



## 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	Upper extremity soft tissue injuries  Lower extremity injuries and fractures



	seat placement)	
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.**

<b>System Assessed</b>	<b>Pertinent Details for Assessment</b>
<b>Airway</b>	Phonation Dentition/debris/blood in airway C-Spine immobilization Palpation for tracheal deviation, expanding neck hematomas
<b>Breathing</b>	Inspection for chest rise and excursion, respiratory effort Palpate for chest wall tenderness, deformity, subcutaneous emphysema, flails segments
<b>Circulation</b>	Palpation of distal pulses, capillary refill Palpation of abdomen Pelvic stability
<b>Disability</b>	Pupils, GCS, capacity to move all limbs, rectal tone with DRE
<b>Exposure</b>	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
<b>General</b>	Level of consciousness  GCS  Specific Complaints	GCS </8  Focal motor deficit	
<b>Head</b>	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
<b>Face</b>	Contusions  Lacerations  Midface instability  Malocclusion	Airway obstruction secondary to bleeding	Facial fractures  Mandible fracture
<b>Neck (maintain cervical)</b>	Penetrating injury, lacerations	Carotid injury	



<p><b>immobilization)</b></p>	<p>Tracheal deviation</p> <p>JVD</p> <p>Subcutaneous emphysema</p> <p>Hematoma</p> <p>Midline cervical tenderness</p>	<p>Pericardial tamponade</p> <p>Tracheal, laryngeal fracture</p> <p>Vascular injury</p> <p>Cervical fracture, dislocation</p>	
<p><b>Chest</b></p>	<p>Respiratory effort, excursion</p> <p>Contusions</p> <p>Lacerations</p> <p>Focal tenderness, crepitus</p> <p>Subcutaneous emphysema</p> <p>Muffled Heart Sounds</p> <p>Breath sounds (symmetric)</p>	<p>Impending respiratory failure</p> <p>Flail chest</p> <p>Cardiac tamponade</p> <p>Tension PTX</p>	<p>Cardiopulmonary injuries</p> <p>Intrathoracic injury</p> <p>Rib fractures</p> <p>PTX</p> <p>PTX, Hemothorax</p>
<p><b>Abdomen/Flank</b></p>	<p>Contusions</p> <p>Penetrating injury, lacerations</p> <p>Tenderness</p> <p>Peritoneal signs</p>	<p>Intra-abdominal hemorrhage</p> <p>Intraabdominal hemorrhage</p> <p>Abdominal catastrophe</p>	<p>Solid, hollow viscus injury</p> <p>Solid, hollow viscus injury</p> <p>Solid, hollow viscus injury</p>
<p><b>Pelvis/GU</b></p>	<p>Contusions</p>	<p>Pelvic Hemorrhage</p>	





	<p>Lacerations</p> <p>Stability, symphyseal tenderness</p> <p>Blood (urethral meatus, vaginal bleeding, hematuria)</p> <p>Rectal examination</p>	<p>Unstable pelvic fracture/pelvic hemorrhage</p> <p>Unstable pelvic fracture</p> <p>Colorectal injury (bleeding)</p>	<p>Urogenital injury</p> <p>Urethral injury</p> <p>Urethral injury (high-riding prostate)</p>
<b>Neurologic, spinal cord</b>	<p>Midline bony spinal tenderness</p> <p>Mental status</p> <p>Paresthesias</p> <p>Sensory level</p> <p>Motor function, including sphincter tone</p>	<p>Spinal fracture, dislocation</p> <p>Epidural hematoma, subdural hematoma</p> <p>Spinal fracture, dislocation</p> <p>Spinal fracture, dislocation</p>	<p>Cerebral contusions, shear injury</p> <p>Spinal cord injury, contusion, nerve root Injury</p>
<b>Extremities</b>	<p>Contusions</p> <p>Lacerations</p> <p>Deformity</p> <p>Focal Tenderness</p> <p>Pulses</p> <p>Capillary Refill</p>	<p>Compartment Syndrome</p> <p>Vascular injury</p> <p>Neurovascular injury</p> <p>Arterial injury</p> <p>Hemorrhagic shock, arterial injury</p>	<p>Rhabdomyolysis</p> <p>Fracture</p> <p>Fracture</p>



**[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. Troponin/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) Initial 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:

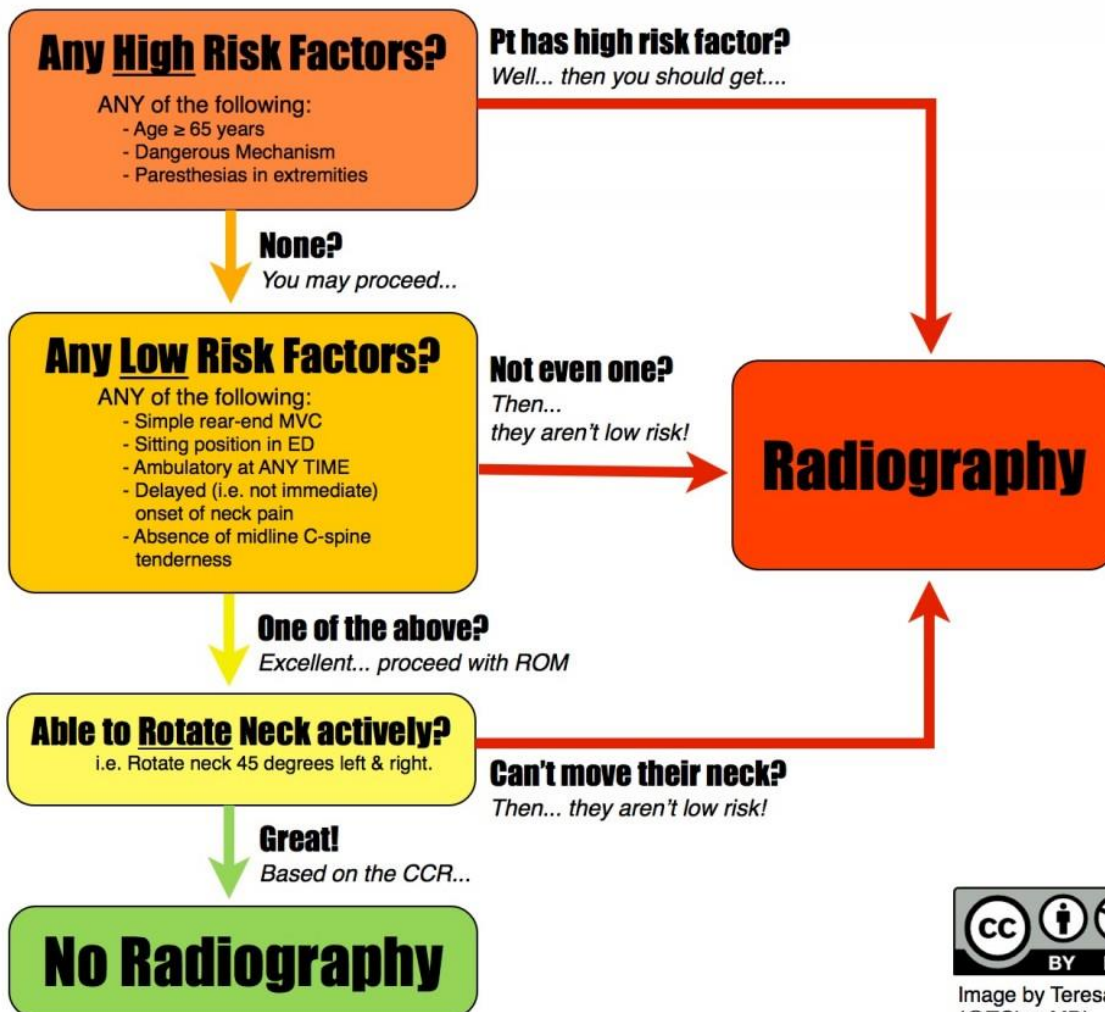


Image by Teresa M. Chan (@TChanMD)

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	<ul style="list-style-type: none"><li>- Direct laceration</li><li>- Crush Injury</li></ul>
Handgun Rounds	<ul style="list-style-type: none"><li>- Direct laceration</li><li>- Crush Injury</li></ul>
Shotgun Rounds	<ul style="list-style-type: none"><li>- From long-range:<ul style="list-style-type: none"><li>- Direct laceration</li><li>- Crush injury</li></ul></li><li>- From short-range:<ul style="list-style-type: none"><li>- Massive tissue injury</li></ul></li></ul>
Rifle Rounds	<ul style="list-style-type: none"><li>- Direct laceration</li><li>- Crush injury</li><li>- Shock waves</li><li>- Cavitation</li></ul>

**[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 concomitant 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)