

M U N I
M E D

Airway management, oxygen therapy

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Learning outcomes

- The student recognizes a patient who requires acute airway management.
- The student knows the basic maneuvers for airway opening and has a theoretical basis for breathing through the face mask.
- The student is familiar with basic supraglottic and infraglottic devices for securing airway.
- The student knows the indications for tracheostomy and coniotomy /coniotomy puncture.
- The student knows oxygen delivery systems.

Content

– Airway management

1. Indications for acute airway management
2. Devices for airway management
 - Supraglottic devices
 - Infraglottic devices

– Oxygen therapy

1. Definition
2. Oxygen delivery systems
 - Low-flow systems
 - High-flow systems

Airway management

- Patent airway is **the top priority**.
- Unsolved airway obstruction = **respiratory arrest followed by circulatory arrest**
- Airway management can be:

Acute

Scheduled

I.e. after induction of anaesthesia

Indications for acute airway management

	Indication	Example of clinical case
1.	Inability to keep airway open	Upper airway obstruction (oedeme, tumor, inflammation, foreign body, tongue falling backward,...)
2.	Inability to protect airway from aspiration	Lack of CNS stimulation (unconsciousness, GCS \leq 8, intoxication, craniotrauma, CNS tumors,...)
3.	Ventilation failure	Lung pathology (ARDS, asthma, COPD, bronchospasms, pulmonary oedema, ...), impaired lung mechanics (pneumothorax, hemothorax, seriál rib fracture,...), disorder of neuromuscular transmission (myastenie, organophosphate poisoning, ...)
4.	Oxygenation failure	

Devices for airway management

Supraglottic devices

- Face mask
- Airway
- Laryngeal mask

Infraglottic devices

- Tracheal tube
- Tracheostomy
- Coniopuncture/coniotomy

Face mask

- Used as the interface between the patient and the resuscitator (mouth-to-mask) or an self-inflating bag
- During CPR, **bag-mask ventilation** is the recommended procedure, ensuring effective ventilation



Face mask

– To achieve the best bag-mask ventilation, you should:

1. Keep airway open by optimal head position
 - **Head tilt - Chin lift**
 - **Jaw-thrust maneuver** (tilting head, lifting chin and opening mouth)
 - Think about **the neutral head position** in infants
2. Good mask seal
3. Suitable ventilation frequency and volume



Airway

- **When to use:** cannot effectively ventilate through face mask, the tongue is occluding the upper part of airway

Oropharyngeal airway

- **Only in comatose patients!!**
Otherwise the insertion may lead to vomiting or laryngospasm.



Nasopharyngeal airway

- **Can be used in semi-conscious or conscious patients!** May cause bleeding from nostrils.



Laryngeal mask

- **When to use:** wide spectrum of (securing airway during general anaesthesia, emergency airway device when the intubation is unsuccessful and the ventilation through face mask ineffective)
- **Contraindication to its elective use:** poor pulmonary compliance, high airway resistance, pharyngeal pathology, risk for aspiration

1st generation



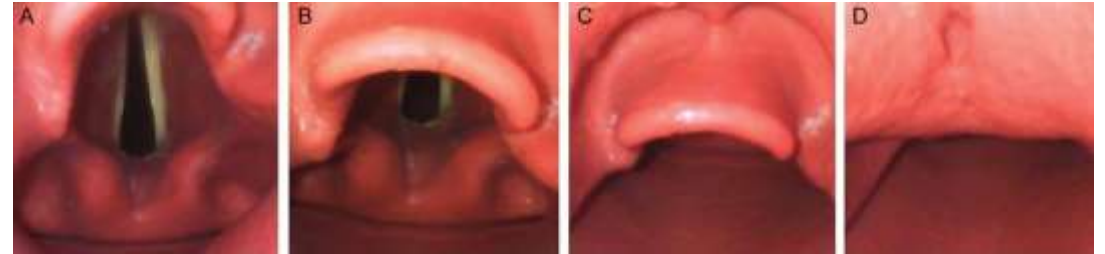
Intensive care med. - practice (aVLAM9X1c)

2nd generation



Tracheal intubation

- Gold standard in airway management
- low risk of aspiration
- **Different technique:**
 - Orotracheal vs. Nasotracheal intubation
 - Videolaryngoscopy vs direct laryngoscopy intubation
 - Flexible bronchoscopy intubation
 - Blind intubation
 - Awake intubation
 - Rapid sequence induction and intubation



– Basic equipment:

- Laryngoscope, event. videolaryngoscope
- Tracheal tube
- Magill forceps
- Stylet or bougie

Tracheostomy

- **When to use:** patients who requires to have secured airway for a long period of time

Indication	Example of clinical case
Difficult weaning from mechanical ventilation	Patient after COPD exacerbation
Unsolvable airway obstruction	Inoperable tumor of epiglottis
Threatened airway obstruction ((trauma, epiglottitis, etc.)	Soft tissue injuries and facial fractures with swelling
Lack of protective airway reflexes	Bulbar palsy
Inability to keep open airway	Persistent coma after craniotrauma

Tracheostomy

Percutaneous tracheostomy

- Performed by an intensivist in ICU with use of Seldinger technique
- **Contraindication:**
 - Severe coagulopathy
 - Cervical spine injury
 - Adverse anatomical conditions (eg. obesity)
 - Condition after surgery at the place of performance



Intensive care med. - practice (aVLAM9X1c)

Surgical tracheostomy

- Performed by a surgeon
- Can be done either in ICU or at operating theatre



Coniopunction/coniotomy

- Urgent infraglottic airway management
- It has its fixed place in the algorithm of **Difficult Airway Management**- *it is necessary to do it in time, not only in the situation of circulatory arrest*
- Performed when we are not able to secure airway neither by intubation nor by any supraglottic devices and the patient cannot be effectively ventilated through face mask.
- surgical severing of the *cricothyroid ligament*



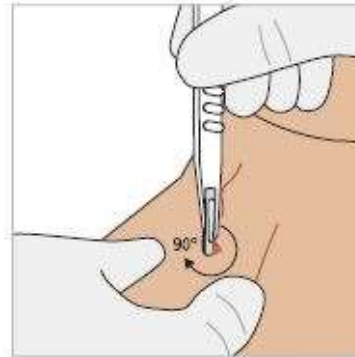
Coniopunction/coniotomy

Coniopunction

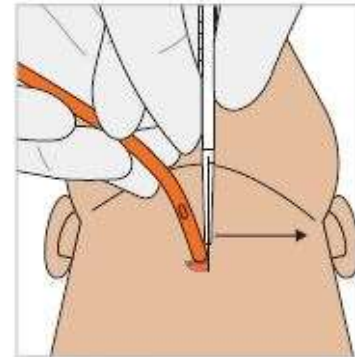
- It is a **puncture** of the ligament, either with an ordinary needle or a designated trocar (special sets Quick Trach, Mini-Trach and others)
- **Disadvantages:** ventilation is difficult through the small diameter of the needle and requires a special device



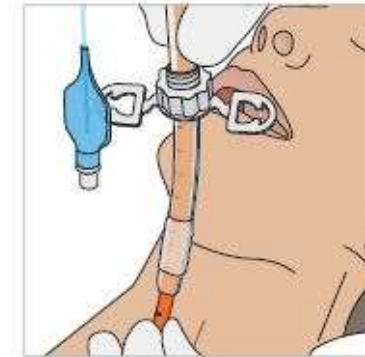
1. Incision



2. Rotation



3. Bougie



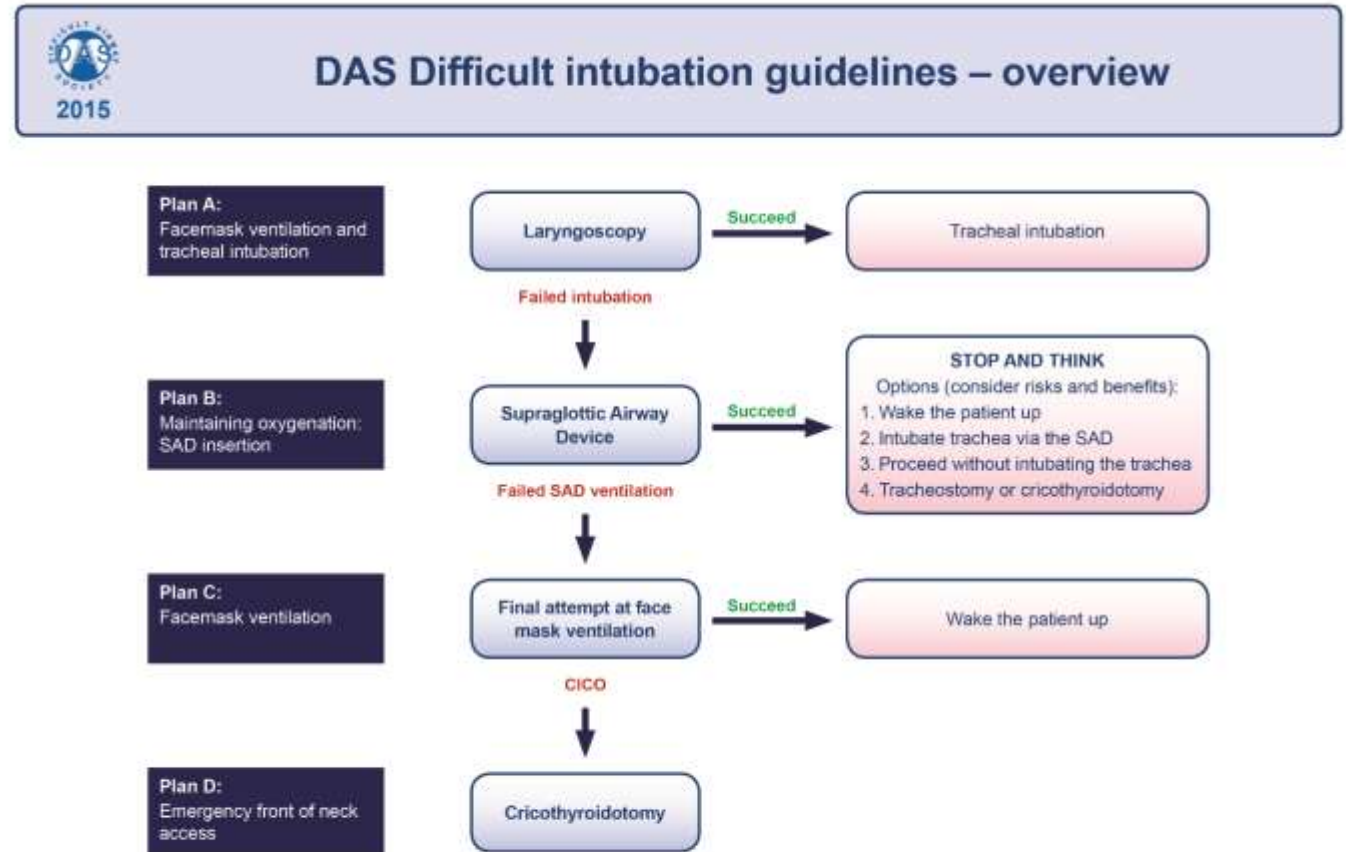
4. Tube trachéal

Coniotomy

- **Preferred** over coniopuncture
- We perform the **BACT** (Bougie-Assisted Cricothyrotomy) procedure - this is probably the fastest, easiest and safest way for coniotomy

Difficult Airway Management

- The main goal is **oxygenation!**
- **Pre-oxygenate** every patient with 100% FiO₂ before any airway management, if possible.



This flowchart forms part of the DAS Guidelines for unanticipated difficult intubation in adults 2015 and should be used in conjunction with the text.

Oxygen therapy

- The main effort in **treatment of hypoxemia** is its correction in order to prevent tissue hypoxia
- In **spontaneously ventilating patients**, oxygen therapy is the method of choice
- In case of failure of oxygen therapy, we move to **mechanical ventilation** (invasive or non-invasive), or even further to **extracorporeal membrane oxygenation (ECMO)**

Oxygen delivery systems

- We divide into **low-flow** or **high-flow** systems, based on the amplitude of O_2 flow
- The main difference between systems is the **O_2 fraction** (FiO_2), which the given system allows us to administer to the patient

Oxygen delivery systems

Low-flow systems

- **Nasal prongs:** suitable flow rate up to 4 l / min, higher flow rate leads to airway drying and is uncomfortable for the patient, **FiO₂ 25 - 40%**
- **Simple oxygen mask:** suitable flow 2 - 10 l / min, it does not seal on the face, therefore ambient air is inhaled as well, thus **FiO₂** can reach only up to **60%**
- **Oxygen mask with reservoir bag:** the entire inspiratory volume comes from the reservoir -> the O₂ flow must reach at least the size of the minute ventilation - the reservoir must always be filled !! Otherwise, the patient inhales the ambient air and does not reach high FiO₂, **FiO₂ 50 - 90%**
- **Be careful!** A non-moistened and unheated gas mixture can cause airway drying, mucus hyperviscosity, sputum retention -> development of tracheal / bronchial obstruction -> increased risk of airway infection; increased risk of mucosal keratinization - **heat and moisten the gas mixture if the flow is higher than 4 l / min! !**

Oxygen delivery systems

Low-flow systems



Oxygen delivery systems

High-flow system

- **HFNO** (High Flow Nasal Oxygenation): requires a special device, flow up to **60 l / min**, **FiO₂ 21 - 100%**, the gas mixture is heated to 37 °C, completely humidified -> good tolerance even of higher flows, it also allows to create a slight PEEP (positive end-expiratory pressure), its magnitude depends on the flow, and also reduces the anatomical dead space (washes out the nasal and oral cavities with a high flow of gases during expiration)



Take home message

- Effective oxygenation and ventilation are the number one clinical priority.
- Preoxygenate your patient with 100% O₂ before each airway management, if possible.
- Effective bag-mask ventilation is one of the basic skills and is method of choice for oxygenation during CPR.

Sources

Pictures:

- <https://resus.me/head-rotation-for-mask-ventilation/>
- <https://www.indiatoday.in/coronavirus-outbreak/story/covid-19-shortage-of-ventilators-iit-team-pitches-bag-valve-mask-as-alternative-1661659-2020-03-31>
- https://en.wikipedia.org/wiki/Oropharyngeal_airway
- https://www.alibaba.com/product-detail/Comfortable-Nasal-Airway-Tube-Nasopharyngeal-Airway_62174452817.html
- <http://medakmedical.com/en/lma.html?code=175030>
- <https://myteleflex.com/teleflex-us/en/USD/Emergency-Medicine/Airway-Management/Supraglottic-Airways/LMA%C2%AE-Classic%E2%84%A2-Reusable-Airway/p/100040>
- <https://www.vbm-medical.com/products/airway-management/laryngeal-tube-lts-d/>
- <http://www.naemsp-blog.com/emsmed/2017/10/13/a-debate-of-supraglottic-proportions-xmmgr>
- <https://medtree.co.uk/vbm-lts-d-laryngeal-tube>
- <https://epmonthly.com/article/ems-delivered-airways-part-ii/>
- <https://www.amesa.cz/amesa/Combitube-kombirourka>
- https://www.brainkart.com/article/Techniques-of-Direct-and-Indirect-Laryngoscopy---Intubation_26929/
- <http://rc.rcjournal.com/content/59/6/850>
- <https://bmedinst.com/standard-conventional-laryngoscope-blades>
- <https://www.dsmedical.co.uk/treatment-c14/airway-management-c30/smiths-medical-intubation-stylet-p710>
- <https://www.amazon.in/IndoSurgicalsTM-Magill-Forceps-Child-Quality/dp/B019K9Z9YI>
- <https://www.indiamart.com/proddetail/nasal-cannula-22310660333.html>
- <https://www.medicaleshop.com/John-Bunn-Simple-Oxygen-Mask-with-Tubing>
- <https://www.amazon.com/Pediatric-Elongated-Standard-Non-Rebreather-Reservoir/dp/B0827Z8X5F>
- https://www.alibaba.com/product-detail/Nasal-Cannula-Oxygen-tube-High-flow_1600109289452.html
- <https://emottawablog.com/2020/08/video-laryngoscopy-compared-to-augmented-direct-laryngoscopy-in-adult-emergency-department-tracheal-intubations-a-national-emergency-airway-registry-near-study/>
- <https://www.stgeorges.nhs.uk/gps-and-clinicians/clinical-resources/tracheostomy-guidelines/tracheostomy-tubes/>
- https://www.researchgate.net/publication/291097308_The_role_of_ultrasound_in_percutaneous_dilatational_tracheostomy/figures?lo=1
- <https://www.wikiskripta.eu/w/Soubor:Koniotomie.png>
- <https://www.laubscher.ch/de-wAssets/img/?DD>

Sources

Text:

- MALÁSKA, Jan, Jan STAŠEK, Milan KRATOCHVÍL a Václav ZVONÍČEK. *Intenzivní medicína v praxi*. Praha: Maxdorf, [2020]. Jessenius.
- Guidelines for Difficult Airway Management

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