Mechanism of Injury in Trauma

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Conflict of Interest Disclosure

- **Bryan E. Bledsoe, DO, FACEP, FAEMS**
  - No conflicts of interest to disclose

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Mechanism of Injury

- Does mechanism of injury (MOI) predict morbidity and mortality in trauma in 2020?
- Does mechanism of injury (MOI) predict trauma center need in 2020?

Mechanism of Injury

- Mechanism of Injury:
  - The manner in which a physical injury occurred. The MOI is used to estimate the forces involved in trauma and, thus, the potential severity for wounding, fractures, and internal organ damage that a patient may suffer as a result of the injury.

Mechanism of Injury

- **ACS MOI Criteria (2012 data):**
  - Falls:
    - Adult: >20 feet
    - Children: >10 feet or 2-3 times height of child.
  - MVCs:
    - Intrusion (including roof):
      - >12 inches occupant side
      - >18 inches any side
    - Ejection (partial or complete)
    - Death in same passenger compartment
    - Vehicle telemetry data consistent with a high risk of injury.
- **ACS MOI Criteria (2012 data):**
  - Auto vs. Pedestrian/bicyclist:
    - Thrown
    - Run over
    - With significant (>20 MPH) impact.
  - Motorcycle crash:
    - >20 MPH

Mechanism of Injury

- Why does it matter?
- What is the desired over triage rate necessary to catch most patients who would benefit from trauma center care?
- Trauma activation fees in the United States are incredibly expensive.
- Many hospitals in the United States are activating virtually every incoming trauma patient because of the activation fees.

Mechanism of Injury

- ACS (2006 criteria) suggests a 25-50% over-triage rate and a 5% under-triage rate is desirable.
- MOI criteria may improve under-triage somewhat, but significantly increases over-triage.
- Over/under triage:
  - Under-triage can increase mortality by lack of trauma center care.
  - Over-triage:
    - Contributes to ED crowding.
    - Increases trauma center throughput times.
    - Uses unnecessary resources.
    - Increases costs.
    - Bypasses capable hospitals.
    - Increases unnecessary HAA utilization.

Mechanism of Injury

- Australian study of 794 trauma patients:
  - Activations: 428
  - Major trauma criteria met: 135 (32%)
  - Over-triage rate was: 68%
  - MOI was responsible for over half of over-triage cases.
  - Removal of least predictive MOI criteria decreased over-triage to 50% and before there was an increase in undertriage.

Cameron M, McDermott KM, Campbell L. The performance of trauma team activation criteria at an Australian regional hospital. *Injury*. 2019;50:39-45

Mechanism of Injury

Table 3
Association of Pre-hospital Criteria with overtriage when no Clinical Criteria are met.

Criteria	Trauma team activations	Associated major trauma	Proportion of overtriage
MVC ejection	24	3	0.07
MVC entrapment	7	0	0.02
MVC fatality at scene	9	1	0.03
Pedestrian vs car > 30km/h	15	0	0.05
Fall > 3 m	17	0	0.06
Central crush injury	4	0	0.01
Central penetrating injury	52	5	0.16
>3 simultaneous patients	51	2	0.17
Total	167	10	0.57

Twelve activations were MVCs with ">3 simultaneous patients" and one Major Trauma was both a "MVC ejection" and ">3 simultaneous patients".

Cameron M, McDermott KM, Campbell L. The performance of trauma team activation criteria at an Australian regional hospital. *Injury*. 2019;50:39-45

Mechanism of Injury

- Wisconsin study (1999 ACS Trauma Triage Criteria):
  - MOI alone (no other trauma center usage criteria):
    - 91% overtriage
    - 4% undetriage
- For patients NOT meeting anatomic/physiologic criteria
  - Good predictor:
    - Death of another occupant
    - Fall distance
    - Extrication time
  - Moderate predictor:
    - Intrusion
    - Ejection
    - Vehicle deformity
  - Poor predictor:
    - MVC speed
    - Rollover
    - Pedestrian/bicyclist thrown, runover
    - Pedestrian/bicycle striking speed
    - Motorcycle crash speed
    - Separation from motorcycle

Lerner B, et al. Does mechanism of injury predict trauma center need? *Prehosp Emerg Care*. 2011;15(4):518-525

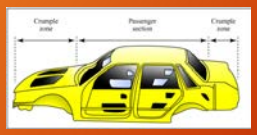
Mechanism of Injury

- Some criteria require providers (or the patient) to estimate speed.
- How accurate is that?

Mechanism of Injury

- Passenger compartment intrusion:
  - 12 inches?
  - 18 inches?
- How accurate is provider estimation of passenger compartment intrusion?

Mechanism of Injury



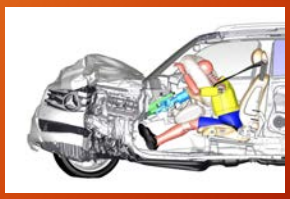
- Modern motor vehicle construction has changed the dynamics of passenger compartment intrusion.
- Supplemental restraint systems (SRS) have made vehicle much safer.

Mechanism of Injury

- LSU Study:
  - 3,569 patients transported yo trauma center based upon MOI alone (Step 3 criteria):
    - 821 (23%) met trauma center need.
  - Significant predictors of TCN:
    - Death in the same passenger compartment
    - Ejection from vehicle
    - Extrication time >20 minutes
    - Fall >20 feet,
    - Pedestrian thrown/runover.
- Criteria not meeting TCN:
  - Vehicle intrusion
  - Rollover MVC with speed >40 MPH
  - Injury from auto-pedestrian/auto-bicycle of > more 5 MPH
  - Both of the motorcycle crash (MCC) criteria.
- Elimination of the vehicle intrusion and MCC criteria and reevaluation of extrication time merits further study.

Stuke LE et al. Not all mechanisms are created equal: a single-center experience with the national guidelines for field triage of injured patients. *J Trauma*.2013:75(1):140-5

Mechanism of Injury



Mechanism of Injury

- Pediatric trauma patients:
  - Emphasize anatomic/physiologic criteria.
  - De-emphasize MOI criteria:
    - Results in selection of higher-acuity patients for major activation while maintaining acceptable under-triage and over-triage rates overall.
    - This improved accuracy of major APB criteria for pediatric trauma triage.

Krieger AR, et al. Efficacy of anatomic and physiologic indicators versus mechanism of injury criteria for trauma activation in pediatric emergencies . *J Trauma*. 2012:73(6):1471-1477.

Mechanism of Injury

- Trauma assessment and trauma center determination is generally a non-linear process (despite the ACS criteria).
- Anatomic and physiologic criteria are most important.
- There is increasing emphasis on Step 4 criteria (burns, anticoagulant use, etc.).
- MOI alone (without anatomic/physiologic criteria) leads to significant over-triage.
- Allowing EMS provider "gestalt" may be a better method of avoiding over-triage and preventing under-triage.

Mechanism of Injury

- There was little scientific evidence regarding the predictive value of MOI criteria for major trauma and trauma center need.
- MOI criteria alone result in significant over-triage.
- Trauma triage protocols need to be refined to reflect the evolving science.