Morbidity & Mortality

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Case Presentation

**Trauma Code:** 29 yo male s/p GSW x 2 to LLE
- GSW#1 – left groin just medial to femoral pulse
- GSW#2 – left medial thigh approximately 4 fingerbreadths below first GSW
- Active hemorrhage at scene per EMS
- GCS 4/5/6 on arrival
- No PMH/PSH
Case Presentation

• Vitals:
  • BP 106/48  HR 83  RR 16  O2sat 100%

• Physical Exam:
  • Gen: A&Ox3, in acute distress due to pain from LLE
  • HEENT: NCAT
  • Neck: FROM
  • Chest: CTA B/L
  • CV: S1 S2
  • Abd: soft, NT/ND
  • Ext: GSWx2 to left groin and left medial thigh, no active bleeding, 2+ femoral and DP/PT pulses, moderate stable hematoma left thigh, externally rotated, sensation intact; left hand with laceration of left ring finger, through and through wound proximal to PIP of left middle finger, ABIs: 1.1 b/l
Case Presentation

VBG 7.371/45.1/29.1/24.1/55%/+0.9
Lactate 5.3
Case Presentation

• Negative CXR.
• Bullet casings in region of left proximal femur.
• Proximal comminuted femoral fracture.
Comminuted spiral oblique displaced fracture of proximal left femoral shaft. Bullet fragment in soft tissues laterally.
Comminuted midshaft fracture of proximal phalanx of third digit, left hand.
Case Presentation

Huh?
But... Hey, wait...
Angiogram
Case Presentation

- Negative angiogram by IR.
- Upon transfer from IR table to stretcher, patient experienced significant hemorrhage from proximal wound, likely high flow venous bleeding.
- Taken immediately to operating room with digital pressure in wound for emergent surgical exploration.
Operative Course

- Left groin exploration via longitudinal incision
- Macerated left femoral vein just proximal to saphenofemoral junction including anterior and posterior walls
- Left saphenous vein anterior wall injury
- Left femoral and saphenous veins ligated at SFJ
- Arterial tree intact
Postoperative Course

POD#0: Left femur traction pin placed by Orthopedics. Leg elevated and wrapped.
POD#3: Taken to OR for left thigh fasciotomy for compartment syndrome.
POD#6: Taken to OR for IM nailing of left subtrochanteric femur fracture and VAC placement.
POD#9: Transferred to floor. Currently awaiting rehab and placement.
Indications for Angiogram in Lower Extremity Trauma
Hard & Soft Signs of Vascular Injury

- **Hard Signs**
  - Active arterial bleeding
  - Pulselessness/
    evidence of ischemia
  - Expanding pulsatile hematoma
  - Bruit or thrill
  - Arterial pressure index <0.90 pulse deficit

- **Soft Signs**
  - Neurologic injury in proximity to vessel
  - Small to moderate sized hematoma
  - Unexplained hypotension
  - Large blood loss at scene
  - Injury in proximity to major vessel

Arterial Pressure Index

- Johansen et al (1991) – API<0.9 for identification of occult arterial injury
  - 95% sensitivity
  - 97% specificity
- API>0.9 – 99% negative predictive value for arterial injury
- Safe, accurate, cost-effective

Anatomy

- Common iliac artery
- Internal iliac artery
- External iliac artery
- Femoral artery
- Deep artery of thigh
- Popliteal artery
- Anterior tibial artery
- Peroneal artery
- Posterior tibial artery
- Common iliac vein
- Internal iliac vein
- Common femoral vein
- Saphenous vein
- Femoral vein
- Deep femoral vein
- Popliteal vein
- Posterior tibial vein
- Anterior tibial vein
- Peroneal vein
Negative groin explorations

- Snyder et al (1978)
  - 177 patients with 183 penetrating injuries evaluated using arteriography
  - 1 false negative and 14 false positive
  - Arteriography invaluable in patients in whom the diagnosis is less clear
  - 2-4% complication rate

Indications for arteriography:

Extremity trauma

- Unclear location or extent of vascular injury
- Extensive soft tissue injury
- Fracture or dislocation
- Trajectory parallel to an artery
- Multiple wounds
- Shotgun injuries
- Peripheral vascular disease

Other Indications: The Proximity Controversy

  - Group 1 – 43 patients with 44 clinically occult injuries subsequently demonstrated on angiography
    - 4 (9%) deteriorated within a month and required operative repair
    - Follow up with mean 9.1 years for 58% of group – all asymptomatic
  - Group 2 – 287 patients with 309 asymptomatic proximity injuries evaluated by PE alone
    - 4 (1.3%) deteriorated and required surgery
    - Follow up with mean 5.4 years for 29% of group – all asymptomatic

The Proximity Controversy

- Routine proximity angiograms will identify abnormalities in up to 10% of cases
- Authors champion PE alone
- Patients who require surgery will develop hard signs
- “Minimal” vascular injuries – most heal by themselves
  - Intimal flaps
  - Segmental narrowings
  - Small false aneurysms
  - Small AVFs

The Proximity Controversy

- Weaver et al (1990) – use of angiogram to screen for an arterial injury when proximity alone is the indication rarely identifies a significant injury and should be abandoned
- N=373 with penetrating extremity injury
- Inclusion criteria:
  - Bruit, history of hemorrhage or hypotension, fracture, hematoma, decreased capillary refill, major soft-tissue injury, nerve or pulse deficit
  - Absent above findings but “proximity” to a major neurovascular bundle
- 216 patients underwent angiogram
  - 65 injuries identified, 19 required intervention
- Indication was “proximity” in 157 patients
  - 17 injuries identified, 1 required repair

The County

- Prospective study using penetrating extremity trauma registry over 10 months
- N=228 patient with 320 injuries
  - 51 patients had 50 arterial and 17 venous injuries
  - Limb salvage 100%
  - 22 patients taken to OR immediately
- 41 admitted patients underwent angiography with 46.4% of patients with positive findings
  - Nine required surgery
- Angiogram for proximity done in 153 injuries
  - 7 arterial injuries revealed (4.6%)
  - 3 required surgery

Peripheral Vascular Trauma

- **Bleeding**
  - Likely needs exploration
  - Nonmassive bleeding in a hemodynamically stable patient: indication for angiogram
  - Below knee injuries: consider angiography to avoid exploration

- **Ischemia**
  - Likely needs exploration
  - May consider angio to define ischemic segment

Figure 2 - Massive musculoskeletal trauma
Knee Dislocation

- Popliteal artery injury is frequently associated with knee dislocation following blunt trauma.
- Incidence of vascular injuries more common with *posterior* than anterior dislocations because of higher force needed to produce this injury.
- **Posterior dislocations**: more likely to result in direct injury & even rupture of popliteal artery (isolated transection).
- **Anterior dislocations**: stretching of popliteal artery may lead to intimal disruption & thrombosis (damage is over a longer segment of the artery).
Knee Dislocation

Venous Injuries

- Timberlake showed no difference in outcome between ligation and repair making ligation an acceptable alternative.
- Kurtoglu et al investigated effects of venous ligation on major veins when primary repair was impossible due to extensive laceration.
- Early leg swelling after ligation most common morbidity.
- No sequelae of chronic venous insufficiency.
- DVT treated with oral anticoagulation and compression stockings.

Alternatives in Diagnosis

- Catheter-based angiography is gold standard for diagnosis of vascular injuries
  - VERSUS

- Color flow duplex imaging
- Computed Tomographic Angiography
- Magnetic Resonance Angiography
Evaluation of Vascular Injury

1. Suspected vascular injury
   - Treat shock
   - Reduce fractures/dislocations

2. Hard signs present or develop?
   - Yes
     - Pulselessness?
       - Expanding hematoma?
       - Active bleeding?
         - Yes
           - Location/extent unclear?
             - No
               - Operative exposure
             - Yes
               - Intraoperative arteriogram
         - No
           - Need urgent non-vascular operation?
             - Yes
               - Formal arteriogram
             - No
               - Abnormal
                 - Duplex ultrasound/

3. No
   - Thoracic outlet, groin, or neck location?
     - Yes
     - Management as appropriate
     - No
       - Management as appropriate

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The End.
References