



Fifth lecture

Anesthetic equipment

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Tracheal tubes

tracheal tube

TTs are most commonly made from polyvinyl chloride. In the past, TTs were marked "I.T." or "Z-79" to indicate that they had been implant tested to ensure nontoxicity. The shape and rigidity of TTs can be altered by inserting a stylet. The patient end of the tube is beveled to aid visualization and insertion through the vocal cords. Résistance to airflow depends primarily on tube diameter, but is also affected by tube length and curvature. TT size is usually designated in millimeters of internal diameter.

Most adult TTs have a cuff inflation system consisting of a valve, pilot balloon, inflating tube, and cuff The valve prevents air loss after cuff inflation. The pilot balloon provides a gross indication of cuff inflation. The inflating tube connects the valve to the cuff and is incorporated into the tube's wall. By creating a tracheal seal, TT cuffs permit positive-pressure ventilation and reduce the aspiration Un cuffed tubes are often used in infants and young children to minimize the risk of pressure injury and post intubation croup; however, in recent years, cuffed pediatric tubes have been increasingly favored

<u>Age</u>	<u>internal Diameter (mm)</u>	<u>Cut Length (cm)</u>
Full term	3.5	12
Child	age/4 +4	14+age /2
Adult		
Female	7.0-7.5	24
Male	7.5-9.0	24

Table shows the classical formula to calculate the suitable size of endotracheal tube



Figure shows Classical type of tracheal tube

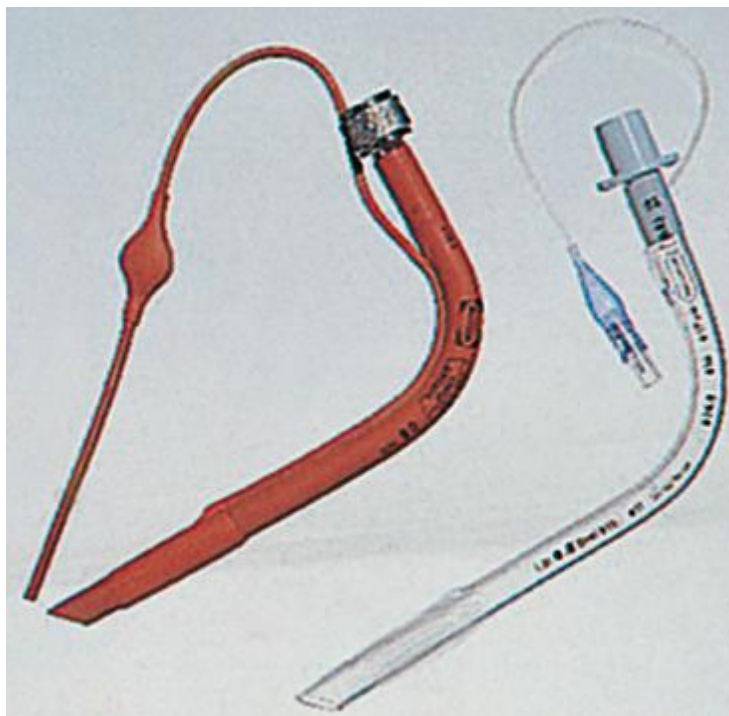
Specialty designed tracheal tubes

OXFORD TRACHEAL TUBE

This anatomically L-shaped tracheal tube is used in anaesthesia for head and neck surgery because it is non kinking

The tube can be made of rubber or plastic and can be cuffed or uncuffed. The bevel is oval and faces posteriorly, and an introducing stylet is supplied to aid the insertion of the tube.

This is undesirable especially in pediatric anesthesia. The distance from the bevel to the curve of the tube is fixed. If the tube is too long, the problem cannot be corrected by withdrawing the tube and shortening it because this means losing its anatomical fit.



Oxford tracheal tube

ARMoured/REINFORCED TRACHEAL TUBE

Armored tracheal tubes are made of plastic or silicone rubber. The walls of the armored tube are thicker than ordinary tracheal tubes because they contain an embedded spiral of metal wire or tough nylon. They are used in anaesthesia for head and neck

surgery. The spiral helps to prevent the kinking and occlusion of the tracheal tube when the head and/or neck is rotated or flexed so giving it strength and flexibility at the same time. An introducer stylet is used to aid intubation. Because of the spiral, it is not possible to cut the tube to the desired length. This increases the risk of bronchial intubation.



Armoured cuffed tracheal tube.

POLAR AND RING, ADAIR AND ELWYN (RAE)

TRACHEAL TUBES

The **polar tube** is a north- or south-facing preformed nasal cuffed or uncuffed tracheal tube. It is used mainly during anaesthesia for maxillofacial surgery as it does not impede surgical access. Because of its design and shape, it lies over the nose and the forehead. It can be converted to an ordinary tracheal tube by cutting it at the scissors mark just proximal to the pilot tube and reconnecting the 15-mm connector. An oral version of the polar tube exists

The **RAE tube** has a preformed shape to fit the mouth or nose without kinking. It has a bend located just as the tube emerges, so the connections to the breathing system are at the level of the chin or forehead and not interfering with the surgical access. RAE tubes can be either north- or south-facing, cuffed or uncuffed.

Because of its preformed shape, there is a higher risk of bronchial intubation than with ordinary tracheal tubes. The cuffed RAE tracheal tube has one Murphy eye whereas the uncuffed version has two eyes. Since the uncuffed version is mainly used in pediatric practice, two Murphy eyes ensure adequate ventilation

The tube can be temporarily straightened to insert a suction catheter



A



B



C



Polar and RAE tracheal tubes: (A) cuffed nasal north facing; (B) non-cuffed nasal north facing; (C) cuffed oral southfacing; and (D) non-cuffed oral north-facing.

LASER-RESISTANT TRACHEAL TUBES

These tubes are used in anaesthesia for laser surgery on the larynx or trachea . They are designed to withstand the effect of carbon dioxide and potassium titanyl - phosphate (KTP) laser beams, avoiding the risk of fire or damage to the tracheal tube. One design has a flexible stainless steel body. Reflected beams from the tube is defocused to reduce the accidental laser strikes to healthy tissues. Other designs have a laser-resistant metal foil wrapped around the tube for protection. The cuff is filled with methylene blue colored saline. If the laser manages to damage the cuff, the coloring will help identify rupture and the saline will help prevent an airway fire, some designs have two cuffs. This ensures a tracheal seal should the upper cuff be damaged by laser. An air-filled cuff, hit by the laser beam, may ignite and so

it is recommended that the cuffs are filled with saline instead of air



Laser resistant tracheal tubes. Note the stainless steel tube (left) with two cuffs. The tube on the right is covered with laser protective wrapping

EVOKED POTENTIALS TRACHEAL TUBES

These tubes are used in a number of surgical procedures that have the risks of damage to nerves, e.g. thyroid surgery. Bipolar stainless steel contact electrical electrodes are embedded in the tracheal tubes above the cuff where they are in contact with the vocal cords. These electrodes are connected to a nerve stimulator. An additional earth electrode is attached to the skin of the patient.

The use of such tubes allows continuous nerve monitoring throughout surgery providing visual and audible warnings.



Evoked potential tracheal tube. Note the electrodes (just above the cuff) with their cables. The other cable is earth

MICROLARYNGEAL TUBE

This tube allows better exposure and surgical access to the larynx. It has a small diameter (usually 5-mm ID) with an adult sized cuff . Its length is sufficient to allow nasal intubation if required. The tube is made of ivory PVC to reduce trauma to the nasal mucosa



Micro laryngeal tracheal tube

Tracheostomy tracheal tubes

These are curved plastic tubes usually inserted through the second, third and fourth tracheal cartilage rings

Components

1. An introducer is used for insertion.
2. Wings are attached to the proximal part of the tube to fix it in place with a ribbon or suture. Some designs have an adjustable flange to fit the variable thickness of the subcutaneous tissue
3. They can be cuffed or un cuffed. The former has a pilot balloon.
4. The proximal end can have a standard 15-mm connector.
5. The tip is usually cut square, rather than bevelled. This decreases the risk of obstruction by lying against the tracheal wall.
6. Different sizes of tracheostomy tubes are available to fit neonate to adults
9. Some designs have a one-way flap valve and a window at the angle of the tube to allow the patient to speak.



Indications for tracheostomy

1. Long-term intermittent positive pressure ventilation.
2. Upper airway obstruction that cannot be bypassed with an oral/nasal tracheal tube.
3. Maintenance of an airway and to protect the lungs in patients with impaired pharyngeal or laryngeal reflexes and after major head and neck surgery (e.g. laryngectomy).
4. Long-term control of excessive bronchial secretions especially in patients with a reduced level of consciousness.
5. To facilitate weaning from a ventilator. This is due to

a reduction in the sedation required, as the patients tolerate tracheostomy tubes better than tracheal tubes. Also, there is a reduction in the anatomical dead space.

Benefits of tracheostomy

- Increased patient comfort.
- Less need for sedation.
- Improved access for oral hygiene.
- Possibility of oral nutrition.
- Bronchial suctioning aided.
- Reduced dead space.
- Reduced airway resistance.
- Reduced risk of glottic trauma

Problems in practice and safety features

Surgical tracheostomy has a mortality rate of <1% but has a total complications rate as high as 40%. The complications rate is higher in the intensive care unit and emergency patients.

The complications can be divided into:

1. Immediate:

- a. haemorrhage
- b. tube misplacement (e.g. into a main bronchus)
- c. occlusion of tube by cuff herniation

d. occlusion of the tube tip against carina or tracheal wall

e. pneumothorax.

2. Delayed:

a. blockage of the tube by secretions which can be sudden or gradual; this is rare with adequate humidification and suction

b. infection of the stoma

c. over inflation of the cuff leads to ulceration and distension of the trachea

d. mucosal ulceration because of excessive cuff pressures, asymmetrical inflation of the cuff or tube migration.

3. Late:

a. granulomata of the trachea may cause respiratory difficulty after extubation

b. persistent sinus at the tracheostomy site

c. tracheal dilatation

d. tracheal stenosis at the cuff site

e. scar formation

Tracheostomy tubes

- Can be plastic or metal, cuffed or un cuffed.

- The tip is cut horizontally.
- Used for long-term intubation.
- Percutaneous tracheostomy tubes are becoming more popular and have fewer complications than the surgical technique.
- Speaking versions exist

Cricothyrotomy tube

This tube is used to maintain the airway in emergency situations such as on the battlefield. It is inserted into the trachea through the cricothyroid cartilage.

Components

1. A scalpel and syringe.
2. A needle with a Veress design and a dilator. The needle has a 'red flag' indicator. This helps in locating the tissue
3. 6-mm cuffed tube.

Mechanism of action

1. After a 2-cm horizontal skin incision has been made, the needle is inserted perpendicular to the skin.
2. As the needle enters the trachea, the red indicator disappears. The needle is advanced carefully until the red reappears, indicating contact with the posterior wall of the trachea.
3. As the cricothyrotomy tube is advanced into the trachea, the needle and the dilator are removed.

Problems in practice and safety features

The cricothyrotomy tube has complications similar to the Mini tracheostomy tube.



Double lumen endobronchial tubes

During thoracic surgery, one lung needs to be deflated. This offers the surgeon easier and better access within the designated hemithorax. In order to achieve this, double lumen tubes are used which allow the anaesthetist to selectively deflate one lung while maintaining standard ventilation of the other.



Components

1. The double lumen tube has two separate colour-coded lumens, each with its own bevel . One lumen ends in the trachea and the other lumen ends in either the left or right main bronchus.
2. Each lumen has its own cuff (tracheal and bronchial cuffs) and colour-coded pilot balloons. Both lumens and pilot balloons are labelled.
3. There are two curves to the tube: the standard anterior curve to fit into the oropharyngeal laryngeal tracheal airway and the second curve, either to the right or left, to fit into the right or left bronchus respectively.
4. The proximal end of these tubes is connected to a Y-shaped catheter mount attached to the breathing System.

Thank you