

Man vs Machine; polytrauma with unstable pelvic Fractures



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Disclosures

- None

Objectives

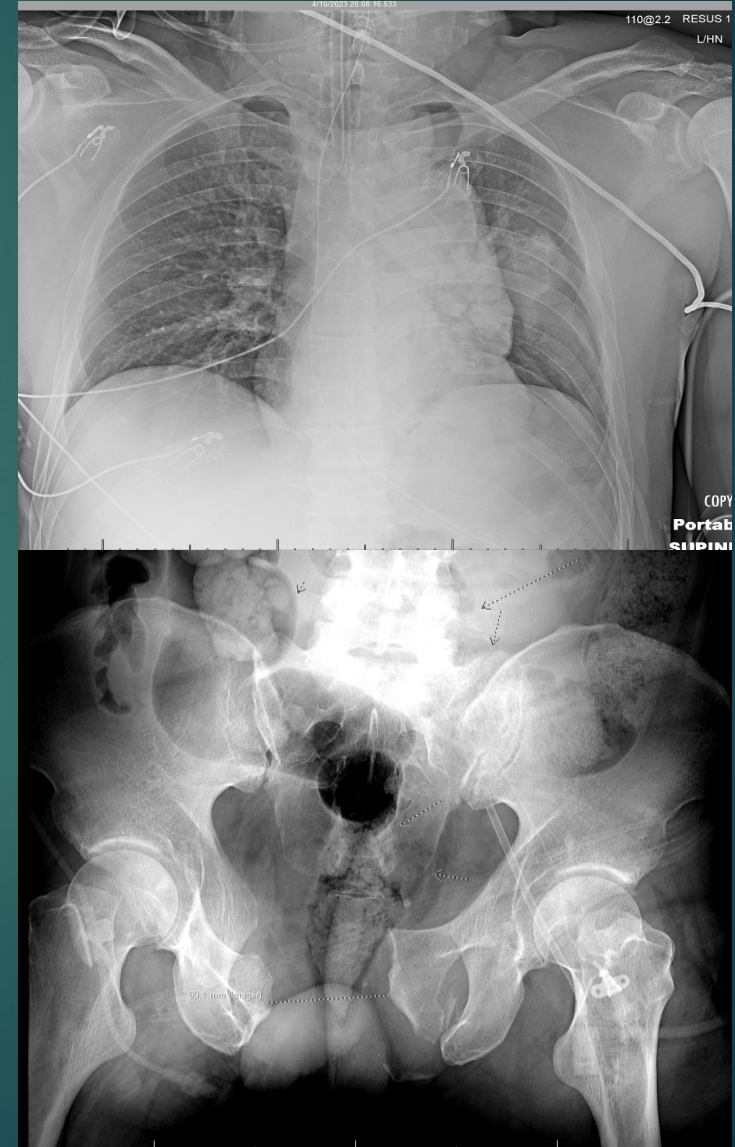
- Discuss a complex poly-trauma case
- Triage management of injuries in a complex poly-trauma patient with multiple life-threatening injuries
- Discuss initial management of unstable pelvic fractures
 - Diagnosis
 - Initial stabilization
 - Hemorrhage control

Patient Presentation

- EMS report
 - 40M who presents after peds v auto, normotensive but minimally responsive, low respiratory drive
 - GCS 1/2/5
 - EMS unable to obtain IV access, Respiratory support w/ BVM initiated
- EDRU findings: (19:34)
 - Pale, cool to touch, minimally responsive
 - Trauma techs unable to obtain IV access
 - Weak distal signals, non-palpable PT/DP bilaterally
 - Had doppler signals BL
 - GCS 1/2/5, SMAE

EDRU course

- Left femoral cordis and arterial line placed
- Large-bore IV access bilateral AC fossa
- Repeat BP with mild hypotension (80s systolic)
 - Given 1u whole blood with response to 100s
 - 250 cc bolus of 3% HTS for presumed head trauma
- Intubated for low GCS (1/2/5) and poor respiratory effort
- FAST negative
- Large posterior scalp laceration, scattered lacerations/abrasions, unstable pelvis, no blood at urethral meatus or on DRE.
- CXR/PXR obtained: Pelvic Binder placed



EDRU course

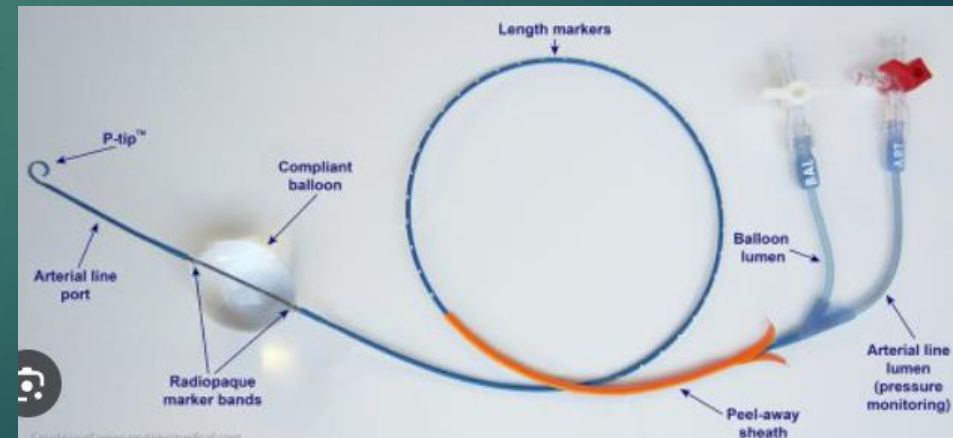
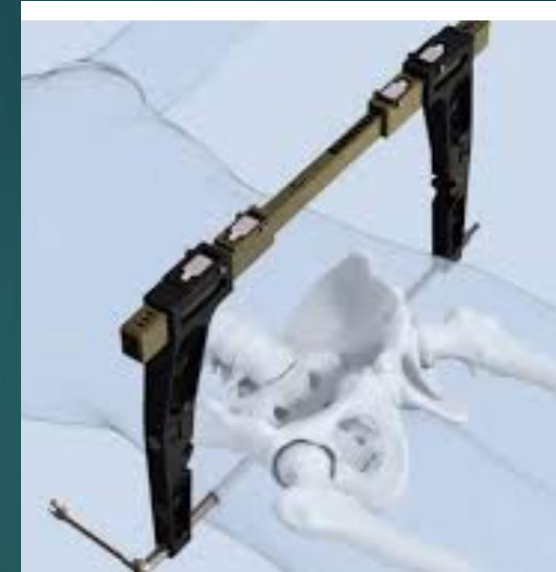
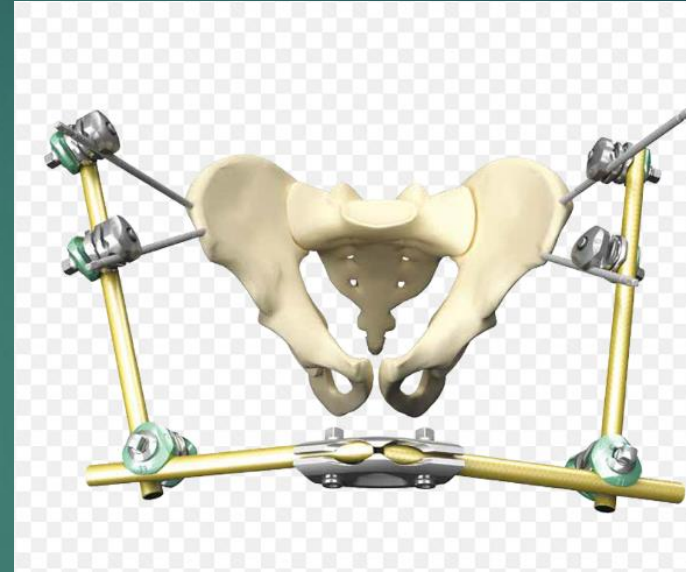
- Becomes hypotensive again to 80s
- Given 2nd unit WB and responds well
- Now what?...

Trauma Alert, Metallica

- Becomes hypotensive again to 80s
- Given 2nd unit WB and responds well
- Now what?...

- CT scanner
- Operating room
- Tube thoracostomy
- Angioembolization
- C-clamp

- External fixation
- REBOA
- Place in cube



Trauma Alert, Metallica

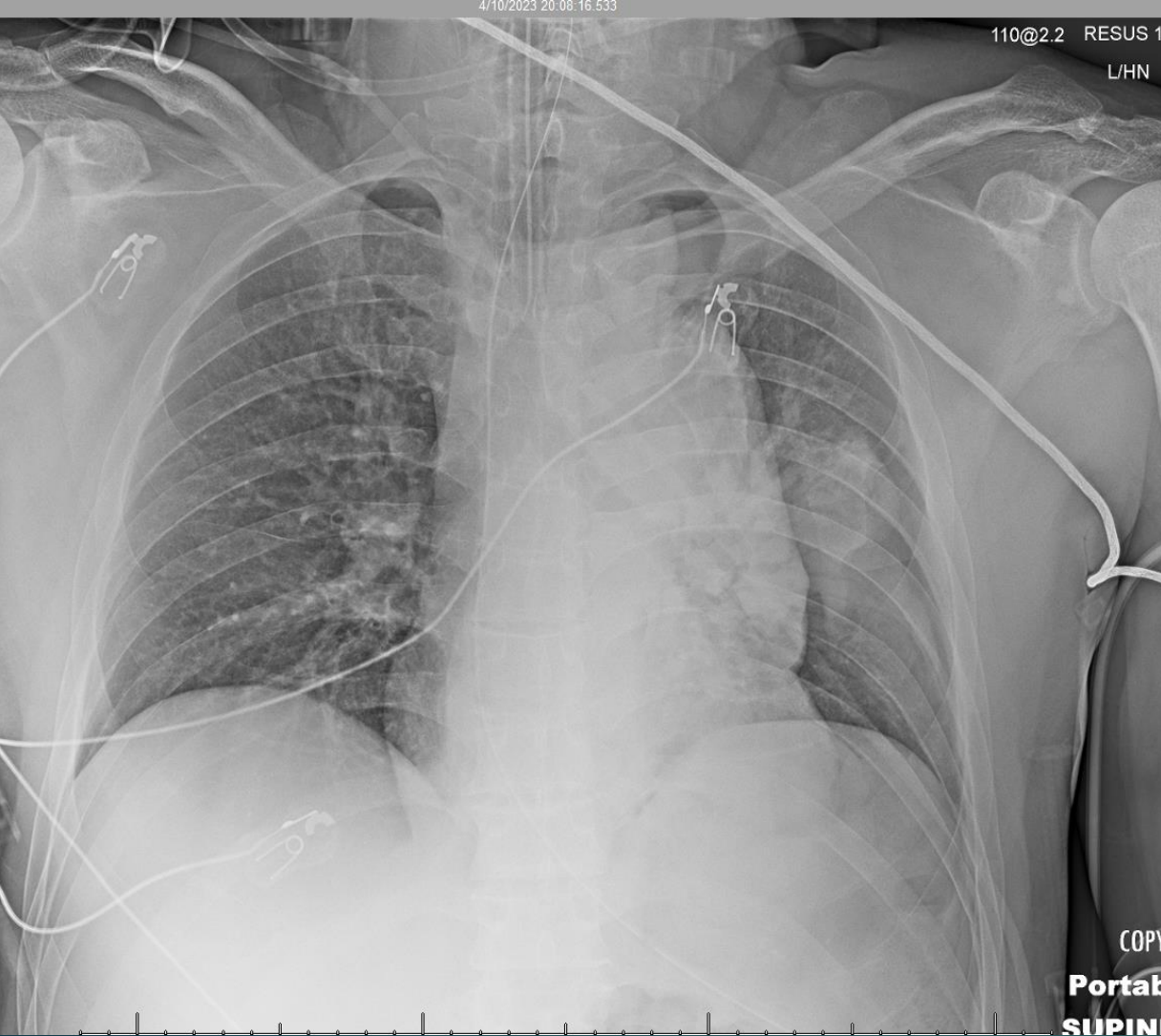
- Taken to CT scanner
 - Large L PTX identified on scout film of chest
- Taken back to trauma bay for left tube thoracostomy
- Required further blood transfusions, MTP was activated
 - 3U whole blood, 2U FFP, 4u vasopressin, and TXA
- Taken to OR emergently



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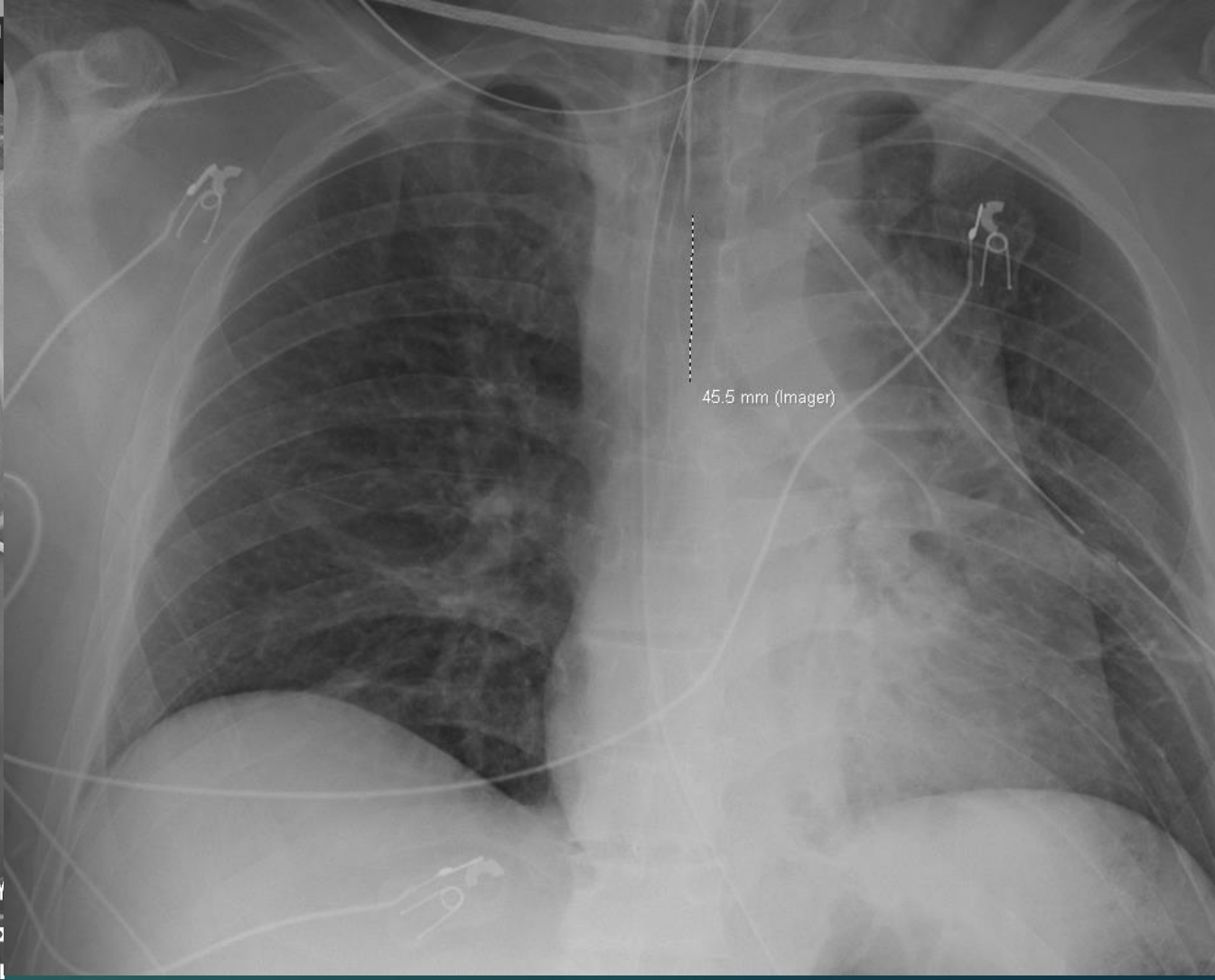
L/HN



COPY

Portab

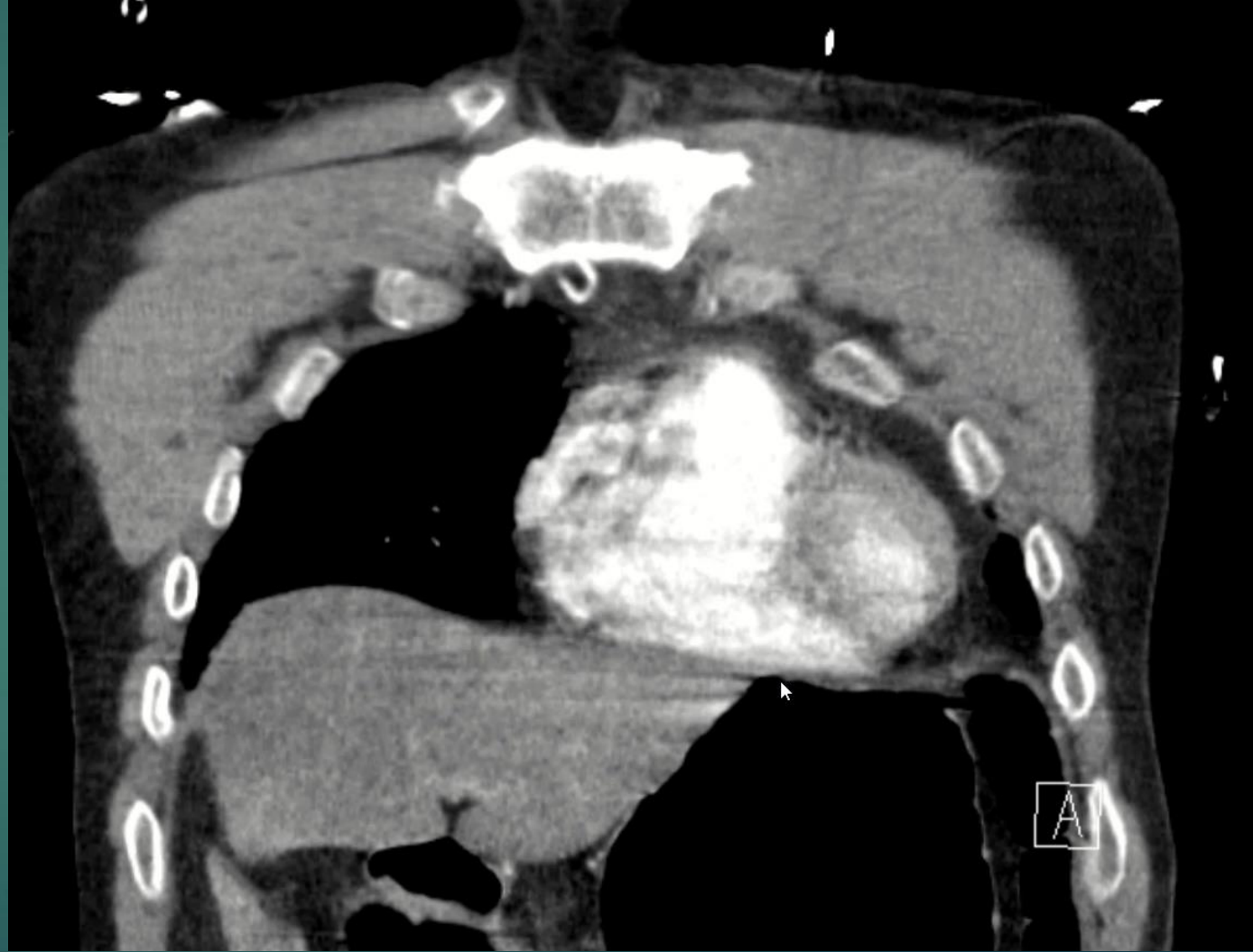
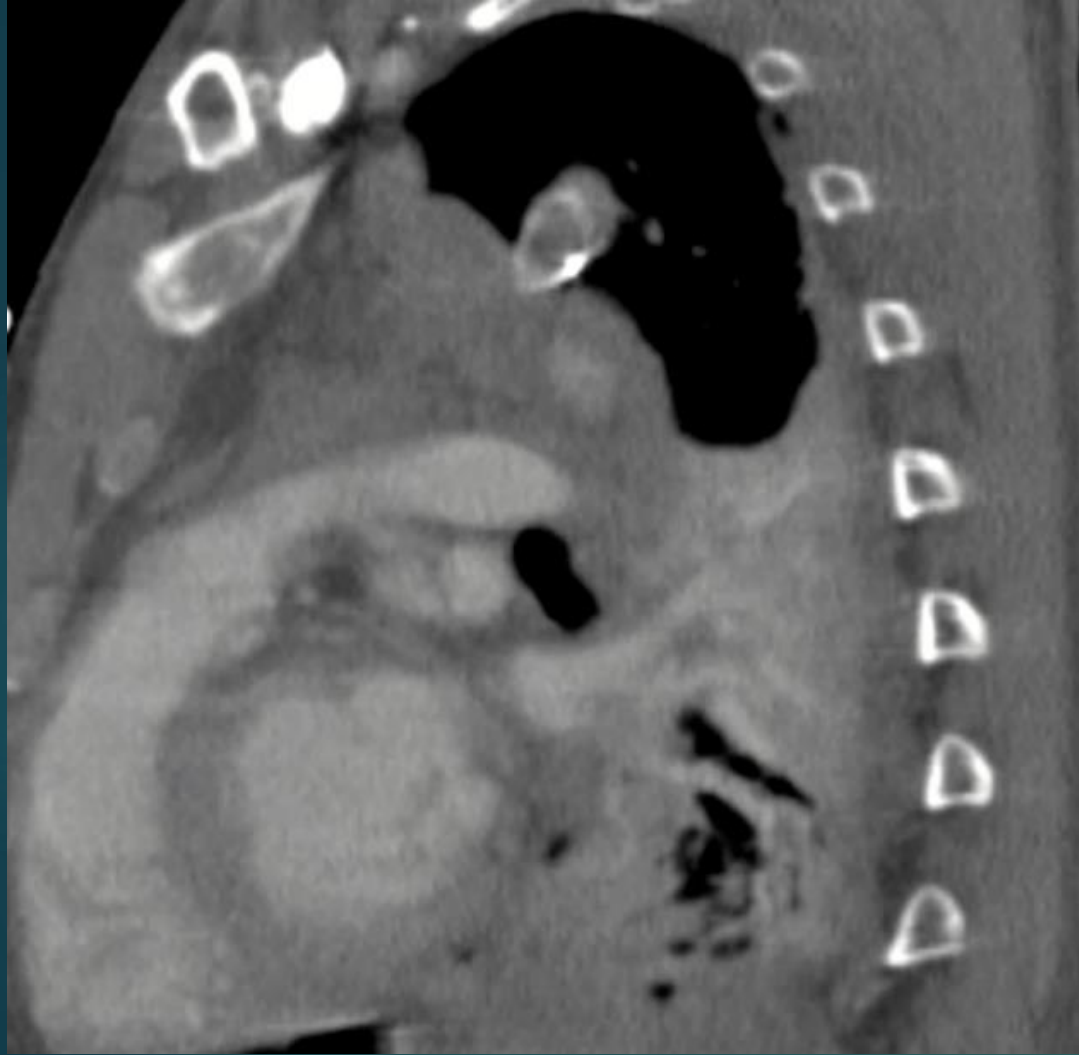
SUPINI



Hospital course: HD 0

- Pre-peritoneal pelvic packing performed (PPP) (~2100)
- Foley balloon identified in preperitoneal space
- Urology consulted
 - Requested CT cystogram
- Hemodynamics stabilized after PPP; laparotomy deferred
 - Continued difficulty with DP/PT pulses, signals present
- Taken from OR directly to CT scanner on way to ICU (~2230)







Trauma Alert, Metallica

- R ICA irregularity concerning for traumatic dissection
- Descending aortic inj, just distal to arch
- L HPTX
- Trace R HPTX
- L 4-9, R 6-8 rib fxs
- T2 vertebral body (with retropulsion)
- T8 vertebral body fx
- Posterior scalp lac
- Extraperitoneal bladder injury
- Urethral injury
- Left de-vascularized kidney (grade 5)
- Right grade 3 kidney inj
- G3 splenic inj
- Low-grade hepatic inj
- Transverse process fx: L3-5
- Left sacral fxs
- Left acetabular fxs
- Open book pelvic fx
- Left fibular fracture
- Right fifth metatarsal fracture



Hospital course: HD 0-1

- Return to the OR with Urology/Trauma
 - Cystoscopy (urethral and bladder neck disruption)
 - suprapubic tube (SPT) placement
- Normotensive post-op, still no DP/PT pulses, weak signals present (~0300)
- CTA of BLE w/ runoff
 - Delays in viewing and formal read
 - Lost LLE signals ~0500,
 - Providers not notified until 0600,
 - Discovered when trauma team got out of OR/ pre-rounding day team
- Taken emergently to OR by vascular for ALI and thoracic aortic injury(0800)

Hospital course: HD 1

- Taken emergently to OR by vascular for ALI and aortic injury (0800)
 - TEVAR
 - Fem-pop-tib artery embolectomies
 - 4-compartment fasciotomy
- Taken back to OR by Trauma/Urology (1500)
 - Removal of peritoneal packing
 - Bladder/ureteral repair and formalization of SPT with Foley placement (Urology)
 - Left nephrectomy
 - Left open for planned second look
 - 2/2 medical oozing from pelvis/L nephrectomy bed which were packed
- Persistent but improving lactic acidosis
- Returned to ICU for continued resuscitation

Hospital course: HD 2-5

- Declining mental status, rCTH c/f worsening cerebral edema
- NSGY placed external ventricular drain (EVD) (1400)
- Returned to OR for 2nd look by trauma (1600)

HD 3

- Lost pulse/signals in LLE, taken back to OR by vascular (0700)
- Pop-tib artery embolectomy
- Good return of pulses/signals

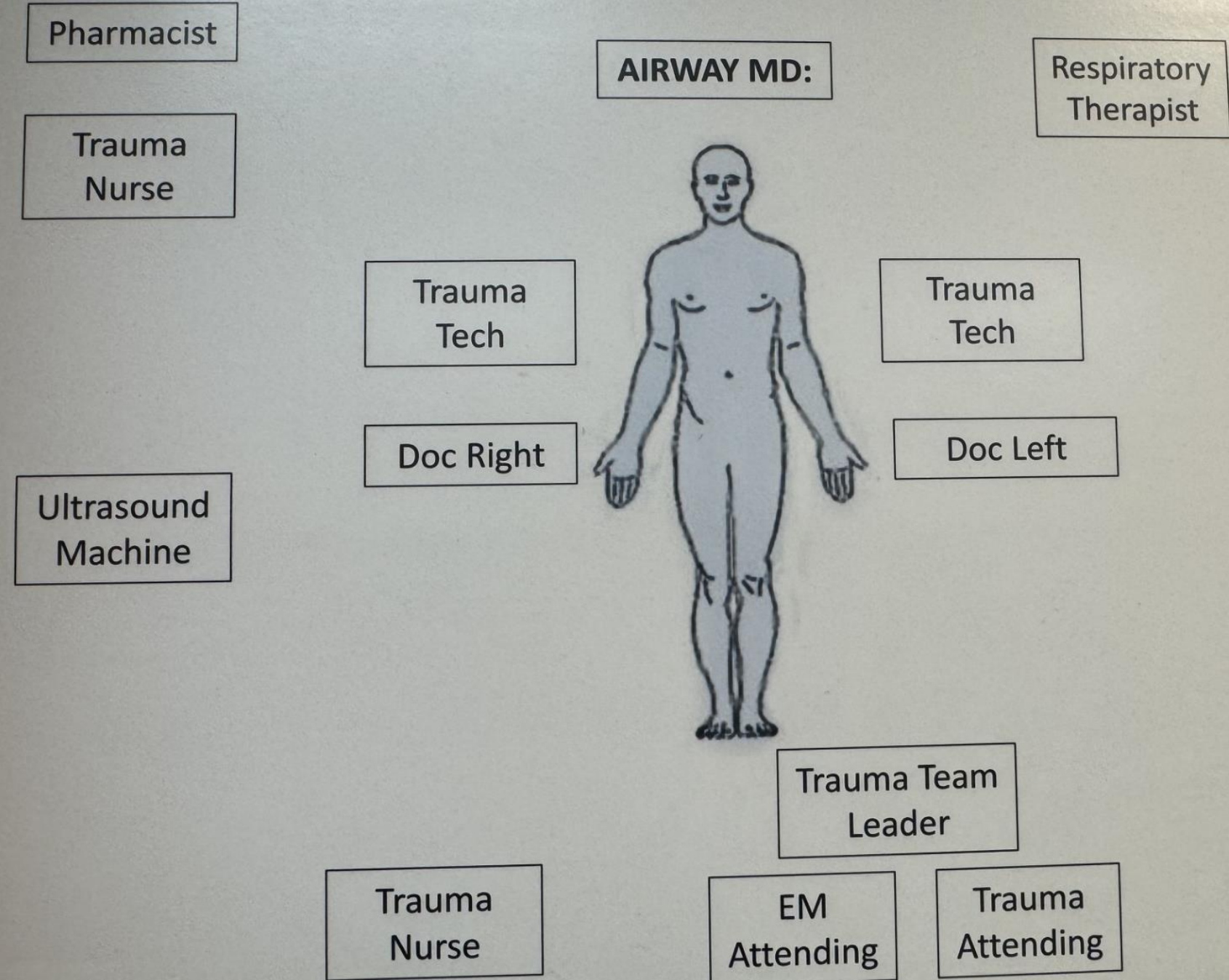
HD 5

- Taken to OR by ortho for pelvic fixation

Trauma Resuscitation

- ABC's
 - With every change quickly reassess ABCs
 - If something isn't making sense, start over with ABCs
 - Large bore IV access bilaterally
 - Consider early central access (venous and arterial)
 - A line for monitoring, can be exchanged for 7F sheath/REBOA
- Optimize trauma bay
 - One clear TTL directing management
 - Remaining in room should be relatively quiet and minimize distractions
 - Closed loop communication
 - Simulations with multidisciplinary teams
 - Pre-briefs
- Address most life-threatening injury first
 - ABCs!!!!

UNM TRAUMA TEAM ROLES AND POSITIONS



Trauma Team Leader

- 1) Stands at the foot of the bed
- 2) Directs overall resuscitation (e.g. fluid resuscitation, blood products, interventions, disposition)
- 3) Responsible for majority of communication during resuscitation
- 4) Determines need for major invasive procedures performed (e.g. central lines, chest tubes, thoracotomy)
- 5) Determines if the patient is safe for transport to CT scanner vs the need for immediate operative therapy for suspected injuries
- 6) TTL will not perform procedures in order to focus on directing the resuscitation
- 7) TTL may delegate additional tasks to others not explicitly mentioned here (i.e., FAST exam, dressing wounds etc.)



Airway Doc

- 1) Stands at head of the bed
- 2) Evaluates "A"; Airway & verbalizes to TTL & team
- 3) Accountable for ensuring that the airway checklist is performed and that necessary materials needed for safe emergent intubation are available
- 4) Evaluates "B: Breathing", lung auscultation & tactile exam for subcutaneous emphysema, calling it out to TTL
- 5) Provides/ Discusses mechanical ventilator settings with RRT
- 6) Evaluates "D"; Disability (GCS) & verbalizes to TTL & team (after evaluation of C: circulation by Doc Right)
- 7) Communicator to the patient; Relays key information to patient and obtains patient feedback.
- 8) Other duties as assigned by TTL
- 9) Cervical spine stabilization during patient turning
- 10) Once primary and secondary assessments are complete, may either perform or supervise the performance of the FAST exam as designated by TTL



Doc Right

- 1) Evaluates "C"; Circulation (assessment of BP, central & peripheral pulses, current IV access) and verbalizes to the TTL & team.
- 2) Performs the secondary assessment from head to toe and reports all positive and negative findings to TTL & team
- 3) Obtains "AMPLE" history at the completion of the secondary assessment
- 4) May perform other tasks as delegated by TTL



Trauma Attending

- 1) Must be present within 15 minutes of patient arrival for a TAP
- 2) Assumes overall responsibility for the resuscitation and for supervising the Trauma Team Leader
- 3) Collaborates with EM Attending

EM Attending

- 1) Responsible for supervising the Emergency Medicine Resident during Primary Assessment of the airway
- 2) Supervises or assumes management of the airways (including induction plan & techniques)
- 3) Assumes the role of supervising TTL when the Trauma Attending is not available or during multiple traumas
- 4) Supervises doctor delegated to perform FAST exam
- 5) Collaborates with Trauma Attending in supervising TTL once airway is secured (EM Attending moves to foot of head)



Doc Left

- 1) Stands on left side of patient
- 2) Assists with exposing patient by cutting/ removing clothing
- 3) Performs procedures as delegated by TTL (IO, CVC, chest tubes)
- 4) Remains with patient to the CT scanner to interpret scans & close loop on patient disposition between EM & surgery team members
- 5) Responsible for keeping TTL & attendings informed of patient's condition and diagnostic findings
- 6) May perform other tasks as delegated by TTL



Trauma Nurse

A. Trauma Nurse A:

- 1) Responsible for keeping a written record of the resuscitation events on trauma flow sheet (if Nurse B available, Nurse A RN stands next to TTL)
- 2) Assists with retrieval of equipment
- 3) Administers medications as ordered
- 4) Places patient on the telemetry monitor (shared with tech)
- 5) Administers blood products and fluids as instructed by TTL
- 6) Assists with crowd control

B. Trauma Nurse B (if available):

- 1) Places patient on the telemetry monitor
- 2) Administers blood products and fluids as ordered
- 3) Administers medications as ordered
- 4) Sets up and runs Level 1 Rapid infuser
- 5) Places patient on defibrillator pads and operates defibrillator
- 6) Assists with crowd control



Trauma Techs

- 1) One stands to the mid right of the patient
- 2) Second stands to the upper left of the patient
- 3) Responsible for ensuring IV fluid bags/tubing and arterial pressure transducer equipment is setup prior to patient arrival
- 4) Responsible for obtaining either automated or manual blood pressure (first attempt automated, then manual)
- 5) Places the patient on telemetry monitoring
- 6) Obtains peripheral IV's if not established by prehospital providers (1st IV for fluids & meds, 2nd IV for labs)
- 7) Assists in obtaining labs including type and screen
- 8) Connects patient to defibrillator as delegated by TTL
- 9) Places gastric tubes and/or urinary catheters as delegated by TTL



Respiratory Therapist

- 1) Ensures Airway management equipment (ETCO₂/ ventilator) are ready
- 2) Assists with airway/ breathing management as requested
- 3) Reviews ventilator strategy with Airway Doc & TTL
- 4) Accompanies intubated patient during transport

Pharmacist

- 1) Anticipates need for and prepares drugs for administration
- 2) Assures appropriate doses & identifies potential interactions
- 3) Provides clinical support as requested



Trauma Resuscitation

- Permissive hypotension
- Resuscitation with Blood products
 - Low titer group O whole blood preferred
 - 1:1:1 or guided by clotting studies (ROTEM/TEG) if able
 - 2g Ca for every 3-4u blood products
- Minimize crystalloid administration if able
 - Use in first 24hrs is associated with Increased mortality
 - Worsened coagulopathy
 - Decreased O2 delivery to peripheral tissues
 - Pulmonary complications
 - ARDS
 - edema
 - Prolonged mechanical ventilation (7%/L)
 - Colloid is 3%/L
- Triage Injuries
 - ABC's, Hemorrhage control, immediate life-threatening injuries first

Contents of Blood Products and Expected Physiologic Effects				
	Contents	Volume	Expected Response	Physiologic Effects
Whole blood	<ul style="list-style-type: none"> • Erythrocytes • Clotting factors (plasma) • Platelets 	500 mL	Variable	<ul style="list-style-type: none"> • Increased oxygen-carrying capacity • Repletion of coagulation factors and platelets to assist with hemostasis
Packed red blood cells	Erythrocytes	300-400 mL	Raise hemoglobin by 1 g/dL per unit	Increased oxygen-carrying capacity
Fresh frozen plasma	All clotting factors	200-300 mL	Decrease in PT/INR and pTT*	Repletion of coagulation factors to assist with hemostasis
Platelets	Platelets	200-300 mL	Raise platelet count by 30,000-60,000/ μ L	Repletion of platelets to assist with hemostasis
Cryoprecipitate	<ul style="list-style-type: none"> • Factor VIII • Fibrinogen • Von Willebrand factor • Factor XIII • Fibronectin 	50-200 mL	Raise fibrinogen by 50 mg/dL per unit	Repletion of certain procoagulants to assist with hemostasis

*Depending on starting point, this is not generally a linear response.
 NR = international normalized ratio; PT = prothrombin time; pTT = partial thromboplastin time.

REVIEW

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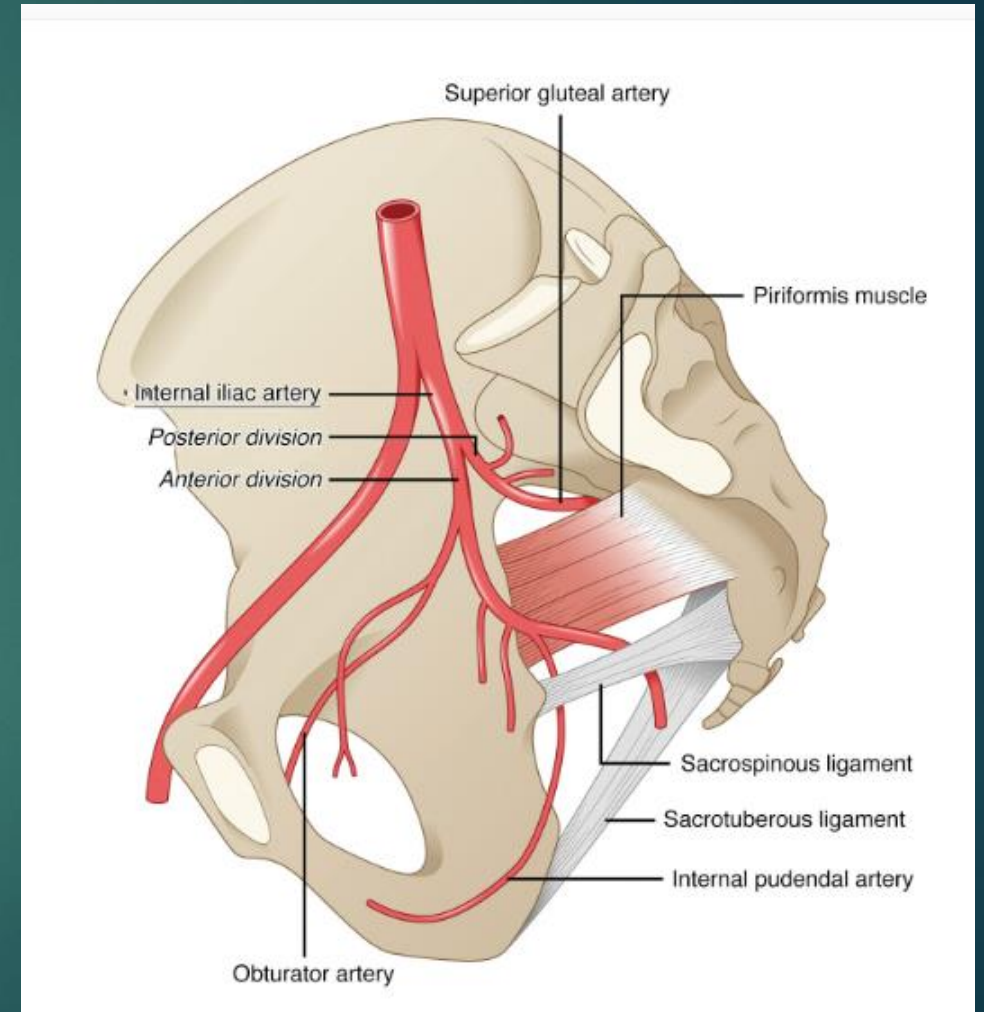


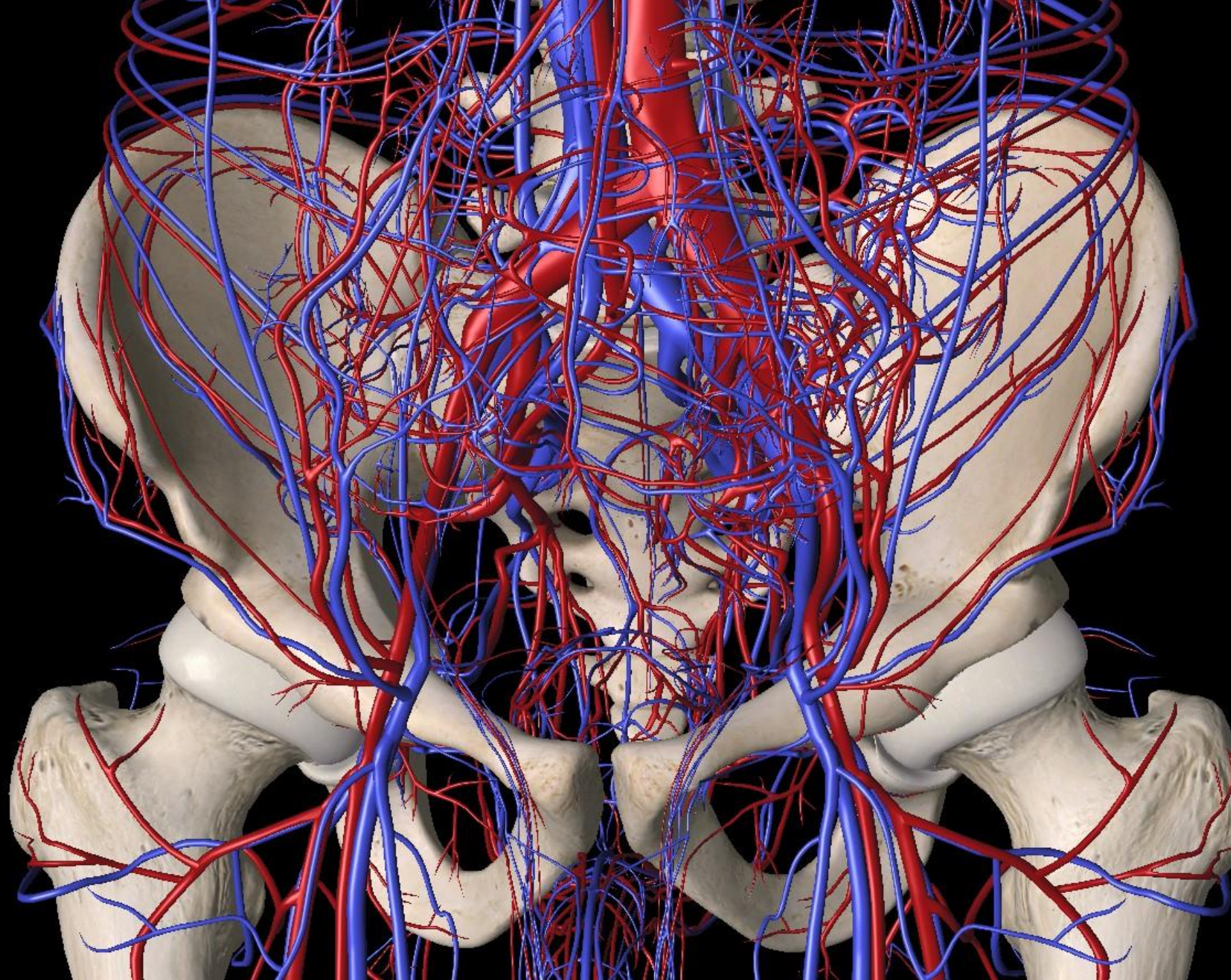
Pelvic trauma: WSES classification and guidelines

Federico Coccolini^{1*}, Philip F. Stahel², Giulia Montori¹, Walter Biffi³, Tal M Horer⁴, Fausto Catena⁵, Yoram Kluger⁶, Ernest E. Moore⁷, Andrew B. Peitzman⁸, Rao Ivatury⁹, Raul Coimbra¹⁰, Gustavo Pereira Fraga¹¹, Bruno Pereira¹¹, Sandro Rizoli¹², Andrew Kirkpatrick¹³, Ari Leppaniemi¹⁴, Roberto Manfredi¹, Stefano Magnone¹, Osvaldo Chiara¹⁵, Leonardo Solaini¹, Marco Ceresoli¹, Niccolò Allievi¹, Catherine Arvieux¹⁶, George Velmahos¹⁷, Zsolt Balogh¹⁸, Noel Naidoo¹⁹, Dieter Weber²⁰, Fikri Abu-Zidan²¹, Massimo Sartelli²² and Luca Ansaloni¹

Unstable pelvic fractures

- Generally caused by high energy mechanisms
- 10-15% of pelvic fractures present in shock
- Up to 32% mortality (exsanguination)
 - Bone edges
 - ~80% venous: presacral plexus and pre-vescical veins
 - ~20% arterial: internal iliac, internal pudendal, obturator artery, superior gluteal artery, and lateral sacral artery.
- 80% have associated thoracoabdominal injuries





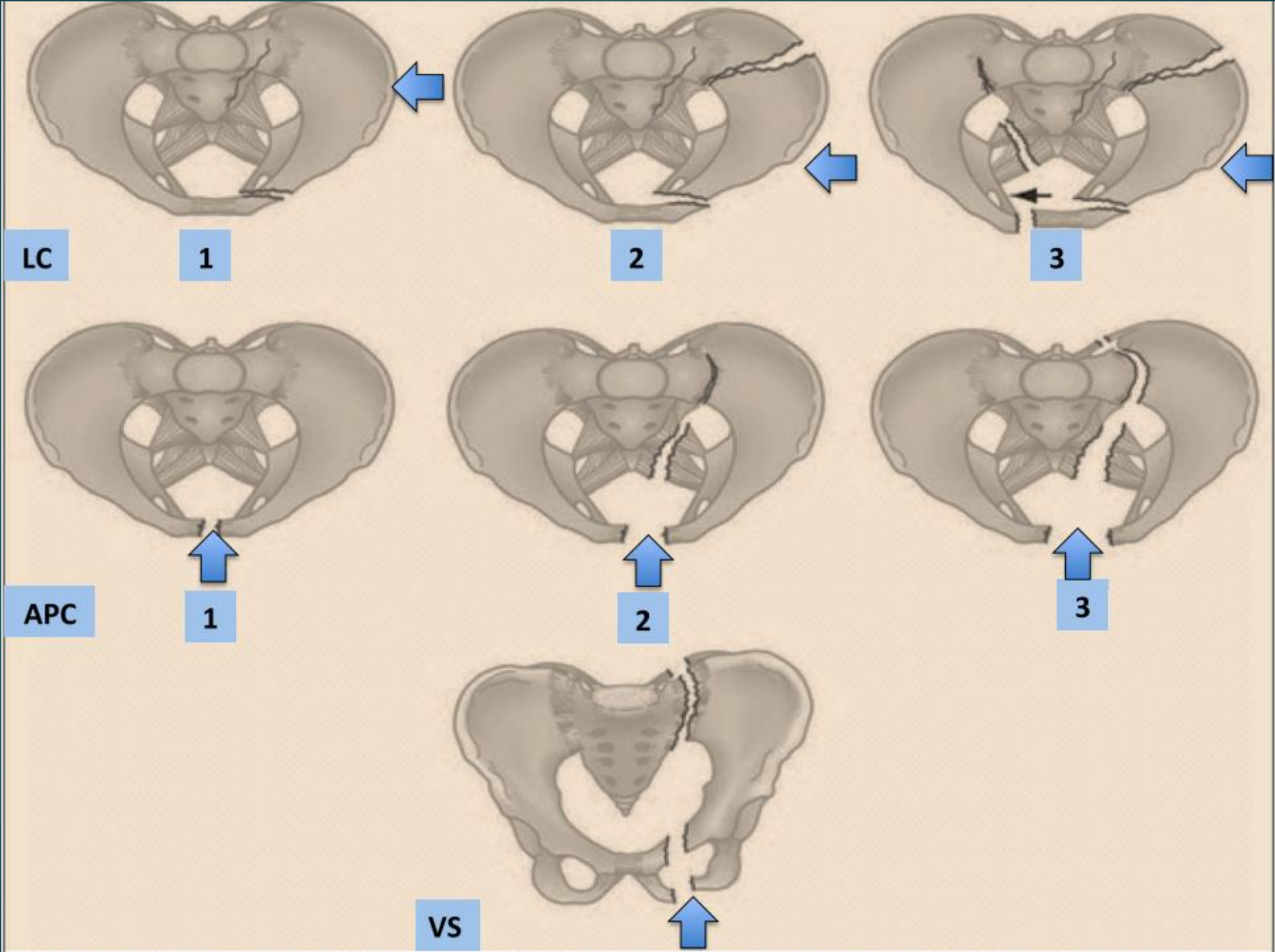


Table 2 WSES pelvic injuries classification (*: patients hemodynamically stable and mechanically unstable with no other lesions requiring treatment and with a negative CT-scan, can proceed directly to definitive mechanical stabilization. LC: Lateral Compression, APC: Antero-posterior Compression, VS: Vertical Shear, CM: Combined Mechanism, NOM: Non-Operative Management, OM: Operative Management, REBOA: Resuscitative Endo-Aortic Balloon)

	WSES grade	Young-Burgees classification	Haemodynamic	Mechanic	CT-scan	First-line Treatment
MINOR	WSES grade I	APC I – LC I	Stable	Stable	Yes	NOM
MODERATE	WSES grade II	LC II/III - APC II/III	Stable	Unstable	Yes	Pelvic Binder in the field ± Angioembolization (if blush at CT-scan) OM – Anterior External Fixation *
	WSES grade III	VS - CM	Stable	Unstable	Yes	Pelvic Binder in the field ± Angioembolization (if blush at CT-scan) OM - C-Clamp *
SEVERE	WSES grade IV	Any	Unstable	Any	No	Pelvic Binder in the field Preperitoneal Pelvic Packing ± Mechanical fixation (see over) ± REBOA ± Angioembolization

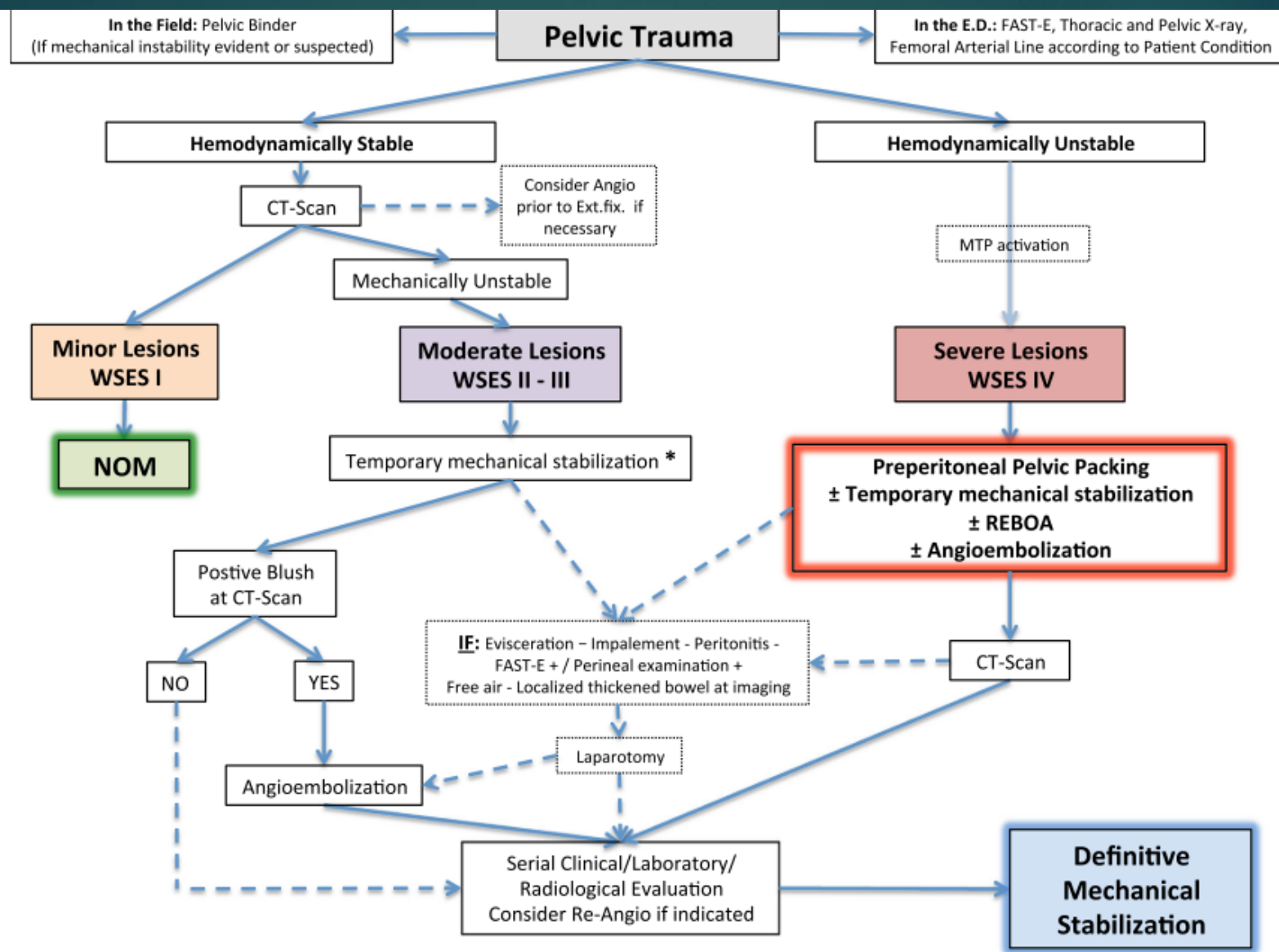


Fig. 3 Pelvic Trauma management algorithm (*: patients hemodynamically stable and mechanically unstable with no other lesions requiring treatment and with a negative CT-scan, can proceed directly to definitive mechanical stabilization. MTP: Massive Transfusion Protocol, FAST-E: Eco-FAST Extended, ED: Emergency Department, CT: Computed Tomography, NOM: Non Operative Management, HEMODYNAMIC STABILITY is the condition in which the patient achieve a constant or an amelioration of blood pressure after fluids with a blood pressure >90 mmHg and heart rate <100 bpm; HEMODYNAMIC INSTABILITY is the condition in which the patient has an admission systolic blood pressure <90 mmHg, or > 90 mmHg but requiring bolus infusions/transfusions and/or vasopressor drugs, or admission base deficit (BD) >6 mmol/l, or shock index > 1, or transfusion requirement of at least 4–6 Units of packed red blood cells within the first 24 h)

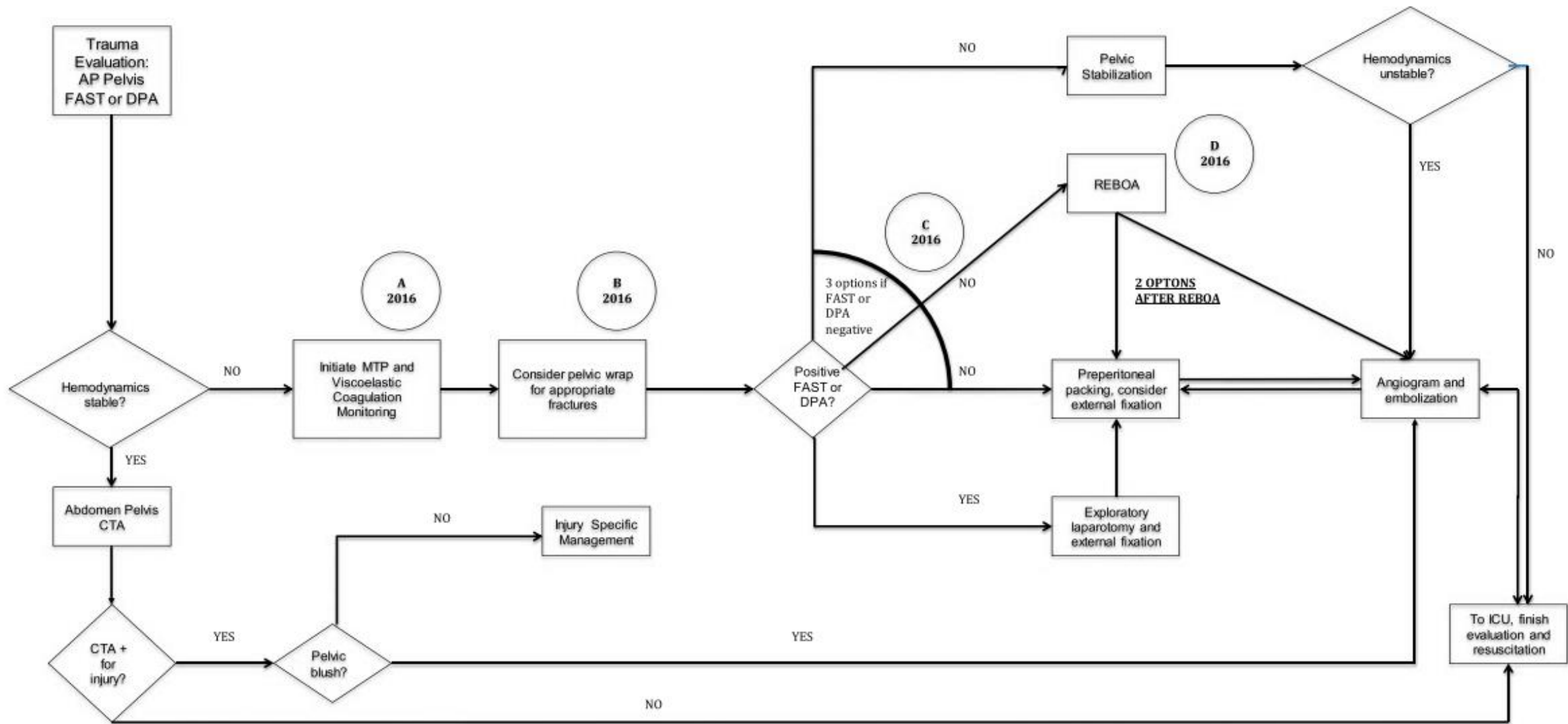
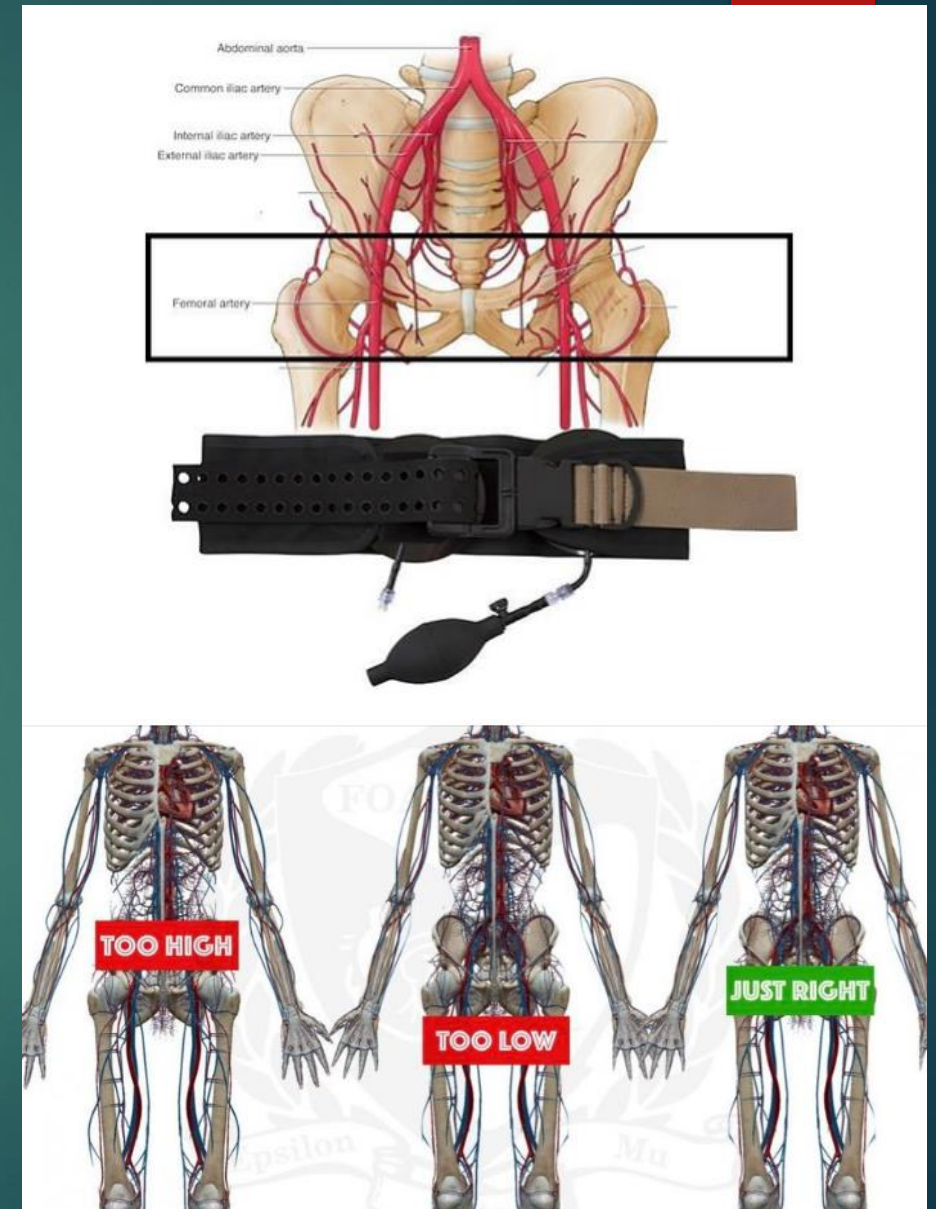


Figure 1. Management of pelvic fracture with hemodynamic instability.

Pelvic Splinting

- Anatomic landmark is the greater trochanter
 - Can be difficult to identify in obesity
- Pelvic binder
 - Frequently placed incorrectly
 - Improvise one if needed
 - Bedsheet
 - Significantly improved if addition on Windlass
- C-clamp
- External Fixation



Pelvic

- Anatomical
- trochanter
- Coccyx
- Pelvic
- Femur
- Iliac
- C-cl
- External

PELVIC BINDERS

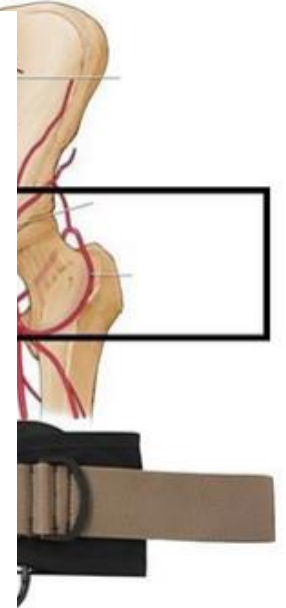
NO



YES



Abdominal aorta



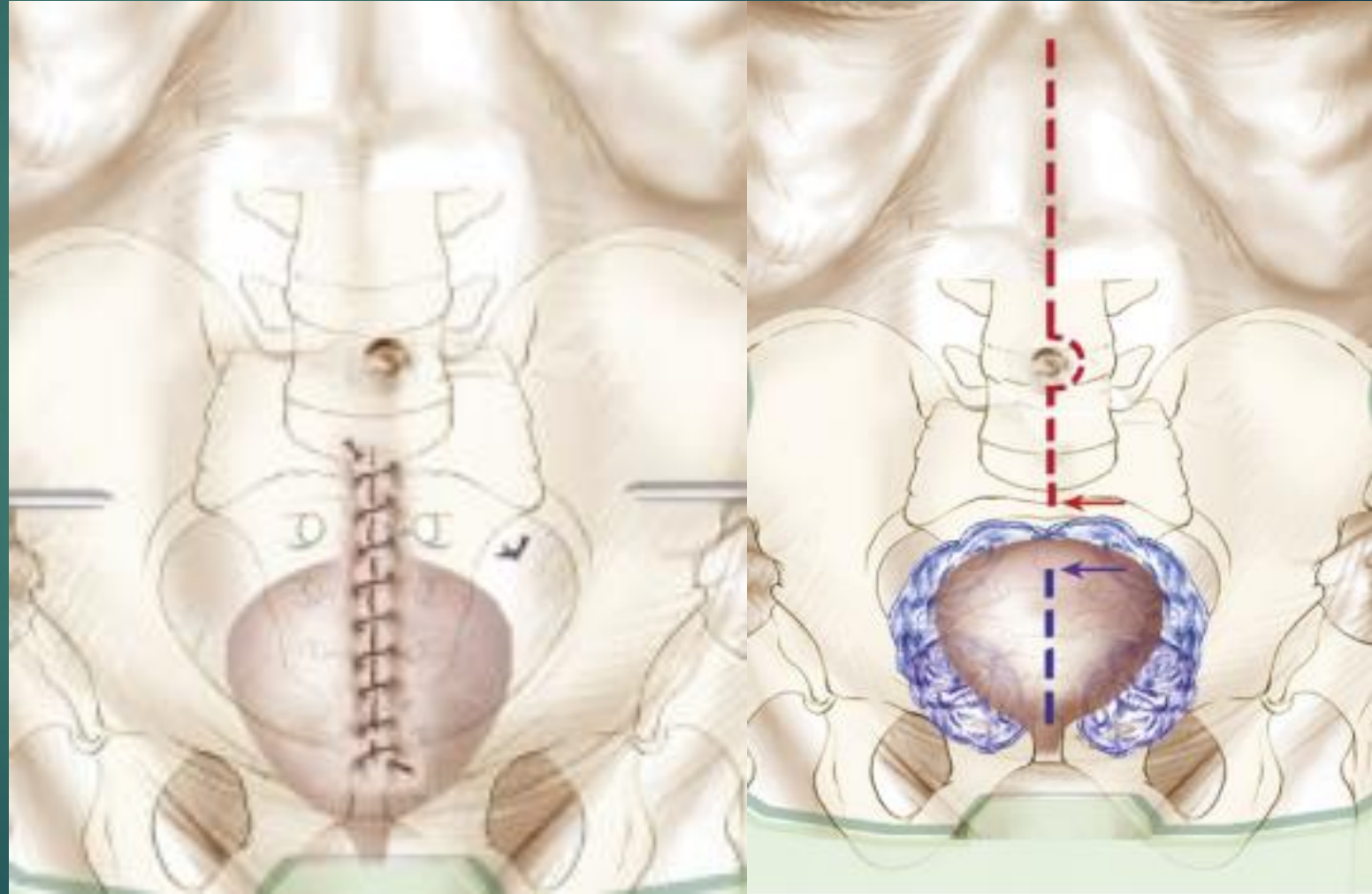
Pre-peritoneal pelvic packing (PPP)

- Dissect down to anterior fascia
- Incise the linea alba
 - Take care not to enter peritoneum
 - Evacuate hematoma
- Bluntly dissect bilaterally to SI joint
 - Generally, hematoma has already done this
- Pack laparotomy pads tightly
 - But not too tight (can cause ischemia)



Pre-peritoneal pelvic packing (PPP)

- Quickly close
 - Baseball stitch (fascia or skin)
 - Staple skin
- Re-apply binder (or alternative fixation)
- If patient also requires Ex lap, try to keep incisions separate





Resources

- Coccolini F, Stahel PF, Montori G, Biffl W, Horer TM, Catena F, Kluger Y, Moore EE, Peitzman AB, Ivatury R, Coimbra R, Fraga GP, Pereira B, Rizoli S, Kirkpatrick A, Leppaniemi A, Manfredi R, Magnone S, Chiara O, Solaini L, Ceresoli M, Allievi N, Arvieux C, Velmahos G, Balogh Z, Naidoo N, Weber D, Abu-Zidan F, Sartelli M, Ansaloni L. Pelvic trauma: WSES classification and guidelines. *World J Emerg Surg.* 2017 Jan 18;12:5. doi: 10.1186/s13017-017-0117-6. PMID: 28115984; PMCID: PMC5241998.
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