

# Endotracheal intubation (pediatrics)

Tracheal intubation consists of inserting a tube through the mouth or nose into the trachea. The tube ensures free airways, protects against aspiration into the lungs and enables connection to a breathing or anesthesia device. In children, we choose the outer diameter of the tube according to the width of the subglottic space, not according to the size of the glottis.

Tracheostomy is the insertion of a tracheostomy cannula into the airways after surgical opening of the trachea on the front surface of the neck. A tracheostomy tube secures the airway and allows the patient to be connected to a ventilator. It is most often indicated for patients in intensive care.

## Indications for intubation

- ineffective mask ventilation during resuscitation
- the need for prolonged artificial pulmonary ventilation
- the need for lower airway suctioning
- insufficient ventilation
- excessive work of breathing
- inadequate CNS control of ventilation
- recurrent convulsions with desaturation
- [[congenital diaphragmatic hernia
- indication of surfactant administration
- *elective intubation*: trauma, surgical procedures, shock

## Means to secure the airway

- oral (CAVE: must not be used in a conscious or somnolent child) / nasal airway
- face mask + bag (allows to ventilate and oxygenate the patient during spontaneous, assisted and controlled ventilation; appropriate size!)
- laryngoscope (handle with batteries and spoon, most often Macintosh, for children No. 1 or 2)
- endotracheal cannula (uncuffed reduces the risk of subglottic edema and post-intubation stenoses; too large tubes damage the larynx and trachea, too small tubes increase airway resistance)
- laryngeal mask (alternative airway device)
- Magill's insertion forceps (used for insertion of a tracheal tube during nasotracheal intubation; also used for insertion of a gastric tube under laryngoscopic control)
- aspiration catheters (for aspiration of the upper respiratory tract and for aspiration through an endotracheal cannula; different sizes according to Charie)
- drug used for intubation:
  - atropine
  - muscle relaxants (CAVE: obstructive etiology of respiratory insufficiency !)
  - sedatives
  - analgesics



Means for intubation

## Orotracheal intubation

Before intubation, we oxygenate the patient well by ventilation using a mask with 100% O<sub>2</sub> to prevent prolonged hypoxia. We will ensure monitoring of ECG, S<sub>a</sub>O<sub>2</sub>, heart rate and blood pressure. In the correct position of the head for intubation, the mouth is in line with the pharyngeal and laryngeal axis. We tilt the head slightly backwards, not into hyperextension (especially in newborns), slightly support the head with an intubation pillow. This is the so-called "sniff position", when the neck is bent forward and the atlanto-occipital joint is tilted. If necessary, we will use *Sellick's touch* (grasp the annular cartilage from the front with the thumb and forefinger and push it perpendicular to the front surface of the neck towards the cervical spine) to prevent aspiration or flow of liquid contents from the hypopharynx during emergency intubation (the so-called crash introduction) or in the event that the intubation was not successful and the patient is needed breathe through a breathing bag with a mask.

After correctly positioning the head, open the oral cavity sufficiently. We will use either a pull on the tip of the chin or the teeth of the lower jaw, or the so-called *cross finger* maneuver = touch, when we open the mouth with the crossed thumb and index (middle) finger of the right hand in such a way that we push the teeth of the lower jaw with the thumb and the teeth of the upper jaw with the index finger.

Hold the laryngoscopic handle firmly in the left hand and insert the spoon through the right corner of the mouth, gently lift the tongue and move it to the left. We always introduce the spoon "under the tongue", i.e. without contact with the teeth of the upper jaw. If we do not see the epiglottis, or entrance to the larynx due to the "obstructing" tongue, it is better to pull out the spoon of the laryngoscope and make a new attempt at intubation.

For successful intubation, the following are most important: the correct size of the laryngoscope spoon, the correct position of the head, the laryngoscope should be introduced without contact with the upper jaw, the tongue should be pushed back well, the laryngoscope should be fixed in the midline and then the laryngoscope should be carefully lifted in the direction of the handle, and finally the endotracheal tube should be inserted from the right side, not groove of the laryngoscope.

## Curved spoon intubation procedure

We move the spoon slowly along the base of the tongue until we see the epiglottis. We then place the tip of the spoon between the base of the tongue and the epiglottis (into the epiglottic vallecula). Subsequently, we forcefully lift the laryngoscope in the direction of the handle, i.e. forwards and upwards; in this maneuver, the epiglottis rises and exposes the entrance to the larynx. Using a curved spoon allows more room in the oral cavity for the tube.

## Straight spoon intubation procedure

During intubation, a straight spoon is placed on the laryngeal surface of the epiglottis, i.e. the epiglottis is "picked up" on the spoon of the laryngoscope; when the laryngoscope is raised, the entrance to the larynx can be seen. A straight spoon is preferred in the smallest children, where the epiglottis is relatively long and malleable, and where good visibility is often not achieved with a curved spoon. When introducing the tube, it is usually possible to do without an introducer.

## Insertion of an endotracheal tube

We always introduce the cannula **from the right side** (never through the channel of the laryngoscope, as this obscures the view of the entrance to the larynx), with a guide as needed. We introduce the ETR between the vocal cords, insert the cannula up to the distal line markings (if the cannula has two or three distal line markings, the second and third markings should be visible, if the entire end of the cannula is black, this part should be below the level of the vocal cords). When using an endotracheal cannula with a cuff, we insert the cuff under the vocal cords. Subsequently, a laryngoscope, possibly + remove the introducer, check the position of the endotracheal cannula and carefully inflate the cuff. The tracheal tube is reliably fixed with a patch. After successful intubation, a nasogastric tube is inserted into the stomach and air is pumped out.

Insertion of the ETR too deep threatens endobronchial intubation, most often into the right bronchus.

Note: Intubation through the mouth is easier and faster to perform, it facilitates suction from the lower respiratory tract, on the other hand, intubation through the nose ensures better fixation of the tube in the larynx and enables easier suction from the oral cavity.

## Rules for securing the airway

- perform preoxygenation in all patients
- kurarimimetic should only be given when we are convinced that the patient can really be "breathed" through the face mask
- if unexpectedly difficult intubation occurs, call an experienced anesthetist, prepare devices for emergency airway management, after > 3 unsuccessful attempts use a laryngeal mask, combi tube or fiberoptic intubation
- when neither intubation nor artificial ventilation with bag and mask ("cannot ventilate, cannot intubate") is possible, consider supraglottic procedures (laryngeal mask, combitube) or infraglottic procedures (transtracheal oxygenation or coniotomy = mini tracheostomy)
- always check the position of the tracheal tube

## Checking the position of the endotracheal tube

- introduce the tube under visual control between the vocal cords
- **visual inspection:** symmetrical movements of the chest wall with ventilation, tracking movements of the clavicles, shoulder joint and subclavicular space; if the tube is inserted correctly, there are synchronous movements of the right and left sides during UPV, if only one side moves: unilateral intubation is likely, if there are no movements at all: esophageal intubation is likely
- **auscultation:** breath sounds are heard symmetrically over both lung fields and no gurgling is heard in the stomach
- **capnography** : recording of a capnographic curve
- **X- ray image of the chest:** the ideal location of the ETR tip is in the area of the junction of the lower clavicle lines
- if the situation allows: fibroscopic control

## Nasotracheal intubation

Before nasotracheal intubation, it is advantageous to spray the nasal mucosa with a vasoconstrictor agent. We will use a larger or better-passable nostril, but preferably the right nostril. The lower nasal passage is the widest,

through which the tube can be inserted into the nasopharynx most easily.

After induction of anesthesia with the disappearance of protective reflexes, a tracheal tube coated with mesocain gel is introduced through the nasopharynx into the hypopharynx (if it encounters resistance, we pull it out and tilt the head more) and continue under visual control in direct laryngoscopy. When inserting the tracheal tube through the nose, it is necessary to proceed with gentle pressure and to penetrate the oropharynx with circular movements (usually the tube is inserted somewhat medially towards the nasal septum and at the same time somewhat caudally).

We grasp the visible end of the tracheal tube in the oral cavity with Magill's forceps. Using them, we introduce the tip of the tube between the vocal cords and into the larynx. When moving the pipe without the help of pliers, it is possible to adjust the direction of movement by turning the tip of the pipe. The tube clearance is chosen a little smaller and the length of the inserted part should correspond to approximately 1 and 1/2 the distance of the tragus from the nasal vent. After the introduction of the tracheal tube, we make sure that, during controlled overpressure breathing, there is a slight escape of the mixture of gases from the airways during inspiration.

## Difficulties with nasotracheal intubation

We most often register the following difficulties:

- The tube is stuck in front of the epiglottis, i.e. between the root of the tongue and the front surface of the epiglottis. In this complication, the neck arches clearly forward in the place of the thyroid cartilage. By tilting the head forward, it is possible to try to direct the tube further back.
- The tube hits the anterior commissure of the glottis. There is also a visible bulge on the front of the neck in the place of the thyroid cartilage. Here, too, it is necessary to adjust the direction of the pipe by tilting.
- A tube was inserted into the esophagus. The incident is usually manifested by symptoms: the tube easily moves forward, breathing phenomena are not heard at the mouth of the tube. Here, the tube must first be pulled out, then the tilt of the head increased and the attempt repeated. In the case of delayed confirmation of esophageal intubation, the tube is immediately removed and the patient is breathed through a bag with a 100% O<sub>2</sub> mask.
- The tube entered the piriformis sinus. There is a noticeable arching on one side of the neck, when trying to move the tube we encounter a lot of resistance, the breath sounds disappear at the proximal end of the tube. We pull the tube back by 2 to 3 cm, turn it by 45 to 90° and move it forward again. It is also possible to bow the head to the side and repeat the attempt.
- Massive epistaxis.
- Injury to the conch, pharynx and pharyngeal tonsils.

## Intubation in children

Intubation of children over 10 years of age does not differ from intubation of adults. There are differences and peculiarities in newborns and small children:

- achieving parallel axis for intubation is more difficult
- straightening the epiglottis is more difficult
- the head and tongue are large in the newborn, the neck is short
- the larynx is higher than in an adult, the epiglottis is U-shaped
- The cricoid cartilage (dttto subglottic space) is the narrowest place to insert the tube.

## Complications of intubation

Minor complications, such as sore throat or swelling of the glottis, occur in almost all patients intubated for more than 48 hours. It is true that the longer the intubation, the more frequent the complications. High pressures in the sealing cuff damage the mucosa and cartilaginous structures more than low pressures. Conversely, the movement of the tube and vocal cords is also inappropriate (the mucous membrane of the trachea and larynx is traumatized, especially if the sealing cuff is inflated). Esophageal perforation occurs most often during difficult intubation, early symptoms include subcutaneous emphysema and pneumothorax, mortality is high. Perforation of the trachea, on the other hand, most often occurs during smooth intubation, manifesting as subcutaneous emphysema and/or pneumothorax. Perforation of the pharynx occurs most often in connection with the use of a metal introducer. Dislocation of the arytenoid cartilages is caused by too deep insertion of the laryngoscope spoon behind the thyroid cartilage and subsequent pulling. Manifests after extubation as voice disorders up to a whisper.

The most common complications of intubation:

- trauma to the teeth and soft tissues of the oral cavity
- arrhythmia
- hypotension with bradycardia / hypertension with tachycardia
- apnea

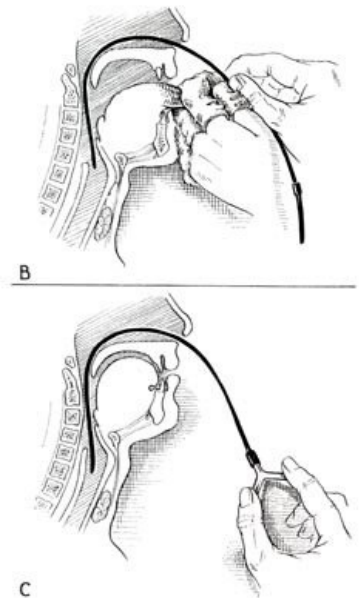


FIGURE 62.—Continued. B. Forward fixation of larynx with left hand, by holding tongue forward with gauze-covered fingers. With the right hand, the catheter is rapidly advanced through the nares and past the glottis as the patient inspires deeply. If he is comatose, a mouth gag is used, and the epiglottis is picked up with the left forefinger. The catheter is then guided through the larynx. C. Advancement of catheter into trachea by intermittent suction over Y-tube. Once it is in trachea, it is moved back and forth to stimulate coughing.

Nasotracheal intubation (diagram)

- laryngospasm
- bronchospasm
- vomiting
- aspiration
- intubation into the esophagus / bronchus
- dislocation of the arytenoid cartilage

## Extubation

Extubation is performed when the patient has good spontaneous ventilation. We perform it with the patient almost awake or still under deep anesthesia. Extubation under deep anesthesia has the advantage of reducing the likelihood of coughing and laryngospasm. The prerequisite is sufficient spontaneous ventilation without a tube and at the same time there must be no risk of aspiration.

Method:

- We will prepare aids for possible reintubation.
- We suck the secretion from the pharynx.
- We only suction from the trachea if there is a reason for it. We do not routinely pump.
- We release the sealing cuff and carefully pull out the tube. If there is a risk of aspiration, the side position is indicated.
- We administer oxygen to the patient and monitor ventilation.

Extubation of a conscious patient is performed if there is a risk of aspiration. The disadvantage is that the tube irritates most patients to cough and there is a greater risk of laryngo/bronchospasm. If the cough is severe, it is necessary to extubate as soon as possible or to sedate the patient pharmacologically.

CAVE: Only those who know how to intubate can extubate!

## Rules for successful intubation (summary)

- as part of analgesedation before intubation, always consider possible contraindications for individual drugs (e.g. do not administer thiopental in hypotension, succinyl in myopathies, etc.)
- always preoxygenate the patient and first try mask ventilation before administering a peripheral muscle relaxant (Esmarch's triad). In case of problematic ventilation, we maintain the optimal position of the airways and the mask with both hands (the nurse breathes through the bag), or we will try to insert an air duct. If the patient cannot breathe, you cannot risk intubation using the apnea technique!
- optimal head position = "sniffing" position
- open the oral cavity sufficiently
- we insert the spoon in the middle, always "let it slide down the tongue" = without contact with the teeth of the upper jaw behind the right tonsil
- we move the tongue to the left by moving the spoon to the midline, we pick up the tongue nicely from below (no contact with the upper jaw), whenever the tongue gets confused in our view, we take out the spoon and make a new laryngoscopic attempt
- we must always get the laryngoscope to the midline and pull in the direction of the handle = up + forward
- if we can see the epiglottis, but we can't see the vocal cords: we try to get the tip of the spoon even closer to the "foot" of the epiglottis + pull the lower jaw even more with a laryngoscopic spoon + help by applying pressure on the larynx from the outside
- if we see darkness or a hole whose walls resemble the rectum and we do not see the epiglottis = we are too deep (in the esophagus)
- if the tongue "gets in the way", we are too shallow

## Procedure in infants

- we lightly support the head, which we otherwise leave in a practically neutral position (no tilt!)
- in this case, we do not have to open the mouth wide (we can help by gently pulling the infant's forehead towards us)
- rather, we insert the laryngoscope perpendicular to the tongue ("like a spade in the garden")
- the pull of the laryngoscope is more forward than up
- more than any other children adequate preoxygenation
- proceed as carefully as possible (bleeding threatens with loss of orientation and at the same time swelling of the airways can lead to a "can't intubate, can't ventilate" situation)
- use the boot-loader as a precaution

## Links

### Source

- HAVRÁNEK, Jiří: *Provision of airways* . (edited)

### External links

- [[ <https://www.lf3.cuni.cz/3LF-780.html> Advanced emergency resuscitation – multimedia training program,

video demonstration

intubation (Clinic of Anesthesiology and Resuscitation FNKV)]

- Difficult airway management in a child - interactive algorithm + test (<https://www.akutne.cz/algorithm/cs/401--/>)

## **Related Articles**

- Securing the airway
- Securing the airway (half heels)
- Endotracheal intubation
- Crush introduction to anesthesia
- Difficult intubation
- Tracheostomy