

52.1 The general method for airway obstruction

If a patient survives his original injury, the next hazard that he has to overcome is obstruction to his airway. Making sure that he can breathe must thus be your first priority. He is in particular danger if: (1) He is unconscious from a head injury (63.1) which depresses his cough reflex and causes him to lose control of his tongue and jaw. (2) His face, mouth, mandible, or neck has been injured (62.1). (3) His face or his respiratory tract has been burnt (58.27). (4) Rarely, his larynx or trachea may be injured (52.4). *The most important single measure in preventing airway obstruction is to make sure that a patient is transported in the recovery position (51-2).* After this, the next methods are those which are also used to prevent obstruction during anaesthesia. These are described in Section 4.2 of *Primary Anaesthesia*, and are shown in Fig. 52-1. Most of them are quick, and if one does not succeed, try the next one rapidly. The earlier ones are almost always enough. If they fail, and a patient is conscious or partly conscious, try 'awake intubation'. This is safe, it will not unduly distress him, and it is not practised as often as it should be. Laryngotomy and tracheostomy are rarely needed, but, when a patient does need them, he needs them urgently to save his life. *You should find yourself intubating patients frequently, but doing a laryngotomy or tracheostomy only rarely. They are difficult to manage.*

NEVER REFER A PATIENT WITH AN INSECURE AIRWAY

THE GENERAL METHOD FOR AIRWAY OBSTRUCTION

DIAGNOSIS Try to diagnose that a patient's airway is obstructed early. Watch for noisy breathing, restlessness and confusion, cyanosis of his mucous membranes (often a difficult sign to detect), sweating and hypertension (caused by carbon dioxide retention), a fast pulse (later becoming slow as his myocardium fails), forceful movements of his chest wall, and intercostal and subcostal indrawing.

If he makes wet bubbling sounds, there is fluid in his respiratory tract, which needs removing.

If he has respiratory stridor, his larynx is probably obstructed.

If he has to-and-fro stridor, his trachea is probably obstructed.

CAUTION! Airway obstruction can be completely silent.

PREVENTION Make sure that the ambulance men transport him in the recovery position (A, Fig. 52-1).

THE TREATMENT OF AIRWAY OBSTRUCTION

Extend the patient's neck and draw his jaw forwards (B, Fig. 52-1). Remove pieces of vomit or foreign bodies from his pharynx with your finger (C). Insert an oropharyngeal airway (D).

If he is noisy, restless, and is struggling for breath, you can intubate him while he is still awake or partly conscious as described below (E).

If he is unconscious, you can intubate him as if he were anaesthetized (A 13.2).

CAUTION ! (1) If you suspect that a patient has a spinal injury, extending his neck to pass a tracheal tube may injure his spinal cord if you are not careful. Fortunately, most cervical spine injuries are flexion ones, and the little extension or even the neutral position required for intubation is not dangerous—provided you remember to avoid too much extension. (2) Nasotracheal intubation is more difficult, and there will not be a cuff on the tube.

If intubation fails or is impractical, do a laryngotomy with a needle (F), or a knife (G), or do a tracheostomy (H). Unfortunately, a temporary laryngotomy is difficult to manage.

If a patient has a maxillofacial injury (62.1), you may need to pull his tongue forward with forceps or a stitch (I), or pass a nasotracheal catheter (J), or give him a nasotracheal airway (K), or apply a postnasal pack (L). Sometimes he may need bronchoscopic aspiration (M).

THE AWAKE INTUBATION OF A SEVERELY INJURED PATIENT

SEDATION If a patient is conscious, give him an opioid, intravenously or intramuscularly. The intravenous morphine that he may already have had may be enough. If he is moribund, no sedation is necessary.

METHOD If possible, and especially if a patient is not fully conscious or is a child, try to intubate him without using a

TREATING AIRWAY OBSTRUCTION

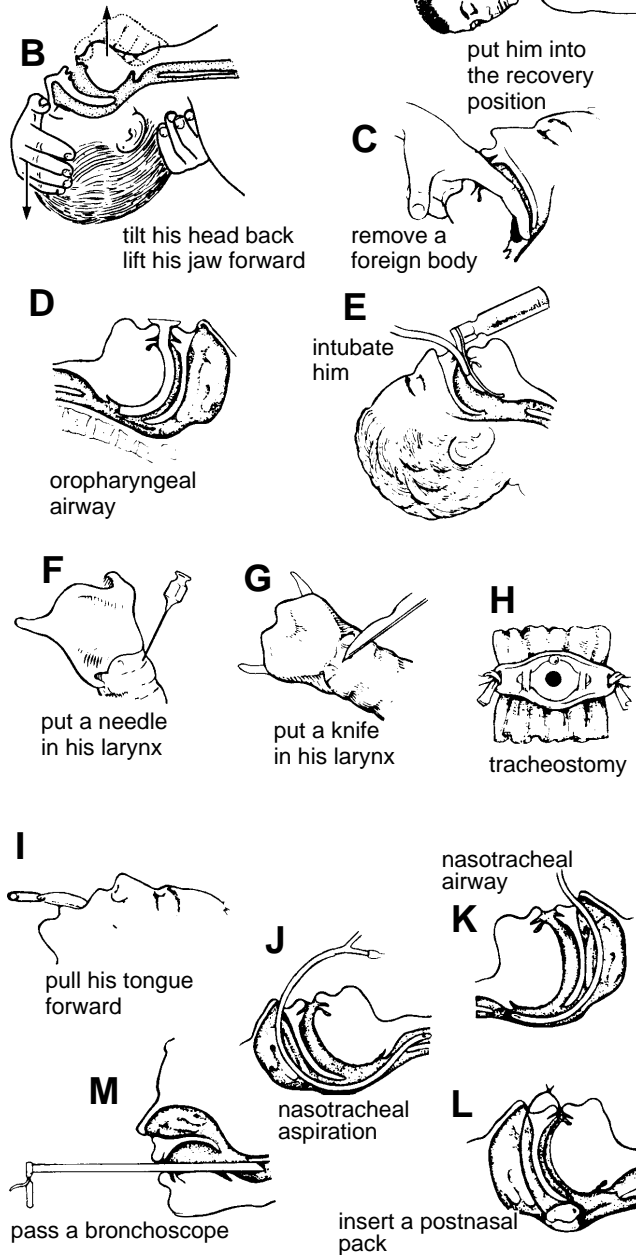


Fig. 52.1: METHODS FOR AIRWAY OBSTRUCTION. Try the earlier and easier methods first. After Naclerio, by kind permission of Grune and Stratton.

local anaesthetic. This will take some minutes to act, and will delay the return of his protective reflexes.

If necessary, draw 5 ml of 4% lignocaine into a syringe and needle. Ask him to open his mouth and spray 1 to 1.5 ml of solution onto and over the back of his tongue.

Ask him to close his eyes and breathe deeply. Reassure him, and then gently introduce a well lubricated laryngoscope over his tongue until you see the tip of his epiglottis. Then spray a further 1 to 1.5 ml of solution onto it.

When you see his vocal cords, spray the remaining 2–3

A TRACHEOSTOMY SET

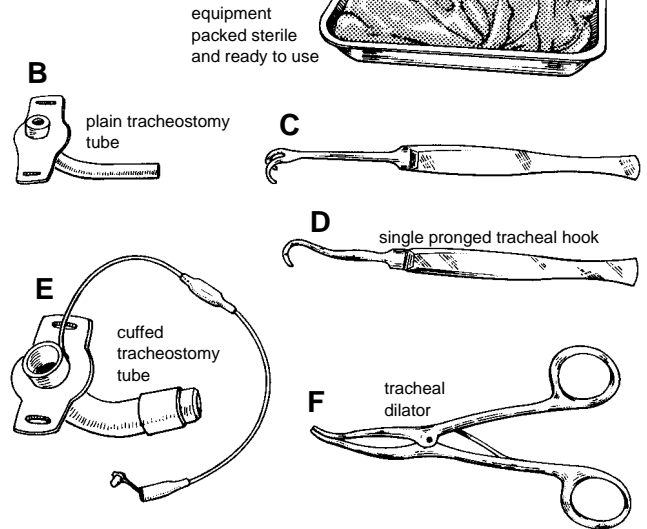


Fig. 52.2: A TRACHEOSTOMY SET. Always have this ready and sterile. You may need it in a hurry.

ml into his upper larynx and between his cords.

When his cords are widely abducted, pass the tracheal tube into his trachea and inflate the cuff. He will cough a little, but he will soon tolerate the tube. With his airway isolated, you can, if necessary, induce him intravenously.

CAUTION! Don't let a patient's tracheal tube remain in place for more than 48 hours with the cuff inflated. Deflate the cuff as soon as is safe, or it will ulcerate his tracheal mucosa. Tracheal tubes vary, and you can leave some in longer than others. Even if you have been successful in intubating him, he may still need a tracheostomy later.

IF YOU CANNOT INTUBATE, DO A LARYNGOTOMY. DON'T LET A TRACHEAL TUBE STAY IN PLACE MORE THAN 48 HOURS

52.2 Laryngotomy and tracheostomy

If a patient's respiration is obstructed and you cannot relieve it by simpler methods or by intubation, you may occasionally have to open his respiratory tract below the obstruction. You can enter it through his cricothyroid membrane, or his trachea.

As a useful emergency method, you can pass two or more large (1.5 mm) short needles through his cricothyroid membrane, whatever age he is. In an adult (but not in a child) you have the additional possibility of opening his cricothyroid membrane (laryngotomy) with a sharp knife. If necessary, you can do this in 30 seconds or less—it may be so urgent that you do not have time to sterilize the knife. As an emergency procedure in an adult this is simpler and safer than the other alternative, which is an emergency tracheostomy. Permanent impairment of the patient's voice or airway is unusual after a laryngotomy. But it is a temporary procedure only, so he will need a formal tracheostomy later.

If possible anticipate the need for an emergency tracheostomy and do it as an elective procedure under local anaesthesia, ketamine, or tracheal anaesthesia. It will: (1) Provide immediate relief for a patient's upper airway obstruction. (2) Reduce his dead space by 100 ml and nearly double his alveolar ventilation. (3) Provide an opening through which you can suck out secretions. (4) Provide him with an airway that can be continued indefinitely.

But, a tracheostomy will also: (1) Greatly diminish the effectiveness of his cough reflex. (2) Short circuit the humidifying effect of his upper respiratory tract, and so dry his tracheal mucosa and make his bronchial secretions more viscid. (3) Make infection of his lower respiratory tract much more likely, so careful aseptic procedures are essential. (4) Occasionally cause severe bleeding. (5) Carry the risk of tracheal stenosis later, especially in a child.

Intubation is almost always possible, so that tracheostomy is only very rarely necessary. Only do it if: (1) Intubation fails or is unsatisfactory, and there is no other way of maintaining an injured patient's airway. Or, (2) intubation has to be prolonged for more than 48 hours. If his tracheostomy proves to be unnecessary later, you can close it. If it was necessary, you have saved his life. Even so, a tracheostomy has serious risks, especially when nursing care is poor. Here are two patients whose lives it saved.

OMARI (36) was crushed by some heavy scaffolding in a sugar works. He was dyspnoeic with paradoxical movement on the left side of his chest, which had no breath sounds and diminished vocal resonance. It was resonant anteriorly, and dull at the base posteriorly. His trachea and apex beat were shifted to the right. X-rays confirmed the diagnosis of multiple fractured ribs with a flail chest and a left haemopneumothorax.

A chest drain connected to an underwater seal was inserted in his left mid-axilla, and he was given oxygen. Much air and a litre of blood flowed into the drain bottle, but he remained distressed and cyanosed. His chest was too painful to allow him to cough. Secretions began to accumulate, so he was bronchoscoped and copious sputum sucked out. Unfortunately, bronchoscopy was too traumatic to be repeated. Further X-rays showed diffuse mottling throughout both his lung fields. A tracheostomy was done, and his trachea was repeatedly aspirated, after which his general condition improved and his cyanosis disappeared. Eight days later his tracheostomy tube was removed and 3 weeks after discharge, he returned to work.

HAMID heard a lion chasing his cows. He went out with his spear, but the lion leapt at him, biting his throat, and penetrating his larynx. He arrived in hospital at the point of death, with blood bubbling from his mouth. It obscured his oedematous distorted larynx, so that intubation was impossible. A tracheostomy was done with some difficulty under local anaesthesia. He immediately began to breathe normally. Much blood was sucked from his trachea, and blood stopped coming from his mouth. He recovered completely.

You will need tracheostomy equipment in a hurry, so have a set ready sterilized in the theatre. You will need it for other indications, besides trauma, and particularly for respiratory infections in children. Here is the equipment for it.

- **DILATOR**, tracheal, extra small for children, one only. Use this to dilate the trachea before inserting a tracheostomy tube.
- **TUBE**, tracheostomy, plain, uncuffed, reusable, with 15 mm termination, 15 Ch one, 18 Ch one, 21 Ch two, 24

Ch three, 27 Ch four, 30 Ch three, 36 Ch one, 42 Ch one one carton of 15 assorted tubes only. Traditionally a silver tracheostomy tube was used with an inner tube and obturator. Plastic ones are equally good, but they must be firm enough to hold their shape in the trachea.

- **TUBE**, tracheostomy, standard, cuffed and reusable complete with obturator and one way valve, 24 Ch two, 27 Ch two, 30 Ch two, 36 Ch two, 39 Ch one, 42 Ch one, one carton of 10 assorted tubes only.
- **RETRACTOR**, tracheostomy, single, sharp hook, blunt, one only.
- **RETRACTOR**, tracheostomy, double hook, blunt, two only. If you don't have one of these, use a Langenbeck retractor instead.

LARYNGOTOMY AND TRACHEOSTOMY

EMERGENCY LARYNGOTOMY

INDICATIONS Any of those given below for a formal tracheostomy when the patient is in immediate danger of death, and there is no time to do a formal tracheostomy.

METHOD Put anything under the patient's shoulders that will extend his neck, and make his larynx more prominent.

Find the prominence of his thyroid cartilage in the midline, and follow it downwards to the prominence of his cricoid cartilage, as in A, Fig. 52-3. Feel these on your own throat now.

Use your finger nail to mark the depression formed by his cricothyroid membrane in the midline between his thyroid and cricoid cartilages.

You can now insert needles or a knife.

USING NEEDLES (patients of any age) Insert 2 or more short wide bore (1.6 mm or larger) needles through the patient's cricothyroid membrane (B). Give him oxygen through one of them if necessary. Or, use a disposable needle and cannula ('Medicut') and leave it in place.

USING A KNIFE (patients over 10 years only) Make a vertical midline incision over the patient's thyroid and cricoid cartilages (C). Retract the subcutaneous tissues between your fingers. Spread the wound apart until you can see his cricothyroid membrane.

Insert the first 2 cm of the tip of a solid bladed knife horizontally through the patient's cricothyroid membrane as near his cricoid cartilage as you can (D). This will avoid his cricothyroid arteries which run across the membrane superiorly.

CAUTION! Stand clear as you cut, you may be showered with droplets of blood and secretions as he coughs through his tracheostomy wound.

Widen the opening in his cricothyroid membrane. Put the handle of the scalpel into it horizontally, and turn it through 90° (E). If you don't have a tracheostomy tube, put any convenient tube into the hole.

Do an elective tracheostomy as soon as you can. If you delay it, perichondritis, stenosis, and subglottic oedema may follow.

EMERGENCY LARYNGOTOMY

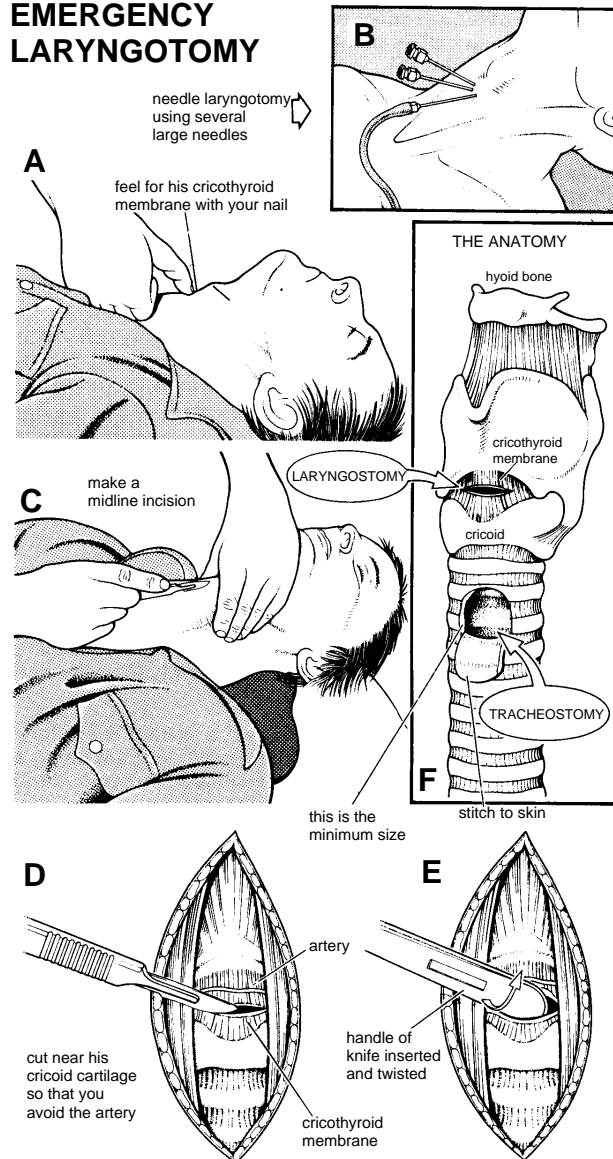


Fig. 52.3: EMERGENCY LARYNGOTOMY. You may need to do this for any of the indications for a formal tracheostomy when the patient is in immediate danger of death, and there is no time to do one. With the kind permission of Peter London.

EMERGENCY TRACHEOSTOMY

INDICATIONS Children and desperate emergencies only. A formal tracheostomy after intubation is safer.

METHOD There will not be time to make a flap, so make a vertical cut just above the patient's suprasternal notch. Make room underneath his skin with any convenient blunt instrument.

Neglect bleeding for the time being, unless it makes finding his trachea difficult. Leave his first and second rings and cut his third and fourth. There will be less chance of a stricture here. Turn the knife sideways. He will cough profusely. Insert a tracheostomy tube and stitch it to his skin.

FORMAL TRACHEOSTOMY

INDICATIONS The main indications in trauma are: (1) When intubation fails or is unsatisfactory, and there is no other way of maintaining an injured patient's airway. (2) When intubation has to be prolonged for more than 48 hours. Acute respiratory infection in children is the most common overall indication.

Intubation which has failed or is impossible in a patient with: (1) Severe cyanosis who is dying of respiratory obstruction. (2) Severe jaw injuries. (3) Severe laryngeal injuries. (4) Severe burns of the face.

Severe chest injuries in which a patient with a flail chest or lung contusion is becoming increasingly cyanosed and has failed to respond to the insertion of a chest drain for a thorax or pneumothorax.

Severe head injuries in which a patient is in deep coma and has already had burr holes and treatment for cerebral oedema. He has been intubated and hyperventilated with a ventilator. He is now beginning to run the risk of complications from his tracheal tube. Oral and bronchoscopic suction are proving inadequate.

Also: (1) Respiratory obstruction due to a diphtheritic membrane or some other respiratory infection, especially in a child. (2) The need for prolonged ventilation. (3) Massive secretions needing frequent bronchoscopy. (4) Poliomyelitis, with respiratory paralysis. (5) Respiratory obstruction following thyroidectomy.

EQUIPMENT A sucker and catheter. A tracheal retractor or hook. A suitable tracheal tube, as listed above. The inner tube should be 3 mm longer than the outer one, so that secretions remain inside it. If you aim to prevent secretions accumulating, or to provide continuous anaesthesia with positive pressure ventilation, use a cuffed tube with a long curve, so that it makes an adequate airtight seal. Choose it carefully. *Don't use a too small tube.* If it is too long, it may reach to a patient's carina and block one of his bronchi. An incorrectly fitting tube may erode an artery and cause severe bleeding.

ANAESTHESIA (1) Intravenous ketamine. (2) Give the patient a general anaesthetic and pass a tracheal tube. (3) Infiltrate his tissues with a local anaesthetic solution (A 5.4). Local anaesthesia on a struggling patient is difficult; if you use it, find some sturdy helpers. Before any tracheostomy, warn the patient that he may not be able to talk immediately after the operation.

OPENING THE TRACHEA If you are inexperienced, make a 5 cm vertical incision starting just below the patient's cricoid cartilage, as in A, Fig. 52-4. When you have had several successes, make a transverse incision 5 cm long 2 cm below the border of his cricoid cartilage. Cut through the patient's subcutaneous fat, and his cervical fascia (C).

CAUTION! (1) From now on use blunt dissection. Use it to raise short flaps and expose his anterior jugular vein and the underlying muscles.

Use blunt dissection to define and separate the fibrous median raphe between his right and left sternohyoid muscles. His sternothyroid muscles lie slightly deeper, find them and retract them laterally. You will now see the isthmus of

his thyroid gland and part of his trachea. They vary considerably.

If the isthmus of his thyroid is small, there is no need to divide it.

If the isthmus of his thyroid is large and interferes with your approach to his trachea, divide it. Make a small horizontal incision through his pre-tracheal fascia over the lower border of his cricoid cartilage. Put a small haemostat into the incision and feel behind his thyroid isthmus and its fibrous attachment to the front of his trachea (D). When you have found the plane of cleavage, use blunt dissection to separate the isthmus from the trachea. Put a large haemostat on each side of the isthmus, and cut it. Later, oversew the cut surfaces or tie them (E).

Put sutures into the skin edges ready to close the wound round the tube later.

Insert a tracheal hook below his cricoid cartilage and pull his trachea forwards and upwards (not illustrated). Have a sucker and a catheter ready.

CAUTION! Control all bleeding before you open the patient's trachea. Cut the membrane below its second or third ring transversely, and keep the sucker near the opening. Then stand clear. If there is blood in his trachea, he will cough it everywhere.

Turn a flap (F) containing his second tracheal ring downwards and insert the tube. The flap will act as a guide to direct the tube into his trachea and will make changing it easier. A flap largely eliminates the great danger of a tracheostomy, which is inability to replace the tube quickly when it has come out accidentally. When the tube is safely in place, stitch the flap to his skin.

CAUTION! (1) Don't disturb his first tracheal ring. (2) Don't remove any trachea. (3) Don't incise more than 40% of the circumference of his trachea, or severe stenosis may follow.

Inject 2 ml of lignocaine into the stoma in his trachea; he will tolerate the tube more easily with his mucosa anaesthetized.

INSERTING AND FIXING THE TUBE

With the obturator in the tube, place the tube in the patient's trachea (G). You will find this easier if you use the tracheal dilator (H). Remove the obturator, and replace it by the inner tube.

The tube must not slip out, so stitch it and tie it in two places: (1) On either side of the tube pass a silk suture through a bite of skin and tie it through the slots on the outer tracheal tube. (2) Tie the tube in place with tapes round the patient's neck. Tie it with his head well flexed, or the tapes may become slack when he sits up in bed with his head forward.

Pack vaseline gauze round the tube, and bring the edges of the skin incision together with sutures. Leave a little space round the tube, to minimize the danger of subcutaneous emphysema.

CAUTION! (1) Don't stitch his skin too tightly or too loosely round the tube. Surgical emphysema can be caused by: (a) closing his skin too tightly round the tube (causing him to drive air out into his tissues when he coughs round a partly blocked tube), or (b) closing it too loosely, enabling him to draw air into his tissues when he makes a panic inspiration through a blocked tube. (2) To avoid emphysema, *don't let the tube become blocked*. (3) If you use a cuffed tube, avoid

FORMAL TRACHEOSTOMY

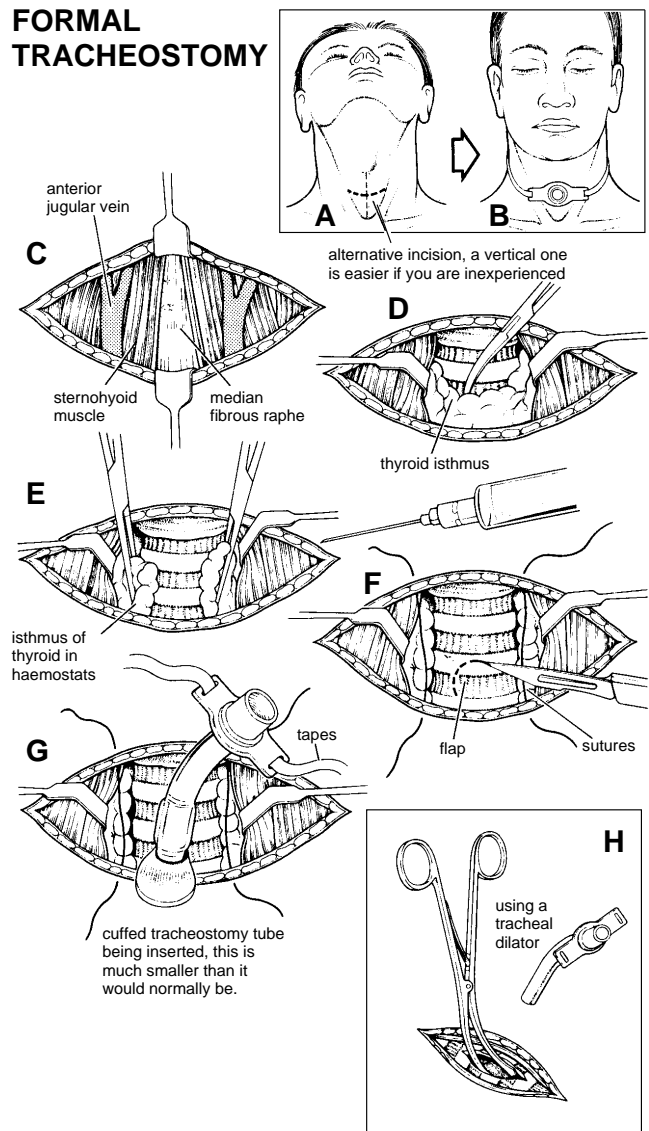


Fig. 52.4: A FORMAL TRACHEOSTOMY A, the choice of incisions. B, the tube finally in place. C, incising the patient's skin and pre-tracheal fascia. D, passing a haemostat behind the isthmus of his thyroid. E, clamping his cut thyroid. F, cutting the flap in his second tracheal ring. G, inserting the tracheal tube; this has been drawn much smaller for convenience. H, using a tracheal dilator. With the kind permission of Peter London.

too short a cuff or too high a pressure inside it. (4) Deflate the cuff 4-hourly for 15 minutes to reduce the risk of his tracheal mucosa necrosing.

THE POSTOPERATIVE CARE OF A TRACHEOSTOMY Keep the patient in a steam room to prevent crusts forming in the tube. If necessary use a steam kettle or squirt a fine spray of saline into the tube every 15 minutes. Suck out secretions with a soft sterile catheter. Suck them out only as you withdraw it. Avoid prolonged or too frequent suction.

CAUTION! Suck out his trachea aseptically. This is no less important than catheterizing his bladder aseptically. Use a fresh, sterile catheter each time. Remove and clean the inner tube every 4 hours during the first few days.

If viscid secretions have formed, loosen them by injecting 3 ml of sterile saline solution and then aspirate.

If the tube easily slips out, change it for one with a better

shape. If necessary, take a soft tissue lateral X-ray of the patient's neck, to show how the tube is lying in his trachea.

CAUTION! (1) Try not to change the outer tube before the fourth postoperative day. If you take it out too soon, it may be difficult to replace. Check the tension of the tapes regularly. (2) Minimize the risk of infection by sucking out his trachea regularly under careful aseptic precautions.

Later, insert a smaller tube and tell the patient to try to breathe and speak with his finger over the hole. As soon as he can do this easily, remove the tube.

DIFFICULTIES WITH A TRACHEOSTOMY

If there is FIERCE BLEEDING while you are inserting a tracheostomy tube the blood may be coming from: (1) The veins of the patient's anterior jugular system. (2) The isthmus of his thyroid. (3) The wall of his trachea. If blood enters his trachea round the tracheostomy tube, immediately insert a cuffed tube. Then open the wound and tie any bleeding vessels. Next time make a vertical incision.

If the patient's tracheostomy TUBE SLIPS OUT, you may have: (1) Made the tracheostomy in the wrong place. (2) Used the wrong shape of tube. (3) Failed to adjust the tapes round his neck. (4) Not stitched the outer tube's flanges to his skin.

If the INNER TUBE BLOCKS, change it frequently, humidify the air he breathes, and suck regularly.

If his TRACHEA BECOMES STENOSED, it has probably done so because you opened it below the level of the second tracheal ring.

If he CANNOT TOLERATE THE REMOVAL OF THE TUBE, the reason may be psychogenic. If he is an adult, gradually reduce its size, then cork it for progressively longer periods before removing it.

52.3 Injuries of the larynx and trachea

Injuries to a patient's nose (62.4) and mouth (62.1) are discussed elsewhere. Injuries to his larynx and trachea are rare and difficult. His main danger is the aspiration of blood into his lungs and surgical emphysema (65.10). Try to pass a cuffed tube beyond the wound, either through his nose or mouth, or through the wound itself. A tube will also reduce the danger of emphysema.