

Trauma and Critical Care Resuscitation

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UTMC-K Level 1 Trauma Center

- Regional Teaching Hospital
- Surgery Residency and Surgical Critical Care Fellowship
- 250 mile Radius Level 1 Trauma Center Service Area Covering 4 States
- 3425 Trauma Admissions 2004
- 24 Bed Dedicated Trauma/Neuro Intensive Care Unit
- 30% Trauma ICU Admission Rate

Epidemiology

- U.S. trauma related costs exceed \$400 billion dollars annually
- MVC's account for 70% of trauma morbidity and mortality
- Leading cause of death in persons aged 1 – 44 years
- 60 million injuries per year occurs in the U.S.
 - Results in an average of 36.8 million hospital visits per year (40% of all ED visits)

Epidemiology

- Injury is a disease
- It has a “host” and “vectors”
 - The patient is the host
 - Vectors include cars, motorcycles, ATVs, PWCs, et al
- The prevention, research and treatment of trauma is woefully under funded compared to infectious disease, heart disease and cancer
- Trauma continues to affect the most productive members of society and particularly our most valuable national resource, children

A Typical Day in the Trauma Center

- It's a beautiful day in East Tennessee
- You have had 2 cups of coffee
- Your only patient is just waiting on a floor bed, has a PCA, foley and feeds themselves
- Your biggest decision so far today is...
....."Do I want the sirloin or grilled salmon from STEAKOUT Delivery".....
- Finally, a nice QUIET day...and then it starts



MOTOROLA

13: Inbound Trauma
N432UT 1PT(S) Arrive
UT: 10:26 FULL ALERT
10:21AM 02/04/06

2006/02/04



 **MOTOROLA**

10:MOD ALERT GSW TO
HEAD A & O,
USS/BLEED CONTROLLED
ETA 7 MIN FEMALE

2006/02/04





MOTOROLA

08: Inbound Trauma
N431UT 1PT(S) Arrive
UT: 13:23 MODIFIED
ALERT

2006/02/04

The Trauma System & Notification

■ The Page Out

- Modified Alert
 - Stable VS, not intubated
- Arriving via LifeStar
- ETA is 5 minutes
- Today's weather, 40 degrees/light rain

■ LifeStar's Radio Call

- 34 y/o male
- MVC URD, ejected, + LOC, L femur deformity, decreased BS on the left, no visible movement of the lower extremities, responded to a fluid challenge



What are you thinking about possible injuries?

- Think head to toe
- Think worse case scenario and work backwards
- Maintain a high index of suspicion
- Never assume anything!

What did LifeStar See?



The Trauma Assessment

■ Getting the Trauma Bay Ready

– Staff at the bedside

- Trauma Response Team (Attending, Resident, PA/NP, 2 RN's)
- X-ray, Lab, Respiratory Therapy

– Necessary Equipment

- Airway Box/Ventilator/Oxygen
- Pre-assembled IVF's
- Level 1 Infuser
- Monitor/Manual BP cuff
- Medications

“The Trauma Team” Diagram

Head – MD/MLP

Team Leader, examines head to chest,
Manages ABC's

Lead Trauma RN

Assessment, Vitals, IV Access, Assist
Team Leader, Documentation

Right 1 – MD/MLP

FAST U/S, upper extremity,
soine & abdomen exam,
chest tube

Trauma Assist RN/Paramedic

IV access, operate Level 1
infuser, blood products, meds

Right 2 – MD/MLP

Femoral access/blood, rectal,
foley, lower extremity exam

Left 1 – MD/MLP

Extremity exam, chest tube,
admit H&P

Attending Trauma Surgeon
Supervises all activities

Out of the box:

X-ray, lab, security,
chaplain, unit
secretary, patient
representative,
bystanders

The Trauma Assessment



The Trauma Assessment

Primary Assessment

- Airway
 - Clear, talking
- Airway
- Airway
- Airway
- Airway
- Airway

The Trauma Assessment

Primary Assessment

■ Breathing

- Absent breath sounds on left
- Rate >40/min, Pulse Ox 85%

■ Circulation

- HR 110 thready, SBP 100, distal pulses 1+
- No obvious bleeding, left thigh is swollen/firm
- IV Access
 - Minimum (2) 14 gauge sites or Central High Flow Line
 - Use Warmed LR

The Trauma Assessment

Primary Assessment

■ Disability

- Brief Neurologic Assessment
 - GCS is 13 (confused, sleepy)
 - Weak upper and no lower extremity movement
 - Pupils are 4mm, equal, reactive

■ Exposure

- Completely Undress
- Warm blankets to prevent hypothermia

Trauma Assessment

Adjuncts to the Primary Survey

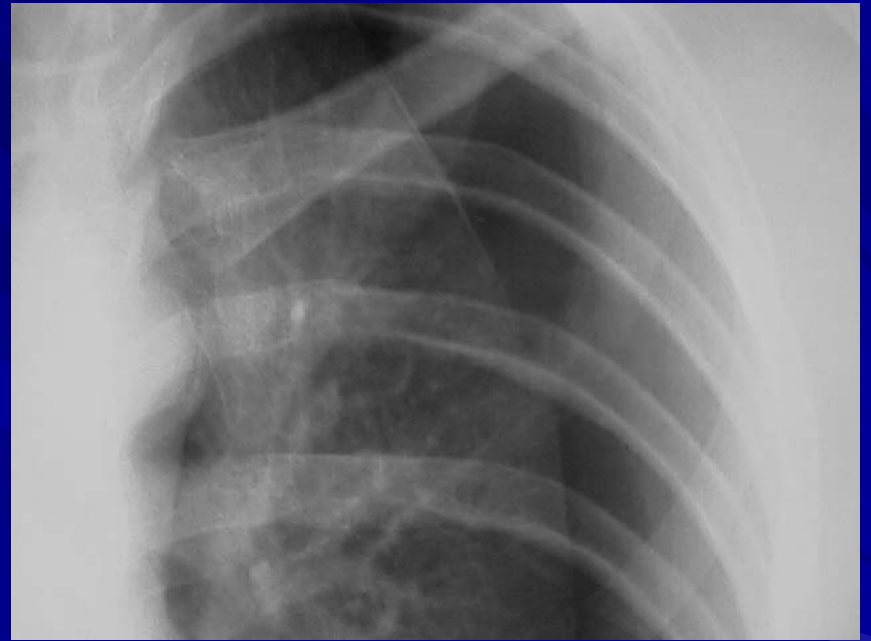
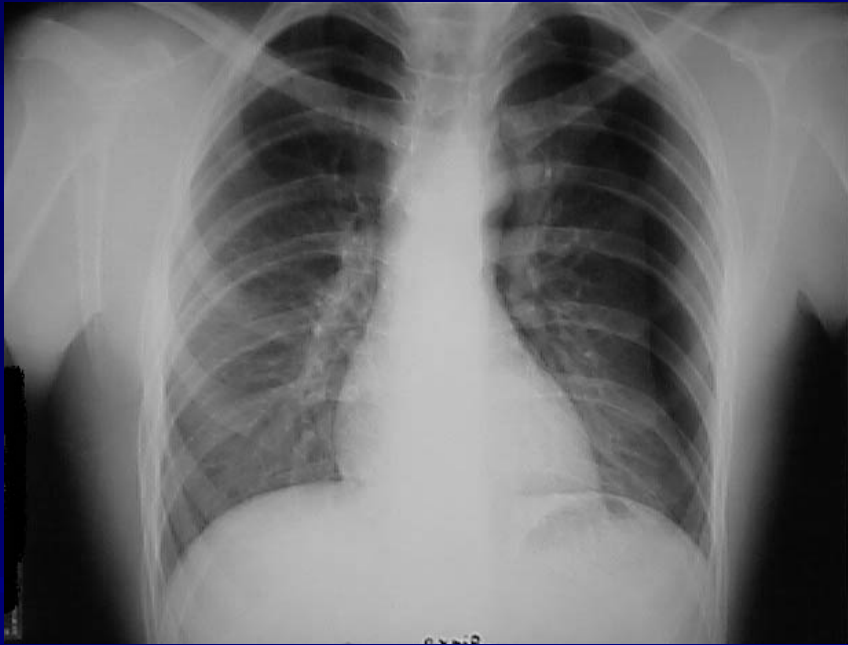
- Obtain ABG
 - Ph 7.25, PCO₂ 50, PO₂ 64, O₂ Sat 90%, HCO₃ 17, Base -7
- Attach Cardiac Monitor
 - Sinus Tach
- Order initial labs and x-rays
 - CBC, UA, T & C, Coags, CXR, Trauma CT Scan, L femur xray
- Perform FAST U/S
- Reassess ABC's
 - Airway clear
 - Breathing - more labored and shallow, O₂ sat 89% on NRB
 - Circulation - HR120, SBP 95 (after 2 L fluid bolus)

Trauma Assessment

Secondary Survey & Management

- Finger and Tube in every hole & Flip
 - Foley, NG, Rectal
- Give pain and sedation medications as needed
- Head to Toe Examination
- History – PMH/PSH, meds/allergies
- Interventions

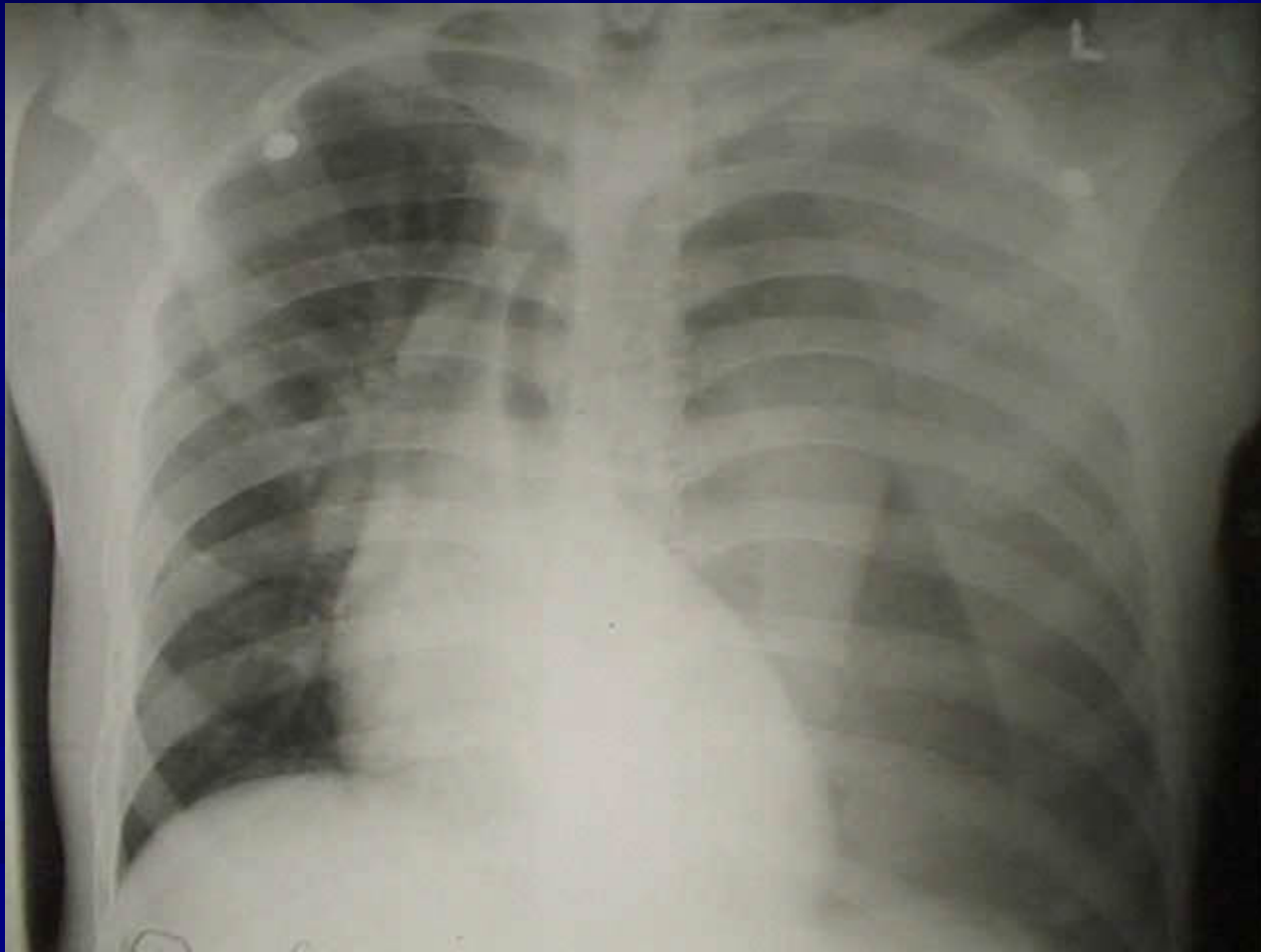
Chest X-rays



Chest Tube (Thoracostomy)



What happens if you forget your
ABC's?



Trauma Assessment

- Physical Exam findings
 - Posterior C-spine tenderness
 - Decreasing level of consciousness (GCS 8)
 - Seat belt sign over chest and abdomen
 - Bilateral breath sounds after the chest tube
 - Abdomen is distended and without tenderness, no rectal tone
 - Deformed mid thigh, cool to touch, delayed cap refill
 - Left DP/PT barely palpable
 - Minimal upper extremity flexion, flaccid lower extremities

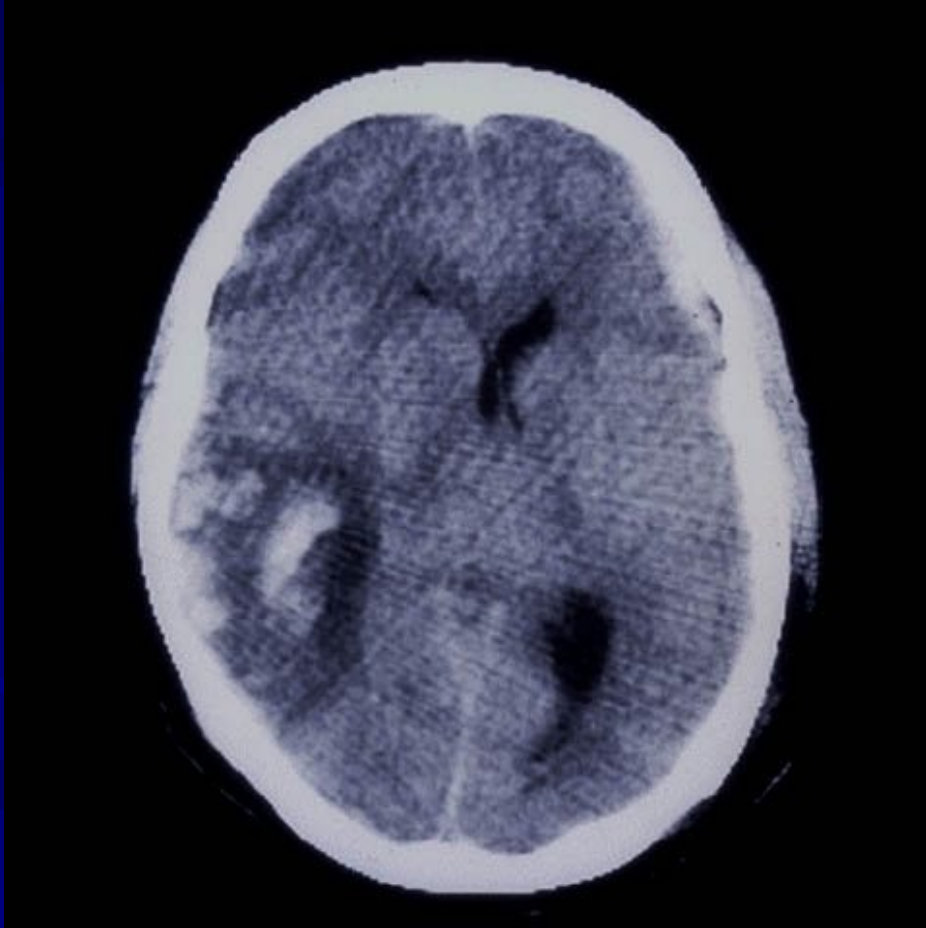
Trauma Assessment

- Your lab results and X-Rays
 - H/H 6.9/20; UA trace blood; INR 2.5
 - FAST Exam showed splenic renal interface and pelvic free fluid
 - 2nd ABG – pH 7.19, pCO₂ 53, pO₂ 85, HCO₃ 15, Base -9
- Vital signs after the secondary survey
 - HR 130, SBP 80 (after 4L LR), O₂ Sat 96%
 - RR more rapid and shallow, struggling on NRB

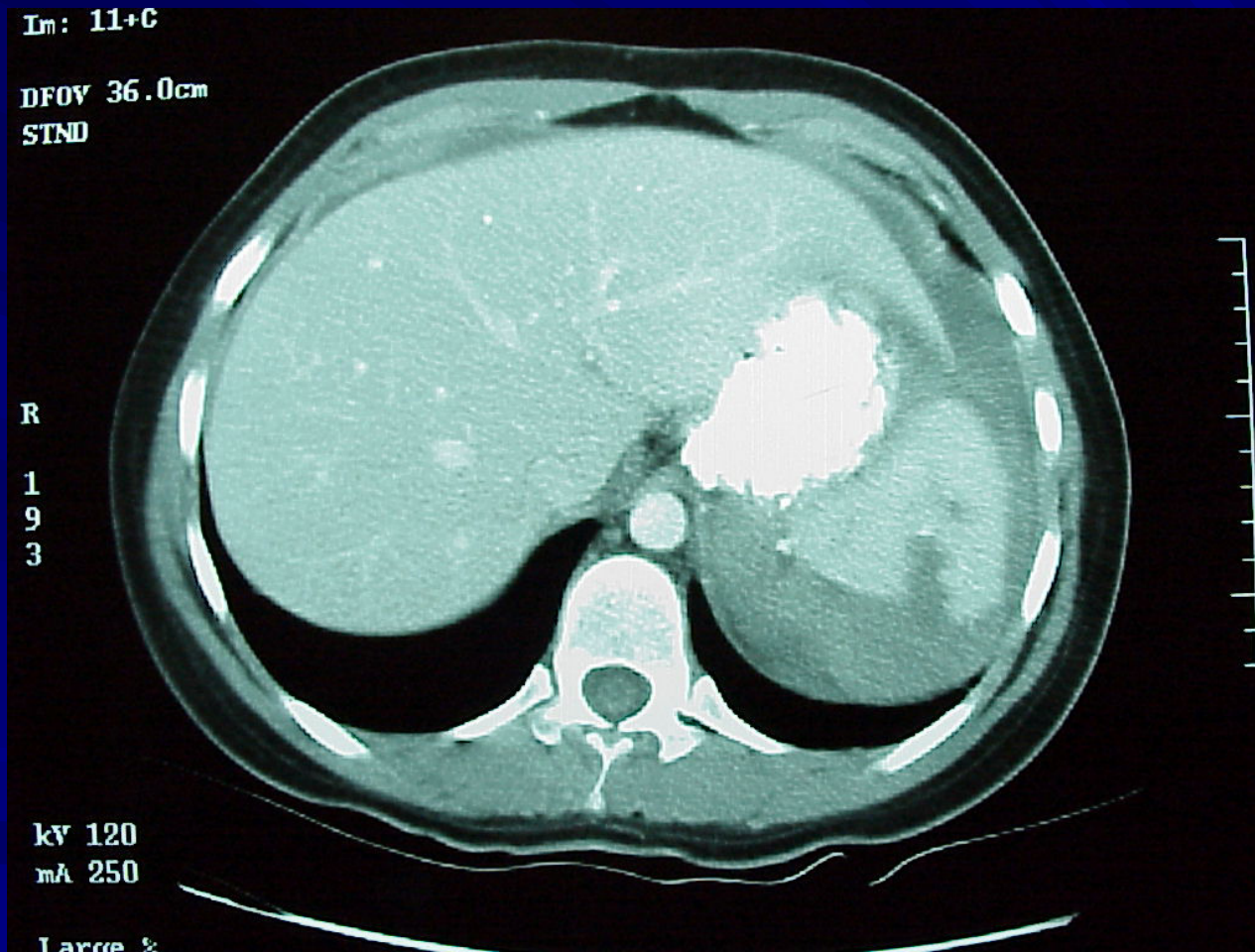
Without A, there is no B, Without B, there is no C

- Constantly recheck your ABC's
- This patient is on the verge respiratory arrest due to:
 - Chest trauma, pneumothorax
 - Increased work of breathing due to C-spine injury and subsequent diaphragm paralysis
- Rapid Sequence Intubation
 - Analgesia – Morphine or Fentanyl
 - Sedation – Versed or Etomidate
 - Paralyzing Agent – Succinylcholine or Vecuronium

CT Scan and X-Rays



CT Scan



CT Scan and X-Rays



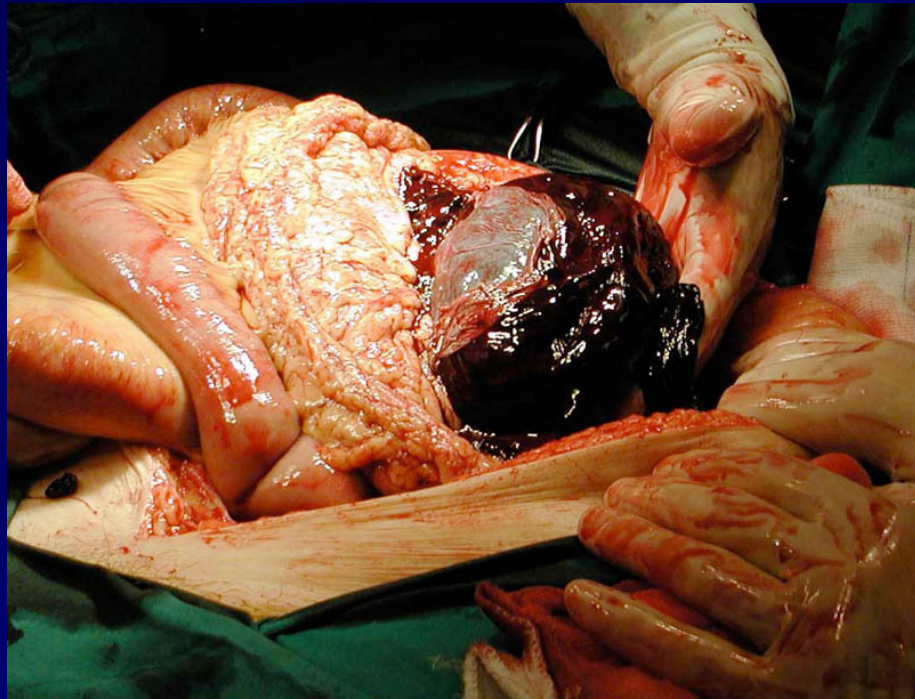
Identifying Injury

- Let's list the injuries
 - Closed head injury w/decreasing GCS
 - C-spine injury w/quadraplegia
 - Left Pneumothorax
 - Grade 2 spleen laceration
 - Left femur fracture
 - Hemodynamic Instability

Stabilization and Definitive Treatment

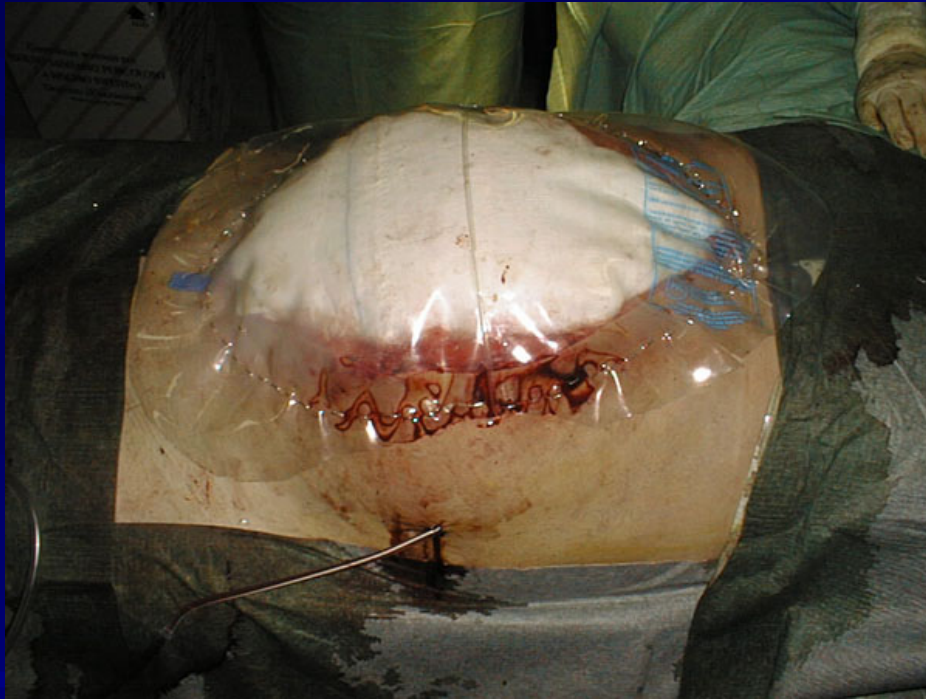
- Call the OR
- Notify orthopedic & neurosurgeon
- Give fluids/blood products through the high flow line
 - Continue LR
 - PRBC's, FFP, Platelets
- Continue to warm to >97 degrees
- Transfer the patient to the OR for definitive hemostasis
 - Exploratory Laparotomy
 - Left Femur ORIF

What did the surgeons find?



- 2L blood in abdomen
- Splenectomy performed
- No other intraabdominal injuries
- 1L blood loss from femur intramedullary nail
- Received 8u PRBC's, 8u FFP and 10,000cc crystalloid

Your patient arrives in the Surgical Critical Care Unit



- Abdomen is open and vac packed
- HR 125, SBP 82
- On full Vent Support
- End of case HCT 21
- Patient is starting to emerge from anesthesia

Critical Care Unit Assessment

- The Critical Care Unit Team
 - MD/MLP
 - RN
 - Respiratory Therapist
 - Pharmacist
- Review events & treatment to this point
- Order new labs/chest x-ray
 - CBC, BMP, ABG, COAGS, CXR
- Tertiary Exam (Head to toe) Look for undiscovered injuries
- Establish Care & Treatment Plans for 24 hours

Critical Care Unit Assessment

- Continue the resuscitation
 - Endpoints include:
 - UOP > 30cc (0.5cc/kg/hr)
 - Base Deficit < 3
 - Stabilized HCT and SBP without pressor support
- Sedation & Analgesia
 - Narcotics, PRN & Drips
 - Fentanyl, Morphine
 - Amnesics & Anxiolytics
 - Versed, Ativan, Propofol

Critical Care Unit Assessment

- Communicate with your secondary patient
 - Have the MD/MLP present if possible
 - Give the family a brief “what to expect” summary before they reach the bedside
 - Identify the next of kin/decision maker
 - “Speak the local language”
 - It’s o.k. to care

Critical Care Unit Assessment

■ Preventive Measures

– DVT Prophylaxis

- PAS
- Lovenox, heparin, IVC filter
- Ambulation

– PUD Prophylaxis

- Diet
- Enteral Feeding
- H2 blockers & Proton Pump Inhibitors

Critical Care Unit Assessment

- Ventilator Associated Pneumonia Bundle
 - HOB at 30 degrees
 - Oral Care
 - DVT & PUD prophylaxis
- Patient Positioning
 - Reposition every 2 hours
 - Utilize Skin Protection Bed Systems
 - KinAire, RotaRest

The Physiologic Effects of Trauma

CHI/SAH/IPH

■ Central Nervous System

- Sensory/Motor/cognitive deficits
- Loss of basic reflexes

■ Cardiovascular

- Arrhythmias

■ Respiratory

- Impaired respiratory drive

■ Renal

- Electrolyte disorders
- Large volume diuresis

■ Gastrointestinal

- Increased incidence of PUD

■ Coagulation

- Increased bleeding and elevated INR

■ Acid Base

- Impaired respiratory and perfusion causes acidosis

■ Common Complications

- Increased ICP, herniation, brain death

The Physiologic Effects of Trauma

Spinal Cord Injury

■ Cardiovascular

- Loss of sympathetic vascular tone
- Hypotension
- Bradyarrhythmias

■ Respiratory

- Loss of innervation to diaphragm, abdominal and intercostals
- Increased pCO₂, work of breathing
- Prolonged vent support and possible tracheostomy

■ Renal

- Hypotension causes hypoperfusion and ARF
- Incontinence/Catheterization

■ Gastrointestinal

- Inability to self feed, requiring enteral feeding
- Hypoalbuminemia, malnutrition

■ Coagulation

- High risk for DVT/PE
- Requires IVC filter

■ Common Complications

- Muscle wasting syndrome
- Skin breakdown/decubitus
- Infection

The Physiologic Effects of Trauma

Chest Trauma/Pneumothorax

■ Central Nervous System

- Altered MS due to elevated pCO₂

■ Cardiovascular

- Hypoxemia
- Impaired function with tension PTX

■ Respiratory

- Decreased pO₂, elevated pCO₂
- Increased work of breathing
- Elevated Airway pressures
- Altered tissue perfusion

■ Renal

- Compensates for elevated pCO₂, holds on to HCO₃

■ Common Complications

- Atelectasis
- Respiratory failure
- Empyema
- ARDS
- VAP

The Physiologic Effects of Trauma

Spleen Laceration

- Central Nervous System
 - Shunting preserves function until late stage
- Cardiovascular
 - Hypotension
 - Hyperdynamic cardiac function
 - Decreased tissue perfusion
- Respiratory
 - Compensatory increased respiratory rate
- Renal
 - Hypoperfusion causes ARF/CRF (elevated BUN/Cr)
- Gastrointestinal
 - Decreased gastric pH and increased risk for PUD
 - NPO period can cause malnutrition/failure to heal
- Coagulation
 - Large volume blood loss leads to consumptive coagulopathy and further hemorrhage
- Acid-Base
 - Blood loss leads to anaerobic metabolism
 - Build up of lactic acid and increased base deficit
- Common Complications
 - High risk for encapsulated bacterial infections
 - At risk for OPSS (Overwhelming Post Splenectomy Sepsis)
 - Must give H. flu, Meningococcal & S. Pneumo vaccines

The Physiologic Effects of Trauma

Femur Fracture

- Central Nervous System
 - Alerted MS, seizure coma due to fat emboli
- Cardiovascular
 - Tachycardia, hypotension due to blood loss
 - Blood loss can be 1-2L in the thigh
 - Possible arterial occlusion around fracture site
- Respiratory
 - Fat Emboli Syndrome
 - Inflammatory and obstructive mechanism
 - High risk for DVT, PE

The Physiologic Effects of Trauma

Hypothermia

- Central Nervous System
 - CNS depression
- Cardiovascular
 - Bradycardia (not vagal mediated)
 - Hypotension
- Coagulation
 - Increased bleeding due to cold related factor dysfunction
- Acid – Base
 - Worsening acidosis

Questions or Comments?

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