Solid Organ Injury

Tessa Woods, DO

Outline
- Brain
- Lung
- Heart
- Liver
- Kidney
- Adrenal glands
- Duodenum/Pancreas
- Spleen

Brain

Triage
- GCS
  - Most valuable piece of information
    - 3-4 = poor outcome regardless of CT
      - Some don’t even perform CT in these patients
    - 5 = indeterminate category
    - 6 = most would be aggressive in treatment
- Poor prognostic factors
  - Self-inlicted injury
  - Bilaterally fixed and dilated pupils
  - Confusion
  - Bullet passage across midline
  - Through the ventricle
  - Across more than one lobe of the brain

Introduction
- Definition
  - Disruption or alteration of brain structure or function caused by external mechanical forces
    - Transient or permanent
    - Mild TBI
      - may have no evidence of radiologic abnormality
  - More than 50,000 die annually from TBI
  - Annual burden in the US - $76 billion
### Types of Injury

**Classification and Management**
- **Primary vs Secondary Injury**
  - **Primary** - occurring from forces imparted at the time of the accident
  - **Secondary** - occurring subsequent to impact

#### Primary
- Focal disruption of tissue (contusions/hematoma)

#### Secondary
- Hypoxemia, ischemia, hypoglycemia
- One brief period hypoxemia/hypotension - devastating in injured brain

### Diffuse Axonal Injury

- **Caused by**
  - Rotational/mechanical forces
  - Acceleration/deceleration injury

- **Grading**
  - Grades 1-5 based on MRI
  - Severity:
    - **Mild**
      - Axonal stretching
      - Transient neuronal dysfunction
    - **Severe**
      - Cellular events leading to impairment of axoplasmic transport
      - Axonal disconnection at the site of impairment

### Concussion

- **Mildest form of traumatic brain injury**
- **Usually transient**
- **Normal imaging**
  - **MRI abnormal** - 25%

- **Symptoms**
  - Headache, irritability, confusion, amnesia, nausea, vomiting, memory problems, etc.

- **Grading systems not recommended**
  - No correlation with outcome/treatment/duration of symptoms

### Abusive head trauma

- **Original injury triad in children**
  - Long bone metaphyseal fx
  - Sdh
  - Retinal hemorrhage

- **Shaking**
  - May lead to diffuse sdh
  - Epidural - accidental

- **Retinal hemorrhage in 65-95% with inflicted injuries, unilateral or bilateral**

- **Mortality**: 15-38%
  - 60% if patient is comatose on presentation

- **Survivors**
  - 60-70% - neurologic handicap
Focal Injuries

- **Epidural Hematoma**
  - Between dura and inner skull
  - Temporal bone fx that lacerates middle meningeal artery
  - Classic (rare)
    - Brief loss of consciousness
    - Lucid interval
    - Obliteration
    - Contralateral hemiparesis
    - Isolated pupillary dilation

- **Subarachnoid hemorrhage**
  - Occurs between pial and arachnoid membranes
  - Traumatic
  - Results from venous tears in subarachnoid space

- **Subdural hematomas**
  - Blood between arachnoid and inner dural layers of the meninges
  - Technically “intradural” hematoma
  - Traumatic stretching and tearing of cortical bridging veins

- **Intracerebral hematoma and contusion**
  - May expand rapidly
  - OR if
    - Volume exceeds 50 cm³
    - GCS 6-8 with frontal or temporal contusions greater than 20 cm³ in volume with midline shift greater than or equal to 5 mm
    - Cisternal compression on CT

- **Mortality**
  - Unilateral: 5-12%
  - Bilateral 25%

- **OR if**
  - EDH greater than 30 cm³ in volume regardless of GCS, shift 5 mm
  - Neuropathological features
  - Maximal hematoma thickness greater than 1 cm

New England Journal of Medicine
### Management

<table>
<thead>
<tr>
<th>Initial goals</th>
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<tbody>
<tr>
<td>Normothermia, euvolemia</td>
</tr>
<tr>
<td>NS, avoid dextrose</td>
</tr>
<tr>
<td>Prophylaxis for ulcers</td>
</tr>
<tr>
<td>Cooling</td>
</tr>
<tr>
<td>HOB 30 degrees</td>
</tr>
<tr>
<td>Check collar for fit</td>
</tr>
<tr>
<td>Frequent neuro checks</td>
</tr>
<tr>
<td>Hbg - used to be 10, failed to be substantiated, now many use 7</td>
</tr>
<tr>
<td>Some recommend 8</td>
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<th>Blood pressure and oxygenation</th>
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<td>Single episode hypoxemia (PaO2 less than 60)</td>
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<td>RBC - Baseline nutrition higher</td>
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<tr>
<td>- 120-130% even when sedated and paralyzed</td>
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### Nutrition Guidelines

<table>
<thead>
<tr>
<th>Initiate if within 24-48 hours</th>
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<tr>
<td>Regardless of route</td>
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<table>
<thead>
<tr>
<th>Brain Trauma Foundation</th>
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<tbody>
<tr>
<td>Prospective study</td>
</tr>
<tr>
<td>- Amount of early enteral nutrition</td>
</tr>
<tr>
<td>- Dose risk of death</td>
</tr>
<tr>
<td>- 80-90% decrease in morbidity for every 10 kcal/kg increase in energy intake, achieving a plateau at 25 kcal/kg</td>
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<tr>
<th>Maybe arginine containing immune-modulating formulations or epha/dha supplement</th>
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<td>- 1 small trial of 40 patients</td>
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### Management

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<tr>
<td>Seizures</td>
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<tr>
<td>- Early - first 7 days, late after 7 days</td>
</tr>
<tr>
<td>- Increases ICP</td>
</tr>
<tr>
<td>- Increases metabolic demand</td>
</tr>
<tr>
<td>- Increased risk: gcs below 10, depressed skull fx, cortical contusions or intracranial hemorrhage, penetrating injury or seizures within 24 hours of brain injury</td>
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<tr>
<td>- Only shown to be helpful in first 8 days of injury</td>
</tr>
<tr>
<td>- Keppra - not really proven in studies</td>
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<td>- do not use prophylaxis for late seizures</td>
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### Management

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<td>54% incidence dvt without prophylactic treatment</td>
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<td>25% if in SCDF</td>
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| Unclear guidelines on resuming prophylaxis |
| TQIP/ACS |

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<th>Elevate within 72 hours</th>
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<td>Less than 72 hours appears safe in patients at low risk for progression and head stable</td>
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<td>Consider IVC filter if high risk</td>
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### Elevated ICP - TQIP/ACS

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<th>3-Tiered Approach</th>
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<td>Failure to treat ICP on one Tier - move forward</td>
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<tr>
<td>- Hgb 90</td>
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<td>- Sedation analgesia (propofol, fentanyl, versed)</td>
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<td>- Ventricular drainage intermittent, continuous only if drain reading poorly</td>
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<td>- Repeat CT head</td>
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Elevated ICP - TQIP/ACS

- Tier 2
  - EVD
  - Hypervolemic therapy intermittent
    - Mannitol
    - Hypertonic saline (hold if na over 160)
  - PaCO2 30-35 mmHg
  - Repeat CT imaging
  - Neuromuscular paralysis

- Tier 3
  - Decompressive hemi-craniectomy
  - Neuromuscular paralysis
    - Maintain 2 twitches with the train of four
    - Barbiturate or propofol coma
  - Hyperthermia not currently recommended - rescue only

Lung

- Lung lacerations
  - Symptoms
    - Large air leaks
    - Hemoptysis
  - Dx
    - Bronchoscopy
    - Careful control of airway - double lumen tube, etc.
  - Tx
    - Majority - nonop
      - Tube thoracostomy for air/blood
    - Symptomatic - OR
      - Bleeding - transcatheter embolization or poor operative candidate

- Rib fractures
  - Flail chest - 3 or more adjacent ribs are segmentally fractured
  - High rate of resp failure, underlying pulm contusion, infection
  - Tx supportive
    - Plating - still determining role
    - EAST practice management guidelines 2017
      - Meta-analysis with 22 studies, 3 prospective randomized trials
      - Plating - conditional
        - Hemorrhagic
        - Mechanical ventilation
      - Rib fractures do not usually require ortho consultation

Lung Trauma

- Pulmonary contusion
  - Symptoms
    - Clinically silent to severe
    - Evolve over 3 days
    - Resolve at about 1 week
  - May exacerbate hypoxia and shunting
    - Upright positioning
    - IS
    - Analgesia

Lung Trauma

- Indications for operation
  - Massive hemothorax
    - 1500 cc or more open initial tube placement
    - 200-250 cc/hr over 3 consecutive hours
  - Thoracic trauma with persistent hemodynamic instability
  - Monitor chest tubes closely
    - Cessation of bleeding - clotted chest tube, poor positioning
    - Consider ESR
  - Early VATS/thoracotomy

Lung Trauma

- Resection complications
  - Bronchial stump dehiscence
    - Devastating complication
  - Some reinforce bronchial stump with viable tissue
    - Muscle
      - Intercostal muscle flap
    - Diaphragmatic flap
    - Pericardial flap
    - Mediastinal pleura
  - Latissimus
    - Omentum
    - Lat dorsal flap

Lung Trauma

- Damage Control in the Chest
  - Pack and leave chest open
    - Does not interfere with cardiac or pulmonary function
  - Series of 44 patients
    - Mean pH 7.07, ISS 29
    - Mortality 23%
    - All physiologically normal at time of chest closure
    - Average 2-3 days

Heart
Heart

- Epidemiology
  - Difficult to ascertain true quantity due to low volumes

- Mechanism
  - Area most prone to injury: right and left ventricles
  - Be weary of:
    - Coronary arteries
    - Valves
    - Intracardiac fistulas (ventricular septal defects)
  - Foreign bodies
    - Removal if greater than 1 cm in size, contaminated or symptomatic
    - Generally okay to leave intracardiac missiles
    - Right sided can embolize to PA then be removed with cath based technique if large
    - Left - embolize through a PFO or atrial septal defect

- Right sided can embolize to PA then be removed with cath based technique if large

- Rare - embolize through a PFO or atrial septal defect


Heart

- Blunt Injury
  - Replaced term “cardiac contusion”
  - Be wary of:
    - Septal rupture, free wall rupture, coronary artery thrombosis, cardiac failure, dysrhythmia, rupture of chordae tendineae or papillary muscles

- Pericardial tear
  - Right - twisting of heart and prevention of venous return
  - Left - herniation
    - Sudden loss of pulse when the patient is repositioned or placed on a stretcher

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Heart

- Iatrogenic cardiac injury
  - CVC, cardiac cath, endovascular interventions, pericardiocentesis
  - SVC/central perforations - more common with left sided lines

- Be wary of tamponade
  - Pericardial effusion
  - Subxyphoid pericardial window
  - Median sternotomy
  - May be hard to find the injury

Heart

- Electrical Injury
  - Acute myocardial necrosis with or without ventricular failure
  - Myocardial ischemia
  - Dysrhythmias
  - Conduction abnormalities
  - Acute loss with peripheral vasospasm
  - ECG abnormalities

Heart

- Injury Presentation
  - 60-100 ml blood in pericardial sac to induce clinical picture
  - Best signs of pericardial tamponade: narrowing of pulse pressure

- Blunt
  - Dysrhythmias
    - Mc gowen’s sign (right ventricular
      tachycardia), sinus tach
    - Ventricular tach, fibr
    - Supraventricular tachyaryrhythmias

Heart

- Dx
  - Beck’s triad, Kussmaul’s sign - present in only 10% of patients with cardiac tamponade
  - FAST
  - CXR
  - CT scan for trajectory
  - ECG
    - Level 1 rec: FAST
  - Cardiac enzymes
    - Minimal evidence
  - ECHO
    - Often limited by chest wall injury
    - TEE in OR
Heart

- TX
  - Left anterior thoracotomy
    - Decompress right side with blunt dissection across anterior mediastinum
    - Can extend to clamshell
  - Median sternotomy
    - Small stab wounds to the precordium
    - Limits access to posterior mediastinal structures and descending thoracic aorta for cross-clamping
  - Cardiorrhaphy
    - Place sutures deep to the artery

- Results
  - Mortality rate overall for penetrating: 30-50%

Liver

Liver Injury

- Intra/epidemiology
  - Occurs in 5% of all trauma admissions
  - High susceptibility
  - Size of organ
  - Location of organ

- Anatomy
  - Common hepatic
    - 25% of blood flow to liver
  - Hepatic veins
  - Easily torn
  - Must completely mobilize liver to access
  - Retrohepatic vena cava is 8-10 cm in length
  - Be aware of small direct hepatic vessels
Liver Injury

- Anatomy
  - Portal vein
    - 75% of hepatic flow
    - Posterior to hepatic artery and bile ducts
    - Divide pancreas at neck or generous Kocher maneuver
  - Ligaments

Liver Injury

- Management
  - Nonoperative
    - More common recently
    - Unless
      - Clear peritoneal signs
      - Hemodynamically unstable
  - Be wary of hypothermia
    - Congestion
  - Do
    - Hemodynamically unstable
    - Find the body cavity
      - US
      - DPL
  - Dx
    - Hemodynamically stable
      - Find the body cavity
      - US
      - DPL

Liver Injury

- Dx
  - FAST
    - Nig does not preclude injury
  - CT scan
  - Grade
    - Amount of hemoperitoneum
    - Active extravasation
    - Presence of pseudoaneurysm

Liver Injury

- Management
  - HD normal with blunt injury
    - Nonop now standard of care
    - Some say up to four units of blood nonop
    - Hemodynamic over grade
    - Pseudoaneurysm, active extravasation and hemoperitoneum have higher risk of nonop failure
    - Consider angiographic control
  - Complications
    - Abscess
    - CT guided drainage
    - Wide surgical drainage
    - Hemorrhage
    - angioembolization
    - Bile leaks
    - Sphincterotomy
    - Burns
    - Drainage

Liver Injury

- Management
  - HD normal with penetrating injury
    - Nonop if
      - No peritoneal signs
      - Not mentally impaired
    - Complications
      - Bile-pleural fluid or diaphragm injury
  - Operative management
    - Minor
      - Electrocautery
      - Argon beam coagulation
      - Topical hemostatics
      - Omental tongue
    - Major
      - Packing
      - Sleeve resection
      - Finger fracture
      - Percutaneous placement
      - Pringle maneuver
      - Resection
      - Schick cholangiogram
      - EDRA
Liver Injury

- Gallbladder injury?
  - Take it out
  - Also remove if injury to right hepatic artery

Kidney

- Anatomy
  - Malpizz laparotomy
  - Access kidney prior to exploring hematoma
  - Ureter
    - Blood supply
      - Renal artery from above
      - Aorta or common iliac arteries
      - Vesical arteries from below

- Kidney

- Epidemiology
  - Occur in 1-3% of all trauma patients
  - Up to 10% of those with abdominal trauma

- PE
  - Tsp flank, abdomen
  - Hematuria
    - Magnitude correlates poorly with renal injury

- Imaging
  - CT scan now gold standard
  - US for renal perfusion and vascular anatomy
    - Also in OR

- Non-op management
  - Majority managed non-op except
    - Hd instability
    - Ongoing hemorrhage
    - Pulsatile or expanding hematoma upon exploration
    - Avulsion of pedicle
  - Deal with complications
    - Fistula
    - Stent
    - Angi embolization

- Operative management
  - Some say early operative approach to debulk devitalized tissue, etc...
    - Gr 5-8
    - 90-100% require urgent nephrectomy
    - Pedicled injury
    - Repair - absorbable suture for pedicle

Adrenal Glands

- Uncommon
  - Hematoma non-expansile
  - Nonexp
  - Growing hematoma, injury
  - Suture or placement of biologic mesh may prevent total adrenalectomy
- Due to blood supply: rarely devascularized

Adrenal gland

Duodenum/Pancreas
**Pancreas and Duodenum**

**Intro**
- Significant challenge
  - Compromised clinical detection of injury
  - Anatomic factors
    - High complication rate
    - Infrequently injured
  - Experience limited
  - Poor outcomes

**Pancreas and Duodenum**


**Pancreas and Duodenum**

**Predictors of survival**
- Age
- Overall injury severity
- Indices of shock
- Severe brain injury

**Pancreas and Duodenum**

- Not-pancreatic or duodenal injury grade of injury

**Pancreas and Duodenum**

**Penetrating**
- Explore
  - Kocher maneuver
  - Body and tail of pancreas
  - Divide gastrocolic ligament
  - Bending in neck of pancreas
  - Divide with stapler without hesitation

**Pancreas and Duodenum**

**Blunt**
- Handlebar injuries
  - Difficult
  - Amylase, lipase not indicated

**Pancreas and Duodenum**

**Dx**
- Hemodynamically unstable?
  - OR
    - GSW?
    - X-ray chest, abdomen if possible
    - Trajectory
    - Body cavities

**Pancreas and Duodenum**

**Dx**
- FAST not helpful for retroperitoneum
- CT
  - Duodenum real
  - Best with oral contrast
  - Repeat if needed
  - May be subtle
  - 80% sensitive
  - Clear laceration?
  - Most recommend exploration
Pancreas and Duodenum

- Evaluate the duct
  - Important determinant of prognosis
  - ERCP
    - Some say MRCP - but controversy
  - If main duct injury - needs exploration
  - Intraop:
    - ERCP
    - Infuse contrast into gallbladder
    - Duodenotomy - high complication rate

Pancreas and Duodenum

- Duodenum
  - Management
    - Grade 1 and 2
      - Almost all hematomas resolve 2-3 weeks
      - Luminal compromise up to 30%:
        - Consider distal feeding tube
        - Intraop only if mass effect and luminal compromise
        - Expectant management:
          - Npo, ngt
          - Repair if needed

Pancreas and Duodenum

- Duodenum
  - Grade 1 and 2
    - Duodenal lacs
      - Primary single layer for small simple
      - Laceration to pancreatic side of duct?
        - Maybe antimesenteric duodenotomy with repair of injury from inside
  - Grade 3
    - Simple
      - Duodenorrhaphy
        - Tension free
      - Duodenoduodenectomy
        - Know where ampulla is
        - Duodenojejunal anastomosis may need separate leak with roux limb
        - Patch graft
        - Pyloric exclusion
          - GJ with oversew pylorus
        - More historical, controversy
          - Many say primary repair enough
          - Consider drains - closed suction

Pancreas and Duodenum

- Duodenum
  - Grade 4/5
    - Above technique
      - Roux-en-y hepaticoj
    - Whipple
      - absolute last resort
      - often done at inter date

Pancreas and Duodenum

- Pancreas
  - Grade 1 and 2
    - More literature in children...
  - Found intraop?
    - Drain
      - Don't attempt repair unless evidence of duct disruption
      - Test drain for amylase - less than serum, remove
Pancreas and Duodenum

- Pancreas
  - Grade 3
    - Minimal duct disruption?
      - Maybe ERCP and stent, otherwise OR
    - Tail injury: resect
  - Grade 4
    - Wide drainage
      - 85-90% of gland resected is okay
    - Whipple frequently done when not warranted
    - Should be staged
  - Grade 5
    - Whipple frequently done when not warranted

- Complications
  - Hemorrhage
  - Pancreatic fistula
  - Duodenal fistula and stricture
  - Abdominal abscess
  - Pseudocyst/pancreatitis
  - Pancreatic insufficiency

- Spleen

- Pancreas
  - Controversial
  - Nonsurgical dx requires mrcp or ercp
  - No OR
  - Longer LOS, higher morbidity, higher pseudocyst formation and longer time to diet

- Pancreas
  - Grade 4
    - Wide drainage
      - 85-90% of gland resected is okay
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Spleen

- Anatomy
  - 317 patients imaged
    - Two patterns of splenic arterial anatomy
      - Concentrated pattern
        - Multiple branches less than 2 cm from the splenic hilum
      - Distributed pattern
        - Branching occurred more than 2 cm from the splenic hilum
        - Usually two major branches that proceeded from the bifurcation

- Ligaments
  - Chief ligaments
    - Gastrosplenic
    - Splenorenal
  - Minor ligaments
    - Spenophrenic
    - Splenocolic
    - Presplenec fold
    - Pancreaticosplenic
    - Phrenocolic
    - Pancreatic-colic ligament

Let's just take part of it out....

- Partial splenectomy probably not safe in the setting of trauma secondary to coagulopathy
  - Splenic segmental arteries are NOT END ARTERIES
    - Important implications for surgeons
      - Partial splenectomy
      - Angiographic management

Splenectomy Complications

- Bleeding
- Injury to adjacent structures
  - Colon, diaphragm
- SSI

Splenic Injuries in Children

- OPSI
  - Septicemia/meningitis
    - Usually S. Pneumonia, H. Influenza or N. meningitis
  - Fatal infections usually within the first two years
  - Mortality risk 30%
  - Some implant spleen in omentum
  - Evidence of partial recovery of spleen filtration functions
    - No evidence of help with opsi
  - Overall risk 3.2%
    - Rate similar in children but mortality is higher
    - Lowest risk in splenectomy done for injury

- SSI
**Spleen Injuries in Children**

- Nonop is preferred approach
- Clinical practice guidelines proposed by the Trauma Committee of the American Pediatric Surgery Association (APSA) for isolated liver and spleen
  - Outcomes in more than 850 patients
  - Compliance in these guidelines: feasible and safe
  - 300 patients, prospective review at two trauma centers
  - Journal of Pediatric Surgery, 2002

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- Does contrast blush mandate action?
  - Bird and Coauthors, Journal of Trauma and Acute Care Surgery, 2012
    - 38 patients at rural centers over 13 years
    - Followed APSA - successful 97% non-op management
    - None had a contrast blush on angiography
  - Bansal and coauthors, American Journal of Surgery, 2015
    - Retrospective, 270 pts, single hospital
    - Grade 3-4
    - 47 patients had contrast blush
    - None had angiography/splenectomy

- Smaller arteries
  - Angioembolization carries higher risk?
    - Splenic infarct
    - Splenic abscess
    - Postembolization syndrome
    - Abdominal pain
    - Nausea
    - Vomiting
    - Fever
    - Ileus

- American Journal of Surgery, 2015, Rostas and colleagues
  - LMWH in 528 patients over 5 years
    - Early - within 48 hours or less after injury
    - Intermediate 48-72 hours
    - Late - greater than 72 hours
  - Transfusion needs similar in all groups and no increased risk in early implementation

**Spleen Injuries in Children**

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- Compliance in these guidelines: feasible and safe
- 300 patients, prospective review at two trauma centers
- Journal of Pediatric Surgery, 2002

- Does contrast blush mandate action?
  - Bird and Coauthors, Journal of Trauma and Acute Care Surgery, 2012
    - 38 patients at rural centers over 13 years
    - Followed APSA - successful 97% non-op management
    - None had a contrast blush on angiography
  - Bansal and coauthors, American Journal of Surgery, 2015
    - Retrospective, 270 pts, single hospital
    - Grade 3-4
    - 47 patients had contrast blush
    - None had angiography/splenectomy

- Smaller arteries
  - Angioembolization carries higher risk?
    - Splenic infarct
    - Splenic abscess
    - Postembolization syndrome
    - Abdominal pain
    - Nausea
    - Vomiting
    - Fever
    - Ileus

- American Journal of Surgery, 2015, Rostas and colleagues
  - LMWH in 528 patients over 5 years
    - Early - within 48 hours or less after injury
    - Intermediate 48-72 hours
    - Late - greater than 72 hours
  - Transfusion needs similar in all groups and no increased risk in early implementation

**Adults**

- Journal of Trauma and Acute Care Surgery, 2012, based on EAST guidelines
  - Systematic observational review 126 studies
  - Level 1 recommendation:
    - Hb instability/peritonitis -> OR
  - Angioemb can be considered if:
    - Grade 3-4
    - Contrast blush
    - Moderate hemoperitoneum
    - Evidence of ongoing bleeding
  - Level 2
    - Contrast blush does not mandate angioembolization
    - Repeat ct imaging may be considered
  - Okay to use VTE prophylaxis

**Adults - VTE Prophylaxis**

- Traditional “high risk” factors:
  - Older age
  - High grade injuries
  - Contrast blush

- Newer data:
  - No significant improvement in outcomes
  - Exposure to complications
Prospective study, single center
168 patients
- Major complications after angio: 9%
- Nonoperative management: 14%
- Overall decrease in complication rate by 25% in patients who underwent embolization


Nonoperative management should only occur in an environment with 5% failure rate.

3 splenectomy in 73 patients undergoing nonoperative management.

Retrospective, 113 patients, 11 years
- Nonoperative management: 1085 patients
- Immediate operative management: 103 patients
- Successful in 63%

Remainder had evidence of ongoing splenic bleeding.


Level 2 recs:
1. Angio should be considered for:
   a. massive hemorrhage
   b. evolving encapsulated hematoma
   c. evidence of ongoing splenic bleeding
2. Nonoperative management can only occur in an environment that can handle it

Level 3 recs:
1. Contrast blush on CT scan alone is not absolute indication for angio - various angiography patterns can be seen
2. PT, PTT, TEG reading normal

American Surgeon, 2013, Post and colleagues
- Retrospective, 258 patients, 9 years
- Nonoperative management: 14.8% of this group
- Major complications in 14% (splenic infarct, cyst, abscess, etc.)
- Most complications seen in patients who underwent splenic artery embolization

Penetrating Splenic Injuries

Berg and coauthors, Injury, 2014
- Retrospective, 201 patients, 18 years
- Immediate operative management: 83% of patients
- Nonoperative management: 14 patients
- Successful in 84%
- 3 who died

Percutaneous techniques, 2014

Laparoscopy, Endoscopy and Percutaneous techniques, 2014

Piccolo and coauthors, Surgical Laparoscopy, Endoscopy and Percutaneous techniques, 2014
- 113 patients
- Risk of splenic injury with angiography: 1/100,000

- 75 articles, 162 patients, 85% had spleen injury
- More than 75% of the occurrence was in the female with median age 65
- None associated with "difficult" retroperitoneoscopy
- 75 patients underwent on:
  a. NO had splenicartery ligation
  b. Overall mortality: 5%
  c. Abdominal pain within 24 hours

References
8. Berg and colleagues, Injury, 2014
15. Berg and colleagues, Injury, 2014
17. Berg and colleagues, Injury, 2014
**Bladder**

- Intra or extraperitoneal
  - Extraperitoneal
    - Non-standard
    - 18-20Fr catheter for 10-14 days
    - Follow with cystogram
    - Repeat week Foley
  - Consider operative if:
    - Concomitant vaginal or rectal injury
    - Avulsion of bladder neck
    - Need for pelvic exploration for other surgical indications
    - Retropubic access needed for pelvic fix

- Nonop - standard
  - 18-20Fr catheter for 10-14 days
  - Follow with cystogram
  - Repeat week Foley

- Intrapereitoneal
  - Operative repair
  - Generally large lacerate tear in dome of bladder
  - Suture with a full bladder
  - Debride edges if necessary
  - Two layer heavy absorbable suture
  - Bladder cath
  - 5-10 days
    - Cysto prior to removal, though some do without new