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EMERGENCY SURGERY



R Rajamahendran

JAYPEE

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CHAPTER 3

Trauma: General Aspects
(Based on Advanced Trauma Life Support, 10th Edition)

R Rajamahendran

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INTRODUCTION

- The most common cause of death in the first four decades of life is trauma.
- It is the third common cause of death overall.

MECHANISMS OF INJURY

- *Overt mechanism:*
  - Penetrating trauma
  - Blunt trauma
  - Thermal trauma
  - Blast injury
- *Covert mechanism:*
  - Blunt trauma
  - Penetrating trauma
  - Penetrating knife
  - Gunshot injury

The track can be identified by the anatomy, which shows the organs injured.

Extra Edge

Overt injury:
- Some injuries are so obvious that they present even before the patient details are not known
- *Example: Singed facial hair* associated with carbonaceous sputum suggest inhalational burns and anesthetic colleague should be called as soon we identify such problem before the patient goes for larynx edema

Covert injuries:
- These cases need application of common sense and identifying the hidden injuries
- *Example: Seat belt injury*—flexion and distraction will have an overt injury of dislocated knee, chance fracture of lumbar spine, *but hidden duodenal injury and popliteal artery rupture should be sought*

Advanced Trauma Life Support (ATLS)

Steps in ATLS:
- *Primary survey:* With simultaneous resuscitation, identify which is killing the patient
- *Secondary survey:* Identify other injuries
- *Definitive care*

TRIAGE

Triage a French word that means *"to sort".*
Four color codes are given **(Fig. 1) (Table 1)**

- *Red:* First priority is a critical patient
- *Yellow*: Urgent is second priority
- *Green:* Minor and third priority
- *Black:* Dead or about-to-die patients.

BLUNT TRAUMA

- The most common cause is road traffic accident.
- Use of seat belt by the front row occupants reduces their death rate by 45%.

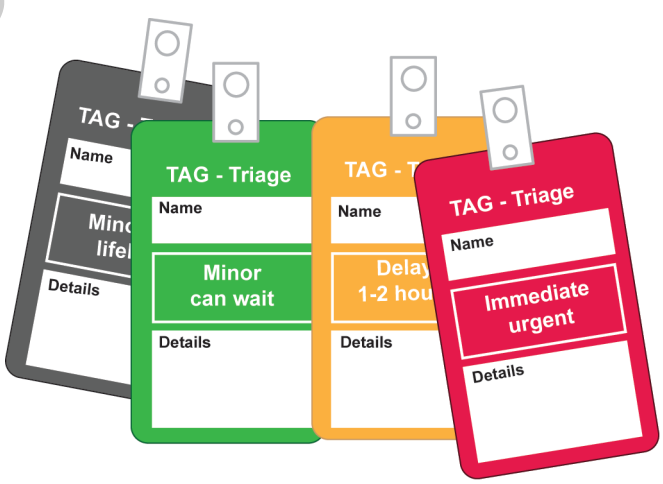

Fig. 1: Triage.

TABLE 1: Priority levels with corresponding colors.

Priority	*Color*	*Example*
I	Red	Tension pneumothorax
II	Yellow	Pelvic fracture
III	Green	Simple fracture
Last—zero priority	Black	Unsalvageable

- Remember, if the rear seat belts are worn, the death rate of front seat occupants with seat belts is reduced to 80%.
- Seat belt mark if present in thorax has *four-fold thoracic trauma* and mark in *abdomen has three fold risk* than those not having mark.

Primary Survey: cABCDE

- c—exsanguinating external hemorrhage
- A—airway
- B—breathing
- C—circulation
- D—disability and neurological status
- E—exposure

C—Exsanguinating External Hemorrhage

- Even before airway is managed, exsanguinating external hemorrhage must be controlled first by pressure or packing.
- In limbs, tourniquet must be applied for concerned time and early surgical repair must be done.

Airway with Cervical Spine Control

- For head injury with *Glasgow coma scale* (*GCS) score ≤8,* immediate intubation is needed.
- While maintaining the patent's airway, always maintain *cervical spine stability.*
- *Things to be done in airway:*
  - Suctioning secretions or blood from airway
  - *Airway maneuvers:* Jaw thrust, chin lift, oropharyngeal or nasopharyngeal airway insertion.

Breathing and Ventilation

- *Oxygen* must be offered to all trauma patients via reservoir mask in high flow.
- *Ventilation* must be assessed by seeing chest walls and lungs.
- Tension pneumothorax, flail chest, massive hemothorax, and open pneumothorax are all clinical diagnosis and not radiological diagnosis and need immediate treatment.

Circulation

- Circulation is assessed based on three clinical criteria:
  1. Conscious level (implies cerebral perfusion)
  2. Skin color
  3. Rapid thready pulse is more reliable warning sign than blood pressure
- Indicators of shock in the injured patient
  - Agitation or confusion
  - Tachycardia, tachypnea, and diaphoresis
  - Cool mottled extremities
  - Weak distal pulses
  - Decreased pulse pressure and urine output
  - Hypotension
- Emergency resuscitation with *1–2 liters of warm crystalloid solution* through two large bore, short, peripheral intravenous (IV) catheters

Permissive hypotension:
- Maintain good blood supply to vital organs such as brain, heart, and kidney

Target systemic pressure: 70–90 mm Hg
- If head injury suspected, have pressure > 90 mm Hg
- Fluids such as 250 mL of O negative blood or normal saline are infused
- Excessive crystalloids and colloids are avoided as they cause hemodilution and increase coagulopathy and acute respiratory distress syndrome (ARDS)
- Severely injured hypovolemic patients must receive massive transfusion protocol (1 packed red cells: 1 fresh frozen plasma: 1 platelets)

Tranexamic acid:
- 1 gm IV over 10 minutes followed by 1 gm for 8 hours
- It should be given to all trauma patients suspected to have significant hemorrhage with pulse rate (PR) >110 beats per-minute or blood pressure (BP) < 110 mm Hg systolic
- It must be administered in 3 hours of injury and even given by paramedics in prehospital environment

Identification and management of hemorrhage:
- *Gold standard investigation: Whole body computed tomography scan (WBCT)* from head to pelvis with IV contrast for severely injured adult blunt trauma patient
- WBCT is done as early as possible with resuscitation being on the go
- Provisional hot report is issued in minutes for WBCT and definitive report is obtained after 30–60 minutes
- All patients who undergo immediate laparotomy [e.g., abdominal injuries or pelvic bleeding after focused assessment with sonography for trauma (FAST)] must have a pelvic binder until pelvic fracture is excluded by WBCT

Disability and Exposure

- *Glasgow coma scale* is the score used in trauma setting to measure the disability.
- Fully expose the patient and examine front and back.

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- Log roll should not be performed until pelvic fracture is excluded.
- If you want to move the patient during primary survey, for example, to CT scan, *20 degrees roll with inline spinal stabilization must be used.*
- *Springing the pelvis to look for pelvic fracture is not performed nowadays. Diagnose pelvic fracture only by radiological method.*

Radiographs in Trauma

- Lateral cervical spine
- Anteroposterior chest
- Anteroposterior pelvis

Damage control surgery in orthopedics (DCO): Temporary stabilization of long bone fractures with external fixators and planning for intramedullary nailing after 4 days.

Early total care (ETC): Early fracture fixation of all fractures.

But DCO and ETC are not competition for each other and must complement each other at needed places

- *Example:* If you are planning ETC of intramuscular (IM) nailing of a femur fracture and on table patient becomes unstable due to chest trauma or head trauma, we must convert ETC to DCO by just external fixation

Criteria for DCO/damage control surgery (DCS)	*Criteria for ETC*
• Hypothermia <34°	• Hemodynamically stable
• Acidosis <7.2	• No inotropes needed
• Serum lactate >5 mmol/L	• No hypoxia
• Coagulopathy	• No hypercapnia
• Blood pressure (BP) <70 mm Hg	• Lactate level <2 mmol/L
• Transfusion approaching around 15 units	• Normal coagulation/ Normothermia
• Injury severity score >36	• Urine output >1 mL/kg/h

Resuscitation in Trauma

Resuscitative Thoracotomy

- Open pericardium to relieve cardiac tamponade.
- Perform internal cardiac massage.
- Cross clamp the distal thoracic aorta.
- Manage intrathoracic bleeding.

Criteria for Selection:

- Patients with penetrating thoracic trauma who have signs of life on reaching emergency department are selected. Survival rate of this procedure in penetrating trauma is 35%.
- Blunt trauma patients usually have poor outcomes with survival rates as low as 1%.

Emergency Department Thoracotomy (Table 2)

TABLE 2: Indications and contraindications for emergency intervention.

Indications	*Contraindications*
Salvageable postinjury cardiac arrest: • Penetrating trauma to torso within 15 minutes of prehospital CPR • Blunt trauma within 10 minutes of prehospital CPR • Penetrating neck trauma or extremity trauma in 5 minutes *Severe postinjury hypotension (<60 mm Hg):* • Cardiac tamponade • Intrathoracic hemorrhage, intraabdominal bleed, and neck injury bleeding • Air embolism	• *Penetrating trauma:* CPR > 15 minute and no signs of life (pupillary reflex, respiratory effort, or motor activity nil) • *Blunt trauma:* CPR > 10 minutes with no signs of life or asystole without cardiac tamponade

(CPR: cardiopulmonary resuscitation)

Recent advance:

Resuscitative endovascular balloon occlusion of the aorta (REBOA): Quicker, less invasive method of achieving aortic occlusion during initial resuscitation, providing another tool to combat early exsanguinating blood loss.

Goals of Resuscitation

- Optimizing tissue perfusion
- Ensuring normothermia
- Restoring coagulation
- Judicious use of crystalloids and transfusion
- Maintain oxygen delivery index >500 mL/min per square meter and cardiac index >3.8L/min per square meter

Extra Edge

- *Norepinephrine* is the agent of choice in increasing systemic vascular resistance
- Goal to normalize lactate is within 24 hours
- Acute coagulopathy of trauma (ACOT)
- Activated protein C is a key element in ACOT
- Thromboelastography (TEG) and rotational thromboelastometry (ROTEM) viscoelastic hemostatic assays—helps in goal directed hemostasis
- *Massive transfusion [10 units of packed red blood cells (PRBC) in 6 hours] Protocol:* 1:2 red cell: plasma ratio used

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Venous lactate level—uses in resuscitation:
- Useful marker of resuscitation and physiological state of the patient
- *Values:* <2 mmol/L—fully resuscitate and give early total care (ETC) is possible
- *2–3 mmol/L:* Observe whether improving or deteriorating on resuscitation
- *>3 mmol/L:* Under resuscitated, resuscitate further or do damage control surgery (DCS) if surgery is urgent
- *>5 mmol/L:* No doubt, DCS is the management

Injury Scoring Systems (Box 1)

- *Abbreviated injury scale (AIS):* Anatomic system of injury classification
- Injury severity score (ISS)
- Glassgow coma scale (GCS) scoring
- Revised trauma scoring (RTS)
- Trauma and injury severity score (TRISS)
- Mangled extremity severity score (MESS)

Abbreviated Injury Scale

- It tells the probability of threat to life scale based on individual injury.
- It has a seven-digit code and is represented as 123456.7.
- Post dot code (7th digit) describes the severity code and ranges from 1 to 6 as follows
  1 Minor
  2 Moderate
  3 Serious
  4 Severe
  5 Critical
  6 Maximum (fatal)
- Pre dot codes represent the anatomic region, structure, specific structure, and level of injury as follows"
  1 Anatomic body region
  2 Type of anatomic structure
  3/4 Specific anatomic structure
  5/6 Level of injury
- Pre dot code for Body region (first digit) is as follows
  1 Head
  2 Face
  3 Neck
  4 Thorax
  5 Abdomen and Pelvis
  6 Spine
  7 Upper extremities
  8 Lower extremities
  9 Burns and other trauma

Abbreviated injury scale severity code and its probability of death is as follows:

AIS severity code	*Probability of death %*
1	0
2	1–2
3	8–10
4–5	50
6	100

BOX 1: Various injury scoring systems.

Revised trauma score (RTS):
- R—respiratory rate
- T—tie and see Blood pressure (BP)
- S—scale (Glasgow coma scale)

Trauma injury and severity score (TRISS):
- R—RTS
- I—injury severity score
- S—seen Age
- S—specific mechanism (blunt or penetrating)

Mangled extremity severity score (MESS):
- M—main energy that caused injury
- E—extremity ischemia
- S—seen Age
- S—shock

Secondary Survey

- Head-to-toe examination
- Further evaluation with imaging and other diagnostic modalities
- More detailed neurologic evaluation
- Torso examination, seat belt marks, and superficial injury to neck and abdomen
- Assessment of pelvis and pulse rate (PR) to assess position of prostate and for any bleeding
- Perfusion of the extremities

AMPLE Assessment

- A—allergy
- M—medications
- P—past medical history
- L—last meal
- E—events of incident

DAMAGE CONTROL SURGERY (ABBREVIATED LAPAROTOMY)

The surgery is restricted to two goals only:
- Stop any active bleed.
- Control any contamination.

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TABLE 3: Phases of trauma management.

Phase 1: Initial exploration	*Phase 2: Secondary resuscitation*	*Phase 3: Definitive treatment*
• Control active hemorrhage and contamination • *Midline incision:* Four quadrant packing done • Gastrointestinal tract (GIT) perforations closed with sutures or staples • External drains kept for pancreatic/bile duct injuries • Temporary closure of abdomen using plastic sheet known as Opsite • This technique of closure is known as "VACPAC or Opsite sandwich"	• Transfer to intensive care unit (ICU) • Ventilatory support • *Correct the deadly triad:* Hypothermia, acidosis, and coagulopathy	• Planned re-exploration and definite surgery • Done 48–72 hours after secondary phase • Complex reconstruction must be avoided

TABLE 4: Stages and indications of damage control surgery.

Stage	*Procedure*
I	Select the patient
II	Control hemorrhage and contamination
III	Intensive care unit (ICU) resuscitation
IV	Definitive repairs
V	Closure of abdomen

Indications of damage control surgery:

- *Anatomical:*
  - Difficult to achieve hemostasis
  - Complex injury such as liver, pancreas, etc.
  - Combined solid, hollow, and vascular injuries
  - Inaccessible major venous like retrohepatic inferior vena cava (IVC) injury
  - Nonoperative control of other injuries is in more demand such as in pelvic fracture
  - Time consuming procedure anticipated
- *Physiological:*
  - Temperature <34°C
  - pH <7.2
  - Serum lactate >5 mmol/L (n = 2.5)
  - Prothrombin time (PT) >16 seconds
  - Partial thromboplastin time (PTT) >60 seconds
  - >10 units transfused
  - Systolic BP <90 mm Hg for > 60 seconds
- *Environmental:*
  - Operating time >60 minutes
  - Inability to approximate abdominal incision
  - Relook of abdomen needed

The aim is to resuscitate the patient and plan for definite surgeries after the patient becomes stable.

Indications for Damage Control Surgery

- Refractory hypothermia (temperature <35°C)
- Profound acidosis (arterial pH <7.2 and base deficit <15 mmol/L)
- Refractory coagulopathy

TABLE 5: Management strategies for various traumatic injuries.

Arterial injuries	Interposition polytetrafluoroethylene (PTFE) graft
Venous injuries	Preferentially ligated
Hepatic injuries	Perihepatic packing
Translobar gunshot wounds of liver	Balloon catheter tamponade
Bleeding pulmonary injuries	Wedge resection using stapler
Penetrating pulmonary injuries	Pulmonary tractotomy
Cardiac injuries	Pledgeted repair
Pancreatic injuries	Packed and evaluation of ductal integrity later
Urologic injuries	Catheter diversion
Small gastrointestinal (GI) injuries	Rapid whipstitch using prolene and temporary closure of abdomen

Note: Corresponding traumas are discussed in concerned chapters by specialists.

DEADLY TRIAD

Following a trauma and protracted surgery in physiologically unstable patient, the three factors that carry high mortality are:

- Hypothermia
- Acidosis
- Coagulopathy

Hence, originated a phenomenon—Damage Control Surgery.

Phases of DCS ***(Tables 3 and 4)****:*

- *Phase 1:* Initial exploration
- *Phase 2:* Secondary resuscitation
- *Phase 3:* Definitive operation

Procedures in Damage Control Surgery

Procedures in DCS are given in **Table 5**.

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Key Features

- The book covers all the essentials aspects of surgery related to emergencies
- Latest protocols are updated in emergency management
- It has been authored by concerned specialists for more accuracy of the contents
- The management part is updated with the latest journals and new editions of standard textbooks
- This book is suitable not only for surgery residents, but also for practicing surgeons to know the latest updates of emergencies
- More than 100 colored images of illustrations and intraoperative emergencies are added
- Lots of tables and flowcharts for understanding the protocols are made.



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