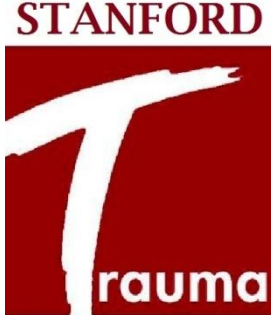
Trauma Guidelines



Stanford
HEALTH CARE
STANFORD MEDICINE

Lucile Packard
Children's Hospital
Stanford

June 2016

ADULT
Glasgow Coma Scale

Eye Opening	
Spontaneous	4
To Voice	3
To Pain	2
None	1
Verbal Response	
Oriented	5
Confused	4
Inappropriate words	3
Incomprehensible words	2
None	1
Motor Response	
Obeys commands	6
Localizes to pain	5
Withdraws to pain	4
Abnormal flexion	3
Abnormal extension	2
None	1

Qualifiers:

- Patient Chemically Sedated
- Patient Intubated
- Obstruction to the Patients Eye

Trauma Guidelines

Stanford Hospital and Clinics
Lucile Packard Children's Hospital Stanford
Training Programs

The protocols in this book are guidelines only. Individual cases may vary and clinical judgment should always be used. When in doubt, consult with the trauma attending on-call.

This manual reflects an abridged version of the Stanford/LPCHS Trauma Program documents.

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PHONE NUMBERS – Trauma/ICU

Trauma/ICU Attendings	**Cell**	**Pager**
James Badger, MD	650-740-0708	10850
Tim Browder, MD	702-757-8276	23728
David Gregg, MD	650-400-3901	10263
Javier Lorenzo, MD	pager only	24043
Paul Maggio, MD	650-521-7453	13299
Paul Mohabir, MD	650-804-4811	14318
David Spain, MD	650-776-3912	23990
Kristan Staudenmayer, MD	650-704-0631	23359
Tom Weiser, MD	617-794-5887	23439
Sherry Wren, MD	650-380-4058	13893

Trauma/ICU Contacts	**Office/Pager**	**Spectra**
SICU Fellow	12989 (pager)	
SICU Senior Resident		43085
SICU Junior Resident		53234
Trauma Senior		49040
Trauma Floor Intern	12163	53245
Trauma Advanced Practice Providers:		
- Jesse Alfaro, NP	650-384-9507 (cell)	
- Jessica Behrend, NP	650-850-2446 (cell)	
- Mickey Claudius, NP	650-213-6611 (cell)	
- Ya-Chen Lee, NP	650-847-7154 (cell)	
- Courtney Nelson, PA	650-847-9971 (cell)	
Trauma Case Manager (Michelle Paw)	650-561-5501	
Trauma Social Worker (Kate Aragon)	650-475-6908	
Trauma Nurse Coordinators		
- Denise Greci Robinson	925-784-3259 (cell)	
- Jo Ann Schumaker-Watt	650-656-7979 (cell)	
Trauma Program Manager – Shelly	650-521-7613 (cell)	
Trauma Clinic Main Line	650-723-6961	
Trauma Services Office	650-723-7570	

Other Contacts	**Spectra**
Blue MICU	33688
Green MICU	68069
Emergency Anesthesia	67814

ED		3-7337
E2/SICU		5-7122
North ICU	(E29)	3-6081
OR		8-4318
PACU		5-4834
B1		4-0690
B2	(Monitored)	3-7101
B3	(Monitored)	8-7442
C1	(ATU)	5-8106
C1	(CDU)	4-1710
C2	(Trauma Floor Patients)	3-5236
C3	(Medicine)	3-7266
D-ground	(Pharmacy)	5-4954
D1	(CCU)	5-7111
D1	(CSU)	5-7114
D1	(Pharmacy)	5-5159
D2	(Monitored)	5-7112
D3	(Monitored Trauma)	5-7113
DGR	(Ortho-trauma)	5-7110
Dialysis		3-7585
E1		5-7121
E3		5-7123
EGR		5-7120
F1		5-7131
F2		5-7132
F3		5-7133
FGR		3-7231
G1	(Nsurg/NCOR)	3-7136
G2		3-6935
G2S	(Monitored)	4-3131
H1		7-5800
H2		3-5001
LPCH- OR		1-2820
LPCH- PICU		7-8850
Outpatient		3-5274
Outpatient (Staff)		3-3312

Labs	
ABG	6-2127
Blood Bank	3-6445
Core Lab	2-5530
Echo	3-7406
Microbiology	4-4588
Surgical Pathology	3-7211
Central Supply	3-5272
Radiology	
Main SHC	3-6717
Bronchoscopy	5-4654
Cath/Angio	3-6738
Cath/Angio (Cancer Center)	5-3325
Colonoscopy/Endoscopy	3-5919
CT/GI	3-6855
CT Day Tech	3-7573
CT Night Tech	1-9659
ED Radiology Resident	6-2107
GI/Fluoroscopy	3-6762
IR	5-3615
Mammogram	5-1323
MRI	3-6335
MRI (after hrs tech)	3-6335
Nuclear Med	3-6884
Xray Day Tech	1-5541
Xray Eve Tech	3-6717
Xray Night Tech	1-9658
Ultrasound	3-3498

Main Operator	3-4000	
Page Operator	3-6661	
SHC Admitting	3-6221	
Crisis Nurse	1-6542	
ED Registration	3-2248	
ED Resource RN	4-2243	
ED Room 5	5-5096	
Medical Records	3-5721	
Nursing Supervisor Pager	1-6918	
Nursing Supervisor Spectralink	6-1767	
Peds Radiology Hotline		
07:00 – 17:00 days M-F	7-8757	
After-hours/Weekends	7-8758	
PT/OT	8-7026	
Speech	1-5087	
Transfer Center	3-4696 or	800-800-1551

Surgical Clinics:

Trauma Clinic	3-6961
Orthopedic Clinic	3-5643
ENT Clinic	3-5281
Plastic Surgery Clinic	3-7001
Neurosurgery Clinic	3-6469
Vascular Surgery Clinic	5-5227

TRAUMA/ACS ROTATION GOALS & EXPECTATIONS

Trauma Chief Resident (PGY-4):

Goals:

- Primary responsibility for the management of all patients admitted to or evaluated by the team in conjunction with the attending surgeon
- Functions as the team leader, assuming direct responsibility for day-to-day care of patients on the service and coordinating care with consulting services
- Gain knowledge of surgical care through discussion on rounds with the attending and by independent reading
- Gain operative skills through pre-operative reading and preparation and by direct intra-operative teaching from attendings

Expectations:

- Function as a team leader for daily patient care
- Attends all Trauma 97 and 99 activations
- Function effectively as trauma captain or trauma resident (if ED resident is captain) for trauma resuscitations
- Ensures trauma resident documentation is complete and timely for trauma H&P's, daily notes, & discharges
- Notify trauma attending of all Trauma 97 patients within 1 hour of evaluation and prior to any patient discharge from the ED
- Notify trauma attending if any acute change in patient condition including ICU admissions, patient deaths, admissions, or discharges
- Attends trauma clinic on Wednesday
- Attends General Surgery Clinic on Tuesday
- Prepare weekly case presentation for Monday trauma conference.

TRAUMA/ACS ROTATION GOALS & EXPECTATIONS

Trauma Junior Resident (PGY-1):

Goals:

- Develops knowledge & experience in the evaluation and management of critically injured and ill surgical patients
- Gain knowledge of surgical care through discussion on rounds with the team and by independent reading
- Refine procedural skills commonly required for these patients
- Experience and understand the day-to-day function of a busy surgical service.

Expectations:

- Interact with all members of team including ancillary and support staff in a productive, professional manner
- Execute the daily plans for the floor patients in a timely and efficient manner
- Assist in trauma resuscitations
- Maintain appropriate documentation
- Notify trauma chief resident of any significant change in patient condition immediately. If they are not available, notify the trauma attending
- Help coordinate discharge plans especially for patients without insurance with case management/social work
- Attends general surgery clinic on Tuesdays
- Attends trauma clinic on Wednesdays

Medical students - Medical students are an integral member of the team. They should assist in all aspects of patient care as dictated by the senior resident. This includes rounding daily on 2-3 floor patients, responding to all traumas in the ED, & attending the weekly Friday SICU conference. They may write patient notes, but these do not suffice for medical documentation, and thus cannot serve as the progress note in lieu of a resident note.

Trauma APP Schedule:

Monday through Saturday (12-hour shifts) 05:30-18:00
for Floor Coverage

Trauma APP Roles & Responsibilities:

- AM/Afternoon rounds with team, no pre-rounding
- Takes 1st call for all trauma patients on the floor
- Writes daily progress notes with or without TTS on those patients
- Updates and manages problem list for trauma patients
- Review all trauma patients for labs, orders, protocols
- Follows up throughout the day on labs, consults, additional studies
- Collaborates, communicates with and updates the Trauma senior resident, fellow and/or Trauma attending
- Communicates daily plan of care to patients, family members and consulting providers as able
- Responds to all Trauma 99 and 97 activations
- Communicates daily with social work and case management for disposition planning
- Assists with complex patient discharges and transfers
- Acts as contact person for communication to accepting MDs in other facilities
- Performs bedside procedures as needed
- Mentors residents during activations/procedures
- Independently rounds on Trauma patients in SICU to evaluate readiness for transfer out of ICU
- Writes transfers orders for SICU trauma patients
- Signs out pertinent patient issues to Trauma senior before leaving
- Attends monthly TMAC and PIPS/PPEC

TRAUMA ADMISSION POLICY

In order to facilitate patient care and to eliminate potential misunderstandings between various services caring for trauma patients, the Trauma Committee has established the following guidelines regarding admission to and transfer of trauma patients between services:

- Patients with a mechanism for potential multiple system injuries should be evaluated by the Trauma Service.
- **Patients with multiple system injuries, hemodynamic instability, or spinal cord injuries will be admitted to the Trauma Service.**
- **Patients with isolated orthopedic or neurosurgical injuries requiring ICU care will be admitted to the Surgical ICU/Trauma Service.**
- Admission to the Trauma Service is appropriate if an on-going evaluation for occult injuries is in progress.
- Patients with single system injuries, without a mechanism for multiple system injury shall be directly admitted to the appropriate service.
- Pre-existing medical conditions such as congestive heart failure, seizures, arrhythmias, diabetes, or COPD do not necessarily constitute reasons to remain on the Trauma Service with a single system injury.
- Once suspected occult injuries have been ruled out and the patient with single system injuries is stable, the patient may be transferred from the Trauma Service to the appropriate service.
- **Trauma Service will complete a tertiary survey within 24 hours of admission.**

TRAUMA TEAM NOTIFICATION & RESPONSE

EMERGENCY DEPARTMENT:

- When alerted of an incoming trauma, the ED RN confers with ED attending to determine trauma alert status, calls the direct line (211) to request appropriate trauma team activation, specifies adult or pediatric activation (99), alert (97), or notification (95), number of patients, & ETA.

TRAUMA TEAM RESPONSE:

- **Trauma 99** activations are seen by the trauma attending, chief, and junior resident.
- **Trauma 97** activations are seen by the trauma chief and junior resident.
- **Trauma 95** notifications are initially seen by *ED only*. If the patient is stable and an injury is identified, the ED will request a **Trauma Consult** as needed.
- Any patient that meets criteria for a higher level of activation can be upgraded at any time by any member of the trauma team.
- All residents should ***sign in*** with the recording nurse.

ACTIVATING BACK-UP PERSONNEL:

Decision for activating additional personnel is at the discretion of the Trauma Attending & Trauma Chief Resident. The Back-up team is expected to arrive within 30 minutes.

NOTIFICATION OF SPECIALITY CONSULTS:

When a specialty related injury is identified, timely consultation should be obtained especially in the event of a life-threatening, or extensive injury. The Trauma Chief Resident is responsible for notifying the consult service, but may be delegated to appropriate trauma/ED resident personnel. If the consultant does not arrive within 20 minutes, the chief resident of that service will be notified. If no response within 20 minutes, the attending will be contacted by the ED or trauma attending.

Full Trauma Team activation (Trauma 99) should occur with the following:

- Adults: Confirmed SBP less than 90 at any time.
- Child less than 6 years: SBP less than 60.
- Child greater than 6 years: SBP less than 90.
- Airway compromise/obstruction or pre-hospital intubation.
- Respiratory distress with a rate less than 10 or greater than 29.
- Significant hypoxia at scene.
- Glasgow Coma Scale score (GCS) less than 9 with trauma mechanism.
- Gunshot wound/penetrating trauma (non-extremity) above the knee/elbow.
- Traumatic paraplegia or quadriplegia.
- Transfer-in patients receiving blood or vasopressors to maintain vital signs.
- Emergency Medicine discretion
- Adults: Confirmed systolic BP<90 at any time
  - Child >6 years: SBP <90
  - Child <6 years: SBP <60
- Airway Compromise/ Obstruction or pre-hospital intubation
- Respiratory Distress <10 or >29
  - Pediatric: Nasal flaring, retraction, stridor, cyanosis
- GCS <9 with Trauma mechanism
- GSW/Penetrating trauma
  - Head or neck
  - Chest, abdomen or pelvis
  - Extremities proximal to the knee or elbow Traumatic paraplegia or quadriplegia
- Transfer–in patients receiving blood or vasopressors to maintain vital signs
- Emergency Medicine Discretion

Trauma Team Alert (Trauma 97) should occur with the following:

- High speed auto crash greater than 35 mph.
- Ejection.
- Cycle crash greater than 20 mph (e.g., bike, motorcycle, ATV) or rider thrown.
- Pedestrian vs. auto greater than 5 mph impact (e.g., thrown, run over).
- Adult fall greater than 15 feet or children greater than 10 feet.
- GCS 9 to 13 with trauma mechanism.
- Significant blunt injury to head, including pre-hospital witnessed neurological change.
- Major facial injuries (w/o airway compromise).
- Flail or crushed chest.
- Suspected pelvic fracture.
- Two or more long bone fractures (femur or humerus).
- Amputation proximal to wrist or ankle.
- Penetrating extremity injuries proximal to wrists or ankle.
- Burns <20% with significant trauma admit to Trauma Service.
- Burns >20% with trauma stabilize for Burn Center transfer.
- Pregnant woman >=20 ega with a trauma mechanism of injury
- Emergency Medicine discretion.

Trauma 95 should be initiated when there is no significant anatomic injury other than extremity fractures distal to the knee or elbow, or abrasions, lacerations or contusions. These will be initially seen by ED only.

- Rollover.
- Death of occupant of car.
- Prolonged extrication.
- Auto deformity greater than 20 inches or intrusion to space occupied by passenger.
- Consider risk based on age greater than or less than 5, or known cardiac, respiratory, metabolic disease or drug/alcohol influence.
- Adult fall less than 15 feet or children less than 10 feet.
- Emergency Medicine discretion.

TRAUMA TEAM MEMBERS

Trauma Attending:

- Oversees the trauma resuscitation and acts as a resource person for the Team Captain.
- Is the deciding voice.
- Has primary responsibility for overseeing all care rendered.

Emergency Medicine Attending:

- Interfaces with pre-hospital system.
- Initiates trauma activation/alert/consult.
- If no Trauma Attending present, assumes Trauma Attending duties until their arrival.
- Allocates Emergency Department (ED) resources.
- Is responsible for overseeing airway management.

Team Captain:

The Team Captain role is rotated between the Trauma Chief Resident, and the Emergency Medicine (EM)Resident PGY III based on published schedules.

- Assigns roles to team members.
- **NO HANDS ON PATIENT CARE**
  - **ED thoracotomy if necessary will be performed by General Surgery Trauma Chief Resident**
- Directs the trauma resuscitation and assigns residents roles
  - Directs fluid resuscitation.
  - Decides which tests to obtain.
  - Orders medications.
  - Requests consults.
- Discusses case and care plan with the ED and Trauma Attending.
- ***Team captain role will be assigned by calendar schedule with alternative ED and Surgery service performing this role. Monthly calendar is posted in ED Resuscitation Room.***

Trauma Survey and Procedure Residents:

- **Survey Resident** performs primary/secondary survey
  - FAST if Procedure Resident is performing procedures
- **Procedure Resident**–lines, chest tubes, Procedure Resident is either ED R2/3, R3 SICU or Surgery R2 resident
- Survey and procedure resident *should include at least one resident from the service not functioning in the Team Captain role*. During Tuesday (Surgery conference) and Wednesday (ED conference) mornings during each departments educational activities, survey and procedure residents will all be from the available respective service.
- ED thoracotomy will be performed by surgery trauma chief resident

Airway Resident: (Only if extra resident available)

- Establishes airway under direction of ED attending

Trauma Advanced Practice Provider:

- When possible responds to trauma activations and alerts
- Can function in the survey resident role, if necessary, to perform primary & secondary surveys and/or supervise junior resident performing secondary survey
- Able to perform procedures under the supervision of the trauma chief resident
- May accompany patient to procedures/transfers under direction of trauma captain
- Collaborate with trauma captain to determine plan of care

Trauma Nurse Coordinator/Trauma Program Manager:

- When possible, responds to trauma activations/alerts to collaborate with team members to ensure the quality and timeliness of care
- Assists with RN documentation as needed
- Assists with procedures as needed
- Serves to educate ED RN staff regarding trauma patient care principles and practices
- Assists with Rapid Infusion device set-up, if necessary

Emergency Department Resource Nurse:

- Consults with the ED Attending to determine the level of the trauma activation. Directs the Unit Secretary to activate the trauma beepers via emergency page operator when a trauma patient is en route.
- Ensures announcement of overhead intercom that a trauma is arriving with ETA and type of trauma.
- Assures adequate nursing, ancillary staffing.
- Maintains constant communication and awareness of resuscitation team efforts.
- Follows the procedure for telecommunication backup staffing PRN.
- Informs the Trauma Resuscitation Nurse when the patient's family/friends have arrived in department, and directs visitation.
- Utilizes all support services to assist patient, family and friends (i.e. Social Worker, Chaplaincy, etc.).
- Arranges bed access and placement via the nursing supervisor if patient is to be admitted.
- Reports victims of violent crime to security services.

ED – RN A:

- Located on patient right side
- Prior to patient arrival, prepares resuscitation room (age specific equipment, IV line prep, special procedure trays, room temp, etc..)
- Functions as primary patient care RN during initial resuscitation and stabilization
- Establishes PIV access and draws labs
- Administers medications under direction of team captain
- Remains at patient bedside wearing a lead X-ray apron
- Guarantees compliance with RN guidelines for documentation (full vital signs with GCS)
- Communicates pertinent information to the Trauma RN Recorder (ED – RN D).

ED – RN B:

- Located on patient left side
- Places patient on monitors
- Establishes second PIV, if needed
- Initiates IVFs once IV established
- Assists with procedures

ED- RN C: (Only for Trauma 99's)

- Located on patient right side
- Sets up and runs Rapid Infusion device

ED – RN D: (RECORDER)

- Located off to the left of the foot of the bed
- Receives patient status report from Resource RN
- Ensures lab tubes labeled correctly
- Records initial team patient assessment
- Documents all pertinent patient data and care rendered by trauma team in the EPIC TRAUMA NARRATOR
- Ensures full set of initial vital signs recorded (temp, BP, Pulse, Respirations, Oxygen sat & GCS) upon arrival
- Documents repeat VS (BP, HR, RR, sat) every 3-5 mins during initial assessment and continue if patient is receiving interventions for hemodynamic instability. Then every 15 min. x4, 30 min x2, then per admit orders.
- Orders initial trauma labs/studies using the Trauma order sets in the EPIC NARRATOR
- Directs other RNs and ED technician in patient care activities
- Accompanies patient to other services/procedure areas
- Functions as bedside RN once initial survey and interventions completed
- Keeps ED Resource RN informed of potential transfer of patient to other patient service areas
- Inventories trauma room at least every 8 hours

ED Technician:

- Located on patient right side
- Assists the ED – RN A with moving patients and reading the trauma resuscitation area prior to patient arrival
- Performs cardiac compressions if CPR needed
- Connects oxygen tubing to the flow meter
- Removes all patient's clothing
- Connects to automated BP cuff to patient's arm & sets for interval of every 5 minutes, until deemed stable.
- Measures and reports temperature, pulse, respiratory rate, O2 saturation and blood pressure
- Assists with setting up procedure supplies

ED Technician: (continued)

- Makes clothing list and removes, records and collects valuables in plastic zip-lock bag. Turns valuables over to Resource RN to be placed in locked storage.
- Assists with wound care as directed by primary RN
- Assists with preparing patient for transport (obtains oxygen tanks, consolidates IVs)
- Assists with actual patient transport
- Assists with immediate cleaning and restocking of trauma resuscitation room
- Prepares and sends trauma procedure trays to Central Reprocessing as soon as possible

Respiratory Care Technician:

- Carries the trauma beeper 24 hrs/day
- Pediatric RTs respond to pediatric major trauma alerts (less than 14 years of age)
- Institutes and maintains ventilation with a manual resuscitator per the instructions of the Trauma Captain
- Participates with other members of the Trauma Team in establishing an airway, CPR, intubation, airway clearance techniques, bronchial hygiene, administration of pharmacological agents, diagnostic and therapeutic respiratory care procedures, administration of medical gases, aerosols and humidity.
- At the time deemed appropriate by the physician team leader, connects the patient to a mechanical ventilator and adjusts the ventilator in accordance with the verbal or written physician's orders.

X-ray Technician:

- Reports to the Trauma Resuscitation Room when trauma beeper is activated and waits for specific instructions.
- Performs Chest X-ray and Pelvic films promptly for all 99 Activations.

Computed Tomography (CT) Technologist:

- CT Scanner availability is coordinated by the Radiology Department with the commitment being 5-10 minutes for a "99" activation and 15-20 minutes for "97" alerts.
- Ensures that the Radiologist is available to immediately check images to determine type of exams needed (e.g., reconstruction views, additional imaging).

Transfusion Services:

- When a Trauma Team Activation (99) occurs and blood order placed in Epic, the Transfusion Services Charge Technician dispenses 2 units of uncross-matched universal donor blood O-negative or O-positive depending on the gender/age recipient) Packed Red Blood Cells (PRBCs) and 2 units of AB+ liquid plasma into a cooler that is labeled with the patient's trauma number.
- A Transfusion Services Technician delivers the cooler containing the blood products to the Trauma Resuscitation Room in the ED
- Technician collects verification specimen from ED-RN.

Operating Room Charge Nurse:

- The OR has an in-house Trauma OR Team ready 24 hours a day.
  - OR Charge Nurse can be reached via pager (19502) or SpectraLink (4-4590).
  - Anesthesia can be reached via pager (19650) or SpectraLink (6-0249).
- Upon receiving a trauma page, calls the Trauma Resuscitation Room at extension 5-5096 for a status report, and periodically for updates, or responds to the ED to collaborate with the Trauma Surgeon to determine if an OR suite is needed.
- The Trauma Resuscitation Room is warmed, has the Level 1 Infuser ready and Trauma Cart in place.

Social Worker:

- Assists in ensuring family notification and contacting the primary medical doctor (PMD)/insurer for the past medical history (PMH).

Trauma ED Order Sets

- There are standard orders for traumas based upon activation level. The Recording RN should order these through the trauma narrator in EPIC. They are also available under order sets by the following names:
  - **"Trauma 97"**: Initial ED Trauma 97 Automatic Orders
    - Istat Cr, CBC, type and screen, CMP, Istat INR
    - CXR, Peripheral IV
  - **"Trauma 99":** Initial ED Trauma 99 Automatic Orders
    - Istat Cr, Istat INR, Istat VBG/Lactate, CBC, type and screen, CMP, urine tox screen, serum volatile screen, UA
    - CXR, Pelvis Xray, Peripheral IV, Foley
  - **"Trauma Radiology"** – NO automatic orders. Order set contains *options* for initial common CT scans. *Please use these as the CTs are already protocolled.*
  - **"ED Trauma Medication":** NO automatic orders. Order set contains options for analgesics, anti-emetics, antibiotics and tentanus.

Note: For Female patients - please ask RN to check pregnancy test in the order sets.

CLINICAL TRIALS & PREVENTION PROGRAMS

Clinical Trials:

- **START Trial –** randomized control trial of human mesenchymal stem cells (MSCs) for the treatment of moderate to severe ARDS (defined by P/F < 200 on at least 8 of PEEP). Phase II study with 2:1 randomization, primary inclusion is being within 96 hours of meeting criteria for ARDS.
- **EPVent 2 –** phase II RCT comparing strategy of PEEP titration to end-expiratory transpulmonary pressure (measured by an esophageal balloon) vs. a high PEEP LPV strategy. Major inclusion criterion is moderate to severe ARDS (P/F < 200 on at least 5 of PEEP).
- **ROSE** – RCT of cisatracurium started within 72 hours of severe ARDS (p/f<150 on PEEPε 8cm H2O) vs. standards care.
  - clinical coordinator for above studies Rosemary Vojnik (408) 772-3001
- **STOP-AKI –** Phase II Study: Safety, efficacy and tolerability of Human Recombinant Alkaline Phosphatase in patients with sepsis-associated Acute Kidney Injury. Inclusions: 2/4 SIRS criteria & sustained AKI by elevated Cr (>0.3) or Low Urine output. Treatment must start by 24hrs of AKI diagnosis. Major exclusions: CKD, immunocompromised, urosepsis
- **Euphrates** – Hemoperfusion using Polymyxin B cartridge vs. sham in adults with severe septic shock. Inclusions: pts on qualifying pressors for minimum 2hrs, multiple organ failure and high endotoxin levels-tested by research-must begin treatment within 30hrs of pressor
  - clinical coordinator for above studies Valerie Ojha (650) 518-9716
- **Stanford ICU Biobank** – blood, urine, and available respiratory secretions/left-over BAL specimens for genomic studies in critically ill patients with risk factors for ARDS, including trauma, sepsis, and aspiration. Email Angela Rogers ajrogers@stanford.edu

Prevention Programs:

- **FAREWELL TO FALLS** – ideally for elderly patients who have fallen and are being discharged from the ED. Some inpatients also qualify if going home without any home services (i.e. PT/OT Home safety evaluations)
  - Contact Ellen Corman via email : ecorman@stanfordhealthcare.org

- **Screening, Brief Intervention & Referral to Treatment (SBIRT) –** is a comprehensive approach to the delivery of early intervention and treatment services for persons with substance use disorders, as well as those who are at risk of developing these disorders.

Screening is to be performed on all trauma patients*:*

1. Ask the patient:
"When you drink alcohol, how many drinks do you drink?"
2. Patient's blood alcohol level drawn in the ED?: Y N
Level:_____
• If BAL 0.08 or greater or patient drinks more than 2 drinks at a sitting, ask the CAGE questions.

Check One:

Alcohol CAGE Score:

❑ < 2

❑ 2 or more (refer to Social Work)

C = Have you ever felt you should cut down on your drinking?

A = Have people annoyed you by criticizing your drinking?

G = Have you ever felt bad or guilty about your drinking?

E = Do you ever take a drink in the AM to steady your nerves or relieve a hangover?

Scoring: If 2 or more "Yes" answers, patient is at risk of problem drinking or alcoholism.

Plan: If BAL 0.08 or if suspected of intoxication or if cage 2 or more refer to Social Work

Guidelines:

- All lines placed in the field or ED are considered suspect and should be replaced as soon as feasible after admission. Exceptions include central lines placed utilizing full barrier precautions.

- Preferred site of central access during trauma resuscitation is the femoral vein
    - Femoral access should be utilized with caution in an unstable patient with severe pelvic fractures or likely vena caval injuries. Subclavian vein should then be considered
    - Femoral vein catheters should be removed as soon as possible to decrease the risk of DVT

- Patients with suspected cardiogenic shock or in need of central venous pressure monitoring should have a subclavian or internal jugular venous central line.

- ALL central lines should be placed under "full barrier precautions" defined as sterile gown and gloves, cap and mask, and FULL draping (3/4 sheet, lap drape, etc.). Chlorhexidine is the preferred prep agent. Cap and masks are recommended for those nearby, while full barrier precautions should be observed by those assisting.

- Central lines should be covered with chlorhexidine-impregnated dressings, which have been shown to reduce line infections threefold.

References:

- Mermel LA, et al. Am J Med 1991, 91:197S-205S
- Goetz AM, et al. Infect Control Hosp Epi 1998, 16:842-5.
- www.CDC.gov/mmwr/PDF/rr/rr5110.pdf

What are the criteria for activating the MTG?

Adult patients

- requiring > 4 units of PRBCs in the first hour of resuscitation OR
- high likelihood of > 10 units of PRBCs within 12 hours of resuscitation

Pediatric patients

- requiring > 20 ml/Kg of PRBCs in the 1st hour of resuscitation OR
- high likelihood of > 0.1 units/Kg of PBRCs within 12 hours of resuscitation

When the MTG is activated, the following blood products are delivered:

Adult MTG Pack (> 50 Kg)

- 6 Units of PRBCs
- 4 Units of thawed plasma
- 1 Unit of apheresis platelets

Pediatric MTG Pack (≤ 50 Kg)

- 4 Units of PRBCs
- 2 Units of thawed plasma
- 1 Unit of apheresis platelets

HOW TO ACTIVATE THE MTG PROCESS:

General Steps:

1. Determine need for MTG
2. Place order for MTG
   - **Use the appropriate mechanism for ordering based on patient location**
     - EPIC MTG order set (ED or ICU patients)
     - Downtime paper form (OR patients)
3. **Call Blood Bank to notify them of MTG order via phone (3-6445)**
4. All products should be delivered through IV warming device except platelets
5. If additional blood is anticipated beyond the delivered MTG pack, the MTG must be re-ordered via same procedure

For patients in the ED:

- 2 units of uncrossed matched type O blood and universal donor liquid plasma will be delivered for all Trauma 99s automatically by the blood bank personnel. *(Not always O negative if a male patient.)*
- If the patient is experiencing life threatening hemorrhage, additional blood can be ordered by activating MTG
- ***Use EPIC order set for MTG which will be found in the Trauma Narrator***
- MTG blood will be delivered directly to trauma bay by blood bank personnel

For patients in the OR:

- ***Use the Downtime MTG paper order form***. The form must have patient information via a patient label or addressograph to be a valid order
- Runner from OR takes copy of order form to transfusion services to obtain MTG pack that was ordered

For patients in the ICU:

- ***Order in EPIC using "MTG" Order set***
- Runner from unit takes label with patient name and either MRN or DOB to obtain MTG pack from blood bank

ANTIBIOTICS in TRAUMA

BACKGROUND:

- Prophylactic antibiotics are frequently recommended by consulting services, but the data to support many of these recommendations is weak or nonexistent.
- Drug resistant infections attributable to antibiotic overuse are becoming more common and far more virulent.
- Antibiotics cannot overcome poor wound management

OPEN FRACTURES:

- Grade I: wound < 1cm long and clean
- Grade II: wound > 1cm without extensive soft tissue damage, flaps, or avulsions
- Grade III: either an open segmental fracture, open fracture with extensive soft tissue damage, or traumatic amputation

- Bacterial contamination can lead to cellulitis, osteomyelitis, and bony nonunion
- Best managed by debridement of devitalized tissue with concomitant antibiotic therapy
- Infection rate for Grade III open fracture is 24%
- Most difficult fracture to care for is Grade III tibial fracture
- **Class I and II data for prophylactic antibiotics as soon as possible after injury for coverage of gram positive organisms.**
  - Grade III fractures- add coverage for gram negatives
  - High dose penicillin added if concern for fecal/Clostridial contamination.
- **Class I and II data for discontinuation of antibiotics 24hrs after wound closure for Grade I and II fractures.** For Grade III wounds, antibiotics should be continued for only 72 hours after the time of injury or not more than 24 hrs after soft tissue coverage of the wound is achieved, whichever comes first.

ANTIBIOTICS in TRAUMA

OPEN FRACTURES

- Grade I: cefazolin (perioperative)
- Grade II and III: cefazolin and gentamicin until wound is closed

CHEST TUBE PLACEMENT

- 1-2% incidence of empyema
- Insufficient Level I data to support prophylactic antibiotics for duration of CT
- Level II data suggests a single dose of prophylactic antibiotics at time of placement may reduce risks of empyema

FACIAL FRACTURES

- No prospective study demonstrating a decreased incidence of infections after closed facial fractures in patients receiving empiric antibiotics
- Chole et al. showed lower infection in patients who received one dose of cefazolin preoperatively and one dose eight hours later

SKULL BASED FRACTURES

- No evidence to support routine prophylactic or empiric antibiotics in cases without meningitis, irrespective of CSF leak

VASCULAR INJURY

- Single dose of 1st generation cephalosporin for 24hrs if synthetic graft used.

PENETRATING ABDOMINAL TRAUMA

- Single preoperative dose of prophylactic antibiotics with cefazolin or ampicillin/sulbactam is sufficient
- Should be given as soon as technically possible
- In the absence of peritonitis, no further antibiotics are indicated and should be discontinued within 24hrs.

References:
- Hauser CJ, et al. Surgical Infections, 2006: 7(4):379-405
- Luchette FA, et al. J Trauma. 2000;48:753-7
- Maxwell RA, et al. J Trauma. 2004;57:742-9
- Alleyne CH, et al. Neurosurgery, 2000; 47(5):1124-7

BACKGROUND: 1% of traumas requiring intubation need a surgical airway

RISKS: DIFFICULT BAG VALVE MASK (BVM)

- BMI > 26kg/m^2
- Absent teeth
- Presence of a beard, facial disruption, or crusted blood on face
- Age > 55 years

RISKS: DIFFICULT INTUBATION

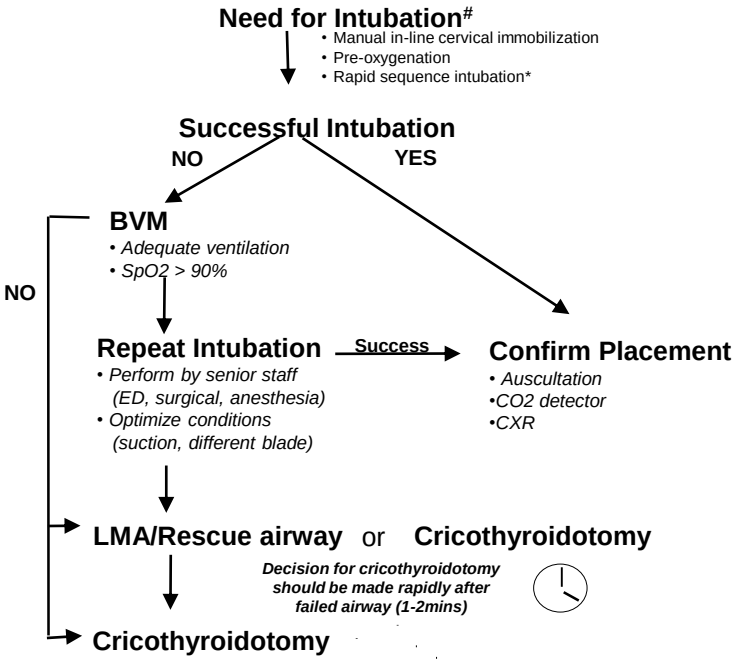
- Massive facial or neck trauma
- Receding mandible (<3 finger breadths from mandibular symphysis to hyoid bone)
- Short, thick neck (<3 finger breadths from sternal notch to thyroid cartilage)
- Narrow mouth opening
- Large or immobile tongue
- Immobilized cervical spine
- Inspiratory Stridor (upper airway compromise)

LMA

- Size 4 for patients < 70kg. Size 5 for patients >70kg
- Rests in hypopharynx over the laryngeal opening
- Risk of aspiration, particularly pregnant or obese patients

CRICOTHYROIDOTOMY:

- Does not mandate conversion to tracheostomy
- Use 6mm cuffed ETT or 4-6 tracheostomy tube
- Contraindicated in pediatric patients (<12 years, risk damage to cricoid and subsequent stenosis) or patients with laryngeal fracture. These patients should undergo tracheostomy



NOTES:

If multiple risk factors for difficult airway, airway management should be performed by senior staff (ED, surgical, anesthesia) If the patient has a high risk airway (laryngeal trauma, facial fractures, etc…) or is already going to the OR, discuss delaying intubation until the OR with the Trauma Attending.

* RSI should be avoided in patients difficult to ventilate via BVM

(1) POSSIBILITY OF SUCCESS (Anticipate Difficulty Airway)

• Examine airway, check anatomy

(2) PREPARATION

• Assemble staff (i.e. ED attending, nurse, respiratory therapist)

• Continuous monitoring of BP, ECG, SaO2

• Consult Anesthesiology if airway problems anticipated

• Prepare equipment

(3) PRE-OXYGENATION

• 100% O2. Bag mask ventilation PRN

(4) PRE-MEDICATION

• See Table 1

(5) INDUCTION

• See Table 2

(6) PARALYSIS

• See Table 3

(7) CRICOID PRESSURE (optional)

(8) INTUBATION

• Inline cervical immobilization

• Intubate orally

• Confirm ETT position with end-tidal CO2

• Release cricoid pressure after balloon is inflated

(9) CONFIRMATION

(10) POST-INTUBATION MANAGEMENT

• Secure Tube

• Re-secure cervical collar

• Sedation: Lorazepam (0.05-0.1 mg/kg) or Midazolam (0.2 mg/kg), or Propofol gtt (initial dose 0.3 mg/kg/hour)

• Paralysis: Rocuronium (0.4-1 mg/kg) or Vecuronium (0.1 mg/kg)

• Pain Management: Morphine (0.2 mg/kg) or Fentanyl (50mcg)

• Chest x-ray

Table 1: Pre-medication Agents

Drug	Indication	Dose
Lidocaine	↑ ICP, RAD	1.5mg/kg
Opioid (fentanyl)	↑ ICP, ischemic heart disease, aortic dissection	3-6mcg/kg
Atropine (optional)	Mitigates bradycardia from succinylcholine	2mg (adults)

Table 2: Induction Agents

Drug	Benefit	Precautions	Dose
Midazolam	Reversible, amnestic, anticonvulsant	Apnea, no analgesia, variable dosing	0.2-0.3 mg/kg
Etomidate	↓ICP, rarely ↓ BP	Myoclonic jerks, vomiting, no analgesia	0.3 mg/kg
Ketamine	↑BP, bronchodilator, dissociative amnesia	↑ secretions, ↑ ICP, Emergence phenomenon	1-2 mg/kg
Propofol	No dose adjustment for liver/renal disease	Profound hypotension	1-2 mg/kg

Table 3: Paralytic Agents

Drug	Dose
Succinylcholine	1.5-2 mg/kg
Rocuronium	1 mg/kg
Vecuronium	0.1 mg/kg

INDICATIONS FOR HEAD CT

* Based from Canadian Guidelines

LOC or amnesia within 24hrs of event

GCS = 15

NEXUS II: BEAN BASH

- B – Behavior abnormal
- E – Emesis intractable
- A – Age > 65
- N – Neurologic Deficit

- B – Bleeding Disorder
- A – Altered Mental Status
- S – Skull Fracture
- H – Hematoma scalp

No → **Observe x4hrs**

Yes → **Head CT**

GCS < 15 → **Head CT**

Head CT should be done within 30 mins

References:

•Stiel IG, et al. Lancet 2001; 357:1391-96
•Mower, et al. J Trauma 2005;59:954-959

Repeat head CTs:

- All patients with radiographic-proven traumatic brain injury (TBI) require repeat imaging within 6 hours.
- Coagulopathic patients without radiographic evidence of TBI but with mechanism of injury:
  - Should be observed for at least 6 hours
  - Consider repeat CT on a case-by-case basis

Monitoring of patients with head injuries:

- All patients require q1 hour neurologic examinations, and most will require ICU admission
- Patients with SAH or contusions who are GCS 15, are asymptomatic, and have no complicating factors may be considered for admission to H1 for q1 hour neuro checks. See following page to determine if patient qualifies for H1.

Neuro checks include: GCS, pupillary assessment, and an abbreviated NIHSS (level of consciousness, language, facial strength, motor and sensory exam in all four extremities, finger-to-nose/cerebellar function).

Management of chemoprophylaxis for DVT:

- In general, chemoprophylaxis for DVTs may be initiated 72 hours after a repeat head CT is stable, unless the SICU, NSG, or NCC attendings states otherwise.
- Chemoprophylaxis can be administered while an EVD is in place, but should be held 12 hours prior to EVD placement or removal.

Therapeutic systemic anticoagulation with heparin:

- Need agreed upon by NSG, SICU, and NCC attendings.
- Obtain baseline CT prior to initiation.
- Use high-risk protocol (no bolus).
- Repeat head CT once PTT is therapeutic.

HEAD INJURY- H1 NEURO UNIT ADMISSION

Inclusion Criteria for pts <65yo w contusions or SAH ONLY:

- GCS 15, no other neuro symptoms (e.g. lateralizing signs, agitation).
- No other physiologic signs that might indicate worsening head injury such as nausea, vomiting, headache
- Not on anti-coagulants or anti-platelet agents (including ASA), and with normal coagulation profile and platelets
- Absence of extra-axial hemorrhage (no SDH or EDH)
- Isolated head injury (i.e. absence of extra-cranial injuries)
- Hemodynamically normal
- Not requiring medication for agitation
- Not requiring opioid pain medication administration more frequently than q8 hours.
- No acute alcohol or drug intoxication.
- Not at known risk for drug or alcohol withdrawal.
- Agreement and documentation by trauma and neurosurgical teams that patient is at low risk for progression and safe for admission to the floor TBI unit.

(Note: this is on a trial basis and will only affect a small number of patients per year.)

All patients will be admitted to the trauma service.

Neurosurgery consult team will follow for at least 24h.

A follow-up head CT will be obtained at 4-6 hours from the original scan in all patients, regardless of exam.

Nursing Expectations: 2:1 patient-to-RN ratio, neuro checks q1h for the first 24hrs, accompany pt to CT

Changes in neurologic function will prompt immediate notification of trauma team.

HEAD INJURY- SERVICE COVERAGE

Admitting service:

- ICU: all TBI patients will be on the SICU service

  Note: patients who undergo craniotomy will be on SICU unless there is an attending-level discussion to transfer to NSG as primary, but NSG will drive decision-making for clinical care.

- H1: all TBI patients will be on the Trauma Service

Consulting Services

- University Neurosurgery (NSG) will be consulted in all of TBI cases, including PAMF patients
- NSG will follow all patients with initial GCS<14 or neurologic intervention (EVD, craniotomy, etc..) until there is an attending-level discussion deciding that NSG no longer needs to follow the patient.
- Neurocritical care (NCC) will be involved in TBI cases with GCS<14 with any type TBI injury or Mild TBI (GCS 14-15) if complicated by any other factor such as large size, high risk for worsening, vascular injury, seizures, or unexplained neurologic findings.
    - After transfer to the floor, the Neurology Stroke Service will continue to consult on patients who were managed by the NCC service in the ICU

Admitting service upon transfer to floor:

- Trauma Service
    - Multisystem injuries with TBI
    - Isolated TBI without craniotomy
- NSG Service: Isolated TBI after craniotomy.

NOTE: "Isolated TBI" refers to a patient for whom there are no other injuries at the time of admission, or patients with other injuries for which no further surgical management is warranted.

BLUNT CEREBROVASCULAR INJURY (BCVI)

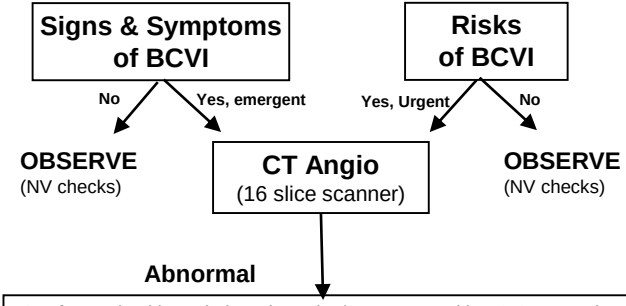
SIGNS & SYMPTOMS OF BCVI:

- Hemorrhage from mouth, nose, ears of potential arterial origin
- Large or expanding cervical hematoma (consider surgery)
- Cervical bruit in patient < 50
- Evidence of cerebral infarction on CT
- Unexplained or CT incongruous central or lateralizing neurologic deficit, transient ischemic attack, or Horner's syndrome

RISKS OF BCVI:

- Mechanism compatible with severe cervical hyperextension/ rotation or hyperflexion, particularly if associated with complex facial fractures
- Near-hanging, seat belt abrasion, or other soft tissue injury of the anterior neck with significant cervical swelling
- High Risk associated injuries
    - GCS ≤ 6
    - Petrous bone fracture
    - Displaced mid-face (Lefort II/III) fractures
    - Cervical vertebral body or transverse foramen fracture
    - Any C1-3 fracture
    - Subluxation or Ligamentous injury
    - Diffuse axonal brain injury
    - Basilar skull fracture involving the carotid canal

BLUNT CEREBROVASCULAR INJURY (BCVI)



Abnormal

- **Grade I:** Intimal irregularity; Dissection/Hematoma with < 25% stenosis.
  - Tx: Anti-platelet most commonly used, alternatively IV heparin
- **Grade II:** Intraluminal thrombus; raised intimal flap; Dissection/Hematoma with >= 25% stenosis.
  - Tx: Anti-platelet or IV heparin
- **Grade III:** Pseudoaneurysms
  - Tx: Anti-platelet or IV heparin
- **Grade IV:** Occlusions
  - Tx: Anti-platelet most commonly used, IV heparin used if presents with acute stroke
- **Grade V:** Transection
  - Tx: Controversial. Consider operative repair if survivable injury

- Heparin: no bolus; 15units/kg/hr; target PTT 1.5-2x normal
- Antiplatelet: ASA 325mg qday

CTA should be done as early as possible

References:

•Biffl WL et al. J. Trauma 2009; 67:1150
•Cothren CC, et al. J Trauma 2003; 55:811
•Biffl WL, et al. Ann Surg 2002;235:699
• Miller PR, et al. Ann Surg 2002:236:386

BACKGROUND:

- Rate of missed cervical spine injuries with plain films alone is unacceptably high (33%); therefore, the imaging study of choice in blunt trauma patients should be a cervical CT scan.

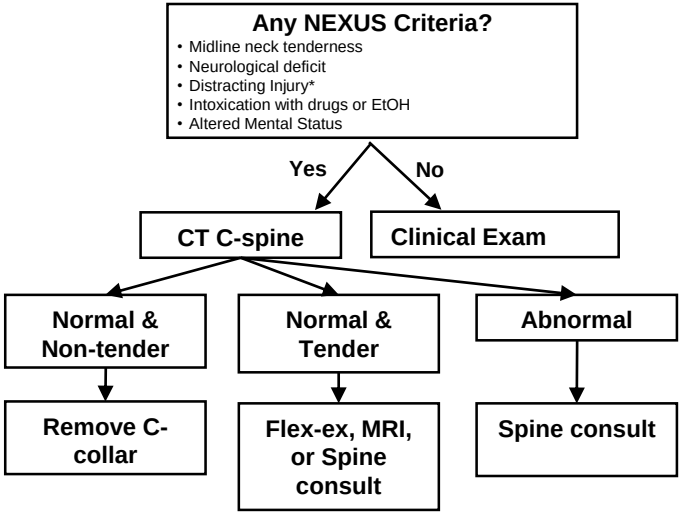
SCREENING CT SCAN:

- For all patients, the NEXUS screening criteria are used to determine who requires a CT scan for clearance of the C-spine.

ROLE OF MRI :

- If an awake patient complains of midline tenderness and has a normal CT of the c-spine, a MRI or flexion-extension films should be obtained to rule out ligamentous injury. These patients should be left in cervical collars until the MRI/Flex-ex report is available.
- For comatose patients, keeping patients in collars awaiting MRI has been associated with increased morbidity. Therefore, **at Stanford MRI is NO LONGER routinely obtained in order to clear the C-spine of comatose patients**. In general, if the CT is negative for injury and the patient can move all extremities, the spine can be cleared at the discretion of the attending.

C-SPINE EVALUATION - ADULT



*Distracting injury defined as injury to the head, neck, chest or upper extremity, or an injury that is so painful that it requires such doses of analgesics that the patient is unable to co-operate with a clinical examination

- ***SCVMC PROTOCOL VARIATIONS**:*
  - *If normal CT C-spine, but have tenderness, obtain either MRI (within 48hrs) or flexion/extension plain films*
  - *If normal CT C-spine, but patient cannot be clinically evaluated, obtain MRI or flexion/extension plain films*

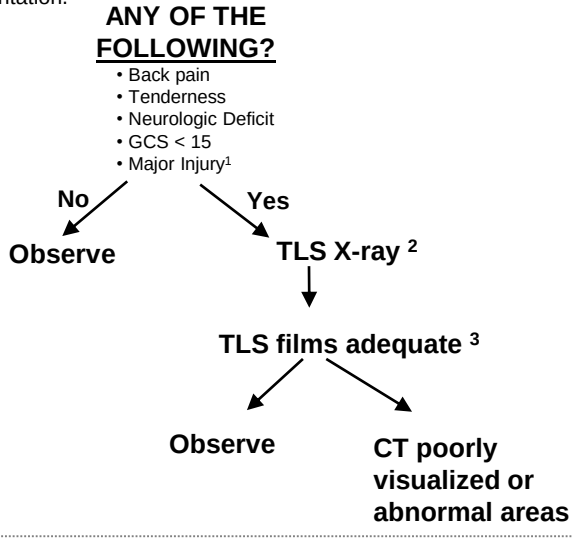
References:

- Mathen et al. J of Trauma 2007; 62(6):1427-31
- Hoffman J, et al. NEJM 2000; 343:94-9
- Heffernan D, et al. J of Trauma 2005;59(6):1396-9
- Muchow R, et al. J of Trauma 2008; 64(1):179-89
- Como J, et al. J of Trauma 2007; 63(3):544-9
- Stelfox H, et al. J of Trauma 2007; 63(3):630-6.

TLS SPINE EVALUATION

BACKGROUND:

- Thoracic/Lumbar/Sacral (TLS) spine fractures occur at about the same rate as cervical spine fractures (2-5% of blunt trauma)
- Although most patients present with pain and tenderness, up to 20% do not have associated pain and tenderness at presentation.



[1] Hemothorax, flail chest, liver/spleen laceration, long bone fracture pelvic fracture

[2] CT scan may substitute TLS X-ray in patient already undergoing chest/abdomen scanning

[3] **Adequate TLS films**:

- T1-T5 – anterior images of vertebral bodies are well seen and are normally aligned and without compression.
- T6 – sacrum – The full vertebral body is well seen, normally aligned and without compression. Additionally, posterior elements allowing for some overlap from rib and shoulder girdle structures appear intact

BACKGROUND:

- Multiple rib fractures (more than 4 ribs) in patients >45 yrs have been associated with increased morbidity
- Patients > 65 yrs who sustain blunt chest trauma with 2 or more rib fractures have twice the mortality and thoracic morbidity of younger patients with similar injuries.
- The cornerstone of rib fracture management is early and adequate pain control to avoid complications from splinting (atelectasis, retained secretions, pneumonia)

Multiple Rib Fractures

- Patients > 45yrs with 4 or more fractures
- Patients > 65yrs with 2 or more rib fractures

Within 2 hrs

- Admit for pain control
- Consider ICU admission for any patient with 4+ rib fractures
- **Recommended** ICU admission for age>65 yo & >2 ribs fx. for first 24 hours
- Aggressive early and adequate pain control
- Epidural preferable, PCA as alternative
- Coach patient on coughing and breathing
- Aggressive use of incentive spirometer
- Encourage patient ambulation
- Suctioning when necessary
- Consider rib fixation for flail chest, inability to wean from ventilator, unremitting pain

ZONES:

- Zone 1: clavicle to cricoid
- Zone 2: cricoid to angle of mandible
- Zone 3: above angle of mandible

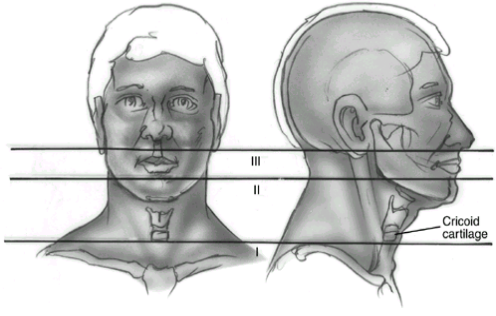
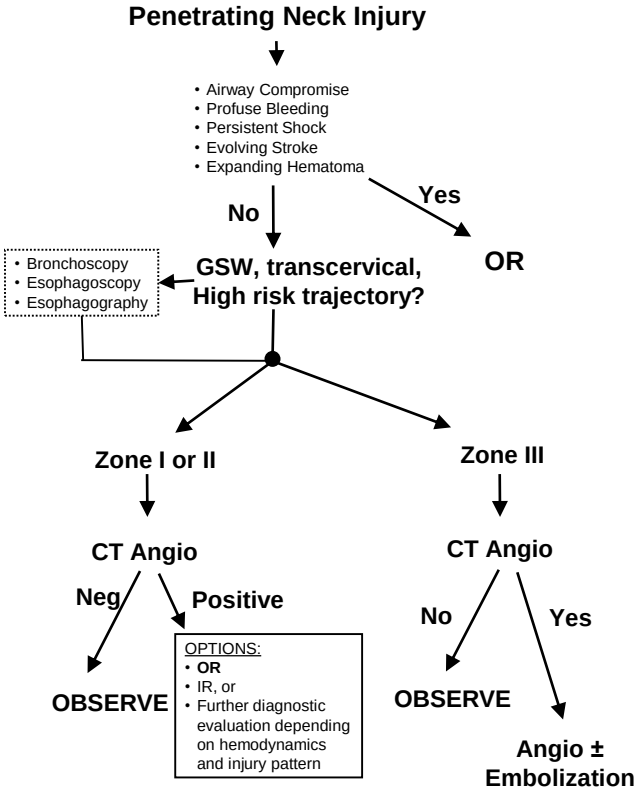


FIG. 73-8. Horizontal entry zones of the neck for penetrating injuries to the neck. (Modified from Jurkovich GJ. The neck. In: Early care of the injured patient. Moore EE, ed. Toronto: BC Becker, 1990:126.)

EXAM FINDINGS:

- Active bleeding; Hypotension; Large or expanding hematoma; pulse deficits (carotid, brachial/radial), bruit
- Hemoptysis/hematemesis; SQ Emphysema; Hoarseness; Dysphagia
- Localizing Signs: Pupils, Limbs, CN's
    - CN's: Facial, Glossopharyngeal (midline position of soft palate); Recurrent Laryngeal (hoarseness, ineffective cough); Accessory (shoulder lift); Hypoglossal (midline position of tongue)
    - Horner's: Myosis, Ptosis
- Brachial Plexus: Median (fist); Radial (wrist extension); Ulnar (abduction/adduction of fingers); Musculocutaneous (forearm flexion); Axillary (arm abduction)

PENETRATING NECK TRAUMA



Obtain CT within 30 mins

References:

- Biffl WL, et al. Am J. Surg 1997; 174:678-682
- Demetriades D, et al. World J Surg 1997; 21:41-48
- Gracias VH, et al. Arch Surg 2001;136:1231-1235
- Sekharan J, et al J Vasc Surg 2000;32:483-489

BLUNT AORTIC INJURY (BAI)

BACKGROUND:

- BAI is the second most common cause of death in blunt trauma, following head injury.
- Deceleration forces cause aortic tearing at points of fixation: ligamentum arteriosum (80-85%), diaphragmatic hiatus (10-15%), and ascending aorta (5-10%).
- 85% of fatalities occur at the accident scene. Of the remainder, 25% occur within 24hrs and another 25% within one week
- CT Angio is the diagnostic test of choice (specificity 100%)
- **CAUTION: A normal CXR does NOT exclude BAI**

CLASSIC CXR FINDINGS:

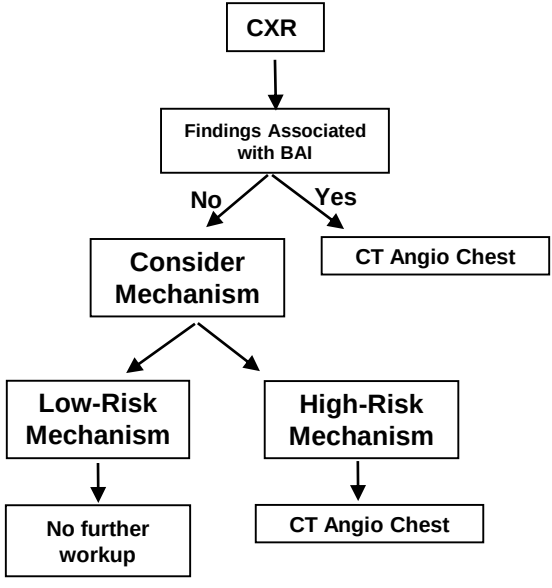
- Widened mediastinum
- Indistinct aortic knob
- Depression of left main stem bronchus
- Deviation of NG tube
- Opacification of aortopulmonary window
- Widening of paratracheal/paraspinous stripes
- Apical capping
- Scapular fracture or 1st/2nd rib fracture

MANAGEMENT:

- Consult immediately either:
    - Vascular Surgery in even months or
    - Cardiac Surgery in odd months
- **Guidelines:**
    - **MAP 60-80 SBP<110**
    - **SBP<120 mandatory, <100 desired**
    - **HR 70-80**
- Medication options once patient has been stabilized (other sources of bleeding assessed):
    - Esmolol (0.5 µg/kg - 300 µg/kg) - **1st line therapy
    - Nitroprusside (2-5 µg/kg/min) or Nitroglycerin (5 -10ug/min)
    - Nicardipine (5-15mg/hr)

**Polytrauma patients with head injury will require MAPs.*

BLUNT AORTIC INJURY (BAI)



CXR during primary survey (5-10 min)

CTA in ED after secondary survey (30-45min)

References:

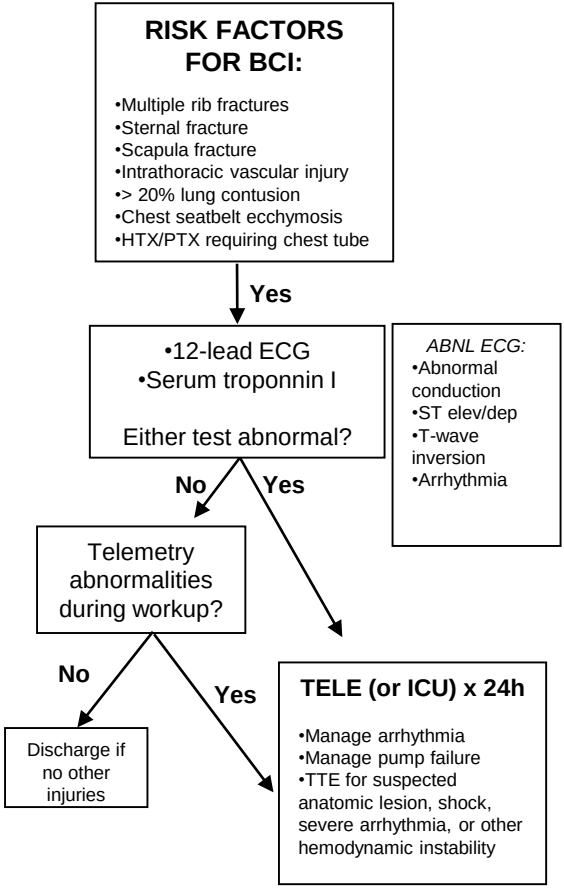
- Dyer DS, et al. J Trauma 2000; 48:673-683
- Razzouk AJ, et al. Arch Surg 2000;135:913-919
- Hochheiser GM, et al. Arch Surg 2002;137:434-438
- Miller PR, et al. Ann Surg 2003;237:877-884
- Symbas PN, et al. Ann Surg 2002; 235:796-802
- Santanielo JM, et al. J Trauma 2002;53:442-445

BLUNT CARDIAC INJURY

- Can result from blunt trauma to the thorax
- Significant complications from blunt cardiac injury include: arrhythmia requiring management, cardiogenic shock, and anatomic defects (valve, septum, or free wall rupture)
- Symptomatic blunt cardiac injury can be as high as 13% in blunt chest trauma; at risk patients should be recognized and monitored closely
- Manifestations occur within 24h of injury
    - Most common presenting symptoms is arrhythmias with sinus tachycardia being the most frequent
- Patients at risk for BCI should have ECG and troponin I level checked. **If both are normal, BCI is ruled out.**
- If either test is positive, the patient should be monitored for 24-48 hours in case the patient develops symptomatic blunt cardiac injury.
- ECHO should be performed in any patient with a new arrhythmia or hemodynamic instability.

References:

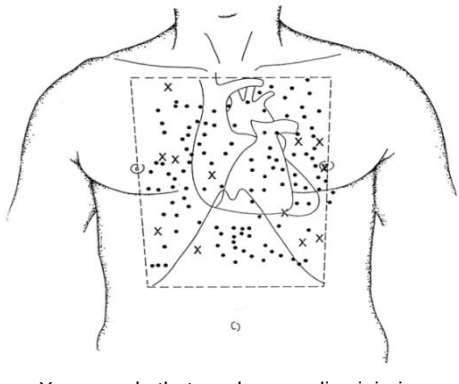
- Salim et al. J Trauma. 2001;50:237-43.
- Velmahos et al. J Trauma. 2003;54:45-51.
- EAST guidelines. www.east.org


RISK FACTORS FOR BCI:
•Multiple rib fractures
•Sternal fracture
•Scapula fracture
•Intrathoracic vascular injury
•> 20% lung contusion
•Chest seatbelt ecchymosis
•HTX/PTX requiring chest tube
Yes
•12-lead ECG
•Serum troponnin I
Either test abnormal?
ABNL ECG:
•Abnormal conduction
•ST elev/dep
•T-wave inversion
•Arrhythmia
No
Yes
Telemetry abnormalities during workup?
No
Yes
Discharge if no other injuries
TELE (or ICU) x 24h
•Manage arrhythmia
•Manage pump failure
•TTE for suspected anatomic lesion, shock, severe arrhythmia, or other hemodynamic instability

PENETRATING CHEST TRAUMA to the "BOX"

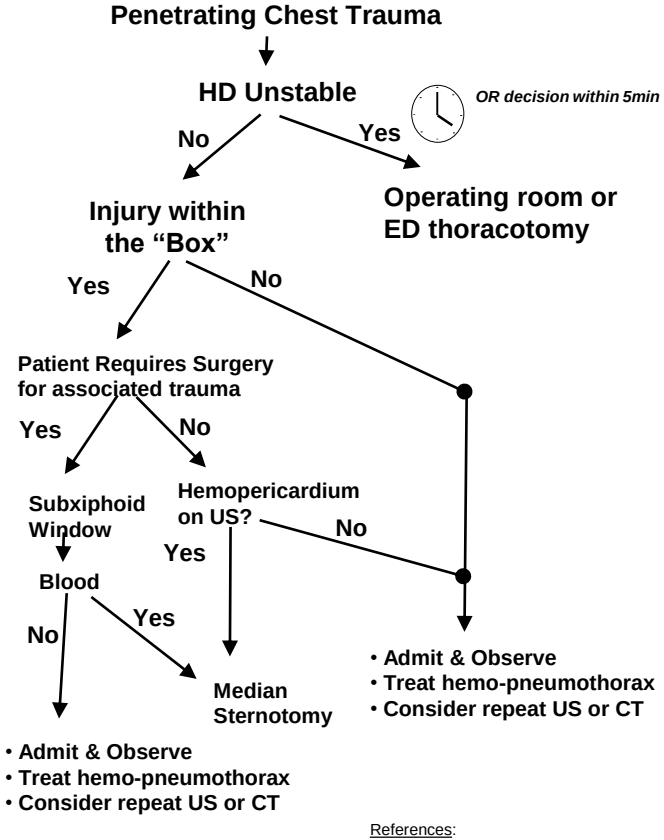
BACKGROUND:

- The **"Box"** = Borders of suprasternal notch, nipples, and costal margin
- Pericardiocentesis is unreliable in the acute trauma setting: 20% false positive and 20% false negative
- Most sensitive test for post-traumatic tamponade is (subxiphoid) pericardial window, but this requires general anesthesia in the OR.
- For patients who do not require general anesthesia for surgery following penetrating trauma, the best non-invasive test for cardiac or pericardial injury is 2D echocardiography. Sensitivity and specificity is 100% and 89%, respectively, for patients without hemothorax. Less accurate in the setting of hemothorax (56%, 93%)
- Penetrating cardiac injuries can occur without entrance or exit wounds in the "box."



X = wounds that produce cardiac injuries

PENETRATING CHEST TRAUMA to the "BOX"



References:

• Asenio JA, et al. Surg Clin N Am 1996; 76:685
• Moreno C, et al. J Trauma 1994; 36:229
•Meyer D, et al. J Trauma 1995; 39:902
• Nagy KK, et al. J Trauma 1995; 38:859

ED THORACOTOMY (EDT)

BACKGROUND:

- Variables to consider: mechanisms of injury (blunt, gunshot, stab); vitals; signs of life
    - Vitals (VS) = palpable pulse or BP
    - Signs of Life (SOL) = pupillary activity, respiratory effort, or narrow complex QRS
- Best outcomes occur in penetrating cardiac wounds
- Worse outcomes occur in blunt abdominal trauma.

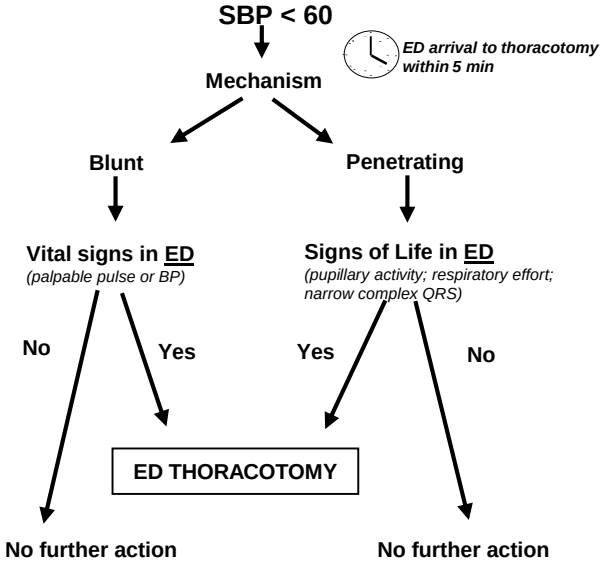
GOALS OF EDT:

- Release pericardial tamponade
- Control cardiac and/or great vessel bleeding
- Control broncho-venous air embolism
- Perform open cardiac massage
- Limit intra-abdominal hemorrhage via aortic cross-clamping

TECHNIQUE:

- 5th or 6th IC space from sternum to posterior axillary line (below nipple line in men, below inframammary crease in women)
- Initial incision should be through all subcutaneous tissue and down to chest wall.
- Intercostal muscles are incised with scissors
- Insert rib spreader. HANDLE toward the axilla.
- Sweep lung away
- Bluntly dissect mid-descending thoracic aorta circumferentially. NGT in the esophagus will help differentiate esophagus from aorta
- Place aortic cross clamp
- Make longitudinal pericardiotomy MEDIAL to phrenic to deliver heart from pericardial cradle
- Temporize wounds with suture or foley
- Cardiac massage if necessary
- Cardioversion with 10-20J if necessary

ED THORACOTOMY (EDT)



OUTCOMES

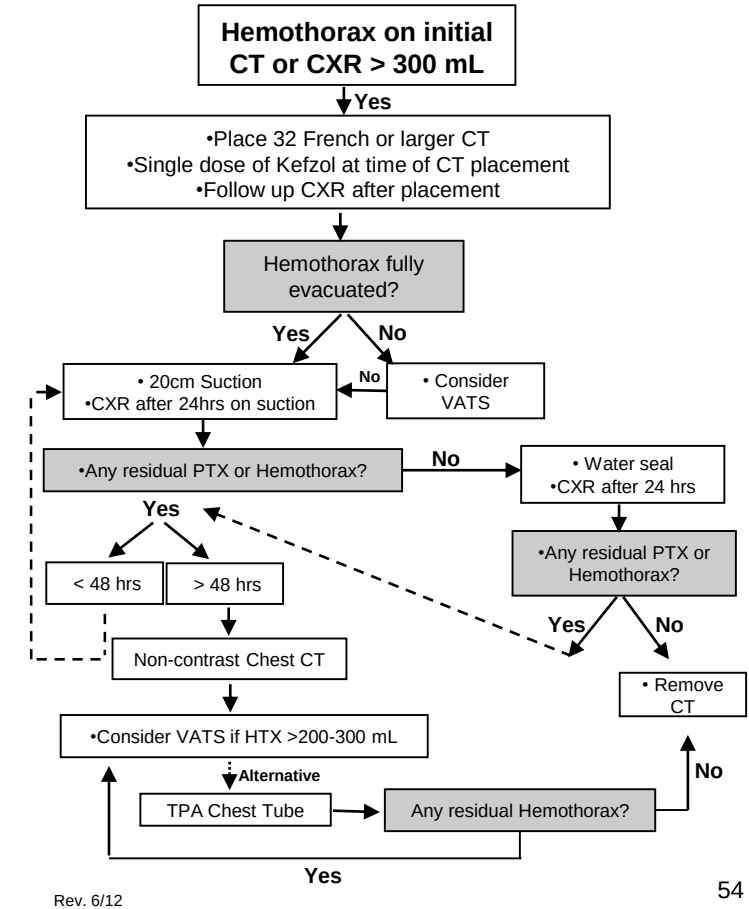
	ED: No SOL	ED: SOL, No VS	ED: VS
BLUNT	1%	1%	3%
GSW	1%	3-5%	10-15%
STAB	3-5%	10-15%	30-40%

BACKGROUND:

- Thoracic injuries are very common occurring in up to 60% of poly-trauma patients and represent 25% of all trauma deaths.
- Hemothorax is found in approximately 300,000 trauma patients per year.
- Most hemothoraces can be treated with simple chest tube drainage with a larger bore CT (32 French or larger).
- Complications from hemothoraces include empyema and retained hemothorax (rHTX). Patients with rHTX have a higher likelihood of empyema.
- If a hemothorax is not drained well by a single chest tube placement, early VATS is now preferred over placement of a second chest tube.
    - For high risk operative candidates or if the volume of retained hemothorax is small, alternative treatment with intrapleural thrombolytics (see TPA protocol below) is an alternative to try to avoid VATS.
- The ideal timing for VATs is between first 3-7 days which reduces the likelihood of conversion to thoracotomy.

TPA Protocol:

- ❑ TPA 6 mg mixed in 50 mL NS infused under sterile conditions into the CT. Clamp CT for 30 minutes and drain.
- ❑ If necessary, can be repeated Q8 hours x 3 doses.


Hemothorax on initial CT or CXR > 300 mL
Yes
•Place 32 French or larger CT
•Single dose of Kefzol at time of CT placement
•Follow up CXR after placement
Hemothorax fully evacuated?
Yes
No
• 20cm Suction
•CXR after 24hrs on suction
No
• Consider VATS
•Any residual PTX or Hemothorax?
No
• Water seal
•CXR after 24 hrs
Yes
< 48 hrs
> 48 hrs
•Any residual PTX or Hemothorax?
Yes
No
Non-contrast Chest CT
• Remove CT
•Consider VATS if HTX >200-300 mL
Alternative
TPA Chest Tube
Any residual Hemothorax?
No
Yes

TRUNCAL STAB WOUNDS (Back, Flank, Abdomen)

BACK/FLANK:

- Defined: between the tips of the scapulae and posterior iliac crests, posterior to the mid-axillary line
- Physical exam alone is unreliable, and DPL is unable to evaluate the retroperitoneum
- Triple contrast (oral, rectal, and IV) CT has sensitivity of 89-100% and a specificity of 98-100% in diagnosing intra-abdominal and retroperitoneal injuries

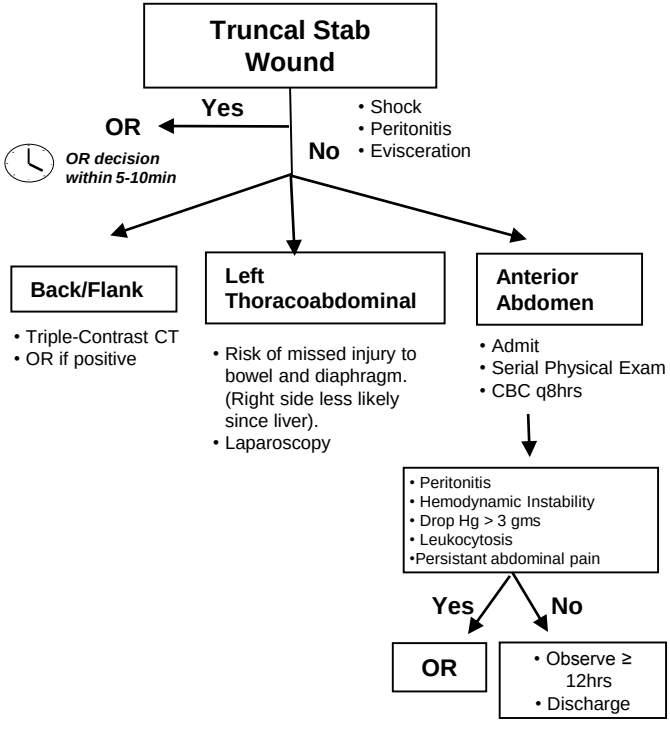
THORACOABDOMINAL:

- Defined: between a circumferential line connecting the nipples and tips of the scapulae superiorly, and the costal margins inferiorly
- Occult diaphragmatic injury is problematic in this patient group.

ANTERIOR ABDOMEN:

- Defined: anterior to the mid-axillary line, from the xiphoid process to the pubic symphysis
- Although controversial, serial abdominal exams in a patient with HD stability and non-peritoneal signs may be employed.

TRUNCAL STAB WOUNDS (Back, Flank, Abdomen)



References:

•Kirton OC, et al. Am J Surg 1997;173:189-93
• Albrecht RM, et al. Am Surg 1999;65:683-7
• Murray JA, et al. J Trauma 1997; 43:624-626
• Tsikitis V, et al. Am J Surg 2004;188:807
• Biffl WL, et al. J Trauma 2011;71: 1494-1502

BLUNT ABDOMINAL TRAUMA

BACKGROUND:

- Only 5-10% of patients admitted to trauma centers with suspected abdominal injury will have abdominal injury
- Abdominal injury requiring operative intervention occurs in 5-10% of all trauma patients.
- Physical exam alone is an unreliable mode of detecting intra-abdominal injury.
- Delay in diagnosis results in marked morbidity and mortality.
- Negative FAST does NOT exclude intra-abdominal injury.

References:

- Grieshop NA, et al. J Trauma 1995;38:727-731
- Fernandez L, et al. J Trauma 1998;45:841-848
- Healey MA, et al. J Trauma 1996;40:875-885
- Livingston DH, et al. J Trauma 1998;44:273-282

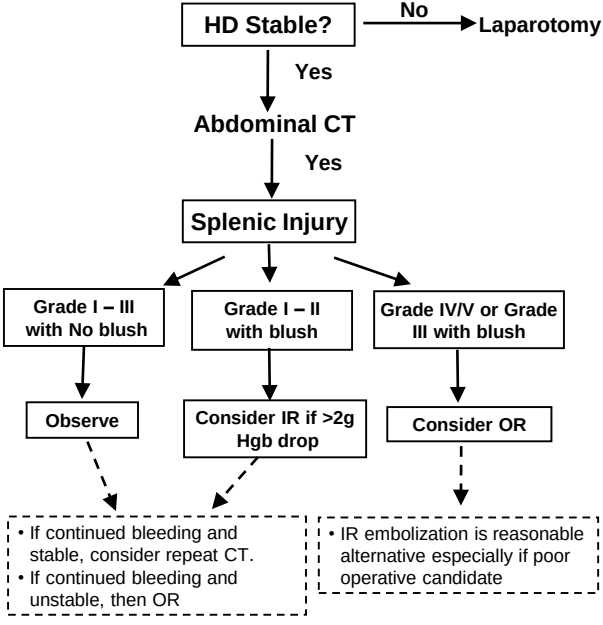
INDICATIONS for Abdominal/Pelvis CT

- **Spinal cord injury, altered consciousness, intoxication, distracting injury, or unreliable exam**
- **Significant abdominal pain or tenderness**
- **Gross hematuria**
- **Pelvic fracture**
- **Unexplained tachycardia and/or transient hypotension (even with normal FAST)**
- **Significant chest trauma**
    - pulmonary contusion
    - greater than 2 unilateral rib fractures
    - scapular fracture
    - mediastinal hematoma

IMPORTANT POINTS:

- Non-operative management (NOM) has become the standard of care for hemodynamically stable patients with low to moderate grade injuries (Grade I – III) lacking a contrast blush on initial CT scan.
- Predictors of NOM failure are associated with:
    - Hypotension in ED
    - Grade III injuries with contrast blush
    - Grade IV/V injuries
- NOM includes
    - Bedrest
    - Telemetry monitoring
    - Hg/Hct check q6hrs
    - Documented serial abdominal exams x 24hrs
- 95% of NOM failures happen within 72 hrs of injury. Thus, there is little utility monitoring NOM patients beyond 3-5 days unless they have another reason to remain hospitalized
- All patients undergoing splenectomy or at high risk for splenectomy (including those who undergo main splenic artery embolization) should have pneumococcal, meningococcal, and Hib vaccines prior to leaving the hospital.
- A decrease in Hg of <2g or significant change in abdominal exam should prompt a repeat CT, unless the patient is HD unstable
- The grade of injury should be documented in the H&P and the grading scale can be found in the trauma manual appendix.

BLUNT SPLENIC TRAUMA



References:

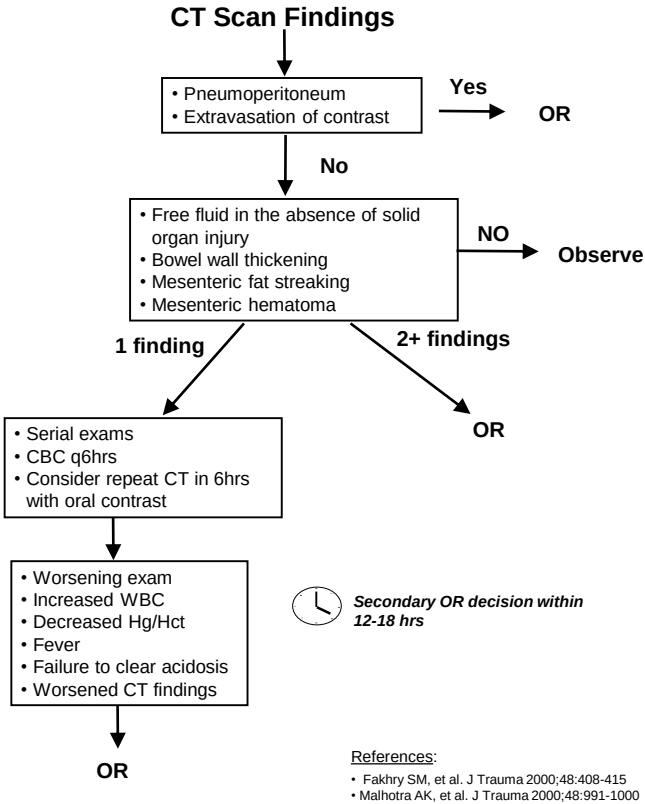
- Crawford RS, et al. Surgery 2007;142:337-41
- Haan J, et al. J Trauma. 2004;56:542-7
- Haan J, et al. Am Surg. 2007;73:13-18
- Smith J, et al. J Trauma. 2008;64:656-665
- Smith HE, et al. J Trauma. 2006; 61:541-5
- Watson GA, et al. J Trauma. 2006;61:1113-1119

BLUNT BOWEL and MESENTERIC INJURY

BACKGROUND:

- CT scan is the best noninvasive test for diagnosing blunt bowel and mesenteric injury (BBMI), aka hollow viscus trauma.
- Oral contrast does not need to be routinely administered as it does not add to the specificity of the test at time of initial evaluation.
- High index of suspicion if “seatbelt sign” or lumbar spine anterior compression fracture (potential injury to duodenum, jejunum, or pancreas)
- A single CT finding suggestive of BBMI had 35% chance of having BBMI. Two CT findings were associated with BBMI in 80%.
- If patient has more than minimal free fluid without solid organ injury seen on CT scan, hollow viscus injury must be considered.
- In some instances of minimal to trace free fluid and suspicious mechanism, serial abdominal exams over 24 hours can be performed.
- Additionally, if repeat CT scan is performed following initial CT scan for concern of delayed presentation of hollow viscus injury, oral contrast should be administered.

BLUNT BOWEL and MESENTERIC INJURY



References:

- Fakhry SM, et al. J Trauma 2000;48:408-415
- Malhotra AK, et al. J Trauma 2000;48:991-1000
- Killeen KL, et al. J Trauma 2001;51:26-36
- Allen TL, et al. J Trauma 2004;56:314-322
- Rodriguez C, et al. J Trauma 2002; 53:79-85

BACKGROUND:

- Important to classify as intraperitoneal or extraperitoneal.
- Need to rule-out rectal injury in all transpelvic gunshot wounds and other penetrating pelvic injuries: digital rectal exam, proctosigmoidoscopy.
- Genitourinary tract injuries are often associated with rectal trauma. Hematuria should raise the level of suspicion for further workup.

ANATOMY

INTRAPERITONEAL:

- Anterior and lateral surfaces of the upper 2/3 of the rectum (serosalized):

EXTRAPERITONEAL:

- Posterior surface and lower 1/3 of the rectum (no serosa)

References:
- Navsaria PH, et al. World J Surg 2007 Jun;31(6):1345-51
- McGrath V, et al. Am Surg. 1998 Dec; 64(12):1136-41
- Gonzalez RP, et al. J Trauma. 1998 Oct; 45(4):656-61

MANAGEMENT:

INTRAPERITONEAL

- Management similar to colon injuries
- Primarily repaired with or without fecal diversion
- Broad spectrum antibiotics covering gram negative and anaerobes.

EXTRAPERITONEAL

- Leave untouched, diverting colostomy.
- If injury is easily visualized with minimal dissection, then primary repair
- Broad spectrum antibiotics covering gram negative and anaerobes.

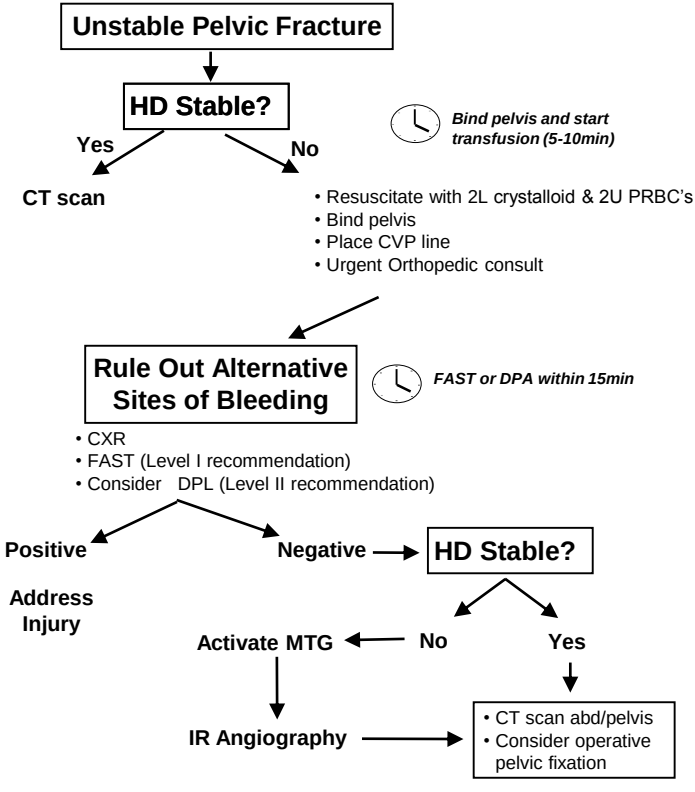
References:
- Navsaria PH, et al. World J Surg 2007 Jun;31(6):1345-51
- McGrath V, et al. Am Surg. 1998 Dec; 64(12):1136-41
- Gonzalez RP, et al. J Trauma. 1998 Oct; 45(4):656-61

BACKGROUND:

- Force required to fracture pelvis is substantial
- Can get large amount of bleeding
- Consider if patient in shock without other source of bleeding
- Consider lower GU trauma in all patients with displacement of pubic bone/pelvic ring toward bladder or with gross hematuria.

PRINCIPLES OF MANAGEMENT:

- Reduce pelvic volume: wrap pelvis, external fixation
    - Level III recommendation – Recommended to do but no evidence to support this decreases blood loss or improves survival
- Control hemorrhage via IR techniques
    - Level I recommendations:
        - Hemodynamically unstable with pelvis fracture after other causes excluded by FAST or DPL
        - HD stable patients with evidence of arterial hemorrhage on CT scan
    - Level II recommendations:
        - Pts > 60 yo with major (open book, butterfly segment, or vertical shear) pelvic fractures irrespective of HD status
        - If repeat HD instability or continued hemoglobin drop following angiography with or without embolization, repeat angiography should be considered after other causes have been excluded
- FAST is good for ruling in bleeding in the presence of pelvic fracture but it is NOT good enough for ruling out bleeding with pelvis fractures in HD stable patients (Level I recommendation).
    - CT abdomen/pelvis is mandatory in HD stable patients with major pelvis fracture or acetabular fractures (Level II recommendation).



References:

• Biffl WL, et al. Ann Surg 2001;233:843-850
• Cullinane DC, et al. J Trauma 2011; 71:1850-1868
•Pereira SJ, et al. Surgery 2000;128:678-685

PERIPHERAL VASCULAR INJURY

BACKGROUND:

- Limb salvage requires prompt diagnosis and timely reperfusion.

- Factors associated with high rates of limb loss include:
  - Treatment delay >6 hours
  - Blunt mechanisms (more transfer of kinetic injury)
  - Popliteal artery injuries
  - Associated injuries especially those with significant soft tissue loss, nerve injury, and/or bony fractures
  - High velocity gunshot (hunting/military weapons) or close-range shotgun wounds
  - Pre-existing vascular disease
  - Failure or delay in Fasciotomy
  - Presenting with frank ischemia
  - In profound shock on arrival to trauma bay

- Fasciotomy should be considered in all patients in whom time to reperfusion approaches 4-6 hours

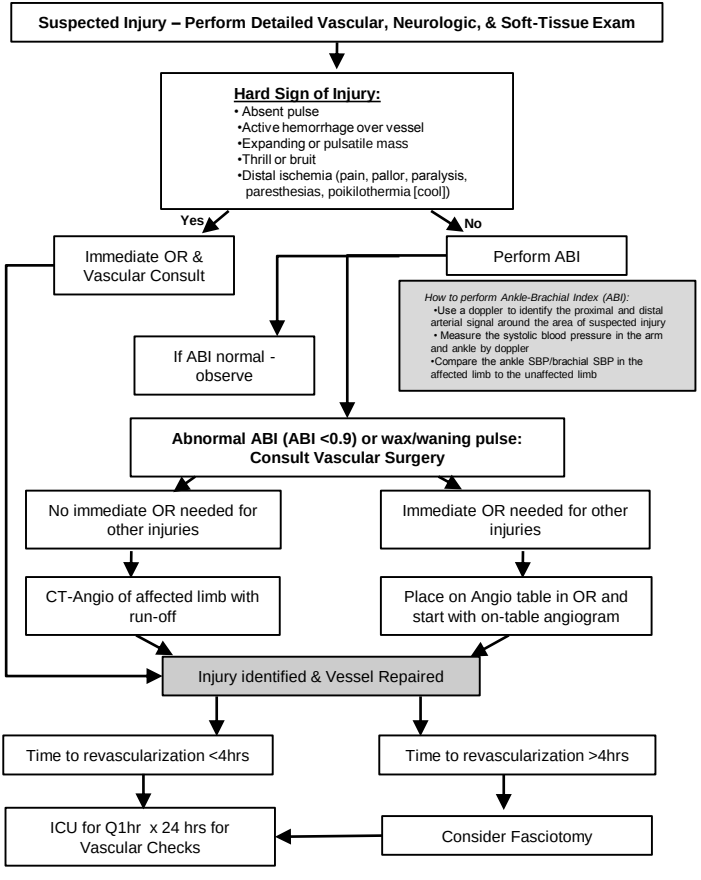
- **For any injury with potential for peripheral vascular injury, you must document a detailed vascular exam, neurologic exam (motor and sensory), and a soft-tissue exam.**
  - Vascular exam includes documenting pulses proximal and distal to area of suspected injury.

- Vascular injuries associated with particular orthopedic injuries:
  - Knee dislocation/Tibial plateau fracture – Popliteal artery
  - Femur fracture – Superficial femoral artery
  - Supracondylar humerus fracture – Brachial artery
  - Clavicle fracture – Subclavian artery
  - Shoulder dislocation – Axillary artery

References:

- Callcut RC, et al. J Trauma 2009; 67(2):252-257.
- Levy RM et al. The Trauma Manual. 2008. 255.

PERIPHERAL VASCULAR INJURY



COMPARTMENT SYNDROME – EXTREMITY

BACKGROUND:

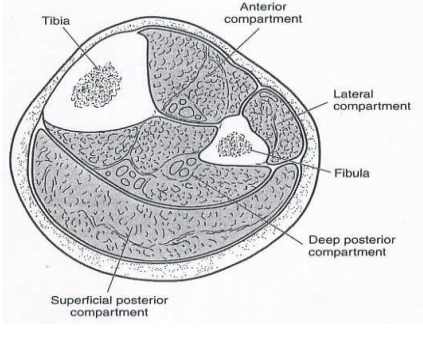
- Condition in which the perfusion pressure falls below the tissue pressure in a closed anatomic space, with subsequent compromise of tissue circulation and function
- As many as 45% of all cases are caused by tibial fractures
- Other causes include long-bone fracture, vascular injury, crush injury, drug overdose, and a tight cast or dressing.

ANATOMY COMPARTMENTS:

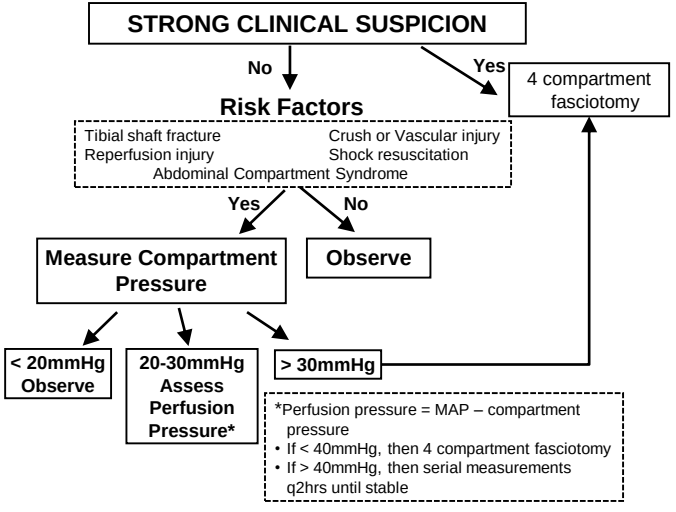
- Anterior: Deep peroneal nerve (dorsiflexion, sensation 1st and 2nd toes)
- Lateral: Superficial peroneal nerves (eversion, lateral foot sensation)
- Deep Posterior: Tibial nerve (planterflexions); posterior tibial artery, peroneal artery
- Superficial Posterior: Sural nerve

TECHNIQUE – MEASURE (STRYKER SYSTEM):

- **For Stanford Hospital, the Stryker can be found in the ortho cast room.**
- Prep and drape extremity, knee 30° flexion, ankle 90° flexion
- Setup the transducer per instructions with the kit.



COMPARTMENT SYNDROME – EXTREMITY

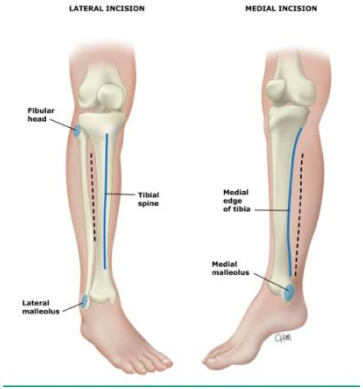


COMPARTMENT SYNDROME – FASCIOTOMY

TECHNIQUE – Fasciotomy:

- Longitudinal lateral incision midway between the tibia and fibula overlying the intermuscular septum separating the anterior and lateral compartments. Incision extends from 1cm below the fibula head (to avoid injury to the common peroneal nerve) to above the ankle
- Using Mayo scissors, open the fascia of both the anterior and lateral compartments
- Longitudinal medial incision is made 2cm posterior to the tibia edge to decompress the superficial posterior compartment. Open the fascia overlying the superficial compartment. Avoid injury to the greater saphenous vein.
- Detach the soleus from the posterior surface of the tibia to decompress the deep posterior compartment. Avoid injury to the posterior tibia vessels.
- Early closure (5-7 days) reduces wound infection.
- Monitor for rhabdomyolysis. IV hydration to maintain adequate urinary output (at least 1-2 ml/kg/h), follow serial creatinine kinase (CK) levels.

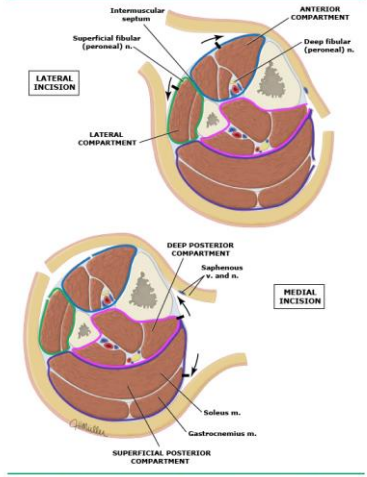
Incisions for four compartment lower extremity fasciotomy



The two incision four-compartment fasciotomy uses medial and lateral longitudinal incisions that are 12 to 20 cm in length. The lateral incision is centered between the fibular shaft and the spine of the tibia. The medial incision is placed 1 to 2 cm medial to the tibial margin. A single incision fasciotomy uses the lateral of these incisions.

UpToDate

Two incision leg fasciotomy



The medial and lateral incisions are depicted. Arrows represent the subcutaneous flaps that will be developed to gain access to the respective compartments. The four compartments to be decompressed are outlined in color. The approximate location for the fascial incision for each compartment is represented by a black line.

UpToDate

BACKGROUND:

- Trauma is the leading cause of non-obstetrical maternal death
- Life threatening maternal trauma associated with 50% fetal loss
- Less severe injuries still have fetal loss rates of up to 5%

BLUNT TRAUMA:

- ***Placental Abruption:*** Over 50% of fetal losses are due to placental abruption (usually occurs within 6 hours of the event). Classic triad of frequent contractions, bleeding and abdominal pain occurs in fewer than half of cases. Ultrasound will identify placental clot only 50% of the time. If mother is hypotensive without a source, consider abruption.
- ***Uterine Rupture:*** Not common. Classic presentation is searing pain, and transabdominal palpation of fetal parts
- ***Fetal-Maternal Hemorrhage:*** Defined by fetal blood cells in the maternal circulation. All pregnant trauma patients with Rh (-) blood type should be considered for RhoGam within 72hrs.

PENETRATING TRAUMA:

- Associated with high fetal loss rates
- Cesarean section is frequently necessary

DETERMINING FETAL AGE:

- Evaluate fundal height
    - Below umbilicus – less than 20 wga – NON-VIABLE
    - Above umbilicus – cm from pubis to fundus = weeks gestational age +/- 2 weeks

PERIMORTEM C-SECTION:

- Once there is maternal loss of vital signs, there should be an immediate consideration for the performance of a Cesarean section if the fetus is viable.
- Survival is optimized if performed within 4 minutes. If fetus is delivered >15 min after maternal death, fetal survival is only 5%.

INITIAL MANAGEMENT:

- Highest priority in a pregnant trauma victim is to evaluate and stabilize the mother
- Special considerations (ABC): Airway: mother increased risk for aspiration; Breathing: left shift fetal O_2 Hg dissociation curve, so minimal decreases in maternal S_AO_2 can compromise fetal oxygenation; and Circulation: a) mother can exhibit delayed manifestations of shock; b) supine positioning can compress IVC, thus position mother's right hip on a pillow or IV bag to displace the uterus to the left

DETERMINING FETAL VIABILITY:

- Survival neonate delivered at 21 weeks is 0%; 25 weeks =75%.
- 50% of surviving newborns delivered < 25weeks have severe disabilities

RADIATION EXPOSURE:

- Rate of childhood leukemia increases from 1/3000 (background) to 1/2000 among children exposed to in-utero radiation
- Greatest potential risk is in the first trimester
- The concern for radiation, however, should not prevent medically indicated diagnostic x-rays from being performed on the mother.

Estimated Fetal Exposure For Various Imaging Methods

Plain Films	Fetal dose (rads)
Cervical spine	0.002
Upper or lower extremity	0.001
Chest (2 views)	0.00007
Abdominal (multiple views)	0.245
Thoracic spine	0.009
Lumbosacral spine	0.359
Pelvis	0.040
Hip (single view)	0.213
CT scans (slice thickness: 10mm)	Fetal dose (rads)
Head (10 slices)	<0.050
Chest (10 slices)	<0.100
Abdomen (10 slices)	2.600

OB Trauma Patient Response

- **For any severe trauma (trauma 99) in a pregnant woman <u>> 20 weeks</u> the OB team should be called via the OB stat pager (call 211 and ask for an OB stat* to come to the ED)**
  - The Stanford OB attending will cover all OB patients for code 99 until their primary OB can be contacted and present.
  - If the OB Stanford attending is not available the MFM (maternal fetal medicine physician) on call will be asked by the OB team to cover until the OB Stanford attending is available
  - Consider calling Neonatal Code Blue if emergent delivery will take place (call 211)
- **For less severe trauma (codes 97,95) or in a patient <u>< 20 weeks</u>**
  - The patient's primary OB attending should be consulted via phone on the patient's arrival.
  - If the patient is a Stanford patient, the ED should call L&D, identify that the ED is calling for an OB trauma in a Stanford patient and ask to be connected to the OB attending on call immediately.
- **If the OB Stanford attending is busy (in a c/s etc) they will delegate someone to respond.**
  - An L&D nurse can be sent to the ED for fetal monitoring if indicated.

** OB stat will provide the following personnel: OB Stanford attending, OB chief resident, OB anesthesia attending, OB anesthesia resident, L&D Charge nurse, nursing supervisor*

To ensure optimal patient care as well as a productive educational experience, the Trauma Critical Care staff have formulated the following guidelines. These policies cover the roles and responsibilities of each member of the Surgical Critical Care Team, specific policies regarding patient care, and other issues essential to the efficient running of the Surgical Critical Care Service.

The SICU is a closed ICU model and patients are transferred to the care of the critical care team on a full-time basis. Care is expected to be coordinated with the primary surgical and consulting care services, but patient management in the ICU, including order writing, formally resides exclusively within the domain of the ICU team.

Attendings are to be notified of all new admissions to the ICU.

Fellow/Resident/Medical Student Roles

The fellow is responsible for direct oversight of resident staff in the care of patients and in the performance of all procedures. The fellow is to perform an independent assessment of each patient admitted to the SICU, and develop a plan of care for each individual patient. In addition the fellow is responsible for organizing the weekly Surgical Critical Care conference

The PGY-3 is the Chief Resident on the service. **This resident is responsible for the Surgical Critical Care Service**. This includes running daily work rounds, review of the previous night's work-ups including radiology studies and coordinating care with the primary surgical and consulting services.

In addition to providing medical student supervision, residents are expected to participate in daily patient care, including independent assessment and documentation. **ICU progress notes must be documented using the Epic smart text, "IP ICU PROGRESS NOTE," and all notes must be selected for attending co-signature**. Under no circumstances is it acceptable to copy a medical student's note in place of a resident's progress note.

Medical students will assist in all aspects of patient care as dictated by the senior resident. This includes patient assessment, documentation, and presentation during attending rounds. Students are also expected to deliver a Friday noon conference presentation on a critical care topic.

General Policies

1. All residents will follow the ACGME requirement for resident work hours

2. Attending rounds begin in the SICU at 10 am on Mondays and Tuesdays, and at 8 am Wednesdays through Fridays. Weekend times may vary, but must occur before 10 am

3. All admissions to and discharges from the ICU require approval of the ICU attending

4. Admission orders, except for patients admitted directly to the SICU, should be written by the primary surgical service and reviewed by a member of the SICU team

5. All transfer orders should be written by the accepting service and reviewed by a member of the SICU team prior to the patient leaving the ICU

6.The Daily Goal Sheet must be completed during rounds, preferably by the fellow. This document is meant to be used by all providers (physicians, nurses, respiratory therapists, and pharmacist), and is designed to improve communication and patient care

7. Available members from the SICU are expected to respond to all Trauma 99 activations

8. All trauma patients should have the tertiary survey form completed within the first 24 hours of patient admission

9. Unanticipated changes in patient condition must be communicated to the ICU attending and primary surgical services

10. All procedures performed in the ICU require documentation in Epic

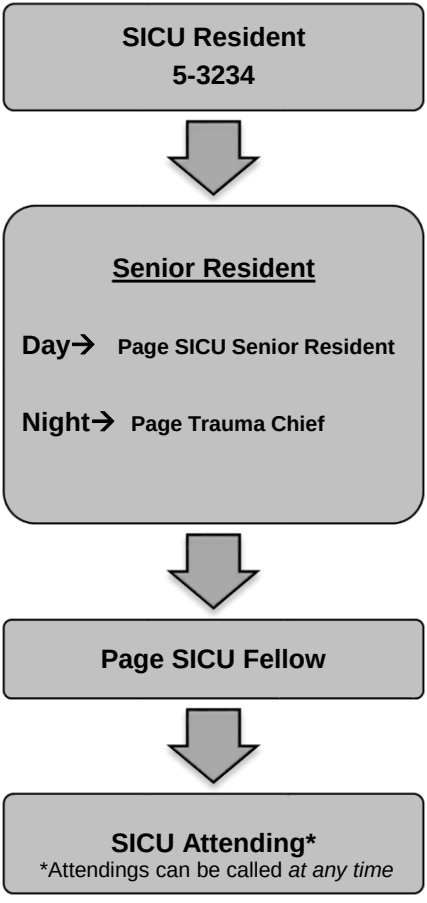
11. For procedures in the ICU the hospital promotes the Universal Protocol to Prevent Wrong Site, Wrong Procedure and Wrong Person Surgery. It is expected, to the extent possible and appropriate, that the patient and team members will be involved in site marking and a “time-out” immediately before a procedure to verify the correct patient, procedure and site. For procedures requiring moderate sedation or anesthesia and a boarding pass must be completed by participating nursing staff. Invasive procedures not requiring sedation or anesthesia require only documentation of a time-out by the physician. Any exceptions, circumstances, etc. precluding the Universal Protocol MUST be documented in the medical record
12. The Trauma Chief Resident is available at night for additional support in the ICU. If the Chief Resident is unavailable or more help is needed the fellow or ICU attending should be contacted
13. All Trauma deaths must be referred to the coroner. Refer to the Epic **“IP Death Certificate Worksheet,”** for a complete list of indications
14. A SICU representative is expected to attend the weekly multidisciplinary meeting to discuss patient needs. Meetings are held each Monday at 2 pm in the E2 conference room
15. Conferences:
    - Surgical Critical Care Conference, 12 pm Fridays
    - ICU Multidisciplinary Conference for 10:30 am, last Monday of the month, Rm H3565
    - Emergency Medicine/Trauma Conference, second Wednesday of the month, LKSC
    - Emergency Medicine/Critical Care Medicine Conference, third Wednesday of the month. LKSC
    - SICU RN/resident Journal Club, every other month

SURGICAL CRITICAL CARE CALL TRIGGERS

The following are a list of absolute indications for alerting the SICU attending[1]

- New admission or transfer to the ICU
- Unplanned intubation or respiratory failure requiring ventilator support
- Inability to oxygenate ($pO_2<60$) or ventilate (acute increase in $pCO_2>10$ mmHg)
- Unanticipated changes to a patient's hemodynamic condition including persistent hypotension, new arrhythmia with hemodynamic instability, cardiac arrest, or CODE BLUE
- Development of a significant neurologic change (CVA, seizure, new onset paralysis)
- Medication or treatment errors requiring clinical intervention (invasive procedures, increased monitoring, new medications excepting Narcan)
- Unexpected blood product transfusions not previously discussed with attending, or activation of the Massive Transfusion Guidelines (MTG)
- Ongoing fluid resuscitation of greater than 4L crystalloid to maintain hemodynamic stability
- Initiation of new pressors, or continued escalation of pressor requirements (addition of an additional pressor, maximization of a single agent with ongoing hypotension)
- Any patient requiring an urgent operation (or return to OR) with any service

ElBardissi et al. Ann Surg 2009



ICU Rounds

Morning
10am Mon/Tue
8am Wed-Sun

Afternoon
4-6pm

Fellow check-in
9-10pm

Night check-in w/ bedside nurses
10pm

Phone Numbers:
SICU fellow - pager
SICU attendings:
Spain 650-776-3912
Maggio 650-521-7453
Staud. 650-704-0631
Weiser 617-794-5887
Lorenzo 650-704-2825
Mohabir 650-804-4811
Browder 702-757-8276

Rev. 6/16

COMMONLY USED ICU ORDER SETS

A number of order sets exist in EPIC for ICU patient care and these order sets should be utilized. They can be found under the following headings:

Use the following for admission orders:

- IP ICU Sur/Trauma ICU Admit

Use the following for ordering blood products:

- Massive Transfusion Adult (>50kg)
  - For massively hemorrhaging patients in the ED, OR, or ICU
- IP Emergency Release Blood Products
  - For hemorrhaging patients who can not wait for cross matched blood but do not require massive transfusion
- IP Lab Transfusion Service
  - For routine transfusion orders

Common additional routine order sets needed:

- IP ICU Electrolyte Replacement Scales (aka ICU)
- IP Insulin Continuous IV Infusion
- IP Insulin Transition Off IV Infusion
- IP Subcutaneous Insulin
- IP Gen Tube Feeding

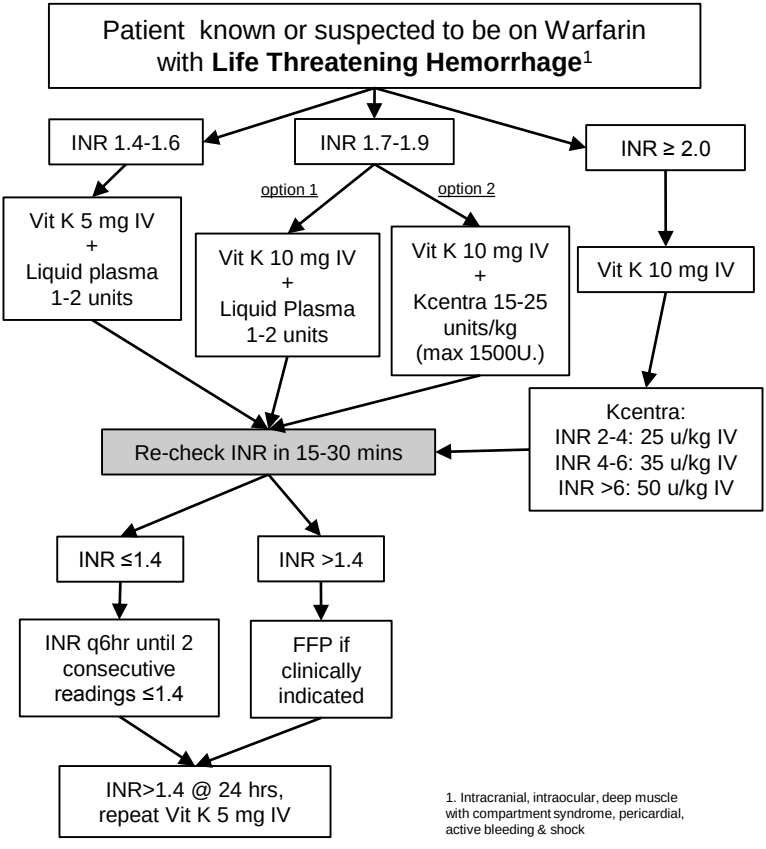
Use the following for intubated patients:

- IP ICU Intubation
- IP ICU Sedation Vacation and Spontaneous Breathing Trial

Condition specific order sets:

- IP Neu Hypothermia After Cardiac Arrest
- IP ICU Sepsis Management
- IP ICU Pneumonia
- IP ICU COPD
- IP ICU Acute pancreatitis
- IP ICU GI Bleed

EMERGENCY WARFARIN REVERSAL



1. Intracranial, intraocular, deep muscle with compartment syndrome, pericardial, active bleeding & shock

NB: repeat dosing with KCentra not recommended. Kcentra is contraindicated in patients with HIT.

Rev. 6/16

General Care of Severe Head Injury (GCS 3-8):

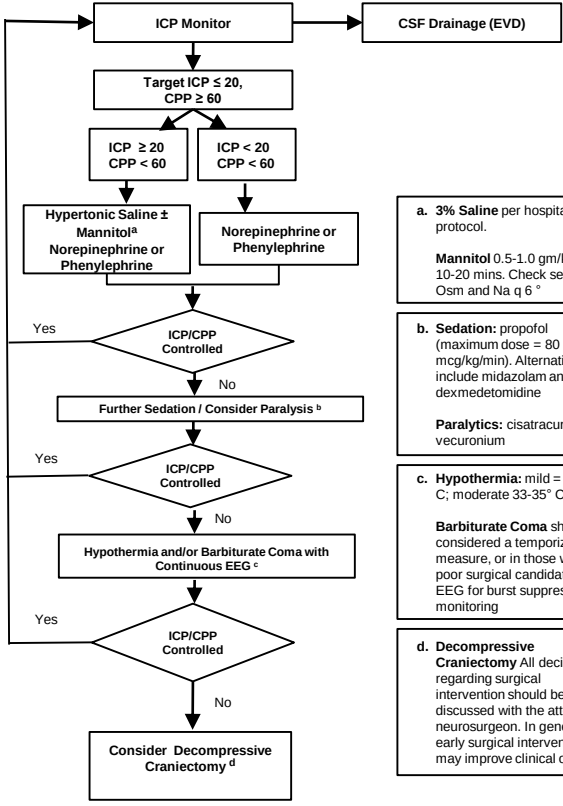
1. Endotracheal Intubation/Mechanical Ventilation
   - Target :
     - PaO_2 > 100 mm Hg[@]
     - $PaCO_2$ 35-45 mm Hg*
     - pH 7.35-7.45
2. Euvolemic Resuscitation – with NS.
   - Goal:
     - CVP 5-7 mm Hg
     - Na 135-145
3. Avoid hypotension (SBP<100 mm Hg)
   - Goal:
     - MAP ≥ 80 or SBP > 120 mm Hg
4. ICP Monitoring –ventriculostomy is preferred [#]
   - Goal:
     - CPP>= 60 mm Hg
5. Seizure Prophylaxis (Phenytoin 1000 mg loading dose and 300 mg/day for 7 days in divided doses)
6. Normothermia (36.0-38.3°C)
7. Euglycemia (80-180 mg/dL)
8. Prophylaxis:
   - Stress ulcer prophylaxis
   - DVT Chemoprophylaxis by 72 hours with SQ heparin in the absence of contraindications
9. Short-acting sedatives/analgesics
10. Head of bed 30 °
11. Avoid INR> 1.4, platelet count <75K and Hemoglobin <8 mg/dL

[@]ABG trumps O2 sat except when weaning. Goal SpO2>=90%

*There is no role for prophylactic or prolonged hyperventilation to decrease ICP. Temporary hyperventilation to a $PaCO_2$ 30-35 may be considered in acute neurologic deterioration.

[#] The guidelines recommend "ICP should be monitored with an EVD in all salvageable patients with GCS 3-8 after resuscitation with signs and symptoms of raised ICP, and considered in patients with severe head injury, normal CT scan, and two or more of the following on admission: age over 40 years, unilateral or bilateral motor posturing, or SBP < 100 mg Hg." An ICP number (or any number) should not be the sole factor in determining clinical management. Instead, physiological parameters obtained should be evaluated and clinical management adjusted to optimize all physiological parameters

The following guidelines are traditionally initiated in a stepwise fashion for ICP control, although newer recommendations support the initiation of interventions in any order based on the clinical situation.



a. **3% Saline** per hospital protocol.

Mannitol 0.5-1.0 gm/kg over 10-20 mins. Check serum Osm and Na q 6 °

b. **Sedation:** propofol (maximum dose = 80 mcg/kg/min). Alternatives include midazolam and dexmedetomidine

Paralytics: cisatracurium or vecuronium

c. **Hypothermia:** mild = 35-37° C; moderate 33-35° C.

Barbiturate Coma should be considered a temporizing measure, or in those who are poor surgical candidates. EEG for burst suppression monitoring

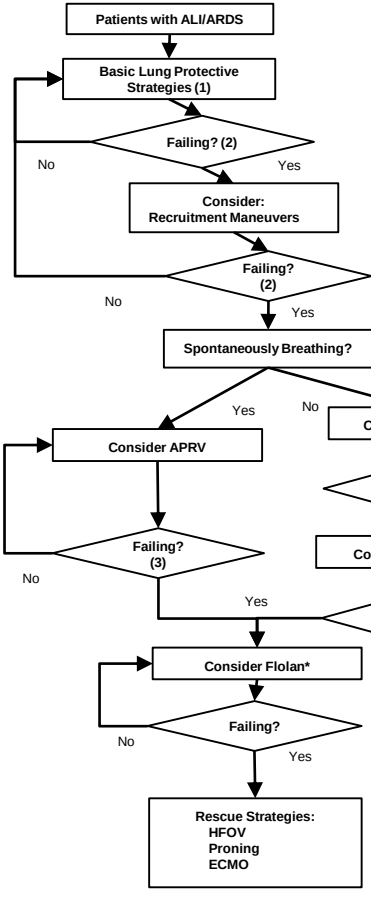
d. **Decompressive Craniectomy** All decisions regarding surgical intervention should be discussed with the attending neurosurgeon. In general, early surgical interventions may improve clinical outcome

References

1. Brain Trauma Foundation Guidelines for Management of Severe Traumatic Brain Injury. New York: 2007. Link: www.braintrauma.org

Richmond Agitation Scale		
Score	Term	Description
+4	Combative	Overly combative or violent. Immediate danger to staff.
+3	Very Agitated	Agitated Pulls/Removes tubes or catheters. Has aggressive behavior towards staff.
+2	Agitated	Frequent non-purposeful movement. Patient ventilator dyssynchrony.
+1	Restless	Anxious or apprehensive but movements Not aggressive or vigorous.
0	Alert & Calm	
-1	Drowsy	Not fully alert, but has sustained (>10 sec) awakening with eye contact, to voice
-2	Light Sedation	Briefly (<10 sec) awakens with eye contact to voice.
-3	Moderate Sedation	Any movement (but no eye contact) to voice.
-4	Deep Sedation	No response to voice, but any movement to physical stimulation
-5	Unarousable	No response to voice or physical stimulation

ARDS Ventilator Management



1. Basic LPVS

ARDSNet ventilation strategy:
- Assist Control
- Vt 5-7 ml/kg PBW
- PIP <30-35 cm H2O

2. Criteria for failing LPVS

On LPVS 24-72 hrs and PaO2 <55 torr on ≥ 70% oxygen & PEEP >15

On LPVS < 24 hrs and PaO2 <55 torr on 100% oxygen & PEEP > 20

Recruitment Maneuvers

Use 30-40 cm H2O x 30-40 sec.

3. General Failure Criteria

- PaO2 < 55 torr
- SpO2 < 88%

APRV

Refer to RT Care policy

Flolan

See Epic Flolan Order Set

***Inhaled Nitric Oxide**

iNO is no longer used routinely for severe hypoxia, but may be consider if due to intra-cardiac shunt and bleeding risk with Flolan is too high.

iNO Test
-15 min test on 20 ppm
-Requires at least 10% increase in PaO2

Rescue Strategies:

HFOV
Refer to RT Care policy

Proning
Recent evidence points to improvements in oxygenation; hospital does not yet have a protocol for this

ECMO
Absolute contraindication: on vent >10 days pre-ECMO
Evaluate, but low survival (<10%) on vent 7-10 days pre-ECMO
Refer to ECMO protocol

EMPIRIC ANTIBIOTICS IN THE SICU - PNEUMONIA

- *Obtain cultures prior to initiation of antibiotics. Bronch or miniBAL recommended*
- *De-escalate once cultures and susceptibilities are confirmed*
- *Use Epic "ICU Pneumonia" orderset*

EARLY PNEUMONIA/VAP WITHOUT RISK FACTORS FOR MDRs, ONSET < 48H, OR INTUBATED ≤ 4 DAYS

- **Treatment duration**: 8 days

Anti-pneumococcal beta-lactam	OR	Respiratory fluoroquinolone
Ceftriaxone	OR	**Levofloxacin** or Moxifloxacin**(*Moxi preferred if suspected aspiration pneumonia)*

LATE HCAP/VAP WITH RISK FACTORS FOR MDRs

- **Treatment duration**: 8 days.
  - Consider 15 days for non-fermenting GNRs (pseudomonas, acinetobacter, stenotrophomonas), or severely immunocompromised

MDR Risk Factors

- *Duration of hospitalization > 5 days*
- *Intubated > 4 days*
- *Prior antibiotics within last 90 days*
- *Chronic dialysis/indwelling lines*
- *High frequency contact with healthcare facility*

MRSA coverage	PLUS	Anti-pseudomonal beta-lactam	±	Aminoglycoside or Fluoroquinolone
• **Vancomycin** • Linezolid	+	• **Piperacillin-tazobactam (Zosyn)** • Cefepime • Meropenem (if high suspicion of ESBL) • Aztreonam (penicillin allergic patients)	±	• **Levofloxacin** • Tobramycin

*Consider ***empiric*** double coverage in severely immunocompromised, shock, and/or those at high risk of MDR organisms.

- For **aspiration pneumonia**, include anaerobic coverage (e.g. Zosyn, Unasyn (ampicillin/sulbactam), moxifloxacin, meropenem, metronidazole, clindamycin)
- Avoid using two agents from the same class, e.g., two beta-lactams
- For **MSSA**, nafcillin (or other beta lactam, e.g. Unasyn, Zosyn, cefazolin, ceftriaxone, cefepime) is preferred over vancomycin

- ATS/IDSA Guidelines, Am J Respir Crit Care Med 2005
- Chastre, J etal, JAMA 2003 290;19
- Esposito S et al, JAC 2012; 67: 2570 – 2575
- Wunderink RG et al, CID 2012 Mar 1;54(5)

ABDOMINAL INFECTIONS: SECONDARY PERITONITIS (BOWEL PERFORATION, RUPTURED APPENDIX, RUPTURED DIVERTICULA)

** Obtain cultures prior to initiation of antibiotics*

** De-escalate once cultures and susceptibilities are confirmed*

Mild to moderate	Severe	Optional coverage
• Ertapenem • Moxifloxacin • Cefoxitin (*no enterococcus activity)	• Piperacillin-tazobactam (Zosyn) • Meropenem (*if ESBL likely)	**- MRSA**: In those at high risk - (e.g. vancomycin, linezolid) **- Antifungal**: Continued evidence of systemic infection while on anti-bacterial therapy, especially if colonized with candida - (e.g. fluconazole) **- VRE:** Patients whom VRE has previously been recovered, previous receipt of antibiotics that select for *Enterococcus* species, immunocompromised/liver transplant patients - (e.g. Linezolid)

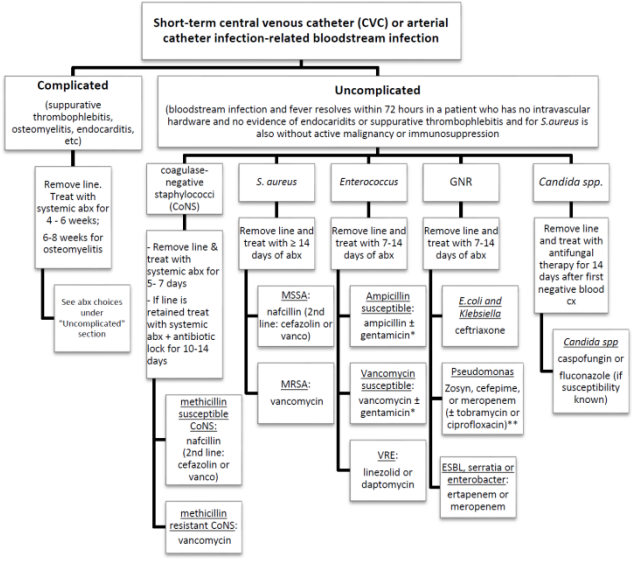
Treatment duration:

Description	Treatment Duration
Established infections	4 - 7 days
-If inadequate source control	Treat until afebrile and with normal WBC for 48 hours
-For culture-positive fungal infections or immunocompromised patients	14 - 21 days
Bowel injuries attributable to penetrating, blunt, or iatrogenic trauma that are repaired within 12 h	< 24 hours
Intraoperative contamination of the operative field by enteric content	< 24 hours

- Solomkin JS et al, CID 2010; 50:133–64
- Esposito S et al, JAC 2012; 67: 2570 – 2575
- Pappas PG et. Al, CID 2009; 48:503-35

LINE (CATHETER-ASSOCIATED BLOODSTREAM) INFECTION

* *Obtain cultures prior to initiation of antibiotics*
* *De-escalate once cultures and susceptibilities are confirmed*



*Addition of gentamicin recommended for enterococcus endocarditis

**May use tobramycin or ciprofloxacin empirically for double coverage of pseudomonas until susceptibilities known, then de-escalate to single agent

Mermel LA et al, CID 2009; 49:1–45

EMPIRIC ANTIBIOTICS IN THE SICU – UTI AND UROSEPSIS

Complicated UTI and Urosepsis:

** Use Epic "IP Med/UTI/pyelonephritis" orderset*

** Obtain cultures prior to initiation of antibiotics*

** De-escalate once cultures and susceptibilities are confirmed*

COMPLICATED UTI AND/OR UROSEPSIS	COMMENTS
Community acquired UTI • **Ceftriaxone** • **Ampicillin/sulbactam (Unasyn)** • **Ciprofloxacin** • **Levofloxacin** **Nosocomial UTI** • **Piperacillin/tazobactam (Zosyn)** • **Cefepime** • **Ceftazidime** • **Ertapenem**(*ESBL coverage) • **Meropenem**(*ESBL coverage) • **Tobramycin**	▪ **Treatment duration:** ▪ **7 days** if rapidly improvement ▪ **10-14 days** if delayed response ▪ May change to PO therapy once patient stabilizes (afebrile x24h) - *E.g. Ciprofloxacin, levofloxacin, Augmentin, Septra, ampicillin, cephalexin* ▪ Moxifloxacin and nitrofurantoin are not recommended
Candida (*yeast in urine DOES NOT necessarily indicate infection. Usually a colonizer. Do NOT treat if asymptomatic) • **Fluconazole (1st line)** • **Ampho B ± flucytosine** • **AmphoB bladder irrigation** is generally not recommended but may be useful for fluconazole-resistant *Candida* species, especially *C. glabrata*	• **When to consider treatment:** - S/p renal transplant - Neutropenic - Urology patient with hardware - High risk of dissemination ▪ **Treatment duration: 14 days** ▪ Caspofungin not recommended: low urine concentrations

Hootenet.al,CID 2010; 50:625–663
Pappas PG et. Al, CID 2009; 48:503-35

** Obtain cultures prior to initiation of antibiotics*
** Use Epic "ICU Sepsis" orderset*

Duration:

- ***Empiric* antibiotics for 3–5 days**: Adjust/de-escalate once susceptibilities are available.
- **Duration of therapy typically 7–10 days**; longer courses may be appropriate in patients who have a slow clinical response, undrainable foci of infection, bacteremia with S. aureus; some fungal and viral infections or immunologic deficiencies, including neutropenia

Candida coverage should be considered in patients with any of the following:

- *Prolonged ICU stay*
- *TPN use*
- *Abdominal surgery*
- *Continued signs/sx of infection unresponsive to antibacterial therapy*
- *Severely immunocompromised patients*

- Treatment should be directed towards suspected source(s) of infection
- Avoid using two agents from the same class, e.g. two beta-lactams

MRSA coverage		Anti-pseudomonal agent	±	Secondary agent for gram negative coverage	±	Other
• Vancomycin • Linezolid		• Piperacillin-tazobactam (Zosyn) • Cefepime • Meropenem *(if high suspicion of ESBL)* • Aztreonam *(penicillin allergies)*	±	• Tobramycin • Levofloxacin *(has atypical coverage)* • Ciprofloxacin *Consider ***empiric*** double coverage in severely immune-compromised, shock, and/or those at high risk of MDR organisms.	±	**Depending on source, consider:** **Candida**: Caspofungin **Meningitis***: -Ampicillin+ceftriaxone -Acyclovir **Use meningitis dosing* **Influenza, H1N1** Oseltamivir **Atypicals** Azithromycin, doxycycline

SHC 2012 susceptibilities (%)

	Zosyn	Cefepime	Levofloxacin	Cipro	Meropenem	Tobramycin	Aztreonam
Pseudomonas aeruginosa	94	87	76	79	88	93	76

Dellinger RP et al, CCM 2013;41(580-637)

DVT/PE Prophylaxis in Adults Following Multiple Trauma

Multiply injured trauma patients are at high risk for development of thromboembolic complications and should receive chemoprophylaxis as soon as it is safe. Without prophylaxis, the rate of VTE (venous thromboembolism) is as high as 58% in high risk trauma patients. Accurate assessment of VTE risk is critical for proper prophylaxis and a risk assessment profile (RAP) score has been developed and validated to characterize such risk. Patients with a RAP score ≥ 5 are at the highest risk and chemoprophylaxis is cost-effective in this patient population. High risk patients who receive early chemoprophylaxis have only a 5% risk of VTE, whereas delays in initiating prophylaxis result in a marked risk elevation that exceeds a threefold higher risk if delayed beyond 4 days. When indicated, anti-coagulation should be immediate and continuous. Duration of therapy is dictated by the period of immobilization and therapy should continue through rehabilitation until ambulation is achieved.

Although chemoprophylaxis is associated with a low risk of bleeding (1-3% depending upon agent utilized), the benefit outweighs the risk for most trauma patients. However, for select patient populations the risk exceeds the immediate benefit and therefore, absolute contra-indications to chemoprophylaxis exist. These include intracranial bleeding (<=24hrs. post injury), incomplete spinal cord injury associated with hematoma, uncorrected coagulopathy, and active hemorrhage. There currently is no universally accepted timeframe in which initiating prophylaxis for neurosurgical/spinal cord injuries is absolutely safe and therefore, **our local standard mandates spine service or neurosurgery consultation to determine initiation timeframe. However, most experts agree that in this select group, DVT prophylaxis may commence as early as 48 hours post injury.**

For major trauma patients, low molecular weight heparin (LMWH) is the most effective means of protecting against DVT. Use of prophylactic IVC filters should be reserved for high risk patients that have a contraindication to chemoprophylaxis. In minor trauma patients requiring hospitalization, sequential compression devices (SCDs) and early ambulation alone are recommended as the risk of VTE is extremely low. Routine screening duplex ultrasound is not recommended and should only be performed in patients who are at high risk of VTE who have received suboptimal chemoprophylaxis.

DVT/PE PROPHYLAXIS: RAP SCORE

Risk Assessment Profile Score (RAP)

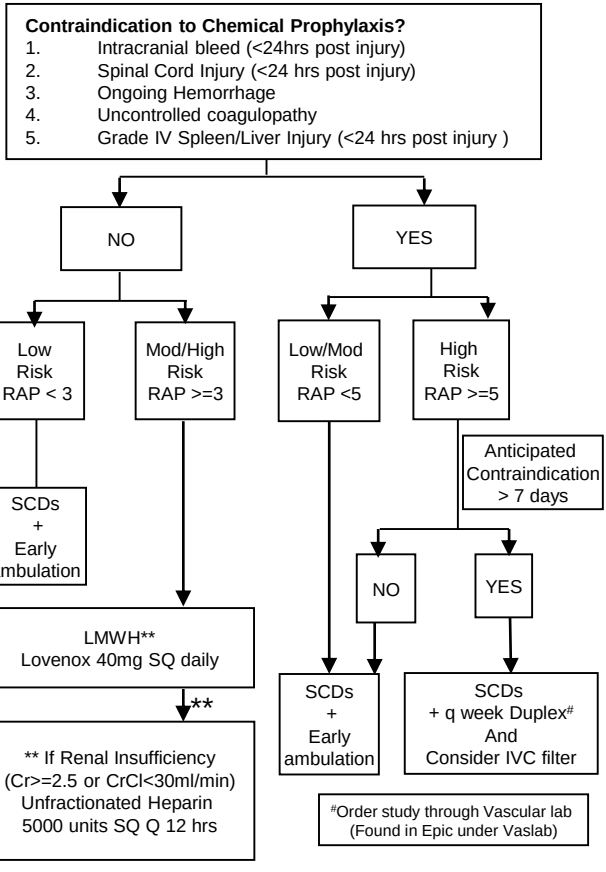
Underlying condition	
Morbid obesity	2
Malignancy	2
Abnormal coagulation factors at admission	2
History of Thromboembolism	4
Iatrogenic factors	
Femoral line >24 hours	2
4 or more transfusions in first 24 hours	2
Surgical procedure >2 hours	2
Repair or ligation of major vascular injury	3
Injury-related factors	
AIS score >2 for chest*	2
AIS score >2 for abdomen	2
AIS score >2 for head, or Coma (GCS <8 for >4 hours)	3
Spinal Fractures	3
Complex lower extremity fracture**	4
Pelvic fracture	4
Spinal cord injury +/- paraplegia or quadriplegia	4
Age	
40-59 years	2
60-74 years	3
>=75 years	4

**Abbreviated Injury Score*

***Grade IIIb, comminuted fractures (>3 fragments), unilateral femur and tibia, or bilateral femur OR tibia*

References:

1. Geerts WH, Bergqvist D, Pineo GF, et al. Prevention of venous thromboembolism. American College of Chest Physicians evidence based clinical practice guidelines (8th Ed.). Chest 2008; 133 (Suppl6): 381S-453S.
2. Geerts WH, Jay RM, Code KI et al. A comparison of low-dose heparin with low molecular weight heparin as prophylaxis against venous thromboembolism after major trauma. N Engl J Med 1996;335:701-707.
3. Greenfield LJ, Proctor MC, Rodriguez JL, et al. Post-trauma thromboembolism prophylaxis. J Trauma 1997;42:100-103.


Contraindication to Chemical Prophylaxis?
1. Intracranial bleed (<24hrs post injury)
2. Spinal Cord Injury (<24 hrs post injury)
3. Ongoing Hemorrhage
4. Uncontrolled coagulopathy
5. Grade IV Spleen/Liver Injury (<24 hrs post injury)
NO
YES
Low Risk RAP < 3
Mod/High Risk RAP >=3
Low/Mod Risk RAP <5
High Risk RAP >=5
SCDs + Early ambulation
Anticipated Contraindication > 7 days
NO
YES
LMWH** Lovenox 40mg SQ daily
**
SCDs + Early ambulation
SCDs + q week Duplex# And Consider IVC filter
** If Renal Insufficiency (Cr>=2.5 or CrCl<30ml/min) Unfractionated Heparin 5000 units SQ Q 12 hrs
#Order study through Vascular lab (Found in Epic under Vaslab)

The role of adequate and timely nutritional therapy in the ICU cannot be overstated. Early nutritional support has been associated with reduced disease severity, diminished complications, decreased ICU LOS, and improved patient outcomes. All appropriate patients will have enteral nutrition initiated by 48 hours and caloric goal to be reached by 72 hours after initiation. A nutrition consult should be obtained for all candidates of total enteral (TEN) or parenteral (TPN) nutrition therapy.

Relative contraindications to enteral feeds include:
•Peritonitis
•Intestinal obstruction
•Mesenteric ischemia
•Major GI bleed
•Complicated enteroenteric fisula
•Severe malabsorptive state
•Patients requiring neuromuscular blockade
•Patient requiring ongoing resuscitation with fluids and vasoactive support to maintain MAP > 60 mmHg

Enteral Access: All feeding tubes will be confirmed by radiography, **not** auscultation alone. Gastric access (NGT/OGT) is adequate for most patients. Post-pyloric placement will be determined to be necessary by one of the following:
•Gastric outlet obstruction
•Gastroparesis with persistent high gastric residuals despite prokinetic agents or recurrent emesis
•Open abdomen patient
•Unable to maintain head of bed at ≥ 30 degrees
•Attending physician preference

Selection of Appropriate Enteral Formulation: Osmolite 1.2 Cal (no fiber) or Jevity 1.2 Cal (fiber enriched) is adequate therapy for most critically ill patients. Glutamine (Impact Glutamine) should be considered in burn and trauma patients (avoid in patients with severe sepsis). Patients with ARDS ALI should be placed on an enteral formulation characterized by an anitinflammatory lipid profile and antioxidants (Pivot 1.5).

Metabolic Requirements: May be calculated using predictive equations (ie, Harris-Benedict, Ireton Jones, or Penn State equations) or indirect calorimetry.

• Conditions to consider obtaining indirect calorimetry include:

- Extremely obese patients (Class III – BMI > 40 kg/m2)
- Multiple organ dysfunction syndrome (MODS) / ARDS
- Multiple or neurologic trauma / Burns
- Severe sepsis
- HIV patients
- Malnourished patients, amputees, severe thyroid disorders, failure to respond to medical therapy.
- Postoperative organ transplantation
- Large or multiple open wounds

Peri-Procedural Guidelines For Enteral Nutrition

Hold On-Call to OR/Procedure:

Principals: Patients must have a secure airway, no planned manipulation of the GI tract and no prone positioning

(1) Intubated patients (orotracheal, nasotracheal or tracheostomy) with a post-pyloric feeding tube or feeding jejunostomy tube should have nutrition continued until the OR/procedure. Feeding held during procedure.

(2) Intubated patients (OT, NT, Trach) with a OG or NG (with sump) should have nutrition continue until the OR/procedure. *OG/NG placed to suction* on-call for the procedure. Feeding held during the procedure.

(3) Intubated patients with a single lumen NG (no sump, keofeed that is not post pyloric, PEG), nutrition should be stopped on call to the OR and *aspiration of gastric contents should be done with a syringe*.

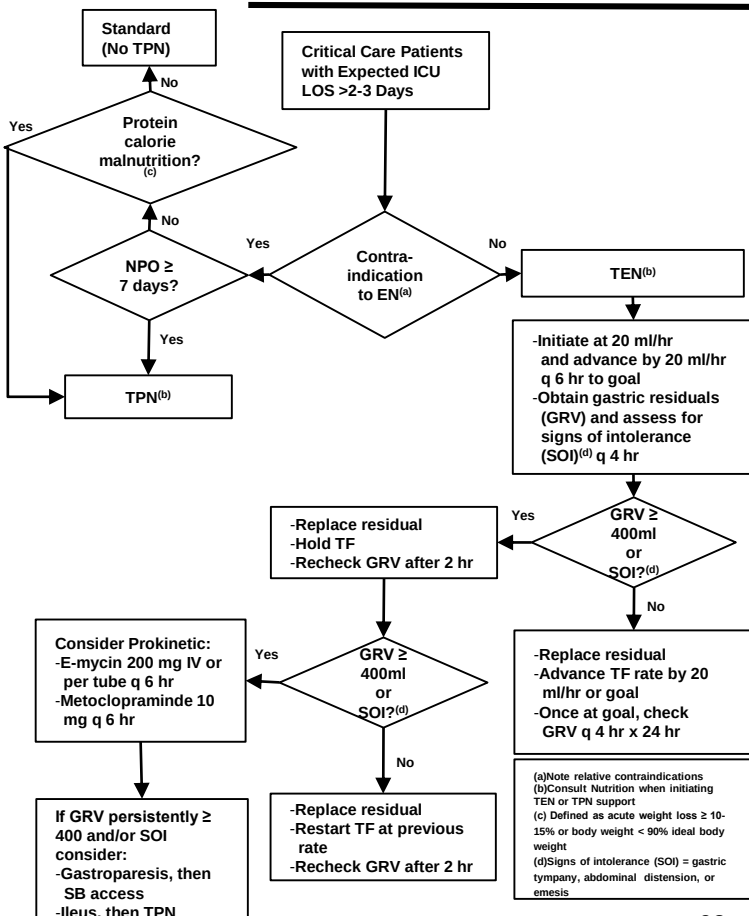
Hold 6 hours Prior to OR/Procedure

(1) Intubated patients undergoing a procedure that involves manipulation of the airway or GI tract (exchange of the ETT, tracheostomy , larygectomy or any abdominal surgery), feeding should be discontinued 6 hours prior to the procedure. Feeding tube should be flushed and residual aspirated on call to OR.

(2) Non-intubated patient on oral diet or receiving pre-pyloric tube feeding should have their tube feeding held 6 hour prior to the OR.

References:
1.Guidelines for the Provision and Assessment of Nutrition Support Therapy in the Adult Critically Ill Patient.. JPEN,2009;33;277
2. Pousman RM, et al. Feasibility of Implementing a Reduced Fasting Protocol for Crtically Ill Trauma Patients Undergoing Operative and Nonoperative Procedures. JPEN, 2009;33;176

CRITICAL CARE - NUTRITION



Definition: "An individual who has sustained irreversible cessation of all functions of the entire brain, including the brain stem, is dead."

The Uniform Determination of Death Act, *AMA*,1980.

(1) Required criteria prior to diagnosis:

- Known mechanism of injury
- Normothermia (>34°C)
- Normotension (SBP >80mmHg)
- Absence of CNS depressants, paralytics or confounding drugs (ie., sedatives)
- Absence of significant metabolic and/or electrolyte abnormalities

(2) Loss of brain stem reflexes:

- pupillary reflex (check with magnifying glass if necessary)
- corneal reflex
- oculocephalic reflex (doll's eyes)-no movement of eyes with fast turn of head
- oculovestibular reflex (cold calorics)-have HOB at 30 degrees, no movement of eyes after instilling ice water in ear, use 5 min interval between sides.
- cough reflex (gag not reliable)-test cough with deep ET suctioning (to carina)
- response to painful stimuli (excluding spinal reflexes)-supraorbital nerve, TMJ pressure or nail bed pressure
- spontaneous respirations
- If brainstem reflexes negative, proceed with apnea exam- may need to correct BP with fluid boluses or pressors in SBP < 90
- C-spine fracture above C4 may not have intact diaphragm function and may preclude a reliable apnea test therefore consider EEG or other test of cerebral blood flow.

(3) Apnea exam:

- Adjust ventilator settings to normalize ABG, esp pCO_2 (35-45)
- Pre-oxygenate with 100% O_2 for 10-15 minutes
- Disconnect ventilator but oxygenate patient with 100% O_2 by T-piece***
- Observe for spontaneous respirations
- After 10 min of apnea, draw ABG
- Hyperventilate for 2 min then reconnect ventilator and return to previous settings

*** Abort if patient becomes unstable (SaO_2 <80%, hypotension, arrhythmias). Immediately draw an ABG, hyperventilate patient, and then reconnect to the ventilator.

DOCUMENTATION OF BRAIN DEATH:

● Two different licensed physicians (independent of the transplant service) should document brain death. Two notes are needed; however, only one documented apnea exam is necessary.

-Stanford (attending and/or fellow, one physician must be from neurology or neurosurgery)

- SCVMC -attending

● Clearly document the following: 1) absence of aforementioned brain stem reflexes, 2) pCO_2 > 60 during apnea exam, and 3) that "the patient is brain dead"

● The two brain death notes must have a date and time. Second note is the legal time of death.

● Consider alternative studies (e.g. EEG, CBF, and/or cerebral angiography) if unable to perform apnea exam (e.g. patient instability or pentobarbital coma).

ECMO can be used for respiratory (V-V) and/or cardiac (V-A) support.

V-V Indications:

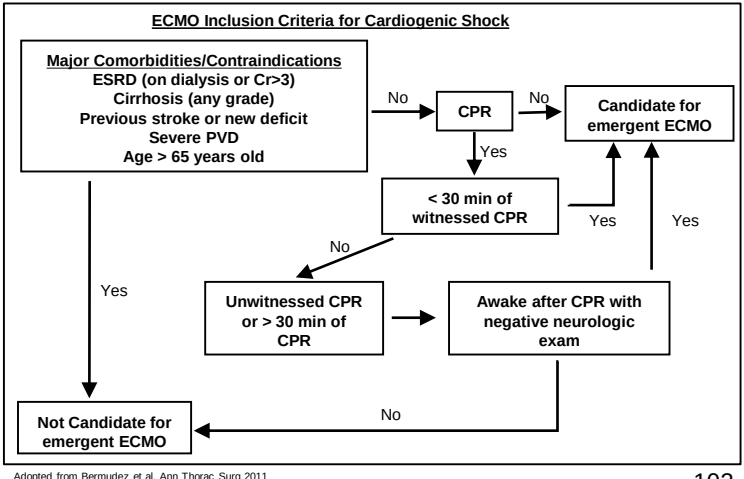
1. Severe Respiratory Failure despite and after optimal treatment.
   - Must meet **ALL** of the following criteria:
     - Mechanical Ventilation <=7 days
     - PaO2/FiO2 <80 on 100% FiO2 ***–or-*** PaO2/FiO2 <100 on 100% FiO2 *with* PaCO2>100 mmHg for >1 hour
     - Murray Score >=3
   - Common causes of Severe Respiratory Failure include:
     - severe pneumonia, ARDS, acute lung (graft) failure after transplant, pulmonary contusion, smoke inhalation, status asthmaticus, and airway obstructions.
2. Bridge to lung transplant
   - Must already be active on transplant list ***–or-*** decompensate during the initial evaluation process
   - Absence of other established organ dysfunction including:
     - Renal failure
     - Severe liver failure
     - Systemic infection

V-A Indications:

1. AMI refractory to convention therapy including IABP
2. Post cardiac surgery – failure to wean from bypass
3. Myocarditis with significant heart failure
4. Early graft failure: post heart/heart-lung transplant
5. Massive PE
6. Bridge to VAD or cardiac transplantation

Contraindications to ECMO initiation:

- Absolute to ALL forms of ECMO:
  1. Age > 65 years
  2. Non-recoverable cardiac disease
  3. Non-recoverable pulmonary disease
  4. Non-recoverable neurologic disease
  5. Active malignancy
  6. BMI>40
  7. Advanced liver disease
- Relative Contraindications to ALL forms of ECMO:
  1. Trauma with multiple bleeding sites
  2. Multiple organ failure
- Absolute V-V ECMO Contraindications:
  1. Severe pulmonary hypertension (mPAP > 50mmHg)
  2. Severe right or left heart failure (EF<25%)
  3. Cardiac arrest
- Absolute V-A ECMO Contraindications:
  1. Aortic dissection
  2. Severe aortic valve regurgitation



Adopted from Bermudez et al. Ann Thorac Surg 2011

When a Patient dies, you may be asked to pronounce the patient.

Death Exam and Pronouncing a patient

1. Check ID bracelet
2. Check pupils for position and response to light
3. Check response to tactile stimuli
4. Examine respectfully: No pinches or nipple twists
5. Check for spontaneous respirations
6. Check for heart sounds and pulses
6. Record time of death

Make sure to call the family and any teams that were taking care of the patient.

For documentation, go through the “Discharge as Deceased” tab in Epic. Fill out the “Death Certificate” flow sheet with all the relevant information. All deaths should be reported to the Coroner, and all the Traumas are Coroner’s cases. The phone number to call is (408) 793-1900. The nurse will call CTDN. Write a Death Summary and discharge the patient as deceased.

PEDIATRIC TRAUMA GUIDELINES

Stanford Health Care

Lucile Packard Children's Hospital Stanford

Level I Pediatric Trauma Center.

Pediatric Surgery & Trauma Contacts

Pediatric Trauma Medical Director

Karl Sylvester, MD	650-804-0597

Pediatric General Surgery

24/7 answering service	650-723-6439
Matias Bruzoni, MD	650-213-6105
Stephanie Chao, MD	650-504-1852
Julie Fuchs, MD	650-384-9463
Gary Hartman, MD	650-353-0720
Claudia Mueller, MD	650-319-5037
David Powell, MD	410-858-0410
Karl Sylvester, MD	650-804-0597
James Wall, MD	650-556-5042
Chad Thorson, MD, Fellow	305-978-8868
Raji Koppolu, CPNP	18426 pager
Samantha Lee, CPNP	28100 pager

Pediatric Trauma Program Manager

Karla Earnest, RN, MS, MSN, CNS 650-353-6845
Email: trauma@stanfordchildrens.org 15698 pager,

Pediatric Trauma Nurse Coordinator

Michelle Padreddii, RN, BSN 650-319-5669
Email: mpadreddii@stanfordchildrens.org 15470 pager

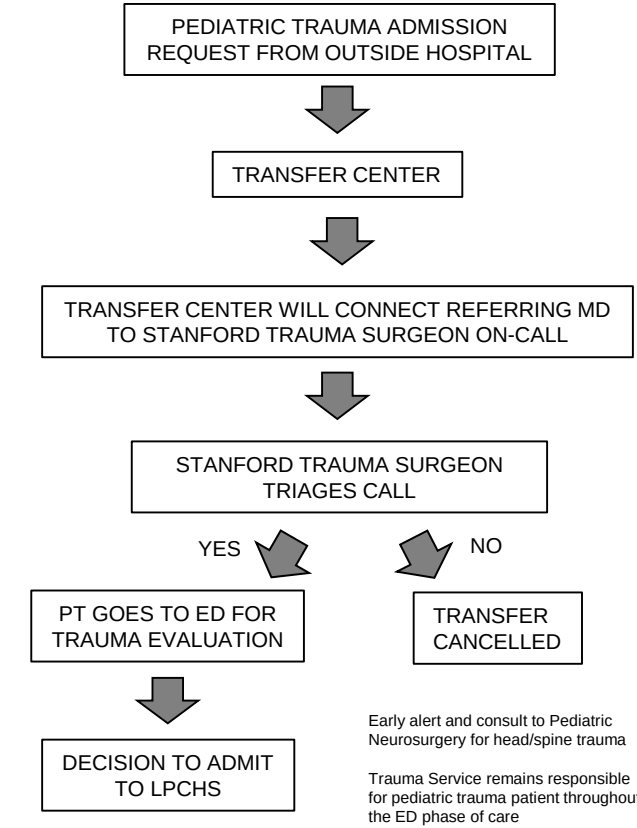
Pediatric Radiology Hotline: For CT Scan Reads

• 0700 – 1700 Days, M-F	7-8757
• After-hours/Weekends	7-8758

Lucile Packard Children's Hospital Stanford

LPCHS Nursing Supervisor	7-8430
LPCHS-OR 24/7	1-2820
LPCHS-OR RSN	1-2820
Pager	3-8222
Patient Placement (Beds)	5-7788
Pediatric Surgery/Trauma 24/7	3-6439
Pediatric Anesthesia Fellow 24/7	1-9706
Pediatric Anesthesia back-up 24/7	1-9705
Pediatric ED Child Life	6-0896
Pediatric ED - desk	3-4422
Pediatric ED RSN	4-0057
PICU - desk	7-8850
PICU Fellow	1-9748
Radiology Manager On-Call 24/7	18703 pager
SCAN Consult 24/7	27226 pager
SHC ED - desk	3-7337
SHC ED RSN	4-2243
SHC Nursing Supervisor	6-1767
SHC-OR	3-7251
Social Work 24/7	18083 pager
Transfer Center	3-7342
Vascular Access	4-7422
Wound Ostomy Care Nurse (LPCHS)	650-815-5891

Pediatric Trauma Inter-facility Transfers



Early alert and consult to Pediatric Neurosurgery for head/spine trauma

Trauma Service remains responsible for pediatric trauma patient throughout the ED phase of care

Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS

Approved: Pediatric Trauma Task Force 12/10;
Revised: 3/11, 3/13, 3/14, 3/16

Pediatric Trauma Admissions to Stanford

and OR Determination

Admission determination:

- For admission to Stanford Health Care, pediatric patients must be at least 14 years of age and 80 pounds (36.4 kg)
- LPCHS admits pediatric patients <18 years of age and maternity patients

OR determination:

- Pediatric patients will transfer to LPCHS-OR from the ED for treatment.
- In the event that surgery is required immediately (less than 30 minutes from arrival in ED), and the Trauma Surgeon feels that transfer to the Stanford-OR is the most efficient plan of care for the patient, the Stanford-OR will receive the patient.
- In this case, the Pediatric Anesthesiologist and LPCHS-OR Team will come to the Stanford-OR to assist in the care of the pediatric patient.
- Care will be provided by the Stanford-OR Team until the LPCHS-OR Team arrives.
- The Stanford-OR Team will remain available to assist with patient care, as needed.

LPCHS-OR Response to Stanford-OR

Pediatric Equipment available in Stanford-OR

- Broselow Code Cart
- Pediatric Trauma Cart
  - Pediatric downtime documentation pack
  - Pediatric cardiac pack
  - Pediatric neuro trauma pack
  - Pediatric general trauma pack
- Pediatric Anesthesia Cart

LPCHS-OR Response Team Members

- Circulating RN
- Surgical Tech
- Anesthesia Tech
- Pediatric Attending Anesthesiologist
- Pediatric Attending Surgeon

Stanford-OR needs to provide:

- For emergent pediatric Cardiac case
  - Slush drape & Slush machine
  - Internal defib paddles (Sizes 1.0, 1.6, 2.0, 2.7)
- For emergent pediatric Neurosurgery case
  - Craniotomy set
  - Midas drill
  - Solution warmer drape

Pediatric Massive Transfusion

Pediatric MTG Activation Criteria

- Requires > 20 ml/Kg of PRBCs in the 1st hour of resuscitation
- High likelihood of > 0.1 units/kg of PBRCs within 12 hours of resuscitation

Pediatric MTG Pack (20-50 Kg)

- 4 Units of PRBCs
- 2 Units of thawed plasma
- 1 Unit of apheresis platelets

Process

- Call Blood Bank (3-6445)
- Activate pediatric MTG
- Provide the following information:
  - Patient name
  - MRN
  - DOB
  - Name of ordering MD
  - Contact name and phone number
- Send a runner to Transfusion Service, Room H1404, with the “Emergency Release of Blood Products Transfusion Service Order and Call Slip” form containing:
  - Minimum 2 patient identifiers
  - Physician signature (or RN’s for verbal order)

Pediatric Emergency Department

Assemble equipment

Utilize Broselow Tape and Cart

Utilize Difficult Airway Cart for alternative airway supplies

Call Pediatric Anesthesia Code 55 for anticipated difficult airway

Airway/Alertness/Simultaneous C-spine stabilization

- Facial, cervical, laryngeal trauma
- Congenital anomalies and syndromes
- Maintain manual in-line c-spine immobilization
- The C-Collar can be opened during in-line-c-spine immobilization

Breathing and Ventilation

- Pre-oxygenate patient with 100% O2 by face mask.
- Assess chest rise
- Bag/valve/mask ventilate if no spontaneous breathing
- Use oral airway for unconscious patients to improve ventilation

Circulation with hemorrhage control

- Obtain intraosseous (IO) access if two peripheral IVs cannot be rapidly placed

Monitor

- Continuous cardio-pulmonary monitoring, cardiac rhythm and rate, pulse oximetry, and frequent BPs

Sedation and muscle relaxation:

Vagolytic

- **Atropine 0.02 mg/kg IV • Minimum dose: 0.1 mg**
- Consider in patients <8 years old to block laryngoscopy induced bradycardia

Intracranial Antihypertensive

- **Lidocaine 1 mg/kg IV push**
- Give when increased ICP is known or suspected

Sedative

- **Etomidate 0.3 mg/kg IV**
  - Decreases ICP, minimal CV effects
- **Ketamine 1.5-2 mg/kg IV**
  - Bronchodilator, increases BP and HR

Paralytic

- **Succinylcholine 2 mg/kg IV**
  - Contraindications: glaucoma, penetrating eye injuries, skeletal muscle myopathies, history of malignant hyperthermia or pseudocholinesterase deficiency, patients with known hyperkalemia (recent laboratory results), or severe burns or crush injuries beyond the acute phase (>1 day old)
- **Rocuronium 1 mg/kg IV**
  - May have slower onset of action (30-90 vs 30-60 seconds) and is longer acting (28-60 vs 3-12 minutes) than succinylcholine

Intubation

- Utilize laryngeal manipulation (BURP maneuver) to visualize cords as needed
- Await full paralysis
- Intubate orally
  - Depth of intubation: 3 x ETT size
- Confirm ETT placement with auscultation and end-tidal CO2 device
- If second intubation attempt is required, hand over the procedure responsibility to a more experienced provider
- For multiple intubation attempts:
  - Call Pediatric Anesthesia Code 55 for difficult airway
  - Consider airway alternatives from the Difficult Airway Cart (Bougie, Frova, Glide Scope, Endoscope, LMA, surgical cricothyrotomy,etc.)

Post-intubation

- Continuous end-tidal CO2 capnography
- Confirm proper placement of ET tube by CXR
- Maintain sedation with Propofol drip (head injury) or benzodiazepines and opioids

References

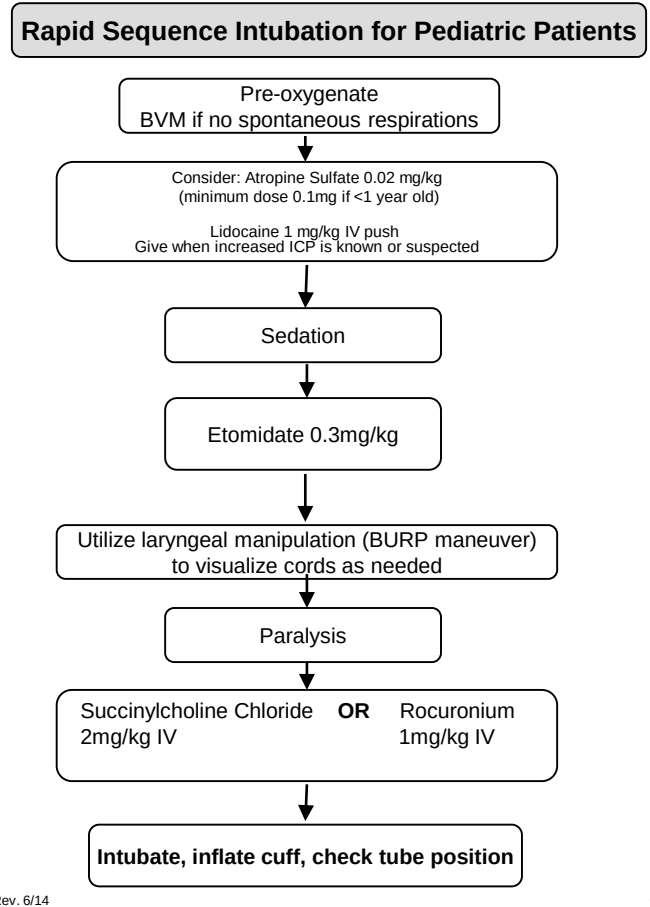
American College of Surgeons: Advanced Trauma Life Support: Student Course Manual, 2012. 9th edition.

Bhalla T, Dewhirst E, Sawardekar, A, et al. Perioperative management of the pediatric patient with traumatic brain injury. *Pediatric Anesthesia* 2012; 22:627-640.

Bledsoe GH, Schexnayder SM. Pediatric rapid sequence intubation: A review. *Ped Emerg Care* 2004; 20:339-344.

Chng Y, Sagarin M, Chiang V, et al. Pediatric emergency airway management. *Acad Emerg Med* 2004;11:438-439.

Sagarin MJ, Chiang V, Sakles JC, et al. Rapid sequence intubation for pediatric emergency airway management. *Ped Emerg Care* 2002;18:417-423.


Rapid Sequence Intubation for Pediatric Patients
Pre-oxygenate
BVM if no spontaneous respirations
Consider: Atropine Sulfate 0.02 mg/kg
(minimum dose 0.1mg if <1 year old)
Lidocaine 1 mg/kg IV push
Give when increased ICP is known or suspected
Sedation
Etomidate 0.3mg/kg
Utilize laryngeal manipulation (BURP maneuver)
to visualize cords as needed
Paralysis
Succinylcholine Chloride
2mg/kg IV
OR
Rocuronium
1mg/kg IV
Intubate, inflate cuff, check tube position

Pediatric Surgery Response to Trauma

Pediatric Surgery response to the ED for Trauma 99

- Attending will respond to the ED within 30 minutes
- Fellow or Senior Surgical Resident will respond to the ED within 30 minutes

Documentation Options

- Trauma Flow Sheet – MD Name and time stamp (S-EPIC) – *Tell the Recording RN your name and role when you arrive in the ED*
- Pediatric Surgery Consult Note in the ED (S-EPIC)
- Pediatric Surgery – Trauma Acceptance Note (LPCHS-EPIC)
- Pediatric Trauma H&P (LPCHS-EPIC)

Trauma Tertiary Survey

- All trauma patients admitted to PICU
- All Trauma 99 & 97 Activations admitted to Acute Care
- Upon request of Admitting Sub-specialty Service for isolated injury

Approved: Pediatric Surgery Division and Pediatric Trauma Medical Director, 2/2016

Neurosurgery & Orthopedic Surgery Response to ED

Neurosurgery will respond to the ED within 30 minutes for the following:

- Significant penetrating injury to head
- Acute intracranial hematoma with >4mm midline shift
- Obvious, severe open cranial injury
- Comatose patient with unilateral fixed, dilated pupil
- Patient with traumatic intracranial or spinal injury needing emergent operative management

Approved: Pediatric Neurosurgery Division, 3/2016

Orthopedic Surgery will respond to the ED within 30 minutes for the following injuries:

- Fractured or dislocated extremity without a pulse
- Any dislocation that could not be reduced

Approved: Orthopedic Surgery Division, 3/2016

LPCHS Roles & Response to Pediatric Trauma 99

Emergency MD

- Confers with ED RN to determine trauma activation status
- Initiates trauma survey and care

ED-RSN *or designee*

- Sends out pediatric trauma page by calling 211
- Provides notification call with basic ring-down info for Pediatric Trauma 99 to LPCHS-OR RSN (1-2820)
  - Age, mechanism, and known injuries

Adult Trauma Surgeon

- Responds to ED
- Leads trauma survey and resuscitation

Pediatric Trauma Surgeon

- Responds to the ED for Pediatric Trauma 99
- Provides consultation
- Provides notification call to LPCHS-OR ARC (1-9706 or 1-2820)
- Provides face-to-face IPASS hand-off to OR Team

PICU Fellow

- Responds to the ED for Pediatric Trauma 99
- Role: Provides airway back-up assistance or supervision to ED Resident, as needed
- Remains in ED if patient requires active management
  - PICU Attending responds within 30 minutes to cover PICU
  - If assistance with active patient management is not needed , PICU Fellow returns to PICU
- Transports unstable patient to LPCH OR
- Provides concurrent status updates to PICU and OR
- Provides face-to-face IPASS hand-off to OR Team

PICU RSN *or designee*

- Receives Pediatric Trauma 99 page
- Ensures PICU Fellow and Attending are notified
- Works with PICU Fellow and Attending to plan for potential trauma admission, including:
  - Staffing
  - Bed availability
  - Pre-admission orders
  - Room preparation
- Coordinates PICU admission with ED or OR

Anesthesia Resource Coordinator (ARC)

- Receives trauma page or call from OR RSN
- Alerts Anesthesia Attending to respond to ED
- Works with OR RSN to book case and designate OR room
- If no LPCHS-OR availability, calls Stanford ARC (6-0249)

Pediatric Anesthesia Attending

- Pediatric Anesthesia Attending responds to the ED
  - Evaluates airway in conjunction with ED Physician and PICU Fellow
  - Coordinates with OR
- Receives IPASS hand-off from Surgical Team or PICU Fellow
- *After-hours:*
  - *Attending receives page from OR RSN and responds to OR within 30 minutes*
  - *Calls PICU Fellow for update (1-9748)*
  - *Checks with OR RSN for Trauma Notification info*

Approved: 11/2014 Pediatric Trauma Task Force, Stanford Trauma Service, Pediatric ED Medical Director, Pediatric Anesthesia Medical Director, PICU Trauma Liaison, and PICU Surgical Director

Pediatric Anesthesia Resident or Fellow

- Available 24/7 to respond to ED
- Responsible for emergent OR room set-up
- *After-hours: May start an emergent case under supervision of OB Anesthesia Attending prior to Pediatric Anesthesia Attending arrival*

OB Anesthesia Attending

- *After-hours:*
  - *Remains in contact with OR Desk to assist prior to Pediatric Anesthesia Attending arrival*

LPCHS-OR RSN

- Receives Pediatric Trauma 99 page
- Receives Notification Call from ED RSN
- Works with ARC to book case and designate OR room
- *After-hours: Pages OR Call Team via 222 system to document timing and sends text page*

LPCHS-OR RN Call Team

- Receives call from LPCHS-OR RSN
- Sets up OR to receive trauma patient
- After-hours:
  - *Receives page from OR RSN and responds to OR within 30 minutes*
  - *Provides Omnicell access for OB Anesthesiologist prior to Pediatric Anesthesia Attending arrival*

LPCHS-OR Anesthesia Tech

- Receives call from LPCHS-OR RSN
- Sets up OR to receive trauma patient
- *After-hours:*
  - *Receives page from OR RSN and responds to OR within 30 minutes*

Approved: 11/2014 Pediatric Trauma Task Force, Stanford Trauma Service, Pediatric ED Medical Director, Pediatric Anesthesia Medical Director, PICU Trauma Liaison, and PICU Surgical Director

ED to LPCHS-OR Notification Phone Call

Call: 1-9706, Backup: 1-2820

I-PASS: Notification Phone Call to LPCHS-OR

Trauma/Surgical Attending to LPCHS-OR

ILLNESS SEVERITY

□Critical □ Stable

PATIENT SUMMARY

Brief Intro:

Name, age, weight (if available), traumatic mechanism, known major injuries/emergent medical condition, Operation planned.

A. Airway (Compromised, difficult, intubated)

B. Breathing (PTX, HemoTX, chest tubes, O2 sats)

C. Circulation (most recent vitals, ACCESS, blood products given/ordered/MTP)

ACTION LIST

PREOPERATIVE PREPARATION

- What do you plan to do in ER prior to coming to the OR, including studies?
- ETA to OR?
- What do you think we will have to do in OR prior to start (Major lines/tubes)?

SITUATION AWARENESS

OPERATIVE PLAN

- Operation, anticipated surgical complications and blood loss

---

SYNTHESIS *by receiver*

- Does the receiver verbally accept the notification phone call?

ED to LPCHS-OR Emergent Transfer Hand-off

I-PASS: Surgical Team or PICU Fellow to Operative Team

Face to Face Hand-off

ILLNESS SEVERITY

□Critical □ Stable

PATIENT SUMMARY

Brief Intro: Age, weight, traumatic mechanism, known major injuries/emergent medical condition

A. Airway - Intubation in ER, difficulty with intubation, C-spine, facial fractures, etc.
B. Breathing - PTX, hemoTX, other chest findings, oxygenation/ventilation requirements
C. Circulation/hemorrhage control - Most recent vitals, resuscitation given thus far, blood products available and on order/MTP, IV Access and attempted access
D. Disability - GCS score, spine precautions, intracranial injury if any

Other injuries:

- Head to toe

AMPLE History, if available

- Allergies
- Medications at baseline and administered since arrival
- PMH/PSH

Recent lab values, pertinent pending labs

Lines and tubes:

- What patient has, what is needed

ACTION LIST

PREOPERATIVE PREPARATION

- Antibiotics
- Blood products

SITUATION AWARENESS

OPERATIVE PLAN

- Operation
- Blood loss
- Anticipated surgical complications

SYNTHESIS *by receiver*

Does the receiving OR team verbally accept and understand the handoff?

Pediatric Trauma Admission to LPCHS: Impact of Name Change on Blood Product Availability

- Pediatric Trauma 99 arrives in ED
- Patient is assigned “Doe” name and MRN
- O-neg blood & FFP is brought to bedside in ED prior to patient arrival
- If patient transfers emergently to LPCHS-OR:
  - O-neg blood & FFP transfers with patient from ED to LPCHS-OR
  - O-neg blood & FFP remains with patient until stabilized
  - Keep Doe Name & MRN until patient is stabilized

ALERT:

- For patients new to LPCHS, access to the patient medical record and ability to place orders may be delayed while the Doe name and MRN are changed to patient given name
- For least impact to downstream processes, change the name after the patient transfers to the PICU and is stabilized post-op
- Current EPIC processes do not allow charts to merge until after discharge.

Approved: Pediatric Trauma Task Force, 11/2015

ED to LPCHS Trauma Admission Guide

Emergency Department	Admitting Surgeon
Pediatric Trauma 97/99 with disposition LPCHS	<u>If PICU</u> • Pediatric Surgery • Neurosurgery <u>If Floor</u> • Pediatric Surgery • Neurosurgery • Orthopedic Surgery • Other surgical service

Approved: Pediatric Trauma Task Force, Pediatric Trauma Medical Director, Pediatric Emergency Medical Director, Pediatric Trauma Neurosurgery Liaison, and PICU Trauma Liaison, 4/2016

Pediatric Trauma Hand-off for T99 & T97

	Pediatric Trauma 97 Hand-off	Pediatric Trauma 99 Hand-off
ED discharge Home	• Trauma Service responsible for pt • Call Peds Sx Fellow/Sr Res to arrange follow-up	• Trauma Service responsible for pt • Call Peds Sx Fellow/Sr Res to arrange follow-up
PICU or OR Admission	Trauma Attending to Peds Sx Attending *AND* PICU Attending	Trauma Attending to Peds Sx Attending *AND* PICU Attending
Acute Care Admission	Trauma Resident to Peds Sx Fellow/Sr Res	Trauma Attending to Peds Sx Attending

- Early alert and consult to Pediatric Neurosurgery for head/spine trauma
- Trauma Service remains responsible for pediatric trauma patient throughout their ED phase of care
- Pediatric Surgery assumes care of pediatric trauma patient at time of admission to LPCHS or at handoff in ED
- Utilize Trauma Service hand-off attestation via Stanford-EPIC dot phrase (.pedstrauma) to document hand-off to Pediatric Surgery ***AND*** PICU for any injured patient requiring PICU admission

Any Head Injury/Trauma with:

- Loss of Consciousness or seizure
- Abnormal findings on head CT
- Concussive symptoms with or without Loss of Consciousness
  - GCS <14
  - Agitation
  - Somnolence
  - Repetitive questioning
  - Slow response to verbal communication
  - Severe headaches
  - Vomiting
- Spine injury
- Consider Pediatric Neurosurgery consult for any patient <3 months of age

Reference:
Pediatric Emergency Care Applied Research Network (PECARN): Pediatric Head Injury/Trauma Algorithm

Approved: Pediatric Trauma Task Force and Pediatric Neurosurgery Trauma Liaison, 1/2015
Revised: 3/2016

Pediatric Head Trauma CT Decision Guideline

HIGH RISK

- GCS ≤ 13
- Palpable skull fracture
- Altered Mental Status
  - Agitation
  - Somnolence
  - Slow response
  - Repetitive questioning

Yes

- Non-contrast head CT
- Consult Neurosurgery

No

MODERATE RISK

- Scalp hematoma (excluding frontal)
- LOC or amnestic
- Change in behavior (subjective)
- Severe mechanism if injury
  - Fall > 3 feet
  - MVA with/ejection, rollover, or fatality
  - Bike/ped vs. vehicle w/o helmet
  - Struck by high-impact object

Yes

- Non-contrast head CT
- Consult Neurosurgery
- Imaging based on clinical findings:
  - Multiple vs isolated factors
  - Worsening symptoms
  - (altered mental status, headache, vomiting)
  - < 3 months of age

No

LOW RISK

- CT not indicated
- Observation

Relative Radiation Level Designations

Relative Radiation Level*	Adult Effective Dose Estimate Range	Pediatric Effective Dose Estimate Range
O	0 mSv	0 mSv
☻	<0.1 mSv	<0.03 mSv
☻☻	0.1-1 mSv	0.03-0.3 mSv
☻☻☻	1-10 mSv	0.3-3 mSv
☻☻☻☻	10-30 mSv	3-10 mSv
☻☻☻☻☻	30-100 mSv	10-30 mSv

***RRL assignments for some of the examinations cannot be made, because the actual patient doses in these procedures vary as a function of a number of factors (eg, region of the body exposed to ionizing radiation, the imaging guidance that is used). The RRLs for these examinations are designated as "V aries".**

References:
Ryan ME, Palasis S, Salgal G, et al. ACR Appropriateness Criteria Head Trauma-Child. *J Am Coll Radiol.* 2014;11:939-947.
Schonfelf D, Bressan S, Da Dalt L, et al. Pediatric Emergency Care Applied Research Network head injury clinical prediction rules are reliable in practice. Arch Dis Child. 2014;99:427-431.

Adapted from PECARN TBI, age-based clinical prediction rules of outcome

Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force and Pediatric Radiology Division, 8/2015

Cervical Spine Clearance in Children after Trauma

If the child is stable, conscious and communicative and has no high-risk mechanism or distracting injuries per NEXUS/CCR criteria, the **ED or Trauma or Neurosurgery Attending** may assess for midline posterior c-spine tenderness and ROM. If no tenderness, range of motion is full, and the child is neurologically intact, the **ED/Trauma/Neurosurgery Attending** may clear the C-spine without X-rays. The child should not be taking any medications or drugs to alter neuro exam.

If the child is crying, moving all limbs, and moving the neck, they may have "cleared themselves", in absence of painful distracting injury.

If the child is < 3 years old, developmentally delayed, or unable to communicate, consider pediatric neurosurgery consult if unsure NEXUS/CCR criteria are met.

If the child is unconscious, has distracting injuries, presents with motor or sensory deficits, or is inconsolable, place the child in rigid c-collar, if not already done. Proceed with neuroimaging (CT c-spine if stable) and consult pediatric neurosurgery.

- CT c-spine is more sensitive than plain film x-rays and is preferred if range of motion is limited.
- C-spine clearance will require CT c-spine and MRI to rule out ligamentous injury.

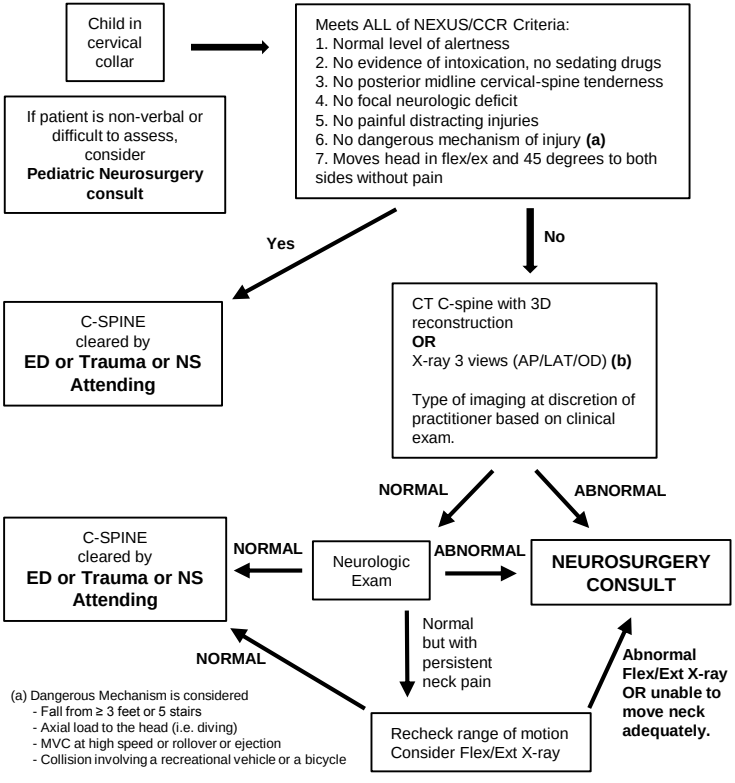
If positive for neurological deficit, high suspicion for spinal shock, or evidence of c-spine injury on imaging, child must be immobilized with a rigid c-collar and c-spine precautions must be used during transport. Consult pediatric neurosurgery.

All children with c-spine injury should be managed in PICU. Maintain normal BP, MAP or CPP goals for spinal cord perfusion.

References

- Anderson RC, Kan P, Hansen KW and Brockmeyer DL. Cervical spine clearance after trauma in children. *Neurosurgical Focus 2006*
- Stiell IG, Clement CM, McKnight RD, et al. The Canadian C-Spine Rule versus the NEXUS Low-Risk Criteria in Patients with Trauma. *N. England J Med.* 2003;349:2510-8.

Cervical Spine Clearance in Children after Trauma



(a) Dangerous Mechanism is considered
- Fall from ≥ 3 feet or 5 stairs
- Axial load to the head (i.e. diving)
- MVC at high speed or rollover or ejection
- Collision involving a recreational vehicle or a bicycle

(b) 3 views of c-spine are considered adequate if C1-T1 are visualized and open-mouth odontoid view visualizes dens and C1 lateral masses. If inadequate or unable to perform plain films, obtain CT scan of C spine with 3D reconstructions.

Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force and Pediatric Radiology Division, 8/2015

Pediatric Blunt Cerebrovascular Injury

SIGNS AND SYMPTOMS OF BCVI

- Seat belt abrasion or soft tissue injury of the anterior neck resulting in significant swelling or altered mental status
- Cervical bruit
- Expanding cervical hematoma
- Focal neurologic deficit

RISKS OF BCVI

- Mechanism compatible with severe cervical hyperextension/rotation or hyperflexion, particularly if associated with
  - Displaced midface or complex mandibular fracture
  - Closed head injury consistent with diffuse axonal injury
- Near hanging resulting in anoxic brain injury
- Cervical spine fracture patterns: subluxation, fractures extending into the transverse foramen, fractures of C1-C3
- Basilar skull fracture with carotid canal involvement
- Diffuse axonal injury with GCS ≤ 6

IMAGING for BCVI

- Noninvasive imaging with CT angiography or MR angiography is considered the first-line imaging for arterial injury: Imaging is indicated for patients with any clinical sign or symptoms of BCVI, unexplained neurologic symptoms and asymptomatic patients with any of the mechanisms of injury.
- CTA: provides high spatial resolution and rapid assessment but exposes the patient to ionizing radiation
- MRA: can evaluate intracranial vasculature without radiation and be performed in conjunction with MRI for evaluation of hemorrhage and ischemia (lengthy study, may difficult in emergent situation)

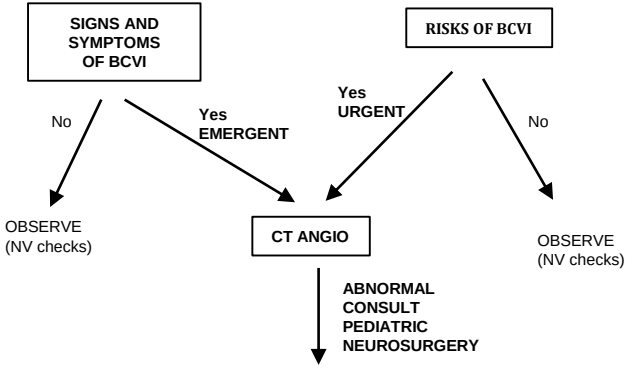
References:

- BBiffle WL, Ray CE, Moore EE, et al. Treatment-Related Outcomes From Blunt Cerebrovascular Injuries: Importance of Routine Follow-Up Arteriography. Annals of Surgery, 2002; 235: 699-707.
- Bromberg WJ, Collier BC, Diebel LN, et al. Blunt Cerebrovascular Injury Practice Management Guidelines: The Eastern Association for the Surgery of Trauma. *J of Trauma*, 2010; 68: 471-477.
- Ryan ME, Palasis S, Saigal G, et al. ACR Appropriateness Criteria head Trauma - Child, *J Am Coll of Radiology*, 2014;11:939-947.

Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force, and Pediatric Radiology Division, 8/2015

Pediatric Blunt Cerebrovascular Injury

Adapted from adult protocol

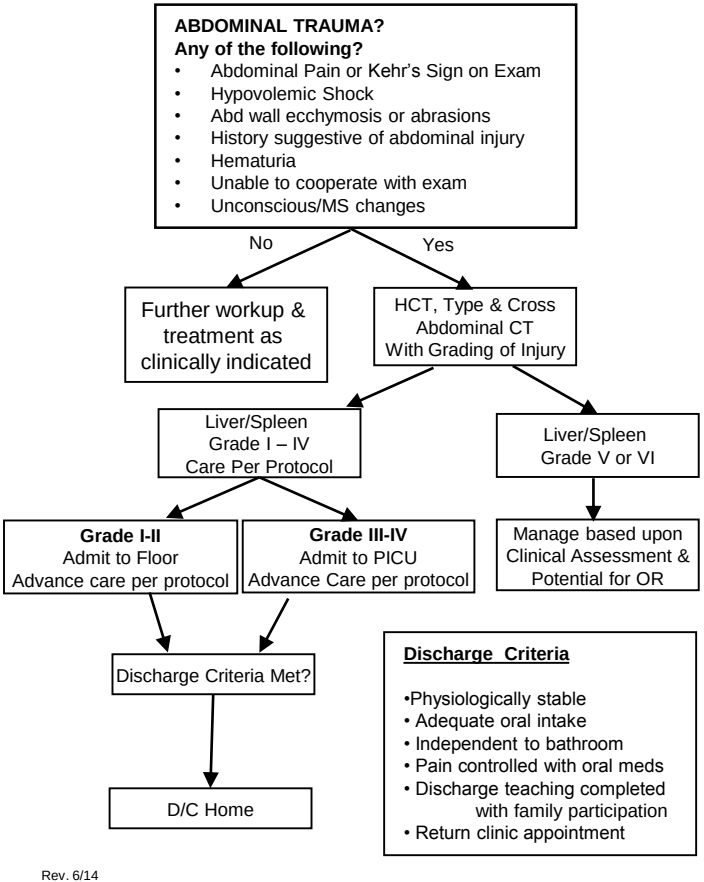


Grading Scale

Grade I – irregularity of vessel wall or a dissection/intramural hematoma with < 25% narrowing
Grade II – intraluminal thrombus, dissection or intramural hematoma >25% narrowing
Grade III- pseudoaneurysm
Grade IV – vessel occlusion
Grade V – Transection or hemodynamically significant arteriovenous fistulae

Approved: Pediatric Neurosurgery Division, Pediatric Trauma Task Force and Pediatric Radiology Division, 8/2015

Pediatric Trauma Blunt Spleen/Liver Management



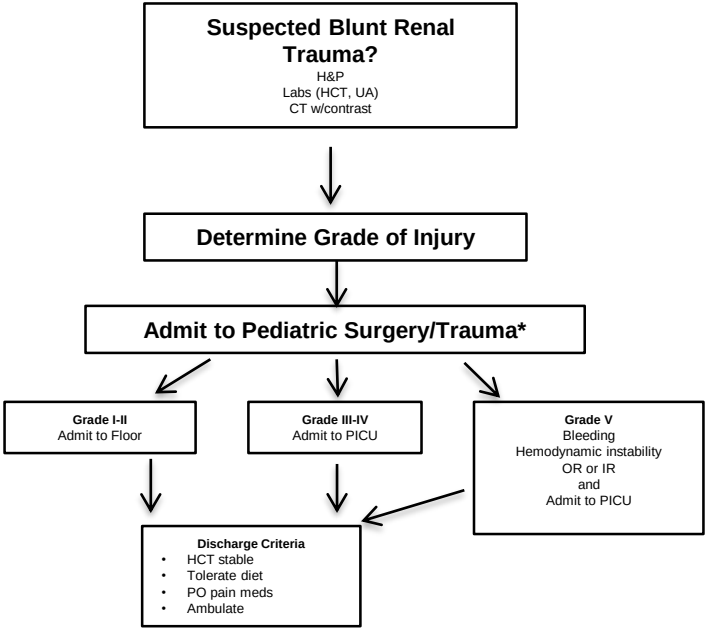
Care Protocol Based Upon Grade

CT GRADE	I	II	III	IV
PICU LOS	NONE	NONE	24 HOURS	24 HOURS
HOSPITAL LOS	24 – 48 HOURS	48 – 72 HOURS	72 – 96 HOURS	96 – 120 HOURS
PRE-DISCHARGE IMAGING	NONE	NONE	NONE	NONE
POST-DISCHARGE IMAGING	NONE	NONE	NONE	NONE
POST INJURY ACTIVITY RESTRICTION/ F/U VISIT	3 WEEKS	4 WEEKS	5 WEEKS	6 WEEKS
VITAL SIGNS	Q2hX 8h, THEN Q4h	Q2hX 8h, THEN Q4h	Q2hX 8h, THEN Q4h	Q1h x 12h; q2h x 12h, THEN q4h
BEDREST	8h	24h	24h	48h
HCT	12 h POST INJURY	12 h POST INJURY	12 h AND 36 h POST INJURY	6h, 18h, 40-48h, POST INJURY

Delayed clinical findings may present ≥ 48h post trauma

St. Peter SD, et al. *J Pediatric Surgery*. 2013; 48: 2437-2441.
Jen HC, et al. *Annals of Surgery*. 2010; 251:1162-1166.
Davies DA, et al. *J Pediatric Surgery*. 2009; 44:1005-1008
Leinwand MJ, et al. *J Pediatric Surgery*. 2004; 39:487-490.
Stylanos S, et al. *J Pediatric Surgery*. 2000; 35:164-169.

Pediatric Blunt Renal Trauma Management



Approved Pediatric Trauma Task Force, 4/2015; Revised, 2/2016

- Consider Consult to Urology

Pediatric Blunt Renal Trauma Management

CT Grade	I	II	III	IV
PICU LOS	NONE	NONE	24hrs	24 hrs
Hospital LOS	Based on discharge criteria: HCT stable, Tolerate diet, PO pain meds, and ambulate			
Pre-discharge imaging	NONE	NONE	NONE	RUS for urinary extravasation
Post-discharge imaging	NONE	NONE	NONE	RUS as needed
Post-discharge activity	3 weeks	4 weeks	5 weeks	6 weeks
Bedrest	Ambulate when able			
HCT	12 h post injury	12 h post injury	12 h and 36 h post injury	6h, 18h, 40-48h post injury

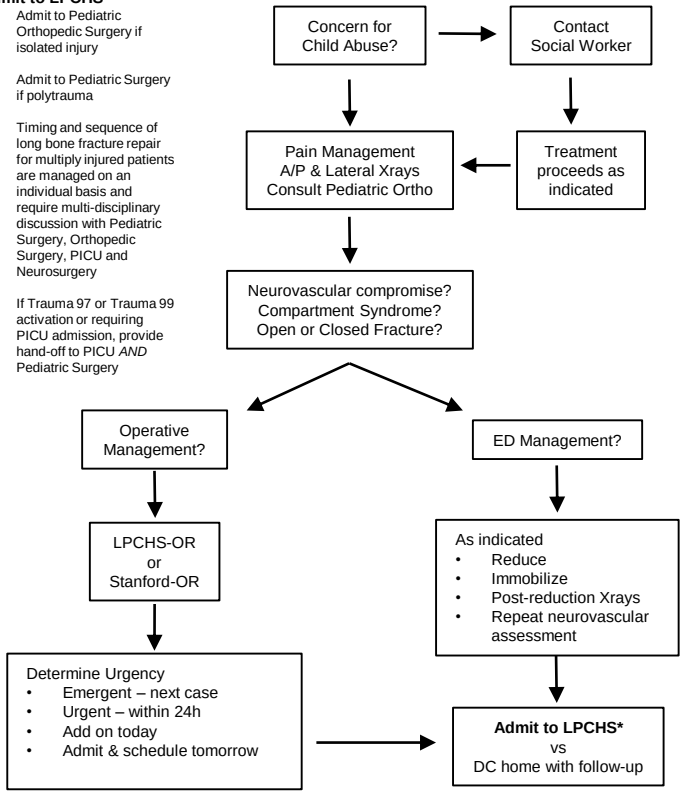
Approved Pediatric Trauma Task Force, 4/2015

J Pediatric Surgery 2014; 49: 198-201
J Pediatric Urology 2014; 10: 815-818
J Pediatric Surgery 2010; 45: 1311-1314

Pediatric Extremity Fracture

Admit to LPCHS*

- Admit to Pediatric Orthopedic Surgery if isolated injury
- Admit to Pediatric Surgery if polytrauma
- Timing and sequence of long bone fracture repair for multiply injured patients are managed on an individual basis and require multi-disciplinary discussion with Pediatric Surgery, Orthopedic Surgery, PICU and Neurosurgery
- If Trauma 97 or Trauma 99 activation or requiring PICU admission, provide hand-off to PICU *AND* Pediatric Surgery



Pediatric Extremity Fracture

May consider Stanford-OR if
≥14y and ≥80 lbs (36.4 kg)
AND
Adult-type fracture with skeletal maturity

Open Fractures
IV Antibiotic: one dose pre-op
- Cefazolin 30mg/kg q8h x 24h
- If Penicillin allergy: Clindamycin 10mg/kg q6h x 24h

Time to OR: Emergent, next case

Supracondylar fracture, displaced
- Closed reduction and percutaneous pinning with 2-3 lateral pins; if other, document reason
- Open reduction internal fixation

Femur fractures
<6 months
- Pavlik harness
- Spica cast

>6 months to 5 years
- Spica cast

5 to 11 years
- Flexible intramedullary nail
- Rigid intramedullary nail
- Sub-muscular plate
- If other, document reason

Documentation Guidelines
- Concern for Non-accidental trauma or Child Abuse
- Mechanism of injury
- Assessment
- ED procedures
- Plan of care
- Hand-off

Discharge Criteria
- Tolerating regular diet
- Pain controlled with PO meds
- Cleared by PT for safe DC home

Discharge Instructions
- Pain management
- Return precautions
- Cast care
- Durable medical equipment use
- Follow-up Ortho Clinic appointment

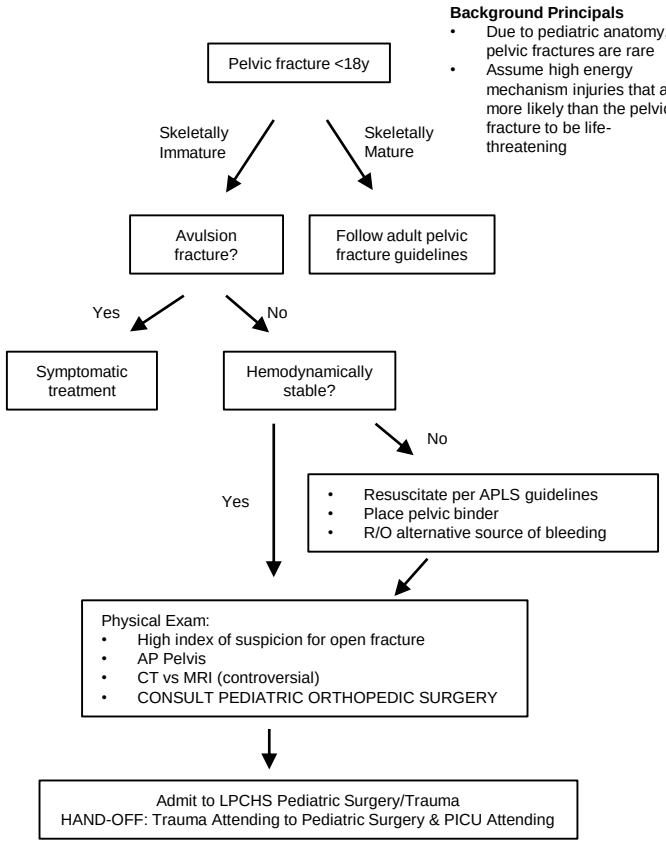
References:
- The Treatment of Pediatric Supracondylar Humerus Fractures. 2011. *American Academy of Orthopaedic Surgeons*.
- Treatment of Pediatric Diaphyseal Femur Fractures. 2015. *American Academy of Orthopaedic Surgeons.*
- *Tachdjian's Pediatric Orthopaedics*, 4th edition, edited by John Anthony Herring, 2008, page 2372.

Neurovascular Assessment
- Distal pulses and perfusion
- Sensation
- Supracondylar fractures:

Nerve	Motor	Sensory
Median (AIN)	"OK" sign and thumb abduction	Index finger
Radial (PIN)	"Thumb's up" sign	Dorsal web space
Ulnar	Scissors"	Small finger

Compartment Syndrome Assessment
Increasing agitation or anxiety
Increasing analgesia requirement
Palpation or measurement of compartment pressures

Pediatric Pelvic Fracture



Approved: Pediatric Trauma Task Force and Pediatric Orthopedic Surgery Trauma Liaison, 2/2016

Pediatric Pelvic Fracture

May consider Stanford-OR if

- ≥14y and ≥80 lbs (36.4 kg)
  AND
- Adult-type fracture with skeletal maturity
- Consider consult to OTA* colleague
  OR
- Too hemodynamically unstable for safe transfer from ED to LPCHS-OR

Documentation Guidelines

- Mechanism of injury
- Assessment
- ED procedures
- Plan of care
- Hand-off

Discharge Criteria

- Tolerating regular diet
- Pain controlled with PO meds
- Cleared by PT for safe DC home

Discharge Instructions

- Pain management
- Return precautions
- Cast care, if applicable
- Durable medical equipment use
- Follow-up Ortho Clinic appointment

*OTA – Orthopedic Trauma Association, Fellow

References:

High-energy pediatric pelvic and acetabular fracures. Amorosa LF, Kloben P, Jelfet DI; *Orthrop Clin North Am*, 2014. 45(4):483-500.

Approved: Pediatric Trauma Task Force and Pediatric Orthopedic Surgery Trauma Liaison, 2/2016

Pediatric VTE

VTE RISK FACTORS*

Trauma:
- >1 lower long bone fracture
- complex pelvic fractures
- spinal cord injury
- operative intervention > 2 hours
- transfusion > 4 units PRBC

Acute infection

Central line (tunneled or temporary)

History of venous thrombosis)

Inflammatory disease (eg IBD, SLE)

Major lower extremity orthopedic surgery

Medications: asparaginase, estrogen

Nephrotic Syndrome

Obesity (BMI > 95th percentile for age)

Oncologic diagnosis

Pregnancy

Thrombophilia (personal or family history)

CONTRAINDICATIONS TO ANTICOAGULATION**

Neurosurgical procedure or TBI requires Multidisciplinary Discussion with Neurosurgery Team

Absolute:
Bleeding disorder

Hemorrhage (evidence of or at high risk for)

Platelet count unable to sustained >50,000/mm^3

Relative:
Acute stroke
Uncorrected coagulopathy

Intracranial mass/neurosurgical procedure

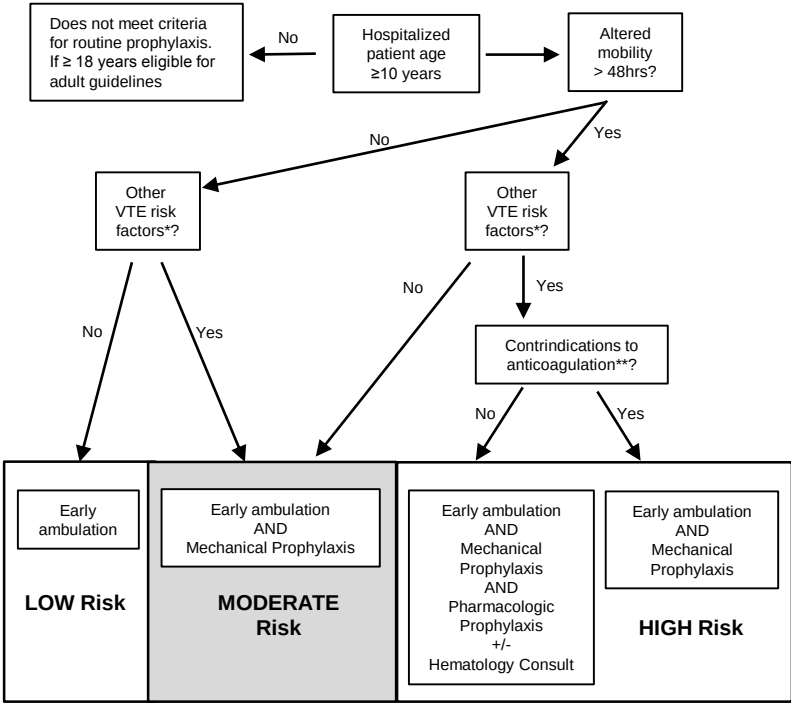
Lumbar puncture or epidural catheter removal in prior 12 hrs

PHARMACOLOGIC PROPHYLAXIS***

Enoxaparin:
- Patients ≤ 18 years old and < 50kg: 0.5mg/kg/dose SQ q12hrs or 1 mg/kg/dose DAILY
- Patients ≤ 18 years old and > 50kg: 40mg SQ daily (for CrCl < 30, 30mg SQ daily)
- Monitoring not necessary unless concerned about clearance with renal dysfunction

Heparin gtt:
- Patients ≤ 18 years old: 10 units/kg/hr
- Do NOT elevate HAL > 0.3 or aPTT above 50 seconds

Pediatric VTE



References:
Thompson AJ, et al. *J Pediatr Surg*. 2013. 48(6):1413-21.
Azu MC, et al. *J Trauma* 2005. 59(6):1345-9.
Thorson CM, et al. Crit Care Med. 2012. 40(11):2967-73.
Mahajerin A, et al. Haematologica 2015. 100(8):1045-50.

Approved: Pediatric Trauma Task Force, PICU Trauma Liaison and PICU Surgical Director, 3/2016

SUSPECTED CHILD ABUSE & NEGLECT

Be alert to possible abuse when there is a discrepancy in the reported history and physical findings.

Contact Social Work for CPS report and SCAN Team referral.

Consult a child abuse pediatrician for the following physical examination findings:

- Bruising in non-mobile children
- Bruising of the torso, neck, or ears in children <4y
- Injury ascribed to household accidents without trauma history
  - Head trauma in children <2y
  - Long bone fractures in children <2y
- Burns
  - Patterned
  - Widely separated, especially bilateral
  - With different stages of healing
  - In unusual areas such as backs of hands, torso, or buttocks
- Any thin, holohemispheric subdural hemorrhage in children <2y
- Any widespread retinal hemorrhage

Board Certified Child Abuse Pediatrician

- Consult 24/7, pager 2-SCAN (2-7226)

Approved 5/15
Pediatric Trauma Task Force and SCAN Medical Director

PICU Trauma Admission and Management Guidelines

Trauma patients are co-managed by the PICU and Pediatric Surgery or Neurosurgery.

- Pediatric Surgery admits all injured children requiring PICU level of care and consults the appropriate subspecialty surgeons and/or the Suspected Child Abuse and Neglect (SCAN) Team, as needed.
- Neurosurgery may admit injured children with confirmed isolated head or spine trauma and consults the Suspected Child Abuse and Neglect (SCAN) Team, as needed.
- The PICU manages the day to day needs and coordinates surgical consults and recommendations for care of the trauma patient. The PICU is the first responder in case of patient deterioration and manages appropriate resuscitative efforts.
- All major and critical decisions regarding patient clinical management are made collaboratively involving both the PICU and the admitting surgical specialty surgeons.

All trauma patients admitted to the PICU must have a Surgical/Trauma H&P as well as a Medical/PICU H&P authored by the respective team.

All trauma patients must have a Trauma Tertiary Survey by Pediatric Surgery.

Outside hospital trauma transfers to PICU:

- Patients injured <24 hours prior requesting transfer from an outside hospital ED must transfer to the Stanford-ED for Primary and Secondary Trauma Surveys before admitting to the PICU
- Patients injured >24 hours prior may transfer to the ED or PICU based on admitting surgeon preference
- Outside hospital in-patients must admit directly to PICU
    - Direct admits <24 hours post-injury require a full trauma evaluation by an ATLS certified provider within 15 minutes of arrival; the ATLS provider may be a PICU or Pediatric Surgery Fellow or Attending.
- The Transfer Center should automatically direct requests for transfer of injured children to the Trauma Service in the ED; however, occasionally requests for direct transfer of injured patients to the PICU slip through. Please refer these calls back to the Trauma Service through the Transfer Center.

C-spines are cleared by Neurosurgery or Pediatric Surgery Attendings.

Approved: 5/11/2015 by Pediatric Trauma Medical Director, PICU Surgical Director, and PICU Trauma Liaison
Revised: 4/19/2016

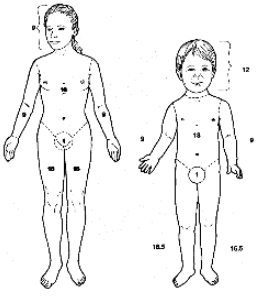
PEDIATRIC TRAUMA PEARLS

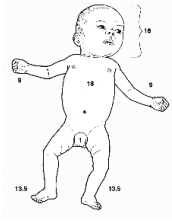
Basic principles to consider when caring for the injured child:

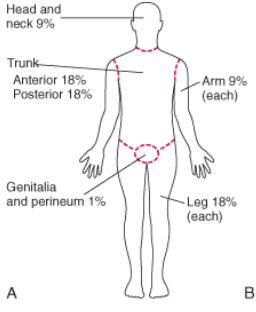
- Use of a commercial length-based resuscitation tape (Broselow) expedites care by providing appropriate weight-based equipment sizes and medication dosages.
- Children have narrow airways which can occlude easily with edema or foreign bodies. Keep a low threshold for initiating endotracheal intubation and for requesting support from pediatric anesthesia or PICU.
- Children may not show a change in systolic blood pressure until >45% of the blood volume is lost.
- Tachycardia in the presence of normothermia and controlled pain, suggests cardiovascular compensation.
- Children are susceptible to heat loss due to a high ratio of body surface area to body mass, large head, and small amount of subcutaneous tissue.
- Eighty percent of pediatric trauma death is associated with head injury. Involve pediatric neurosurgery early.
- The estimated total blood volume of a child is 75-80ml/kg. Resuscitation goals for hypovolemic shock:
  - Obtain intraosseous (IO) access if two peripheral IVs cannot be rapidly placed
  - Administer warmed crystalloid fluid bolus (20ml/kg); repeat 1-2 times
  - If signs of shock persist, administer 10ml/kg warmed PRBCs (type specific or O-negative).
  - Monitor intake and urinary output:
    - Newborn and infant 2ml/kg/hour
    - Toddler 1.5ml/kg/hour
    - Older child through adolescence 1ml/kg/hour
- Acute compartment syndrome indicators include increasing:
  - Analgesic requirement
  - Anxiety
  - Agitation

American Heart Association. (2011). *Pediatric Advanced Life Support: Provider Manual. Dallas, TX: author.*
Bae, DS, Kadiyala, K, Waters, PM, and et al. Acute Compartment Syndrome in Children: Contemporary diagnosis, treatment, and outcome. *J Pediatric Orthopedics* 2001; 21:680-688.

Lund-Browder Burn Percentages







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

	Age				
Body Part	**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

Consider Transfer to Burn Center for deep partial (2nd degree) or full thickness (3rd degree) burns ≥10% Body surface Area

PEDIATRIC NORMAL VITAL SIGNS

Age	Weight		SBP	HR	Respirations
	Lbs	kg			
Newborn	7	3.5	50 – 70	90-160	30 - 60
1-6 mos	7	3.5	70 – 95	100-160	30 – 60
6 mos	15	7	80 – 100	90-120	25 – 40
1 year	22	10	80 – 100	90-120	20 – 30
3 years	33	15	80 – 110	80-120	20 – 30
6 years	40	18	80 – 110	70– 110	18 – 25
10 years	60	28	90 – 120	60 – 90	15 - 20

PEDIATRIC WEIGHT (Kilograms)

Approximate weight in kg: 50th percentile boys and girls (USA)

AGE	BOYS	GIRLS
3 MONTHS	5.9	5.4
6 MONTHS	7.8	7.2
1 YEAR	10.1	9.5
2 YEARS	12.3	11.8
3 YEARS	14.6	14.1
4 YEARS	16.6	15.9
5 YEARS	18.6	17.6
8 YEARS	25	24.8
10 YEARS	32	32
14 YEARS	50	50

Estimated Circulating Blood Volume	
Neonates	85 – 90 ml/kg
Infants	75 – 80 ml/kg
Children	70 – 75ml/kg
Adolescent/Adult	65 – 70 ml/kg

PEDIATRIC G-Tubes, Chest Tubes, Foley

AGE	NG TUBE SIZE	CHEST TUBE SIZE	URINARY CATHETER SIZE
Infant 3 – 9 kg	5 – 8 Fr	10 – 12 Fr	6 – 8 Fr
Small Child 10 – 11 kg	8 – 10 Fr	16 – 20 Fr	8 – 10 Fr
Child 12 – 14 kg	10 Fr	20 – 24 Fr	10 Fr
Child 15 – 18 kg	10 Fr	20 – 24 Fr	10 – 12 Fr
Child 19 – 22 kg	12 – 14 Fr	24 – 32 Fr	10 – 12 Fr
Young adult 24 – 28 kg	14 – 18 Fr	28 – 32 Fr	12 Fr
Young adult 30 – 36 kg	16 – 18 Fr	32 – 38 Fr	12 Fr

PEDIATRIC Laryngoscope blades, ETT, Suction

Age Of Patient	Laryngoscope Blade	Endotracheal Tube Size (Internal Diameter In mm)	Distance From Mid Trachea To Lips (cm)	Suction Catheter Size (French)
		Age (yrs) + 16 / 4	**3 x ETT size**	**2 x ETT size**
Term Infant	Miller 0 – 1 Wis-Hipple 1	3.5 cuffed, 3.5 uncuffed	9 – 10	6 – 8
6 months		4.0 cuffed & uncuffed	10.5 – 12	8
1 year	Miller 1 Wis-Hipple 1½	4.0 cuffed & uncuffed	12 – 13.5	8
2 years	Miller 2 Macintosh 2-3	4.5 & 4.0 cuffed	13.5	8
4 years		5.0 & 4.5 cuffed	15	10
6 years		5.5 & 5.0 cuffed	16.5	10

PEDIATRIC Laryngoscope blades, ETT, Suction

Age Of Patient	Laryngoscope Blade	Endotracheal Tube Size (Internal Diameter In mm)	Distance From Mid Trachea To Lips (cm)	Suction Catheter Size (French)
		Age (yrs) + 16 / 4	**3 x ETT size**	**2 x ETT size**
8 years	Miller 2 Macintosh 2-3	6.0 cuffed	18	12
10 years		6.5 cuffed	19.5	12
12 years	Macintosh 3	7.0 cuffed	21	12
Adoles-cent	Macintosh 3 Miller 3	7.0, 8.0 cuffed	21	12

SOLID ORGAN GRADING - SPLEEN

	Injury Type	Description of injury	AIS
I	Hematoma	Subcapsular, <10% surface area	2
	Laceration	Capsular tear, <1 cm parenchymal depth	2
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal, <5 cm in diameter; minor; superficial; nonexpanding	2
	Laceration	Capsular tear, 1-3 cm parenchymal depth that does not involve a trabecular vessel; minor; superficial	2
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma; intraparenchymal hematoma $\geq$ 5 cm or expanding; major	3
	Laceration	No hilar or segmental parenchymal disruption or destruction; parenchymal depth >3 cm or involving trabecular vessels; moderate	3
IV	Laceration	Laceration involving segmental or hilar vessels producing major devascularization (>25% of spleen) but no hilar injury; major	4
V	Laceration	Completely shattered spleen; tissue loss; avulsion; stellate; massive	5
	Vascular	Hilar vascular injury that devascularizes spleen	5
*Advance one grade for multiple injuries up to Grade III			

SOLID ORGAN GRADING - LIVER

	Injury Type	Description of injury	AIS
I	Hematoma	Subcapsular, <10% surface area	2
	Laceration	Capsular tear, <1 cm parenchymal depth	2
II	Hematoma	Subcapsular, 10% to 50% surface area; intraparenchymal, <10 cm in diameter	2
	Laceration	Capsular tear, 1-3 cm parenchymal depth, <10 cm in length	2
III	Hematoma	Subcapsular, >50% surface area or expanding; ruptured subcapsular or parenchymal hematoma;intraparenchymal hematoma > 10 cm or expanding; blood loss >20%; major	3
	Laceration	Parenchymal depth >3 cm; major duct involvement; blood loss >20%; moderate	3
IV	Laceration	Parenchymal disruption involving 25% to 75% hepatic lobe or 1-3 Couinaud's segments; multiple lacerations >3 cm deep; "burst" injury; major	4
V	Laceration	Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud's segments within a single lobe	5
	Vascular	Juxtahepatic venous injuries (i.e., retrohepatic vena cava/central major hepatic veins); massive; complex	5
VI	Vascular	Hepatic avulsion (total separation of all vascular attachments)	6

*Advance one grade for multiple injuries up to Grade III

SOLID ORGAN GRADING - KIDNEY

	Injury Type	Description of injury	AIS
I	Contusion	Microscopic or gross hematuria, urologic studies normal	2
	Hematoma	Subcapsular, nonexpanding without parenchymal laceration	2
II	Hematoma	Nonexpanding perirenal hematoma confined to renal retroperitoneum; minor; superficial	2
	Laceration	Parenchymal depth of renal cortex (<1.0 cm) without urinary extravasation; minor; superficial	2
III	Hematoma	Subcapsular; >50% surface; major; large	3
	Laceration	Parenchymal depth of renal cortex (>1.0 cm) without collecting system rupture or urinary extravasation; moderate	3
IV	Laceration	Parenchymal laceration extending through the renal cortex, medulla, and collecting system	4
	Vascular	Main renal artery or vein injury with contained hemorrhage; major	4
V	Laceration	Completely shattered kidney	5
	Vascular	Avulsion of renal hilum which devascularizes kidney (total destruction of organ)	5

*Advance one grade for bilateral injuries up to Grade III

SOLID ORGAN GRADING - PANCREAS

	Injury Type	Description of injury	AIS
I	Contusion	Minor; superficial; no duct involvement	2
	Laceration	Minor; superficial laceration without duct injury	2
II	Hematoma	Major contusion without duct injury or tissue loss	2
	Laceration	Major laceration without duct injury or tissue loss	3
III	Laceration	Distal transection or parenchymal injury with duct injury; moderate with major duct involvement	3
IV	Laceration	Proximal transection or parenchymal injury involving ampulla†; moderate if involving ampulla; major if multiple lacerations; major if involving ampulla	4
V	Laceration	Massive disruption of pancreatic head; avulsion; complex; rupture; stellate; tissue loss	5

*Advance one grade for multiple injuries up to Grade III
†Proximal pancreas is to the patient's right of the superior mesenteric vein

PEDIATRIC
Modified Glasgow Coma Scale

CHILD	Eye Opening	INFANT
Spontaneous	**4**	Spontaneous
To speech	**3**	To speech
To pain only	**2**	To pain only
No response	**1**	No response
CHILD	**Verbal Response**	**INFANT**
Oriented, appropriate	**5**	Coos and babbles
Confused	**4**	Irritable cries
Inappropriate words	**3**	Cries to pain
Incomprehensible sounds	**2**	Moans to pain
No response	**1**	No response
CHILD	**Motor Response**	**INFANT**
Obeys commands	**6**	Spontaneous, purposeful
Localizes to pain	**5**	Withdraws to touch
Withdraws to pain	**4**	Withdraws to pain
Abnormal flexion	**3**	Abnormal flexion
Abnormal extension	**2**	Abnormal extension
No response	**1**	No response

Qualifiers:

Patient Chemically Sedated
Patient Intubated
Patient Eye Obstruction