Mechanism of Injury
OBJECTIVES

- Review anatomy of the pelvis and the vessels that pass through it
- Identify the different types of pelvic fractures and how they are caused.
- Discuss the traumatic nature of pelvic injuries and why they are a life or death emergency.
- Discuss the pelvic binder and it’s proper placement
- Identify the treatment of pelvic injuries both pre-hospital and at the trauma center.
- Katelyn Morrison case study
The Sacrum & Pelvis

- Anterior superior iliac spine
- Coccyx
- Obturator foramen
- Inferior pubic ramus
- Iliac crest
- Sacrum
- Ilium
- Sacroiliac joint
- Greater sciatic notch
- Iliac spine
- Greater trochanter of femur
- Lesser sciatic notch
- Ischial tuberosity
- Lesser trochanter of femur
- Pubic arch
- Pubic symphysis
TYPES OF PELVIC FRACTURES

- **RED** arrow shows the direction of force applied.
- Lateral compression fractures are most likely seen in falls and vehicle crashes.
- AP compression fractures are more likely to be motorcycle, ATV, bikes crashes or vehicle crashes where the force is from a specific object.
- Vertical shear fractures are most likely the result of severe impact to one leg or another. This could come from falls where they land on their feet or crashes where the patient had their feet and legs elevated.
Sacral Fracture
Vertical shear fracture
Malgaigne fracture is an unstable type of pelvic fracture, which involves one hemipelvis, and results from vertical shear energy vectors.
Organs near pelvis
- Parts of digestive system
- Reproductive organs
- Bladder and urethra

Blood Vessels run through and around
- Right and left iliac arteries from off aorta
- Right and left iliac veins returning from legs
- Blood vessels supplying pelvis and tissues around pelvis
VASCULATURE AND NERVES

- Many arteries and veins both pass through as well as feed the pelvic area.
- Many nerves coming from the spinal cord pass through as well as terminating in the pelvic area.
- Most of these vessels and nerves sit in areas where fractures are most commonly seen.
Arteries bleed extensively and are hard to tamponade

Surgery is the definitive care for these patients

Most pelvic areas will hold the majority if not all of the patient’s blood volume.
Shock is a medical emergency in which the organs and tissues of the body are not receiving an adequate flow of blood. This deprives the organs and tissues of oxygen (carried in the blood) and allows the buildup of waste products. Shock can result in serious damage or even death.
PELVIC TRAUMA AND SHOCK

- The definitive care for patients with pelvic trauma involving one or more arteries is the operating room.
- Pelvic binders simply tamponade the bleeding in an effort to help the patient survive the trip to the operating room.

<table>
<thead>
<tr>
<th>Fracture</th>
<th>Blood Loss (mL)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Single rib</td>
<td>125</td>
</tr>
<tr>
<td>Radius or ulna</td>
<td>250–500</td>
</tr>
<tr>
<td>Humerus</td>
<td>750</td>
</tr>
<tr>
<td>Tibia or fibula</td>
<td>500–1000</td>
</tr>
<tr>
<td>Femur</td>
<td>1000–2000</td>
</tr>
<tr>
<td>Pelvis</td>
<td>Massive</td>
</tr>
</tbody>
</table>
## Assessment of Stages of Shock

<table>
<thead>
<tr>
<th>% Blood Volume Loss</th>
<th>&lt;15%</th>
<th>15 - 30%</th>
<th>30 - 40%</th>
<th>&gt;40%</th>
</tr>
</thead>
<tbody>
<tr>
<td>HR</td>
<td>&lt;100</td>
<td>&gt;100</td>
<td>&gt;120</td>
<td>&gt;140</td>
</tr>
<tr>
<td>SBP</td>
<td>Normal</td>
<td>Normal to slight drop, orthostatic</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Pulse Pressure</td>
<td>Normal or ↑</td>
<td>↓</td>
<td>↓</td>
<td>↓</td>
</tr>
<tr>
<td>Cap Refill</td>
<td>&lt; 3 sec.</td>
<td>&gt; 3 sec.</td>
<td>&gt; 3 sec. or absent</td>
<td>Absent</td>
</tr>
<tr>
<td>Resp</td>
<td>14 - 20</td>
<td>20 - 30</td>
<td>30 - 40</td>
<td>&gt;35</td>
</tr>
<tr>
<td>CNS</td>
<td>Anxious</td>
<td>Very Anxious</td>
<td>Confused</td>
<td>Lethargic</td>
</tr>
<tr>
<td>Treatment</td>
<td>1-2 Liters Crystalloid and Maintenance</td>
<td>2 Liters Crystalloid, Re-evaluate</td>
<td>2 Liters Crystalloid, Re-evaluate, replace blood loss 1:3 crystalloid, 1:1 colloid or blood products.</td>
<td></td>
</tr>
</tbody>
</table>
Most common mechanism of pelvic fractures:
- MVC 58%
- Falls 30%
- Pedestrian struck by vehicle 22%

Associated injuries with pelvic trauma:
- Venous hemorrhage 38%
- Visceral injury 17%
- Nerve deficits 15%
- Bladder/Urethra injury 6%
- Thoracic aorta rupture 1%
MORBIDITY AND MORTALITY ASSOCIATED WITH PELVIC TRAUMA

- Pelvic fractures represent approximately 3% of skeletal injuries

- Overall mortality of pelvic fractures ranges from 5%-16%
  - Acetabular fractures 3%

- Unstable pelvic fractures have a rate of approximately 8%
  - Open pelvic fractures are associated with a rate of up to 45%
  - These comprise of 2%-4% of all pelvic fractures

- Most fatalities stem from associated internal injuries
PELVIC FRACTURE MANAGEMENT OF THE UNSTABLE PATIENT

- **ABC’s & initial stabilization** (IV access, crystalloid, blood products)
- Application of *Pelvic Sheet/ Binder/ External fixator* (open-book with intact posterior ligaments has most potential for benefit)
- **Adjuncts:** Foley (but not if blood at meatus)
- **FAST** to assess for intraperitoneal injury (and help with disposition – laparotomy vs. angio)
- **AP pelvis**
- ABX (Ancef) and Tetanus if open.
STABILIZATION

- Pelvic Binder
  - Commercial device that can be used for prehospital and emergent stabilization of pelvic fractures.
  - In APC ("open-book") fractures, use of a pelvic binder will close the ring and tamponade venous bleeding.
  - An improvised binder can be made using a sheet to provide circumferential compression around the pelvis.
- Skeletal Traction – May be used to correct vertical displacement of the hemi-pelvis.
STABILIZATION

- One of the commercial devices being widely used in MD.
- Comes in 3 sizes
  - Small: 27”-47”
  - Standard: 32”-50”
  - Large: 36”-60”
- Standard size fits 98% population
- Radiolucent (allows for x-rays without removal)
- Reusable

The objective was to determine the efficacy and optimal application parameters of circumferential compression to reduce external rotation-type pelvic fractures.

Used cadavers as subjects

The conclusion was significant;

Application of circumferential compression to the pelvic soft tissue envelope with a pelvic strap was an efficient means to achieve controlled reduction of external rotation-type pelvic fractures. This study derived application parameters with direct clinical implication for noninvasive emergent management of traumatic pelvic ring disruptions.
Still a pilot program.

PELVIC BINDER PLACEMENT

- Should be centered at the level of the greater trochanter
- This also the lower 1/3 of the pelvis.
- Patient needs to be in a supine position
- The binder can be placed on a backboard prior to placing the patient on the board to reduce movement and disruption of the pelvic fracture.
- The binder should be tightened to manufacturer’s instructions for that specific device.
- Once the device is placed it is not to be removed until directed to do so by the physician.
Incorrect Placement

- Without Binder
- With Binder

- Bladder Lives Here

- Over-Reduced Pelvis
CASE STUDY:

KATELYN MORRISON 18 YOF

Motorcycle Crash August 14, 2015
Ritchie Highway/ Cedar Hill Lane
Glen Burnie, MD
Katelyn was the rear passenger on a motorcycle driven by her boyfriend.

Left the traffic light at the prior intersection at a high rate of speed (estimated by the boyfriend at between 80-90 mph)

After cresting a hill there was a passenger vehicle stopped in the road to make a U-turn.
Dispatched at 2137 hrs. for an MVC

No initial or additional information that this involved a motorcycle while en-route.

Even after arrival of 1st due units there was no update as to the seriousness of the crash or that it involved a motorcycle.
ARRIVAL

- We arrived at 2144 hrs. (9 min after the 911 call)
- This was the 1st vehicle we saw, pulled into the entrance to a cemetery.
- As we got closer to the scene we were able to see a patient lying in the road being cared for by the 1st due paramedic unit.
- Quick scene survey and communication with the paramedics caring for the patient in the road.
MOTORCYCLE VS. CAR

- Left the previous red light at a high rate of speed.
- Estimated by the driver of the MC at 80-90 MPH
- Crested the hill and did not see the stopped vehicle in time.
- Struck the right rear of the vehicle ejecting both riders.
The initial patient (male) was surrounded by a large amount of blood but was being cared for.

We were told that there was a second patient further down the road being cared for by the 1st due engine company (BLS only).

Due to the distance to the patient, I asked that the medic unit be moved closer.

This distance was later estimated at greater than 150'.

Our patient was lying in the road also, with the BLS providers attempting to splint an open FX to the left forearm.

Wide-eyed look by all providers on scene.

THE PATIENT
Initial visual survey found an approx. 18 yo patient with multiple extremity fractures.

Approach was from the feet of the patient and due to the position of both legs (90 degrees to pelvis) the appearance was that this was a male patient with injuries to his genital area.

Initial patient contact found a responsive female patient in an extreme amount of pain with multiple critical injuries.

The most critical being an obvious pelvic injury as evidenced by the current position of both legs. There were no distal pulses in either leg.

Her injuries required immediate intervention.
A set of vitals was obtained by the BLS providers as Fentanyl was being prepared for administration by my partner.

50 mcg Fentanyl was given intra-nasally. This wasn’t the optimum dose for the patient but time was critical but this was an immediate dose prior to relocation of her legs.

A long board was placed next to the patient with a pelvic binder in place on the board.

Both legs were grasped and pulled back to midline and down to a neutral position with pulses restored to both legs.

The pelvic binder was placed due to the legs wanting to separate at the pelvis and the patient was moved to the board.

THE PATIENT
The patient was loaded and a driver taken from the engine company in order for both providers to be with the patient.

Shock Trauma was approx. 10-12 miles away.

IO location was difficult due to fractures to almost all extremities

Vitals at 5 min intervals

BP dropping along with consciousness and respiratory effort

LR hung running WO. Pressure bag on.

O2 via NRB with BVM ready for use if needed

HR increasing

Expedited report via EMRC with expectations of patient being in possible cardiac arrest upon arrival.
ARRIVAL AT SHOCK TRAUMA

- Turned over to Bed #1
- Second pelvic binder placed immediately by shock trauma over our binder.
- FAST exam and assessment
- And a whole lot more....
- **Chest:** Lateral fractures of the left ribs 3-9. Lateral fractures of the right ribs 4-6 without significant dislocation. Left pneumothorax. Contusions of the left upper lobe. Atelectasis in both lower lobes.

- **Pelvis:** Anterior-posterior compression type fracture of the pelvis with 5.5 cm dehiscence of the symphysis, bilateral dislocation pubic rami fractures and right SI joint dehiscence.

- **Thoracic Spine:** Fractures of T3, T10, T11 and burst fracture of T12 with ventral dislocated fragments of the anterior vertebral body and into the spinal canal.

- **Upper Ext:** Comminuted mid diaphyseal fractures of the radius and ulna on the left arm. Comminuted fracture of the distal radial metaphysis with shortening. A radially displaced fracture of the fifth metacarpal neck.

- **Lower Ext:** Posteriorly displaced fracture of the right lateral malleolus.

**INJURIES AFTER INITIAL WORK-UP**
Could this really be the same patient we expected to have a fatal outcome?
LOTS OF HARD WORK TO COME!
Thank you!

- Of course you & Denise
- Jessica Manning - ICU Nurse
- Kate Heikes - ICU Nurse
- Melissa Perry - OT therapist at Rehabilitation
- Jessica Lewis - PT therapist at Rehabilitation
- Karla Morrison - Mother
- Amy Partin - Aunt / RN
- Ryan Neal - Boyfriend
1) Pelvic Trauma, Atlas of Pelvic Fractures. Beth Israel Deaconess Medical Center. Dorothy Tamayo, MS3 and Dr. Gillian Lieberman, MD. 2011.

2) EMS Magazine. The Pelvic Fracture, Stabilization in the Field. Michael Bottlang, PHD and James C. Krieg, MD. 2003


5) PHTLS. Mosby. 2007


10) University of MD. Medical Records for Katelyn Morrison. 2015-2016.