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# What Should We Know About Trauma Mechanism and Pre-hospital Assessment

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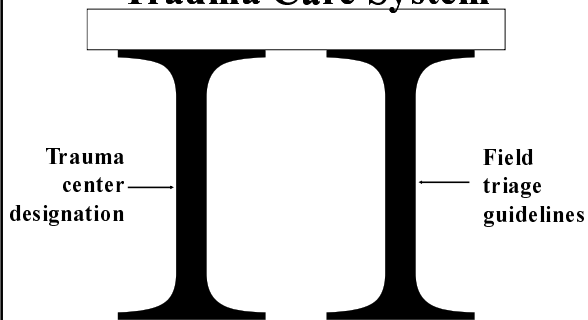
## Lecture Outline

- Overview
- What we should know about trauma mechanism
- What we should know about pre-hospital assessment of trauma
- Case discussion
- Summary

## Overview

- **Three critical tasks must be rapidly performed by prehospital providers caring for trauma victims:**
  - For multiple victims: triage with initiation of life-saving treatment
  - For the individual victim: examination with recognition of severe injuries and injuries with potential to cause rapid decompensation
  - Stabilization and transport to a hospital capable of addressing the identified injuries

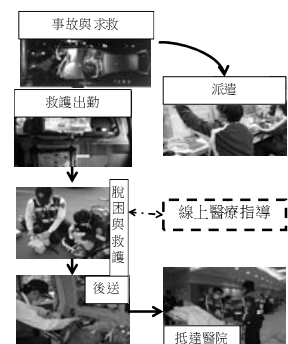
## Trauma Care System



Mattox KL, Feliciano DV, Moore EE, et al. Trauma, 4th ed. P58, 2000

## Goal of Trauma Care System

- **Three R's**
  - Get the right patient
  - to the right hospital
  - at the right time



2003/8/29

## Scenario

- 48歲女性機車騎士在上班途中與一輛遊覽車發生碰撞事故後被EMT送往貴院。傷者意識清醒，主訴左大腿腫痛、無法站立。
  - 你如何獲得現場線索以判斷創傷型式與機轉？
  - 傷者可能受傷部位為何？
  - 你認為傷者應被送往哪一層級的醫院？為什麼？

## Trauma Mechanism

- The physician must understand the kinematics of trauma and integrate this knowledge with the trauma producing episode.
- Pre-hospital personnel are the primary source of this important component of the patient's history.

## General Principles

- Law of energy and motion
  - Newton's first law : A body at rest will remain at rest unless acted on by an outside force.
  - Newton's second law : The force an object can exert is the product of its mass times its acceleration.
- Three phases of trauma event
  - Precrash
  - Crash
  - Postcrash

## Three phases of trauma event

- Precrash
  - Acute or pre-existing medical conditions
  - Ingestion of recreational substances
- Crash
  - Impacts of crashes
  - The effect of all forces on the patient
- Postcrash
  - Understanding of the kinematics of trauma
  - The index of suspicion regarding injuries
  - Strong assessment skills

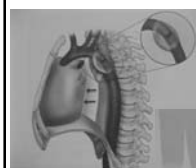
## Patterns and Mechanisms of Trauma

- Patterns of blunt trauma
  - Motor vehicle crashes
  - Motorcycle crashes
  - Pedestrian injuries
  - Falls
  - Sports injuries

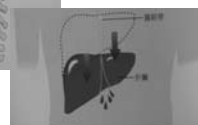
Chap. 4 Kinematics of Trauma. PHTLS, 7<sup>th</sup> ed, 2011

## Patterns and Mechanisms of Trauma

- Mechanisms of blunt trauma
  - Compression
  - Shear



Shear



Compression

## Motor Vehicle Crashes

- **Five phases of trauma:**
  - Phase 1: Deceleration of the vehicle
  - Phase 2: Deceleration of occupant
  - Phase 3: Deceleration of internal organs
  - Phase 4: Secondary collisions
  - Phase 5: Additional impacts received by the vehicle

## Motor Vehicle Crashes

- **Impact Patterns**
  - Frontal impact
  - Rear impact
  - Lateral impact
  - Rotational impact
  - Rollover



## Motorcycle Crashes

- **Attention should be given to:**
  - Deformity of motorcycle
  - Side damaged
  - Distance of skid
  - Deformity of objects or vehicles
  - Helmet deformity

## Motorcycle Crashes

- **Four types of motorcycle impact:**
  - Head-on impact
  - Angular impact
  - Ejected
  - Laying the bike down

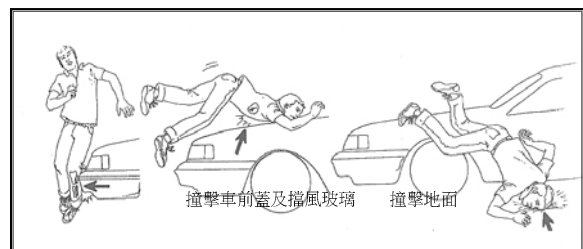


## Pedestrian injuries

- **Three predominant MOIs:**
  - First impact: auto strikes body with its bumpers.
  - Second impact: adult is thrown on hood and/or grille of vehicle.
  - Third impact: body strikes the ground or some other object.

## Pedestrian injuries

- **Three predominant MOIs:**



## Fall

- **Severity of injuries impacted by:**

- Height
- Position
  - ✓ Don Juan syndrome or lover's leap
- Surface
- Physical condition

## Patterns and Mechanisms of Trauma

- **Patterns of penetrating trauma**

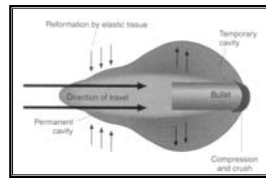
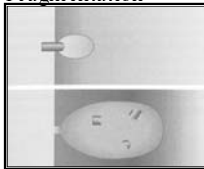
- Low-energy weapons
  - ✓ Handheld cutting devices: knife, ice pick...etc.
- Medium-energy weapons
  - ✓ Handguns and some rifles
- High-energy weapons
  - ✓ Rifles with muzzle velocity >2000ft/sec
  - ✓ Assault weapons
  - ✓ Shotguns

Chap. 4 Kinematics of Trauma. PHTLS, 7<sup>th</sup> ed, 2011

## Mechanisms of Trauma

- **Mechanisms of penetrating trauma**

- Cavitation
  - ✓ Temporary
  - ✓ Permanent
- Fragmentation



## Patterns and Mechanisms of Trauma

- **Blast injuries**

- Primary: Produced by contact of blast shockwave with body
- Secondary: Projectiles (*the most common source of injury from blast*)
- Tertiary: Propulsion of the body into another object
- Quaternary: Heat and flames
- Quinary: Radiation, chemicals, bacteria

Chap. 4 Kinematics of Trauma. PHTLS, 7<sup>th</sup> ed, 2011

## Blast injuries

- **Blast injuries**



## Pre-hospital Assessment

- **Scene assessment**
- **Patient assessment**
- **Transport considerations**

## Scene Assessment

- Obtaining a general impression of situation for scene safety
- Looking at the cause and results of the incident
- Observing family members and bystanders

## Patient Assessment

- Establishment of priorities
    - Multiple vs Mass casualty incident
  - Primary survey
    - C-spine security
  - Resuscitation
    - Limited scene intervention
  - Secondary survey
  - Monitoring and reassessment
- Injury severity**
- ✓ Vital signs and GCS
  - ✓ Anatomic injuries
  - ✓ Trauma mechanism
    - Using kinematics in assessment

## Triage



- Multiple casualties
  - Definition: Number of pt's and their severity do not exceed the ability of facility to render care.
  - Principle: Life-threatening and multi-system injuries patients are treated first
- Mass casualties
  - Definition: Number of patients and their severity exceed the capability of facility and staff.
  - Principle: Pt's with the greatest chance of survival and requiring the least expenditure are treated first.

## NEXUS (National Emergency X-Radiography Utilization Study)

Table 1. The NEXUS Low-Risk Criteria.\*

Cervical-spine radiography is indicated for patients with trauma unless they meet all of the following criteria:

- No posterior midline cervical-spine tenderness,<sup>†</sup>
- No evidence of intoxication,<sup>‡</sup>
- A normal level of alertness,<sup>§</sup>
- No focal neurologic deficit,<sup>¶</sup> and
- No painful distracting injuries.<sup>||</sup>

NEJM 2003;349:25:10-8

## The Canadian C-Spine Rule for Radiography in Alert and Stable Trauma Patients

JAMA. 2001;286:1841-1848

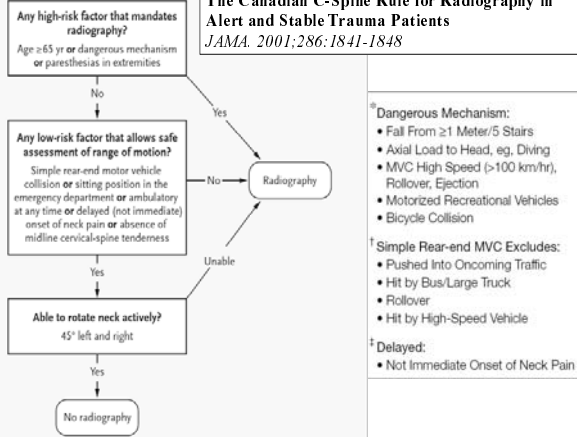


Table 4. Sensitivity, Specificity, and Negative Predictive Value of the Two Rules for 162 Cases of "Clinically Important" Injury among 7438 Patients.\*

Result of Assessment	Canadian C-Spine Rule		NEXUS Criteria	
	Injury	No Injury	Injury	No Injury
Positive (no.)	161	3995	147	4599
Negative (no.)	1	3281	15	2677
Sensitivity (%)	99.4 (95% CI, 96–100) <sup>†</sup>		90.7 (95% CI, 85–94) <sup>†</sup>	
Specificity (%)	45.1 (95% CI, 44–46) <sup>†</sup>		36.8 (95% CI, 36–38) <sup>†</sup>	
Negative predictive value (%)	100		99.4	

N Engl J Med 2003; 349:2510-8.

**Table 2. Performance Criteria of CCR and NLC in Ruling in or Ruling Out Cervical Spine Injuries in Patients With Low Risk Blunt Trauma to the Cervical Spine Seeking Emergency Care**

	CCR* (All Patients)	NLC† (All Patients)	NLC‡ (Patients ≥65 yr)
Characteristics	Value% (95% CI)	Value% (95% CI)	Value% (95% CI)
Sensitivity	100 (98–100)	99.0 (98.0–99.6)	98.5 (94.8–99.7)
Specificity	42.5 (40–44)	12.9 (12.8–13.0)	14.6 (14.5–14.8)
PPV <sup>2</sup>	2.9 (2.5–3.4)	2.7 (2.6–2.8)	5.3 (5.2–5.3)
NPV <sup>1</sup>	100 (99.9–100)	99.8 (99.6–100)	99.5 (98.3–99.9)

\*Canadian C-Spine Rule, n = 8924.<sup>13–15</sup>

†Nexus Low Risk Criteria, n = 34,069.<sup>16–22</sup>

‡Patients ≥65 yr Include (n = 2943).<sup>23</sup>

NPV indicates negative predictive value; PPV, positive predictive value.

Spine 2008;33:S101–S122

## High Energy Mechanisms

- **High-risk auto crash**
  - Intrusion, including roof: >12 inches occupant site; >18 inches any site
  - Ejection (partial or complete) from automobile
  - Death in same passenger compartment -Vehicle telemetry data consistent with a high risk of injury

## High Energy Mechanisms

- **Auto vs. pedestrian/bicyclist thrown, run over, or with significant (>20 mph) impact**
- **Motorcycle crash >20 mph**
- **Falls**
  - Adults: >20 feet (one story is equal to 10 feet)
  - Children: >10 feet or two or three times the height of the child

## High Energy Mechanisms

- **Penetrating Trauma**
  - High energy weapons injury involve head, neck and torso
- **Blast injuries**

## High Energy Mechanisms



## Dangerous Mechanisms

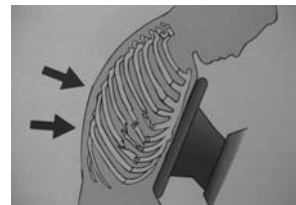
- **Head**
  - 高能量機轉
  - 頭部穿刺傷
  - 行人被撞事件（機動車或汽卡車），且撞到頭部
  - 乘客從車輛中或機動車飛出，且撞到頭部
  - 高處墜落超過1公尺或5個階梯且撞到頭部

## Dangerous Mechanisms

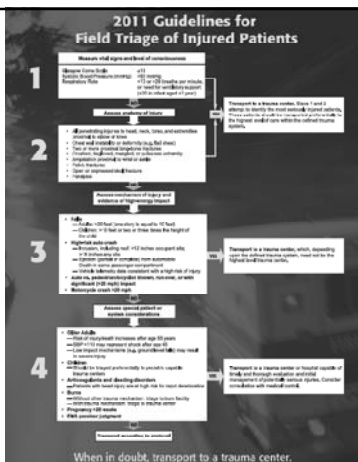
- C-spine
  - 高能量機轉
  - 頸椎附近穿刺傷
  - 高處墜落超過1公尺或5個階梯且撞到頭部
  - 頭部軸向撞擊（如潛水）
  - 遊樂運動設施事故
  - 腳踏車碰撞事件

## Dangerous Mechanisms

- Chest
  - 胸部穿刺傷
  - 方向盤變形
- Abdomen
  - 兩乳連線中點以下至鼠蹊以上穿刺傷



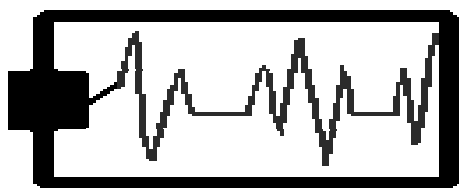
## Field Triage Scheme



## Transport Considerations

- Patient needs
- Level of receiving facility
  - ✓ 重度級急救責任醫院
  - ✓ 中度級急救責任醫院
  - ✓ 一般度級急救責任醫院
- Mode of transportation
  - ✓ Ground transportation
  - ✓ Helicopter transportation

## Questions?



## Summary

- What we should know about trauma mechanism:
  - Trauma pattern
  - Trauma kinematics
  - High energy mechanism
  - Dangerous mechanism

## **Summary**

- **What we should know about pre-hospital assessment:**
  - Triage for multiple or mass casualty incident
  - Indications for C-spine immobilization
  - Limited scene resuscitation
  - Field triage guideline
  - Transport considerations

**Thanks for Your  
Attention**

