

## 14.1 Introduction

Tracheotomy (from the Greek “to cut the trachea”) is one of the oldest, most known, and performed procedures in the whole general surgery. Its purpose is to create a direct connection between the patient’s outside and inside (airways) to overcome several obstacles that prevent air from reaching the lungs naturally.

The first certain document of tracheostomy is attributed to Galeno about some procedure performed by the famous practitioner Asclepiade of Bytina around the end of II century A.C. in Rome (“Asclepiadem ultimum auxilium potuit in iis qui maxime soffocantur laringem incidere). In the Seventh century, Paul of Egina subdivided tracheostomy into two different methods for the emergency and the routine: He proposed to cut both skin and trachea in the first case (our cricothyrotomy) and, with a more respectful surgery for cutaneous, muscular and vascular layers, to incise, in the other case, the tracheal wall between the second and the third ring (as we perform nowadays in the majority of patients). But the recurrent epidemic of diphtheria in the XVIII century

was the moment that particularly contributed to the spread of tracheostomy as a rescue-for-life surgery. Finally, the famous French surgeon Bretonneau (the father of word “diphtheria” and the curve cannula inventor) and specially his learner Trousseau set the definitive rules of tracheostomy:

supine and not sitting patient, hyperextended head, incision of the layers till finding the tracheal wall and vertical cut between the second and third ring, need of surgery when respiratory conditions are not extremely compromised (“il faut la pratiquer le plus tot possible”).

Nowadays, tracheostomy has great importance as a rescue-for-life procedure and as a necessary surgery in complex pathologies that need prolonged intubation and/or assisted ventilation.

## 14.2 Indications

Nowadays tracheostomy has three major indications:

1. To get over a severe obstruction of the upper airways
2. To protect and clean lower airways from tough and recurrent secretions
3. To support ventilation in general pathologies with hypo-oxygenation [1–6].

In the first case, we consider:

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1. Tumors blocking pharynx, larynx, or upper trachea
2. Congenital or acquired anomalies with airways stenosis
3. Fractures or lesions of larynx and/or trachea
4. Bilateral paralysis of vocal cords
5. Severe maxillo-facial traumas with soft tissues edema with subsequent stenosis
6. Nontraumatic edema of soft tissues (infective, allergic, inflammatory)
7. Facial or neck or mucosal wall burns of pharynx and larynx
8. Embedded and nonremovable foreign bodies [1, 2, 5, 6]

In the second case, we consider:

1. deficient cough besides chest or abdominal surgery with the presence of persistent and thick secretions
2. bronchopneumonia with important deficiency of ventilation and secretion drainage
3. vomiting with gastric fluid or feed inhalation (in unconscious patients) [1–3, 5]

In children, we must add these diseases:

1. laryngeal cleft with inhalation
2. persistent and recurrent trachea-bronchial fistula
3. pharyngolaryngeal incoordination for fluids or saliva inhalation [2–5]

In the third case, we consider:

1. Obstructive lung diseases and severe alveolar hypoventilation (emphysema, bronchiectasis, and asthma).
2. Respiratory depression by drug intoxication or by poisoning.
3. Severe thorax traumas with a crush, rib fractures, emphysema, or pneumothorax;
4. Paralysis of severe decrease of lung bellow (muscular or neurological diseases which involve the thorax wall).

In newborns, we must add the “distress respiratory syndrome” due to congenital or acquired lack to produce so much surfactant to allow alveolar distension [2, 5].

### 14.3 Procedure

As we saw, tracheostomy is surgery to allow a direct connection between the neck skin and the tracheal wall to enable the air to flow to the lower airways.

In Italian traditional surgery, we distinguish:

Tracheostomy: when we suture the whole tracheal wall to the skin;

Tracheotomy: when we suture only the external tracheal wall to the skin;

Cricotomy: when we cut the cricothyroid membrane in an emergency [6].

On the contrary in the literature and in the most used surgical books, the authors usually distinguish:

Over-isthmus tracheotomy: when the opening of the trachea is performed above the thyroid isthmus (1–2° ring);

Trans-isthmus tracheotomy: when the opening of the trachea is performed through the thyroid isthmus after its cutting (2–3° or rarely 4° ring);

Under-isthmus tracheotomy: when the opening of the trachea is performed under the thyroid isthmus (4–5–6° ring) [1–5].

In children or newborns, the procedure must take into account some important anatomical differences:

- larynx position (usually higher in the neck)
- more open angle of the thyroid cartilage with less protrusion on the neck skin (less evident Adam’s apple)
- tracheal rings not often recognizable (due to their immaturity)
- more jutting structures (hyoid bone and cricoid instead of thyroid)
- thyroid gland with a little and usually movable isthmus [4, 5].

In any case, the tracheostomy presents some common elements to which we must add variants considering single-case needs and personal skill:

The first step is the skin incision with horizontal cervical cut usually in the middle point between cricoid and jugular; we dissect subcutaneous tissue layer by layer, we opened pre-thyroid

muscle in the middle, we cut and open cervical bands, we move or cut thyroid isthmus which crosses the trachea at 2° or 3° ring, we point out a stripping tracheal wall removing any tissue adherence, and finally we cut the trachea with a vertical cut on the midline.

At this point several variants exist:

1. position
2. opening shape
3. tracheal wall connection to the skin.

Regarding the position, besides the three variants described, many others exist:

1. Tracheostomy for ventilatory support: 3° or 4° ring
2. Tracheostomy for laryngotracheal stenosis: 1° or 6–7° ring
3. Tracheostomy for tracheal stenosis: exactly through the stenosis
4. Tracheostomy for intra-thoracic stenosis: 6–7° ring with a long stenting tailored cannula
5. Tracheostomy for recurrent stenosis in a previous T.: in the same stenosis position [4–6].

Regarding the shape of the tracheal wall opening, we have many variants available: we must take into account before the child's age and after the perspective of a more or less long stay of tracheostomy.

In children, we prefer a linear incision of the tracheal wall without the sacrifice of tracheal tissue for a complete recovery allowing in case of tracheostomy removing, even if the cannula reintroduction may become less easy.

In adults, we must prefer an easy and safe cannula reintroduction in case of accidental removal even if we must lose a tracheal tissue quote; in such cases, the variants are:

- complete anterior opening (removing a square of the anterior wall)
- superior window (square incision on three sides—superior, and lateral left and right without complete removing)

- inferior window (square incision on three sides—superior and lateral left and right without complete removing)

In the end, regarding the connection of the tracheal wall to the skin, we distinguish two variants:

- Tracheotomy when we suture only the external tracheal wall to the skin: it is the procedure of second choice when we suppose a short-term tracheostomy.
- Tracheostomy when we suture the whole tracheal wall to the skin to realize a stable connection; it is the first-choice procedure especially when we suppose to maintain the tracheostomy for a long time [6].

A brief note deserves the always more diffuse practice of percutaneous tracheostomy, especially in E.R units; it is a faster procedure, usually performed by the anesthetist himself because it does not need a surgical time of neck opening. It consists of a progressive cracking of superficial layers till the tracheal wall through different devices, which allows also a more and more efficient stoma dilatation, till reaching a sufficient way for the cannula introduction.

But this tracheostomy is a “blind” procedure, it may undergo unpredictable anatomic alterations, and it implies a risk of structural lesions of the trachea especially of the posterior wall with an early or late possible tracheoesophageal fistula. This is the reason why this procedure is limited to adults or teenagers [5].

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## 14.4 Complications

They are divided into early and late complications.

The early complications are:

- bleeding
- subcutaneous emphysema
- infections
- accidental decannulation [1, 3–6]

The late ones are:

- excessive granulation tissue and suprastomal collapse
- stenosis or granulations of the tip of the cannula
- granulations of the stoma which may complicate the cannula introduction
- innominate artery fistula (rare)
- lower respiratory tract infections
- accidental decannulation with obstruction
- wrong-way creation during the introduction [2, 4–6].

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## 14.5 Final Comments

Nowadays, tracheostomy has yet great importance as a rescue for life surgery or necessary procedure in complex pathologies that require prolonged intubation and/or assisted ventilation.

Its execution is limited (especially in children) in specialized centers and in general anesthesia. Usually, it needs 24–48 h recovery in intensive care for a strict early observation.

Despite the demanding procedure, in most cases, it is not so difficult when it happens in intubated patient. Instead, when it occurs in an emergency, in uncomfortable conditions, and in non-intubated patient, it represents a challenging surgery burdened with many risks also for a skilled team.

In most cases, the subject recovery is good and quite fast, and he can surprisingly adapt to the new situation.

The aphonia, which is usually the main problem for the patient, is generally solvable through

different devices such as the phonatory valve (except in cases with large amputation of the larynx or the vocal fold tissue). The dysphagia and the difficulty to perform abdominal contractions (Valsalva's maneuver) are usually transient and not serious problems.

Today, on the market, we can find a big variety of cannulas and other devices of any length, dimension, and diameter that may satisfy every need. Particularly, I would mention, in very complicated cases, tailored soft cannulas with devices (such as adjustable flange) that may adapt to almost any needs of the patient trachea.

In conclusion, the life of tracheostomized subjects is nowadays easier, and they can live, and not only survive, in a quite sufficient way even if their inability persists, obviously, to be serious.

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