By the Name of ALLAH the Most Gracious the Most Merciful

Truama

L1

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To be read in

Bailey & Love's Short Practice of Surgery 28th Edition.

Truama Ch 26 – 34 .

Definition

- Is a force inducing injury to any part of the human body as the result of energy transfer from an inflicting source.
- These are chemical, thermal, ionising radiation and mechanical.
- The extent and severity of the trauma sustained depends upon the magnitude, nature and duration of the inflicting cause.
- Major trauma denotes injuries to more than one body region or organ system.

- Road traffic accidents (RTAs), falls and intentional violence continue .
- The vast majority of trauma is not life- or limb-threatening.
- Severe trauma continues to be a major cause of death in young patients .

- **International Classification of Diseases**, a system that can be limited in providing accurate descriptions of injury severity.
- In contrast, the **Abbreviated Injury Scale dictionary** consists of a greater level of detail (including more than 2000 injury codes) and assigns to every injury a severity score between 1 (mild) and 6 (maximum).
- This can be summated into the so-called **Injury Severity Score** (ISS) , which provides an indication of the anatomical severity of injury suffered by the individual patient. Major trauma is defined as an ISS greater than 15. The majority of patients admitted to hospital with injury have low ISS values, ranging between 4 and 9, with injuries such as an isolated limb fracture and/or isolated mild head injury. Overall, major trauma affects approximately 15% of all injured patients.

The assessment of trauma

The assessment of trauma

- Appreciate the factors in the relationship: mechanism + patient factors = injuries sustained
- Use this to allow obvious features to lead to the discovery of less obvious injuries
- When the features do not appear to ‘add up’ this should be an alert for the clinician to think ‘outside the box’ and connect the dots

- When analysis of the formula ‘mechanism + patient = injury’ has failed to identify hidden injury, there are two other approaches:

1- the look everywhere approach

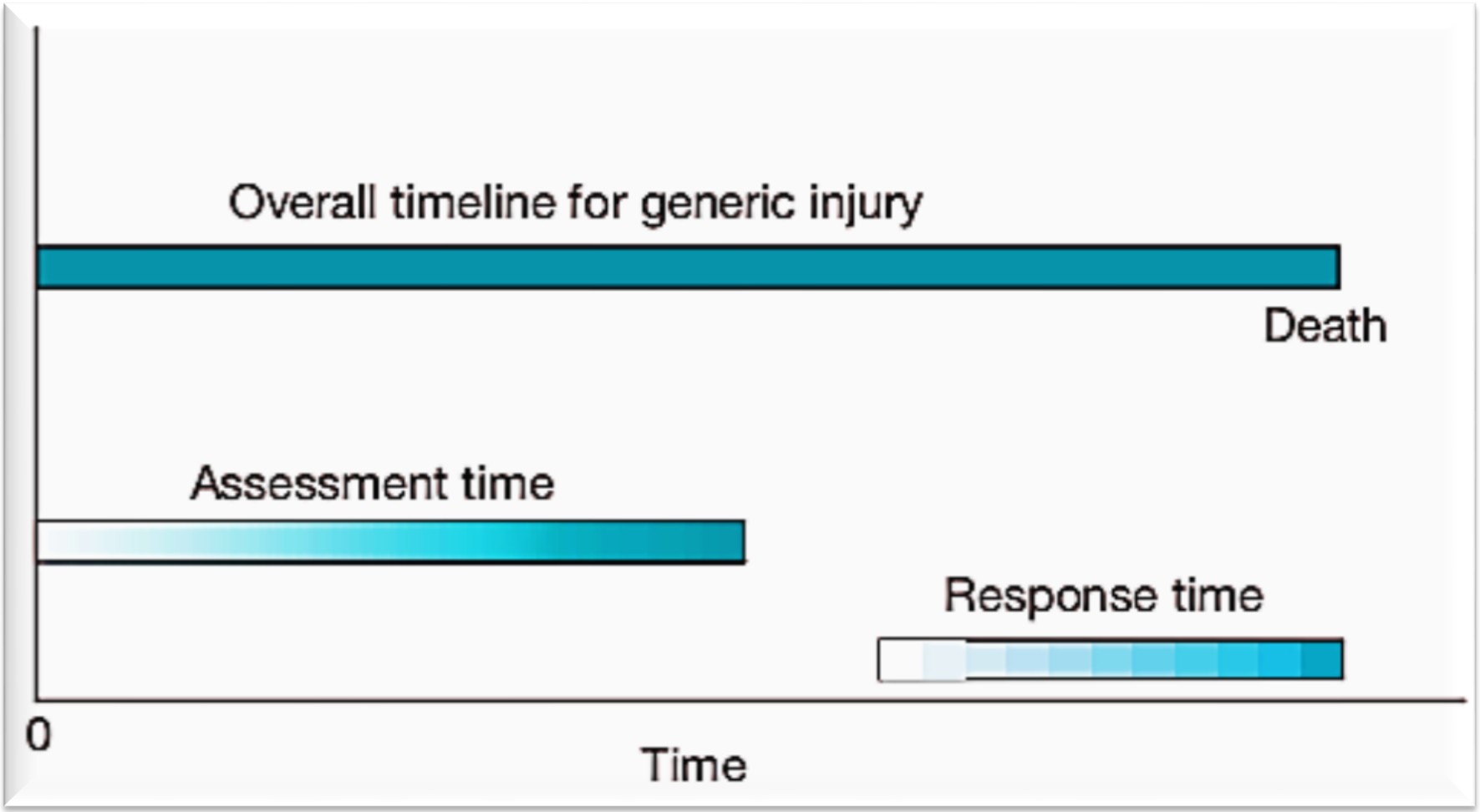
2- the focused exclusion approach.

Trauma assessment

- Knowledge of timelines for important diagnoses is essential
- Initial assessment should focus on what kills first
- Screen high-risk patients before clinical signs become apparent, as it may be too late to intervene once signs develop

THE MANAGEMENT OF TRAUMA

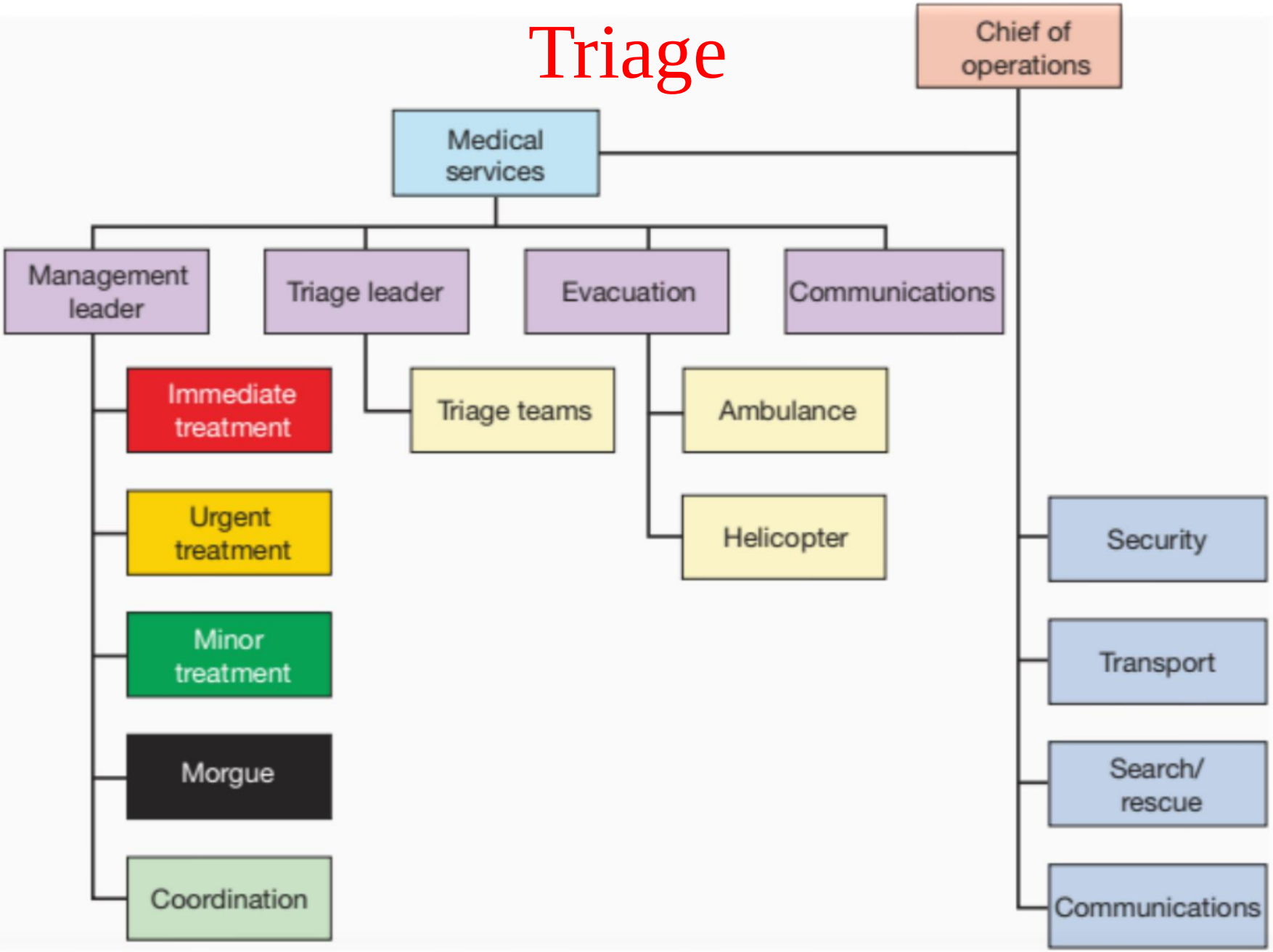
- '**Timeline principle**' is crucial to a deeper understanding of how to prioritise assessment, investigation and treatment in what may be a rapidly evolving situation following injury.
- There is an optimal time window during which an intervention can have a radically positive effect on treatment outcome.
- Based on this timeline, interventions may be grossly categorised as Emergent (life-saving), Acute (restoring and maintaining physiological and physical stability) and Delayed or semielective (focusing on the treatment of post-fracture fixation complications [non-union, infection and malunion from the orthopaedic trauma point of view]).
- What kills first should be managed first (airway obstruction, tension haemothorax and haemopericardium, Entraabdominal bleeding , External bleeding then ischemic limb.


Overall timeline for generic injury
Death
Assessment time
Response time
0
Time

IDENTIFICATION OF SEVERE TRAUMA

- Key information in the pre-alert includes basic demographic information (age and gender), mechanism of injury, injuries identified and vital signs, including respiratory rate, pulse, blood pressure and Glasgow Coma Scale (GCS).
- It is essential that the findings of the primary, secondary and tertiary surveys are clearly recorded in the patient's case notes.

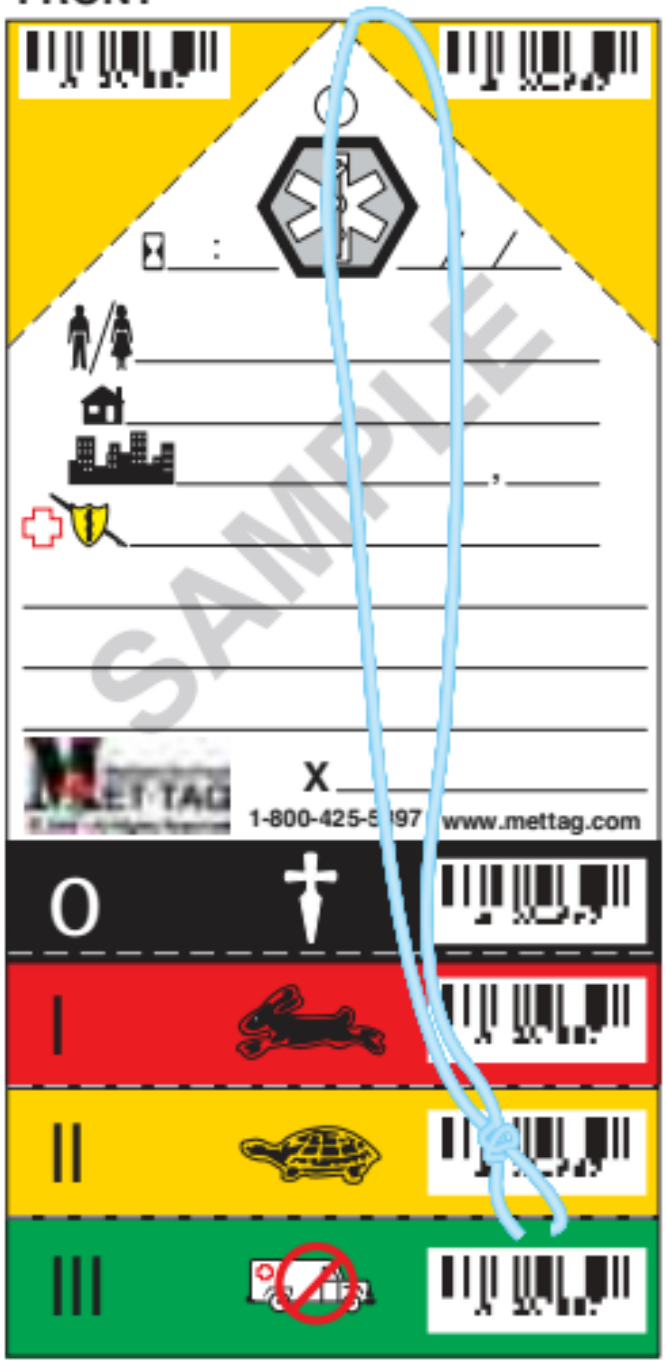
Triage


Chief of operations
Medical services
Management leader
Triage leader
Evacuation
Communications
Immediate treatment
Urgent treatment
Minor treatment
Morgue
Coordination
Triage teams
Ambulance
Helicopter
Security
Transport
Search/ rescue
Communications

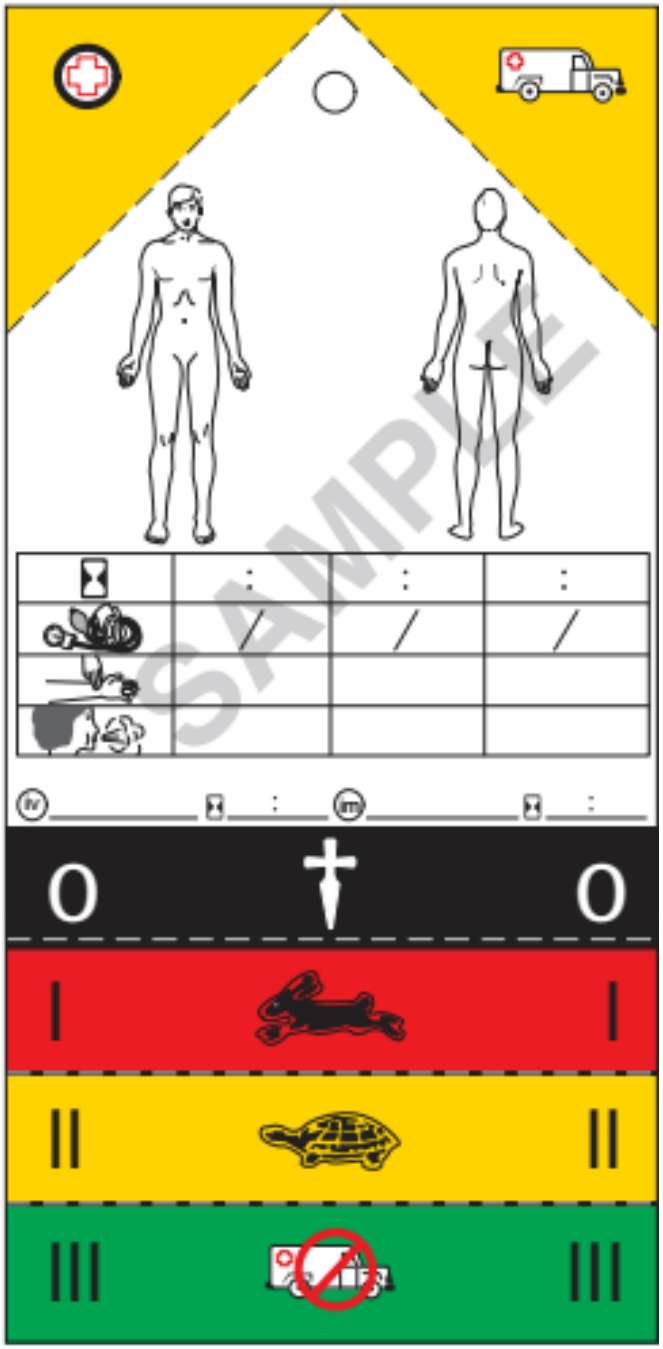

TAG - TRIAGE
Name
MINOR
can wait
Details
TAG - TRIAGE
Name
IMMEDIATE
urgent
Details

Priority	Colour	Medical need	Clinical status
First (I)	Red	Immediate	Critical, but likely to survive if treatment given early
Second (II)	Yellow	Urgent	Critical, likely to survive if treatment given within hours
Third (III)	Green	Non-urgent	Stable, likely to survive even if treatment is delayed for hours to days
Last (0)	Black	Unsalvageable	Not breathing, pulseless, so severely injured that no medical care is likely to help

FRONT


SAMPLE
X
1-800-425-8197 www.mettag.com
0
I
II
III

BACK


SAMPLE
0
0
I
I
II
II
III
III

The Advanced Trauma Life Support (ATLS) system

- It delineates an order of priorities defined by ABCD; that is, airway, breathing, circulation and disability (neurology).
- This hierarchy of priorities is based on the ‘time dependence’ principle.

The cABCDE of trauma care

- c – Control of massive external haemorrhage
- A – Airway with cervical spine protection
- B – Breathing and ventilation
- C – Circulation and haemorrhage control: apply a pelvic binder and do not remove until a pelvic fracture is excluded
- D – Disability (neurological status)
- E – Exposure (assess for other injuries)

PRIMARY SURVEY

- The primary survey aims to identify and manage the most immediately life-threatening pathologies first and follows cABCDE.

c: Exsanguinating external haemorrhage

- Exsanguinating external haemorrhage from massive arterial bleeding needs to be controlled even before the airway is managed.
- Gunshot wounds or blasts.
- Controlled immediately by the application of packs and pressure directly onto the bleeding wound and proximal artery.
- Application of a tourniquet proximal to the wound.(record)

A: Airway with cervical spine control

- Cervical spine immobilised .
- First clearing the airway by suctioning secretions or blood, followed by simple airway manoeuvres such as a jaw thrust, chin lift and insertion of an oropharyngeal or nasopharyngeal airway.
- Cuffed endotracheal tube.

B: Breathing and ventilation

- All patients should receive high-flow oxygen. Life-threatening chest pathology such as tension pneumothorax, massive haemothorax and flail segment should be diagnosed and managed immediately. Equipment and expertise for rapid insertion of intercostal chest drains should be available.

C: Circulation and haemorrhage control

- At least two large-bore IV cannulae.
- Central or intraosseous venous access .
- Blood cross-match.
- Permissive hypotension : higher pressure of >90 mmHg should be the target if a head injury is suspected. Small boluses of IV fluids (e.g. 250 mL of O negative blood, or normal saline if blood is not immediately available) should be administered to achieve this target, which should result in a palpable radial pulse.
- Excessive IV crystalloid or colloid solutions should be avoided because they cause haemodilution, increase coagulopathy and volume over load.

- The resuscitated blood / fluid must be warmed.
- All hospitals managing severe trauma should have a massive transfusion protocol that aims to provide blood and blood products in a ratio of 1 packed red cells : 1 fresh-frozen plasma : 1 platelets.
- Tranexamic acid is an antifibrinolytic drug that reduces the risk of mortality from bleeding in both blunt and penetrating trauma. One gram is given intravenously over 10 minutes, followed by a further 1-g dose over 8 hours. Ideally within the first hour from injury; the first dose should not be administered more than 3 hours from injury.
- A focused abdominal sonography for trauma (FAST) scan (if immediately available) may also be useful in this scenario to locate the major source of haemorrhage.
- Pelvic binder applied and not removed.
- Whole-body CT (WBCT) (multiple injury or deranged physiology) after surgical control of haemorrhage has been achieved.

D: Disability and E: Exposure

- On admission, the GCS score should be calculated the pupils assessed for size and reaction to light and the patient observed to determine whether they are moving all four limbs.
- The core temperature must be recorded. Patients are managed with cervical spine protection (cervical collar and blocks) and protection of the thoracolumbar spine using standard log roll techniques until a spinal injury has been excluded.
- Early WBCT scan will rapidly identify the majority of intracranial and spinal pathology

Best eye response (E)
4 Eyes opening spontaneously
3 Eye opening to speech
2 Eye opening in response to pain
1 No eye opening

Best verbal response (V)
5 Oriented
4 Confused
3 Inappropriate words
2 Incomprehensible sounds
1 None

Best motor response (M)
6 Obeys commands
5 Localises to pain
4 Withdraws from pain
3 Flexion in response to pain
2 Extension to pain
1 No motor response

SECONDARY SURVEY

- All severely injured patients require a detailed top-to-toe examination after life-threatening injuries have been identified and managed during the primary survey.

TERTIARY SURVEY

- When extubated and alert to identify any missed ‘minor’ injuries, such as a scaphoid fracture in the wrist or a rotator cuJ tear in the shoulder.

DAMAGE CONTROL SURGERY VERSUS EARLY TOTAL CARE

- The DCS approach is to restore physiology over anatomy and is typically divided into several phases:
  - **Phase 1.** Recognition of injury severity and the need for damage control principles, both surgical and resuscitative. Features of phase 1 include rapid-sequence induction of anaesthesia and intubation, early rewarming and prompt movement to the operating theatre.
  - **Phase 2**. Immediate laparotomy with rapid control of bleeding and contamination, abdominal packing and temporary wound closure.
  - **Phase 3**. Movement to the intensive care unit (ICU) for ongoing resuscitation with normalisation of biochemical and physiological parameters.
  - **Phase 4**. Re-exploration in the operating theatre to perform definitive repair of all injuries. Multiple procedures on multiple occasions may be required. Even at this stage, non-essential procedures may be truncated or delayed if physiology deteriorates.

Venous lactate is an essential marker of resuscitation

- <2 mmol/L – ETC
- 2–3 mmol/L – look at the trend (increasing or decreasing)
- >3 mmol/L – may be under-resuscitated; should either have further resuscitation or DCS if surgery is urgent
- >5 mmol/L – DCS .

- The identification of patients suitable for ETC versus DCS should be made by senior surgeons and anaesthetists/critical care doctors.
- This may be an easy decision, for example the haemodynamically unstable patient with intra-abdominal bleeding will always undergo rapid damage control laparotomy. In other cases a careful review of the patient's physiology and coagulation state will be required.

SUMMARY

- The early assessment and management of trauma patients should follow established ATLS principles.
- A WBCT scan, from the head to the pelvis, with IV contrast is the gold standard investigation for major trauma patients and should be performed early and whenever possible.
- Warmed blood and blood products in a 1:1:1 ratio of blood : plasma : platelets should be used with tranexamic acid in the early resuscitation of haemodynamically unstable trauma patients.
- Trauma patients requiring surgery should have an early decision made whether a damage control or ETC approach is required.
- Surgical procedures in physiologically compromised patients should be limited to those required to save the life and/or limb of the patient, while simultaneous resuscitation is continued.

- When injuries involve the input of diffferent disciplines in terms of surgical intervention, for instance a general surgeon for a liver laceration, a neurosurgeon for an intracranial haematoma, an orthopaedic surgeon for a pelvic and femoral fracture and a maxillofacial surgeon for a depressed orbital fracture, the most important intervention should go first. Clearly, communication and prioritisation among the team members is essential.

- Potentially rapidly evolving situations, such as airway obstruction, tension haemothorax and haemopericardium, if left untreated, will inevitably have catastrophic consequences and therefore should be given priority in terms of the initial medical response to an injured patient. Thus, the seriousness and the immediate impact of a specific clinical condition should dictate its prioritisation, leading to a systematic approach (‘what kills first should be managed first’)

Traumatic brain injury

- Traumatic brain injury (TBI) can be considered as the combination of primary injury sustained on impact, and hence not medically modifiable, and secondary injury developing in the following hours and days.

CLASSIFICATION OF HEAD INJURY

- The severity of head injury is classified according to the postresuscitation Glasgow Coma Scale (GCS) score as it is the GCS score – and in particular the motor score – that is the best predictor of neurological outcome.

Minor head injury	GCS 15 with no LOC
Mild head injury	GCS 14 or 15 with LOC
Moderate head injury	GCS 9–13
Severe head injury	GCS 3–8

Best eye response (E)
4 Eyes opening spontaneously
3 Eye opening to speech
2 Eye opening in response to pain
1 No eye opening

Best verbal response (V)
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Best motor response (M)
6 Obeys commands
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4 Withdraws from pain
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2 Extension to pain
1 No motor response

MINOR AND MILD HEAD INJURY

- After exclusion of associated cervical spine injury, it is important to consider the possibility of a ‘lucid interval’ that may precede delayed deterioration due to an expanding intracranial haematoma.
- Decisions on imaging and discharge are best made guided by published criteria.
- In preverbal children and other vulnerable groups, nonaccidental injury must be considered
- Amnesia, confusion, headaches and somnolence are typical features of concussion.

UK National Institute for Health and Care Excellence discharge criteria in minor and mild head injury.

- GCS 15/15 with no focal deficits
- Normal CT brain if indicated .
- Patient not under the inLuence of alcohol or drugs
- Patient accompanied by a responsible adult
- Verbal and written head injury advice: seek medical attention if:
  - Persistent/worsening headache despite analgesia
  - Persistent vomiting
  - Drowsiness
  - Visual disturbance
  - Limb weakness or numbness

MODERATE AND SEVERE TRAUMATIC BRAIN INJURY

- Resuscitation is performed according to Advanced Trauma Life Support (ATLS) guidelines, beginning with management of the airway with cervical spine control and proceeding to assess and manage breathing and circulation. The history obtained in parallel is key to shaping ongoing management.

- History
- Bystanders and paramedics may give vital information on the:
  - Preinjury state (fits, alcohol, chest pain)
  - Mechanism and energy involved in the injury (speed of vehicles, height fallen)
  - Conscious state and haemodynamic stability of the patient after the accident
  - Length of time taken for extrication
- Check the medication history, especially anticoagulants and antiplatelet agents

- Primary survey
- Ensure adequate oxygenation and circulation
- Exclude hypoglycaemia
- Check pupil size and response and GCS score as soon as possible
- Check for focal neurological defecits before intubation if possible

- Secondary survey
  - Raccoon's eyes (periorbital bruising) & rhinorrhea (CSF leak from the nose) point to anterior cranial fossa fracture.
  - Battle's sign (bruising behind the ear) & ottorhea (CSF leak from the nose) point to middle cranial fossa fracture.
  - Cervical spine fractures are common and must be actively excluded
  - Log-roll to check the whole spine for steps and tenderness and for a per rectum examination

- Fractures: skull vault
  Fractures: skull base
  Extradural haematoma
  Acute subdural haematoma
  Traumatic subarachnoid haemorrhage
  Cerebral contusions

Fractures: skull base

- Clinical signs of skull base fracture include bleeding or CSF leak from the ears (otorrhoea) or nose (rhinorrhoea) and bruising behind the ear or around the eyes. Skull base fractures may be complicated by pituitary dysfunction, arterial dissection or cranial nerve deficits, with anosmia, facial palsy or hearing loss typical. CSF leak will generally resolve spontaneously but persistent leak can result in meningitis so repair may be required. Blind nasogastric tube placement is contraindicated in these patients.

Extradural haematoma

- Extradural haematoma is a neurosurgical emergency.
- It results from rupture of an artery, vein or venous sinus, in association with a skull fracture. The classical injury is a fracture to the thin squamous temporal bone, with associated damage to the middle meningeal artery.
- Transient loss of consciousness is typical, and the patient may then present in the subsequent lucid interval with headache but without any neurological deficit.
- Require immediate transfer to a neurosurgical unit for decision on evacuation

Acute subdural haematoma

- High-energy injuries.
- This results in an expanding haematoma with rapid deterioration and development of signs of raised ICP reminiscent of extradural haematoma, without the lucid interval.
- Older and often anticoagulated, a lower energy injury leads to venous bleeding around the brain.
- These collections require prompt evacuation, typically by craniotomy or craniectomy .

Traumatic subarachnoid haemorrhage

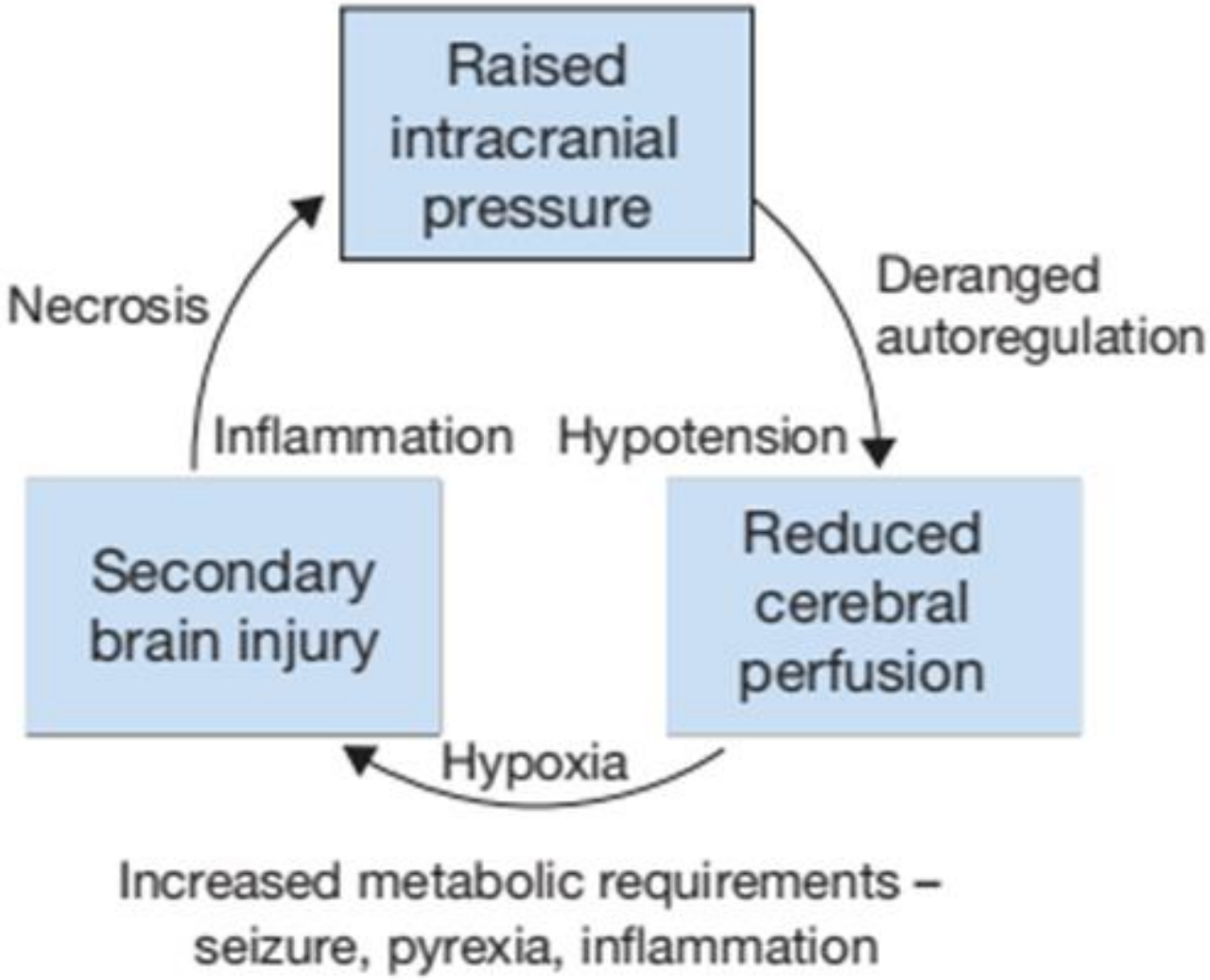
- Trauma is the commonest cause of subarachnoid haemorrhage.
- Is managed conservatively.
- The possibility of spontaneous subarachnoid haemorrhage actually leading to collapse and so causing a head injury needs to be borne in mind, and formal or CT angiography may be required to exclude this.

Cerebral contusions

- Contusions are common and are found predominantly where the brain is in contact with the irregularly ridged inside of the skull, i.e. at the inferior frontal lobes and temporal poles.
- ‘Coup contre-coup’ contusions refer to brain injury both at the site of impact and distant to this, where the brain impacts on the inside of the skull as the skull and brain accelerate and then decelerate out of synchrony with each other.

Medical management

- Management strategies aim to minimise secondary brain injury through avoidance of hypoxia and hypotension and control of ICP. Unchecked, secondary injury leads to a further cycle of deterioration.(sedatives, analgesics and ultimately muscle relaxants. Ventilation and serum sodium levels & external ventricular CSF drainage
- Control of intracranial pressure
- Pituitary dysfunction (The syndrome of inappropriate antidiuretic hormone (SIADH) leads to water retention and hyponatraemia in the context of pituitary damage.).
- Seizures .
- Nutrition (Enteral nutrition is preferred to intravenous parenteral nutrition)


Raised intracranial pressure
Deranged autoregulation
Hypotension
Reduced cerebral perfusion
Hypoxia
Secondary brain injury
Inflammation
Necrosis
Increased metabolic requirements – seizure, pyrexia, inflammation

Outcomes and Sequelae

- The long-term sequelae of moderate and severe TBI include headache and memory and cognitive impairments, contributing to the postconcussive syndrome described above.
- Rehabilitation represents a complex and prolonged multidisciplinary challenge.
- The Glasgow Outcome Scale score is used to quantify the degree of recovery achieved after head injury, especially for research purposes.
- Good recovery implies independence and potential to return to work rather than a full return to previous capacity.

Glasgow Outcome Scale

Good recovery	5
Moderate disability	4
Severe disability	3
Persistent vegetative state	2
Dead	1

The Neck and Spine

Spinal stability

Spinal stability is the ability of the spine to withstand physiological loads with acceptable pain, avoiding progressive deformity or neurological deficit.

Spinal immobilisation.

Spinal log roll

Patient assessment

- Use ATLS principles in all cases of spinal injury
- In polytrauma cases suspect a spinal injury
- A second spinal injury at a remote level may be present in 10% of cases
- Spinal boards cause pressure sores

Traumatic spondylolisthesis of the axis (hangman's fracture C2 on C3)

PHYSICAL EXAMINATION

- Initial assessment . Primary survey, followed by examination to the abdomen and chest. Spinal cord injury may mask signs of intra-abdominal injury.
- Spinal examination (Significant swelling, tenderness, palpable steps or gaps suggest a spinal injury. A rectal examination to assess anal tone and perianal sensation. Seatbelt marks on the abdomen and (a high-energy accident.)
- Neurological examination(sensory & motor function)

Level of neurological impairment

- The extent of spinal cord injury is defined by the American Spinal Injury Association (ASIA) Impairment Scale (modified from the Frankel classification):

- A: complete spinal cord injury;
- B: sensation present, motor absent;
- C: sensation present, motor present but not useful (MRC grade <3/5)
- D: sensation present, motor useful (MRC grade ≥3/5)
- E: normal function.

- MRC = Medical Research Council grading system

Identification of shock

- Three categories of shock may occur in spinal trauma
- Hypovolaemic shock. Hypotension with tachycardia
- and cold clammy peripheries. This is most often due to haemorrhage. (resuscitation).
- Neurogenic shock. { hypotension, a normal heart rate or bradycardia and warm peripheries}. This is due to unopposed vagal tone resulting from cervical spinal cord injury at or above the level of sympathetic outflow (T5). (inotropic support, and avoid fluid overload).
- Spinal shock is a temporary physiological disorganisation of spinal cord function that starts within minutes following the injury. It can last 6 weeks or longer. It is characterised by paralysis, decreased tone and hyporeflexia.

INTERNATIONAL STANDARDS FOR NEUROLOGICAL CLASSIFICATION OF SPINAL CORD INJURY (ISNCSCI)

ASIA | ISCOS

Patient Name _____ Date/Time of Exam _____

Examiner Name _____ Signature _____

RIGHT

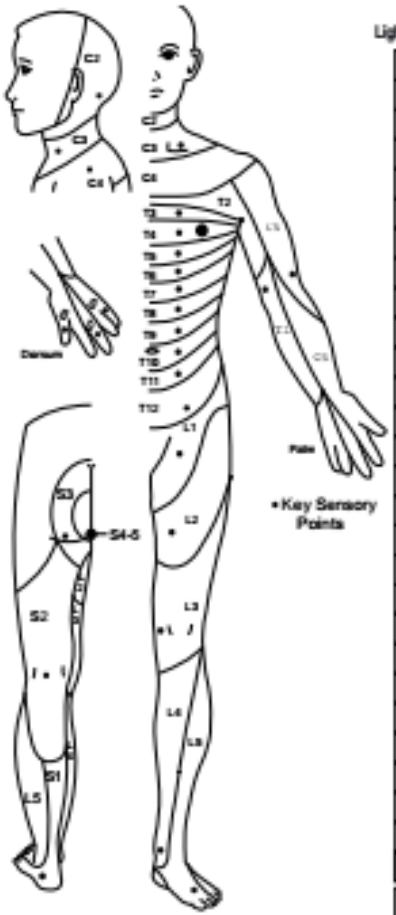
		MOTOR KEY MUSCLES	Light Touch (LTR)	Pin Prick (PPR)
	C2			
	C3			
	C4			
Elbow flexors	C5			
Wrist extensors	C6			
Elbow extensors	C7			
Finger flexors	C8			
Finger abductors (little finger)	T1			
	T2			
	T3			
	T4			
	T5			
	T6			
	T7			
	T8			
	T9			
	T10			
	T11			
	T12			
	L1			
Hip flexors	L2			
Knee extensors	L3			
Ankle dorsiflexors	L4			
Long toe extensors	L5			
Ankle plantar flexors	S1			
	S2			
	S3			
	S4-5			
RIGHT TOTALS (MAXIMUM)			(56)	(56)

UER (Upper Extremity Right)

LER (Lower Extremity Right)

Comments (Non-key Muscle? Reason for NT? Pain? Non-SCI condition?):

(VAC) Voluntary Anal Contraction (Yes/No) ☐



LEFT

		SENSORY KEY SENSORY POINTS Light Touch (LTL)	Pin Prick (PPL)	MOTOR KEY MUSCLES
	C2			
	C3			
	C4			
C5	Elbow flexors			
C6	Wrist extensors			
C7	Elbow extensors			
C8	Finger flexors			
T1	Finger abductors (little finger)			
	T2			
	T3			
	T4			
	T5			
	T6			
	T7			
	T8			
	T9			
	T10			
	T11			
	T12			
	L1			
L2	Hip flexors			
L3	Knee extensors			
L4	Ankle dorsiflexors			
L5	Long toe extensors			
S1	Ankle plantar flexors			
	S2			
	S3			
	S4-5			
LEFT TOTALS (MAXIMUM)		(56)	(56)	(50)

UEL (Upper Extremity Left)

LEL (Lower Extremity Left)

MOTOR (SCORING ON REVERSE SIDE)

0 = Total paralysis
1 = Palpable or visible contraction
2 = Active movement, gravity eliminated
3 = Active movement, against gravity
4 = Active movement, against some resistance
5 = Active movement, against full resistance
NT = Not testable
0*, 1*, 2*, 3*, 4*, NT* = Non-SCI condition present

SENSORY (SCORING ON REVERSE SIDE)

0 = Absent | NT = Not testable
1 = Altered | 0*, 1*, NT* = Non-SCI condition present
2 = Normal

(DAP) Deep Anal Pressure (Yes/No) ☐

MOTOR SUBSCORES

UER ☐ + UEL ☐ = UEMS TOTAL ☐ (MAX (25) + (25) = (50))

LER ☐ + LEL ☐ = LEMS TOTAL ☐ (MAX (25) + (25) = (50))

SENSORY SUBSCORES

LTR ☐ + LTL ☐ = LT TOTAL ☐ (MAX (56) + (56) = (112))

PPR ☐ + PPL ☐ = PP TOTAL ☐ (MAX (56) + (56) = (112))

NEUROLOGICAL LEVELS Steps 1-6 for classification appear reverse

	R	L
1. SENSORY		
2. MOTOR		

3. NEUROLOGICAL LEVEL OF INJURY (NLI) ☐

4. COMPLETE OR INCOMPLETE? ☐ (Incomplete = Any sensory or motor function in S4-5)

5. ASIA IMPAIRMENT SCALE (AIS) ☐

6. ZONE OF PARTIAL PRESERVATION (Most caudal levels with any innervation) (Be injuries with absent motor OR sensory function in S4-5 only)

	R	L
SENSORY		
MOTOR		

Basic management principles

- Neck collar
- Spinal realignment (Skeletal traction using skull tongs/using internal fixation / halo jacket)
- Stabilisation (surgery).
- Decompression of the neural elements .
- Corticosteroids are no longer indicated in acute spinal cord injury because of a lack of evidence to support efficacy.

Skeletal traction using skull tongs

L1 burst fracture and neural compression;

A halo brace can be used to perform a closed realignment and immobilisation of cervical fractures

External immobilisation using a halo jacket

PRAISE BE TO ALLAH