

Lec.1/ Trauma – Basics and Emergency Care

Key Points

Maxillofacial trauma is a challenging area of clinical practice due to its effects on both the function and aesthetics of the face. Injuries to the face may be associated with damage to vital structures such as the eyes, lacrimal apparatus, nasal airways, paranasal sinuses, tongue and various sensory and motor nerves.

✓ Etiology:

Road traffic accidents (**RTA**) or motor vehicle collisions (**MVC**); remain the most important cause of maxillofacial trauma all over the world. Vehicle safety design such as air bags, collapsible wind screen and the compulsory use of seat belt (or helmet for motor cyclist); all are factors that have great influence in reducing maxillofacial injuries from RTA.

Other etiological factors include: fall from height, assaults, industrial injuries, sports, agricultural and missile injuries.

Fall fom height; depending on several factors: (the height of the fall, the landing position, the location of contact, and the impact surface), these factors will determine the pattern and severity of trauma.

Missile injuries; include: blast injuries, bullets, shells...etc. This type of injury usually cause complex pattern of trauma characterized by bone and soft tissue loss and comminuted fractures of the facial bones. These injuries are prevalent in areas of wars, civil wars and terrorism.

✓ Anatomically:

The facial skeleton has been divided into **upper, middle and lower thirds**. The upper third is formed by the frontal bone, the middle third is the region extending downwards from the frontal bone to the level of the upper teeth, and the lower third is the mandible.

Fractures of the middle third of are termed '**midfacial**' fractures or '**fractures of the midface**'

When facial fractures extend into the skull base or frontal bone especially the posterior wall of frontal sinus or orbital roof; they are usually referred to as '**craniofacial**' injuries, these will often require combined management with a neurosurgeon.

✓ **The Cushioned effect of the facial bones:**

The midface can be considered as a fragile ‘**matchbox**’ sitting below and in front of a hard shell (the cranium) containing the brain. The midfacial bones have the capacity to absorb impact energy protecting the brain, any impact is cushioned as the bones collapse and preventing the force transfer to the brain, that’s why the severely facial traumatized patients are conscious.

In the mandible the condylar neck act as cushioned effect and fracture to absorb the force, but when the mandible absorb the entire force; the cushioning effect is reduced and brain injury can result as in boxer’s knockout punch.



A blow to the skull is transmitted directly to the intracranial contents (A) The ‘matchbox’ like structure of the midface cushions the force of impact (B) An impact to the mandible (C) is transmitted indirectly to the cranial base. Damage to the brain may be prevented by protective fracture of the condylar neck.

✓ **As an incidence:**

The most common facial fractures are nasal and mandibular fractures, followed by injuries to the zygoma and maxilla respectively.

✓ **Immediate intervention:**

Definitive repair of a facial fracture is never a life-saving measure, but there is cases with priority 1 (which should be managed within seconds) and immediate intervention is required for:

1. **Airway management (establishment of surgical airway).**
2. **Profuse facial bleeding.**
3. **Sight or vision-threatening injuries as retrobulbar hemorrhage**

Emergency Care: Preparation and (ATLS)

- Preparation is divided into a *prehospital phase* essentially limited to first aid in the field of injury and done mostly by the paramedics while the second *in-hospital phase* in which the patient has been brought to the hospital where he or she can be managed according to the extent of injury.
- **Triage** is a sorting of patients based on the urgency of treatment and the available resources to provide that treatment, may be carried out in both prehospital and in-hospital phases. This is based on the principle that the most severely injured patient requires the more urgent treatment.
- **Triaging of facial injuries:**
 1. Within a few seconds: immediate life or sight saving intervention
 2. Within a few hours: Clinically urgent injuries, contaminated open #
 3. Within a few days: compound #
 4. Within a week: simple or closed #
- **In the period immediately following the accident, no treatment of facial fracture is required unless it has a direct bearing upon the patency of the patient's airway or the control of hemorrhage**
- **The modern management of trauma in multiply injured patient is based on a firm understanding of the pathophysiology of trauma and an understanding of how patients actually die.** This understanding has led to the development of several trauma systems, of which the **Advanced Trauma Life Support (ATLS)** is now generally recognized as the ‘**gold standard**’. ATLS was originally introduced by the American College of Surgeons Committee of Trauma and is now taught in over **50** countries worldwide.
- **Principles of ATLS management:**

1. Phase one/ Primary Survey: ABCDE rapid assessment, which is in order of priority:

Airway and cervical spine control

Breathing and ventilation (oxygenation)

Circulation and control of hemorrhage

Disability – assessment of neurological deficit

Exposure and environmental control

Airway and cervical spine control

- **The highest priority in the initial assessment of the trauma patient is the maintenance of a patent airway** because whatever the cause, obstruction of the patient's airway will rapidly lead to asphyxia.
- The most important early measure is to talk to the patient and stimulate a verbal response. A positive, appropriate verbal response indicates that airway is patent, ventilation is intact, and brain perfusion is adequate.
- **The most important factor in controlling the patency of the airway is level of consciousness**, a fully conscious patient is able to maintain an adequate airway even in the presence of severe disruption of the facial skeleton while a semi- or unconscious patient will rapidly obstruct from the presence of blood and mucus in the airway, inability to cough or inability to adopt a posture to keep the airway clear.
- Patient's position plays a major role in prevention of airway obstruction and suffocation from bleeding and secretions, the patient with facial trauma should be placed in seating position or lying on the side **(if you leave the patients facing towards heaven; it will not be long before they get there!!)**

- Airway maintenance techniques (in sequence):

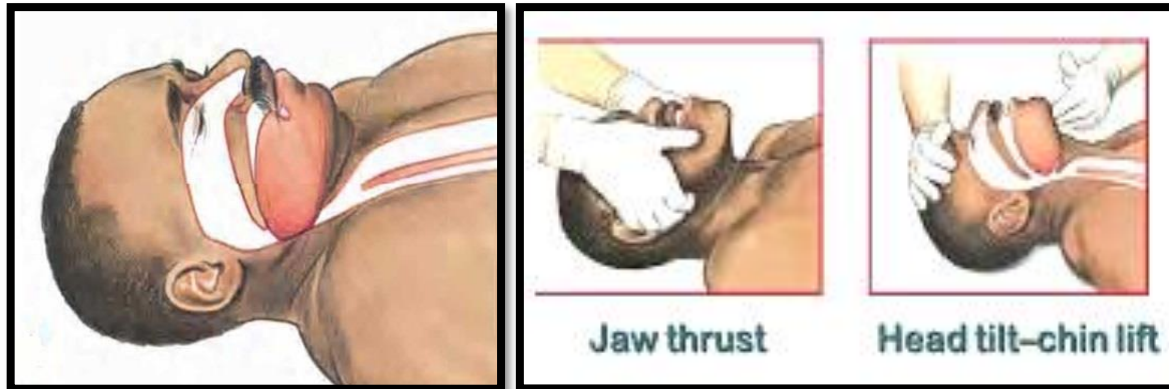
- 1- Careful examination and **clearance of blood, secretions, broken dentures and teeth** from oral cavity and oropharynx.
- 2- Airway obstruction may **follow collapsed maxillary or anterior mandibular fractures**, it can be resolved by temporary reduction and stabilization of fractures with a (**stay or bridle wire**) around stable teeth on either side of the fracture.

In Le Fort fractures, the upper jaw may have been pushed downwards and backwards so that the soft palate is resting upon the dorsum of the tongue and occlude the oral airway. In such cases two fingers are inserted behind the hard palate and the upper jaw is pulled gently upwards and forwards to enable the patient to breathe through the mouth.

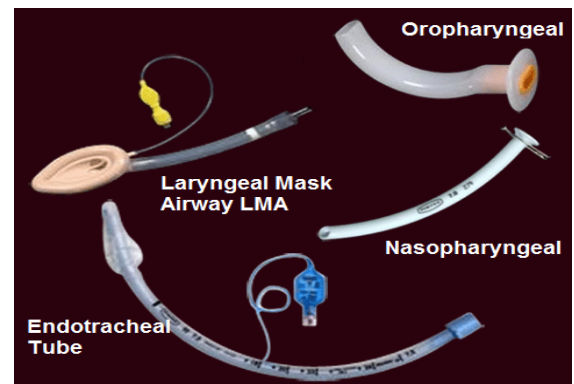
If there is bilateral fractures in the mental region, the skeletal support of the tongue tends to be displaced backwards by the pull action of the **geniohyoid** and **genioglossus** muscles which are attached to the genial tubercles, this will result in a backward displacement of the tongue and obstruct the airway, the chin must be lifted and a tongue stitch may be required and the thread of the suture must be grasped outside the

- 3- By Simple maneuver as **Chin lift** or **Jaw thrust**: both techniques **may be difficult to do in a conscious patient with mandibular fractures. They also aggravate oral bleeding.**

Head tilt chin lift is used when spinal injury is excluded because of the head tilt in this maneuver. Jaw thrust involves placing the fingers behind the angle of the mandible to push the jaw forwards and upwards while the thumbs push down on the chin or lower lip to open the mouth.



- 4- Insertion of **airway** (Oropharyngeal, Nasopharyngeal and Laryngeal mask airway (LMA)), but they are not well tolerated by conscious patients due to stimulation of gag reflex.
- 5- **Endotracheal intubation** is necessary to secure airway if the patient has more severe damage and cannot maintain the airway in compromised level of consciousness



- 6- Emergency surgical airway is required when the airway cannot be secured by any other means. Surgical airway is obtained by cricothyroidotomy (also known as cricothyrotomy) or tracheostomy.

Surgical Cricothyroidotomy is the fastest and safest method of obtaining a surgical airway.

Needle cricothyroidotomy is a temporary procedure (for 45 min.) that is used to oxygenate patients while a definitive airway is being quickly prepared. A cannula is introduced into the lumen of the trachea through the cricothyroid membrane to deliver oxygen.

The cricothyroidotomy procedure is relatively simple to perform and can be done under local anaesthesia, the key factor in the technique is identification of the cricothyroid membrane; the cricothyroid membrane is usually quite superficial and palpable. The skin and membrane are perforated with a scalpel blade then insert a standard tracheostomy tube.

The main complication of cricothyroidotomy is sub-glottic stenosis in children but it is effective and safe in adults.

The indications for tracheostomy in maxillofacial injuries are:

1. When prolonged artificial ventilation is necessary (for example, associated head and chest injuries).
2. To facilitate general anesthesia during surgical repair of complex facial injuries.
3. To ensure a safe postoperative recovery after extensive surgery.
4. Following obstruction of the airway from laryngeal edema or occasionally direct injury to the base of the tongue and oropharynx.
5. Serious hemorrhage into the airway, particularly when a further secondary hemorrhage is a possibility.

In multiple injuries; **Spinal Immobilization** is initially required because of possible spinal injuries, and it is usually done by semi rigid collar or spinal board until damage is excluded by radiograph.

It should be assumed that any significant maxillofacial injury may be associated with a cervical spine injury. Care must be taken when the head and neck are manipulated during maintenance of the airway,

The cervical spine is examined radiologically by:

-Lateral view of the cervical spine

-Cervical anteroposterior and open mouth odontoid views

-CT scanning

- **Breathing and ventilation**

Airway patency alone does not ensure adequate ventilation – adequate gas exchange is required to maximize blood oxygenation and carbon dioxide elimination. Ventilation requires adequate function of the lungs, chest wall and diaphragm. A standard (*look, listen, and feel*) approach is often used to identify breathing difficulties.

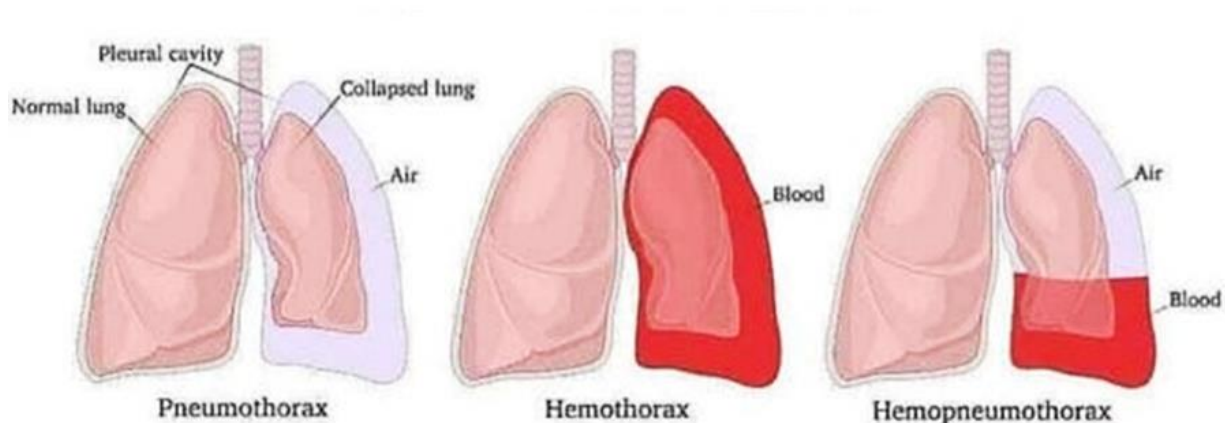
- **Look** for:
 - The signs of hypoxia and agitation
 - Asymmetry of chest wall movement (flail segments)
 - Dilated neck veins (sign of increased intrathoracic pressure).
- **Listen** for: abnormal breath sounds as **stridor** (upper airway obstruction) and **wheezing** (lower airway obstruction).
- **Feel** for: warm air against your hand.

Pneumothorax which develops from damage to the chest wall or laceration of the lung pleura, with a resulting loss of negative intrapleural pressure, it can be: open, closed or tension pneumothorax.

- **Tension (closed) pneumothorax** develops when a chest wall injury allows air to pass into the pleural space but not out of it (a one-way valve). As a result; the accumulated air compresses the lung, impairs the lung function and increases the intrathoracic pressure enough to decrease venous return to the heart, causing shock. Treatment is immediate needle decompression by inserting a large-bore needle, followed by immediate chest tube insertion.
- **Open pneumothorax** is an unsealed opening in the chest wall; that compromise the respiratory process. The definitive management of the open pneumothorax is to place an occlusive dressing over the wound and immediately place an intercostal chest drain.

Hemothorax is the collection of blood in the pleural cavity.

Flail chest occurs when three or more adjacent ribs are fractured in at least two locations, resulting in a freely moving segment of chest wall during respirations.

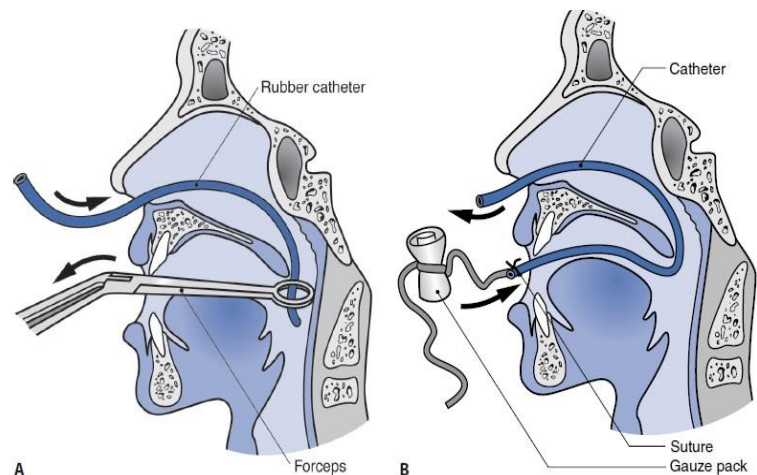


• Circulation and control of hemorrhage

Haemorrhage in the majority of fractures of the facial skeleton is not life-threatening and haemorrhagic shock is unusual. If shock is present this should immediately raise the suspicion of other injury.

- 1- Significant bleeding from external wounds (such as the scalp wounds) can be controlled by **pressure or suture bites with full thickness**, obvious bleeding vessels can be secured by **artery forceps** and **ligated** if possible.
- 2- Haemorrhage originates from a grossly displaced fractures of the mandible or midface can be controlled by **manual reduction** of the fracture and **temporary immobilization** either manually, or by means of a wire ligature passed around teeth on each side of the fracture line ('bridle wire').
- 3- Epistaxis is a consequence of injury to the central middle third of the face; this is usually stops spontaneously or controlled by **anterior nasal packs**.

Profuse haemorrhage into the nasopharynx following injury to maxillary artery terminal branches in association with midface fractures is a common complication. A **postnasal (posterior nasal) pack** is needed in this situation as a matter of urgency. A variety of specifically designed **nasal balloons** or packs are now widely available. **Usually the packs are left in situ around 24–48 hours.**



- 4- Further interventions include **ligation of the external carotid and ethmoidal arteries** via the neck and orbit respectively. These steps are rarely required nowadays and are extremely difficult to undertake as emergency procedures. Due to the extensive collateral circulation of the face ligating a single vessel is unlikely to be successful.
- 5- **Superselective embolization** involves catheter-guided angiography used to identify bleeding points then using of a number of materials designed to stimulate clotting locally.

Surgical Hemostasis

Choice of use depend on the site and nature of injury and hemorrhage:

A. Mechanical procedures :

1. digital pressure
2. vascular hemostat (artery forceps)
3. clamps
4. ligatures (ligation)
5. tourniquets
6. pressure packs (e.g. dry or wet swabs)
7. bone wax

B. Thermal agents

1. Heating:

- Electrocautery: use electrical current to heat a metal wire that is then applied to the target tissue in order to burn or coagulate the specific area of tissue. The heat is created by the resistance of the tissue to the electrical current
- High power argon-laser for superficial erosions

2. Cooling:

- 1) Direct cooling (e.g. iced saline)
- 2) Extreme cooling (cryogenic surgery): e.g. CO₂ liquid and Nitrogen liquid
- 3) Generalized hypothermia down to 35 C°, this reduce blood flow to visceral organs but cause shivering and ventricular fibrillation.

C. Chemical agents

1. Adrenaline & Noradrenaline
2. Turpentine or Tannic acid (applied on gauze packs)
3. Gelfoam (gelatin foam)
4. Oxidized regenerated cellulose (Surgicel)
5. Microcrystalline collagen
6. Thrombin & Russell viper venom

• **Disability- assessment of neurological deficit**

A rapid neurological evaluation is performed to assess the patient’s level of consciousness. A rapid assessment of the patient’s neurological disability can be made by **the four-point AVPU scale**:

- ✓ **A** Alert.
- ✓ **V** respond to Verbal command.
- ✓ **P** respond to Painful stimuli.
- ✓ **U** Unresponsive.

A simple scale of level of consciousness is:

- i. Fully conscious.
- ii. Drowsy with disorientation, but responds rationally to questions and requests.
- iii. Semiconscious responding irrationally to spoken questions and requests.
- iv. Unconscious but responding purposefully to painful stimuli.
- v. Unconscious with decerebrate reflex response to pain.

The Glasgow Coma Scale is the international gold standard, which was developed in 1974, it has three variables: Best motor response, best verbal response and eye opening. The scores range from 3 (clinically dead) to 15, with a higher score representing an increased degree of consciousness.

Eye Opening		Verbal Response		Motor Response	
▪ Spontaneously	(4)	▪ Oriented	(5)	• Obeys commands	(6)
▪ To speech	(3)	▪ Confused	(4)	• Localizes pain	(5)
▪ To pain	(2)	▪ Words	(3)	• Normal flexion to pain	(4)
▪ None	(1)	▪ Sounds	(2)	• Abnormal flexion to pain	(3)
		▪ None	(1)	• Extension to pain	(2)
				• None	(1)

Patients with a head injury who had a GCS of 8 or less should be intubated (endotracheal intubation). Pain stimulation is initiated gradually by pressing the nail tip with pen, the stimulus continues up to ten seconds.

If any of the three parameters could not be tested, then it should be recorded as NT (not testable) as in swelling of eyelids prevent the eye opening or the tracheostomy prevent the verbal communication and so.

It is prudent to ask whether the patient can remember up to the moment of the accident or whether there is a memory gap. **Retrograde amnesia** is failure to remember up to the time of injury and **anterograde amnesia** is loss of memory following the accident, both are indicative of cerebral damage.

- **Exposure, Environment control and 'Eyes' (vision threatening injuries – VTI)**

Exposure:

- Means removing the clothes to ensure that no other injury is missed and it should be carried out in the emergency unit.

Environment:

- Special effort must be made to keep the patient from developing hypothermia during the early stages of trauma care by maintaining warm environment.

Eye: Vision threatening injuries:

1. Orbital compartment syndrome (Retrobulbar Odema)
 2. Globe injuries.
 3. Loss of eyelid integrity.
- Orbital compartment syndrome is an acute emergency that may require decompression because of the compression and spasm of the posterior ciliary vessels that supply blood to the optic nerve leading to blindness.

Retrobulbar pressures cause optic nerve ischemia , it should be managed medically with:

- Mannitol 1 gm/kg
- Acetazolamide 250-500 mg to reduce intra-ocular pressure
- 3-4mg/kg IV dexamethasone to reduce oedema

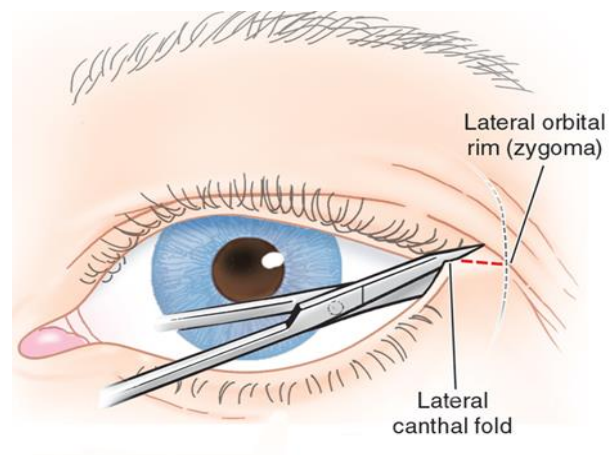
- Visual assessment is extremely important by checking

- 1- The pupil size.
- 2- Reaction to light.
- 3- Look for **proptosis** (protrusion of the eyeball).

▪ **Signs and symptoms of retrobulbar haemorrhage:**

1. Pain
2. Decreasing visual acuity
3. Diplopia (double vision)
4. Proptosis
5. Tense globe
6. Sub-conjunctival oedema/chemosis
7. Dilated pupil
8. Loss of direct light reflex (Relative afferent pupillary defect - RAPD)
9. Ophthalmoplegia

- Surgical intervention can be done through a **lateral canthotomy** made with sharp scissors then blunt forceps inserted into the orbit between the inferior and lateral recti to **enter the intraconal space** to decompress the orbit. The patient should be managed medically (by the previous mentioned protocol) during the preparation for the surgical intervention.



- **Irreversible ischemia of the visual pathway can occur within 1 hour, and permanent visual loss (blindness) within 1hours.**

Anatomical Note: Lateral canthal ligament: it is a fibrous ligament (Y shaped) attached to the tarsal plates (cartilaginous plates to support the upper and lower eye lids).

2-Phase 2/ Resuscitation:-

It includes CPR, IV fluids, hemostasis, It is carried out with phase 1 at the same time

3-Phase 3/ Secondary Survey:-

It does not begin until the primary survey (ABCDE) is completed and resuscitation efforts are well established, the patient is demonstrating normalization of **vital Signs (consciousness, pulse rate PR, respiratory rate RR and urine output UOP).**

It include head to toe evaluation of the patient, with full history that can be memorized as AMPLE (Allergy, Medications currently used, Past illness/ Pregnancy, Last meal, Events and Environment related to the injury).

4- Phase 4/ Definitive Care:-

Finally the patient is admitted to the ward of specialty

CONTROL OF PAIN

There is usually little pain from maxillofacial injuries. It is extremely important to avoid giving powerful analgesics which:

- 1) Depress the level of consciousness and respiration
- 2) Morphine also depresses the cough reflex
- 3) It causes constriction of the pupil (miosis), which may mask an early sign of the rise in intracranial pressure (as in cerebral hemorrhage).
- 4) Masks pain which may be due to intra-abdominal or intra-thoracic injuries.

This is the End of the Lecture – Good Luck