

## BATLS

# Battlefield Advanced Trauma Life Support (BATLS)

### CHAPTER 3

### TRIAGE

#### Aim

0301. On successfully completing this topic you will have a sound understanding of how to prioritise casualties for treatment and evacuation, so that the survival of the maximum number is ensured.

#### Introduction

0302. The management of a single seriously injured casualty in peacetime military or civilian practice is frequently problematic. On the battlefield, problems are compounded by: environment, difficult terrain and tactical constraints. The situation is even more difficult when faced with large numbers of casualties.

0303. If a system for prioritisation of care of the injured is not in place, many salvageable casualties may die unnecessarily. Triage (from the French verb *trier*, to sieve or to sort), has evolved through military conflicts dating from the Napoleonic Wars to recent civilian disasters.

#### Definition

0304. The process of triage is complex. The preferred definition is:

*Sorting casualties and the assignment of treatment and evacuation priorities to wounded at each role of medical care.*

#### Triage Priorities

0305. There are four triage priorities:

- *Priority One (P1)*. Those needing immediate life-saving resuscitation and/or surgery.
- *Priority Two (P2)*. Those needing early resuscitation and/or surgery, but some delay is acceptable.
- *Priority Three (P3)*. Those who require treatment but where a longer delay is acceptable.
- *Dead*.

0306. This is the P (*Priority*) System, of triage. Triage must be repeated at every link of the evacuation chain and the priority adjusted to reflect deterioration or improvement in the casualty's clinical condition.

#### Mass Casualties

0307. A mass casualty situation overwhelms the available medical and

logistic capabilities (JSP 110). In these circumstances the aim of the medical services must be to give care to the greatest benefit of the largest number - that is '*to do most for the most*'.

0308. The term mass casualties is reserved for a situation when medical resources are overwhelmed. When resources are adequate, the incident is said to be '*compensated*'. In a military setting, an '*uncompensated*' situation may exist temporarily or over a prolonged period. It may be appropriate for the local commander to introduce mass casualty triage without a formal declaration having been made by a higher authority.

0309. The triage system in an uncompensated situation thus becomes;

- **P1 - Immediate Treatment**. Those needing emergency life-saving treatment. Procedures should not be time consuming and concern only those with a high chance of good quality survival. Examples are remedial airway obstruction, accessible haemorrhage and emergency amputations.

- **P2 - Delayed Treatment**. Those needing major surgery (after initial sustaining treatment such as intravenous fluids, antibiotics and splinting), or medical treatment, but where conditions permit delay without endangering life. Examples are open fractures of long bones, large joint dislocations and burns covering 15-30% BSA.

- **P3 - Minimal Treatment**. Those with relatively minor injuries who can effectively take care of themselves or be helped by untrained personnel. Examples are minor lacerations and uncomplicated fractures.

- **P1 Hold - Expectant Treatment**. Those with serious multiple injuries needing extensive treatment or with a poor chance of survival. These casualties receive appropriate supportive treatment compatible with resources, for example, analgesia. Examples are severe head and spinal injuries, extensive burns and large doses of radiation.

0310. The T (Treatment) System of triage, is an alternative to the P System and is routinely used by the RN, the RAF,

NATO allies, the International Committee of the Red Cross, civilian ambulance services and in civilian disaster programmes.

0311. The relationship between the two systems is as follows;

- **P1** is equivalent to **T1**
- **P2** is equivalent to **T2**
- **P3** is equivalent to **T3**
- **P1 Hold** is equivalent to **T4**
- **Dead** is still **Dead**.

### Triage for Treatment

0312 A simple, safe, rapid and reproducible system is required that can be applied by any Serviceman with appropriate medical training. Physiological systems that look at the consequences of injury (a change in the vital signs: *Respiratory Rate, Pulse Rate and Capillary Refill Time [CRT]*) are more reliable than anatomical systems (which require extensive clinical knowledge and a need to undress the casualty).

0313. A widely accepted physiological method of triage for treatment is the *Triage Sieve*. This involves an assessment of the casualty's mobility, then an assessment of

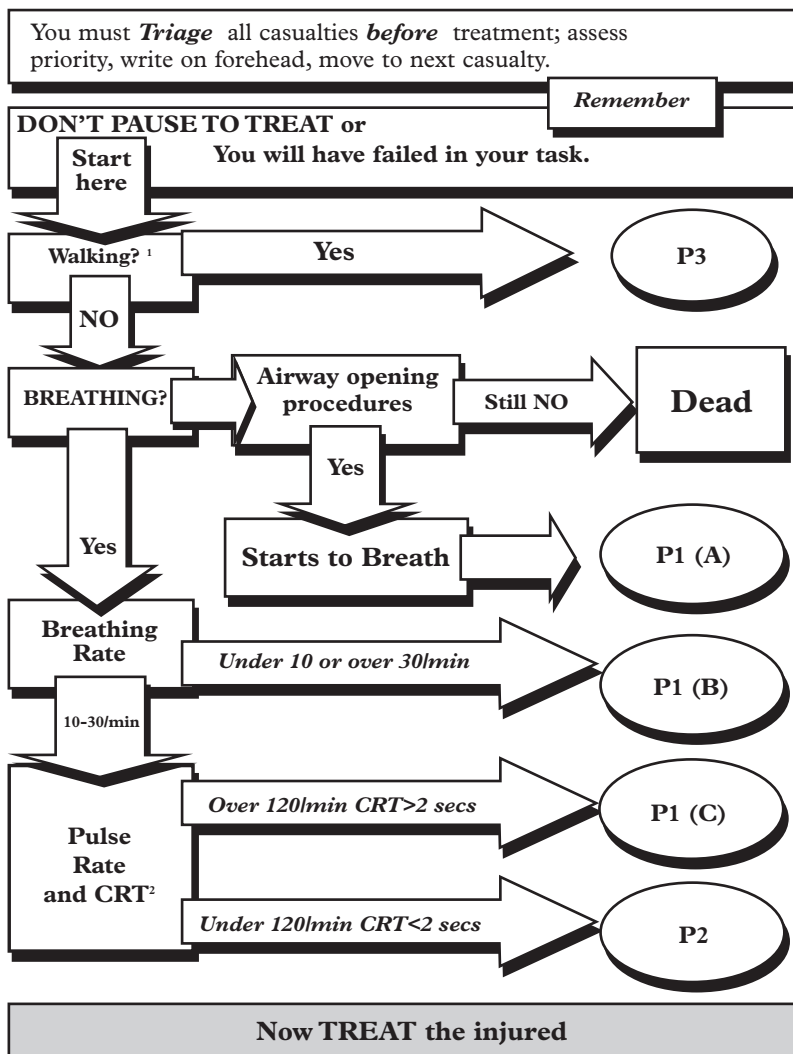
the airway, breathing and circulation (see Table 3.1).

0314. Triage is only a 'snapshot' of how the casualty is at the time of assessment. In order to identify changes in the casualty's condition, the triage sieve **must** be repeated at each link of the evacuation chain. It is important initially **not** to try to predict how a casualty may deteriorate, this will lead to over-triage (a higher than necessary triage category) and can overwhelm the system with P1 and P2 casualties.

### Triage for Evacuation

0315. Limited time and personnel resources may prohibit a more detailed triage assessment other than that given by the triage sieve. When possible, the *Triage Sort* can be used to refine triage sieve decisions. Triage sort uses the respiratory rate, systolic blood pressure and Glasgow Coma Scale, to numerically score the casualty from 0 to 12 and give an indication of priority for evacuation and/or the need for further intervention. This score has a proven direct relationship to outcome from severe injury.

Table 3.1 The triage sieve



1 It must also be realised that some in this group, despite being ambulatory, may have injuries of sufficient magnitude to cause a clinical deterioration requiring a change in priority. 2 Is unreliable in the cold or dark.

Table 3.2 Triage sort coded values

Physiological variable	Measured value	Score
Respiratory rate	10-30	4
	>30	3
	6-9	2
	1-5	1
	0	0
Systolic blood pressure	>90	4
	89-76	3
	75-50	2
	<49	1
	0	0
Glasgow Coma Scale	15-13	4
	12-9	3
	8-6	2
	5-4	1
	3	0

0316. Priorities are assigned as follows:

- **P1 (T1)** 1-10<sup>3</sup>
- **P2 (T2)** 11
- **P3 (T3)** 12
- **P1 Hold (T4)** 1-3<sup>3</sup>
- **Dead** 0

0317. The coded values for the Triage Sort are given in Table 3.2. After coding each of the three parameters, add them together to give a score ranging from 0 (dead) to 12 (physiologically normal).

0318. Evacuation will be delayed when the number of casualties outstrips available transport. In this situation, the greater time spent with the casualty will allow additional anatomical assessment of injuries. Where the priority determined by physiology does not match the anatomical severity of injuries, the priority can be upgraded.

**Example:** A soldier loses his left leg in a landmine incident. Immediate first aid is effective in stopping haemorrhage. He is

3. The overlap in scores allows for the seriously injured to be placed in either category, depending on number of casualties and resources available for evacuation.

transported to the RAP. He cannot walk, his respiratory rate is 22 and his pulse is 110/minute. He is triaged P2 for treatment (Triage Sieve). He then receives intravenous fluids and analgesia. His systolic BP is 115 mmHg, his respiratory rate is 20, he is fully alert, with a GCS of 15. He scores 12 on his Triage Sort, which is P3 for evacuation. Clearly, he requires early surgical treatment and the RMO upgrades his priority to P2 for evacuation to the field hospital.

0319. To help understand priority allocations for evacuation, it is appropriate to consider the standard casualty evacuation chain which is usually through the logistical Lines of Support. These lines of support relate to the Combat Services Support (CSS) provided at levels of operational deployment, that is, First Line at unit level, Second Line at brigade or divisional level, Third Line between the divisional rear boundary and point of entry, and Fourth Line at the base<sup>4</sup>. These should not be confused with Roles of Medical Support which is the term used throughout NATO to define the levels of medical capability<sup>5</sup>.

- **Role 1** Treatment to restore and stabilise vital functions. (Regimental Aid Post/Medical Section(s)).
- **Role 2** Resuscitation and stabilising treatment - may include stabilising (Damage Control) surgery (Dressing Station).
- **Role 3** Hospitalisation and life-saving surgery, definitive surgery (Field Hospital).
- **Role 4** Time consuming specialist and long term treatment (NHS Hospital).

0320. It should be assumed that early surgery takes place at the field hospital, with subsequent care taking place back in the United Kingdom, within the National Health Service. There will be occasions when surgery, through a field surgical team being attached, is available forward of field hospitals. This will be the norm in airborne and airmobile operations and when FIRST<sup>6</sup> teams are attached to Close Support Squadrons of Medical Regiments. Specialist teams, such as burns teams and head and neck teams, can be allocated to selected field hospitals: this will influence the disposal and transfer of candidate casualties.

0321. United Kingdom military operations are increasingly Joint Service in nature, for example, surgical support at Role Three may be found from the RN in the form of a Primary Casualty Receiving Ship (PCRS). An intermediate hospital may be set up, at a convenient location on either the tactical or strategic LOCs.

## Application at Role One and Role Two

0322. For the regimental medical officer (RMO) and the dressing station medical officer, casualties are likely to be graded for treatment and/or evacuation as follows:

### • P1

**Airway:** Obstruction including that due to maxillofacial injury. Airway burns with the potential for obstruction.

**Breathing:** Tension pneumothorax - open chest wound - flail chest/pulmonary contusion. Respiratory rate <10>30. Triage Sort Score 1-10.

**Circulation:** Major haemorrhage - external or internal - compressible or non compressible. CRT >2S. Pulse rate >120/mm. Massive muscle injuries. Multiple fractures and/or multiple wounds. Burns between 15 and 30% Body Surface Area (BSA).

### • P2

Lesser visceral injuries. Vascular injuries not having features of P1. Cerebral injuries that are deteriorating (See table 8.2). Burns of less than 15% BSA involving face, eyelids, hands, perineum and across joints (see paragraph 1222). Large joint dislocations.

### • P3

Lesser fractures and dislocations. Lesser soft tissue injuries ultimately requiring surgery. Maxillofacial injuries with no airway problems. Eye injuries. Other burns less than 15% BSA.

0323. Expectant (P1 Hold [T4]) cases would include, for example, burns of greater than 30% BSA, gunshot wounds to the brain and other injuries with a poor prognosis.

0324. Medical cases are categorised in exactly the same way in relation to their need for resuscitation and timely intervention by a physician. Psychiatric cases invariably tend to fit into the P3 bracket, with the particular caveat they should be treated as far forward as possible; this approach will result in the maximum number being rendered fit and returned to duty. The further rearward a psychiatric case is evacuated, the less likely this is to happen.

## Application at Role Three

0325. The critical decision at the field hospital is whether the casualty needs resuscitation and surgery now, or whether

4. See Army Doctrinal Publication Vol 3 Logistics (Army Code 71566). 5. For example, there will be Role 1 and Role 2 medical units at Third Line. 6. Forward Immediate Resuscitation and Surgery Teams.

he can withstand further delay. The identification of casualties requiring expert treatment by specialist teams must also be considered.

0326. At this level, in the presence of mass casualties, the P1 Hold (T4) category will represent:

- Cases whose survival is uncertain.
- Cases who require prolonged surgery, who must wait until time and facilities are available.
- Major burns cases who are kept for 48 hours prior to transfer to a specialist burns team.

0327. When there are many casualties, the expedient of the greatest good of the greatest number must prevail.

### Summary

- Triage is the sorting of casualties into orders of priority for treatment and evacuation. The triage process is dynamic and needs reassessment throughout the casualty evacuation chain. It will be coloured by doctrinal and organisational factors which affect time between and location of, medical echelons in the chain. Even when faced with large numbers of casualties, the A B C routine must be followed in order to identify life-threatening problems and indicate priorities.
- The principles of management of the injured remain as primary survey, resuscitation, secondary survey and definitive care, albeit that the last two may be carried out at a more rearward echelon. The philosophy of treatment for large numbers of casualties is:
  - To evacuate rearwards all those who can withstand the journey.
  - To address the medical resources towards those who have the best chance of survival.

*This is achieved through effective and efficient triage.*

## CHAPTER 4 AIRWAY MANAGEMENT AND VENTILATION

### Aim

0401. On successfully completing this topic you will be able to:

- Recognize those conditions causing airway and breathing difficulty in the battlefield casualty.
- Discuss the principles of airway and ventilatory management.
- Demonstrate basic and advanced methods of airway management.

### Anatomy and Physiology of the Airway

0402. The upper airway consists of the nose, mouth and pharynx. The lower airway

consists of the larynx, trachea and lungs. An open airway allows air (containing oxygen) to enter the lungs, oxygenate the blood, which is then carried to the tissues. A reduction in oxygen levels in the blood or tissues, is termed hypoxia. Tissue hypoxia causes cell damage and, if prolonged, can lead to organ failure and death. Some organs are more sensitive to hypoxia than others. For example, cerebral hypoxia even for a short period of time will cause agitation, then a decreased level of consciousness and eventually, irreversible or fatal brain damage.

0403. Carbon dioxide is produced by cellular metabolism and carried in the blood to the lungs; it is then exhaled. If there is airway obstruction, there is a build up of carbon dioxide in the blood (hypercarbia). This causes drowsiness.

***Supplementary oxygen must be administered to all seriously injured battle casualties as early as possible in the evacuation chain.***

0404. Obstruction to either the upper or lower airway can compromise ventilation of the lungs and quickly result in cerebral hypoxia. *Management of the upper and lower airway is the first concern in any battlefield casualty.*

***The airway must be opened, maintained and protected, with ventilatory support provided if necessary.***

### Airway and Breathing

0405. Early preventable deaths from airway problems after injury are frequently due to:

- Failure to recognize the urgent need for intervention in casualties with a compromised airway.
- Limited experience in airway clearing skills.
- Faulty judgement in selecting the correct airway manoeuvre.
- Failure to secure the airway prior to evacuation.
- Becoming distracted by less urgent problems.

### Awareness

0406. Particular problems that will endanger the airway:

- Head injury with decreased level of consciousness (see paragraph 0822).
- Other causes of decreased level of consciousness (poisoning, alcohol, low oxygen, carbon monoxide).
- Maxillofacial injuries:
  - Mid face fractures can move backwards and block the airway.
  - Mandible fractures can allow the tongue to fall backwards.
  - Bleeding and secretions caused by these injuries can block the airway.
- Injuries to the neck:

- Direct trauma to the larynx and supporting structures.
- Bleeding inside the neck compressing the hypopharynx or trachea.
- Burns to the face and neck:
  - Swelling of the upper and lower airway due to direct burns or inhaling hot smoke, gases or steam, will cause airway obstruction.

0407. Airway problems may be:

- *Immediate* (block the airway quickly) or,
- *Delayed* (come on after a time delay - minutes or hours) or,
- *Deteriorate with time*; this is often insidious because of its slow progression and is easily overlooked.

0408. An airway that has been cleared may obstruct again if the casualty's level of consciousness decreases, there is further bleeding into the airway or there is increasing swelling in or around the airway.

#### Recognition

0409. **Talk** to the casualty! Failure to respond implies an altered level of consciousness with the potential for airway compromise. A positive appropriate reply in a normal voice indicates that the airway is patent, breathing normal and brain perfusion adequate. Any inappropriate or incomprehensible response may suggest airway or breathing compromise, or both.

0410. **Look** to see if the casualty is agitated, drowsy or cyanosed. The absence of cyanosis does not mean the casualty is adequately oxygenated.

**Remember that a casualty who refuses to lie down quietly may be trying to sit up in an attempt to keep his airway open and/or his breathing adequate.**

0411. **Listen** for abnormal sounds. Snoring, gurgling and gargling sounds are associated with partial obstruction of the pharynx. Hoarseness implies laryngeal injury. The abusive casualty may be hypoxic and should not be presumed to be merely insubordinate or intoxicated. **Total obstruction equals total silence!**

0412. **Feel** for air movement on expiration and check if the trachea is in the midline.

#### Management

0413. Management comprises:

- Clearing the obstructed airway.
- Maintaining the intact airway.
- Protecting the airway at risk.

0414. Techniques for clearing, maintaining and protecting the airway need to be modified in the trauma casualty when cervical spine injury is suspected or present. Cervical spine injury is suspected:

- In falls from a height.
- In vehicle collisions.

- When pedestrians have been hit by a vehicle.
- Where casualties have been thrown by explosions.
- In the unconscious casualty (especially where there is blunt injury above the clavicle).
- In the conscious casualty complaining of neck pain or loss of sensation or motor function in one or both arms. (see paragraph 1002-1006).

0415. Moving a casualty with bony spinal injury risks damaging the spinal cord. Ideally, these casualties should only be moved when the appropriate spinal immobilization devices are in place. (see paragraph 1007).

***In situations where there is danger to the casualty or rescuer, rapid extraction of the casualty using improvised immobilisation or none at all, will be needed.***

***Priority is CLEAR THE AIRWAY but stay safe.***

0416. Penetrating missile neck wounds that directly involve the bony cervical spine or spinal cord carry a 95% mortality. They can be ignored in terms of cervical spine protection; *get on and manage the airway!* A combination of blunt and penetrating neck injuries should be managed as for blunt injury.

#### Clearing the airway

0417. In the casualty with suspected cervical spine injury, manual inline immobilization of the cervical spine and airway clearance are carried out together. In a casualty with an altered level of consciousness, the tongue falls backwards and obstructs the hypopharynx. This obstruction can be readily corrected by the *jaw-thrust* or *chin-lift* manoeuvres. Blood and debris can be cleared by suction and finger sweeps.



Fig 4.1 Jaw-thrust

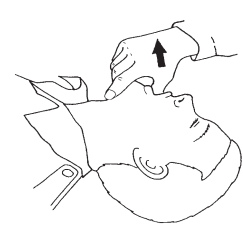


Fig 4.2 Chin-lift

0418. **Jaw-thrust.** Grasp the angles of the mandible, one hand on each side and move the mandible forward. The jaw-thrust is used for the injured casualty because it does not destabilise a possible cervical spine fracture and risk converting a fracture without spinal cord injury to one with spinal cord injury. This manoeuvre will open 95%

of obstructed upper airways. The jaw-thrust is illustrated at Fig 4.1.

0419. *Chin-lift.* Place the fingers of one hand under the chin and gently lift it upwards to bring the chin anteriorly. To open the mouth, use the thumb of the same hand to depress the lower lip slightly. The thumb may also be placed behind the lower incisors and, simultaneously, the chin gently lifted. This will open the upper airway in 70-80% of casualties. The chin-lift is illustrated at Fig 4.2.

***Make sure you do not hyperextend the neck.***

0420. *Suction.* Remove blood and secretions from the oropharynx with a rigid suction device (for example, a *Yankauer* sucker). If there is bleeding at the external nares clear this with suction. A casualty with facial injuries may also have a cribriform plate fracture; this means that suction catheters should not be inserted through the nose as they could enter the skull and injure the brain.

0421. *Finger sweeps.* Finger sweeps into the back of the mouth and pharynx may be useful for dislodging foreign bodies, particularly if no suction device is available.

***Make sure that your fingers do not inadvertently push foreign bodies further into the airway.***

0422. *Displacement of fractured maxilla or mandible.* Where airway obstruction results from a fractured maxilla, insert the index or middle finger or both, through the mouth behind the hard palate and pull it forward to disimpact the displaced bone. When an anterior mandibular fracture allows the tongue to fall back into the hypopharynx you may have to pull the mandible forward manually.

*Maintaining the airway*

0423. How to maintain the casualty's airway will depend on:

- The casualty's injuries.
- The casualty's level of consciousness.
- The equipment available.

0424. Clearing the casualty's airway may result in his level of consciousness improving and being able to maintain his own airway.

0425. If the casualty cannot maintain his own airway you (or an assistant) need to

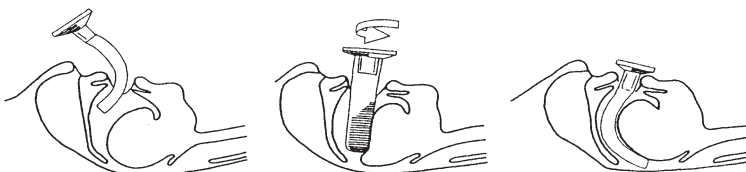


Fig 4.3 Nasopharyngeal airway

continue with the jaw-thrust or chin-lift or try using an oropharyngeal airway or nasopharyngeal airway.

0426. *Oropharyngeal airway.* The oropharyngeal airway (Guedel type) is inserted into the casualty's mouth over the tongue. It stops the tongue falling back and provides a clear passage for air flow. The preferred method is to insert the airway concavity upwards until the tip reaches the soft palate and then rotate it 180°, slipping it into place over the tongue (see Fig 4.3).

***Make sure that the airway does not push the tongue backwards as this will block rather than open the airway.***

0427. A casualty with a gag reflex may reject the oral airway. If so, move on to the nasopharyngeal airway.

0428. *Nasopharyngeal airway.* A nasopharyngeal airway can be used when

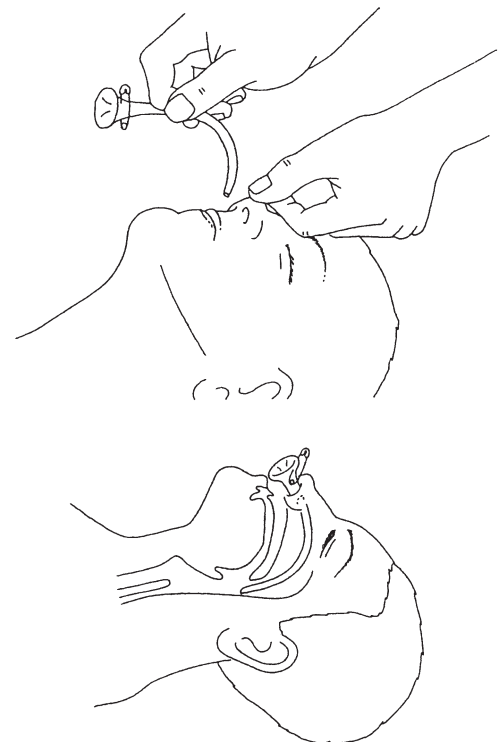


Fig 4.4 Nasopharyngeal airway

there is oral injury, a fractured mandible or masseter spasm. It is better tolerated than the Guedel by the more responsive casualty and is less likely to be dislodged during evacuation (see Fig 4.4). A suspected fractured base of skull is not a contraindication for use of this airway if an oropharyngeal airway cannot be inserted.

0429. Lubricate the airway and insert it through either nostril, straight backwards - not upwards - so that its tip enters the hypopharynx. A safety pin should be applied across the proximal end before insertion to prevent the tube disappearing into the casualty's airway. If this happens it could compromise rather than maintain the airway. A complication of inserting the

nasopharyngeal airway is bleeding from the nose. Gentle insertion, good lubrication and using an airway that passes easily into the nose will decrease the incidence of bleeding.

***The oropharyngeal and nasopharyngeal devices MAINTAIN the airway but do not protect it from aspiration.***

0430. A casualty whose airway has been cleared and maintained by the techniques described above may need help with their breathing if this is depressed due to injuries or toxic agents.

0431. Ventilation is covered at paragraphs 0446-0451 and is practised in Skill Station 1.

*Protecting the airway at risk - advanced airway techniques*

0432. Advanced airway techniques include:

- Surgical cricothyroidotomy.
- Surgical tracheostomy.
- Endotracheal intubation.

0433. Indications for performing advanced airway techniques are:-

- *Inability to clear or maintain* an airway using simple manoeuvres and airways in, for example:
  - Injury around the face.
  - Face and airway burns (causing swelling of the airway, see paragraphs 0406 and 1213).
  - An obstruction in the upper airway that cannot be removed and needs to be by-passed.
  - Neck injury or swelling blocking

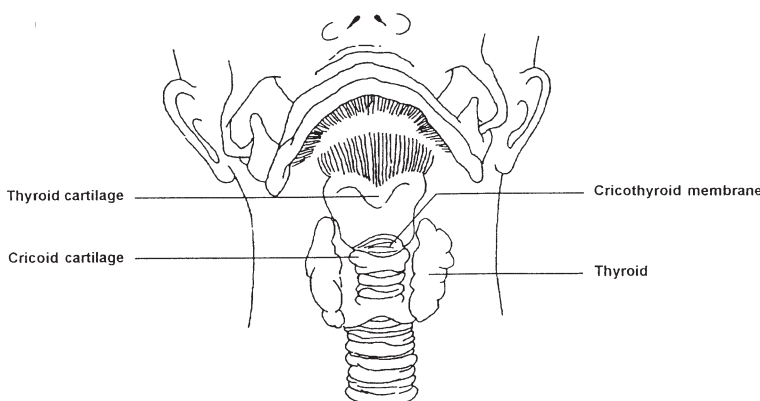


Fig 4.5 Cricothyroid membrane

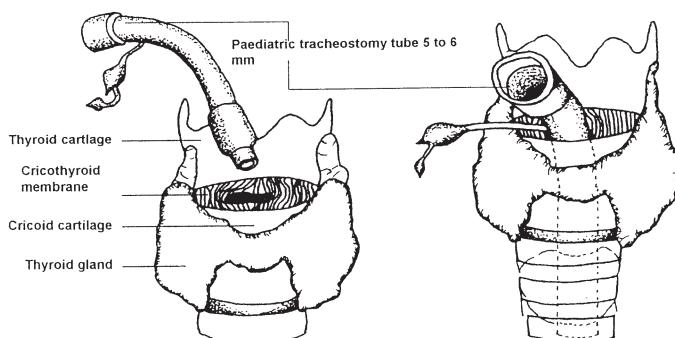


Fig 4.6 Insertion of tracheostomy tube

the lower airway.

- *To protect the airway* from:
  - Obstruction due to swelling.
  - Aspiration of gastric contents or other fluid. (*Note:* A cuffed endotracheal tube or cuffed surgical airway maintains a clear passage and the cuff provides a seal).
- To allow accurate control of oxygenation and ventilation.
- As part of head injury management by helping to control oxygen and carbon dioxide levels in cerebral blood flow (see Chapter 8):
- In the management of some chest injuries.
- In surgery and anaesthesia.

**DEFINITIVE AIRWAY**

***This is a cuffed tube placed in the trachea by the surgical route or by endotracheal intubation.***

**SURGICAL AIRWAY**

0434. A surgical airway is used when:

- A casualty needing a definitive airway for resuscitation or evacuation is too awake to tolerate endotracheal intubation without the use of anaesthetic drugs.
- Trauma to the face and neck make endotracheal intubation impossible.
- A casualty with face and neck burns requires airway protection to pre-empt delayed obstruction but expert anaesthetic help is unavailable to carry out endotracheal intubation.

*Surgical cricothyroidotomy*

9435. Surgical cricothyroidotomy places a tube into the trachea via the cricothyroid membrane (See fig 4.5). A small tracheostomy tube (5-7 mm) is suitable. This will be practised in skill station 2 and is illustrated in Fig 4.6. During the procedure, appropriate cervical spine protection must be maintained when indicated. There are also commercially available cricothyroidotomy sets in use with some NATO armies. A cricothyroidotomy can be replaced by a formal tracheostomy (if needed) at a later time.

*Emergency tracheostomy*

0436. A formal surgical tracheostomy takes longer and is more difficult, than a surgical cricothyroidotomy. Commercial sets are available for rapid tracheostomy using a Seldinger (guide wire) technique.

*Endotracheal intubation*

0437. This technique uses a laryngoscope to visualise the vocal cords. A cuffed endotracheal tube is placed through the vocal cords into the trachea. This skill is illustrated at Fig 4.7 [shown in Skill Station 2] and will be practised in the Skill Station.

0438. At Role 1 and Role 2, in the absence of anaesthetic skills and drugs, endotracheal intubation will only be achieved in deeply unconscious casualties (GCS 4 or less). Attempting intubation in the semiconscious casualty will result in gagging on the laryngoscope and coughing on the endotracheal tube. In casualties with raised intracranial pressure this will increase the pressure even further and worsen the situation. If the casualty gags or coughs, *stop* and try another method of airway management.

*Note:* This presents a dilemma with head injuries in coma (GCS 8 or less). Ideally these casualties should be intubated and ventilated to prevent cerebral hypoxia and hypercapnia worsening. In many of them, attempting to do this without the aid of anaesthetic drugs worsens the situation by raising ICP. A surgical airway with ventilation and oxygenation may be required.

0439. In casualties who are not deeply unconscious, maintain the airway with simple techniques. If protection is necessary, insert a surgical cricothyroidotomy under local anaesthesia.

0440. Where anaesthetic skills and drugs are available or can be brought to the casualty by an Incident Response Team (IRT), endotracheal intubation can be achieved using:

- Rapid sequence induction of anaesthesia with:
- Application of cricoid pressure (Sellick's manoeuvre) and,
- Maintenance of cervical spine immobilisation when indicated.

0441. *Intermittent oxygenation during difficult intubation.* Intubation of the hypoventilating or apnoeic casualty may require several attempts and even then, may not be successful. If oxygen is available, you must avoid prolonged efforts to intubate without intermittently oxygenating and ventilating the casualty. You should practise taking a deep breath when starting an attempt at intubation; if you have to take further breath before successfully intubating the casualty, abort the attempt.

0442. Correct placement of the endotracheal tube is checked in Skill Station 2. The main points are:

- See if the endotracheal tube has passed between the vocal cords. Remember to maintain immobilisation of the cervical spine when indicated.
- Listen on both sides in the mid-axillary line for equal breath sounds.
- Listen over the stomach for gurgling sounds during assisted ventilation for evidence of oesophageal intubation.
- Feel and listen for air movement at the proximal end of the tube if the casualty is breathing spontaneously.
- Monitor end-tidal carbon dioxide levels if equipment is available.

- If in doubt about the position of the endotracheal tube, take it out and oxygenate the casualty by another method.

***It is failure to oxygenate the casualty that kills, not inability to intubate.***

***If you need to take over care of an intubated casualty make sure the endotracheal tube is in the correct place and has not moved during evacuation or transfer of the casualty.***

*Note:* Other methods for maintaining the airways. Both the laryngeal mask airway and combitubes have been used in civilian practice to manage the trauma casualty's airway. Their role in military trauma has still to be evaluated.

## Oxygenation and Assisted Ventilation

### *Oxygenation*

0443. The primary goal in providing supplementary oxygen is to maximise the delivery of oxygen to the cells. This is done by providing the highest possible oxygen concentration to the lungs using high flow oxygen at 10-15 litres per minute, as soon as oxygen is available. A disposable face mask without a reservoir bag can deliver 35-60% oxygen, depending on type of mask and oxygen flow. A face mask with an oxygen reservoir can be used to deliver up to 85% oxygen. A correctly fitting bag-valve-mask system with a reservoir, can be used to deliver up to 100% oxygen to the lungs.

### *Ventilation*

0444. Spontaneous ventilation (self ventilation) means the same as breathing. Assisted (artificial) ventilation means the casualty is receiving help with breathing. The aim is to improve gaseous exchange in the lungs and to breathe for the casualty if spontaneous ventilation has stopped or is inadequate. Indications for assisted ventilation include:

- Head injury.
- Chest injury.
- Respiratory depression due to drugs (such as nerve agents and opiates).

0445. Assisted ventilation can be achieved by the following techniques:

- Mouth to mouth (or nose).
- Mouth to mask.
- Bag-valve-mask.
- Bag-valve-endotracheal tube or surgical airway.
- Automatic ventilation (used by specialist resuscitation teams in field hospitals for prolonged casualty ventilation).

0446. Assisted ventilation is described in Skill Station 1 and will be practiced there.

0447. *Mouth to mouth (one man) technique.* If a pocket mask with a one-way

valve and oxygen inlet is not available, you can give assisted ventilation by removing the mask from the bag-valve-mask device and blowing into the connecting port.

*Note:* Do not use the mouth to mask technique if there is a *chemical agent vapour hazard* either in the environment or on the casualty.

0448. *Bag-valve-mask.* This technique can be performed one or two handed and is best performed with an oral or nasal airway in place.

0449. *Bag-valve-endotracheal tube/surgical airway.* The technique you will use will depend on the circumstances and equipment available. If a manual bag-valve-endotracheal tube/surgical airway technique is used, the bag is squeezed to achieve obvious chest movement at a rate of approximately 12-15 breaths per minute, that is, one second squeeze - three to four seconds release. An oxygen source and a reservoir should be attached to the bag as soon as they are available.

### Evacuation of Airway Compromised Casualties

0450. Casualties who have lost their normal protective airway reflexes are in danger of aspirating gastric contents, blood and debris and developing airway obstruction; they become hypoxic.

Caring for and monitoring a casualty in the back of military vehicles or helicopters can be difficult, especially in low light conditions. A balance has to be made between:

- The need to move the casualty.
- The safety of the casualty during evacuation.
- The resources available to move the casualty.
- Distance for evacuation.
- The tactical situation.

***If available, seek specialist advice from hospital teams, aeromed teams or incident response teams.***

The casualty with a definitive airway in place  
0451. Best practice is that they are evacuated by trained personnel with appropriate anaesthetic and intensive care skills and electronic monitors. If there is concern about the ability to care for an intubated casualty (for example, replacing a displaced endotracheal tube) during evacuation, consider providing a definitive surgical airway. In casualties being evacuated by air, inflate the cuff with saline; air expands at altitude.

The casualty at risk from aspiration but a definitive airway cannot be provided

0452. Maintain the airway with a Guedel or nasopharyngeal airway and transfer the casualty in the lateral position with an escort who has oxygen, suction and can care for the casualty en route. Continue cervical

spine immobilization as can best be managed but airway management takes precedence.

***Unconscious casualties without a definitive airway must not be transferred lying on their backs.***

The casualty at risk from airway blocking during transfer.

0453. Where the casualty's airway is at risk from blocking during transfer, for example, airway burns:

- Get specialist advice.
- Consider providing a surgical airway, or endotracheal intubation if anaesthetic expertise is to hand.

*Note:* On balance, a surgical airway is the method of choice. It may be difficult in the extreme incising through burnt skin. Aim not to go through burnt skin but, your prime concern is to protect the airway during casualty transfer!

### Summary

- Airway obstruction must be recognised and relieved quickly.
- Beware of cervical spine injury during airway management.
- Start with simple techniques such as jaw-thrust/chin-lift/oropharyngeal suction.
- Try Guedel or nasopharyngeal airways.
- Give high flow oxygen from a mask with a reservoir.
- Definitive airways protect against aspiration of gastric contents and blood.
- Definitive airways include:
  - Surgical cricothyroidotomy.
  - Endotracheal intubation.

*Note:* Choice of definitive airway will depend on skills and equipment available:

- Casualties with inadequate respiration will need assisted ventilation.
- This can be done by mouth, by bag and mask or by automatic ventilators.

### SKILLS STATIONS:

1. Basic Airway Management and Ventilation
2. Advanced Airway Management: Adult Orotracheal Intubation

### Aim

The aim of these skills stations is to demonstrate and practise basic and advanced airway management. You will also discuss the indications for oral endotracheal intubation and associated complications.

On successfully completing these stations, you will be proficient in:

- Basic airway clearing techniques.
- Oropharyngeal airway insertion.
- Nasopharyngeal airway insertion.
- Ventilation without intubation.
- Orotracheal intubation.

## Equipment

Adult intubation manikins.
Adult endotracheal tubes size 7.0, 8.0 and 9.0.
Laryngoscope handles.
Laryngoscope blades, adult, curved.
Extra batteries for laryngoscope handles.
Extra laryngoscope bulbs.
Stethoscopes.
Lubricant (for example, silicone spray that accompanies intubation manikin).
Semi-rigid cervical collar applied to one adult intubation manikin, or sandbags.
Magill's forceps.
Malleable endotracheal introducers.
Oropharyngeal airways size 2, 3 and 4.
Nasopharyngeal airways size 6.0 and 7.0.
Bag-valve-mask devices.
Pocket face masks (with a one-way valve to prevent back-flow of air and secretions).
Rigid suction devices (Yankauer sucker).
Safety pins.
Scissors.
1" open weave cotton bandage.

### SKILLS STATIONS 1 BASIC AIRWAY MANAGEMENT AND VENTILATION

#### Aim

This skill station allows you to practice basic airway techniques and develop a system for airway management.

The order for performing tasks will depend on the situation, the personnel available and their skills. Some tasks will be done simultaneously if more than one person is available.

This skill station assumes there is an assistant to help you.

#### Sequence of actions:

- Approach and reassure casualty. React to the casualty's response.
- Provide manual inline immobilisation of the cervical spine when indicated.
- Hand over manual inline immobilisation to your assistant (get them to place their hands over yours then gently remove your hands as they apply immobilisation). If assistance is not available your sole aim is to *clear the airway*.
- Clear the airway using:
  - Finger sweeps to remove solid debris (if safe to do so).
  - Magill forceps to remove solid debris.
  - Yankauer sucker to remove blood and fluid from the oropharynx.
  - Jaw-thrust.
  - Chin-lift.
- Provide high flow oxygen from a mask with a reservoir bag.
- Decide if the casualty needs an oropharyngeal or nasopharyngeal airway.

*Airway management in the casualty with a fractured maxilla.*

- Using the Mr Hurt manikin with maxillary fractures, practice pulling the fracture forward to clear the airway.

*Airway management in the casualty whose head is not in the neutral position.*

- Gently move the casualty's head into the neutral position if the airway cannot be cleared and maintained in the non-neutral position.
- Stop moving the head if:
  - There is resistance to movement.
  - The casualty complains of pain.

Airway management in the combative casualty who will not accept sand bags and tape

- Compromise by using a semi-rigid cervical collar only.

#### Oropharyngeal Airway Insertion

- Select the correct sized airway. Place the airway against the casualty's face. The correct sized airway will extend from the centre of the casualty's mouth to the angle of the jaw.
- Open the casualty's mouth with the chin-lift manoeuvre.
- Insert the tip of the airway along the roof of the mouth to the soft palate (see fig 4.3).
- Rotate the airway 180°, directing the concavity of the airway towards the feet and slip the airway over the tongue.
- If necessary, ventilate the casualty with mouth-to-mask or bag-valve-mask technique.

#### Nasopharyngeal Airway Insertion

- Assess the nasal passages for any apparent obstruction (fractures, haemorrhage, polyps). Choose a nostril that is patent.
- Select the correct size airway. Size 7 for the adult female and size 8 for an adult male.
- Insert the safety pin across the nostril end of the airway.
- Lubricate the nasopharyngeal airway with a water-soluble lubricant or water.
- Insert the tip of the airway into the nostril and direct it posteriorly and towards the ear lobe.
- Gently slide the nasopharyngeal airway through the nostril into the hypopharynx with a slight rotating motion until the flange rests against the nostril.
- If an obstruction is encountered try the other nostril or try a smaller nasopharyngeal airway. *Trying to force the nasopharyngeal airway past an obstruction may cause severe bleeding.*
- If necessary, ventilate the casualty with mouth-to-mouth or bag-valve-mask technique.

## Ventilation Without Intubation

Mouth-to-mask ventilation, adult (one man technique)

- Attach oxygen tubing to the Laerdal pocket mask.
- Adjust the oxygen flow rate to 10 litres per minute.
- If there is no oxygen inlet, place the oxygen tubing under the side of the mask.
- Insert an oropharyngeal airway.
- Apply the face mask to the casualty using both hands.
- Open the airway using the jaw-thrust manoeuvre, three fingers on the underside of the jaw.
- Take a deep breath and place your mouth over the mouth port and blow.
- Assess the ventilatory efforts by observing the casualty's chest movement.
- Ventilate the casualty in this manner every five seconds.

*Bag-valve-mask ventilation, adult (two man technique)*

- Select the correct sized mask to fit the casualty's face.
- Connect the oxygen tubing to the bag-valve device and adjust the flow of oxygen to 10 litres per minute.
- Ensure the patency of the casualty's airway.
- The first person applies the mask to the casualty's face, making a tight seal with both hands.
- The second person ventilates the casualty by squeezing the bag with both hands.
- Assess the adequacy of ventilation by observing the casualty's chest movement.
- Ventilate the casualty in this manner every five seconds.

*Bag-valve-mask ventilation, adult (one man technique)*

- Follow the first three steps for the two man technique.
- Use one hand to apply the mask to the casualty's face. Use the index finger and thumb to hold the mask in place and use the other fingers to perform a jaw-thrust. Squeeze the bag with the other hand and ventilate as before.

### SKILLS STATIONS 2 ADVANCED AIRWAY MANAGEMENT ADULT OROTRACHEAL INTUBATION

#### Aim

This skill station allows you to practice adult orotracheal intubation (see Fig 4.7). It also helps you to develop systems to substitute manual immobilization by using a cervical collar, sandbags and tape, and check that the endotracheal tube is correctly placed.

*Sequence of actions:*

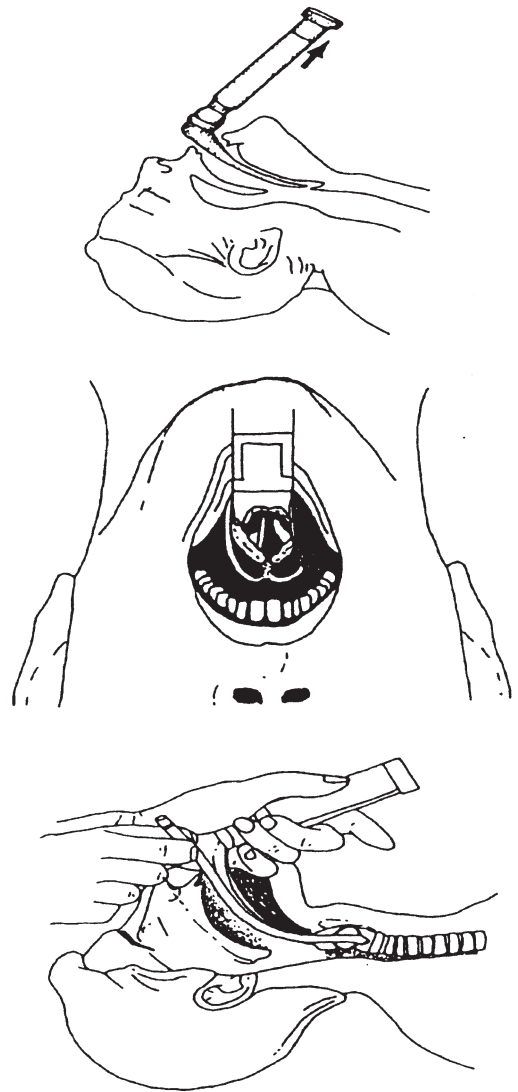


Fig 4.7 Endotracheal tube insertion.

- Ensure that adequate ventilation and oxygenation are in progress.
- Connect the laryngoscope blade and handle; check the bulb for brightness, also check both small and larger endotracheal tubes are to hand, their cuffs are working and the suction is working.
- If indicated, have an assistant manually immobilize the head and neck.
- If indicated, have an assistant apply cricoid pressure.
- Hold the laryngoscope in the left hand.
- Insert the laryngoscope into the right side of the casualty's mouth, displacing the tongue to the left.
- Look for the epiglottis and place the tip of the blade in the vallecula. Lift the epiglottis forward by pulling the handle of the laryngoscope forward and visualize the vocal cords.
- Gently insert the endotracheal tube into the trachea without applying pressure to the teeth or oral tissues.
- Check the placement of the endotracheal tube by bag-valve tube ventilation.
- Inflate the cuff with enough air to provide a gas-tight seal.

- Visually observe lung expansion with ventilation.
- Attach end-tidal CO<sub>2</sub> monitoring if available.
- Auscultate the chest with a stethoscope in both axillae and over the abdomen to check that the tube is not in a main bronchus (usually the right) or in the oesophagus.
- If endotracheal intubation requires several attempts, discontinue and ventilate the casualty between each attempt with a bag-valve-mask device. You should practice taking a deep breath when starting an attempt at intubation. If you have to take a further breath before intubation is achieved, abort the attempt (at intubation) and ventilate the casualty.
- Remember that the best way to ensure that the tube is not in the oesophagus is to see it lying between the vocal cords.
- Allow cricoid pressure to be released when correct endotracheal tube placement is confirmed and the cuff is inflated.
- Fix the tube in position by tying it with an open weave cotton bandage.
- Reapply cervical spine immobilisation.
- Consider placing a Geudel airway in the casualty's mouth next to the endotracheal tube to help stabilise the tube's position and to protect it by acting as a bite block.

- Scalpel handle with blades.
- Small artery forceps.
- Tracheal dilating tongs.
- Cuffed tracheostomy tubes size 6.0 with connector.
- Lignocaine 1% (20 ml) with adrenaline.
- Syringes 5 ml.
- Blue needles 23 gauge.
- Scissors.
- Swabs.
- Sharps disposable boxes.
- Plastic rubbish bag.
- Anatomical models.

*Complications of orotracheal intubation*

- Hypoxia from:**
- Prolonged attempts to intubate.
  - Unrecognised oesophageal intubation.
  - Aspiration of gastric contents during attempts to intubate.
- Damage to the cervical spinal cord if the neck has not been immobilized when there is an unstable neck fracture.
- Pushing the tube too far down into one of the main bronchi (usually the right).  
The unintubated lung does not get ventilated and eventually collapses.
- Rupture or leak of the endotracheal tube cuff, resulting in loss of seal during ventilation and necessitating re-intubation.
- Airway haemorrhage secondary to injury.
- Damage to the larynx.
- Chipping or loosening of the teeth (caused by levering the laryngoscope blade against the teeth).

**SKILLS STATIONS 3  
SURGICAL AIRWAYS**

**Aim**

The aim of this skills station is to give you the opportunity to practise and demonstrate the technique of surgical cricothyroidotomy on anatomical models.

The instructor will also demonstrate needle cricothyroidotomy and oxygen insufflation.

**Equipment**

- Procedure gloves and disposable aprons.
- Medicut IV cannulae 12 gauge.
- Bag-valve-mask devices.
- Oxygen tubing and Y-connector.
- Full oxygen cylinders with flow meters.

*Role of jet insufflation of oxygen via needle cricothyroidotomy*

This technique has only very limited application on the battlefield but may have a role in the field hospital (see Fig 4.8). A 12 or 14 gauge cannula is inserted over a needle through the cricothyroid membrane (needle cricothyroidotomy) and oxygen insufflated into the lungs under pressure. This technique can be done without an insufflator by attaching the cannula to oxygen running at 15 litres per minute. A Y-connector or side hole is incorporated into the connector tubing. Occluding the open end of the Y-connector or side hole one second in every five, forces a stream of oxygen into the trachea. Without a proper insufflator, this technique will only be effective in casualties with normal pulmonary function in the absence of significant chest injury. A casualty with little or no ventilatory effort will not be adequately oxygenated using the Y-connector/side hole technique in the absence of an insufflator.

Because the chest wall in children is more elastic than in adults, a needle cricothyroidotomy attached to high flow oxygen is a useful technique to achieve oxygenation prior to tracheostomy in an emergency (See supplement No 1). The risks of barotrauma, including lung rupture and tension pneumothorax, are high if the technique is not applied with great care.

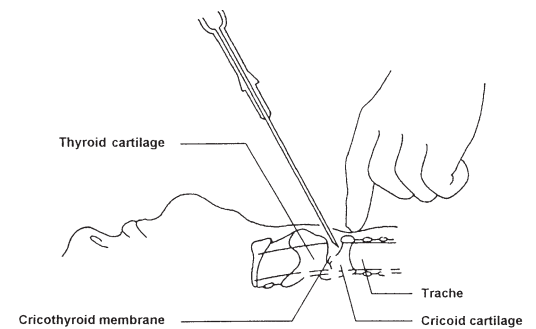


Fig 4.8 Needle cricothyroidotomy

**Surgical Cricothyroidotomy**

- Place the casualty supine with the neck in the neutral position. If not contraindicated, extend the neck and place a sandbag (or suitable alternative)

- under the shoulders; this will bring the landmarks into more prominence. Palpate the thyroid notch and cartilage, cricothyroid membrane and cricoid cartilage.
- Clean the skin and infiltrate with local anaesthetic (unless the casualty is deeply unconscious). This is illustrated at Fig 4.9.

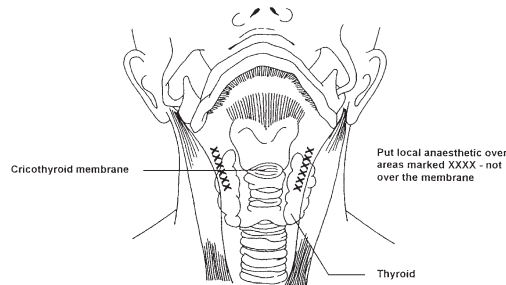


Fig 4.9 Surgical cricothyroidotomy

- Stabilise the thyroid cartilage with the left hand.
- Make a horizontal skin incision over the cricothyroid membrane.
- Carefully incise through the membrane horizontally.
- Insert the scalpel handle into the incision

and rotate it 90° to open the airway. (You can use artery forceps instead of the scalpel handle).

- Insert a 6 mm cuffed tracheostomy tube into the cricothyroid membrane incision, directing the tube distally into the trachea.
- Inflate the cuff.
- If spontaneous breathing does not occur, ventilate the casualty.
- Observe lung inflations and auscultate the chest for adequate ventilation.
- Secure the tube by stitch or tape, or both.

#### Complications of surgical cricothyroidotomy

Creation of a false passage into the tissues.

Asphyxia.

Aspiration (for example, blood).

Laceration of the trachea.

Laceration of the oesophagus.

Haemorrhage or haematoma formation.

Mediastinal emphysema.

Subglottic stenosis/oedema.

***The Professor of Military Surgery wishes to thank the Technical Author for his assistance with this project.***