Ch 33 - Multiple Trauma

EPISODE CONTENT BASED ON ROSEN'S EMERGENCY MEDICINE (9TH ED.)

Italicized text is quoted directly from Rosen's.

Key Concepts:

1. *Immediately after a trauma patient arrives in the ED, the primary survey should be performed in a standardized fashion The goal of the primary survey is to identify and initiate the treatment of critical, life-threatening injuries rapidly.*
2. *The eFAST examination should take place early in the evaluation of the trauma patient, ideally as a part of the primary survey. Thoracic examination of the trauma patient by ultrasound is more accurate than plain radiography.*
3. *Any patient with potentially life-threatening injuries should have blood typing and screening performed. When transfusion is indicated, blood products should be transfused in a 1:1:1 or 1:1:2 ratio of plasma to platelets to PRBC's.*
4. *Tranexamic acid is indicated for patients with evidence of significant hemorrhage or shock and is given as a 1-g bolus followed by a 1-g infusion over 8 hours. Results are best if started within 1 hour of injury, but benefit may occur when it is given within 3 hours.*

Core Questions

1. What are the injuries for the following blunt trauma mechanisms:
    a. Head-on collision
    b. Rear end collision
    c. Lateral (T-bone) collision
    d. Rollover
    e. Ejected from vehicle
    f. Windshield damage
    g. Steering wheel damage
    h. Dashboard involvement or damage
    i. Restraint or seat belt use
    j. Air bag deployment
    k. Low-speed pedestrian versus automobile
    l. High-speed pedestrian versus automobile
    m. Bicycle versus automobile
    n. Non-automobile-related
    o. Vertical impact falls
    p. Horizontal impact falls

2. Outline an approach to the primary survey for the trauma patient.
3. Describe the elements of the eFAST exam.
4. Outline an approach to the secondary survey in the trauma patient.
5. Detail relevant ancillary laboratory tests to order in the trauma patient.
6. List the components of the following imaging decision-making tool
    a. Canadian CT Head Rule
    b. Canadian C-Spine Rule
    c. NEXUS C-Spine Rule
    d. NEXUS Chest Rule
7. What are the indications for a CT abdomen/pelvis in the trauma patient?

Wisecracks

1. What are the mechanisms of injury for the following weapons:
    a. Knives
    b. Handgun rounds
    c. Shotgun rounds
    d. Rifle rounds
2. What is the LD50 in feet for falls from a given height?
3. What is permissive hypotension and what evidence does it have?

Rosen's in Perspective

Alright, guys, we are back at it again. Let's start things off with a case.

You are working your local level one trauma centre when you get a page from your ED triage nurse. You pick up the phone and you get the following story:

45Y female in high-speed rollover MVC with suspected injuries to the C-spine, face, pelvis. Obvious open ?femur fracture to the left leg. Hypotensive and tachycardic at-scene. Passenger in car pronounced dead on scene.

Every word seems to strike more anxiety into your soul. What do you do? How do you prepare the room and your team?

If this case scares you as much as it does us, have no fear. We got you, as always. Today's episode will be the introductory podcast for the upcoming section on trauma. While it may seem rather general, we have tried to pack all of the pearls we could into it to prime your minds for the podcasts to come. In today's episode, we will give you all the tools you will need to skillfully wade into the waters of the trauma world. We will review a solid approach to the trauma patient, detailing the components of the primary and secondary surveys. We will break down the use of POCUS in trauma scenarios as well as give you the information you will need to select

appropriate ancillary and diagnostic imaging tests during your next visit to the trauma room. Last, we will end things with the Rosen's trivia you have all come to know and love.

With that, we will giddy up along the trail. So, grab a coffee, sit back, and enjoy the ride!

Core Questions:

[1] What are the injuries for the following blunt trauma mechanisms:

a. Head-on collision
b. Rear end collision
c. Lateral (T-bone) collision
d. Rollover
e. Ejected from vehicle
f. Windshield damage
g. Steering wheel damage
h. Dashboard involvement or damage
i. Restraint or seat belt use
j. Air bag deployment
k. Low-speed pedestrian versus automobile
l. High-speed pedestrian versus automobile
m. Bicycle versus automobile
n. Non-automobile-related bicycle injuries
o. Vertical impact falls
p. Horizontal impact falls

This table was adapted from *Table 33.1 - Blunt Trauma and Associated Injuries* in Rosen's 9th Edition. Please refer to the text for further details.

Mechanism of Injury	Additional Considerations	Potential Associated Injuries
Head-on Collision	Nil	Facial injuries Lower extremity injuries Aortic injuries
Rear-end Collision	Nil	Hyperextension injuries of the C-spine Cervical spine fractures Central cord syndrome

Lateral (T-bone) Collision	Nil	Thoracic injuries Abdominal injuries - liver/spleen Pelvic injuries Clavicle, humerus, rib fractures
Rollover	Greater chance of ejection Significant mechanism of injury	Crush injuries Compression fractures of the spine
Ejected from Vehicle	Likely unrestrained Significant mortality	Spinal injuries
Windshield Damage	Likely unrestrained	Closed head injuries Coup-contrecoup injuries Facial fractures Skull fractures Cervical spine fractures
Steering Wheel Damage	Likely unrestrained	Thoracic injuries Sternal and rib fractures, flail chest Cardiac contusion Aortic injuries Hemothorax/PTX
Dashboard Involvement or Damage	Nil	Pelvic or acetabular injuries Dislocated hip
Restraint or Seatbelt Use - Proper 3 Point Restraint	Decreased morbidity	Sternal and rib fractures, pulmonary contusions
Restraint of Seatbelt Use - Lap Belt Only	Nil	Chance fracture, abdominal injuries, head and facial injuries and fractures
Restraint of Seatbelt Use - Shoulder Belt Only	Nil	Cervical spine injuries and fractures, “submarine” out of restraint devices (possible ejection)

Airbag Deployment	Front end collisions, less severe head and upper torso injuries Not effective for lateral impacts More severe injuries in children (improper front seat placement)	Upper extremity soft tissue injuries Lower extremity injuries and fractures
Low Speed (braking automobile) pedestrian v. car	Nil	Tibia and fibula fractures Knee injuries
High Speed pedestrian v. car	Nil	Waddel's Triad (tibia and fibula or femur fractures, truncal injuries, craniofacial injuries) Thrown pedestrians at risk for multisystem injuries
Bicycle v. car	Nil	Closed head injuries Handlebar injuries (liver/spleen lacerations, intra-abdominal injuries consider penetrating injuries)
Non-automobile related bicycle injuries	Nil	Extremity injuries Handlebar injuries
Vertical Impact	LD50 = 36-60 ft	Calcaneal and lower extremity fractures Pelvic fractures Closed head injuries Cervical spine injuries Renal and reno-vascular injuries

Horizontal Impact	Nil	Hand and wrist fractures Abdominal and thoracic visceral injuries Aortic injuries

[2] Outline an approach to the primary survey for the trauma patient.

System Assessed	Pertinent Details for Assessment
Airway	Phonation Dentition/debris/blood in airway C-Spine immobilization Palpation for tracheal deviation, expanding neck hematomas
Breathing	Inspection for chest rise and excursion, respiratory effort Palpate for chest wall tenderness, deformity, subcutaneous emphysema, flails segments
Circulation	Palpation of distal pulses, capillary refill Palpation of abdomen Pelvic stability
Disability	Pupils, GCS, capacity to move all limbs, rectal tone with DRE
Exposure	Palpation of all limbs for obvious injuries, logroll to assess for spinal deformities/tenderness Observe for other areas of bleeding (e.g., bleeding from urethra)

[3] Describe the elements of the eFAST exam.

Alright. This is a foundational skill that ALL practitioners of Emergency Medicine must be well-versed in. While this brief explanation most certainly will not give you competence in ultrasound, hopefully it will pique your interest enough to learn more.

Components of the eFAST Exam

1. Check for lung slide bilaterally - assesses for pneumothorax
2. Check for pericardial effusion with a subxiphoid view of the heart - assesses for potential cardiac tamponade in context of blunt trauma
3. Check for free fluid in:
    a. RUQ - this view also helps to identify hemothorax
    b. LUQ - this view also helps to identify hemothorax
    c. Pelvis

Notes on Testing Results:

- For free fluid in the abdomen
    - 42% sensitive, >/98% specific
    - As little as 100 cc of free fluid can be detected

[4] Outline an approach to the secondary survey in the trauma patient.

This table was adapted from *Table 33.2 - Secondary Survey of Trauma Patients* in Rosen's 9th Edition. Please refer to the text for further details.

Region or System	Assessment or Examination	Critical Diagnoses	Emergent Diagnoses
General	Level of consciousness GCS Specific Complaints	GCS </8 Focal motor deficit	
Head	Pupils (size, shape, reactivity, visual fields) Contusions Lacerations Evidence of skull fracture (hemotympanum, Battle's sign, raccoon eyes, palpable defects)	Herniation syndrome	Globe rupture Open skull fracture CSF Leak

Face	Contusions Lacerations Midface instability Malocclusion	Airway obstruction secondary to bleeding	Facial fractures Mandible fracture
Neck (maintain cervical immobilization)	Penetrating injury, lacerations Tracheal deviation JVD Subcutaneous emphysema Hematoma Midline cervical tenderness	Carotid injury Pericardial tamponade Tracheal, laryngeal fracture Vascular injury Cervical fracture, dislocation	
Chest	Respiratory effort, excursion Contusions Lacerations Focal tenderness, crepitus Subcutaneous emphysema Muffled Heart Sounds Breath sounds (symmetric)	Impending respiratory failure Flail chest Cardiac tamponade Tension PTX	Cardiopulmonary injuries Intrathoracic injury Rib fractures PTX PTX, Hemothorax

Abdomen/Flank	Contusions		Solid, hollow viscus injury
	Penetrating injury, lacerations	Intra-abdominal hemorrhage	Solid, hollow viscus injury
	Tenderness	Intraabdominal hemorrhage	Solid, hollow viscus injury
	Peritoneal signs	Abdominal catastrophe	
Pelvis/GU	Contusions	Pelvic Hemorrhage	
	Lacerations		Urogenital injury
	Stability, symphyseal tenderness	Unstable pelvic fracture/pelvic hemorrhage	
	Blood (urethral meatus, vaginal bleeding, hematuria)	Unstable pelvic fracture	Urethral injury
	Rectal examination	Colorectal injury (bleeding)	Urethral injury (high-riding prostate)
Neurologic, spinal cord	Midline bony spinal tenderness	Spinal fracture, dislocation	
	Mental status	Epidural hematoma, subdural hematoma	Cerebral contusions, shear injury
	Paresthesias		Spinal cord injury, contusion, nerve root Injury
	Sensory level	Spinal fracture, dislocation	
	Motor function, including sphincter tone	Spinal fracture, dislocation	

Extremities	Contusions Lacerations Deformity Focal Tenderness Pulses Capillary Refill	Compartment Syndrome Vascular injury Neurovascular injury Arterial injury Hemorrhagic shock, arterial injury	Rhabdomyolysis Fracture Fracture

[5] Detail relevant ancillary laboratory tests to order in the trauma patient.

While this is by no means an exhaustive list, consider ordering the following studies in the patient who has experienced blunt trauma:

1. CBC
2. Electrolytes
3. Extended electrolytes
4. Liver enzyme and function testing
5. INR/aPTT
6. Urinalysis + Creatinine/BUN
7. Blood type and screen or crossmatch (depending on severity of injury and suspicion of impending transfusion)
8. VBG with lactate
9. Trops/CK
10. B-HCG

[6] List the components of the following imaging decision-making tools: Canadian CT Head Rule, Canadian C-Spine Rule, NEXUS C-Spine Rule, NEXUS Chest Rule

Canadian CT Head Rule:
-Medium risk (for brain injury on CT)

a) Amnesia before impact >30 min
b) Dangerous mechanism (pedestrian struck by vehicle, occupant ejected from motor vehicle, fall from elevation >3 feet or 5 stairs or more

-High Risk (for neurological intervention)

a) GCS <15 at 2 hours post injury

b) Suspected open or depressed skull fracture
c) Signs of basilar skull fracture (hemotympanum, racoon eyes, CSF otorrhea/rhinorrhea, Battle's sign)
d) Age >65 years
e) Two or more episodes of emesis

In addition to the risk factors, it is important to remember the inclusion and exclusion criteria so that the rule can be applied in the correct patients.

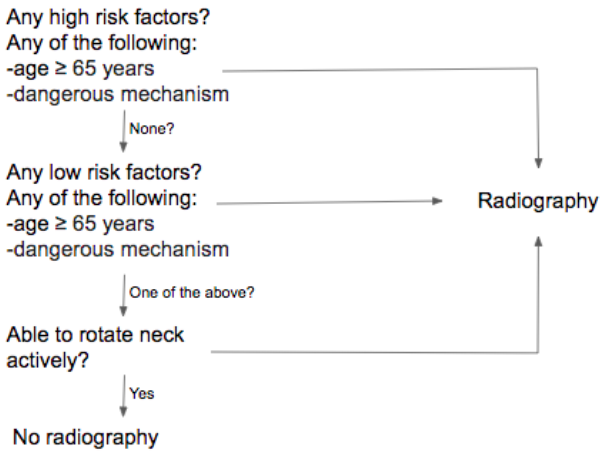
Inclusion criteria:

a) Minor head injury (blunt trauma to the head resulting in witnessed LOC, definite amnesia, or witness disorientation
b) Initia ED GCS greater than or equal to 13
c) Injury within the past 24 hours

Exclusion criteria:

a) Age < 16 years
b) Minimal head injury (no LOC, amnesia, or disorientation)
c) Unclear history of trauma as the primary event ex. primary seizure or syncope
d) Obvious penetrating skull injury or depressed skull fracture
e) Acute focal neurological deficit
f) Unstable vital signs associated with major trauma
g) Seizure prior to ED assessment
h) Bleeding disorder or anticoagulation use
i) Return for reassessment for the same head injury
j) Pregnancy

Canadian C-Spine Rule:



The above table was adapted from Rosen's 9th Edition. Please refer to the text for further details.

Canadian C-Spine Rule Exclusion Criteria:

1) Age <16 years
2) GCS<15
3) Grossly abnormal vitals
4) Injury >48 hours
5) Penetrating trauma
6) Acute paralysis
7) Known vertebral disease (ankylosing spondylitis, rheumatoid arthritis, spinal stenosis, previous spinal surgery)
8) Return visit for reassessment of same injury
9) Pregnant

Nexus C-Spine Rule:

1) No midline tenderness
2) No focal neurological deficits
3) Abnormal alertness
4) No intoxication
5) No painful distracting injury

**Inclusion criteria is blunt neck injury

Nexus CT Chest Rule:

-Clinically major thoracic injuries:

a) Abnormal chest x-ray (absence of any thoracic injury including clavicle fracture or widened mediastinum)
b) Distracting injury
c) Chest wall, sternum, thoracic spine, or scapular tenderness

-All thoracic injuries:

a) Rapid deceleration mechanism (fall from >20 feet/6.1m, or MVC at >64.5km/h with sudden deceleration

**If all the above criteria are met in a chest trauma no CT chest is required. Use only in awake, non-intubated, hemodynamically stable blunt trauma patient 15 years or older in whom CT chest is considered as part of the normal diagnostic evaluation.

[7] What are the indications for a CT abdomen/pelvis in the trauma patient?

As per Rosen's 9th Edition, the following are indications for blunt trauma patients undergoing CT abdomen/pelvis imaging:

1. Abdominal pain or tenderness
2. Significant mechanism of injury
3. Abnormal eFAST exam
4. Gross hematuria
5. Unreliable examination (e.g., altered mental status, distracting injury, head injury)
6. Presence of a seatbelt sign

Wisecracks:

[1] What are the mechanisms of injury for the following weapons:

a. Knives
b. Handgun rounds
c. Shotgun rounds
d. Rifle rounds

Answer:

Weapon	Mechanism of Injury
Knives	- Direct laceration - Crush Injury
Handgun Rounds	- Direct laceration - Crush Injury

Shotgun Rounds	- From long-range:
	  - Direct laceration
	  - Crush injury
	- From short-range:
	  - Massive tissue injury

Rifle Rounds	- Direct laceration - Crush injury - Shock waves - Cavitation

[2] What is the LD50 in feet for falls from a given height?

Answer: LD50 = 36-60 feet

[3] What is permissive hypotension and what evidence does it have?

Answer: THIS IS CONTROVERSIAL AND NOT WIDELY ACCEPTED

Basic Principles:

- Allow the BP to fall enough to prevent exsanguination but high enough to perfuse organs
- Want to avoid dislodgement of unstable clots that have formed
- Helps to avoid over-resuscitation that can lead to coagulopathy and death
- Only used as a damage control intervention to help the patient get to definitive intervention (e.g., surgery)
- Once you control the hemorrhage, normal physiologic parameters are met
- Meant largely for penetrating traumas

Downfalls:

- LITTLE EVIDENCE - really only based on animal studies and one semi-randomized trial in 1994
- Results in worsening secondary injury in patients with concominant TBI's
- While all patients who are shocky post-trauma are assumed to be experiencing hemorrhagic shock, concomitant forms of shock can co-exist. This is not an appropriate strategy for patients with other causes of their shock (e.g., obstructive shock)