Applied anatomy for cricothyrotomy and tracheostomy

Harold Ellis

Abstract

Tracheostomy and cricothyrotomy are means of access to the respiratory tract in upper airway obstruction. Their safe performance relies on accurate anatomical knowledge of the region. The easily palpable gap between the thyroid and cricoid cartilages demarcates the tough cricothyroid ligament that lies safely distal to the vocal cords and is the site for cricothyrotomy. Tracheostomy, either between or dividing the upper rings of the trachea, is carried out by open operation or by the percutaneous route. In these procedures it is essential to have the head fully extended to keep exactly to the midline to protect vital lateral structures.

Keywords Cricoid cartilage; cricothyroid ligament; cricothyrotomy; thyroid cartilage; tracheal rings; tracheostomy

Learning objectives

After reading this article you should:

- appreciate the surgical anatomy of the larynx and cervical trachea
- understand the approach to the cricothyroid ligament for emergency cricothyrotomy, by either the percutaneous or open technique
- appreciate the importance of maintaining the head and neck in the midline position, with the neck fully extended in performing a tracheostomy

In upper airway obstruction, emergency access can be achieved by tracheostomy or, more usually, by way of the cricothyroid ligament. A clear knowledge of the anatomy of this region is essential if these procedures are to be carried out quickly and safely.

The surface anatomy of the larynx and cervical part of the trachea (Figure 1) can be revised by running the index finger down the midline of the neck. The body of the hyoid bone is at the level of C3. The thyroid notch at the laryngeal prominence of the thyroid cartilage is easily felt below this, at the level of C4, and is visible in the post-pubertal male. From this point, the finger descends along the isthmus of the thyroid cartilage to encounter a distinct depression at the cricothyroid junction. Below this dip, the cricoid cartilage at C6 is felt and then the rings of the cervical part of the trachea. The isthmus of the thyroid gland crosses over its third and fourth rings, but is usually impalpable; if it is felt, it implies there is some degree of thyroid gland enlargement.

The gap felt between the thyroid and cricoid demarcates the cricothyroid ligament, which, in its central part, is thick, tough, and mainly made up of yellow elastic fibres.

Cricothyrotomy

Cricothyrotomy is indicated when there is airway obstruction at or above the larynx that cannot be relieved by other means. With the patient supine, the head is held in the strictly midline position, and, in the absence of cervical injury, with the neck fully extended. The gap between the thyroid cartilage isthmus and the cricoid is identified. Under local anaesthetic if necessary, a 2 cm transverse incision is made over the cricothyroid ligament, which is then incised. The handle of the scalpel is placed in the gap and rotated. A small tracheostomy tube (or other available tube, such as a cut piece of catheter) is passed into the trachea. A tube with an internal diameter of 2.5 mm allows adequate gas flow for a self-inflating bag, while a tube of 3 mm allows spontaneous breathing. Commercial sterile cricothyrotomy sets are now available that use the Seldinger technique.

This procedure cannot be performed in patients if the area adjacent to the cricothyroid ligament has been traumatized. It is contraindicated in children, because of the small size of the larynx.

Tracheostomy

Tracheostomy is required only rarely as an emergency, though an elective tracheostomy may be required for long-term airway

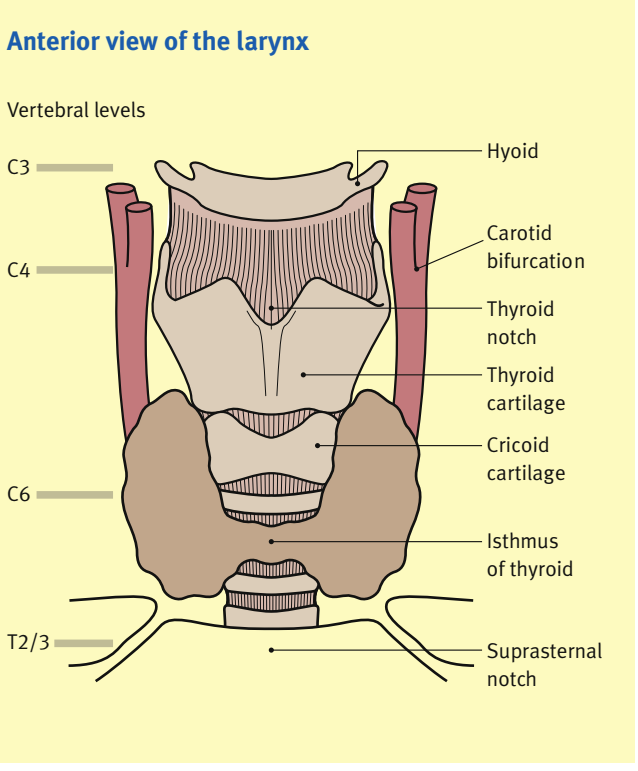

Figure 1

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Tracheostomy

a The incision is placed mid-way between the cricoid cartilage and the suprasternal notch

b The investing layer of fascia covering the pretracheal muscles is exposed

c The isthmus of the thyroid is cleared. This must be divided between artery forceps or displaced downwards

d A vertical incision is made in the trachea

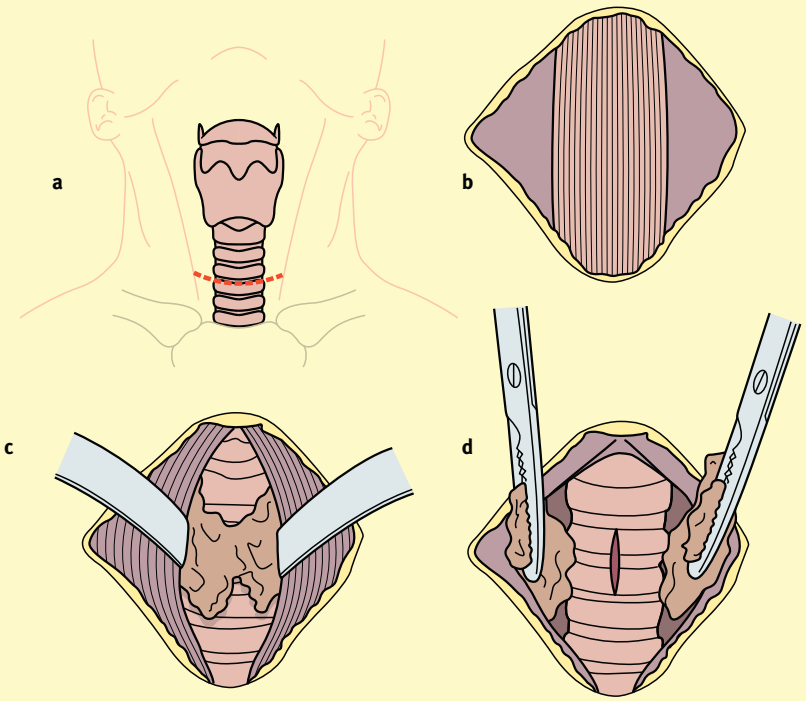

Figure 2

access. The secret of a successful operation is to have the head fully extended, with a sandbag between the shoulders, held absolutely straight, with the chin and sternal notch in a straight line, and to keep exactly to the midline, so that the major neck vessels are out of danger. A short transverse incision is made half way between the cricoid cartilage and the suprasternal notch, though the tyro may find it easier to use a midline incision from the lower border of the thyroid cartilage to just above the suprasternal notch. The incision divides the investing (deep) fascia vertically and passes between the strap muscles, which are held apart with retractors (Figure 2). The trachea is now exposed and confirmed by palpating its rings. Usually it is possible to push down the isthmus of the thyroid gland to expose the upper tracheal rings; if not, the isthmus is lifted up and divided between artery forceps. The trachea is then opened vertically, usually dividing the second and third rings. A tracheostomy tube of the largest size that will fit the opening comfortably is inserted, the trachea aspirated through it and the wound loosely sutured around the tube. (In the elective procedure, the surgeon fashions a fenestra or a flap in the trachea rather than an incision.).

An emergency tracheostomy is a more complex operation than cricothyrotomy, requires more instruments and a modicum of surgical skill. The technique of 'mini-tracheostomy' or percutaneous tracheostomy involves a 1.5 cm vertical incision over the second and third tracheal cartilages. The trachea is entered between these two rings with a needle attached to a fluid-filled syringe. Entry into the trachea is confirmed by the aspiration of air. A guidewire is then passed through the needle, which is withdrawn. A series of dilators is then passed over the wire, finally replaced by a tracheostomy tube. ◆

FURTHER READING

Ellis H, Feldman S, Harrop-Griffiths W. Anatomy for anaesthetists. 8th edn. Oxford: Blackwell Publishing, 2004.