Initial Pelvic Fracture Management

Patrick M Reilly MD FACS

February 27, 2010
John Pryor MD
Field Triage*

* Step One : Physiology
* Step Two : Anatomy
* Step Three : Mechanism
* Step Four : Co-Morbid Conditions

Bleeding Disorder
Anticoagulants

ACS-COT 1999
Field Triage*

* Step One: Physiology

- Increased / Decreased Heart Rate
- Decreased Blood Pressure
- Increased / Decreased Resp Rate
- Decreased Mental Status

ACS-COT 1999
Field Triage*

* Step Two : Anatomy

- Penetrating Trauma Head / Neck / Torso / Proximal Extremities
- Significant Ortho Injuries
- Paralysis
- Amputation Proximal to Wrist & Ankle
- Burn Issues

ACS-COT 1999
Field Triage*

* Step Three : Mechanism
  Falls > 20 Feet
  Rollover
  High Speed Crash
  Ejection
  Others

ACS-COT 1999
Field Triage*

* Step Two : Anatomy

– Penetrating Trauma Head / Neck / Torso / Proximal Extremities

– **Significant Ortho Injuries**

– Paralysis

– Amputation Proximal to Wrist & Ankle

– Burn Issues

ACS-COT 1999
Pelvic Fractures in PA

* May 2001 PTSF Report - 5 Year Review
* 9% of all PTOS Patients
10% of all HUP PTOS Patients
* Mean Hospital LOS 11.3 days
* Mean Hospital LOS - HUP 13.7 days
Pelvic Fractures in PA

* Multiple Injuries
  Mean ISS - PTOS 12.7
  Mean ISS - Pelvis 18.7
  Mean ISS - Pelvis/HUP 20.5

* Head Injury 30%
* Torso Injury 40%
* Upper Ext Fracture 26%
* Lower Ext Fracture 31%
Pelvic Fractures in PA

* Complications
  PTOS 16%
  PTOS / Pelvis 30%

* Mortality
  PTOS 7.4%
  PTOS / Pelvis 9.6%
  PTOS / Pelvis / HUP 9.3%
  Pelvis - ISS ≥ 34 50%
Anatomy

- Close Apposition of Vital Structures
  - iliac artery and vein
  - superior gluteal artery
  - bladder/prostate
  - rectum/vagina
  - sacral plexus
Anatomy

• No Inherent Stability Without Ligaments
  – anterior
    • symphysis pubis
  – sacrotuberous and sacrospinous ligaments
  – posterior
    • anterior SI ligament
    • posterior SI ligament
    • iliolumbar ligament
Exam of Pelvis

- Deformity of pelvis
- Leg length difference
- Abrasions/swelling over pelvis
- Scrotal/labial swelling
- GU--blood at meatus
- Stability--pelvic rock and push pull
- Rectal exam--perineal tears prostate position
• Pelvic Fracture Recommendations
• Mechanical Stability (Difficult to Assess)
  – Asymmetry of Legs
  – Pain in Pelvis
  – Pain on Hip Motion
  – Swelling / Tenderness at Symphysis

Prehospital & Disaster Med 2007
Prehospital Care of Orthopedic Injuries

Eitan Melamed, MD; Amir Blumenfeld, MD; Boaz Kalmovich, MD; Yona Kosashvili, MD; Guy Lin, MD; The Israel Defense Forces Medical Corps Consensus Group on Prehospital Care of Orthopedic Injuries*

• Stabilization for Transport
• Reducing Pain
  – Circumferential Compression of Pelvis
    • Sheet or Binder
  – Spine Board / Collar
  – Bind Legs Together

Prehospital & Disaster Med 2007
Prehospital Diagnosis Difficult
- Altered Mental Status
- Pelvic Pain Complaint Most Common
- Pain on Exam Exam Unreliable

Importance of Mechanism of Injury
• Read the mechanism of injury.
• Ask the alert patient about the presence of pain in the pelvic, back or groin regions and routinely immobilise the pelvis if there is any positive reply.
• Examination is unreliable (especially if reduced GCS, or distracting injuries) and the pelvis should not be palpated, to avoid further internal haemorrhage.
• If there is any suspicion of fracture, immobilise the pelvis using an external compression splint (commercial or modified eg. sheet).
• Do not fully log roll the patient.
• Use a scoop stretcher to facilitate the patient’s movement on to a spinal board or vacuum mattress for transport. In the emergency department, this process should be reversed.
• Fluid resuscitation to maintain a radial pulse only.
• Do not remove a pelvic splint in the presence of a suspected unstable pelvic injury until it is radiologically confirmed that there is no fracture or the patient is in a theatre.
Trauma Pelvic Orthodic Device
TPOD - Potential Advantages

- Stabilizes Pelvis
- Closes Pelvic Volume
- Noninvasive
- Rapid
- Angiography and Laparotomy Compatible
TPOD - HUP Data

- 23 patients
- Imaging After TPOD and Definitive Fixation
- No Difference:
  - Pubic Diastasis
  - Pelvic Cross-Sectional Area
  - Pelvic Volume

AAST 2003
TPOD - Data

- 93 TPOD vs 93 EX-Fix patients
- TPOD Group
  - Less Transfusion
  - Shorter LOS
  - Decreased Mortality (26% vs 37%)*

* $p=0.11$

JACS 2007
Evaluation

• Follow ATLS principles (ABC’S)

• Primary and secondary survey

• Find source of bleeding
  – Major lacerations
  – Occult
    • chest--CXR
    • abdomen--DPL / FAST
    • pelvis--AP pelvis
Radiographic Evaluation

- AP pelvis--adequate initial evaluation for 90-95% cases
Pelvic X-ray

• ATLS Recommendation
  All blunt trauma patients
  Pelvic architecture
    Hemodynamically significant fractures
  Hip dislocation
Radiographic Evaluation

• CT--best view of posterior ring
CT Abdomen/Pelvis

- Commonly used diagnostic modality
- Rapid interpretation
  - Solid organs
  - Retroperitoneal structures
  - Orthopedic injuries
Flow Chart

Blunt Trauma

Hemodynamically Stable

Reliable Physical Exam

Positive Physical Findings

CT planned

No PXR
Flow Chart

Blunt Trauma

Hemodynamically Stable

PXR

Reliable Physical Exam

PXR

Positive Physical Findings

PXR

CT planned

No PXR
Positive Physical Exam
Acute Stabilization Methods

- Tied sheet
- Sand bags
- Lateral decubitus positioning
- Traction
- MAST Trousers
- External Fixation
- Pelvic clamp
External Fixation
External Fixation vs MAST

- Hemorrhage control
  95% vs 71% success
- Transfusion
  3.7u vs 7.4u pRBC
- Mortality (hypotensives)
  21% vs 41%
- Overall mortality
  6% vs 26%
- Mortality with closed
  head injury 7% vs 43%
Pelvic Clamp
Trauma Pelvic Orthotic Device
Ongoing Hypotension : Now What?

• Chest Source
• Abdominal Source
  – FAST Exam
  – Supra-umbilical DPL
• Gross Blood
• Negative - Angiography
Arteriography

• Persistent Hemodynamic Instability
Arteriography

• Contrast Extravasation
CT Contrast Extravasation

- **604 Patients**
  - **42 Contrast Extravasation**
    - 26 Angiograms
    - 19 IR Contrast Extravasation
    - 45% Positive Rate
  - **562 No Contrast Extravasation**
    - 6 Angiograms
    - 2 IR Contrast Extravasation
    - 0.4% Positive Rate

J Trauma 2007
Ongoing Evolution of IR

* Traditional - Diagnostic Tool
  Penetrating Proximity Injuries
  Neck
  Trans - Mediastinum / Pelvis
  Extremity
  Blunt
  Aorta
Ongoing Evolution of IR

* Traditional - Patient Population
  * Hemodynamically Stable
  * Potential for Significant Injury
    * Statistically Low
  * Trauma Surgeon Role
  * Coffee / Donuts
    * Nap
Ongoing Evolution of IR

* Current - Therapeutic Tool
  Bleeding Control
  Pelvis
  Solid Organs
  Soft Tissue
  Vascular Patency
  Subclavian
Ongoing Evolution of IR

* Current - Patient Population
  Hemodynamically Unstable/Meta-Stable
  Potential for Significant Injury
  They Have It
  Trauma Surgeon Role
  Direct Resuscitation
  Team Leader
# Ongoing Evolution of IR: HUP Data

<table>
<thead>
<tr>
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<tr>
<td>Patients</td>
<td>1677</td>
<td>3073</td>
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<td>Angio/100 PT</td>
<td>7.1</td>
<td>4.0*</td>
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<tr>
<td>% Therapeutic</td>
<td>10%</td>
<td>22%*</td>
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*p < 0.05

AAST 2003
IR Therapy: Data

* Vascular Patency
  Case Reports
  Case Series

* Hemorrhage Control
  Retrospective Reports
IR Therapy: Data - Liver

* 40 DC patients
* 37 complete medical records
* 19/37 (51%) had hepatic injuries
* 8/19 patients (42%) underwent angiography
  7 post-operatively
  1 pre-operatively
AAST Grading of Hepatic Injuries

*\ p = < 0.01
## IR Therapy: Data - Liver Operative Phase

<table>
<thead>
<tr>
<th>Parameter</th>
<th>AG+</th>
<th>AG-</th>
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<tbody>
<tr>
<td>LpH</td>
<td>7.15</td>
<td>7.17</td>
<td>0.82</td>
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<tr>
<td>LBE</td>
<td>-10.8</td>
<td>-10.0</td>
<td>0.81</td>
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<tr>
<td>LTemp (C)</td>
<td>34.9</td>
<td>34.3</td>
<td>0.37</td>
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<tr>
<td>SBP (mmHg)</td>
<td>107</td>
<td>119</td>
<td>0.34</td>
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## IR Therapy: Data - Liver Operative Phase

<table>
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<th>Fluid</th>
<th>AG+</th>
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<tr>
<td>Cryst (L/hour)</td>
<td>4.5</td>
<td>2.6</td>
<td>0.04</td>
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<tr>
<td>PRBC (units/hour)</td>
<td>8.7</td>
<td>5.9</td>
<td>0.37</td>
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<tr>
<td>FFP (units/hour)</td>
<td>1.8</td>
<td>2.4</td>
<td>0.60</td>
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<tr>
<td>Plts (units/hour)</td>
<td>5.2</td>
<td>1.9</td>
<td>0.12</td>
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IR Therapy: Data - Liver

Angiographic Phase

* Angiography in 8/19 patients (42%)
* Overall therapeutic embolization rate 87%
* All AG patients were AAST grade IV
* No rebleeding
## IR Therapy: Data - Liver ICU Arrival

<table>
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<th>Parameter</th>
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<th>AG-</th>
<th>p value</th>
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<td>pH</td>
<td>7.30</td>
<td>7.29</td>
<td>0.83</td>
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<tr>
<td>BE</td>
<td>-5.7</td>
<td>-4.7</td>
<td>0.67</td>
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<tr>
<td>LAC</td>
<td>4.6</td>
<td>4.7</td>
<td>0.99</td>
</tr>
<tr>
<td>Temp</td>
<td>35.1</td>
<td>35.1</td>
<td>0.96</td>
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<tr>
<td>PT</td>
<td>16.4</td>
<td>16.5</td>
<td>0.91</td>
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IR Therapy : Data

* LA County / USC
* Intraperitoneal
* Retroperitoneal
* 7 Year Review

Increased Utilization over Time Period

World J Surg 2000
IR Therapy: Data

* 137 Patients
  97 Pelvis
  26 Liver
  12 Kidney

* 102 Attempted Embolizations
  91% Success Rate

* No Major Morbidity Reported

World J Surg 2000
IR Setup

* Trauma Team Present - Continuously
* Dedicated Critical Care Nurse
* Hypothermia Measures
* Trauma Team Leader Maintains Role

Think Ortho Relationship

The ICU is taken to the patient in IR
Repeat Angiography

* Ongoing Hemorrhage
* 31/678 IR for Pelvic Fractures
  16 Embolized
    3 Repeat Embolization
  15 Negative Studies
    5 Repeat Angiography
  4 Initial Embolization

J Trauma 2005
Other Options

• Direct Preperitoneal Packing

J Trauma 2007
Direct retroperitoneal pelvic packing versus pelvic angiography: A comparison of two management protocols for haemodynamically unstable pelvic fractures

Patrick M. Osborn\textsuperscript{a}, Wade R. Smith\textsuperscript{a}, Ernest E. Moore\textsuperscript{b}, C. Clay Cothren\textsuperscript{b}, Steven J. Morgan\textsuperscript{a}, Allison E. Williams\textsuperscript{a,c}, Philip F. Stahel\textsuperscript{a,*}

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\textsuperscript{c}Eastern Colorado Health Care System, Denver Veteran's Affairs Medical Center, Denver, CO 80220, USA

• Retrospective Review
  – 20 Patients per Group
  – Faster to Intervention
  – Less Transfusion Requirements
  – Trend Towards Improved Survival

Injury 2009
What To Do?

J Trauma 2008
Who Do You Call?

- Blood Bank
- Interventional Radiology
- Operating Room?
  - Emergently
- Not Orthopaedic Surgery
Trauma Patient 641/04
Prehospital

• Unrestrained Driver MVC
• Multiple Injuries
• RSI Prehospital
• PennStar
Trauma Patient 641/04
Primary Survey

- A = Intubated
- B = Bilateral BS
- C = Weak L Pedal Pulses; No Pulses on R
- D = GCS 3
- E = Done
Trauma Patient 641/04
Secondary Survey

- Hypotensive
- R Chest Crepitance
- Pelvic Instability
- R Leg Deformities
Trauma Patient 641/04
Dx and Simultaneous Tx

• CXR
• Pelvic Xray
• FAST
• IV Access
• Volume
Trauma Patient 641/04
Treatment and Decision Making

• R Chest Tube
• TPOD
• Trauma Exsanguination Protocol
• Rapid Head CT
• OR - Laparotomy
• IR Notification
Patient 641/04
Operating Room

- 35 Minutes Post Arrival
- Mesenteric Injury
- Splenic Injury
- Pelvic Hematoma
- Damage Control
Trauma Patient 641/04
Operating Room

• OR Labs
  – pH 7.02
  – Base Excess -16.6
  – Hgb 6.0
  – iCa 0.54
Trauma Patient 641/04
Interventional Radiology

• Bleeding Control
• Further Diagnostic Studies
  – R Leg
  – Aorta
  – Bladder
• Ongoing Resuscitation
Trauma Patient 641/04
Intensive Care Unit

- Ongoing Resuscitation
- Cold / Coagulopathic
- Ongoing Bleeding
  - R Chest
  - Fractures
  - Abdomen
- Factor VIIa
Trauma Patient 641/04
Intensive Care Unit

- Eventual Physiologic “Capture”
- Definitive Fracture Care
- Definitive Aortic Repair
- Slow Improvement
- Neurologically Intact
- ISS = 50
Trauma Patient 641/04
Initial 24° Blood Requirements*

• 41 Units pRBCs
• 16 Units Plasma
  – 4 Units Stored Plasma
  – 12 Units FFP
• 7 - “4 Packs” Platelets

* Actually….14 hours
Conclusion

• Pelvic Fractures - Severe Injuries
• CT vs Pelvic Film in Select Patients
  – CT in Trauma Bay?
• TPOD
• Angiography During Resuscitation