Trauma Across the Lifespan

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Avera McKennan Hospital

Objectives

- 1- Discuss current treatment plan for the pediatric, adult & geriatric trauma patient.
- 2- Describe physiologic changes in the geriatric patient affecting the trauma patient during the recovery phase.
- 3- Describe the physiologic response of the pediatric trauma patient.

Primary Survey



Primary Survey – ATLS way

- Airway with c-spine protection
- Breathing and ventilation
- Circulation with hemorrhage control
- Disability: Neuro status
- Exposure with environmental control



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An ENA Course

Run Over by a Tractor

- **1100**: 81 y/o female was working in a field. She got out of the tractor and was walking around it when the tractor rolled over her chest.
  - Estimated down time of 40 minutes prior to family members finding her
  - EMS notified

Preparation Process

- Safety – PPE, decontamination
- Preparation of the Trauma Bay
  - Equipment
  - Room temperature
  - Personnel
- Suspected injuries
  - Anticipated interventions

Anticipated Injuries

- Rib fractures, pneumo/hemothorax
  - Needle decompression & chest tube equipment
- Upper abdominal injury (diaphragm, spleen, liver or small bowel)
  - Blood product, airway equipment, OR team ready
- There may be more to the story….

Geriatric Considerations

- Geriatric population growing in US
- Geriatric population higher in rural settings
- This population represents the disproportionate share of morbidity-mortality d/t traumatic injury
- Elderly abuse – significant public health issue

RTTDC (2015).

Geriatric Considerations

- Physiologic Changes
  - Cardiovascular
  - Thoracic & Pulmonary
  - Renal
  - Immune
  - Integumentary
  - Musculoskeletal
- Co-morbidities
- Medications

RTTDC (2015).

Run Over by a Tractor

- EMS ground (1155-1230)
  - A/O x 3
  - Patient states she “could not breathe”
  - Needle decompression to L) side of chest- small air rush noted
  - Patient states “breathing is better”

Run Over by a Tractor

- EMS ground (1155-1230)
  - IV x 1 placed, x 2 unsuccessful attempts
  - Hypotensive in the 70's > 500 cc NS bolus
  - Air transport contacted for a scene flight
  - Loaded in the back of the rig awaiting flight arrival
  - Fentanyl PRN (total 100 mcg given)

Run Over by a Tractor

- Air Transport (1230 – 1316)
  - **103 – RR 32 – 96% 4 liters NC – 80/59 – GCS 15**
  - Skin cold
  - Difficulty breathing, c/o chest pain
  - Chest contusions
  - Lung sounds equal bilaterally
  - Scattered abrasions
  - Forearm laceration, bleeding controlled

Run Over by a Tractor

- Air Transport (1230 – 1316)
  - 1235: Warming measures applied
  - **1242: 80/59 – HR 112 – RR 33**
  - 1247: Ketamine IV
  - 1249: Lift for Sioux Falls
  - 1250: Tranexamic Acid (TXA) bolus initiated
  - **1252: 127/88 – HR 148 – RR 26 shallow**

What is TXA?

- An antifibrinolytic medication that prevents clot breakdown.
- Used in managing significant hemorrhage in the trauma patient, especially in those requiring multiple transfusion of blood products.

Inclusion/Exclusion Criteria

- Inclusion Criteria
  - Age >16 years
  - Suspected significant hemorrhage
  - SBP<90 and/or HR >120 bpm
  - **Within 3 hours of injury**
  - Physician discretion
- Exclusion Criteria
  - Active clotting
  - Isolated subarachnoid hemorrhage
  - Concurrent use of PCC or NovoSeven
  - Known pregnancy

Recommended Doses

- Bolus: TXA 1 gm in NS 50 ml over 10 minutes (360 ml/hr)
    - *Followed by*:
- Continuous Infusion: TXA 1 gm in NS 250 ml over 8 hours (33 cc/hr)

Run Over by a Tractor

- Air Transport (1230 – 1316)
  - 2 units PRBCs
  - 700 cc NS
  - Warming measures
  - Fentanyl, Ketamine
  - **1312: 94/63 – 108 – 20 – 99%**

LEVEL I TRAUMA TEAM…

Criteria for Adult Level I Trauma Activation

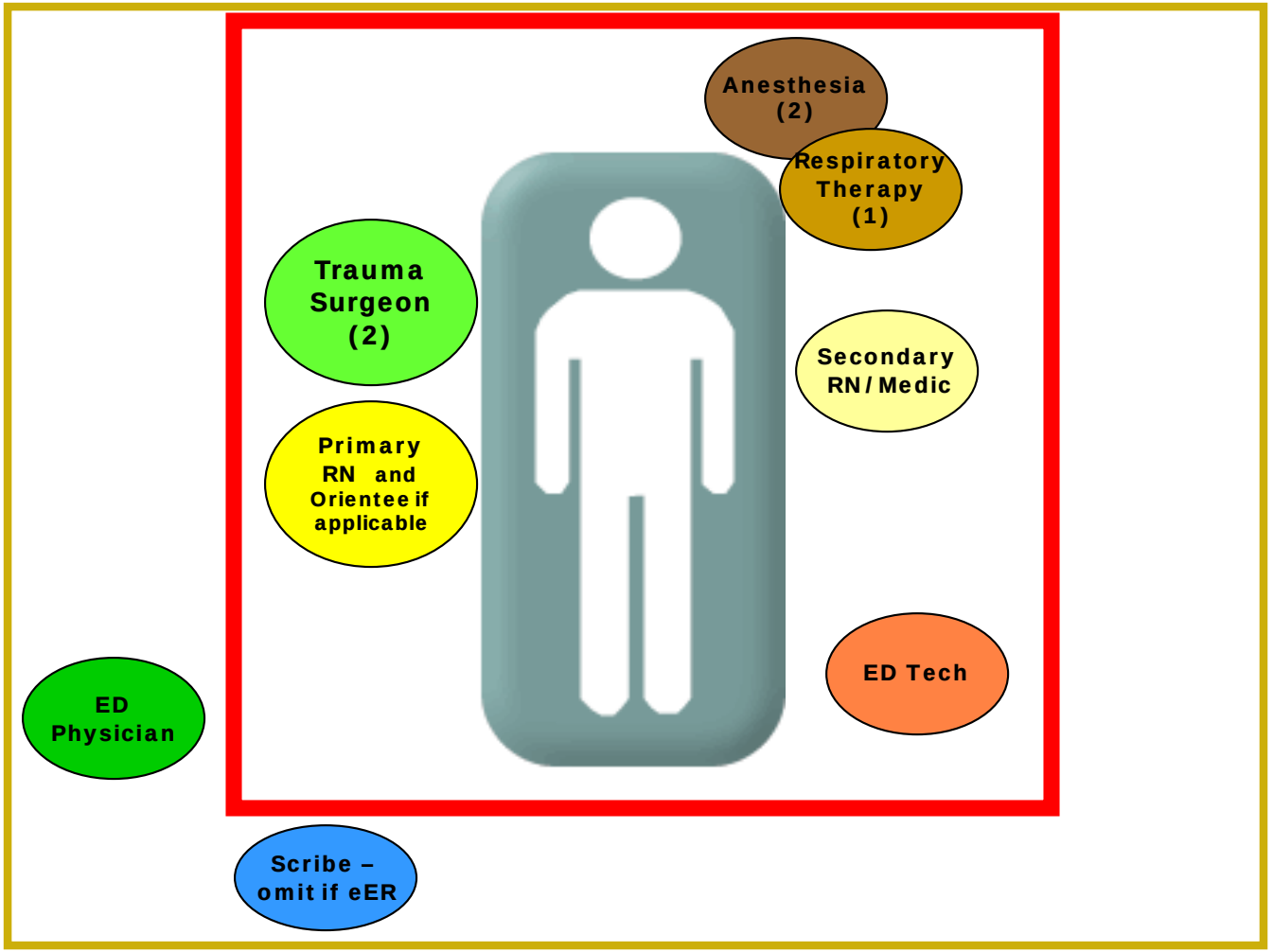
1. Glasgow Coma Scale < 10
2. Confirmed systolic B/P <90
3. Heart rate > systolic B/P
4. Airway and/or Respiratory Compromise with mechanism related to trauma or patients in need of an emergent airway including any intubated patients transferred from the scene
5. "Life or limb threatening" penetrating injury to head, neck, torso, groin, & extremities proximal to knee or elbow, including any GSW to these areas
6. Clinical flail chest
7. Paralysis, loss of sensation, and/or suspected spinal cord injury (related to traumatic injury)
8. Amputation proximal to wrist or ankle
9. Transfer patients from other hospital receiving blood to maintain vital signs
10. Burns >20% (partial or full thickness)
11. Uncontrolled arterial bleeding (to include use of tourniquet)
12. Any patient that the ED physician or pre-hospital provider deems necessary

(Hangings are Level I if GCS <10 or intubated/airway compromise)

Avera McKennan Hospital Trauma Service
Level I Trauma Team Response

INNER CORE

OUTER CORE



Students & Observers: Will be allowed in per Trauma Surgeon & Primary RN discretion.

Run Over by a Tractor

- Avera ED (1321 - 1455)
  - Level 1 Activation
  - **98.2 – 112 – 94% NC – 134/83 – 18 - GCS 15**
  - Patient cool to touch
  - Bruising L) chest, laceration to L) mid arm
  - Lung sounds decreased L) side
  - Restless, answers questions
  - Pt c/o chest pain
  - Moves all extremities

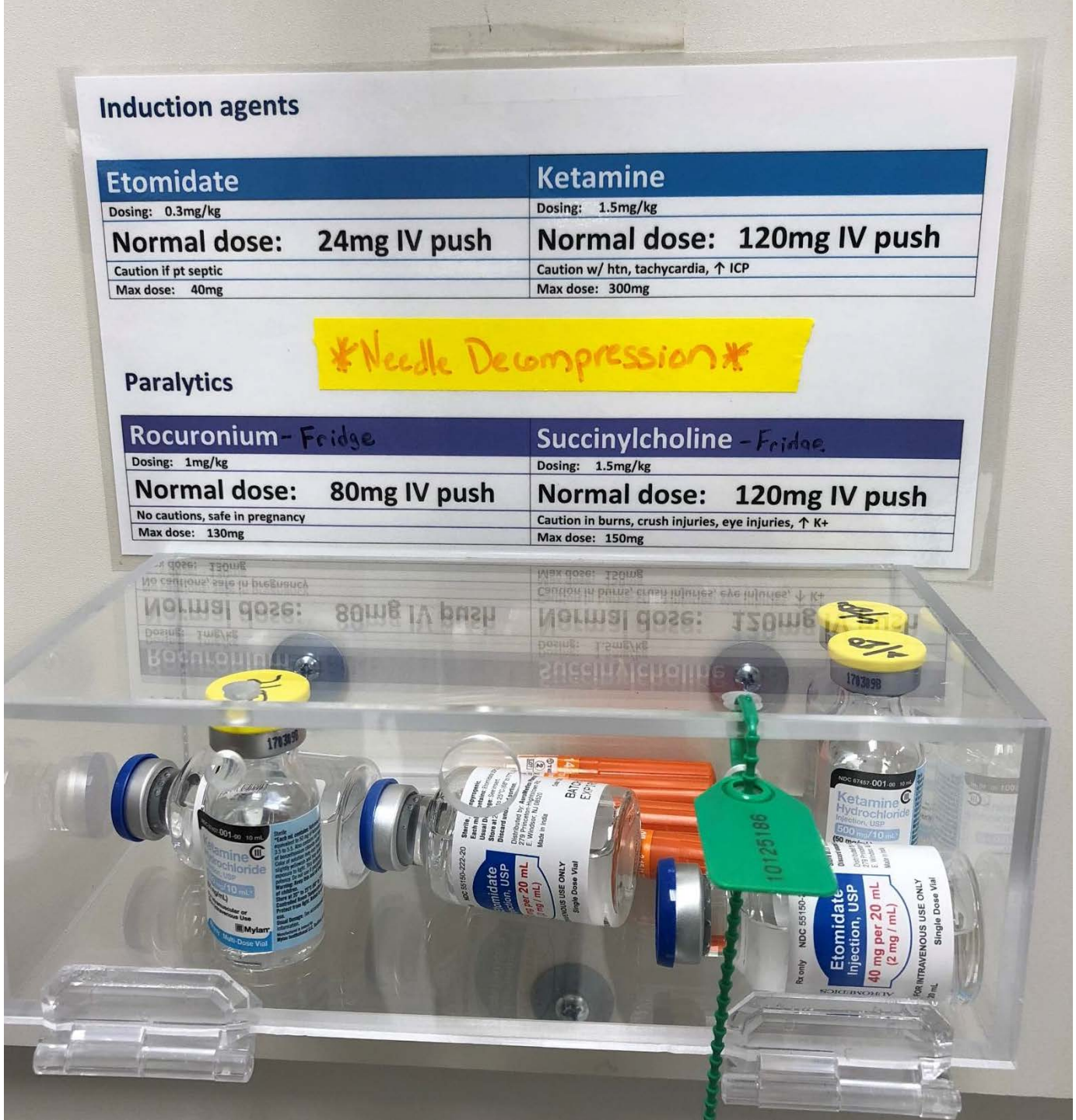
Run Over by a Tractor

- Avera ED (1321 - 1455)
  - 1334: Preparing for RSI
  - 1337: Intubation
    - Propofol 50 mg
    - Succinylcholine 100 mg

- Was this a good option for meds?

RSI (Rapid Sequence Intubation)

- Preparation is key
  - Oxygenation
  - Position
  - Suction
  - Equipment (ETT, stylet, etCO2 detector)
  - Ambu bag
  - Back-up airway
  - Monitor
  - Medications
    - Induction & Paralytic


Induction agents
Etomidate
Dosing: 0.3mg/kg
Normal dose: 24mg IV push
Caution if pt septic
Max dose: 40mg
Ketamine
Dosing: 1.5mg/kg
Normal dose: 120mg IV push
Caution w/ htn, tachycardia, ↑ ICP
Max dose: 300mg
#Needle Decompression#
Paralytics
Rocuronium - Fridge
Dosing: 1mg/kg
Normal dose: 80mg IV push
No cautions, safe in pregnancy
Max dose: 130mg
Succinylcholine - Fridge
Dosing: 1.5mg/kg
Normal dose: 120mg IV push
Caution in burns, crush injuries, eye injuries, ↑ K+
Max dose: 150mg
Ketamine Hydrochloride
Etomidate Injection, USP
40 mg per 20 mL (2 mg / mL)
Single Dose Vial

Run Over by a Tractor

- Avera ED (1321 - 1455)
  - 1334: Preparing for RSI
  - 1337: Intubation (propofol 50 mg, succinylcholine 100 mg)
  - **1343: HR 75 – 53/33**
  - 1344: L) chest tube placed, fluid bolus
  - 1345: Backboard removed
  - 1348: Chest x-ray

Run Over by a Tractor

- Avera ED (1321-1455)
  - 1347: Unable to obtain a SBP – **HR 74**
  - Femoral central line placed
  - 1349: 500cc NS bolus, FAST exam
  - 1350: No pulse/CPR
  - 1351: Return of pulses
  - 1352: R) chest needle decompression
  - 1354: PRBC's (3rd unit)
  - **1355: HR 93 – 91/50**

Lab Values

POC pH	7.176 *L
POC pCO2	60.5 H
POC pO2	20 *L
POC HCO3	22.4
POC Base Excess	-6 L
POC O2 Saturation	21 L

Hgb	
POC Hgb (Calc)	10.5 L
Hct	
POC Hct	31 L

Myoglobin		3677 H

Lactic Acid	3.4 *H

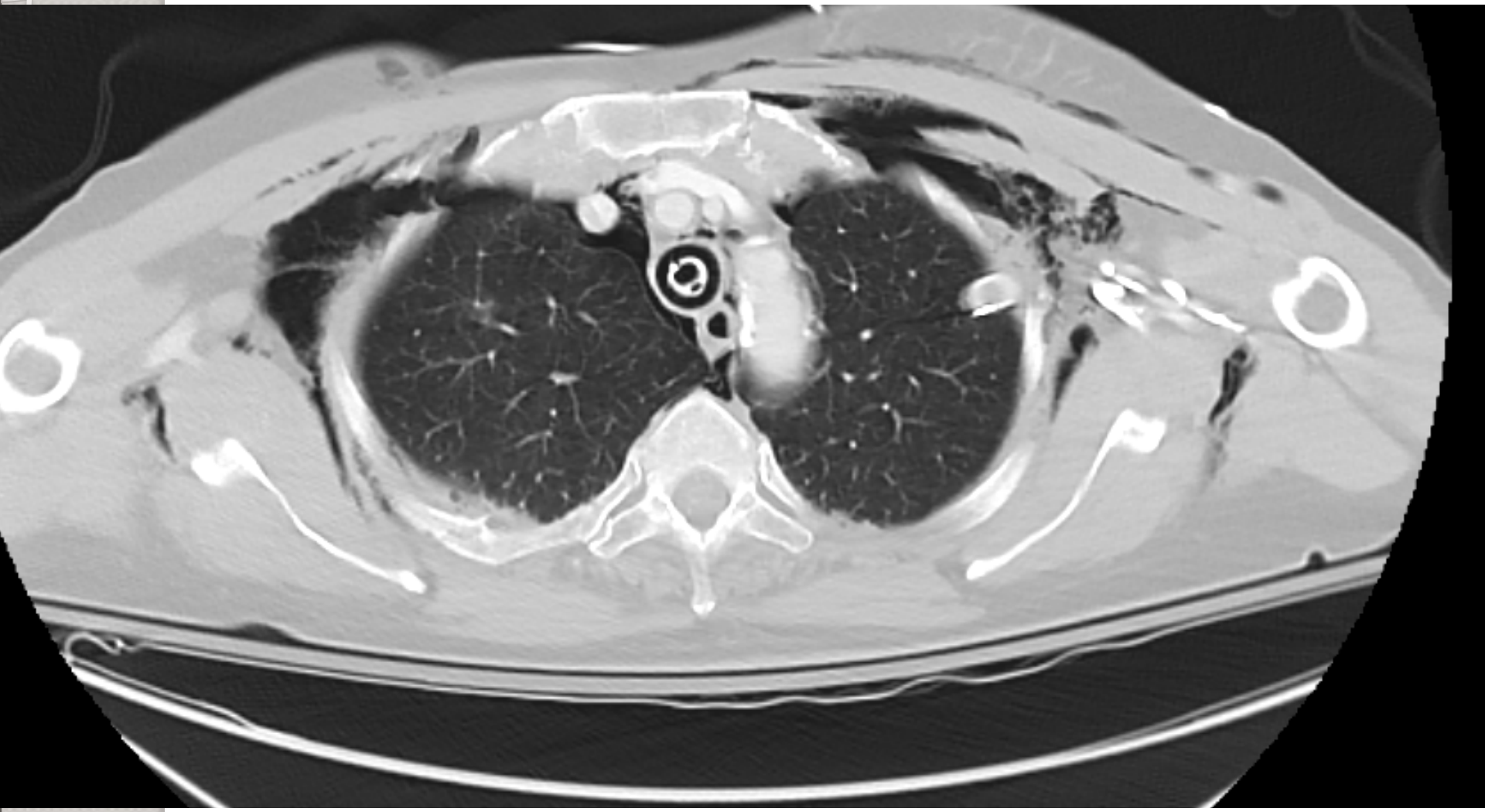
PT	15.9
INR	1.3
APTT	24.0

Run Over by a Tractor

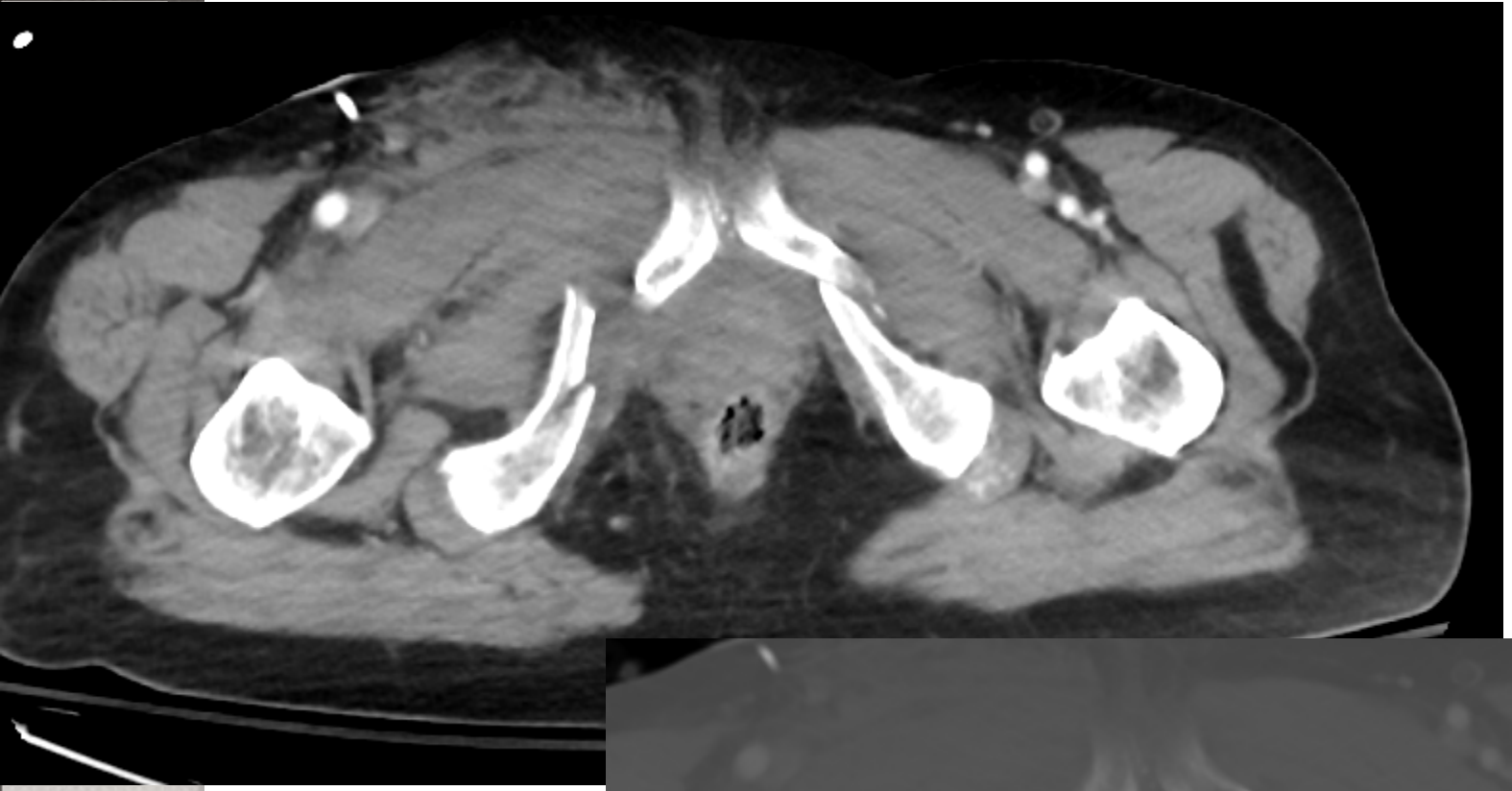
- Avera ED con't (1321 - 1455)
  - 1357: R) chest tube placed
  - 1358: Pt mouthing "pain"
  - 1405: 1L NS on pressure bag
  - 1408: 50/30, Norepinephrine gtt started
  - 1418: PRBCs (4^{th} unit total), artline placed
  - **1425: 127/68 HR 82**

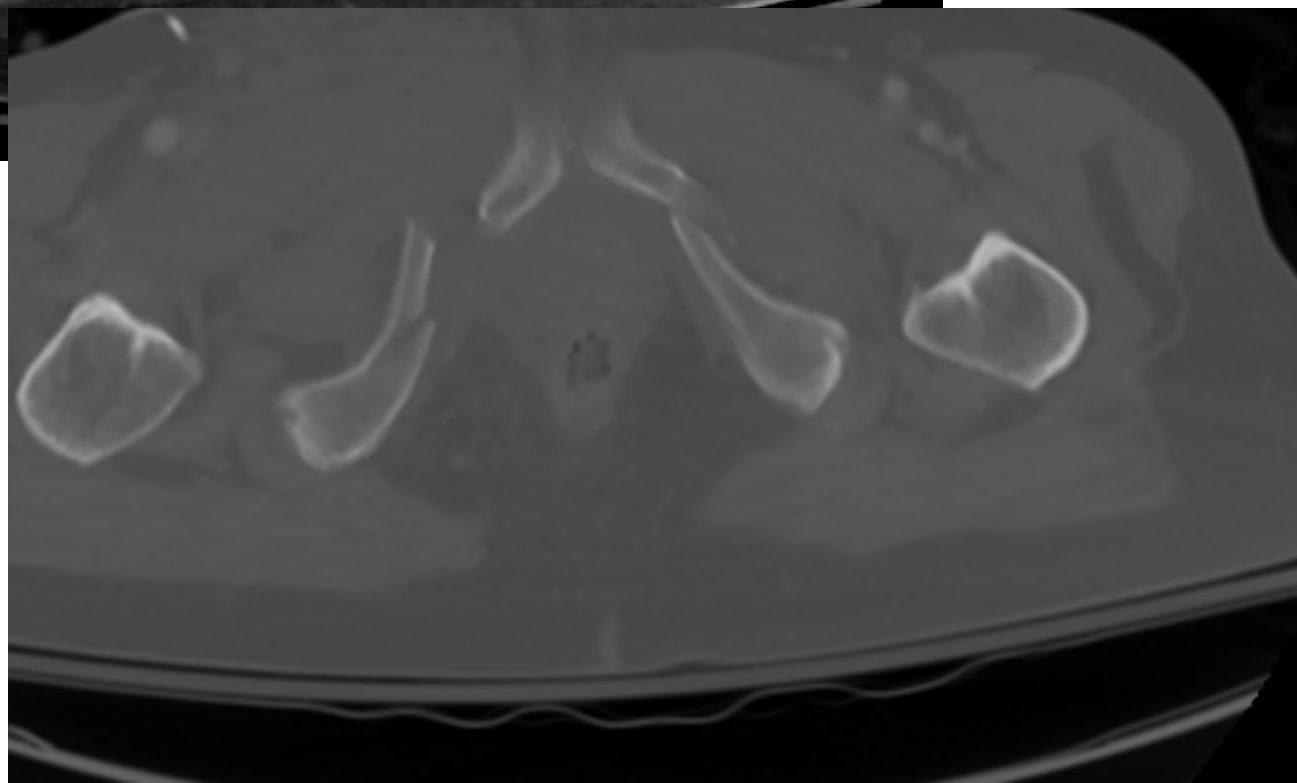
Run Over by a Tractor

- 1423: To CT scan
  - Titrating Norepinephrine, received cortisol, sodium bicarbonate, calcium gluconate, fentanyl
  - SBP fluctuates 100-170s
- 1455: Admitted to ICU









Run Over by a Tractor

- Injuries:
  - Bilateral clavicle fractures
  - R) & L) superior & inferior comminuted pubic rami fracture
  - R) sacroiliac fracture subluxation with crush injury to lateral sacral ala
  - Rib fractures: R) #2-6 - L) #2-6
  - Bilateral hemopneumothorax
  - Pneumomediastinum
  - L4-5 transverse process fracture
  - C6 fracture

ISS - 38
P(s): 0.7238

Run Over by a Tractor

- Co-morbidities:
  - Current smoker
  - Renal CA – nephrectomy in past
  - Recent use of steroids for bronchitis
  - No anticoagulation

Run Over by a Tractor

- Admit to ICU
  - **94.0 (R) – HR 90 – BP stable**
  - Pelvic binder placed
  - Levophed gtt
  - Propofol gtt
  - Fentanyl gtt
  - Artline placed to L) wrist

Run Over by a Tractor

- PTD #1:
  - No changes
- PTD #2:
  - Ischemic fingers L) hand – nitropaste, arterial line removed
  - pH 7.28, lactic acid 1.8 – fluid resuscitation
  - Pelvic binder released

Run Over by a Tractor

- PTD #4:
  - Hgb 7.5 – transfuse 1 unit PRBCs
  - A-fib 150's - Cardiazem bolus & gtt
  - Acute Tubular Necrosis - fluid boluses
  - Pneumonia dx - Zosyn & Vancomycin started
  - T-max 101.3
- PTD #5:
  - Levophed titrated off
  - Venous duplex lower extremities – negative

Run Over by a Tractor

- PTD #7 - 8
  - Lovenox started
  - Antibiotics switched (sputum culture resulted ecoli and pseudomonas)
  - Vomits x 3
  - Hypotension….more fluids

Run Over by a Tractor

- PTD #9 - 10
  - R) chest needle site erythema/necrosis
  - R) foot cyanosis
  - Hgb 7.2 – 2 units PRBCs
  - Pt following commands

Run Over by a Tractor

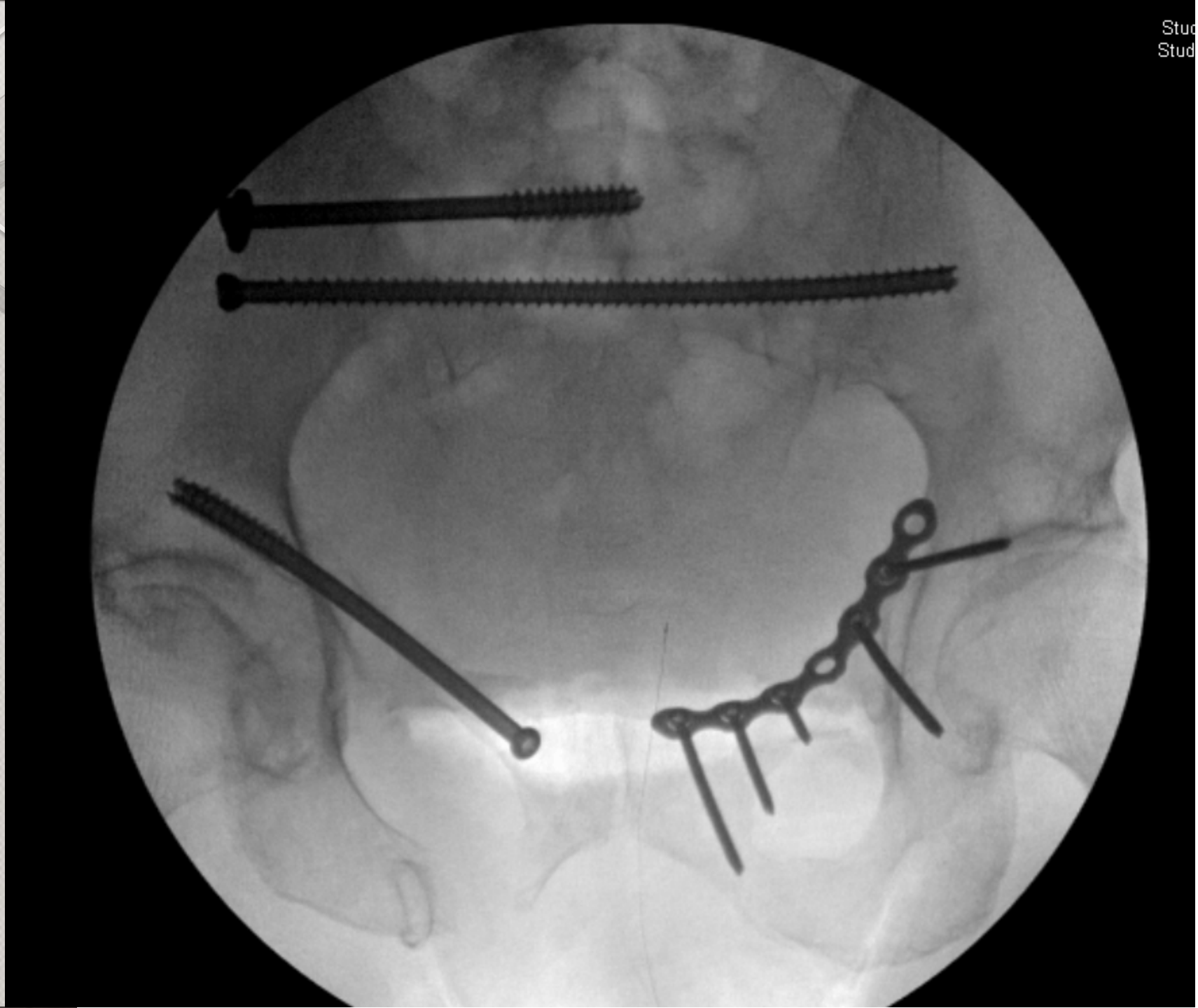
- PTD #9 - 10
  - Palliative care consult
    - Partial DNR but continued aggressive cares
    - Family states patient would definitely want to continue with aggressive medical course for now
    - Family expressed concern with orthopedic management with goal of aggressive care

Run Over by a Tractor

- PTD #13:
  - Code status FULL CODE
  - ORIF bilateral clavicles
- PTD #14:
  - OR: I & D R) chest wound
- PTD #15:
  - Not tolerating tube feeding – TPN started

Run Over by a Tractor

- PTD #16:
  - ORIF anterior & posterior pelvic ring injury. Arterial line placed to foot in OR. Evening…foot white, no pulse.
- PTD #17: Code status to NO CODE
  - Venous duplex…(+) for DVT R) leg
  - Family refuses certain cares
  - No urine output
  - Worsening acidosis



Run Over by a Tractor

- PTD #16:
  - ORIF anterior & posterior pelvic ring injury. Arterial line placed to foot in OR. Evening…foot white, no pulse.
- PTD #17: Code status to NO CODE
  - Venous duplex…(+) for DVT Rt leg
  - Family refuses certain cares
  - No urine output
  - Worsening acidosis

Run Over by a Tractor

- PTD #18:
  - No dialysis
  - Family request palliative, then proceeds to request withdraw of care. Patient extubated 0935
  - 1135: Time of death

Geriatric Trauma

- Undertriage issues
- Advanced directives
- Co-morbidities

CASE 2

MVC

- 10 month old male involved in a semi vs. car crash at highway speed on icy roads. Found outside of vehicle in car seat, ? ejected or removed from vehicle. Brought to transferring facility.
- EMS (1813 - 1826)
  - Vitals: 86 - 14 - 82/45 - 96% RA
  - GCS 7
  - C-collar
  - Ineffective breathing

Preparation Process

- Safety – PPE, decontamination
- Preparation of the Trauma Bay
  - Equipment
  - Room temperature
  - Personnel
- Suspected injuries
  - Anticipated interventions

Anticipated Injuries



- Head Injury
- Chest Injury
- Abdominal Injury
- Musculoskeletal Injury
  - Intubation supplies, IV/IO supplies, Pelvic binder, Chest tube supplies, Warming equipment
- There may be more to the story….



MVC

- Transferring Facility (1826 - 1925)
  - 1826: 97.7 - 131 - 41 - 110/46 - 100% BVM – GCS 3
  - 1 pupil reactive
  - Broslow tape utilized – 10 kg (purple)
  - 1833: IO placed to lower extremity, fluid bolus started
  - 1848: Flight team arrival
  - Total IVF thus far 300 cc

Age Group	Resp	Heart Rate	SBP	Weight (kg)	Weight (lb)
Newborn	30 - 60	100 - 180	50 - 70	2 - 3	4.5 - 7
Infant 1-12 months	20 - 50	80 - 160	70 - 100	4 - 10	9 - 22
Toddler 1-3 yrs.	20 - 35	70 - 150	80 - 110	10 - 14	22 - 31
Preschooler 3-5 yrs.	20 - 30	60 - 120	80 - 110	14 - 18	31 - 40
School Age 6-12 yrs.	15 - 30	60 - 110	80 - 120	20 - 42	41 - 92
Adolescent 13+ yrs.	12 - 20	55 - 110	110 - 120	>50	>110

MVC

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Pediatric Resuscitation

- Isotonic solution
  - 20 mL/kg
  - Up to 3 boluses
  - If doing 3rd bolus, must consider packed red blood cells
- pRBCs
  - 10 mL/kg
  - If requiring blood, ?? Need for additional blood product (platelets & plasma)

ATLS (2012).

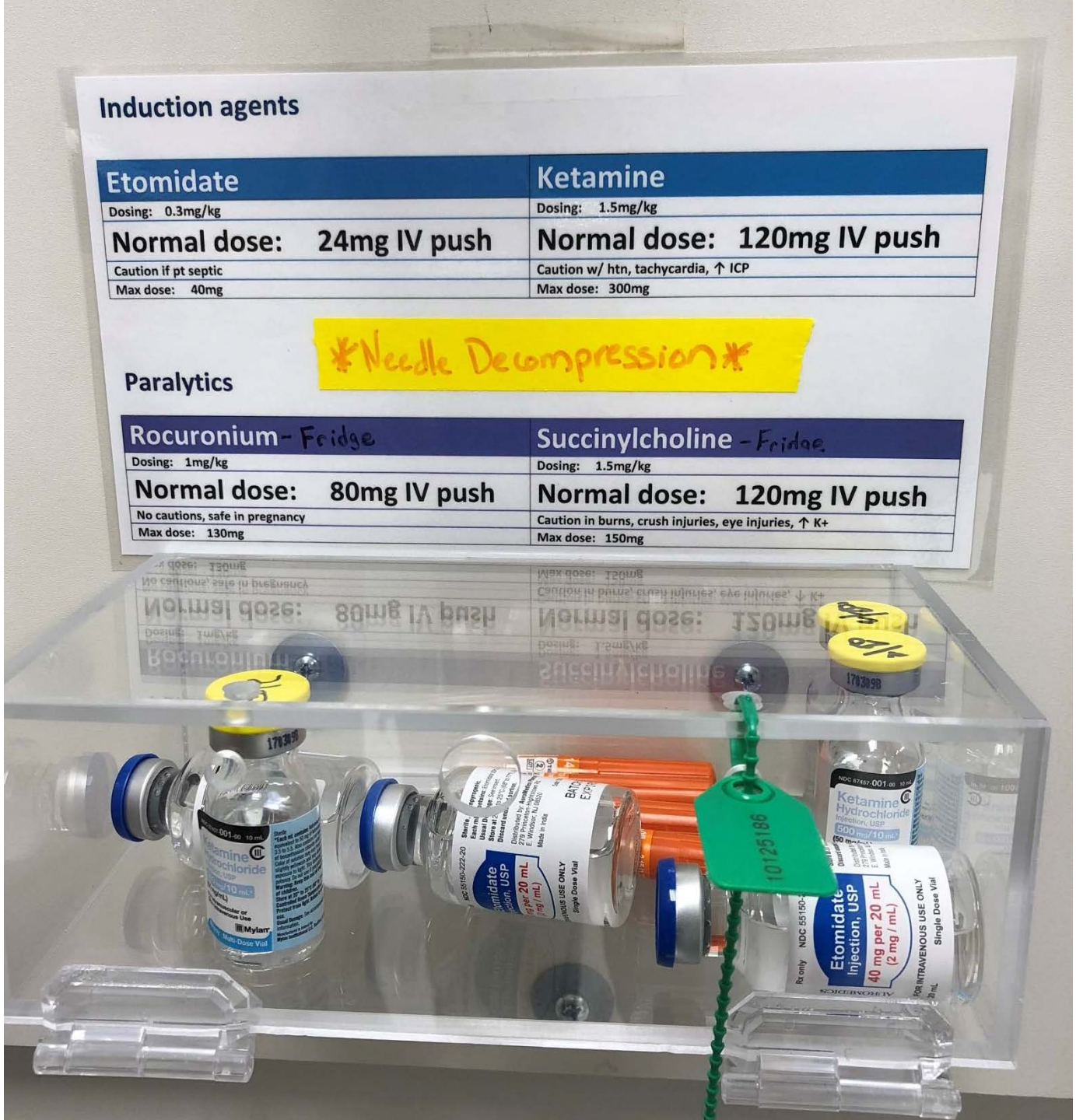
Pediatric Shock

- How do they present?
  - Tachycardia
  - Skin perfusion
  - Peripheral pulses
  - Level of consciousness
  - Blood pressure
    - Pulse pressure
    - Hypotension
      - Up to 30% decrease in blood volume to manifest low BP

ATLS (2012).

MVC

- Air Transport (1848 - 2001)
  - 1848: 198 - 30 - 91/46 - 91% BVM - GCS: 3
  - 1857: RSI
    - Atropine, Ketamine & Rocuronium
- Assessment: Dried blood in nose, bruising R)ear region, lung sounds course, episodes of desaturation, no bruising to chest or abdomen, L)upper extremity bruising


Induction agents
Etomidate
Dosing: 0.3mg/kg
Normal dose: 24mg IV push
Caution if pt septic
Max dose: 40mg
Ketamine
Dosing: 1.5mg/kg
Normal dose: 120mg IV push
Caution w/ htn, tachycardia, ↑ ICP
Max dose: 300mg
#Needle Decompression#
Paralytics
Rocuronium - Fridge
Dosing: 1mg/kg
Normal dose: 80mg IV push
No cautions, safe in pregnancy
Max dose: 130mg
Succinylcholine - Fridge
Dosing: 1.5mg/kg
Normal dose: 120mg IV push
Caution in burns, crush injuries, eye injuries, ↑ K+
Max dose: 150mg
Ketamine Hydrochloride
Etomidate Injection, USP
40 mg per 20 mL (2 mg / mL)
Single Dose Vial

MVC

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- Assessment: Dried blood in nose, bruising R)ear region, lung sounds course, episodes of desaturation, no bruising to chest or abdomen, L)upper extremity bruising

MVC

- 1910: Chest x-ray obtained
- 1920: HR 210 – 95/48 – 94% ambu – RR 40's – Temp 99.1 R
- 1920: 2nd fluid bolus started
- 1925: HR 213 – 95/74 – 97%
  - ETT suctioned
- 1930: Leave ED to RW

MVC

- 1930: Leave ED to RW
- 1940: HR 200 – 80/27 – 84%
- 1945: Suction x 2 in flight– bloody secretions
- 1950: HR 193 – 78/29 – 69%
  - Bagging with ease
- 1950: 100 cc PRBC's

MVC

- Mechanical Issues – need to land at McKennan
- 1955: HR 192 – 96/43 – 84%
- 2005: HR 199 – 87/43 – 92%
- Warming measures
- 2001: Land at McKennan
- 2010: Pt in trauma bay

LEVEL I TRAUMA TEAM…

Criteria for Pediatric Level I Trauma Activation (< 15 y/o)

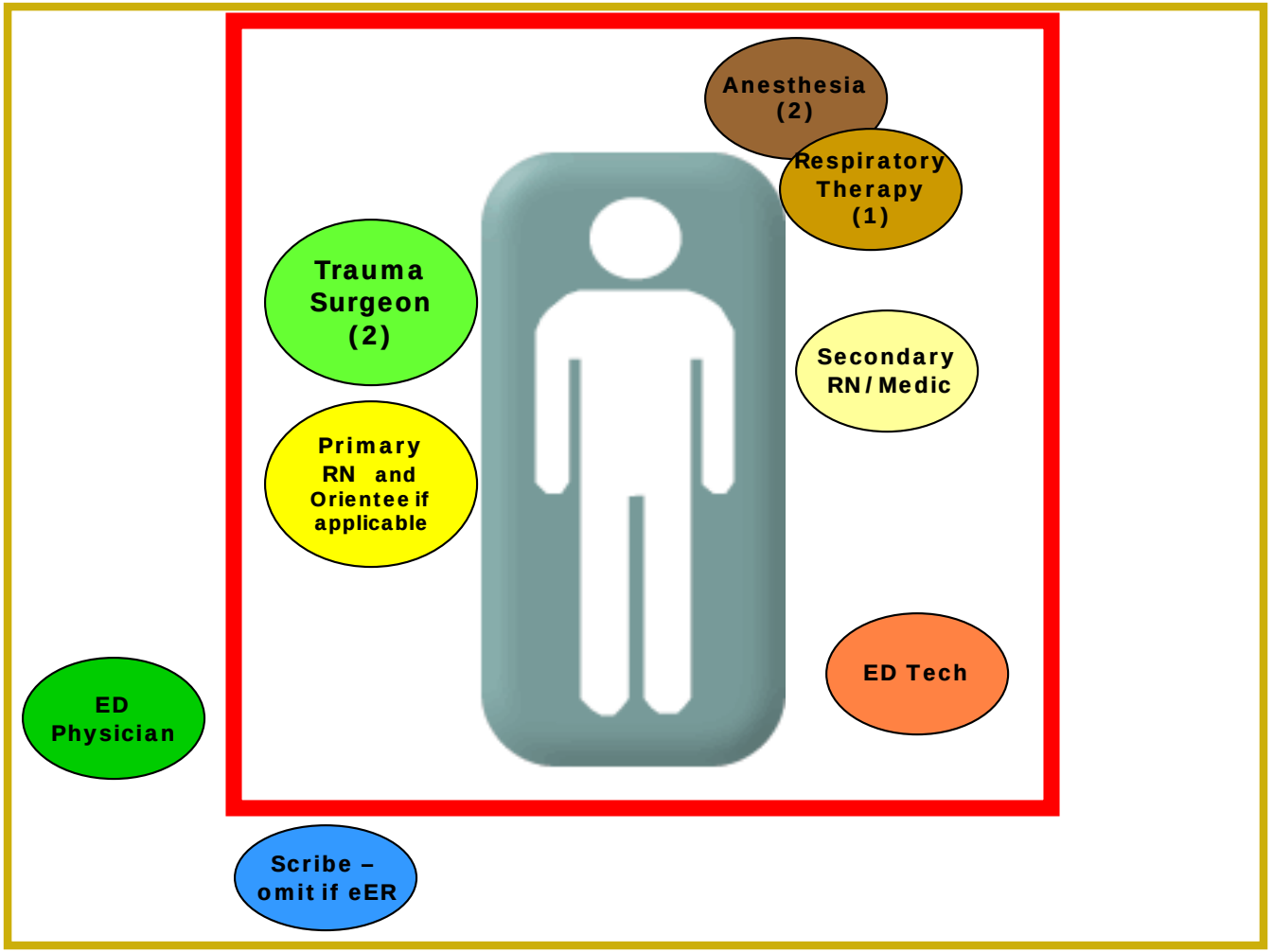
1. Glasgow Coma Scale < 10
2. Physiologic signs of hypotension in a child including tachycardia with evidence of poor perfusion, *to include pelvic and vascular injuries* [SBP < 70 mmHg + (2 x age in years) or < 60 if under 1 year of age)
3. Airway and/or Respiratory Compromise with mechanism related to trauma or patients in need of an emergent airway including intubated patients transferred from the scene
4. "Life or limb threatening" penetrating injury to head, neck, torso, groin, & extremities proximal to knee or elbow, including any GSW to these areas
5. Flail chest
6. Paralysis, loss of sensation, and/or suspected spinal cord injury (related to traumatic injury)
7. Amputation proximal to wrist or ankle
8. Transfer patients from other hospital receiving blood to maintain vital signs
9. Burns >20% (partial or full thickness)
10. Uncontrolled arterial bleeding (to include use of tourniquet)
11. Any patient that the ED physician or pre-hospital provider deems necessary

(Hangings are Level I if GCS <10 or intubated)

Avera McKennan Hospital Trauma Service
Level I Trauma Team Response

INNER CORE

OUTER CORE



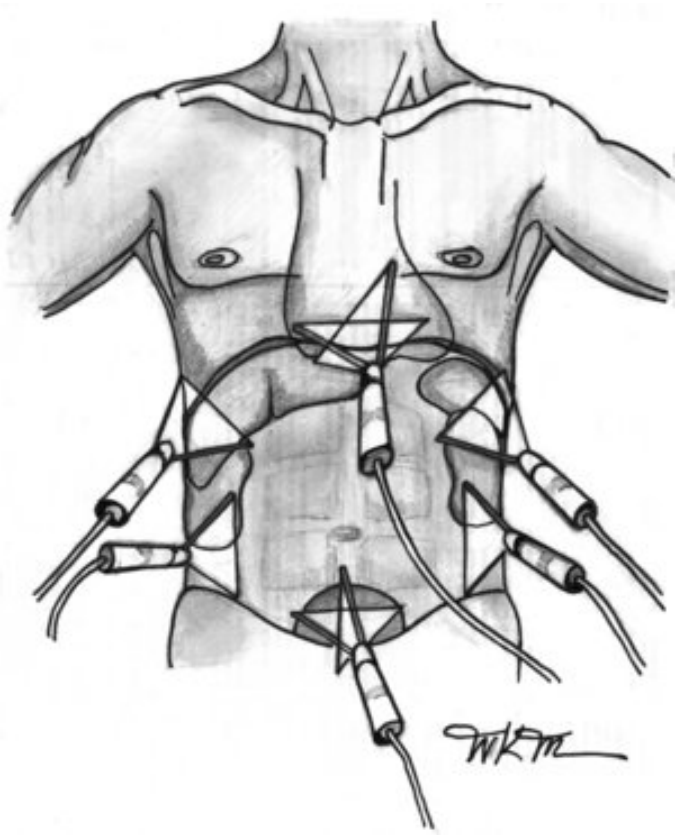
Students & Observers: Will be allowed in per Trauma Surgeon & Primary RN discretion.

MVC

- Avera ED (2007 - 2134)
  - Vitals: 97.3 - 197 - 24 - 84/55 - 86% ambu - GCS: 3
  - PRBC infusing (35 cc administered on ED arrival)
  - Manipulation of ETT (O2 sats decline to 60's at times)
  - Bilateral pupils-sluggish
  - 2010: Trauma surgeon arrival
  - 2021: Chest x-ray
  - 2028: Glucose 353
  - 2030: HR 201 – RR 24 – 78% vent (improves with ambu bag

MVC

- Avera ED (2007 - 2134)
  - 2032: CT scans
    - Sats declining, manual bagging with ETT manipulation
    - Pediatric Intensivist met pt in CT
  - 2100: HR 208 – 77/26
  - 2110: FAST (in CT scan)
  - 2115: 2nd bolus pRBCs started
  - 2134: PICU



MVC

Injuries:

- Grade V spleen laceration
- Bilateral pulmonary contusions
- Lrg. Hemoperitoneum
- Grade II Liver laceration
- CHI / DAI
- IVH / IPH small
- Forehead contusion
- Craniocervical distraction injury

ISS - 59
P(s):0.0654

MVC

- PTD #0
  - 2136: PICU
    - No corneal reflex, cough or gag
  - 2200: Central line placed
  - 2229: Attempted to place bolt
  - 2245: HR remains 190-200s, BP now decreasing - brought to OR
    - 200cc NS bolus

MVC

- PTD #0
  - OR (2306-2355)
    - Exploratory laparotomy, splenectomy, repair of liver laceration, abdominal packing with vac placement
    - FFP – 300 cc
    - pRBC – 425 cc



MVC

- PTD #1
  - PERRL bilateral
  - Rt. side moves to painful stimuli, no movement to the Lt
  - Vital signs much improved: HR 170's – normotensive - O2 sat 95% - Temp 97.0
  - MRI head & spine, EEG (slowing), Echo (-)
  - Planning for transport to other Level II facility (family member is there)

MVC

- PTD #2
  - Hemodynamically stable
  - Abdomen open with wound vac intact
  - Transfer to Level II PICU

Long-term Follow-up

- Pt doing very well
  - Awake & alert
  - Able to eat
  - Minimal deficit to L)side

- **Performance Improvement**
  - Look at cases…how can we do better the next time?

Car Seat Use after Crash

- https://www.nhtsa.gov/car-seats-and-booster-seats/car-seat-use-after-crash

Car Seat Use After a Crash

NHTSA recommends that car seats be replaced following a moderate or severe crash in order to ensure a continued high level of crash protection for child passengers. Car seats do not automatically need to be replaced following a minor crash.

What defines a minor crash?

A minor crash is one in which ALL of the following apply:

- The vehicle was able to be driven away from the crash site.
- The vehicle door nearest the car seat was not damaged.
- None of the passengers in the vehicle sustained any injuries in the crash.
- If the vehicle has air bags, the air bags did not deploy during the crash; and
- There is no visible damage to the car seat.

NEVER use a car seat that has been involved in a moderate to severe crash. Always follow manufacturer's instructions.

THANK YOU FOR WHAT YOU DO…

References

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