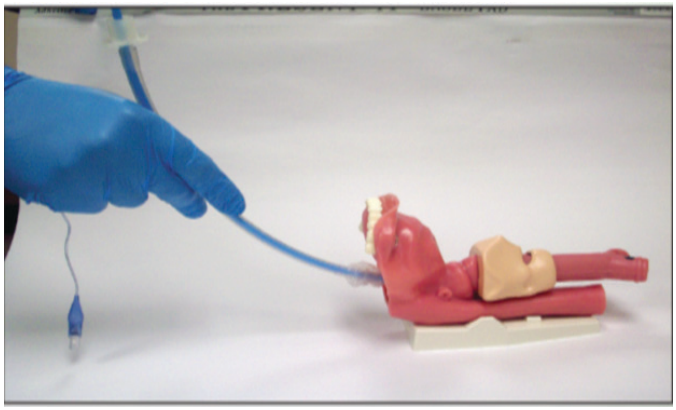
RESTOCK EVERYTHING USED!!!!!

Unable to Intubate Checklist

- Repeat/Re-ventilate
  Preoxygenate for 2 minutes

- Give more sedation
  * Midozolam (Versed) 1-4mg IV and/or
  * Fentanyl 25-100 Micrograms IV

Try again using a BOUGIE



Still Unsuccessful?

* Place oral or nasal airway

* Bag Valve Mask 100% 02 assist ventilations

* **Or someone else qualified to intubate** if available (MD,CRNA,PA, NP)

NEED RESCUE AIRWAY!

Rescue Airways: King Tubes

KING SYSTEMS
A Consort Medical Company

Relentless Innovation. Compassionate Solutions.

Sizing & Information

KING LTS-D

KING LT-D

Cuff Pressure Gauge
ITEM #KLT 900

PRODUCT INFORMATION

Product	Size 2	Size 2.5	Size 3	Size 4	Size 5
KLTD	KLTD202	KLTD2025	KLTD203	KLTD204	KLTD205
KLTD EMS	KLTD212	KLTD2125	KLTD213	KLTD214	KLTD215
KLTSD	n/a	n/a	KLTSD403	KLTSD404	KLTSD405
KLTSD EMS	n/a	n/a	KLTSD413	KLTSD414	KLTSD415

EMS kits are non-sterile and contain a KING LT-D or KING LTS-D, syringe for cuff inflation, lubricant, and abbreviated instructions for use.

SIZING INFORMATION

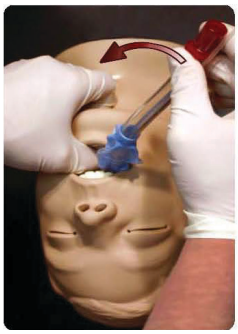
Size	2	2.5	3	4	5
Connector Color	Green	Orange	Yellow	Red	Purple
Patient Criteria	35-45 inches (90-115 cm) or 12-25 kg	41-51 inches (105-130 cm) or 25-35 kg	4-5 feet (122-155 cm)	5-6 feet (155-180 cm)	greater than 6 feet (>180 cm)
Cuff Pressure	60 cm H_2O	60 cm H_2O	60 cm H_2O	60 cm H_2O	60 cm H_2O
KLTD O.D./I.D.	11 mm/7.5 mm	11 mm/7.5 mm	14 mm/10 mm	14 mm/10 mm	14 mm/10 mm
KLTSD O.D./I.D.*	n/a	n/a	18 mm/10 mm	18 mm/10 mm	18 mm/10 mm
KLTD Cuff Volume	25-35 ml	30-40 ml	45-60 ml	60-80 ml	70-90 ml
KLTSD Cuff Volume	n/a	n/a	40-55 ml	50-70 ml	60-80 ml

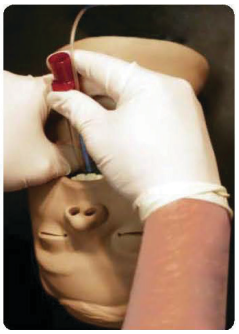
KING LTS-D is not available in size 2 and 2.5

KLTD: Maximum Size Fiberoptic Bronchoscope: 7.0 mm O.D. (size 3, 4, 5) and 4.7 (size 2, 2.5); Maximum Size Tube Exchange Catheter: 19 Fr (size 3, 4, 5) and 14 Fr (size 2, 2.5); Minimum Mouth Opening: 16 mm (size 3, 4, 5) and 12 mm (size 2, 2.5)
KLTSD: *Ventilation Lumen is not round, but is equivalent to a 10 mm I.D. tube; Maximum Size Tube Exchange Catheter: 19 Fr; Maximum Size Fiberoptic Bronchoscope: 6 mm OD; Minimum Mouth Opening: 20 mm

1. Apply chin lift and introduce KING LTS-D into corner of mouth.

2. Advance tip under base of tongue, while rotating tube back to midline.

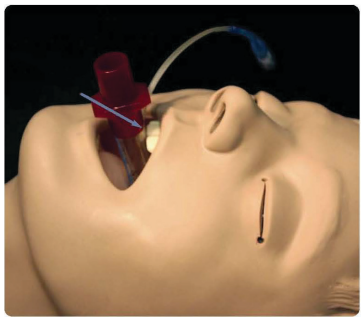




Do not lubricate KING Tube prior to insertion!!!

Rescue Airways: King Tubes (continued...)

3. Without exerting excessive force, advance tube until base of connector is aligned with teeth or gums.

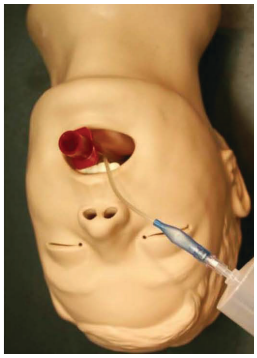


4. Inflate cuffs:

   size 3 - 50ml

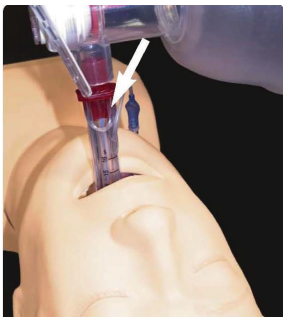
   size 4 - 70ml

   size 5 - 80ml



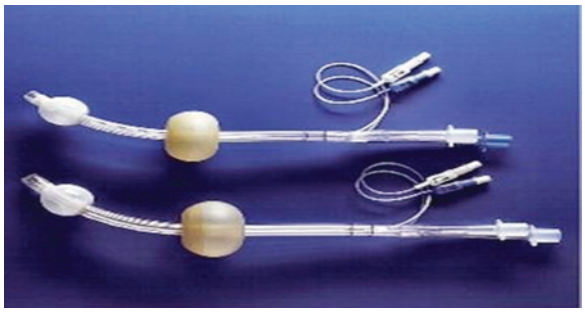
5. Attach resuscitator bag. While gently bagging, slowly withdraw tube until ventilation in easy and free flowing (large tidal volume with minimal airway pressure).

6. Lubricate gastric tube (up to an 18 Fr) prior to inserting into the KING LTS-D's gastric access lumen.



7. Secure the tube

Rescue Airways: Combitube



1. Determine appropriate size
   - 37 Fr tube - 4-5 ft tall (Small Adult)
   - 41 Fr tube - 5-6 ft tall
2. Place head in neutral position
3. Open mouth and pull tongue forward
4. Slide combitube™ along tongue until teeth are between the depth marks just below inflation ports
5. Inflate blue port first using large syringe
   - 85 ml air for 37 Fr tube (Small Adult)
   - 100 ml air for 41 Fr tube
6. Inflate white port next using small syringe
   - 12 ml air for 37 Fr tube (Small Adult)
   - 15 ml air for 41 Fr tube
7. Begin rescue breathing through blue connector
   - If breath sounds present, confirm with ETCO2 and continue rescue breathing
   - If no breath sounds, go to step 8
8. Try rescue breathing through clear short tube
   - Auscultate breath sounds and check etCO2
9. Secure the tube

Rescue Airways: Laryngeal Mask Airway (LMA)

Recommended Size guidelines:

Size 1:	under 5 kg
Size 1.5:	to 10 kg
Size 2:	10 to 20 kg
Size 2.5:	20 to 30 kg
Size 3:	30 kg to small adult
Size 4:	adult
Size 5:	Large adult

LMA Insertion

1. Deflate cuff to ensure it will retain a vacuum

2. Inflate cuff to ensure no leaks, then deflate prior to insertion or keep a small volume of air that may assist with insertion

3. Lubricate LMA with water soluable lubricant

4. Hold LMA like a pencil and insert pressing the mask tip upwards along the hard palate to flatten in out, keeping head in neutral position

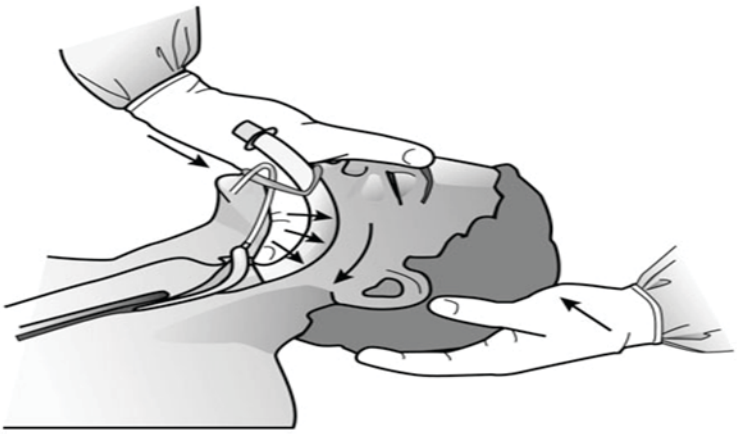
5. Using the index finger, keep pressing upwards as you advance the mask into the pharynx to ensure the tip remains flattened and avoids the tongue

6. Press mask into posterior pharyngeal wall continue to push with index finger to guide mask downward

7. Grasp tube firmly with other hand and press gently downward with other hand to ensure mask is fully inserted

8. Insert mask with recommended volume of air

9. Connect LMA to BVM and ventilate patient and confirm equal breath sounds over both lung fields and absence of ventilator sounds over epigastrium and secure the tube



Surgical Airway Options

Cricothyroidotomy Kit Procedure:

1. Apply prep to neck if time allows.
2. Identify anatomy:
   - Identify thyroid cartilage and thyroid horn.
   - May need to carefully extend neck while maintaining c-spine precautions.
   - Just below thyroid horn feel for a groove. This should be the cricothyroid membrane.
3. Stabilize trachea at the thyroid horn with the middle or index finger of your hand closest to the patients mandible.

4. Puncture skin over cricothyroid membrane with needle on syringe using free hand.
5. Direct needle into groove and aspirate for air as needle is advanced.
   - Stop when gush of air obtained.
   - Stop if catheter meets significant resistance.
   - Stop if catheter doesn't obtain air by the time it is advanced ¾ of its length into neck.

6. When air obtained, remove syringe while stabilizing needle and pass guide wire into the airway through the needle. When guide wire is placed, remove the needle.
7. Make an incision > 1cm in the skin around the guide wire.

Surgical Airway Options (continued...)

8. Place introducer into the airway and feed into the guide wire.

9. While holding guide wire, direct introducer and airway into neck. (Will need to apply force!) When in place remove guide wire and introducer.

10. Secure in place with strap or tape.

11. Oxygen saturation should improve rapidly.
    - Check on TRANSFER ARRANGEMENTS!

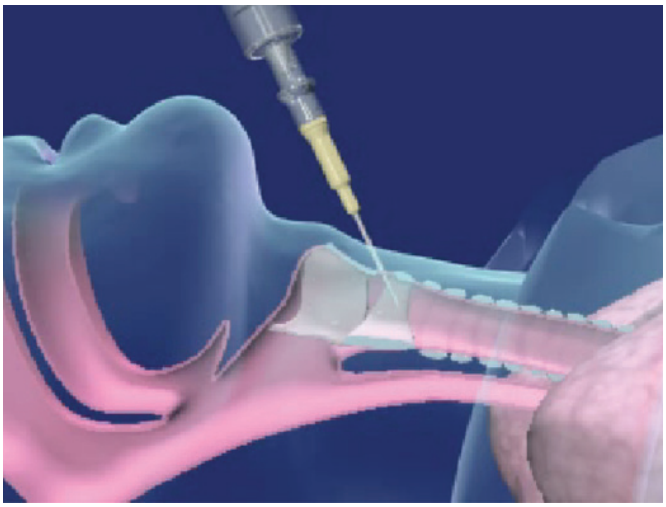
NEEDLE CRICOTHYROIDOTOMY

Equipment:

- Betadine or other prep
- Surgical towels
- Syringe
- 12 or 14 gauge needle with catheter (i.e. large IV catheter)
- Oxygen tubing

Procedure:

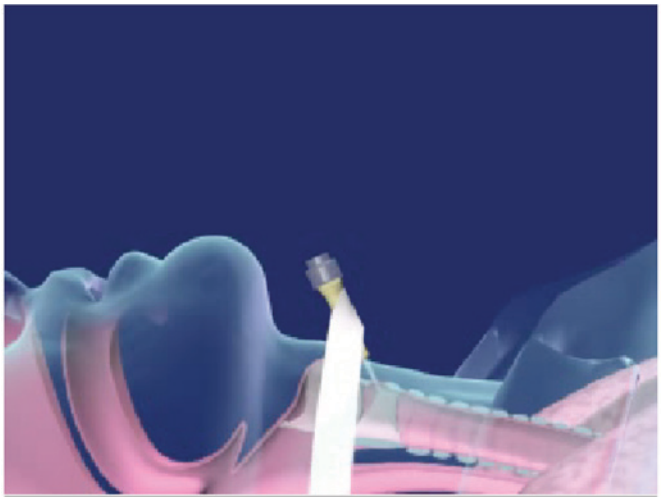
1. Apply prep to neck if time allows.
2. Identify anatomy:
   - Identify thyroid cartilage and thyroid horn.
   - May need to extend neck: (Airway comes before Disability!)
   - Just below thyroid horn feel for a groove. This should be the cricothyroid membrane.
3. Stabilize trachea at the thyroid horn with the middle or index finger of your hand closest to the patient's mandible;



6. Direct needle into groove and aspirate for air as needle is advanced
   - Stop when gush of air obtained.
   - Stop if catheter meets significant resistance.
   - Stop if catheter doesn't obtain air by the time it is advanced ¾ of its length into neck.
7. When air is obtained, advance the catheter to the hub and remove the syringe and needle while holding the catheter in place.

NEEDLE CRICOTHYROIDOTOMY (continued...)

8. Attach oxygen tubing to the catheter with high flow oxygen.



9. Secure in place with tape or suture –this is a temporary measure
10. Oxygen saturations should improve rapidly.
    - Check on TRANSFER ARRANGEMENTS!
    - If help to obtain definitive airway is >30 minutes away.

PREPARE AND PROCEED WITH SURGICAL CRICOTHYROIDOTOMY!!!

SURGICAL CRICOTHYROIDOTOMY

<u>NOT Recommended</u> for PEDIATRIC PATIENT UNDER AGE 8

Equipment:

- Hemostat
- Scalpel
- ETT or tracheostomy Tube (cuffed #5 or #6)
- Suction

Procedure:

1. Stand on patient's right side (assistant on left).
2. Stabilize thyroid cartilage and catheter airway with left hand.
3. Make a transverse or vertical skin incision just below thyroid horn (or around catheter airway).

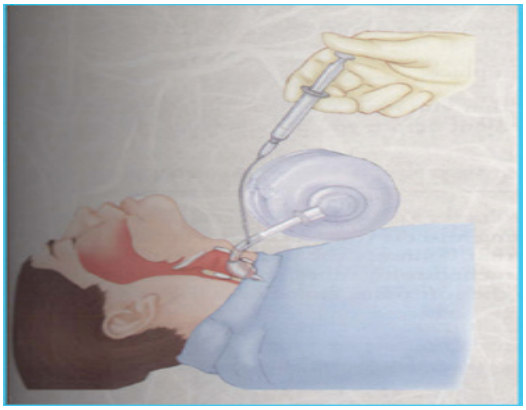
- In theory less bleeding potential with a vertical incision.

Continue incising tissue with scalpel until you reach the upper airway. (EXPECT BLEEDING!)

SURGICAL CRICOTHYROIDOTOMY (continued...)

5. Incise the cricothyroid membrane around the catheter.
6. Remove the catheter and place the hemostat into the airway and spread.
7. Insert #5 or #6 ETT or tracheostomy tube and direct posterior.

8. Inflate cuff and observe and listen to chest.
9. Secure tube.



ALWAYS CONTINUALLY REASSESS THE AIRWAY OF THE PATIENT

GO TO BREATHING

Breathing
Oxygenation & Ventilation

Prevent hypoxia & inadequate tissue oxygenation

Priorities

1. **Oxygenate:** Oxygen is BEST provided via a tight-fitting oxygen reservoir face mask (non-rebreather) with a flow rate of at least 12L/min. (must keep reservoir bag inflated at all times). [1]
   a. Consider pulse oximetry (Requires intact peripheral perfusion). Oxygenate to keep O2 Sat > 95%. [1]

Approximate PaO2 Versus O2 Saturation (pulse oximetry) Levels	
Pulse Ox Levels	P_aO_2
100%	90 mm Hg
90%	60 mm HG
60%	30 mm HG
50%	27 mm HG

2. **Assess VENTILATION:** Rate AND Depth of respirations
   a. **Apneic:** Patient is Not breathing – establish airway and provide BVM ventilations. Prepare for definitive airway (intubation, King, Combi tube, LMA)
   b. **< 12 breaths/min:** TOO SLOW!
      > 28 breaths/min: TOO FAST!
      Establish airway (jaw lift/jaw thrust) Assist ventilations with BVM attached to supplemental oxygen to maintain O2 Sat > 95% 2
   c. **Assess for reason for Abnormal respiratory rates**

Priorities (continued...)

d. **12 - 26 breaths/min:** Assure patent airway.
Provide Oxygen as per #1

3. Assess THE CHEST: Must EXPOSE the chest (down to the skin).
Observe, Palpate, Auscultate ….looking for:

Subcutaneous Emphysema look for the source of the air leak!!

Rib Fractures:

- >50% of significant chest trauma cases due to blunt trauma
- Compressional forces flex and fracture ribs at weakest points
- Ribs 1-3 require great force to fracture
  - Possible underlying lung/great vessel injury
- Ribs 4-9 are most commonly fractured
- Ribs 9-12 less likely to be fractured
  - Transmit energy of trauma to internal organs
  - If fractured, suspect liver (right) and spleen injury (left)
- Hypoventilation is COMMON due to PAIN/SPLINTING

Flail Chest

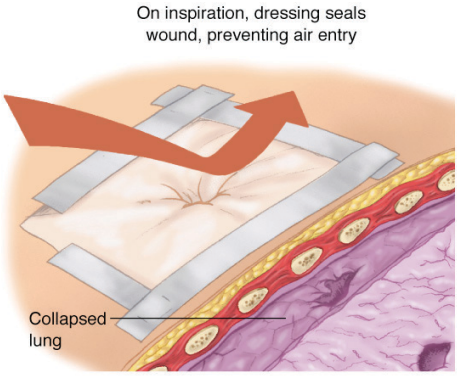
- Segment of the chest that becomes free to move with the pressure changes of respiration due to rib fractures
- Two or more adjacent ribs fractured in two or more places
- Serious chest wall injury with underlying pulmonary injury
  - Reduces volume of respiration
  - HYPOVENTILATION IS COMMON
- Paradoxical flail segment movement
  May feel crepitus, Sub-Q air
  Paradoxical movement may NOT be immediately visible
- Positive pressure ventilation can restore tidal volume

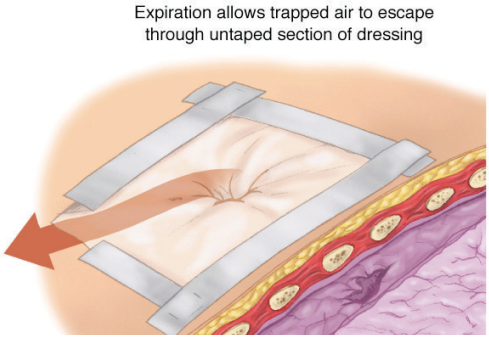
Open Pneumothorax (sucking chest wound)

- Free passage of air between atmosphere and pleural space
- Air replaces lung tissue
- Air will be drawn through wound if wound is 2/3 diameter of the trachea or larger

Priorities (continued...)

- Signs & Symptoms
  - Penetrating chest trauma
  - Sucking chest wound
  - Frothy blood at wound site
  - Severe dyspnea
  - May also have hypovolemia
    (d/t underlying organ damage from the penetrating trauma)
- Requires occlusive dressing taped on 3 sides
  - Vaseline gauze
- Requires CHEST TUBE





Closed Pneumothorax; (may progress to Tension Pneumothorax)

- Occurs when lung tissue is disrupted and air leaks into the pleural space
- Progressive Pathology
  - Air accumulates in pleural space
  - Lung collapses
  - Alveoli collapse (atelectasis)
  - Reduced oxygen and carbon dioxide exchange
  - Ventilation/Perfusion Mismatch
- Increased ventilation but no alveolar perfusion
- Reduced respiratory efficiency results in HYPOXIA
- May require CHEST TUBE

Tension Pneumothorax

- Buildup of air in the thorax. (may also develop after initiation of positive pressure ventilation)
- Air is unable to escape from inside the pleural space
- Excessive pressure reduces effectiveness of respiration collapsing lung on the affected side and shifting trachea & mediastium AWAY from affected side

Priorities (continued...)

- Signs/Symptoms
  - ♦ Early
    - Anxiety
    - Increasing dyspnea despite Rx (O2 etc)
    - Unilateral decreased or absent breath sounds
  - ♦ Progressive
    - Increasing tachypnea & dyspnea
    - Increasing anxiety
    - Tachycardia
    - Narrowing pulse pressure (hypotension)
    - Decreasing breath sounds
  - ♦ Late
    - JVD
    - Tracheal deviation
    - Worsening Hypotension
    - Increasing tachycardia
    - hypoxia
    - Decreasing LOC

IMMEDIATE NEEDLE DECOMPRESSION OF THE AFFECTED SIDE

Indicated when;

- Evidence of worsening respiratory distress or difficulty bagging with BVM (intubated pts)
- Decreased or absent breath sounds
- HYPOTENSION (BP systolic < 90)

Procedure;

DO NOT DELAY NEEDLE DECOMPRESSION TO OBTAIN CHEST XRAY

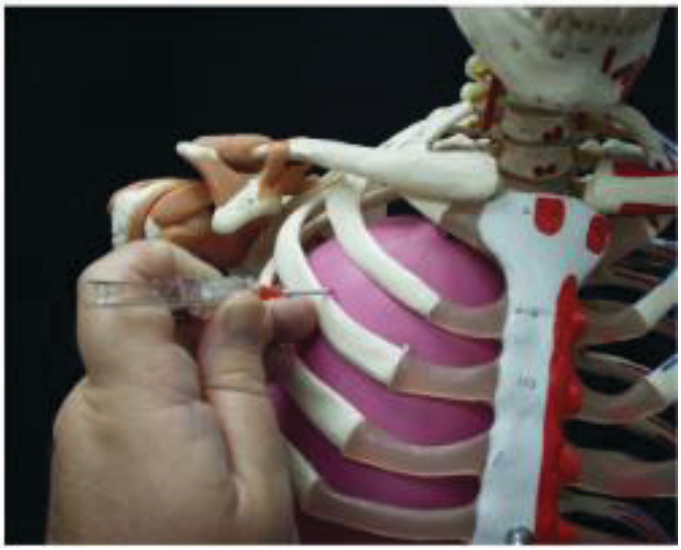
- 14g 3 1/2" (16g x 2 ¼" will work, but nothing shorter)
- Mid clavicular line
- 2nd Intercostal space
  (Slide over 3rd rib into 2nd ICS to miss nerves and blood vessels)

Priorities (continued...)

Landmarks

Angle of Louis marks 2nd ICS

Mid Clavicular Line



Hemothorax

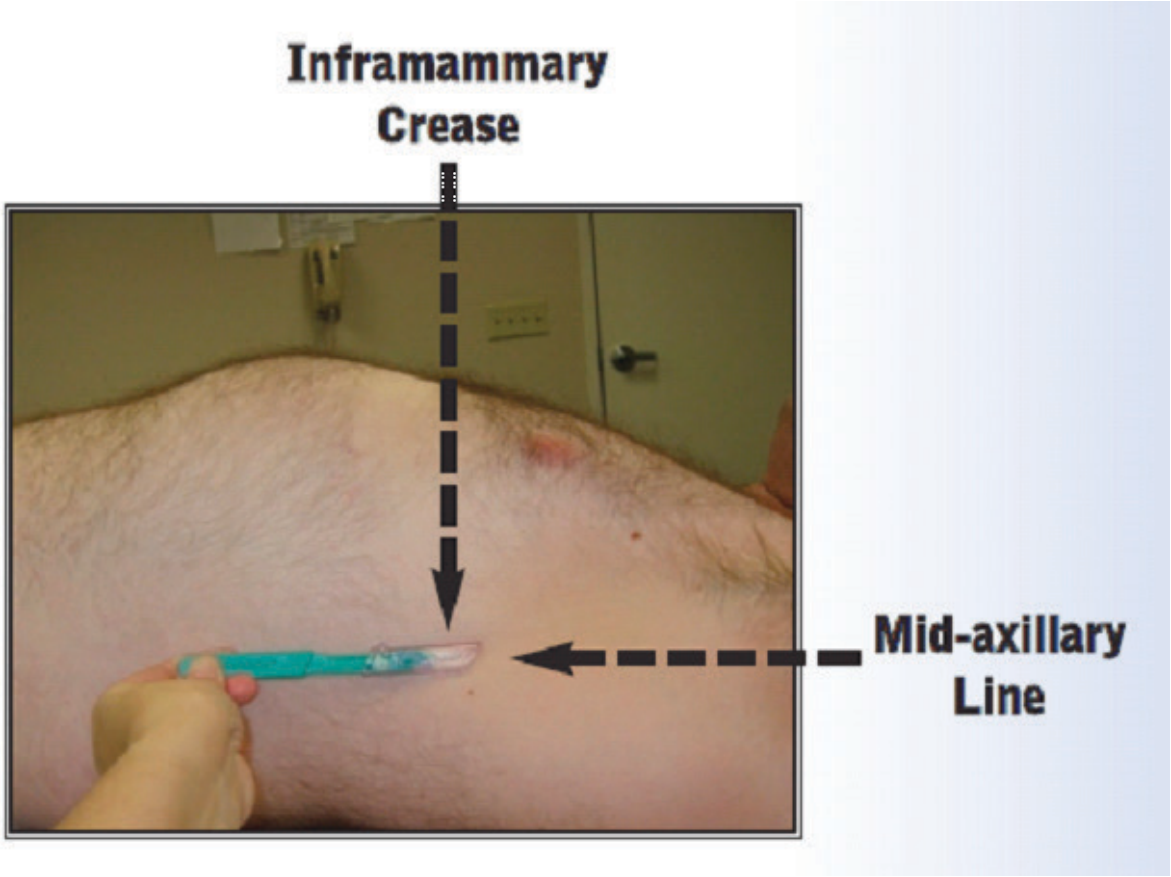
- Accumulation of blood in the pleural space
- Serious hemorrhage may accumulate 1,500 mL of blood
  - Up to 75% mortality rate
  - Each side of thorax may hold up to 3,000 mL
- Blood loss in thorax causes a decrease in tidal volume
  - Ventilation/Perfusion Mismatch & Shock
- May accompany Pneumothorax
- May require Chest Tube if large
- Consider Auto-Transfusion

Chest Tube Placement

- Betadine or other prep
- Sterile drape or towels; Sterile gloves
- Local anesthetic (lidocaine)
- Scalpel
- Long clamp x 2
- Chest tube (32-34 Fr for pneumothorax 36 Fr for hemothorax)
- Chest tube drainage system
- Suture (to suture chest tube in place) 0-silk, 0-prolene, or 0-nylon
- Occlusive dressing

Procedure

1. Confirm correct side
2. Place patient arm above head
3. Prep & drape the appropriate area
4. Inject local anesthetic
5. Make an incision (2-3cm) at insertion site



6. Palpate the top of the rib & place clamp through the intercostal muscles at the top of the rib

7. Spread muscle widely
8. Carefully push clamp into pleural cavity through parietal pleura.
   You should experience a "popping" sensation as you enter the pleural cavity
   Air or blood should evacuate
9. Confirm placement by feeling for lung (soft, smooth , spongy feel)
10. Place chest tube through hole and direct towards lung apex, posteriorly if possible
11. Advance tube 12-16 cm (all drainage holes should be within pleural cavity)
12. Connect tube to drainage system – place on wall suction
13. Suture tube into place
14. Place occlusive dressing around tube and secure
15. Listen to lung sounds
    CONFIRM PLACEMENT WITH CHEST X-RAY
16. **Document medication administered, time, site, tube size, initial drainage amount/type, patient toleration, VS & post-insertion CXR**

Circulation

Priorities

STOP BLEEDING

- Apply direct pressure
- Apply tourniquet if arterial bleeding from an extremity
    - * Blood Pressure Cuff makes good tourniquet
    - * Remember to record time tourniquet applied

Evaluate and Restore Perfusion

- Check pulses and blood pressure

It is Essential to Prevent Hypothermia!!!

- Increase room temperature > 85 degrees
- Use air warming systems (i.e. Bair Hugger™)
- Administer Warmed IV fluids/blood products
- Prevent further heat loss! Remove wet clothes, cover patient's head, apply warm blankets
- Obtain initial & serial temperatures

Place IV lines; Preferred size; 18 gauge or larger

If unable to place peripheral lines quickly;

Consider Intra-Osseus access

Consider Central line if experienced with procedure

Fluid Management

Crystalloids are NOT benign!!

- Associated with edema
- Prolonged mechanical ventilation
- Normal Saline contributes to metabolic acidosis
- Associated with multiple organ failure and systemic inflammatory response syndrome

Limit Normal Saline and Lactated Ringers:

> 3 L Crystalloids is associated with worse outcomes

Tips to limit crystalloid infusion

- Do not leave IV lines "wide open"
- Give IV fluid in 250-500ml boluses only
- Tolerate lower blood pressures
  - SPB > 90 is adequate
  - Mean Arterial Pressure (MAP) 65 is adequate
- Use blood products for resuscitation early
  - PRBCs are first line
  - FFP should be used if available

If patient is now on 3rd liter of Crystalloids ***including*** total amount of IV Fluid given pre-hospital ***and*** patient remains with HR >120 and SBP <90

Does this patient need blood? Has this patient received blood products yet? Consider transfusing PRBC and FFP (if available) in a 2:1 or 1:1 ratio

* **See Adult resuscitation/ transfusion strategy for Community Trauma Hospitals & Trauma Receiving Facilities (next page)**

Adult Resuscitation / Transfusion Strategy for the Unstable Trauma Patient for Community Trauma Hospitals & Trauma Receiving Facilities

Bleeding needs to be evaluated by a surgeon;

In no case should transfusion delay transport to definitive care

SBP < 90 HR > 120 and
Suspected Active bleeding:
Source identified or strongly suspected; significant blood loss on scene PTA.

Initiate transfer:
If limited blood resources and suspected need for transfusion request blood products (PRBC & FFP) be brought to patient by transport team

Maintain Warmth: prevent further heat loss, warm blankets, increase room temperature, Bair Hugger, warm IV fluids, overhead warming lights

Give **WARM** LR bolus 250-500ml
May repeat up to 1 Liter
When SBP remains < 90 and HR remains >120
(be aware of recurrent tachycardia and/or
BP < 90 as indication of continuing bleeding)

If + Response

If HR and SBP maintaining then infuse WARM LR at 150ml/hr

If No Response

If NO response after 1 Liter crystalloid
Initiate rapid process to obtain emergency release blood;
Obtain and Transfuse 1 unit of uncrossmatched PRBCs with commercial blood warming device while obtaining type and cross- matched blood

Disability

Priorities

- Calculate GCS
- Pupil Exam
- Avoid Secondary brain injury
- Identify and manage medical anticoagulation
- Decide if CT scan is appropriate

Record Glasgow Coma Scale score with vital signs

Document ALL three assessment categories; reporting only total scores not helpful (does not indicate what is altered or changes over time)

GCS < 13 indicative of need for neurosurgical evaluation

Transfer Early!

Glasgow Coma Scale
Infant…Child…Adult

Area	Infant <1 YOA	Children	Adult	Score
Eye Opening	Open Spontaneously	Open Spontaneously	Open Spontaneously	**4**
	Open to verbal	Open to verbal	Open to verbal	**3**
	Open only to pain	Open only to pain	Open only to pain	**2**
	No Opening	No Opening	No Opening	**1**
Verbal Response	Coos & Babbles	Babbles or age appropriate words	Oriented: correct month/year response	**5**
	Irritable cry	Irritable cry or confused words/ sentences	Confused: incorrect month/ year response	**4**
	Cries only to pain	Cries only to pain or incomprehnsible	Inappropriate words	**3**
	Moan/Grunt sounds to pain	Moan/Grunt sounds to pain	Incomprehensible words	**2**
	NONE	NONE	NONE	**1**
Motor Response	Normal smooth spontaneous movement	Obeys age appropriate commands	Obeys command (show 2 fingers)	**6**
	Withdraws, pulls away from touch	Localizes to pain source, may reach	Localizes to source of pain	**5**
	Withdraws from pain	Withdraws from pain	Withdraws from pain	**4**
	Abnormal flexion & muscle tone to pain	Abnormal flexion & muscle tone to pain	Abnormal flexion	**3**
	Abnormal extension to pain	Abnormal extension to pain	Abnormal extension	**2**
	NONE	NONE	NONE	**1**

Glasgow Coma Scale "How to" Pearls

According to the Brain Trauma Foundation (BTF), the key to meaningful trend data from GCS assessments is consistency amongst various personnel performing the assessment.

Guidelines from the BTF include:

Eye Opening: Spontaneous means the patient's eyes open as you arrive at the patient's side.

Verbal: Direct the patient to "tell me the month and the year." When the patient's response is correct for both the month and year, he is considered oriented and scores a 5.

Motor: The recommended command is "Show me 2 fingers." The person doing the assessment holds up the 2 fingers of one hand in a V formation. When the patient replicates the movement he is scored a 6.

Pain Stimulus: Because different areas of the body have different intensities of pain response, the BTF recommends the same pain stimulus be used by all care providers… the recommended pain stimulus is to pinch the patient's trapezius muscle ridge on the shoulder midway between the neck and point of the shoulder.

Pupils

- Unequal pupils are cause for concern:
  - May represent high intra-cranial pressure
  - May represent impending herniation

Perform and document serial assessments, pupil size and response

Transfer to Regional Trauma Center

Avoid "Secondary Hits" to the Injured Brain

Hypoxia

O2 Saturations <93% puts injured brain at risk!

- Secure airway: intubation preferred
- 100% FiO2, apply oxygen by Non-Rebreather Mask
- Decrease oxygen demands & consumption by;

  - keeping patient WARM and

  - treating pain, anxiety, combativeness

- Avoid prolonged hyperventilation

Hypotension

MAP <65 mmHg and/or SBP <90 mmHg puts injured brain at risk!

- Stop bleeding
- Transfuse blood products, if available
- Provide vigilant monitoring to detect early changes!

EARLY TRANSFER!

Medical Anticoagulation

If traumatic mechanism and/or signs of trauma and on anticoagulants, triage up one level higher!

Check Home Meds for:

Coumadin (Warfarin)
Plavix (Clopidogrel)
Pradaxa (Dabigatran)
ASA
Other antiplatelet medications

Anticoagulation and GCS < 15 = TROUBLE!

On Plavix, Pradaxa, other antiplatelets, ASA?
(see comparison sheet)

- Transfer to a Regional Trauma Center
- Transfuse Platelets if available and indicated;

Confer with Regional Trauma Center

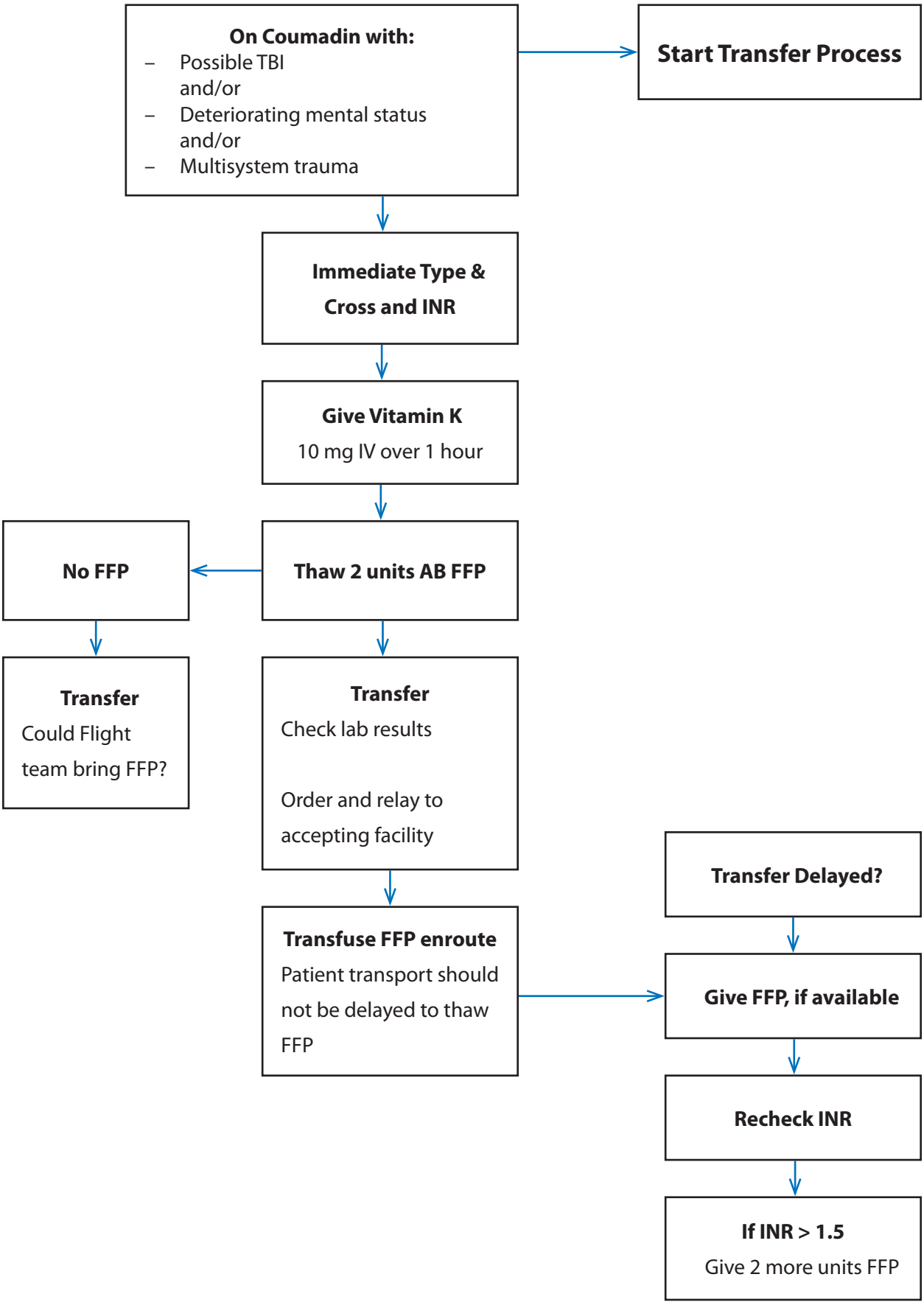
On Coumadin?

- Initiate Transfer
- Initiate Coumadin Reversal Algorithm

COMPARISON OF ORAL ANTICOAGULANTS and ANTIPLATELETS

Drug Name/s and common dose	Indications	Reversal agents
Pradaxa, Pradax Anticoagulant Dabigatran (direct thrombin inhibitor): 150mg BID	AFib, prevention VTE (off label)	experimental evidence for using activated prothrombin complex concentrate (FEIBA) or recombinant factor VIIa
Xarelto Anticoagulant Rivaroxaban (direct factor Xa inhibitor): 10mg qd	VTE prevention, afib and DVT (off label)	activated prothrombin complex concentrate, prothrombin complex concentrate (Beriplex P/N), or recombinant factor VIIa
Coumadin Anticoagulant Warfarin (inhibits formation of vit K dependent clotting factors): Dose varies	Prevention/treatment venous thrombosis/PE, Prevention/treatment of thromboembolism due to Afib or prosthetic heart valve	Vit K Prothrombin Complex Concentrate Factor VII
Aspirin Antiplatelet (inhibits cyclo-oxygenase): Dose varies	Secondary prevention after ischemic stroke, TIA, MI, or unstable angina	Platelet transfusion
Pletal Antiplatelet Cilostazol (inhibits platelet phosphodiesterase III) 100mg bid	Intermittent claudication	No specific antidote
Plavix Antiplatelet Clopidogrel (blocks platelet ADP P2Y12 receptor): 75mg qd	ACS, recent stroke, recent MI, peripheral artery disease	Platelet transfusion DDAVP
Persantine Antiplatelet Dipyridamole (inhibits platelet adenosine uptake): 75-100 mg qid	Prevention of thromboembolism post-heart valve replacement, (with warfarin)	No specific antidote
Aggrenox Antiplatelet Dipyridamole extended release 200mg/aspirin 25mg (inhibits cyclo-oxygenase and inhibits platelet adenosine uptake): one capsule bid	Secondary prevention of stroke post-stroke/ TIA	Platelet transfusion for ASA
Effient Antiplatelet Prasugrel (blocks platelet ADP P2Y12 receptor): 10mg qd	ACS managed with PCI (including stenting), with ASA	Platelet transfusion
Brilinta Antiplatelet Ticagrelor (blocks platelet ADP P2Y12 receptor): 90mg bid	ACS	Aminocaproic acid or tranexamic acid and/or factor VIIa
Ticlopidine Antiplatelet (blocks platelet ADP P2Y12 receptor): 250mg bid	Secondary prevention of stroke post-stroke/ TIA Prevention of stent thrombosis	Platelet transfusion

Coumadin Reversal Algorithm



C-Spine Clearance

Definitive clearance of C-Spine has evolved in parallel with evolution of CT imaging. At this time, CT of C-Spine with coronal and sagittal reconstructions has become standard of care IF NEXUS criteria are not met.

CT can still miss injuries that are ligamentous in nature.

If midline neck pain and/or a neurologic deficit is present with a normal appearing CT, further evaluation by a neurosurgeon and imaging with MRI may be indicated. The cervical collar should be left in place, full spinal precautions maintained and consultation with a regional trauma center obtained

Prolonged time on backboards can cause:

- Pain, skin ischemia/decubitus ulcers

- Remove patient from backboard while awaiting transfer;
  - ✓ Head of bed flat
  - ✓ C-Collar left in place
  - ✓ Minimize patient movement
  - ✓ Log Roll Only!
- Replace padded backboard prior to transfer

NEXUS Criteria;
Bedside clearance of C-Spine is appropriate when;

- Patient is NOT intoxicated

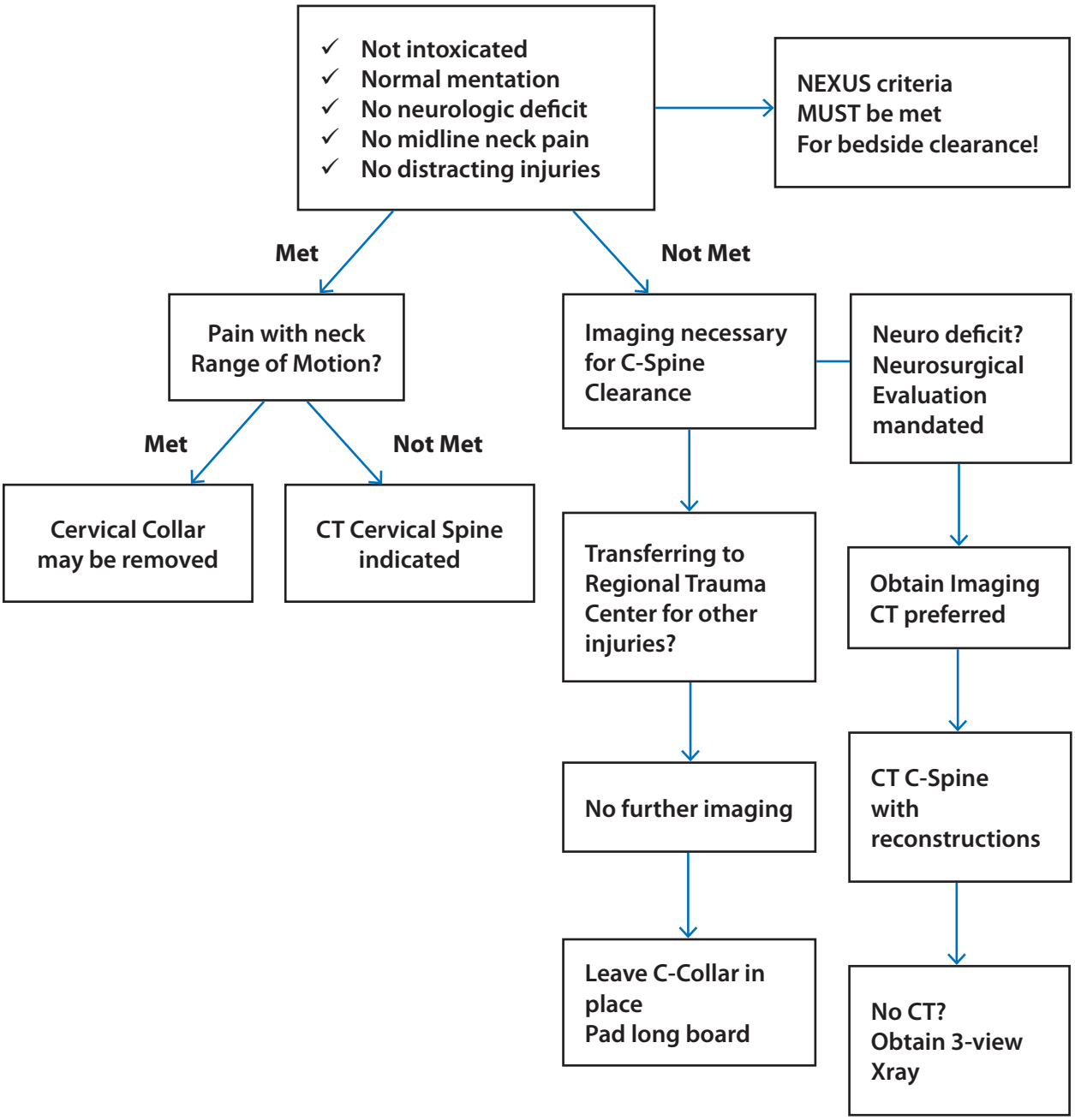
- Patient has normal mentation
  (GCS = 15)

- Patient has NO neurological deficits

- Patient has NO midline neck pain

- Patient has NO distracting injuries

Adult C-Spine Clearance Algorithm



Pediatric C-Spine Clearance
Age < 3 years;

- C-Spine injury < 3 years is extremely rare
- Nearly all such injuries occur above C3
- Remember **SCIWORA** in children!
  Spinal **C**ord **I**njury **W**ithout **R**adiological **A**bnormality
  Accurate history is essential!
- Should Community/Trauma Receiving Facilities clear C-Spines in children < 3 years?
  The vast majority of time, the answer is NO!
  TRANSFER IS INDICATED

Pediatric C-Spine Clearance
Ages 3-16 years of age;

- NEXUS Criteria DOES apply to kids!

Nexus Criteria

Bedside clearance of C-Spine is appropriate when;

Patient is NOT intoxicated
Patient has normal mentation
Patient has NO neurological deficits
Patient has NO midline neck pain
Patient has NO distracting injuries

Clinically clearing the pediatric C-Spine:

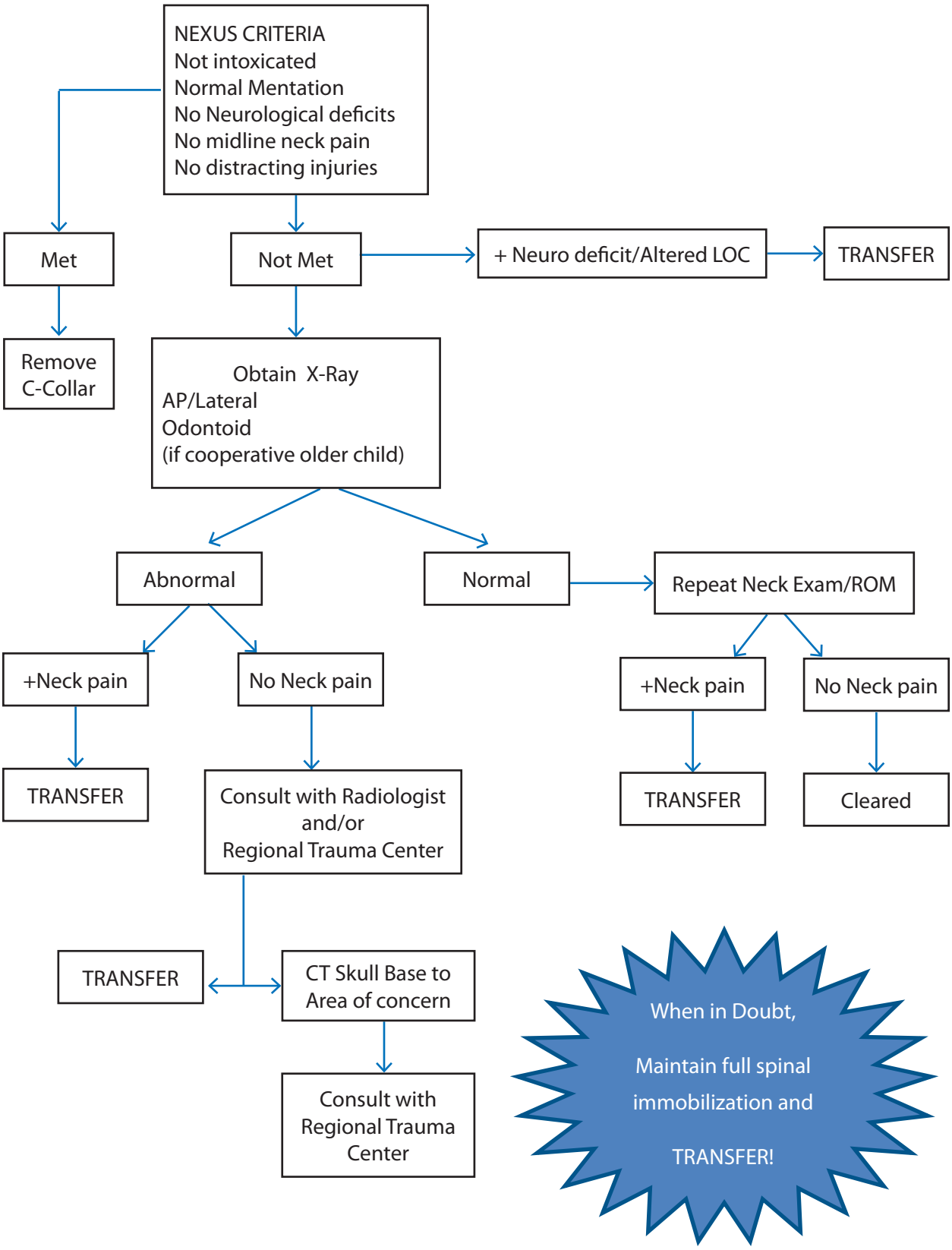
Mental status should be AGE-APPROPRIATE

- Ask parents to help you assess this
- If mental status altered, do not clinically clear
- Obtain imaging (see algorithm next page)

A child does NOT need imaging when;

- ✓ Normal alertness/mental status
- ✓ No midline neck pain
- ✓ No neurologic impairment
- ✓ No distracting injuries

Pediatric C-Spine Clearance Algorithm (3-16 years of age)



CT Scanning

Initial ED Survey

If unsure about need to transfer to higher level of care:

Do not take patient to CT if physiologically unstable: tachycardic &/or hypotensive

Maintain patient warmth at all times

If patient physiologically stable, do any and all CTs necessary to diagnose and treat

If certain patient will need transfer to higher level of care:

Don't CT if you won't be able to fix any problems you find

Don't CT if it will delay transport

If there will be a delay in transport, OK to go to CT if:

- Patient is physiologically stable
- Patient warmth can be maintained
- Patient can be adequately monitored and resuscitated
- Images will be able to be sent and read by receiving facility

OK to go to CT if information gained will help in determining which hospital to transport to

Unless absolutely contraindicated (allergic reaction/renal failure) use IV contrast (if available) if scanning chest, abdomen &/or pelvis

If unable to use IV contrast, do not scan chest, abdomen or pelvis as this will be done at the receiving facility

Burns

B

The initial trauma resuscitation of burns can help to minimize the morbidity and mortality caused by the burn injury.

Priorities

- Airway
- Breathing
- Circulation
- Wound Care
- Transfer

Burn Injury Management

Burns are no different than any other trauma injury.

ABC's are TOP Priority!!!!!

Airway

- Inspect face, nose, and mouth for soot, singed hair, or tissue injury (if present intubate)
- Assess for hoarseness, dry cough, stridor, or respiratory distress (if present intubate)
- Assess for circumferential injury to the neck (if present intubate)

Breathing

- Administer 100% Oxygen at 15L via non-rebreather or ETT

Circulation

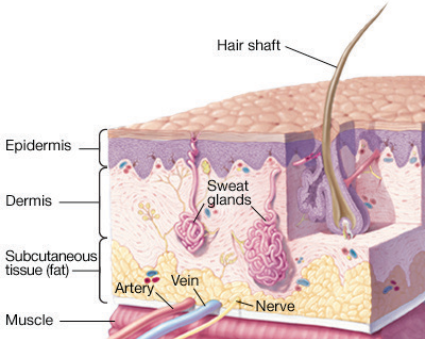
- Assess pulses and capillary refill to affected extremities
- Insert peripheral IV (it is okay to insert into burned tissue if nothing else is available)
- May need to consider Intraosseous/Central Line
- Prevent hypothermia
- Begin Fluid Resuscitation

TRANSFER ARRANGMENTS SHOULD BE INITIATED EARLY!

Types of Burns

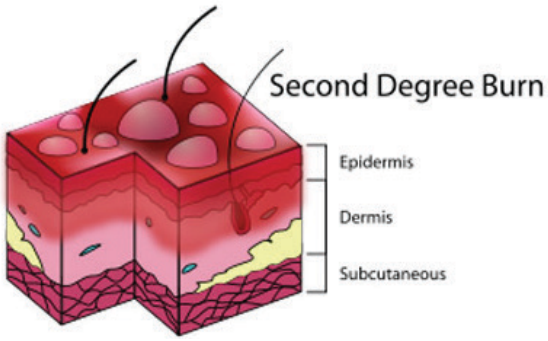
First Degree Burn

Characterized by erythema, pain, and absence of blisters.



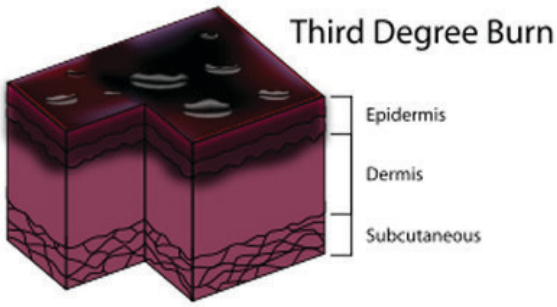
Second Degree Burn

Characterized by a red or mottled appearance with swelling and blister formation. The surface may have a wet or weeping appearance and is painfully hypersensitive.



Third Degree Burn or Full Thickness Burn

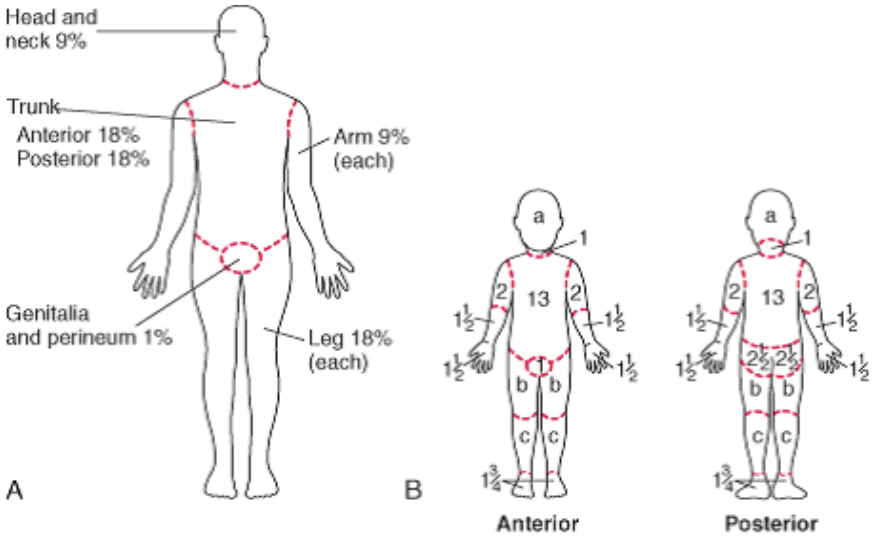
Usually appears dark and leathery. Skin may also appear translucent, mottled, or waxy white. The surface is painless, generally dry, may appear red and does not blanch with pressure.



Fluid Management for Burn Patients

Step 1

Determine the burn percentage of total body surface area



Relative percentage of body surface area (% BSA) affected by growth

Body Part	Age 0 yr	1 yr	5 yr	10 yr	15 yr
a = 1/2 of head	9 1/2	8 1/2	6 1/2	5 1/2	4 1/2
b = 1/2 of 1 thigh	2 3/4	3 1/4	4	4 1/4	4 1/2
c = 1/2 of 1 lower leg	2 1/2	2 1/2	2 3/4	3	3 1/4

Rule of palm for small burns

Use the size of patient's palm, (excluding digits) and counting all areas;

the size of the patient palm= 1%

Step 2

Calculate the amount of fluid needed based on TBSA.
(Fluids should be calculated from the time injury occurred)

Adults and Children > 20KG

TBSA X 4ml X weight in kg over the 1st 24 hours

Lactated Ringers: IV fluid of choice for resuscitation

Take the above number and give ½ of the fluid over the first 8 hours, and the second ½ over the next 16 hours.

Children < 20kg/SA X 3ml X weight in kg over the 1st 24 hour
Take the above number and give ½ of the fluid over the first 8hours, and the second ½ over the next 16 hours.
For children < 4 years old add maintenance fluid of D5LR;

For the 1st 10 Kg of body weight; 100cc/Kg/ 24 hrs
For the 2nd 10 Kg of body weight; 50cc/Kg/24 hrs
For each Kg of body weight above 20 Kg; 20cc/Kg/24 hrs

Wound Care

REMOVE ALL clothing, jewelry, and contact lenses

- For chemical burns immediately remove all clothing, dust off powders, and begin irrigating with water for at least 30 minutes (but PREVENT further heat loss!)

- (When anticipating early transfer) it is unnecessary to debride the burn or apply topical agents. Cover with clean dry sheets. A Bair Hugger™ blanket or other thermal insulation blanket should be applied over sheet to minimize further heat loss

- KEEP patient WARM (monitor temperature)

Other Things to Consider

- ❑ Insert foley catheter
- ❑ IV pain medications (BE GENEROUS!!!)
- ❑ Cardiac Monitor
- ❑ Tetanus Prophylaxis
- ❑ Nasogastric tube

Electrical Burn Treatment

Electrical burns are frequently more serious than they appear on the body surface.

Significant volumes of tissue beneath the surface may be injured and result in acute renal failure and other complications.

- Monitor blood gases and serum bicarbonate levels.
- Infuse IV fluids initially at a rate to maintain urinary output of 100ml/hr in adults
- Observe the urine color for presence of myoglobin (dark, pink, or red)
- If myoglobin present, consult with accepting physician
- Monitor cardiac rate and rhythm
- Monitor for signs and symptoms of compartment syndrome

Burn Transfer Guidelines

Transfer Indicated When There Is:

- Partial thickness and full-thickness burns of greater than 10% of the BSA in patients less than 10 years or over 50 years of age.
- Partial-thickness and full-thickness burns on greater than 20% of the BSA in other age groups.
- Partial-thickness and full-thickness burns involving the face, eyes, ears, hands, feet, genitalia, and perineum, and those that involve skin overlying major joints.
- Full-thickness burns on greater than 5% of the BSA in any age group.
- Chemical or electrical burns or inhalation injuries
- Patients with preexisting illnesses that could complicate treatment, prolong recovery, or affect mortality.
- Evidence of pulmonary injury or respiratory distress
- Brassy or sooty cough or singed nasal hairs
- Carbon Monoxide > 10%
- *Patients who have sustained other trauma injuries in addition to burns or if fixed wing accommodations are not available at your facility, may be transferred to a Regional/ Level II trauma center for stabilization before being transferred to a burn center*

Always consult with a Regional/ Level II Trauma Center before transferring directly to a Burn Center

Cold Injuries and Hypothermia

C

The severity of cold injury depends on temperature, duration of exposure, environmental conditions, amount of protective clothing, and general state of health

Priorities

- Treat Hypothermia
- Transfer

Hypothermia Treatment

- Gently remove clothing

- Do not rub or massage the patient. Do not allow the patient to exercise in any way

- Do not give the patient liquids by mouth

- Obtain rectal temperature, blood pressure, pulse and respiratory rate to identify severity of hypothermia

- Mild hypothermia:
  core temperature 32-35 degrees C (90-95 degrees F)

- Severe hypothermia;
  core temperature < 32 degrees C (90 degrees F)

NOTE: Even "mild" hypothermia patients or those with temperatures in the low 90s can be significantly impacted and benefit from prevention of further heat loss and rewarming (especially those with higher risk: children, the elderly & those with co-morbidities)! Don't wait until a patient is "severely" hypothermic to act!

- Keep patient immobile

- Administer WARM and HUMIDIFIED 100% oxygen

- Apply cardiac monitor
  Arrhythmias are common *while rewarming:*
  Observe carefully for rhythm changes

- Prevent Ventricular Fibrillation while rewarming;
  1. Minimize patient movement, unnecessary cardiac catheters, endotracheal tubes. Intubate gently if unable to maintain airway. If patient has to be intubated, ventilate at a lower rate than usual
  2. No central lines above the waist; may precipitate VF
  3. Handle/transfer gently
  4. Avoid IM/IV medications when core temperature is less than 30 degrees C (86 degrees F);can rapidly reach toxic levels when patient is re-warmed

Hypothermia Treatment (continued...)

- If Ventricular fibrillation occurs, conversion to a sinus rhythm is not likely to be successful until the core temperature in near 32 degrees C (90 degrees F). CPR should be initiated immediately and continued at the normal recommended rate as the patient is rewarmed.

- IV fluid Administration; Lactated Ringer's (preferred) or Normal Saline warmed (37.5 degrees C)
  1. Give 200-300ml rapidly then slow rate to total 1 liter in first hour
  2. Maintain infusion rate to keep urine output at 1-2ml/kg/hr

- Insert foley catheter (ideally with temperature thermistor) for accurate output measurement

Guidelines for Cold Injuries

- Treat hypothermia first!
  As core temperature approaches normal, rapid rewarming of frostbite can then be carried out

- Rapid rewarming by immersion in warm water, 40 degrees C (104 degrees F) for 30-60 minutes

- Thawing is complete when distal tip of extremity blanches
  If patient is being transferred, DO NOT attempt to rewarm the extremity. Repeated warm/cold cycles will severely worsen the injury. Definitive extremity rewarming can occur at the tertiary facility.

- Elevate extremity, non-weight-bearing. Keep warm and dry

- Transfer to Montana Regional/Level II Trauma Center

Helpful Hints

- **DO NOT** massage or manipulate the tissues

- DO administer pain medications

- DO provide adequate hydration by appropriate means

- Administer Lactated Ringers or Normal Saline to correct fluid deficit

- Topicals and dressing are not required if blisters are not present.

- If blisters are present, debridement is avoided unless they are infected. Pad between digits with fluffs or lamb's wool.

- Provide Tetanus Prophylaxis IM

Airway Appendix

1. Preparation

- Patent IV- access, monitor, discussion with patient/family, neuro assessment, positioning, assess patient's airway
- Equipment- intubating equipment, adjuncts and ETTs, suction, BVM, back-up devices and plan, confirmation device, meds – doses calculated, drawn up and labeled
  - Personnel- yourself and your team
    (Difficult to bag-mask)
    - **BONES** – (Beard, Obesity, No teeth, Elderly, Snores/Stiff/ Severe Facial burns or fractures)
    - **MOANS** – (Mask seal, Obesity, Obstruction, Age >55, No teeth, stiff lungs)

- Airway Assessment – **LEMONS**
  - **L**ook externally
  - **E**valuate the 3-3-2
    - Open mouth (1), chin to hyoid (2), and hyoid bone to thyroid notch (3)
  - **M**allampati – size of mouth and oropharynx opening

    Assess oral opening - 3 fingers
    Measure the mandible - 3 fingers
    Position of larynx - 2 fingers
  - **O**bstruction – with swallowing, stridor or muffled voice
  - **N**eck mobility – Difficult surgical airway ; **DOA**
    - **D**isruption or **D**istortion – surgeries, radiation, scarring, burns, hanging, penetrating injuries, lacerations
    - **O**bstruction – hematomas, abcess, tumors
    - **A**ccess problems – obesity, short neck, halo device, flexion deformity of spine, bushy beard
  - **S**aturation – SPO2 <85% can mean impending desaturation that can occur rapidly and less time to perform intubation

2. Preoxygenation

- If patient spontaneously breathing – then NRB for 5 minutes
- <u>Avoid bagging the spontaneously breathing patient unless SPO2 <93%</u>
- If needed, use Sellick & airway agjunct (nasal and/or oral airway)
- 8 effective Vital Capacity breaths with high-flow O2 provides best pre-oxygenation if time is short
- Preoxygenation displaces nitrogen with oxygen, creating an oxygen reservoir in the lungs, blood, and tissues. This reservoir enables patients to tolerate a longer period of apnea without oxygen desaturation

  (This time is shortened, however, in children and in the patient with high metabolic demand and the critically ill)

3. Pretreatment

- Goal is to blunt the patient's physiologic responses to intubation and minimizes bradycardia, hypoxemia, cough/gag reflex, increases in intracranial, intraocular, and intrsgastric pressures
- **Lidocaine** – controversial as to evidence, thought to blunt rise of ICP associated with airway manipulation. No studies have shown any negative effect of using lidocaine as a pretreatment in patient with suspected/actual ICP. Also indicated for use in patients with reactive airway disease undergoing RSU to attenuate the bronchospastic response to intubation
  - **1.5mg/kg – 3-5 minutes before intubation**
- **Atropine** - Controversial as to evidence for blunting bardycardia in pediatric patients
  - **0.02 mg/kg, minimum dose; 0.1mg IV, maximum dose; 1mg 3 minutes prior to intubation**

    Can minimize vagal effects, bradycardia and secretions
    CAUTION; Infants and children <8 years may develop profound badycardia durng intubation

4. Paralysis with induction

- This step involves the adminstration of an induction agent followed rapidly by a paralytic agent, giving the procedure the name "**Rapid Sequence**"
  - **Induction Agents** – provide a rapid loss of consciousness that facilitates ease of intubation
    - **Etomidate** – 0.3mg/kg/IV – rapid onset, short duration, cerebroprotective, not associated with hypotension
    - **Ketamine** – 1-2mg/kg/IV – "dissociative" state, analgesic properties, bronchodilator, may increase intracranial pressure. Avoid in patient with suspected aortic dissection, abdominal aortic aneurysm and acute MI.
    - **Propofol** – 2mg/kg/IV – rapid onset, short duration, cerebroprotective. Propofol is myocardial depressant decreases systemic vascular resistance.

4. Paralysis with induction (continued...)

- **Paralysis agents** – are dadministered immediately after induction agent (Does not provide sedation, analgesia or amnesia so potent induction agent is essential)
  - **Depolarizinig meuromuscualr blockage agents;**
    - **Succinylcholine – 1-1.5mg/kg/IV** – rapid onset (45-60 seconds), shortest duration of action (8-10 minutes). Use with caution in patients with known or suspected hyperkalemia, burns, crush injuries, intra-abdominal sepsis and those with neuromuscular disease.
  - **Non-depolarizing meuromusuclar blockage agents;**
    - **Rocuronium (Zemuron) – 1-1.2mg/kg/IV** – slightly longer onset of action (60-75seconds) and longer duration of action (30-60 minutes). Does not result in muscle depolarization or defasciculation and does not exacerbate hyperkalemia
    - **Norcuron – 0.1-0.2 mg/kg/IV** - longer onset of action (2-3 minutes). Does not result in muscle depolarization
    - **Pancuronium – 0.1mg/kg/IV** – longer onset of action (2-3 mintues), with duration of action 60-90 minutes

5. Protection/position

- Ensure patient position is ideal to improve visualization
- In cases where cervical spine injury is suspected, intubation must be performed without movement of the head, best provided by an experienced assistant.
- Place patient in sniffing position ito help align the axes & faciliate visualization of the glottic opening
- Sellick Manuever (cricoid pressure) may be initiated to prevent gastric contents regurgitating into the lungs
- Firm **B**ackward, **U**pward and **R**ightward **P**ressure (**BURP**) on the patient's thyroid cartilage may improve view, WITH Guidance
- A patient who is hypoxic furing intubation attempts should have BMV ventilation with 100% oxygen to raise PO2 level
- Issues of intubation;
  - Failure to adequately sweep the tongue out of the way. By inserting the blade as far to the right as possible, the intubator can more effectively force the tongue to the left side of the mouth and out of the way
  - Failure to place the tip of the laryngoscope deep enough into the mouth. Pressure placed too far forward on the tongue (curved blade in the vallecula or the straight blade past it) will not allow adequate lifting of the epiglottis and obstruct the view.

6. Placement with confirmation

- Visualize the ET tube passing through the vocal cords
- Confirm tube placement
  - Observe color change of colormetric end-tidal CO2 detector (GOLD is good) with 6 ventilations
  - Utilize wave-form capnography, if available
  - Use 5-point ausculation method;
    - **Listen over each anterior lung fields, each lateral/axillary lung field, and over the epigastrium for presence of good breath sounds. There should be no sounds of air movement over the stomach/epigastrium.**

7. Postintubation Managment

- Secure ET tube; note size, depth of initial tube placment on documentation
- Initiate mechanical ventilation
- Obtain a portable CXR
  - CXR does not confirm placement but assess the tube height above the carina and ensuring that main stem intubation has not occurred.
- Administer sedative/analgesia for patient comfort, to decrease O2 demand and to decrease ICP, especially if patient is paralyzed with longer-acting paralytic agent
- Obtain Arterial Blood Gas (ABG) if available
- Document all components of procedure, time, tube size, depth of insertion and number of attempts
- Maintain rigorous patient monitoring, ventilatory effectiveness, depth of sedation and paralysis, hemodynamic stability and patient comfort

Pearls of RSI

- Good BLS is essential
- Preparation is key to success
- Become familiar with commonly used medications
- Time out before pushing induction med (Is everyone really ready?)
- Have your backup plan at bedside
- Watch O2 saturations
- Paralysis without sedation ……..not a good thing
  - (only a very few circumstances where it's acceptable to paralyze and not sedate)
- Persistent postintubation hypertension may be from inadequate sedation/pain control
  - (Know patient condition and working diagnosis)
- **It isn't enough to simply have all the equipment. Training and practice with intubation, RSI, all back-up devices and techniques aids in successful airway management.**

Other considerations and tips

- **Pregnancy** – Airway difficulties greater in 3rd trimester and nearer to term
  - Assume difficult airway due to weight gain during pregnancy,upper airway edema and mucosal congestion (especially in preeclampsia) = may need smaller ETT than non-pregnant patient
  - Reduced functional residual capacity and increased rate of O2 consumption + more rapid desaturation.
  - Increased incidence of GI reflux
  - Vena Cava compression decreases preload and CO = induction agents may further reduce CO and placental perfusion
  - Peripheral and pulmonary vascular resistance is decreased = decreased BP and increased pulse pressure
  - BVM may be difficult due to added weight to chest, gravid uterus, restricting diaphragm excursion
- **Morbidly Obese** – assume difficult airway and difficult to ventilate using BVM
- **Drugs** – Ideal Body Weight vs. Total Body Weight
- **Elderly** – Less respiratory reserve, baseline O2 saturations decrease with aging, desaturation occurs more rapidly, increased chance of difficult airway to due to arthritic and degenerative diseases, co-morbid chronic diseases, sensitivity to medications = may have to reduce doses of induction agents, ethical and legal considerations

Other considerations and tips

Pediatric RSI

Anatomical differences	Clinical Significance
Large head in proportion to body, prominent occiput with weak supporting musculature	Head bobbing occurs with respiratory distress. Flexion of airway occurs when child is supine. May require towel under shoulder to obtain optimal position
Large tongue in proportion to oropharynx	Tongue can easily occlude airway when supine
Larynx is positioned more anterior and cephalad	High anterior position of glotic opening as compared to the adult
Cricoid cartilage is the narrowest part of the airway, trachea is funnel shaped	Un-cuffed or cuffed ETT Area where foreign body obstruction occurs
Airway diameter is proportional to child's size-approximate size of their little finger	Airway obstruction can develop quickly in infants and small children. Any edema or secretions reduce size and increase airway resistance
Tracheal and bronchial cartilaginous support rings C- shaped rather than O- shaped	Allows airway collapse that can be exacerbated during illness or when neck is hyperextended or flexed
Metabolic rate twice that of adults with twice the O2 consumption Vital capacity; Infants 6-8ml/kg/min Adults 3-4 ml/kg/min	Hypoxia occurs more rapidly when the child is in distress, other factors that increase metabolic rate (fever) contribute to increased respiratory demands.

Pearls of Pediatric RSI

- Always use color-coded resuscitation aids such as the Broselow ™ Tape to help in estimating weight, equipment sizes, and medication does. Don't rely on memory!
- Succinylcholine – is rapidly distributed into extracellular water. Children have larger relative volume of extracellular fluid than adults. 45% of weight at birth is extracellular fluid water, 30% of weight at age 2 months, 20% of weight at age 6 years. (Adults 16-18%). Therefore succinylcholine doses are higher for children than adults.
- Higher rate of metabolism of medications
- Children desaturate more quickly than adults