

North Dakota State Trauma Treatment Manual 2015

*Guidelines for the Treatment of Trauma
In Level IV and V Trauma Centers*



NORTH DAKOTA
DEPARTMENT of HEALTH
EMS and Trauma



NORTH DAKOTA
DEPARTMENT of HEALTH

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North Dakota State Trauma Treatment Guidelines

Background:

Traumatic injury remains a leading healthcare problem within the state of North Dakota. The problem is compounded by a scarce population spread over a large geographic area. As a consequence, delivery of appropriate trauma care does not fit in to the highly refined urban (exclusive) trauma center model that is used by much of the country. In 1995 the foundations of an inclusive state trauma system were put in to place. Participation in the state trauma system of all 42 hospitals has now become mandatory. All hospitals must now maintain a basic level of preparedness and ability to deal with traumatic injury. Participation is verified by the state trauma committee through standardized regular reviews of the hospitals qualifications. Of the 42 hospitals in the state, 36 are Critical Access Hospitals with limited resources and expertise in care of severely injured trauma patients. The core components of trauma center verification for these hospitals are modeled on the principles and practice of Advanced Trauma Life Support® (ATLS®). Health care at these facilities is provided by primary care M.D.'s and mild-level (PA-C or NP) practitioners. All providers who participate in emergency room care must successfully complete the ATLS course as part of their hospital's trauma center designation.

Implicit in the development of an inclusive trauma system is the standardization of 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 North Dakota State Trauma Treatment Guidelines were developed.

This manual was created with reference to the Advanced Trauma Life Support® Course for the purpose of serving as a succinct road map for providers in Critical Access Hospitals to 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 ND Trauma System and will be subject to change as new literature and research is published regarding standards of care for the trauma patient. 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.

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This original document was created August 2010 for use within the North Dakota State Trauma System by:

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THE GOLDEN HOUR OF RURAL TRAUMA

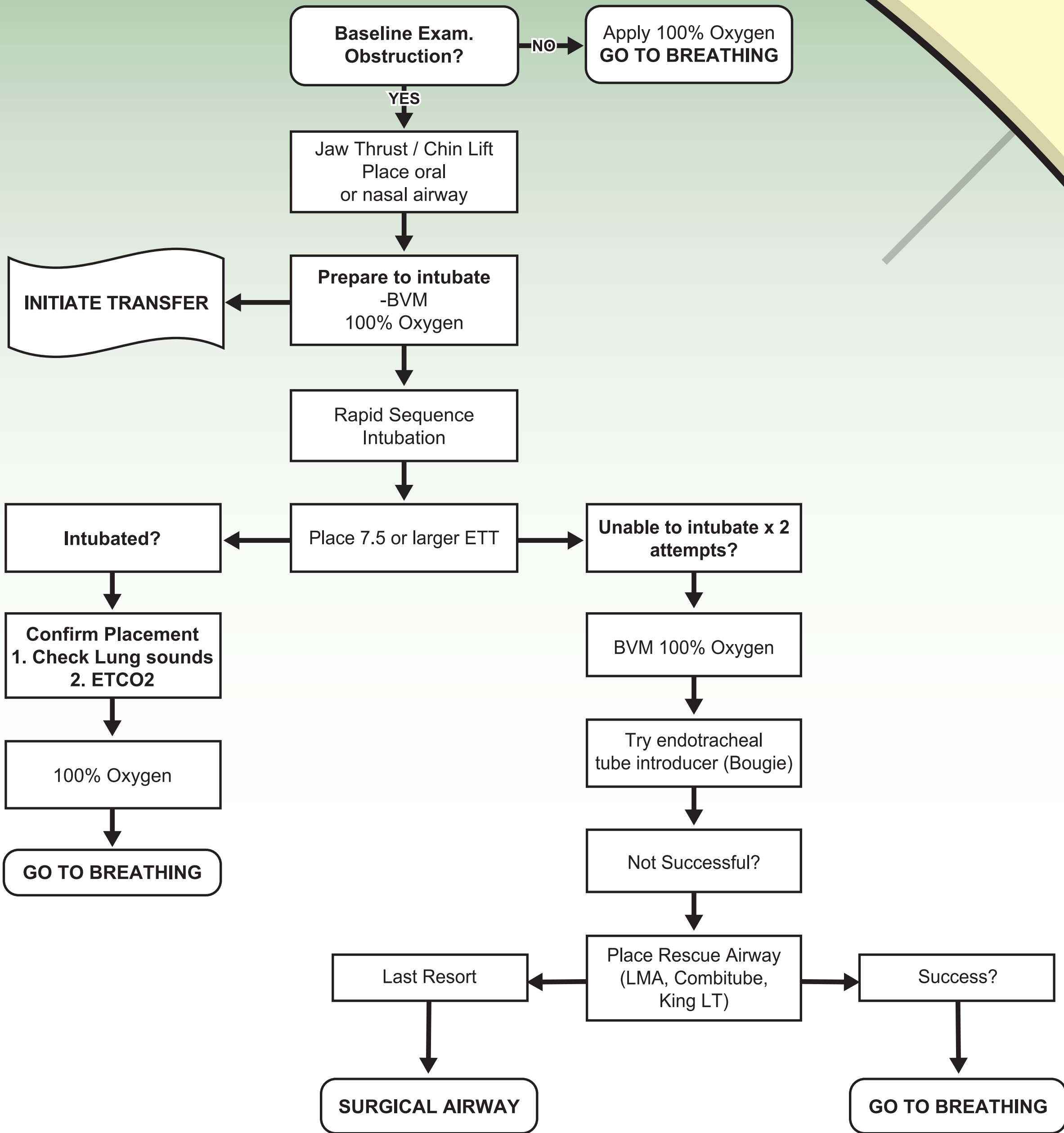
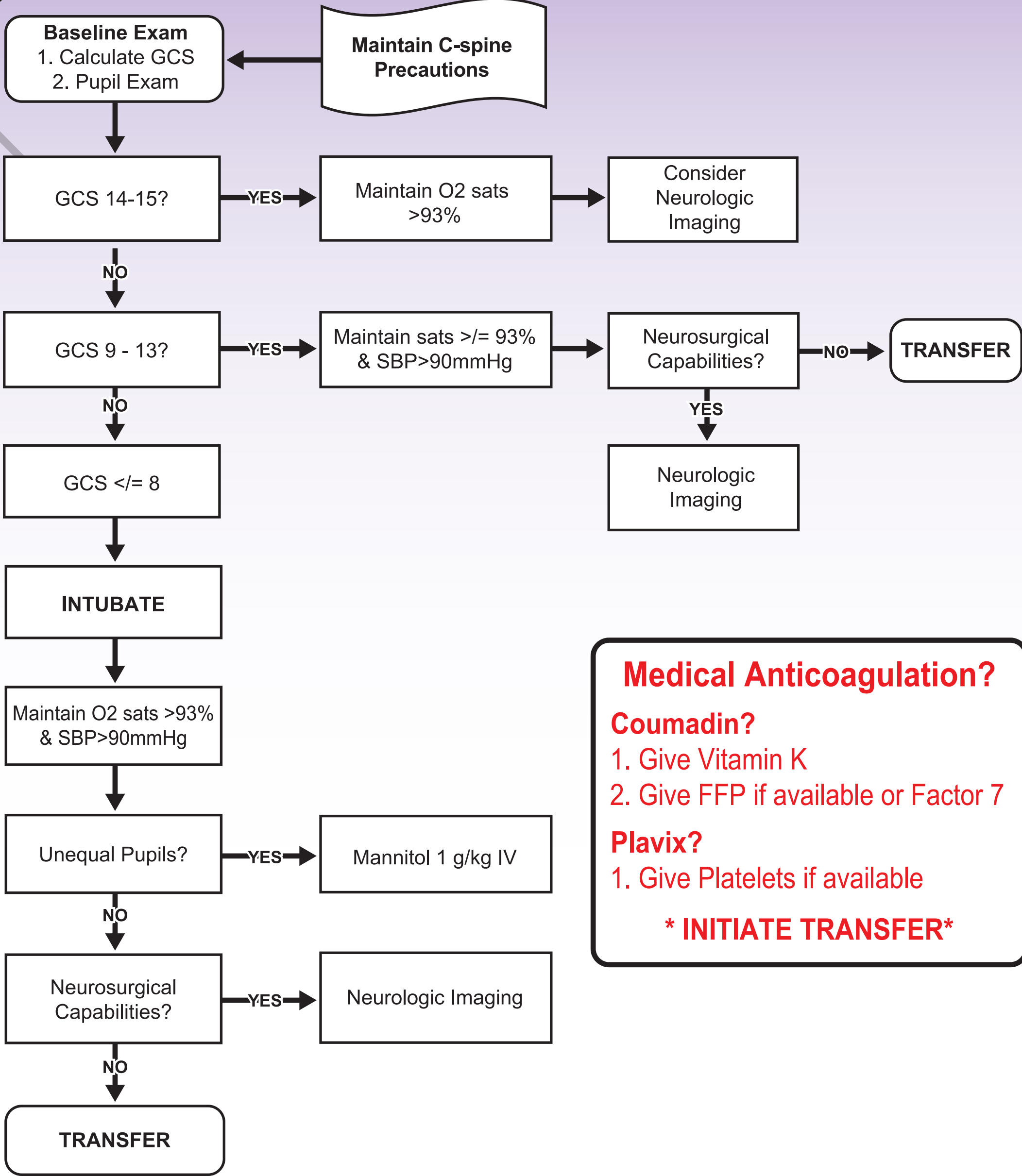
THE DIFFERENCE BETWEEN LIFE AND DEATH

GLASGOW COMA SCORE			
Activity	Score	Infant Response	Adult Response
Eye Opening	4	Spontaneous	Spontaneous
	3	To speech or sound	To speech
	2	To painful stimuli	To pain
	1	None	None
	0	None	None
Verbal	5	Appropriate words, sounds, and social smile	Oriented to person, place, month, year
	4	Cries but consolable	Confused
	3	Persistently irritable	Inappropriate words
	2	Restless / agitated	Incomprehensible
	1	None	None
Motor	6	Spontaneous movement	Obeys commands
	5	Localizes pain	Localizes pain
	4	Withdraws to pain	Withdraws to pain
	3	Abnormal extremity flexion	Abnormal extremity flexion
	2	Abnormal extremity extension	Abnormal extremity extension
	1	None	None

TRAUMA CENTERS & AIR TRANSPORT CONTACTS	
Altru Health System (Grand Forks) – 1-855-425-8781	
Essentia Health (Fargo) – 701-364-8401	
Sanford Health (Bismarck) – 1-855-550-1225	
Sanford Health (Fargo) – 1-800-647-1225	
St. Alexius Med. Center (Bismarck) – 701-530-7001	
Trinity Health (Minot) – 1-800-223-1596	
Air Medical (Bismarck and Minot) – 1-800-441-1310	
Guardian Flight (Williston) – 1-855-291-8989	
North Star Criticair (Minot) – 1-800-223-1596	
Sanford AirMed (Fargo and Bismarck) – 1-800-437-6886	
Valley Med (Grand Forks, Williston, Sidney MT) 1-800-828-0168	

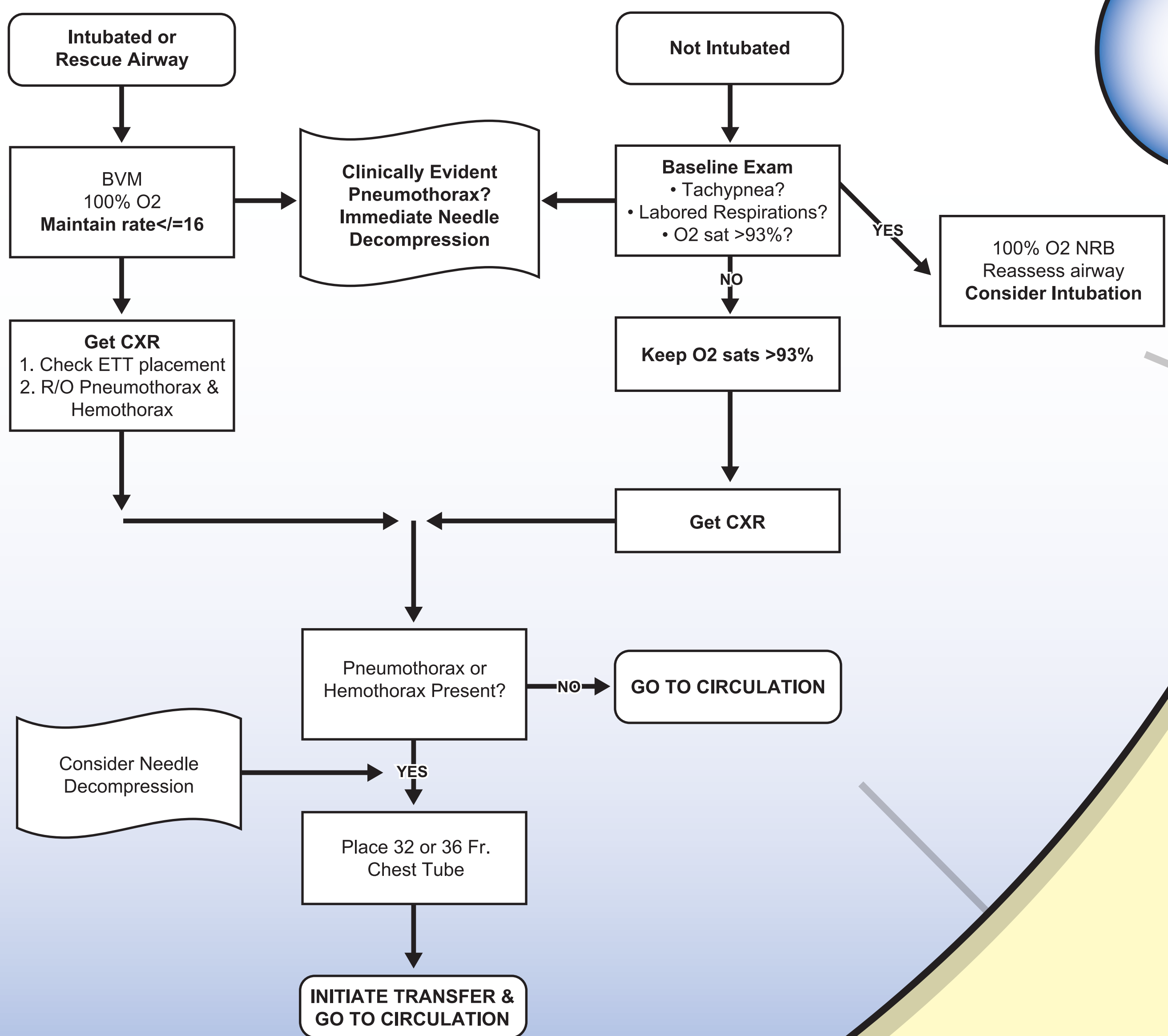
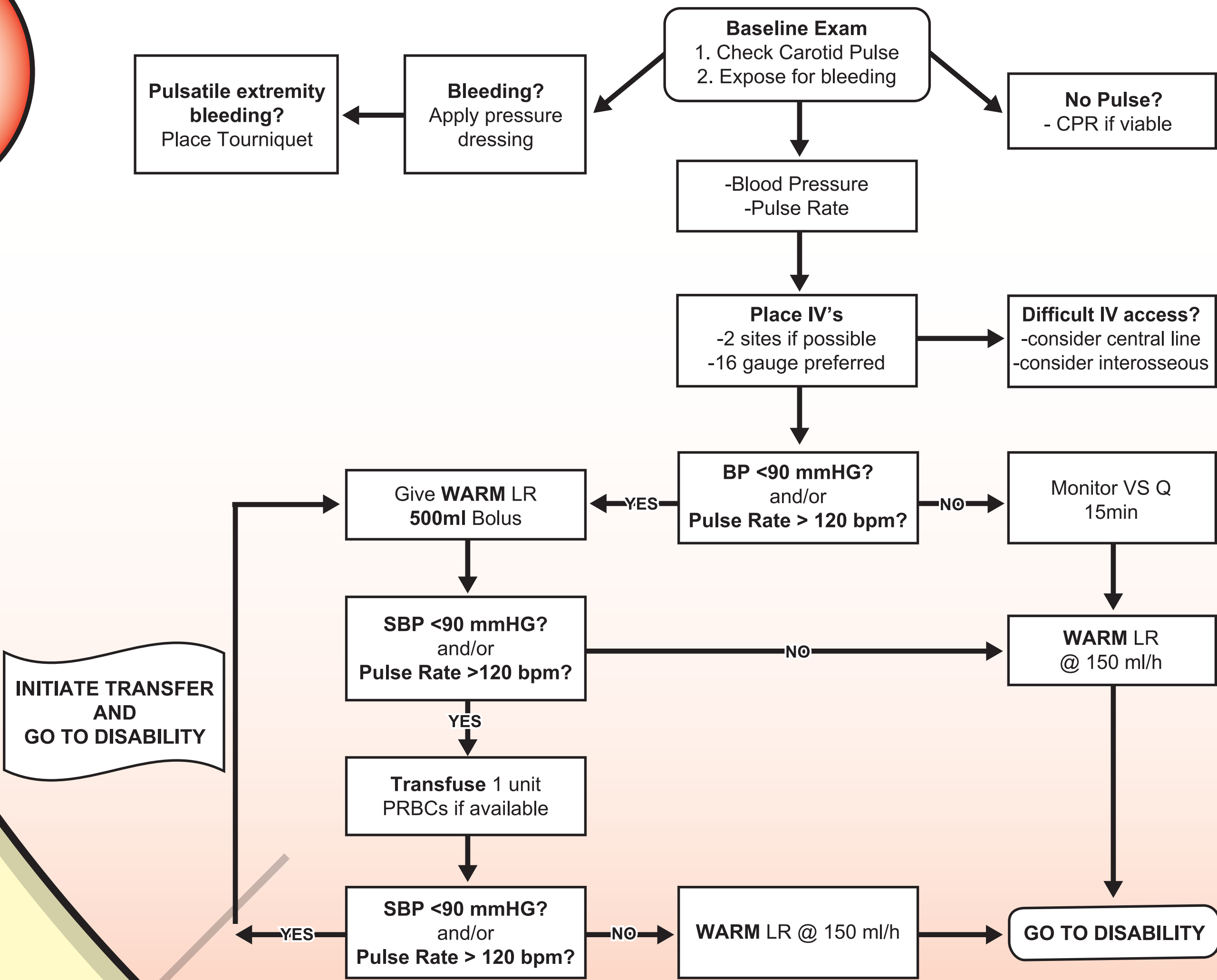
DISABILITY

AIRWAY



CIRCULATION

BREATHING





AIRWAY

Measures to establish airway should be instituted while maintaining C-Spine Control.

Priorities

Baseline Exam

- ☐ Sonorous Respirations?
- ☐ Gurgling?
- ☐ Unresponsive Patient?



If any present,
Need to intubate

No Respiratory Distress/Normal Breathing Pattern

- ☐ Apply O2
- ☐ O2 SAT Monitor



Go To
Breathing

Prepare to Intubate Checklist

- ☐ Initiate Transfer
- ☐ Pre-oxygenate 100% oxygen
- ☐ Oral/nasal airway
- ☐ Bag Valve Mask
- ☐ Suction ready
- ☐ Record pre-intubation GCS score
- ☐ Adequate size endotracheal tube (ETT)
 - * Males: 8 or larger
 - * Females: 7.5 or larger
 - * Pediatric: use Broselow[®] Tape
- ☐ Organize Drug Assisted Intubation Drugs (See Next Page)
- ☐ Consider video assisted intubation equipment
(GlideScope[®], Air Traq[®], King Vision[®], etc.)

Recommended Drug Assisted Intubation (DAI) Drugs

Pre and/or Post RSI Sedation

- Midazolam (Versed) 0.05 mg/kg IV (Quick dose 1-4 mg IV)
- Fentanyl 3mcg/kg IV (Quick dose 25-100mcg IV)

Induction

- Etomidate 0.3 mg/kg IV (Quick dose 20 mg IV)
- Or
- Ketamine 1-2 mg/kg IV

Muscle Relaxation

- Succinylcholine 1.5 mg/kg IV (Quick dose 100 mg IV)



- Underlying myopathy
- Elevated potassium level
- Pre-existing paralysis

Or

- Rocuronium 1 mg/kg IV
- Vecuronium 0.1 mg/kg IV

For pediatric doses refer to the Broselow® tape



Successful Intubation Checklist

- ☐ Confirm lung sounds

Left side diminished?

- Pull back ETT 1-2 cm
- Consider Pneumothorax/Hemothorax (PTX/HTX)

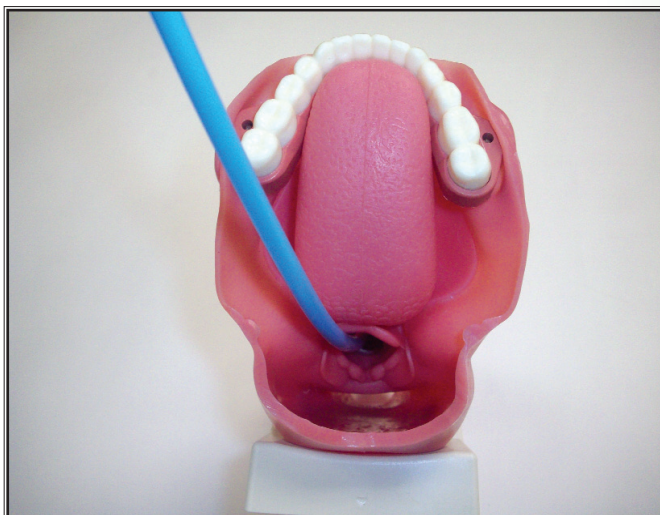
- ☐ Confirm ETCO₂ (color change)
- ☐ Secure the tube at 19-23cm
- ☐ Obtain X-Ray (tip of ETT should sit at clavicles)

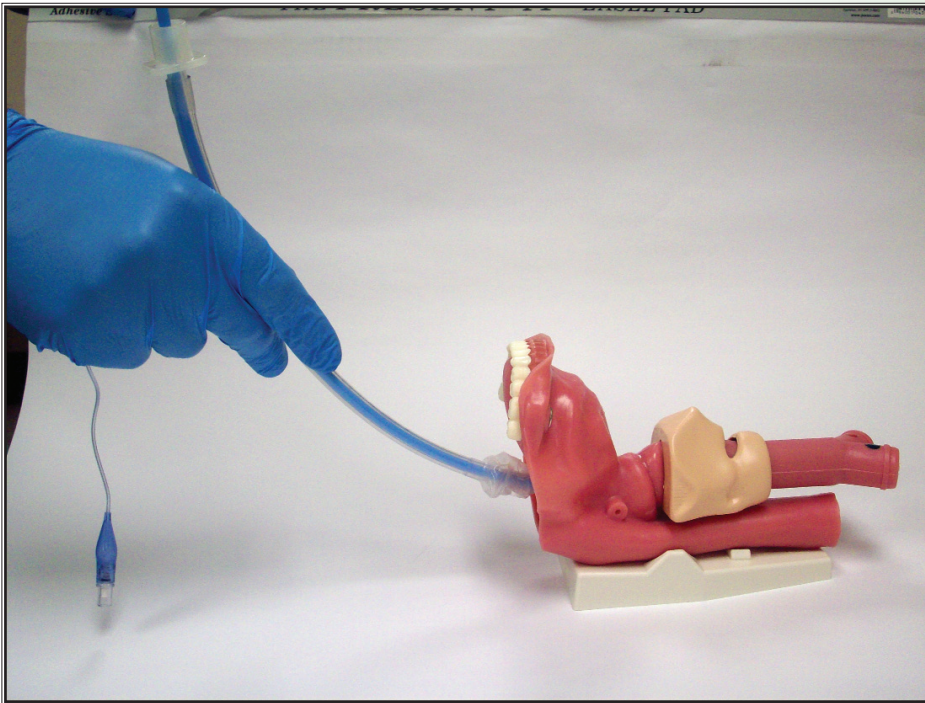
Unable to Intubate Checklist

- ☐ Pre-oxygenate
- ☐ Give more sedation
 - Midazolam (Versed) 1-4 mg IV and/or
 - Fentanyl 25-100 mcg IV
- ☐ Try again using BOUGIE or
- ☐ Consider video assisted intubation
(GlideScope®, Air Traq®, King Vision®, etc.)



Time is of the Essence!





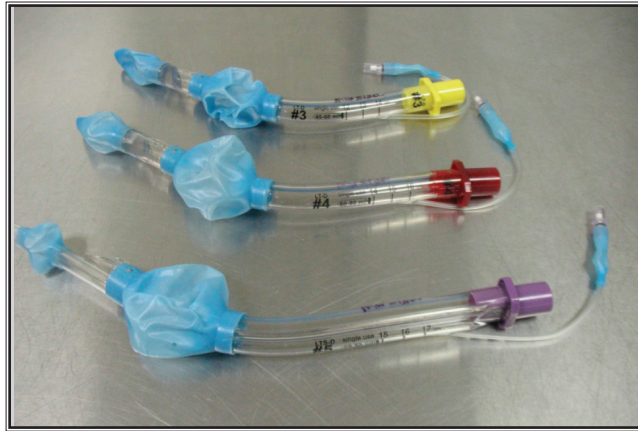
No luck?

- ☐ Place oral or nasal airway
 - BVM 100% O₂

Need Rescue Airway!

Rescue Airways: King LT or Combitube

King LT™



1. Choose correct size (based on height)

Yellow (#3) 4-5 ft tall

Red (#4) 5-6 ft tall

Purple (#5) >6 ft tall

2. Test Cuff
3. Lubricate Tip
4. Head in sniffing or neutral position
5. Rotate King LT™ laterally
 - * The BLUE LINE should touch the corner of mouth
6. Advance tip of tube past the tongue
7. Rotate BLUE LINE back to the midline
8. Advance tube until the connector touches the teeth
 - DEEPER IS BETTER
9. Inflate cuff
10. Check lung sounds and etCO₂

Adapted from manufacturer's printed guidelines. Please refer to manufacturer's printed instructions for more detailed direction on placement.

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

Adapted from manufacturer's printed guidelines. Please refer to manufacturer's printed instructions for more detailed direction on placement.

**Unable to Place Rescue Airway?
Need Surgical Airway!!**

Surgical Airway Options

Melker™ Cricothyroidotomy Kit

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.



4. Puncture skin over cricothyroid membrane with needle on syringe using free hand.

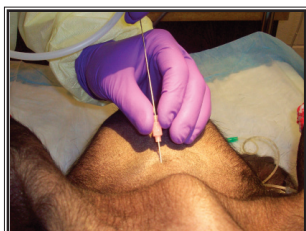


5. Direct needle into groove and aspirate for air as needle is advanced.



- **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 $\frac{3}{4}$ of its length into neck.**

6. When air obtained remove syringe while stabilizing needle and pass guidewire into the airway through the needle. When guidewire is placed remove the needle.



(Continued on next page...)

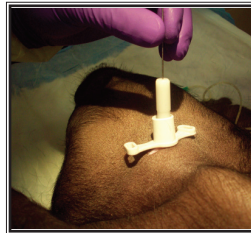
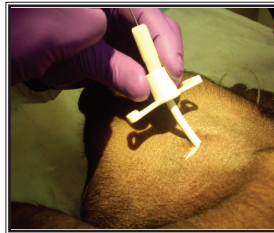
7. Make an incision $> 1\text{cm}$ in the skin around the guidewire.



8. Place introducer into the airway and feed into the guidewire.



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



10. Secure in place with strap or tape.



11. Oxygen saturation should improve rapidly.

- **Check on TRANSFER ARRANGEMENTS!**

**No Melker™ Kit?
See Next Page**

Fastest Airway: 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.



4. Use your index finger to try to feel and mark where the groove is (cricothyroid membrane).
 - If you can't feel anatomy due to thick neck - **GO TO SURGICAL AIRWAY IMMEDIATELY!**
5. Puncture skin over the cricothyroid membrane (midline) with the IV catheter (14 gauge is preferred) using your free hand.



6. Direct needle into groove and aspirate for air as needle is advanced.



- Stop when gush of air is obtained.
- Stop if catheter meets significant resistance.
- Stop if catheter doesn't obtain air by the time it is advanced $\frac{3}{4}$ of its length into neck.

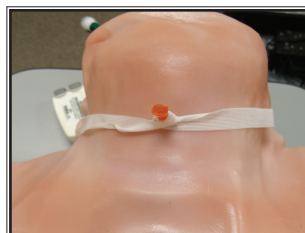
7. When air is obtained, advance the catheter to the hub and remove the syringe and needle while holding the catheter in place.



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



9. Secure in place with tape or suture - will have to improvise!



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

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.**



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



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.



Go To Breathing

B

B R E A T H I N G

Oxygenation & Ventilation

Priorities

Patient Intubated

- ☐ Maintain Respiratory Rate~16
- ☐ Keep O2 saturation > 93%
- ☐ Maintain ETCO2~35mmHg

Patient Not Intubated

- ☐ Oxygenate: Apply 100% FiO2
- ☐ Ventilation: Assess Resp Rate

Rule Out Pneumothorax and Hemothorax

Breathing Management For A Patient Not Intubated

#1: **Oxygenate** by applying 100% FiO₂

#2: **Assess Ventilation**

If respiratory rate <10 or >20 - need to assess WHY?

OR

If patient has shallow respirations need to assess WHY?



- Impending airway obstruction?
- Injury mechanism associated with respiratory failure?
- Severe pain impacting breathing?

**If you answer “Yes” to any of
the above questions
OR**

You are not sure

**CONSIDER REEVALUATION OF “A”
FOR INTUBATION**

**RULE OUT PNEUMOTHORAX AND/OR
HEMOTHORAX**

Is there a Clinically Evident Pneumothorax?

Asymmetric Lung sounds Y ☐ N ☐

If intubated check ETT position

Tracheal Deviation Y ☐ N ☐

Rib Fractures Y ☐ N ☐

Penetrating Chest Trauma

(i.e. Stab, GSW) Y ☐ N ☐

Subcutaneous Emphysema Y ☐ N ☐

If tracheal deviation present, will need needle decompression!

If "Yes" to >1 of above, will need chest tube.

Needle decompression

- Midclavicular line
- 2nd - 3rd intercostal space
- long 14-16 gauge - angio cath or pneumo dart



**Consider chest tube placement
if needle decompression is performed.**

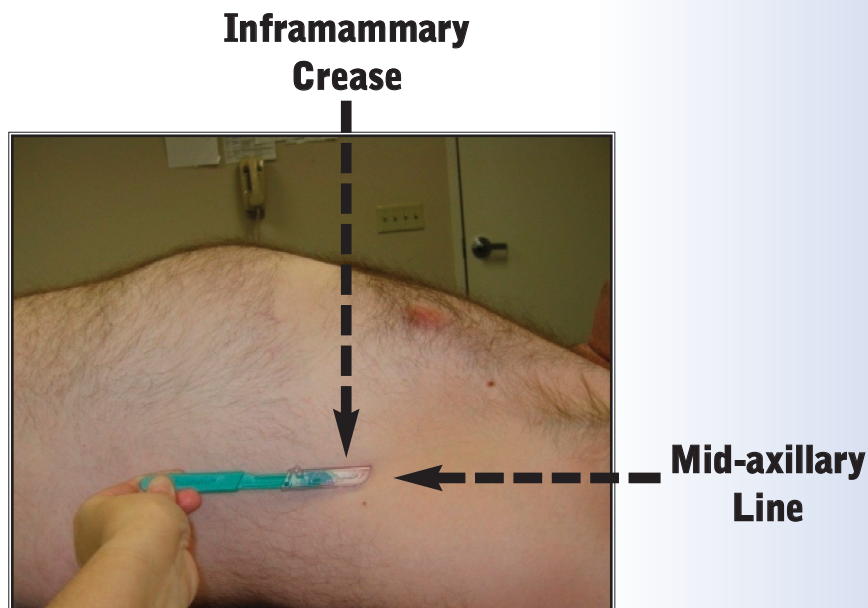
Chest Tube Placement

Equipment:

- Betadine or other prep
- Sterile drape or towels; sterile gloves
- Local anesthetic
- Scalpel
- Long clamp or tissue forceps x 2
- Chest tube: 28 Fr for pneumothorax or 32 Fr for hemothorax
(For pediatric appropriate sizes - see Broselow™ Pediatric Emergency Tape)
- Drainage System
- Suture (O silk, O prolene, or O nylon are best options)
- Gauze dressing (Vaseline gauze an option)

Procedure:

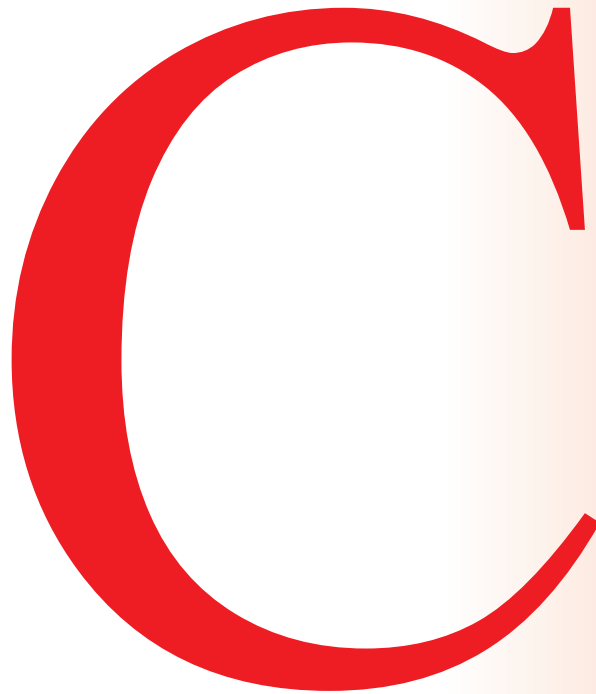
1. Confirm correct side.
2. Place patient arm above head (if able).
3. Prep and drape the appropriate area.
4. Inject local anesthetic.
5. Make an incision (1-2 inches) at site of insertion (see picture).



(Continued on next page...)

6. Feel the top of the rib and place clamp through the intercostal muscles at the top of rib.
7. Spread muscle widely.
8. Carefully push clamp or tissue forceps into pleural cavity through parietal pleura.
 - You should experience a "popping" sensation as you enter the pleural cavity.
 - Air or blood should also evacuate
9. Confirm placement by feeling for lung.
 - Soft, smooth, spongy feel
10. Place chest tube through hole and direct toward apex, posterior if possible.
11. Advance to 12-16 cm.
12. Connect chest tube to drainage system - place on wall suction.
13. Suture tube into place.
14. Place occlusive dressing around tube, secure with tape.
15. Listen to lung sounds.
 - Take chest x-ray if time.

Obtain post-procedure CXR to confirm placement if there is time!



C I R C U L A T I O N

Priorities

Stop Bleeding

- Apply direct manual 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
 - * Femoral and/or carotid palpable? Y ☐ N ☐
If yes, SBP>70mmHg
 - * Radial pulse palpable? Y ☐ N ☐
If yes, SBP>90mmHg

It is Essential to Prevent Hypothermia!!!

- Increase room temp
- Warming systems (i.e. Bair Hugger™)
- Warm IV fluids/blankets

Place IV Lines

16 GAUGE NEEDLE IS PREFERRED

Unable to place lines in reasonable time?

- Consider intraosseus
- Consider central line if experienced with procedure



Fluid Management

Crystalloids are not benign!!

- Associated with edema
- Prolonged mechanical ventilation
- Normal saline causes metabolic acidosis
- Associated with multiple organ failure and systemic inflammatory response syndrome (SIRS)

**Limit Normal Saline (NS) and Lactated Ringers (LR) :
>3L of Crystalloid is associated with worse
outcomes!**

Tips to limit Crystalloid infusion

- Do not leave IV lines "wide-open"
- Give IV fluid in 250-500 ml boluses only
- Tolerate lower blood pressures
 - Mean Arterial Pressure (MAP) 65 is adequate
 - SBP > 90 is adequate
- Use blood products for resuscitation early
 - PRBC's are first line
 - FFP should be used EARLY if available
 - See Massive transfusion strategy for Level III and IV trauma centers

MASSIVE TRANSFUSION STRATEGY FOR LEVEL IV AND V TRAUMA CENTERS

**There is limited application for massive
transfusion in critical access hospitals!
BLEEDING NEEDS TO BE EVALUATED BY A SURGEON:
IN NO CASE SHOULD TRANSFUSION DELAY
TRANSPORT TO DEFINITIVE CARE!**

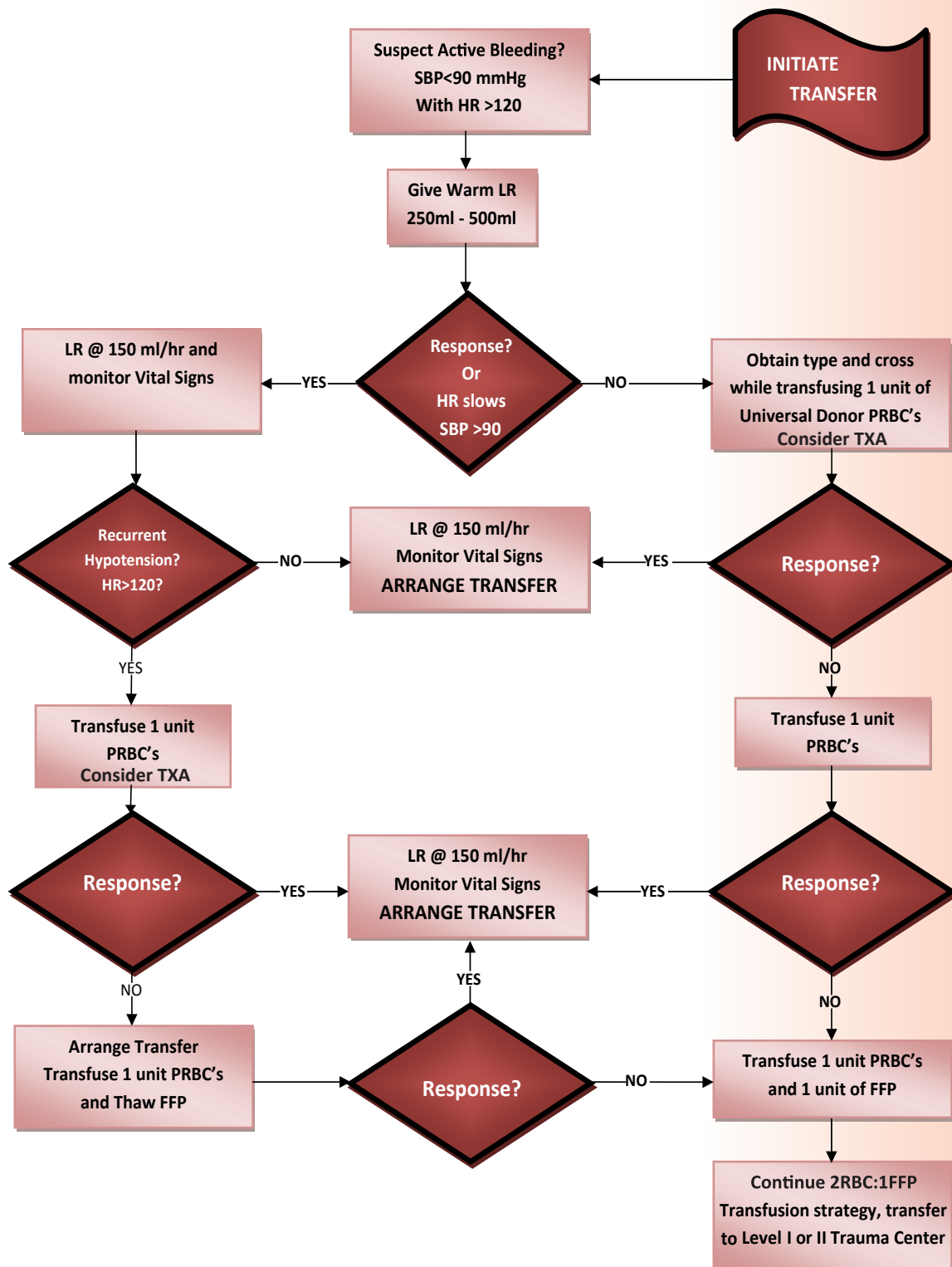
Making the Decision to Transfuse:

- 1) Contact has been made with accepting hospital and transfer arrangements are being made. ☐ Y ☐ N
- 2) A source of bleeding has been identified or a specific source is considered highly likely. ☐ Y ☐ N
- 3) The patient is hypotensive with a systolic blood pressure <90 mmHg. ☐ Y ☐ N
- 4) The patient was not responsive or transiently responsive to the first fluid bolus given per trauma treatment guideline poster algorithm. ☐ Y ☐ N

**If you answered “YES” to all of the above,
it is appropriate to initiate the massive
transfusion protocol.**

**Current literature and limited FFP resources best support
a transfusion ratio of 2 UNITS PRBC'S TO 1 UNIT FFP (2:1 RATIO).**

Resuscitation/Transfusion Strategy for Level IV & V Trauma Centers Possessing Component Blood Products



D

DISABILITY

Priorities

Calculate GCS

Pupil Exam

Avoid Secondary Hits

Identify and manage medical anticoagulation

Decide if CT scan is appropriate

GLASGOW COMA SCORE

Activity	Score	≤ 4 Years Of Age	≥5 Years Of Age
Eye Opening	4	Spontaneous	Spontaneous
	3	To speech or sound	To speech
	2	To painful stimuli	To pain
	1	None	None
Verbal	5	Appropriate words, sounds, and social smile	Oriented to person, place, month, year
	4	Cries but consolable	Confused
	3	Persistently irritable	Inappropriate words
	2	Restless / agitated	Incomprehensible
	1	None	None
Motor	6	Spontaneous movement	Obeys commands
	5	Localizes pain	Localizes pain
	4	Withdraws to pain	Withdraws to pain
	3	Abnormal extremity flexion	Abnormal extremity flexion
	2	Abnormal extremity extension	Abnormal extremity extension
	1	None	None

- Record GCS with vital signs
- GCS < 13 has elevated risk of Traumatic Brain Injury (TBI) and need for neurosurgical intervention.



Transfer Early!

Pupils

Unequal pupils is cause for concern:

1. May represent high intra-cranial pressure
2. May represent impending herniation

In the setting of Trauma and GCS < 8:

Intubate if not already

Consult with a Trauma Center before treatment

Mannitol 1 g/kg IV

Or

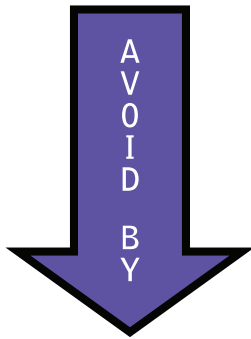
3% NS 250 ml IV bolus

**Transfer to a Level I or II
Trauma Center**

Avoid "Secondary Hits" to the Injured Brain

Hypoxia

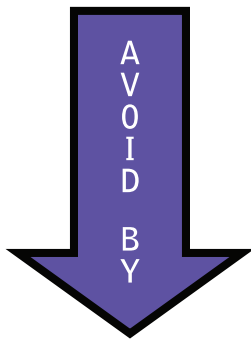
O₂ Sats <93% puts injured brain at risk!



1. Secure airway: intubation preferred
2. 100% FiO₂

Hypotension

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



1. Stopping bleeding
2. Transfusing blood products
3. **EARLY TRANSFER!**

Medical Anticoagulation



Check Home Meds for:

- ☐ Coumadin (Warfarin)
- ☐ Plavix (Clopidogrel)
- ☐ ASA
- ☐ Effient (Prasugrel)
- ☐ Xarelto (Rivaroxaban)
- ☐ Pradaxa (Dabigatran)
- ☐ Pleral (Cilostazol)
- ☐ Brilinta (Ticagrelor)
- ☐ Ticlopidine
- ☐ Eliquis (Apixaban)

Anticoagulation and Trauma = TROUBLE!

On Plavix and ASA?

- Transfer to a Level I or II Trauma Center
- Transfuse Platelets if available

On Coumadin?

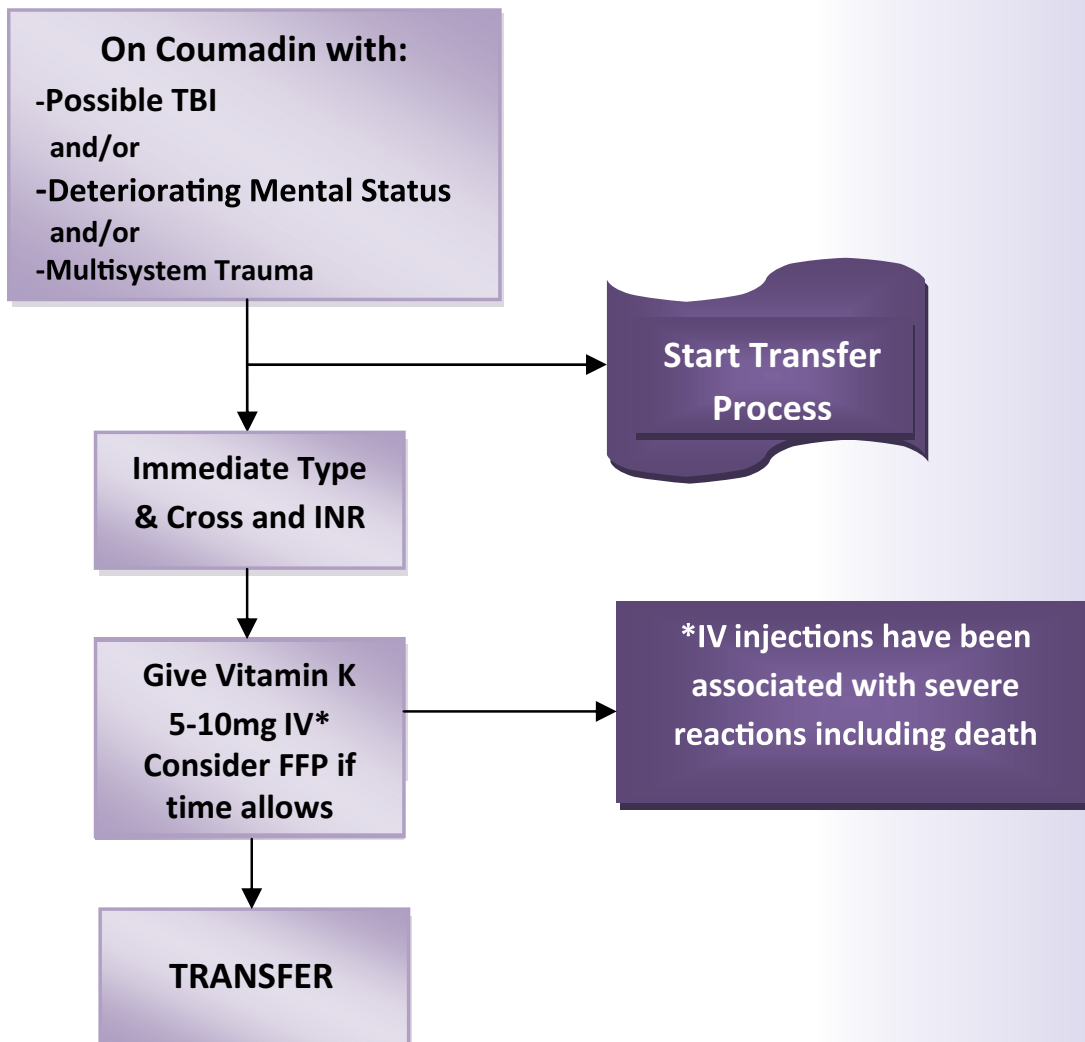
- Initiate Transfer
- Initiate Coumadin Reversal Algorithm (see next page)

On Other Anticoagulants?

- Consult with Level II Trauma Center

When in doubt = Consult

Coumadin Reversal Algorithm



C- Spine Clearance

If patient already meets criteria for transfer - defer CT of the c-spine, and maintain C-Spine immobilization. CT of the c-spine with coronal and sagittal reconstructions has become the standard of care **if** the NEXUS criteria are not met.

NEXUS CRITERIA

Bedside clearance of C-Spine is appropriate when:

- Patient is **NOT** intoxicated.
- Patient has normal mentation (**GCS = 15**).
- Patient has **NO** neurologic deficits.
- Patient has **NO** midline neck pain.
- Patient has **NO** distracting injuries.

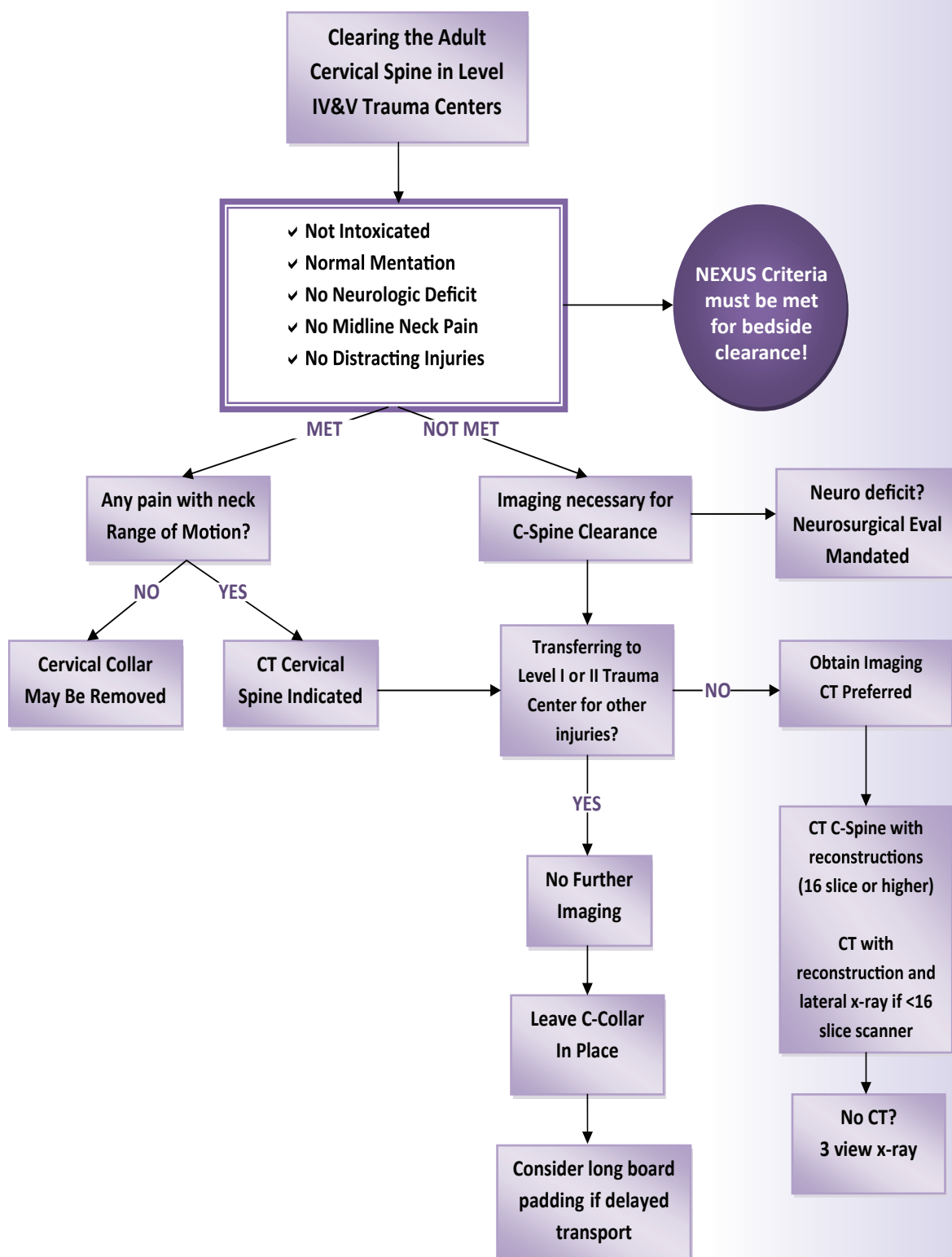
CT can still miss injuries that are ligamentous in nature.

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

Helpful Hint: *If your CT scanner is < 16 slice, obtain a lateral c-spine x-ray in addition to the CT to assist the radiologist in obtaining an accurate read.*

**Consider removing patient from back board
after initial EMS transport.**

Adult C-Spine Clearance Algorithm



Pediatric C-Spine Clearance

Age < 3:

- ➡ C-Spine injury in children < 3 years is extremely rare, occurring in < 1% of injuries in this age group.
- ➡ Nearly all injuries in this age group occur above C3
- ➡ Factors associated with C-Spine injury in children < 3 are:
 - GCS <14
 - GCS eye score = 1
 - MVC mechanism
 - Maybe higher incidents of injury between 2 and 3 years of age.

Reference: Pieretti-Vanmarcke, et al. J Trauma. 2009;67: 543-550.

Should Level IV and V Trauma Centers clear C-Spines in children < 3 years?



**The vast majority of time
the answer is NO!
TRANSFER IS INDICATED**

Age 3-16 Years

See Next Page

Pediatric C-Spine Clearance **(Age 3-16 Years of Age)**



NEXUS Criteria Applies to Kids!

NEXUS CRITERIA

Bedside clearance of C-Spine is appropriate when:

- *Patient is NOT intoxicated.*
- *Patient has normal mentation.*
- *Patient has NO neurologic 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 the parents to help you assess this!
- If mental status is altered, **DO NOT CLINICALLY CLEAR**
 - Obtain Imaging (**SEE ALGORITHM NEXT PAGE**)

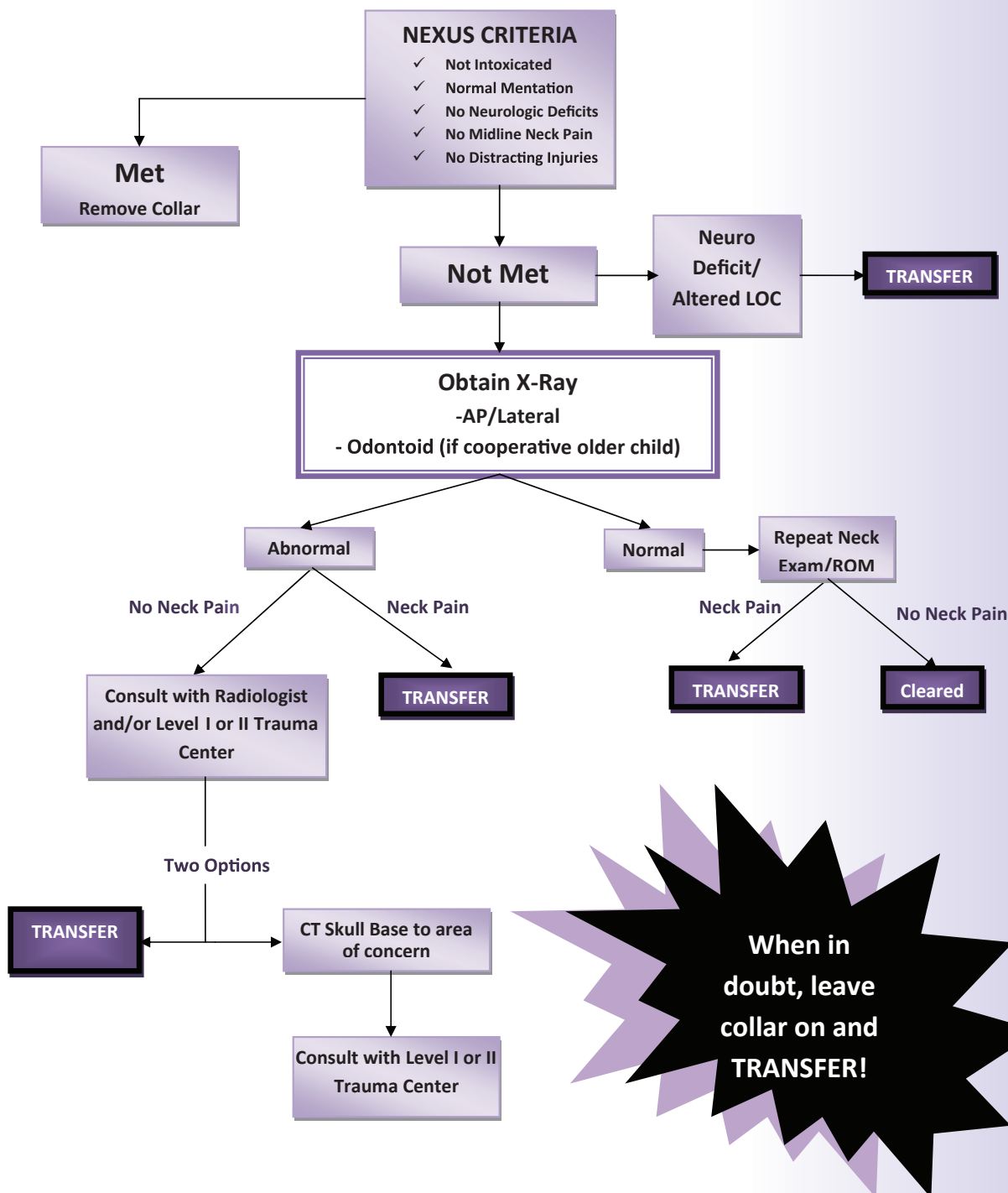


A child does NOT need imaging when:

- ✓ Normal Alertness/Mental Status
- ✓ No Midline Neck Pain
- ✓ No Neurologic Impairment
- ✓ No Distracting Injuries

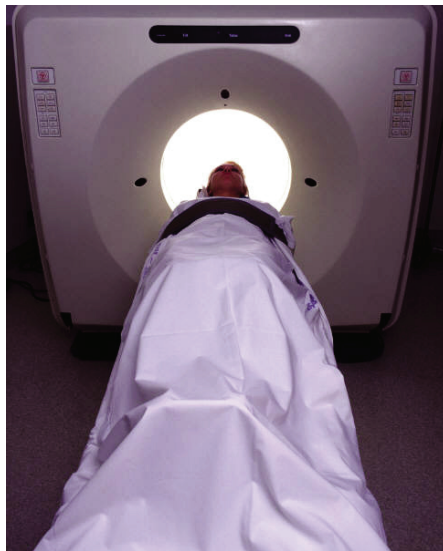
See Algorithm Next Page

Pediatric C-Spine Clearance Algorithm (3-16 Years of Age)



CT Scanning The Patient

USE YOUR CT
SCANNER
WISELY!!!!



“SAFE SCANNING PEARLS”

- ❖ Imaging Should NOT Delay Transfer
- ❖ Limit Pediatric Imaging

Recommendations for CT scanning at Level IV and V Trauma Centers

- Imaging **SHOULD NOT** delay transfer to definitive care
- Limit imaging in **PEDIATRIC** patients: the lifetime risk of radiation associated cancers **INCREASES** by 1% for **EACH CT SCAN** a child younger than 14 is exposed to.



When should we image the BRAIN at Level IV and V Trauma Centers (Adults/Pediatrics)?

Decision checklist for appropriate BRAIN CT:

1. GCS 13-15? Y ☐ N ☐
2. Loss of Consciousness? Y ☐ N ☐
 - Possible or Confirmed LOC
 - M.O.I commonly associated with Traumatic Brain Injury
3. There are NO identified injuries present, that will require transfer? Y ☐ N ☐

If “YES” to all above, CT of the brain can be considered

No Oral Contrast - Always Use IV Contrast.

CT CHEST

**Not recommended unless Chest X-ray
(CXR) is abnormal!**

- CXR will identify ALL immediately life threatening chest problems
- CXR also gives a much lower radiation dose to the patient

CT Abdomen/Pelvis Checklist

Hypotensive	Y ☐	N ☐
Intubated	Y ☐	N ☐
Transfer Indicated	Y ☐	N ☐

**If “YES” to any of the above,
CT NOT INDICATED**



BURNS

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

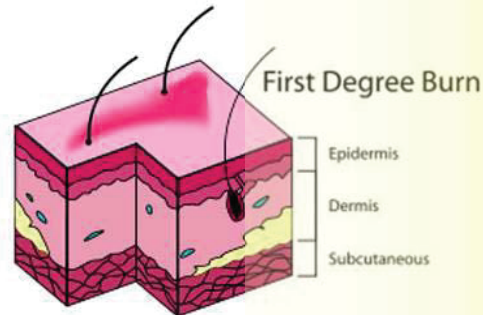
- Assess pulses and capillary refill to affected extremities
- Insert peripheral IV (*it is okay to insert into burned tissue if nothing else is available*)
 - May need to consider Intraosseous/Central Line
- Prevent hypothermia

**TRANSFER ARRANGEMENTS
SHOULD BE INITIATED!!!!**

Types of Burns

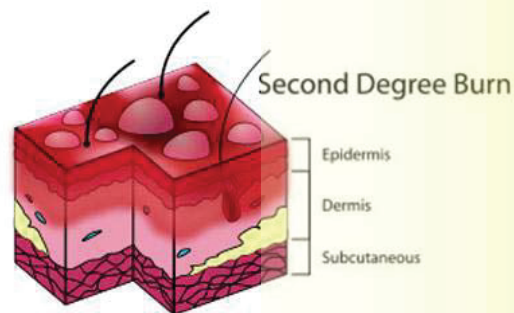
First Degree Burn

- Characterized by erythema, pain, and absence of blisters.



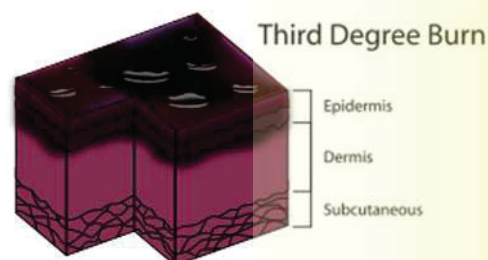
Second Degree Burn

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



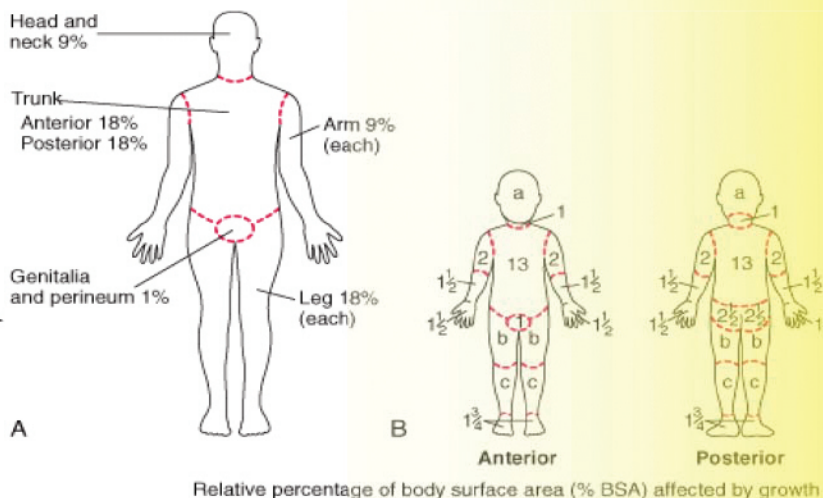
Fluid Management for Burn Patients

Step 1

- ✓ Determine the burn percentage of total body surface area.

Rule of palm for small burns

Use the size of patient's palm, including digits by counting all areas the size of the palm as 1%



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

Step 2

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

Lactated Ringers: fluid of choice for resuscitation

Adults and Children > 20kg

- ❖ TBSA X 4ml X weight in kg over the 1st 24 hours
 - Take the above number and give 1/2 of the fluid over the first 8 hours, and the second 1/2 over the next 16 hours.

Children < 20kg

- ❖ TBSA X 3ml X weight in kg over the 1st 24 hours
 - Take the above number and give 1/2 of the fluid over the first 8 hours, and the second 1/2 over the next 16 hours.
 - Add a maintenance IV of D5LR in addition to LR



Keep urine output at 100 ml/hr for adults and 1-2 ml/Kg/hr for children

Wound Care

- ✓ **REMOVE ALL** clothing, jewelry, and contact lenses.
- ✓ For chemical burns immediately remove all clothing, dust of powders, and begin irrigating with water for at least 30 minutes.
- ✓ **Dress burns loosely with clean dry sterile dressings**
(DO NOT APPLY CREAMS OR TOPICAL SOLUTIONS PRIOR TO TRANSFER)
- ✓ **KEEP** patient **WARM** 
- ✓ If time permits and does not delay transfer, cleanse wounds with saline and antiseptic such as chlorhexidine gluconate or mild soap.

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 consider administering Sodium Bicarbonate or Mannitol to promote diuresis and excretion.
- ✓ 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 level II trauma center for stabilization before being transferred to a burn center.*



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

COLD INJURIES & HYPOTHERMIA

PRIORITIES

- TREAT HYPOTHERMIA
- TRANSFER

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

Guidelines for Cold Injuries

- Treat hypothermia first!!! (**SEE NEXT PAGE**)
 - *As the core temperature approaches normal, rapid rewarming of the frostbite can be carried out.*
- Rapid rewarming by immersion in water 40 degrees C (104 degrees F) for 30-60 minutes.
 - *Thawing is complete when the distal tip of the extremity blanches.*
- Keep Warm and Dry
- Transfer to Level II Trauma Center



Helpful Hints

- ❖ **DO NOT** massage or manipulate the tissues
- ❖ Administer pain medications
- ❖ Give adequate hydration by appropriate means
 - Lactated Ringers or Normal Saline to correct fluid deficit
- ❖ *Pad between digits with fluffs or lamb's wool.*
- ❖ Tetanus Prophylaxis IM

Hypothermia Treatment



- ✓ Gently remove wet clothing.
- ✓ Obtain rectal temperature, BP, pulse, and respirations to identify severity of hypothermia
 - **Mild Hypothermia** - core temperature > 32 degrees C (90 degrees F)
 - **Severe Hypothermia** - core temperature < 32 degrees C (90 degrees F)
- ✓ Keep patient immobile
- ✓ Administer **WARM** and **HUMIDIFIED** oxygen at 100%
- ✓ Cardiac Monitor
 - **ARRHYTHMIAS ARE COMMON** – observe carefully for rhythm changes.
- ✓ Prevent ventricular fibrillation while rewarming
 - **Avoid:**
 - *Rough handling*
 - *Endotracheal tubes*
 - *IV or IM drugs (can rapidly reach toxic levels when patient is rewarmed)*
- ✓ IV Fluid Administration
 - *Lactated Ringers (preferred) or Normal Saline warmed (37.5 degrees C)*
 - *Give 200-300 ml rapidly then slow to give 1 liter in the first hour.*
 - *Maintain infusion rate to keep urine output at 1-2 ml/Kg/hr*
- ✓ Insert foley catheter for accurate urine output measurement

References

- American College of Surgeons Committee on Trauma. Advanced Trauma Life Support for Doctors - Student Course Manual. 9th ed. Chicago, IL: American College of Surgeons; 2012
- Cotton BA, Collier BR, Khetarpal S, Holevar M, Tucker B, Kurek S, et al. Practice management guidelines for prehospital fluid resuscitation in the injured patient. Available at: <http://www.east.org/tpg/FluidResus.pdf>. Accessed March 8, 2011.
- Cotton BA, Guy JS, Morris JA Jr & Abumrad NN. The cellular, metabolic, and systemic consequences of aggressive fluid resuscitation strategies. Shock. 2006;26(No.2):115-121
- Peter R, Koustova E & Alam, HB. Searching for the optimal resuscitation method: Recommendations for the initial fluid resuscitation of combat casualties. J Trauma. 2003;54(Suppl 5):52-62
- Santry HP & Alam HB. Fluid resuscitation: Past, present, and the future. Shock. 2010;33(No. 3):229-241
- Ley EJ, Clond MA, Srour MK, Barnajian M, Mirocha J, Margulies DR, & Salim A. Emergency department crystalloid resuscitation of 1.5 l or more is associated with increased mortality in elderly and nonelderly trauma patients. J Trauma. 2011;70(No.2):398-400
- Kashuk JL, Moore EE, Johnson JL, Haenel J, Wilson M, Moore JB, et al. Postinjury life threatening coagulopathy: Is 1:1 fresh frozen plasma: Packed red blood cells the answer? J Trauma. 2008;65(No. 2):261-271
- McMillian WD & Rogers FB. Management of prehospital antiplatelet and anticoagulant therapy in traumatic head injury: A review. J Trauma. 2009;66(No.3):942-950
- Como JJ, Diaz JJ Jr, Dunham CM, et al. Practice management guidelines for identification of cervical spine injuries following trauma - update from the eastern association for the surgery of trauma practice management guidelines. Available at: <http://www.east.org/g/tpg/cspine2009.pdf>. Accessed March 8, 2011.
- Vanmarcke-Pieretti R, Velmahos GC, Nance ML, Islam S, Falcone RA, Wales PW, et al. Clinical clearance of the cervical spine in blunt trauma patients younger than 3 years: A multi-center study of the American association for the surgery of trauma. J Trauma. 2009;67(No.3):543-550
- Hutchings L & Willett K. Cervical spine clearance in pediatric trauma: A review of current literature. J Trauma. 2009;67(No. 4):687-691
- Hutchings L, Atijosan O, Burgess C & Willett K. Developing a spinal clearance protocol for unconscious pediatric trauma patients. J Trauma. 2009;67(No.4):681-686
- Viccellio P, Simon H, Pressman BD, Shah MN, et al. A prospective multicenter study of cervical spine injury in children. Pediatrics. 2001;108(No.2)
- Chung S, Mikrogianakis A, Wales PW, Dirks P, Shroff M, Singhal A, Grant V, et al. Trauma association of Canada pediatric subcommittee national pediatric cervical spine evaluation pathway: consensus guidelines. J Trauma. 2011;70(No.4):873-884
- Salottolo K, Bar-Or R, Fleishman M, Maruyama G, Slone DS, Mains CW, et al. Current utilization and radiation dose from computed tomography in patients with trauma. Crit Care Med. 2009;27(No.4):1336-1340
- Markel TA, Kumar R, Koontz N, Scherer LR & Applegate KE. The utility of computed tomography as a screening tool for the evaluation of pediatric blunt chest trauma. J Trauma. 2009;67(No.1):23-28
- Barrios C, Malinoski D, Dolich M, Lekawa M, Hoyt D & Cinat M. Utility of thoracic computed tomography after blunt trauma: when is chest radiograph enough? American Surgeon. 2009;75(No.10):966-969