Management of Pelvic Trauma

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Trauma Rounds
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Outline

- Epidemiology of pelvic trauma
- Anatomy of pelvis
- Classification of pelvic fractures
- Case presentation
- Initial management of fractures
- Complications
Epidemiology

- 3% of all fractures that present to ER
- Lateral compression common (55-70%)
- Anterior-posterior compression (15%)
- Vertical shear (5%)
- Combined Mechanical (10-15%)

Causes:
- MVC (55%)
- Pedestrian accidents (18%)
- Motorcycle accidents (10%)
- Falls (10%)
- Crush injuries (5%)
Morbidity/Mortality

- Mortality rate ranges from 15-50%
- If open # increases mortality 30-50%
- If closed 20-40%
- Increases to 30-50% if hypotensive on arrival
- Cause of death:
  - Uncontrolled hemorrhage – 40%
  - Head injury – 30%
  - Multiple organ failure – 30%
Associated Injuries

- Closed head injury – 50%
- Long bone fracture – 48%
- Peripheral nerve injury – 26%
- Thoracic injury – 20%
- Urethra (male) – 15%
- Bladder – 10%
- Spleen – 10%
- Liver – 7%
Pelvis comprised of 3 bones:
  – Sacrum and 2 innominate bones

Innominate bones are fusion of 3 ossification centers – ilium, ischium, pubis

3 centers meet at triradiate cartilage of acetabulum

Vertically oriented ligaments – resist vertically oriented forces – posterior ligaments strongest in body

Transversely oriented ligaments resist rotational forces
Anatomy 101

1. Iliolumbar ligament
2. Dorsal sacroiliac lig.
4. Ventral sacroiliac lig.
5. Sacrospinous lig.
Anatomy 101

- Pelvis contains:
  - Reproductive organs, lower GU system, GI system and sacral plexus
- In men, bladder neck, prostate, and prostatic urethra are anchored to pelvis by puboprostatic ligaments – greater risk of injury
What to look for…

- Tenderness to palpation when “springing” pelvis
- Instability on bimanual compression
- Signs of urethral injury
- Vaginal bleeding or palpable fracture line on bimanual exam
- Hematuria
- Rectal bleeding or Earle sign
- Destot sign
- Grey-Turner sign
Investigations

- AP pelvis x-ray – will show 90% of #
- Outlet view – 45 degrees cephalad
- Inlet view – 45 degrees caudad
- CT
- Retrograde urethrogram – if urethral injury suspected
- Cystogram – if gross hematuria
- Arteriogram +/- embolization
Radiographs
Classification of Pelvic Fractures

- 2 classifications:
  - Tile – focuses on pelvic stability
  - Young-Burgess – focuses on degree of injury

- Young-Burgess – judges stability by fracture pattern, direction of force, knowledge of pelvic ligaments
Young-Burgess
(J Trauma 1990. 30:848-56)

- 4 categories of fracture
  - Lateral compression
  - Anterior-posterior compression
  - Vertical shear
  - Combined mechanical

- Each further subdivided based on severity
Lateral Compression

- Unilateral or bilateral rami fracture with or without pubic symphysis injury
- Usually stable injury, low risk of hemorrhage – decreases volume of pelvis
- Lateral compression 1 (LC1)
  - Unilateral rami # & ipsilateral sacral compression
  - Lateral force compressing sacrum
  - Usually stable
Lateral Compression 2

- Unilateral rami # & ipsilateral post iliac #
- Lateral compression on ilium
- Usually stable
Lateral Compression 3

- LC ½ & contralateral APC
- Trapped b/w unyielding object/rollover
- Unstable
Anterior-Posterior Compression

- Direct anterior force
- AP1
  - Symphysis diastasis <2.5cm or vertical rami # & ant. SI lig. Stretched
  - Low-mod energy force, stable
AP 2

- Symphysis diastasis >2.5 cm or rami # & SI lig torn & sacrotuberous/sacrospinous ligs torn
- High energy “open book”, unstable
Symphisis diastasis or rami # & ant. & post SI ligs. torn, very unstable

High energy – pelvis rotates externally until post iliac wing strikes post sacrum – high risk of hemorrhage
Vertical Shear

- Ant. & post. vertical displacement
- Fall from height or MVC
- Unstable
Combined Mechanical

- Combination of injuries and forces
- Unstable
Radiographs

- AP compression – symphysis diastasis and right SI joint diastasis
Radiographs

- Vertical shear – left hemipelvis displaced vertically, vertical fracture of pubic rami - contralateral
Radiographs

- AP compression – symphysis >2.5 cm, right
- SI diastasis
Radiographs

- Lateral compression – left sacral buckle #, minimally overlapping left rami #
Radiographs

- Lateral compression – internal rotation left hemipelvis, left rami #. Symphysis diastasis with external rotation of right hemipelvis and right SI diastasis (AP compression type injury) – Windswept pelvis
Radiographs

- Vertical shear – left hemipelvis displaced vertically with SI joint diastasis, contralateral rami #
Vertical Shear – vertical displacement of left hemipelvis, left iliac #, left SI joint diastasis
Case #1

- 21 y.o male passenger involved in head on MVC
- Presented to trauma suite hypotensive and tachycardic
- Initial VS: HR= 140; BP= 90/60 SaO2 = 97% 3L NP RR= 24
- Obvious deformity right femur with laceration over injury
- Bruising over left inguinal area
- Large laceration over right orbit – bleeding
Case #1 cont’d

- **Initial ABC’s:**
  - Protecting airway
  - Good a/e bilaterally
  - HR and BP fail to respond to initial 2L bolus done by EMS and further crystalloid resusc.
  - Blood on the way
  - Abdomen – voluntary guarding/firm; tender LLQ
  - Pelvis: ++ tender; ortho resident palpates lateral instability
  - Gross hematuria
Case #1 cont’d

- Still awaiting blood – HR=130 BP=100/70
- GCS = 15/15, moving all 4 extremities, no paresthesias/numbness in extremities
- Blood arrives – transfuse on level I infuser – HR and BP respond
- Initial Hgb = 40, 80 after 10 units PRBC
- Pt intubated with c-spine precautions; art line and right subclavian line inserted.
Case #1 cont’d

- Pt develops coagulopathy – DIC picture
- Receives FFP and cryoprecipitate
- 10 more units of PRBC – Hgb 80-86
- Vitals remain stable with continued PRBC transfusion on level I
Case #1 Investigations

- CXR – pulmonary contusion RLL
- Pelvis – left femoral neck fracture, ? Right superior rami fracture involving acetabulum
- C-spine – WNL
- Femur – comminuted mid shaft fracture
Pt stable for transfer to CT after 7 units PRBC’s

CT chest: small pneumothorax

CT abdo/pelvis:
- Extensive hemorrhage into peritoneal cavity
- Large hematoma right psoas into pelvis
- Laceration right lobe of liver
- Bone windows show: comminuted # right sacrum, # right sup. Rami, subcapital # right femoral neck
Case #1

- Emergent laparotomy – gen sx first
  - Large retroperitoneal hemorrhage, minimal bleeding from liver laceration, serosal tear mid transverse colon, significant splenic laceration requiring removal

- Ortho took over:
  - Anterior external fixation ? Unstable in ER
  - Reduction of femoral neck fracture with internal fixation
  - External fixation of femoral shaft fracture
Case #1

- Still has posterior sacral fracture with large hematoma...

- Emergent abdominal/pelvic arteriogram:
  - Right internal iliac patent, smaller right lateral sacral artery courses through sacral alar fracture- some blushing, no extravasation
  - Small embolotherapy carried out and blushing resolves
Initial Management of Pelvic Fractures

- ABC’s
- Physical examination – look for signs of pelvic fracture
- Test stability of pelvic ring – ONCE!
- Look for associated injuries
- X-rays
- Treatment options
What to ask yourself...

- Patient stable/unstable?
  - If unstable is it due to pelvic fracture
- Is this pelvic fracture stable or unstable?
- Are there any other associated injuries?
- Does this patient need ex. fix.?
- Does this patient need emergent OR?
- Does this patient need arteriogram?
External Fixation

- Options include formal ex. fix., bedsheet or pneumatic antishock garment
- Ex. fix. include anterior and posterior (C clamp) depending on injury location
- Complications include:
  - May take some time to apply
  - Frame can interfere with laparotomy
  - Pin site sepsis/infection
  - ? Worsening posterior bleed
External Fixation

- Hemorrhage after pelvic injury occurs from bony fragments, venous plexus and arterial bleeds – mainly branches of internal iliac a.
- Theory initially was: ex. fix. decreases pelvic volume – allowing for tamponade. Several studies have since refuted that claim.
- Now felt that ex. fix. allows for opposition of bony fragments – allows hemostatic mechanisms to work and form clot – will not control arterial bleeding.
External Fixation

http://www.bonesurgery.com
External Fixation
(J Trauma 1998 Jun;44(6):941-56)

- Consider in pt’s with evidence of unstable # associated with hypotension
- Consider in pt’s with unstable # who warrant laparotomy – ant. abdominal wall aids in stabilization
- Consider in pt’s with unstable # with no hypotension but who require steady and ongoing resuscitation
Emergent Laparotomy

(J Trauma 1998 Jun;44(6):941-56)

- All open fractures
- Hypotension, gross blood in abdomen or evidence of intestinal perforation
- Demonstrate signs of continued intraabdominal bleeding after adequate resuscitation, or evidence of intestinal perforation
Emergent Laparotomy

- To determine blood/abdominal contents in abdomen – consider CT, FAST or DPL
- DPL – should be done supraumbilical
  - Positive if gross blood or intestinal contents or >500,000 RBC/mm³ or >500 WBC/mm³ or gram stain demonstrating bacteria
- Moreno et al. (J Trauma 1986:26:987-989) and Evers et al. (Arch Surg 1989;124:422-424) both showed DPL to be an effective screening device for intraperitoneal bleeding
  - Evers et al. noted that DPL only effective if gross blood shown – high false + if relying on lavage – migration of RBC’s from pelvis
Angiography +/- Embolization

- Overall, 7-11% of pelvic # will require embolization
- Only 2% of lateral compression # have arterial hemorrhage
- 20% of APC, vertical shear and combined mechanical have arterial hemorrhage
- Posterior arterial bleeding more common – internal iliac and branches – superior gluteal and lateral sacral artery most common
- Anterior bleeding rare – usually damaged in LC – pudendal or obturator arteries most common anteriorly
Angiography +/- Embolization

(J Trauma 1998 Jun;44(6):941-56)

- Consider in pt’s with:
  - Ongoing bleeding after non-pelvic sources of blood loss have been r/o
  - Major pelvic #, bleeding in pelvis that cannot be controlled at laparotomy
  - Evidence of arterial extravasation of IV contrast on CT
Pelvic Fracture Algorithm

- Exsanguination with/without open pelvic # - BP<70 mmHg
- Initial ABC’s
- If open fracture – go to OR for celiotomy
- If closed:
  - Supraumbilical DPL or FAST
    - If positive – OR and fixation of pelvis
    - If negative – apply fixation
- Hemodynamicall abnormal:
  - angiography
Algorithm

- BP stabilizes with difficulty and closed/unstable # - BP = 90-110 mmHg
- ABC’s
- DPL, FAST or CT
  - If positive – OR and fixation
  - If negative – fixation
- Hemodynamically abnormal:
  - angiography
**Algorithm**

- BP normal and closed/unstable or stable # - BP=120 mmHg
- ABC’s
- Evaluate for other injuries
  - PE, CT
- Apply fixation device if needed for mobility
Complications

- Can be divided into early and late
- Early:
  - Hemorrhage and coagulopathy
  - Urethral injury – 3 types related to severity of damage to membranous urethra
  - Peripheral nerve injury - # near SI or sacrum – injure sacral plexus. # near greater sciatic notch – injure sciatic nerve
  - Bladder injury
    » extraperitoneal injury (80%) – laceration of bladder from pelvic fragments
    » Intraperitoneal (20%) – direct pressure on full bladder
Complications

- Late:
  - Infection – pelvic hematoma, ex. fix. or usual post op infections
  - Thromboembolic disease
  - Pain/OA
  - Malunion or non union of fracture sites
Summary

- Pelvic fractures are common in trauma setting and can carry high mortality.
- Understanding anatomy and angle of force of impact can help predict severity/location.
- Look for associated injuries.
- Consider ex. fix., laparotomy, arteriogram as needed.
- Check for complications initially and on ward.