

Mechanisms of Trauma

VEHICULAR IMPACT

LATERAL IMPACT

- One-sided rib fractures, spleen or liver injury, hip fractures on that side
- Head acts as a mass that rotates and bends laterally – torso is accelerated away from the collision

REAR IMPACT

- Hyperextension injuries of the neck
- Posterior elements of the cervical spine get fractured
- Fractures at multiple levels are common

QUARTER-PANEL IMPACT: mixture of frontal and lateral or rear and lateral impacts

ROLLOVER

- violent multiple movements which hurt unrestrained passengers more
- skin injuries point to areas of impact

EJECTION

- likelihood of serious injuries is increased 300%

COLLISION-RELATED ORGAN INJURIES

COMPRESSION INJURY

- Blunt myocardial injury
- Pneumothorax, lung contusion as it is instinctive to take a deep breath and hold it, for a patient involved in a crash. Thus, the lungs are full of air and relatively rigid.
- diaphragmatic rupture due to sudden compression of the abdominal cavity leading to an increased intra-abdominal pressure

DECELERATION INJURY

- Aortic rupture as the aortic arch separates from the descending aorta
- Renal pedicle tear as the kidney keeps travelling and the torso stops
- Central hepatic laceration - liver accelerates around the ligamentum teres, the right and left lobes
- Subdural as the brain separates from the posterior dura
- C-spine tends to fracture at C7-T1

RESTRAINT USE

- 3-POINT RESTRAINTS DECREASE MORTALITY BY 65-70%
 - o 10-fold reduction in serious injury
 - o the inertial device works within 0.01sec = driver only moves 15cm
- AIRBAGS ARE ONLY USEFUL IN 70% OF IMPACTS
 - o Only useful in frontal impacts, and only in the first impact
- INAPPROPRIATE USE:
 - o The seatbelt has to be above the anterior superior iliac spine
 - o If its above the ASIS, you will rupture your abdominal organs
 - o The L-spine can suffer a compression fracture due to hyperflexion around a lap belt

PEDESTRIAN INJURIES

- 90% OCCUR AT SPEEDS BELOW 30KPH
 - CHILDREN ARE THE MOST FREQUENTLY HIT PEDESTRIANS
 -
 - MOST COMMON INJURIES:
 - o Thorax (most common)
 - o Head
 - o Lower Limbs
- THREE PHASES OF PEDESTRIAN IMPACT:
- FIRST YOU HIT THE BUMPER → LOWER LIMB INJURY
 - THEN YOU HIT THE HOOD AND WINDSHIELD → HEAD AND TORSO INJURY
 - THEN YOU HIT THE ROAD SURFACE → HEAD, SPINE AND EXTREMITY INJURY

CYCLIST INJURIES

- PROTECTIVE CLOTHES OCCASIONALLY HELP; but:
- Only the helmet does anything
- No evidence that it increases the risk of neck injuries

FALLS

- o THESE ARE EFFECTIVELY DECELERATION INJURIES
- o The more surface area is fallen on, the less the injury
- o If the impact is attenuated by a soft surface or a fall is broken into a series of falls, there is less injury
- o Force is transmitted. Organs will tear free from their anchoring.

BLAST INJURIES

- Two phases:
 - o First, an outwardly expanding wall of gas hits you (Very brief duration)
 - o Then, the negative pressure created by the first wave sucks at you (longer duration)
 - o The force of the blast wave decreases in proportion to the third power of the distance

Classified into 4 tiers of injury

- PRIMARY
 - o Pressure wave injury
 - o Most damage is to GAS-CONTAINING ORGANS
 - o Tympanic membrane is the MOST VULNERABLE: can only tolerate 2 atmospheres
 - o Lung contusion, edema, rupture – may lead to air embolism
 - o Intraocular hemorrhage, retinal detachment
 - o Intestinal rupture
- SECONDARY
 - o Flying objects striking the individual
- TERTIARY
 - o The patient has become a missile and strikes other stationary objects
- QUARTERNARY
 - o Burn injury
 - o Crush injury
 - o Dust inhalation
 - o Toxic fumes inhalation

PENETRATING INJURIES

- **Low energy: knife or hand-thrown weapons**
- **Medium energy: handguns**
- **High energy: military or hunting rifles**

THE WOUNDING CAPABILITY OF A MISSILE INCREASES SHARPLY ABOVE 600 METRES PER SECOND. At this velocity, a temporary cavity is created by tissue being compressed around the area of the impact

CAVITATION:

- **proportional to the surface area of the point of impact'**
- **proportional to the density of the tissue**
- **proportional to velocity of projectile**

diameter of the cavity can be up to 30 times the diameter of the bullet

HOLLOW POINT ROUNDS = more rapid deceleration = more rapid energy transfer, thus more damage

YAW: the orientation of the long axis of the bullet

SHOTGUN WOUNDS

- **muzzle velocity is 360 m/sec**
- **at 40 metres, the pellets deposit in a 75cm diameter circle**
- **injuries at long range are superficial**
- **pellets can carry clothing deep into the wound and cause infection**

**MISSILES FOLLOW THE PATH OF LEAST RESISTANCE.
THIS PATH IS NOT ALWAYS LINEAR**