Case Study

- A 6 y/o boy fell out of 2nd story window onto concrete
- Hemodynamically stable at scene
- Arrived to hospital
  - HR 160’s, BP 50’s, GCS 10, ET tube placed, fluid resuscitation initiated, mucosal surfaces pale, extremities cool to palpation
- Diagnosis?

Case Study (cont’d)

- To Xray-cleared from hemothorax, pneumothorax, pelvic fracture
- FAST-free fluid in abdomen (suggestive of hemorrhage)
- Emergently to OR-ex lap-
  - Diagnosis- Massive hemoperitoneum, Grade IV liver lac, active bleeding
  - Hemostasis with perihepatic packing
Case Study (cont’d)

CT scan
Contrast extravasation right hepatic arterial branch into right lobe of liver with large hematoma
To IR

Case Study (cont’d)

Hepatic Arteriogram

Hemodynamically stable without further blood transfusion
Returned to OR post coil embolization day 2 to remove packing and close belly
Did well, discharged Day 18
Office visit 2 months after D/C doing well without complications
Case Study - Points to Consider

- OR vs IR - response to fluid resuscitation determining factor
- Portal venogram to evaluate hepatoporal venous flow
- Cystic artery to be identified to avoid embolization as feeder into gallbladder necrosis

Thoughts?
Questions?

What IS Interventional Radiology?
Interventional Radiology

Goal of IR in Trauma

Bleeding control with organ preservation

Interventional Radiology

1972-first transcatheter embolization of the internal iliac artery to control hemorrhage associated with pelvic fractures

Types of Embolization Agents

<table>
<thead>
<tr>
<th>Category</th>
<th>Indications</th>
<th>Embolization Agents</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mechanical embolic</td>
<td>Treatment of local vascular abnormality (e.g., venous, hemorrhage, trauma)</td>
<td>Coil (polyester, detachable)</td>
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<tr>
<td>agents</td>
<td></td>
<td>PVA microspheres, Onyx</td>
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<tr>
<td>Flow-directed</td>
<td>Treatment of diffuse vascular abnormality (e.g., AVM, laceration, solid organ pathology)</td>
<td>particles, Spherical embolic agents</td>
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<tr>
<td>embolic agents</td>
<td></td>
<td>Drop-stitch (metal)</td>
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<tr>
<td>Particulate embolic</td>
<td></td>
<td>Resorbable microspheres</td>
</tr>
<tr>
<td>agents</td>
<td></td>
<td>Microparticle suspension, Onyx</td>
</tr>
<tr>
<td>Liquid embolic agents</td>
<td></td>
<td>Scientifics</td>
</tr>
<tr>
<td>Gelfoam</td>
<td></td>
<td>Gelfoam (sponge, particles)</td>
</tr>
</tbody>
</table>
Gelfoam

- When rapid occlusion is desired
- When surgical access is difficult
- When the patient is a poor operative risk
- When selective transcatheter embolization may limit the amount of normal tissue or parenchyma necrotized
- Benefits of OR: visualize organ, packing, quick fix

IR VS OR

- When rapid occlusion is desired
- When surgical access is difficult
- When the patient is a poor operative risk
- When selective transcatheter embolization may limit the amount of normal tissue or parenchyma necrotized
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Disadvantages of IR

- Negative angiogram due to
  - Vasospasm secondary to hypovolemia
  - Spontaneous thrombus formation
  - Venous source
  - Artifact
Role of RN During IR Embolization

- Bair hugger/fluid warmer to prevent coagulopathy
- Blood products
- Labs
- Monitor airway, vitals
- Sedation medications or general anesthesia
- Post Embo Care
- SKI, pain control
- Monitor for complications

Complications of Artery Embolization

- Abscess formation
- Bleeding
- Catheter/guidewire injury to artery
- Hematoma at access site
- Infection
- Organ infarction
- Renal failure
- Tissue/Organ Necrosis

Solid Organ Injury in Trauma

- Most injured
  1. Spleen
  2. Liver
  3. Kidney
- Pelvic trauma-embolization
Pediatric Anatomy

- Liver and Spleen
  - Ribs flexible in children
  - Liver and spleen extend beyond the ribs
  - Larger visera, less overlying fat, weaker abdominal muscles
  - Liver larger and less fibrous stroma, more susceptible to laceration/bleeding
  - Both are highly vascular, potential for fatal blood loss
  - Kidneys have less perinephric fat

Anatomy

- The left and right liver lobes are anatomically and functionally separated
- Each lobe is divided into 2 sectors
  - Left liver lobe
    - left lateral section (Continued: sag 2 and 3)
    - left medial section (Continued: sag 4, left part of segment 1)
  - Right liver lobe
    - right posterior section (Continued: sag 6 a 7)
    - right anterior section (Continued: sag 5, right part of sag 5)
Grading of Liver Injury

The American Association for the Surgery of Trauma (AAST)

Liver
- **Grade I**
  - Hematoma: Subcapsular, <10% surface area, Laceration: Capsular tear <1cm
- **Grade II**
  - Hematoma: Subcapsular, 10-50% surface area, intraparenchymal <10cm in diameter, Laceration: Capsular tear 1-3 parenchymal depth < 10 cm in length

Grading of Injury - Liver (cont’d)

- **Grade III**
  - Hematoma: Subcapsular >50% surface area of ruptured subcapsular or expanding, Laceration: >3cm depth
- **Grade IV**
  - Laceration: Parenchymal disruption involving 25-75% hepatic lobe or 1-3 Couinaud’s segments
- **Grade V**
  - Laceration: Parenchymal disruption involving >75% of hepatic lobe or >3 Couinaud’s segments within a single lobe
- **Grade VI**
  - Hepatic Avulsion

*Advance one grade for multiple injuries up to Grade III*

AAST Grading of Splenic Injury

- **Grade I**
  - Hematoma: Subcapsular, <10% surface area
  - Laceration: Capsular tear, <1cm, parenchymal death
- **Grade II**
  - Hematoma: Subcapsular, 10-50% surface area, intraparenchymal, <5cm
  - Laceration: Capsular tear, 1-3 cm parenchymal depth that does not involve trabecular vessel
AAST Grading of Spleen Injury (cont’d)

- Grade III - Hematoma: Subcapsular, >50% surface area or expanding, ruptured subcapsular or parenchymal hematoma, intraparenchymal hematoma >5cm or expanding
- Laceration: >3cm parenchymal depth or involving trabecular vessels
- Grade IV - Laceration: Involves segmental or hilar vessels producing major devascularization (>25% of spleen)
- Grade V - Laceration: Completely shattered spleen
  Vascular: Hilar vascular injury with devascularized spleen

*Advance one grade for multiple injuries up to Grade III

Spleen Coil Video

https://www.youtube.com/watch?v=3Ss9KUzLSw&list=PLKPtrJyovBj9NM3215KPY21w3penPJ8G&index=4

Spleen Angiogram/Coil Embolization

Selective splenic angiogram confirms active bleeding. Angiogram shows no active bleeding after embolization with coils.
Spleen Embolization Complications

- Study by Ahura et al. in 2015 of 479 splenic embolizations in trauma concluded
- 70%+ embolization of spleen increases chances of the following:
  - Abscess
  - Pleural effusion
  - Ascites
  - PE
  - Portal vein thrombus
  - Liver failure
- *Occurred in 15 of 479 patients

Spleen Embolization vs Splenectomy

- Acute Post Splenectomy Sepsis
- Post Splenectomy Immunizations per CDC
  - Influenza vaccine
  - Tdap vaccine
  - Hib
  - Pneumococcal vaccine
  - Meningococcal vaccine
  - Zoster vaccine
  - HPV vaccine series
  - MMR vaccine
  - Varicella vaccine

Conclusion

CT is gold standard and preferred prior to Embolization
Interventional Radiology limited in pediatrics due to stocked supply of catheters/wires
IR consulted for Grade III+ injuries
IR often used post OR
Interventional Radiology

Goal of Interventional Radiology in Trauma:

Bleeding control with organ preservation

References


