

OR 1.1

Describe and Discuss the Principles of Pre-hospital Care and Casualty Management of a Trauma Victim Including Principles of Triage

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Principles of pre-hospital care and emergency assessment of a trauma victim:

- Trauma victims are evaluated on the field, stabilised and rapidly transported to the nearest medical facility by emergency medical services (EMS).
- It is important to understand the principles underlying these processes - triaging the patient in the ER or on the field (at time of disasters), pre-hospital care including performing a full survey of the patient and directing their subsequent care pathway.
- Whilst **triaging is a part of pre-hospital care**, it is important to understand the concepts of triaging as a distinct process. This chapter will be dealt in two sections - triage and assessment of a trauma victim.

Prehospital management includes the following:

1. Organization
2. Immediate actions and triage
3. Assessment and initial management
4. Extrication and immobilization
5. Transfer to hospital

Organization:

- The 108 Emergency Ambulance Service is a 24x7 service for medical/fire/crime accidents. (Fig. OR 1.1-1)
- It is provided by GVK EMRI (Emergency Management and Research Institute), a non-profitable organisation operating in the Public Private Partnership mode
- The services are free of cost for any Indian.
- It can be availed by anyone by dialling the

toll-free number 108 on their phone in case of any emergency.

- The person who receives the call at the Emergency Response Centre (ERC) takes down the nature of emergency and the location of the caller.
- Depending on the nature of the call, either an ambulance or a fire engine or a police assistance is sent. This is done through the Emergency Response Centre (ERC).
- The nearby emergency help is dispatched within 8-15 minutes depending on whether the spot is in a metro city, rural or urban area.
- The Emergency Response Centre (ERC) co-ordinates between the Despatch Officer, Emergency Response Centre Physician and the Emergency Medical Technician for getting the guidance while on transit.



Fig. OR 1.1-1 108 Emergency Ambulance Service

- On reaching the spot, the emergency ambulance team receives the patient and starts to the nearby Government hospital. (Fig. OR 1.1-2)



Inside the Ambulance



Spine board to shift the spine injury patient



Oxygen facility



Emergency drugs and first aid kit

Fig. OR 1.1-2 Emergency facilities inside the ambulance

- Dead patients and non-emergency cases are not taken up.
- In case of drowning, unconscious patient or trauma involving injury of the spine, the patient is shifted on a spine board.
- A rapid head to toe examination is done and first aid is given on the way to the hospital.
- The emergency medical technician performs intravenous catheterization, starts intravenous fluids, administers oxygen support.

In case of trauma involving fractures, the following are done:

- Assessment for neurovascular compromise by palpating peripheral pulses and ensuring that movement and sensation are intact distal to the injury.
- Identifying any external injuries and apply dressing.
- Immediate splinting of the fractured limb. (Fig. OR 1.1-3)
- A basic rule of splinting is that the joint above and below the broken bone should be immobilised to protect the fracture site.



Fig. OR 1.1-3 Splinting of limb

- Emergency drugs are given only under the supervision of the Emergency Response Centre Physician.
- In case of death during the transit, the patient is taken to the nearest Government hospital.

- The emergency help is despatched within 20 minutes.
- Prehospital care will be given to the patient during transport.

Triage

The very origin of care of wounds incurred in battlefields dates back to Vedic times. Graphic accounts, in the Sushruta Samhita, of some of the wounds cared for could only have happened in a military battlefield. There were injunctions in military law, dating back to Vedic times, about the need for physicians and carers on the battlefield. The triage in those periods were applied to enable rapid return of warriors to the battlefield and transport disabled or dead ones out of the field. The development of the modern-day triage system, however, is credited to two French military surgeons, Pierre-François Percy (1754-1825) and Dominique Jean Larrey (1766-1842) during the Napoleonic wars in late 18th century (1,2).

Triage, from French trier, represents categorising into three and thinning out. In its original battlefield use, the three categories were:

1. Those who would survive, regardless of treatment
2. Those who would die, regardless of treatment
3. Those who would survive if immediate care is provided.

This system enabled soldiers who were “fighting fit” to return to the battlefield.

The modern concept of triage is based on *assigning clinical priority to manage clinical risk*, so that appropriate treatment flows for each patient can be initiated. It is important to understand that triaging is simply a process of decision making, allowing *prioritisation, based on presentation rather than diagnosis*.

Such basic sorting or stratification - ***routine triage*** - is easy to apply and follow in the hospital emergency room (ER) setting. The combination of a presenting complaint with physiological parameters (early warning scores) allows the emergency healthcare professional (HCP) to direct their stream of care and allocating time limits, before which they need to be seen by an emergency physician. There are several triage systems used globally.

The following are some commonly used ones:

- Tamil Nadu Accident and Emergency Care Initiative (TAEI) - Tamil Nadu (Fig. OR 1.1-5)
- Manchester Triage System-MTS (UK/Ireland)
- Australasian Triage System-ATS (Australia/New Zealand)
- Canadian Triage and Acuity Scale-(CTAS) (Canada)
- Smart incident command system-(SICS) (United Kingdom)

Typically, most triage systems use 5-level stratifications similar to the one below:

Canadian Triage and Acuity Scale (CTAS):

Table OR 1.1-1 Canadian Triage and Acuity Scale (CTAS)

Level	Description	Should be seen by provider within
1	Resuscitation	0 minutes
2	Emergency	15 minutes
3	Urgent	30 minutes
4	Less Urgent	60 minutes
5	Non-Urgent	120 minutes

Mass casualty incidents (MCI) or disasters/pandemics require, in addition, *strategic allocation of scarce resources - disaster triage*. It

is based on the principle of *doing the greatest good for the greatest number*, which looks at population-based outcomes rather than individual ones. This principle was illustrated during the recent Covid-19 outbreak. The clinic, hospital, hotel facility, medical/nursing personnel, diagnostic facilities allocation as well as the civil lockdown strategies used in several countries, allowed them to achieve efficient utilisation of scarce resources (in this case, ICU beds). Less sick patients were allocated to hospital or home quarantine.

In the case of disasters where significant trauma is involved, disaster triage commonly uses the 4-scale stratification, similar to the Smart Incident Command System (SICS) used in the UK:

Table OR 1.1-2 Smart incident command system (SICS)

Dead	Patients with RTS 0 to 2 and are beyond help
Priority 1	Patients with RTS 3 to 10 and need immediate attention
Priority 2	Patients with RTS 10 or 11 and can wait for a short time before transport to definitive medical attention
Priority 3	Patients with RTS 12 (maximum score) and can be delayed before transport from the scene

(RTS-Revised Trauma Score -incorporating Glasgow Coma Scale, systolic BP and respiratory rate)

Many emergency medical services use colour coded tags on patients based on the prioritisation given above; these tags also allow for patient identification through specific identification numbers or bar/QR codes printed on the tags.

Other functions that are subsumed in triage

The triage practitioner or HCP (Emergency Healthcare Professional) not only performs the

prioritisation after initial contact but in a hospital setting takes on additional functions that facilitate rapid management and reduce time spent in hospital by the patient:

1. Administer analgesia - for example, someone presenting with renal colic is in severe acute pain; administering ketorolac or diclofenac not only reduces pain, it decreases anxiety, and allows unhampered evaluation.
2. Order investigations in those with limb injuries, like x-ray, that allows rapid diagnosis and enter them into the requisite treatment pathway.
3. Directing patients to appropriate care pathways-self-care, pharmacy, Out Patient appointment with a specialist.
4. Initiate or direct patients into direct specialty-care inpatient pathways based on local guidelines- orthopaedics, obstetrics, neurology (eg.stroke unit), neuro-surgery (eg.acute spinal-cord disorders), psychiatry, etc.

Monitoring of physiological parameters

Following prioritisation of patients - either in hospital or in the field - it is important to continue monitoring the patient as the status may change. For example, a patient with fracture of the femur, may be stable on presentation, but then due to internal haemorrhage, may progress to shock. Hence, it is important to continue with periodic assessment of physiological parameters, especially those in Level 2 or 3.

Presentation priority matrix (PPM)

Once the patient has been prioritised based on their presenting complaint/problem, they are placed in a matrix, that will determine the further flow in each presentation. The following may be the agreed presentational flow in this hospital:
Back pain (or) Falls in the elderly (or) Head injury

Table OR 1.1-3 Presentation priority matrix (PPM)

Level 1	Resuscitation room
Level 2	Major treatment room
Level 3	Minor treatment room
Level 4	Refer to primary care
Level 5	Refer to primary care

Disposition pathways for the above, especially for Levels 1-3 will depend on the outcome of initial management in the ER.

Table OR 1.1-4 Presentational flow for assessment of back pain based on MTS

Category	Presentation
RED	Airway, breathing or circulatory compromise.
ORANGE	New neurological deficit <24HR. Loss of anal power/tone, change in limb neurology, urinary retention. Mechanism of injury suggestive of major trauma to back. Septic. Related abdominal pain. Severe back pain.
YELLOW	New neurological deficit >24 HR. Loss of anal power/tone, change in limb neurology, urinary retention. Direct trauma. Mechanism of injury not suggestive of major trauma to back. Moderate back pain.
GREEN	Mild back pain. Non-traumatic.

The **Manchester Triage System (MTS)** (3), for example, has a total of 53 presentations, majority with 5 level priorities, resulting in a 258 presentation-priorities combination. Some presentation examples are given below:

- Abdominal pain in an adult / abdominal pain in a child

- Allergy
- Assault
- Bites/stings
- Burns/scalds
- Drug abuse /overdose
- Ear / Eye problems
- Seizure
- Foreign body
- Gastro- intestinal bleeding
- Major trauma

Triage followed in India:

Table OR 1.1-5 Colour codes and triage tag

COLOR CODES	TRIAGE TAG
RED	Most critical injury
YELLOW	Less critical injury
GREEN	No life or limb threatened injury
BLACK	Death or obviously fatal injury

Comparison of three-tier triage protocol with internationally available triage system:

- Three colour coding system is followed in TAEI whereas in other parts of the world 4 or 5 colour coding systems are used.

Table OR 1.1-6 Comparison of triage system

Three tier system	Canadian system	Manchester system
Red	1	Red
Red	2	Orange
Red	3	Yellow
Yellow	4	Green
Green	5- non urgent	

Triage Protocol:

History

Mechanism of injury

Examination

Wounds and injuries present

Physiological parameters

- Breathing/airway
- Respiratory rate

- c. Radial pulse
- d. Blood pressure
- e. Capillary refilling time
- f. AVPU scale
- g. GCS scale

patients as Level 1 or 2, and is typically an attempt to avoid undertriage. Most audits expect overtriage levels of 50%.

Table OR 1.1-7 Physiological parameters and triage criteria

		Red criteria	Yellow criteria	Green criteria
Physiological parameters	A	- Noisy breathing	- Patent airway	- Patent airway
	B	- Respiratory rate less than 10 or more than 24/min	- Respiratory rate 10-24/min - SPO ₂ more than 95%	- Respiratory rate 10-24/min - SPO ₂ more than 95%
	C	- Radial pulse: present/absent - Pulse less than 50 or more than 100/min - Systolic BP less than 90 mm Hg - Capillary refill more than 2 sec	- Pulse 50-100/min - Systolic BP more than 90 mmHg - Capillary refill less than 2 sec	- Pulse 50-100/min - Systolic BP more than 90 mm Hg - Capillary refill less than 2 sec
	D	- Responding only to pain - GCS less than 13 - Spine injury with single breath count more than 15	- Responding to verbal commands - GCS 13, 14, 15 - Spine injury with single breath count less than 15	- Alert - GCS 15

Reverse triage

Just as triage refers to prioritisation for admission to hospital, reverse triage applies to discharge processes. This is especially useful when hospitals struggle with lack of beds/resources in order to accept a surge of critically ill patients. Reverse triage allows early discharge of patients who no longer require immediate care; for example, patient could be transferred from ICU to the ward, releasing an ICU bed in the process.

Undertriage

Underestimating severity of the illness resulting in avoidable delay of treatment - miscategorising a Level 1 patient to Level 2 or 3. Typically, in most triage audits, this is expected to be less than 5%.

Overtriage

Overestimating severity of the illness resulting in loss of physician time that could have been allocated to more critically ill or wounded patients. This results from categorising Level 3

Telephone triage

This is usually undertaken by advanced triage practitioners. It requires a high level of skill requiring employment of discriminatory (clinical) questions and provide advice based on the answers (that are usually incorporated into an algorithm for each "presentation"). Telephone triage is useful in reducing waiting times in ERs especially if it is a problem that is likely to be minor and the ER is stressed due to understaffing.

ASSESSMENT OF A TRAUMA VICTIM

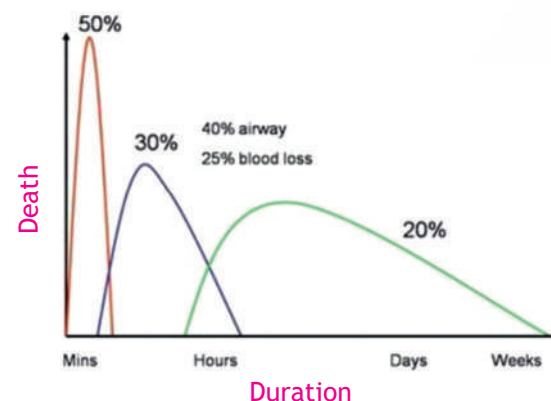


Fig. OR 1.1-4 Trimodal distribution of death

Following the original founding of the ATLS course in the USA in 1978, by Dr James K Styner and

Dr Paul Collicott (4), management of trauma victims has grown into a highly systematic process with defined time scales for assessments and planning treatment (**Fig. OR 1.1-4**). It has become the basis for standard of care for trauma worldwide, across the board - for emergency / trauma physicians, paramedics, nurses and advance practitioners.

The Golden Hour

The 'Golden Hour' of trauma was first described by Dr Adams Cowley, founder of the Baltimore Shock Trauma Institute, in 1975. The theory states that the first hour of medical response and transport after traumatic injury will determine the victim's chances of survival (5). Since 1975, multiple studies have suggested that in a haemodynamically unstable patient, minimal pre-hospital resuscitation time and expedited transport to a trauma centre increases survival. On the other hand, there are several prospective studies that have not shown any correlation between pre-hospital time and survival. Despite conflicting evidence, rapid transport of victims by EMS to hospital remains the standard of care.

Platinum Minutes

With advances in technology and transport, the term 'Platinum Minutes' has emerged (5). The term describes the theory that pre-hospital assessment and resuscitation should take no longer than 10 minutes before a patient is transferred to a major trauma centre (6). Again, like the golden hour, this concept remains to be validated.

CONCEPTS OF TAMIL NADU ACCIDENT AND EMERGENCY CARE INITIATIVE (TAEI)

- Treat the greatest threat to life first.
- The lack of a definitive diagnosis should never impede the application of an indicated treatment.
- A detailed history is not essential to begin the evaluation.

Tamil Nadu Accident and Emergency Care Initiative has the following six pillars (Fig. OR 1.1-5)

1.	Trauma care
2.	Stroke care
3.	Myocardial infarction care
4.	Care of burns
5.	Care of poison victims
6.	Paediatrics

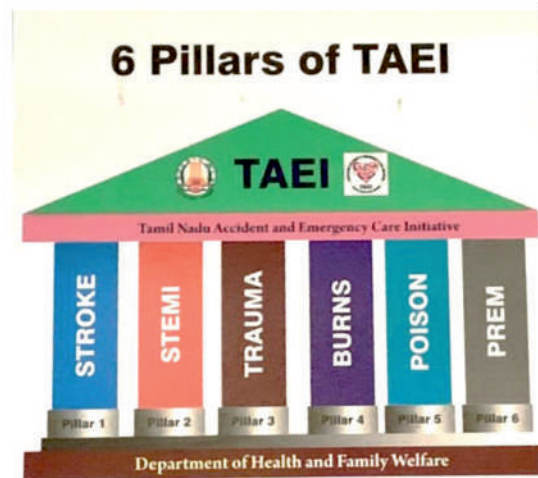


Fig. OR 1.1-5 Six Pillars of TAEI

ATLS Guidelines

1. Preparation
2. Triage
3. Primary survey (ABCDE)
4. Resuscitation
5. Adjuncts to primary survey and resuscitation
6. Secondary survey
7. Adjuncts to secondary survey
8. Continued post resuscitation monitoring and re-evaluation
9. Definitive care

Primary Survey

As with any assessment, a systematic approach is key. *The primary survey allows us to detect and prioritise life threatening injuries and deal with them in a structured manner.* It is important to remember that resources may be limited in a pre-hospital setting so identifying fatal injuries early on allows for quicker transfer to a trauma centre. The primary survey follows the

ABCDE approach of the ATLS (Advanced Trauma Life Support) program established by the American College of Surgeons. Each identified issue must be dealt with as it is found in the A to E order (16).

DR (c)ABCDE

D - DANGER

It is essential to first ensure that the site of trauma is safe to approach. Establishing boundaries around the site of the accident can help achieve this. It is also necessary to identify accident specific risks. For example, anticipating that an airbag may deploy after assessment has begun in a road traffic accident. An incident like this could not only further injure the victim but also put the assessor at risk.

R - RESPONSE

Is the patient responding to you?

- Yes-The assessment continues.
- No-Assess for signs of life.
 1. Signs of life present-assessment continues.
 2. No signs of life present-CPR and cardiac arrest algorithm.

A - AIRWAY (and Cervical Spine)

Ensuring that the victim has a patent airway is a priority. Even a short period of airway compromise leading to hypoxia can be fatal and so establishing an airway is key.

Signs of Airway Obstruction

If the patient is conscious, they may be showing obvious signs of difficulty in breathing. In an unconscious patient, upper airway noises can indicate an airway obstruction.

Stridor is an upper airway noise produced by incomplete obstruction of the trachea. It is usually heard when the upper airway is obstructed by a foreign body.

If a patient is **snoring**, it is a sign that their level of consciousness is so reduced that they are unable to maintain a patent airway as the soft tissue in the throat relaxes and narrows.

If upper airway noises are heard, it is likely that the patient's airway is compromised and this will need rectification.

Assessment and Treatment of Airway Obstruction

The mouth must be inspected for any foreign bodies/vomitus that may be causing airway obstruction. Any attempts to remove a foreign body must be made with forceps. The use of fingers is never advised as an unconscious patient can often bite down on objects in the mouth. If vomitus is present in the airway, suctioning can be used if available at the scene. Any foreign bodies or vomitus must be removed before further airway manoeuvres or adjuncts are used. High flow oxygen is generally administered to all trauma patients through a non-rebreather mask if available at the scene of trauma.

Airway Manoeuvres

Simple airway manoeuvres can be used to ensure a patent airway. In a patient who has undergone significant trauma, this must be done whilst maintaining cervical spine immobilisation. This will be explained in more detail at a later point.

The **Head Tilt Chin Lift** is a simple airway manoeuvre that ensures patency of an obstructed airway due to reduced consciousness. In some patients, a **Jaw Thrust** may be used preferentially. (Fig. OR 1.1-6)

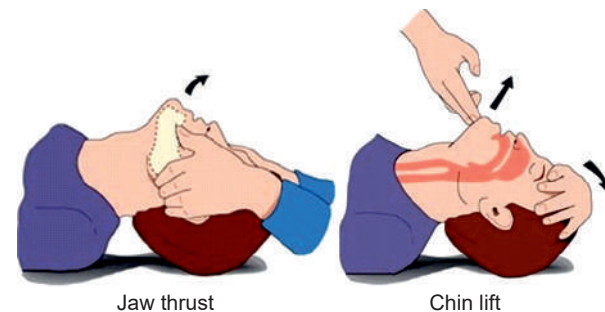


Fig. OR 1.1-6 Jaw Thrust and Head Tilt Chin Lift manoeuvres.

Airways adjuncts

It is not always possible, or efficient, to maintain an airway with a simple airway manoeuvre as it does not allow for continuation of the trauma assessment. This is especially true if there is only one assessor present. In these cases, airway adjuncts may be used.

Oropharyngeal Airways (OPAs) or '**Guedel**' airways work by pushing the tongue down to prevent airway obstruction. The appropriate size of OPA is measured using the distance between the front incisors to the angle of the mandible. (Fig. OR 1.1-7,8)

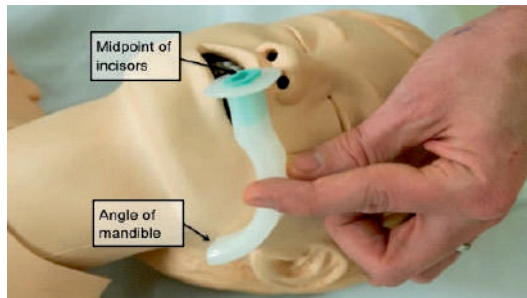


Fig. OR 1.1-7 Measure of an OPA for appropriate size.

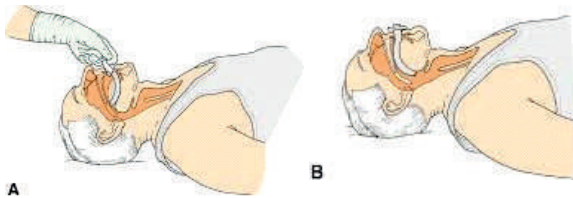


Fig. OR 1.1-8 Insertion of an OPA

If a patient is able to tolerate an OPA, it is a worrisome sign and suggests that their level of consciousness is extremely low. They may eventually need tracheal intubation to establish a definitive airway.

Nasopharyngeal Airways (NPAs) may be used before an OPA or if an OPA is not tolerated (patient is gagging or biting down on OPA). They are contraindicated if a basal skull fracture is suspected. (Fig. OR 1.1-9)

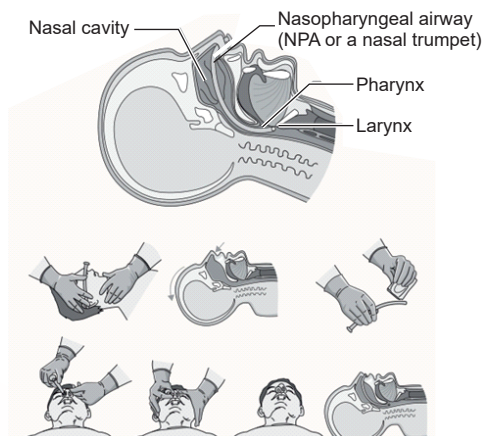


Fig. OR 1.1-9 Insertion of an NPA.

If a more definitive airway is deemed necessary, **Supraglottic Devices** or **Tracheal Intubation** may be employed. Insertion of these devices requires training and should not be attempted without experience. (Fig. OR 1.1-10,11)

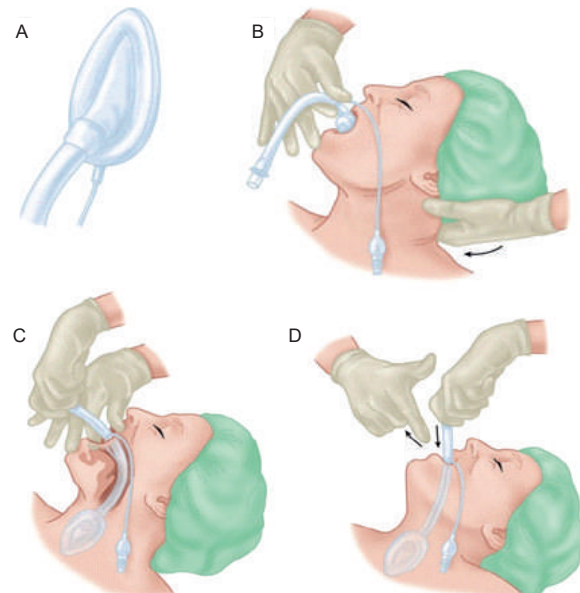


Fig. OR 1.1-10 Insertion of a supraglottic airway device. (Laryngeal mask airway)

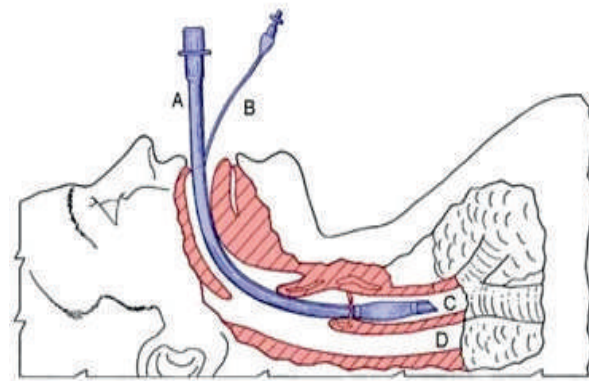


Fig. OR 1.1-11 Endotracheal tube.

Cervical Spine Immobilisation

In a trauma setting, it should always be assumed that the victim has a cervical spine injury. For this reason, it is important to immobilise the cervical spine during the assessment to prevent any potential long-term neurological damage (16).

The cervical spine must be kept in the neutral position whilst immobilised. If equipment

to immobilise the cervical spine is not available (e.g. block and collar/ Miami J Collar) then the patient's neck must be held in position and they should be reminded not to move their neck if conscious. (Fig. OR 1.1-12)

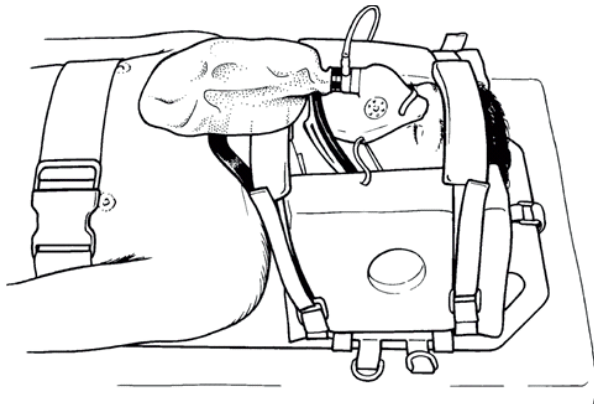


Fig. OR 1.1-12 Block and collar cervical spine immobilisation.

If the cervical spine is immobilised, the head tilt chin lift manoeuvre may not be possible. In these cases, a jaw thrust may be used preferentially. However, a jaw thrust manoeuvre may not be safe in an unconscious victim with suspected facial trauma and so airway adjuncts may be used early on.

B - BREATHING

The next step in the algorithm is the assessment of respiratory function. In a trauma setting, it is important to rule out chest wall injuries that may lead to early death (16).

Oxygen saturation levels (often assessed in A-Airway) and respiratory rate are useful observations. Auscultation of the chest is one of the most useful examinations and can provide many clues. Palpation of the trachea is also necessary and when used in conjunction with chest auscultation, may help in diagnosis of life-threatening conditions such as tension pneumothorax.

Commonly seen thoracic injuries are often remembered by the mnemonic **ATOM FC**. Understanding the pathophysiology of these conditions allows for better assessment of a trauma victim. They are summarised in **Table OR 1.1-8**.

LIFE THREATENING THORACIC TRAUMA TENSION PNEUMOTHORAX

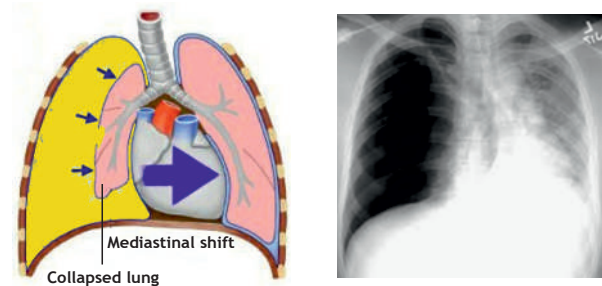


Fig. OR 1.1-13 Tension Pneumothorax

- Pleural space fills with air.
- Mediastinum is displaced (**Fig. OR 1.1-13**)

OPEN PNEUMOTHORAX

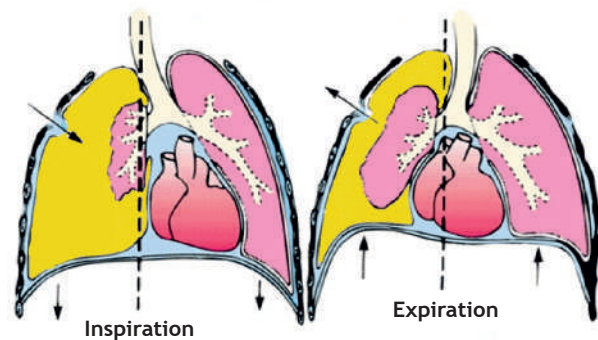


Fig. OR 1.1-14 Open Pneumothorax

- Defect in chest wall allows air to enter pleural space with each inspiration. (**Fig. OR 1.1-14**)

MASSIVE HAEMOTHORAX

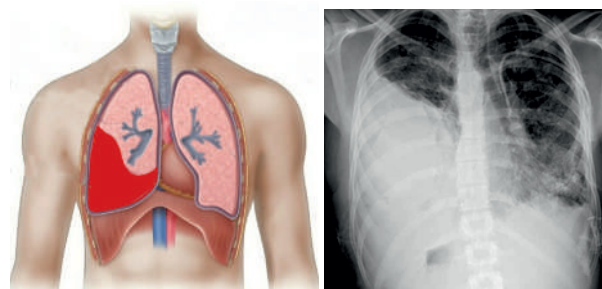


Fig. OR 1.1-15 Massive Haemothorax

- Blood in the pleural space due to chest wall injury (**Fig. OR 1.1-15**)

Table OR 1.1-8 Life threatening conditions in thoracic trauma

	Mechanism	Auscultation	Other Signs	Treatment
Airway obstruction	Foreign body Vomit Patient's tongue	Stridor Snoring	Shortness of breath (SOB) Hypoxia	Removal of foreign body Suctioning. Airway adjuncts. High flow oxygen.
Tension pneumothorax (Fig. OR 1.1-13)	Hemothorax not adequately ventilated. Pleural space fills with air. Intrathoracic pressure exceeds atmospheric pressure. Mediastinum displaced.	Quiet breath sounds on side of pneumothorax	SOB Hypoxia Tracheal deviation away from pneumothorax	Needle thoracocentesis. Definitive treatment is chest drain. High flow oxygen.
Open pneumothorax (Fig. OR 1.1-14)	Pleural pressure and atmospheric pressure equal. Defect in chest wall allows air to enter pleural space with each inspiration.	No breath sounds on side of pneumothorax.	SOB Hypoxia	Occlusive dressing over wound with one side untaped. Acts as flap valve to allow air out during expiration and but not in during inspiration. Definitive treatment is chest drain. High flow oxygen.
Massive haemothorax (Fig. OR 1.1-15)	Blood in the pleural space due to intrathoracic injury or chest wall injury.	Reduced breath sounds on side of haemothorax.	SOB Hypoxia 2-3L of blood in pleural space	Definitive management is chest drain. High flow oxygen.
Flail chest (Fig. OR 1.1-16)	Fracture of 2 or more ribs at 2 different sites creating a segment which remains detached from rest of chest wall. Moves in opposite direction to chest wall (paradoxical). Underlying pulmonary contusion	Nil.	SOB Hypoxia Pain. Reduced vital capacity.	Usually requires ventilatory support.
Cardiac tamponade (Fig. OR 1.1-17)	Mostly in penetrating trauma, when pericardial sac fills with blood and leads to reduced cardiac filling.	Muffled heart sounds.	Beck's Triad: Raised JVP, low BP and muffled heart sounds. Paradoxical pulse (fall of BP during inspiration).	Pericardiocentesis followed by definitive surgical repair.

FLAIL CHEST

- Moves in opposite direction to chest wall (paradoxical) (Fig. OR 1.1-16)

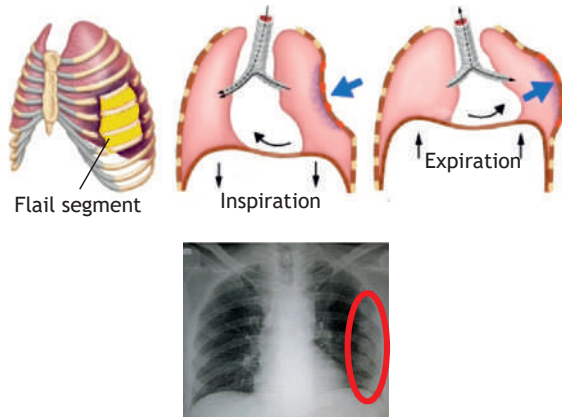


Fig. OR 1.1-16 FLAIL CHEST

CARDIAC TAMPONADE

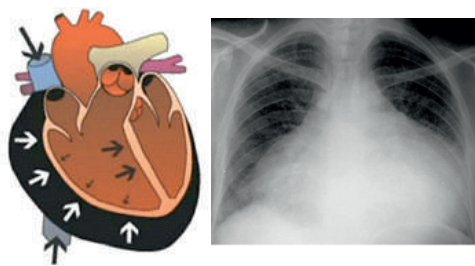


Fig. OR 1.1-17 CARDIAC TAMPONADE

- Pericardial sac fills with blood and leads to reduced cardiac filling. (Fig. OR 1.1-17)

C - CIRCULATION

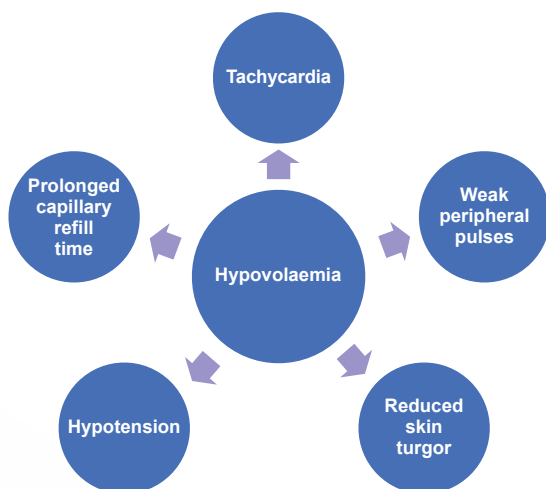


Fig. OR 1.1-18 Signs of hypovolaemia.

Hypovolaemia (and in some cases, hypovolaemic shock) can cause fatal circulatory compromise. In trauma, this is usually secondary to haemorrhage. A concise but proficient cardiovascular examination is crucial. (Fig. OR 1.1-18)

Auscultation of heart sounds is an important step as this could help in the diagnosis of problems such as cardiac tamponade. Early venous access with large bore cannulas (brown/orange 14G - flow of 300ml/s or grey 16G - flow of 200 ml/s) is crucial as hypovolaemic patients need urgent fluid resuscitation.

Shock

This term describes a state of decreased oxygen supply to end organs which, if untreated, leads to multi-organ failure (15).

Types of Shock

As mentioned above, the most common type of shock seen in trauma is *hypovolaemic* shock but there three other types of shock that are important to know. They are *distributive*, *obstructive* and *cardiogenic*.

Hypovolaemic shock secondary to major haemorrhage must be treated with aggressive fluid resuscitation and blood products must be administered as soon as possible. Hypovolaemic shock in trauma may also occur due to soft tissue injury leading to the release of immune mediators, although this is relatively rare.

Neurogenic shock is a type of *distributive shock* in which there is a mismatch between sympathetic and parasympathetic circulatory control. This is usually caused by injury to the central nervous system. Treatment is with fluid resuscitation but it is likely that the patient will need sympathomimetics and may also eventually need mineralocorticoids.

Patients who have a tension pneumothorax or cardiac tamponade may be at risk of **obstructive shock**. It is the rarest form of shock and may be combined with haemorrhagic shock in trauma. Obstruction to pulmonary flow leads to increased right ventricular afterload and decreased left ventricular pre-load. Treatment of the cause is vital.

Cardiogenic shock is rarely seen in trauma.

Special circumstances :

There are a few special circumstances in which the diagnosis of shock may not be as straight forward as it would be in the average healthy adult.

Table OR 1.1-9 Special circumstances in hypovolaemic shock.

	Physiological Differences
Elderly	Poor cardiovascular compensation and may present with haemodynamic instability with less blood loss than the average adult.
Children	Compensate for hypovolaemia by maintaining a tachycardic response and holding a normal blood pressure at much greater blood loss than the average adult.
Athletes	Normally have a lower resting heart rate than the average population and may not appear tachycardic in early response to hypovolaemia.
Pregnancy	Physiological increase in blood volume, cardiac output and heart rate. Therefore, a true haemodynamic response to hypovolaemia may not be seen until later.
Anticoagulation	Medication may make a patient be more prone to bleeding.
Beta-Blockers	May not allow a patient to build a profound tachycardic response to hypovolaemia. Also applies to other rate-limiting medication.

D - DISABILITY

This part of the assessment allows for assessment of a victim's consciousness level, pupils and blood glucose.

Consciousness Level

Glasgow Coma Scale (GCS)

The GCS, originally invented in the early 1970s by Jennet and Teasdale, assesses consciousness levels in patients following traumatic brain injury (7). It allows assessment of cerebral function by assessing eye, voice and motor responses to stimuli.

Table OR 1.1-10 The Glasgow Coma Scale.

Score	Eyes	Voice	Motor
1	No eye opening	No response	No movement
2	Open to pain	Incomprehensible sounds	Extensor response to pain (decerebrate)
3	Open to voice	Inappropriate but fully formed words	Flexor response to pain (decorticate)
4	Open spontaneously	Confused	Withdraws from pain
5		Oriented	Localised to painful stimulus
6			Obeys commands

GCS allows for a total score of 15 (total consciousness) with the lowest score being 3.

A score of <9 indicates that the patient is at risk of hypoxic brain injury and will likely need eventual intubation. The score is only helpful when each component of the GCS is given.

For example, if a patient is opening their eyes to pain, making incomprehensible sounds and withdrawing to painful stimuli:

$$\text{GCS} = \text{E2 V2 M4} = 8$$

GCS may not be appropriate in some patients. For example, a patient who has a pre-existing neurological condition which does not allow them

to move their limbs will always score 1 in motor response, therefore giving an inaccurate final GCS score.

GCS is useful in monitoring a patient with a head injury to assess if there is a decline in consciousness level over a period of time. GCS is part of the revised trauma score (RTS - see Disaster Triage section above).

Table OR 1.1-11 Head injury classification based on GCS

Head injury classification	GCS
Mild	14-15
Moderate	9-13
Severe	3-8
Coma	Less than 3

AVPU Scale

The AVPU scale is a useful tool to grossly assess a patient's level of consciousness (8). Patients are scored categorically as either **alert**, responsive to **voice** stimulus, responsive to **painful** stimulus or **unresponsive** to painful stimuli.

Table OR 1.1-12 AVPU scale-GCS

AVPU scale	GCS
ALERT	15
Responds to VERBAL stimuli	13
Responds to PAINFUL stimuli	8
Unresponsive	6

Pupil Size and Reactivity

Unilaterally/bilaterally dilated pupils or fixing of the pupils may indicate cerebral herniation. Urgent neurosurgical intervention would be needed to reduce intracranial pressure.

Capillary Blood Glucose

Capillary blood glucose measurement is done in a regular A to E assessment. In a trauma

setting, it may not be a priority initially but may be beneficial to find the cause of trauma (eg: hypoglycaemic episode resulting in a fall).

E - EXPOSURE

The final part of the A to E assessment allows for full exposure of the patient to ensure no other life-threatening issues are missed. The assessment may require a log roll of the trauma victim to ensure that no major haemorrhage is missed. The five areas of major haemorrhage are the thorax, abdomen, pelvis, long bones and obvious external haemorrhage. It is important to remove all clothes whilst maintaining dignity and to ensure that the patient is quickly covered to preserve bodily warmth and avoid hypothermia.

Secondary Survey

The secondary survey is a top to toe detailed assessment that allows identification of other injuries (non-life-threatening) that the trauma victim may have suffered. It is not always done in the pre-hospital setting due to limited time before transfer to a trauma centre, but is an important concept to know and understand. It can be carried out in the pre-hospital setting if time permits.

The *look, listen and feel technique* is used throughout the body. As the patient may need to be log rolled to ensure exposure to the back, it is easier to complete the secondary survey anteriorly and then move on to examination of the posterior aspect of the patient.

HEAD

It is always necessary to inspect for superficial injuries and lacerations to the face and scalp. The assessor must carefully palpate for bony tenderness. Traumatic basal skull fractures are common and signs associated with basal skull injuries are shown in (Fig. OR 1.1-19,20,21,22)

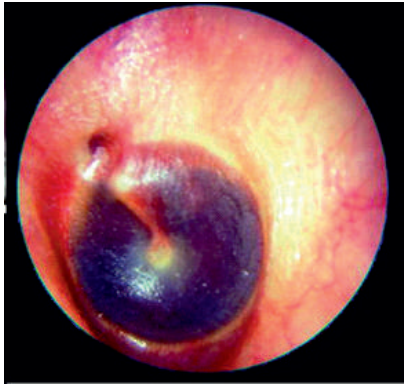


Fig. OR 1.1-19 Haemotympanum



Fig. OR 1.1-20 Battle Sign-bruising over the mastoid process.



Fig. OR 1.1-21 Raccoon Eyes - periorbital bruising



Fig. OR 1.1-22 Rhinorrhoea-bloody/clear, could indicate a CSF leak.

NECK

The neck and spine are possibly the two most important areas to cover in a secondary survey if only limited examination is possible in a pre-hospital setting. The cervical spine must be palpated for bony tenderness. Immobilisation of the cervical spine must continue until cervical spine injury has been ruled out in a hospital setting. The assessor can also auscultate the carotid arteries for murmurs as there may be a possibility of traumatic dissection.

SPINE

Palpation for point tenderness along the entire length of the spine may reveal a traumatic spinal fracture.

Neurological Function

Assessment of peripheral neurological function is appropriate and may include brief assessment of power and sensation.

Power

The most commonly used grading scale for evaluation of power in a limb is the Medical Research Council (MRC) Scale. Originally described in 1943, the scale is the most widely used for scoring power in muscle groups in neurological examination (9).

Table OR 1.1-13 MRC Scale

Score	Assessment
0	No movement.
1	Flicker of movement.
2	Active movement with gravity eliminated.
3	Active movement against gravity.
4	Active movement against gravity and resistance.
5	Normal power.

Sensation

A detailed sensory examination is not necessary in a pre-hospital setting but gross