Respiratory Tract Suction

An information brochure for medical staff and patients
If a person is no longer or inadequately able to cough up secretion, this must be sucked off. Respiratory depression and with it anxiety are a constant companion of these patients. This care primer transfers the necessary information to you regarding respiratory tract suction of secretions including the available technologies, their handling and care. In addition you should feel safe when choosing the appropriate material. You get to know different suction methods together with helpful hints which will facilitate your daily routine. The gained knowledge and with it the increase safety have a positive influence on your patients. With the information in this brochure even the affected person can learn how to suck off his secretion.

Manuela Fucci
Registered nurse
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Upper airways

The upper airways extend from the nasal and pharyngeal cavity to the finest arms of the trachea (bronchial tubes). Their task: Cleaning, warming and humidifying the respirated air.

The nose

- The nasal aditus is blocked by long, rigid hair. They widely prevent penetration of large foreign bodies during breathing.
- The surface of the nasal cavity is largely extended by the inferior, medial and upper nasal conchae.
- The walls of the nasal concha are covered by mucus which consists of multilayered ciliated epithelium. In the ciliated epithelium there are goblet cells which produce mucus. The rhythmic movement of the ciliated epithelium of the nasal mucosa is directed in opposition to the pharyngeal cavity and removes dust particles and bacteria trapped in the mucus. With it, the nasal cavity and even the breathing air are cleansed and humidified. (Excessive production of nose mucus = cold).
- The blood circulation of the nasal mucosa is controlled by cerebral nerves.
- The colder the inhaled air, the more the blood circulation is increased whereby the inhaled air is warmed more.
- Also chemical and psychic stimulations may increase blood circulation and with it influence the mucus production of the nasal
mucosa. The olfactory organ is amongst others a protection of the respiratory tract. So you stop breathing when the air contains malodorant, harmful impurities.

- By the sense of smell the reflectory salivary and gastric juice production is stimulated. The tears channel meets in the inferior nasal concha. During crying one has to blow the nose.

### The larynx

The larynx is a cartilaginous skeleton on the trachea at the front part of the neck. The cartilaginous skeleton is comprised of 5 cartilages which are connected to each other.

- Thyroid cartilage
- Epiglottis
- Cricoid cartilage
- Arytenoid cartilage
- Hyoid bone

The epiglottis is a protective closure which closes the larynx during swallowing.

However, during respiration and speaking the epiglottis leaves the larynx open.

Except the vocal cords, the larynx is covered by mucosal lining which consists of multi-row, cylindric ciliated epithelium with goblet cells which produce mucus. The rhythmic movement of the ciliated epithelium is directed to the pharynx.
1. The trachea extends from the lower part of the larynx, and is situated in the axis of the neck and the thoracic cavity, in front of the esophagus. The trachea is nearly but not quite cylindrical, being flattened posterior; in adults it measures about 10 to 12 cm in length; 16 to 20 C-shaped cartilagerings give the trachea rigidity and allow it to stay open all the time. The bows of the C-shaped cartilage rings are directed to front, while the open part is fixed by the muscular connective tissue posterior wall.

The connecting parts between the individual C-shaped cartilages consist of connective tissue, which is rich of elastic fibers. During coughing the posterior wall is deformed the way that secretion is coughed up by the hereby produced airflow. Like everywhere in the respiratory tract also the trachea is covered by mucosal lining which consists of multi-row, cylindric ciliated epithelium with goblet cells which produce mucus.
The Bronchi

In the chest cavity, approx. 12 cm below the larynx the trachea is divided into two branches which lead into the right and the left lung. Up from this part the branches of the trachea are called bronchi (bifurcation).

The bronchi are divided as follows
- right and left principal bronchus
- lobe bronchi
- segmental bronchi

Only up to the principal bronchus the bronchi have the same structure like the trachea.
The bronchi are covered by mucosal lining which consists of multi-row, cylindric ciliated epithelium with goblet cells which produce mucus, up to the end bronchioles. So the inhaled air is kept humid, warm and clean up to the alveoli where the gas exchange takes place.
In the lungs the external breathing takes place. Here gas exchange occurs - carbon dioxide from the blood is exchanged for oxygen from the alveoli.

In an adult the alveoli walls have a surface of 80 to 100 m² in total. The lung consists of two separated lobes which fill out both lateral halves of the chest cavity.

Between both lobes the organs of the mediastinum are located, whereby the heart requires most of the space. The apex is rounded, and extends into the root of the neck above the level of the sternal end of the first rib. Here it is best to listen to the lung. The base is broad, concave, and rests upon the convex surface of the diaphragm.
The breathing technique

During inhalation the ribs go up in order to increase the volume of the thoracic cavity. Simultaneously the vault goes down by the contraction of the diaphragm.

During exhalation the ribs move downward, the diaphragm flags and the vault moves upward. Inspiratory efforts are mainly produced by the external intercostal muscles.

When ventilation is increased, such as during exercise, expiration becomes active with contraction of the muscles of the abdominal wall and the internal intercostals, the accessory muscles of breathing. To these muscles belong the pectoralis major and minor, the abdominal oblique muscles and the sternocleidomastoid muscle. The anatomy of these muscles enables the upward movement of the ribs.

The abdominal muscles become active and assist expiration, for example, during excessive expiration but also when coughing or sneezing.

Interior Breathing
Anatomy of the lungs in the range of the alveoli
The main body of the lungs are the alveoli. Here the gas exchange takes place. During inspiration the alveoli have a diameter between 0.3 and 0.5 mm, during expiration the diameter is between 0.1 and 0.2 mm. In adults their number is estimated to more than 300 millions. The total surface is approx. 100 qm. The wall of an alveolum has a thickness of only 1/1000 mm and consists of cells which are permeable for oxygen and carbon dioxide. The alveoli are covered by a network of finest capillaries. In the capillaries the gas exchange takes places according to physical law (diffusion).

The volume of the lungs and the breathing volume

The volume of the lungs and the breathing volume depends on constitution, body size, age, sex, and fitness. In a state of rest an adult, weighing 70 kg, inhales and exhales with each breath (approx. 16 per minute) approx. 500 ccm air (breathing volume). Additionally the lung processes about a inspirative reserve capacity of 2.100 to 3.000 ccm, and an expiratorive reserve capacity of 800 to 1.200 ccm Lair. The residual air at maximum exhalation is 1.200 ccm.

Control of breathing

The rhythmic respiration is continuously influenced by the brain and a deliberate influence is limited.

The central control is located in the medula oblongata, the part of the central nervous system which connects the brain and the spinal cord. The rhythmic change between inhalation and exhalation takes places through discharge of inspiratory and expiratory neurons. In case one of these two nerve cell groups is active, the other one is obstructed.
In addition the rhythm is stabilized by peripheral influences. The inhalation is obstructed by a reflex if the lungs are expanded, and with it the exhalation starts simultaneously. And vice versa the decrease in the lung volume leads to an increase in breathing frequency.
Possible indications:

**Paediatrics**
Aspirated amniotic liquor, bronchospasm caused by infections of the upper airways, adenoid growth (enlargement of the tonsils), aspirated objects.

**Tracheotomy/laryngectomy**
After larynx carcinoma, esophagus carcinoma, oral cavity carcinoma, after accidents …

**Geriatrics**
Swallowing disorders, swallowing paralysis, for example, after apoplexy

**Post-operative treatment**
After oral and maxillofacial surgeries

**Diseases**
with increased salivation like, for example, mucoviscidosis.
3. General rules for suction

► The suction procedure should never take longer than 10 to 15 seconds!

► If possible – always two persons should attend the suction in order to quickly take appropriate actions in case of any complications.

► Direct observation of the person involved during the application is most important. The heart beat, the heart rate, the blood pressure, the colour of the skin, the peripheral oxygen saturation and even the sucked off secretion.

► Suction is always performed under sterile conditions. For every suction process a new catheter is used.

► The frequency of suction depends on individual needs. This may vary between once per shift and hourly suction. It is imperative: As often as necessary, as less as possible.

► The vacuum adjustment with premature infants is at 0.18 bar up to max. 0.4 bar with pupils and up to 0.8 bar with adults.

► The person involved should be informed on the suction procedure.

► Prior to suction the patient must have the right position. It is recommended either the sitting position or the lateral position.
Please note:

With every person involved, secretion mobilizing measures are required. Hereto the following measures are recommended:

- Inhalation:
The target is to produce aerosols with a wide range of droplets, in order to bring them into depth. Here various nebulizers can be applied: nozzle atomizer, manual atomizer and ultrasound atomizer.
- Essential oil for liquefaction of the secretion in the form of unguents for external application.
- Packings
- Postural drainage by direct use of gravity
- Vibration massage or tapping massage
Oral, nasal suction

Material:

- Suction device
- Fingertip
- Sterile suction catheter
- Unsterile/sterile gloves
- waste bin
- mask
- single-use apron
- eventually 0.9% NaCl
- lubricant
- eventually oxygen apparatus

Performance:

- Put on almost germ-free gloves
- Connect suction catheter to the suction device
- Vacuum adjustment (with adults up to 0.4 bar, with babies and infants up to 0.2 bar)
- Put on a sterile glove at the hand with the catheter
- Suck off the mouth first and then the nose
- Insert the catheter without suction, eventually prior to insertion it should be moistened with lubricant
- The length is approx. the same as the distance between the earlobe and the mouth or the nose
› Remove with suction and rotating movements
› The contact with the palate and the uvula must be avoided (nausea, vagus stimulation)
› Use the catheter only once
› Rinse the hose system with PVP iodine solution (1:1000) or with distilled water
› Checking the breath
› Checking the secretion
› Suction procedure and eventual findings must be documented
Tracheal suction

Material:

Please see “oral and nasal suction”, in addition a stethoscope is required

Performance:

› Vacuum adjustment (with adults up to 0.4 bar, with babies and infants up to 0.2 bar)
› Put on almost germ-free gloves
› Insert the disconnected catheter through nose or mouth without suction into the trachea, prior to insertion it should be moistened with lubricant; after insertion it is connected to the suction device
› Remove with suction and rotating movements
› Use the catheter only once
› Rinse the hose system with PVP iodine solution (1:1000) or with distilled water
› Checking the breath
› Checking the secretion
› Suction procedure and eventual findings must be documented
Suction in a tracheotomy patient

Material:
• Suction device
• Fingertip
• Suction catheter
• Sterile gloves/unsterile gloves
• Mask
• Single-use apron
• Eventually Cuff pressure gauge
• Tropping
• Eventually 0.9% NaCl
• Spare cannula
• Eventually oxygen apparatus

Performance:
› Vacuum adjustment (with adults up to 0.4 bar, with babies and infants up to 0.2 bar)
› Put on gloves
› Eventually the secretion must be liquefied with NaCl 0.9%
› Insert the catheter through the tubus into the tracheal cannula, with suction
› The catheter is as long as the tracheal cannula
› Remove the catheter with suction and rotating movements
› Use the catheter only once
› Rinse the hose system with PVP iodine solution (1:1000) or with distilled water
› Checking the breath, Checking the secretion
› Measuring the cuff pressure
› Suction procedure and eventual findings must be documented
Cleaning the tracheal cannula

The cleaning method for the tracheal cannula depends on the type of the cannula. Please contact your expert adviser!

**Required accessories**
- Cleaning box
- Cleaning brush
- Cleaning agent

**Procedure**
1. Remove contaminations in thoroughly rinsing the cannula with water and using a cleaning brush.
2. Immerse the disconnected inner and outer part of the cannula into cleaning solution for approx. 10 minutes.
3. Thoroughly rinse the cannula again with water in order to remove the cleaning solution.
4. Apply stoma oil on the inner cannula before reassembling.

**Possible problems and their solution**

**In the case of any bleedings:**
During insertion of the cannula it is possible to hurt the trachea. Here slight but not dangerous bleedings may occur. In the case these bleedings occur frequently, an ENT doctor should examine the opening.

Rarely heavy bleedings may occur. In this case bring the head of the patient in a downward position in order to prevent the blood from penetrating into the bronchi. The patient must urgently be brought to the accident and emergency department of the nearest hospital!

**In the case of a mucus clot in the trachea:**
When a mucus clot formed in the trachea, the patient has problems with breathing. In general a coughing is sufficient to disgorge the mucus clot. Pull out the inner cannula and check whether it is free. In the case these measure were not successful, the patient must immediately be brought to the nearest hospital.
Wichtig:

Für jeden tracheostomierten Patienten sollten ein Absauggerät und ein Inhaliergerät bereitstehen!

Das Stoma muss stets sauber und trocken sein, um das Risiko von Infektionen und Hautreizungen auf ein Minimum zu beschränken!

Exchange of cannulae

Required accessories
- Cannula and fixation
- Slitted tracheal compress
- Stoma oil
- Sterile, super soft compresses (e.g. Viewasof, 10x10 cm)
- 10 ml syringe
- NaCl 0.9% or stoma cleaning pads
- Tracheo spreader

Preparation
- Bring the patient into an upright or sitting position
- If necessary, first free the trachea by suction
- Remove the cannula, if the cannula is blocked it must be cleared first
- Clean the tracheostoma with NaCl moistened compress or stoma cleaning pad

Insert the cannula
Fix the two piece retaining band at the cannula and apply a slitted compress behind the sheath. Then apply stoma oil on the cannula with a compress. Keep the stoma opening stretched with two fingers. Insert the cannula with caution, following the bending of the cannula. Close the retaining band and make sure that the cannula is well fixed.
4. Suction in a respired patient

Open suction

Material:

- Suction device
- Fingertip
- Sterile suction catheter
- Unsterile/sterile gloves
- Sterile compresses
- NaCl 0.9%
- Waste bin
- Closed-circuit breathing apparatus
- Mask
- Apron

Performance:

- Patient must be pre-oxygenated with 100% oxygen for approx. 3 minutes
- Prior to suction the respirator alarm must be deactivated temporarily
- Put on unsterile gloves at the hand with the catheter
- Put on sterile close on the catheter guiding hand
- Remove the respirator or T-piece and deposit it on a sterile compress
- Insert the suction catheter without suction into the trachea
- Remove the catheter with suction and rotating movements
- Use the catheter only once
- Rinse the hose system with PVP iodine solution
- Blow up the lungs several times with the Ambou breathing bag
- Check the oxygen saturation
- Connect the patient to the respirator and reactivate it
- Check the secretion
Closed suction

Material:

- closed suction system
- sterile gloves
- NaCl 0.9%

The closed system consists of an extension with an opening for the tube or the tracheal cannula and an opening for the respiration hoses, a suction valve with connecting piece for the suction device and a protective cover in which the sterile suction catheter is located. Rinsing can be performed at the extension or the suction valve.

Performance:

- Preparations have to be made like for the open suction procedure
- Pre-oxygenation is not necessary
- Connect the suction catheter to the closed system, at the same time hold the tube with one hand
- Insert the suction catheter without suction, using the other hand. The depth of insertion was calculated and marked prior to insertion hand.
- The depth of insertion was calculated and marked prior to insertion
Activate the suction by pressing the suction valve and then pull out the catheter with caution into starting position

In the case a bronchial lavage is requested, inject some milliliters NaCl 0.9% into the inlet for rinsing, here do not apply suction

Fix the syringe with 5 to 10 ml NaCl 0.9% at the inlet, press the suction valve and inject the solution in order to rinse the catheter

Afterwards close the inlet, disconnect the catheter and switch off the suction

The sterile system is changed every 24 hours

The danger of a decrease in oxygen respectively the increase in carbon dioxide during the suction procedure is almost impossible. In most cases a pre-oxygenation is not necessary. The secretion can easily be checked through the inspection window, the closed suction protects the patient from cross infections, is quicker and can be performed with less efforts.

The disconnection from the respiration system should be avoided with this system.
Possible complications:

· Bleedings in the nasopharyngeal cavity
· Injury of the vocal cords
· Injury in the trachea
· Hypoxaemia
· Cardiovascular instability
· Bradycardia (by vagus stimulation)
· Tachcardia (by stress)
· Choke, sickness, vomiting, coughing
· Infections
Catheter size

There are suction catheters in the sizes 6 to 18 CH (= 2 to 6 mm diameter) obtainable. The most common in use are the 14 and 16 CH. Please note that the outer diameter of the suction catheter always must be smaller than the tube resp. the tracheal cannula (approx. half diameter).

Type of catheter

Standard catheter
A straight catheter with lateral eyes, most common in use. It is inserted without suction.

Atraumatic catheter
At the end of this catheter there is an integral ring, above there are lateral openings. This catheter is inserted with suction. Due to the special design of the catheter tip, it must be centred. The central ring prevents the contact between the lateral openings and the mucosa.

Bent catheter
Single-bent as well as s-bent catheters. This catheters enable the suction of the main bronchus. The catheter tip is inserted into the bronchus.

Double lumen catheter
These catheters have an additional lumen which enables the rinsing directly at the catheter tip. So it is possible to rinse a special part of the bronchi.

Oversized catheters
Enable a deep suction.

Short catheter
For tracheotomy patients.
Cleaning and service plan for the new ATMOS product lines
ATMOS Aspirator and ATMOS Battery

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For first use, use of a new device or a reprocessed device:

**Important notes:** Before operating the suction device, the user has to make sure that the device functions and that it is in good order and condition. The user has to observe the instructions in the operating manual as well as all other safety-related and maintenance information enclosed. For cleaning and disinfection only agents which are recommended by the manufacturer, may be used. Only sterile, single-use suction catheters may be used for suctioning. They have to be exchanged before each suction process. During use utmost attention to hygiene (e.g. disinfection of hands, wearing single-use gloves) is indispensable.

After each use the secretion container and the hose must be rinsed thoroughly with water. During storage the contamination of the device and other products must be avoided. The intervals stated in the list are non-binding guide values. Depending on the use shorter intervals may be necessary.

For each patient a new or reprocessed suction device must be used. Otherwise there is high and acute danger of infection for the patient, the user and any third person!
Atmos Plak-Vac™ – the suction toothbrush for oral hygiene

Are you worried about the safety of your patients during oral hygiene?

With coma vigil and bedridden patients it is always a risk to perform oral hygiene. Any choking of the patient must be prevented. Furthermore it is essential that the rinsing solution is extracted from the patient’s mouth.

In former times only a simple toothbrush was available but today - thanks to technical progress - many accessories are at hand. ATMOS has the solution for the above mentioned problems: the Plak-Vac™ toothbrush with its suction mechanism and reusable brushes. It makes oral hygiene easier and the thorough cleaning enhances the general well-being of the patient. With the regular use patients feel a positive stimulation.

The use

The Plak-Vac™ toothbrush is simply connected to the hose of the suction system. This means that regular use significantly reduces infections, bad breath and the danger of aspiration. The suction performance can be controlled. The secretion is extracted by suction and transported directly into the secretion container of the suction device.
Legal considerations

Who is allowed to suction?

Only trained, examined nursing staff is allowed. An order must be given by a doctor.

What is documented?

- Proof of performance with initials and time
- Observations/problems
- Vital parameters

Who is responsible for the supply of a suction device?

Each nursing facility and every home nursing service must provide at least one suction device for emergency use. The device must be financed by the nursing facility of the nursing service. The number of devices available depends on the size of the institution resp. on the number of persons attended.

The situation changes when a patient or an inhabitant must be sucked off continuously due to his diagnosis. Here the general practitioner must prescribe the suction device. By means of a cost estimate the service provider checks the absorption of costs with the sponsor. The prescribed accessories are paid by the sponsor as well. The patient gets the suction device on loan and may not be used for any third person.
Healthcare political considerations

With the introduction of the Diagnostic Related Groups - Medicare reimbursement model (DRG) the transition of a patient back home has changed considerably. The transition is often not only unexpected and quick but also combined with high care expenses. Devices must be procured quickly, decision of the sponsor take time. Course of action regarding the treatment are prescribes sparsely. The patient has not yet completely recovered. These and many other developments require the supply of high-qualified care at home and the relevant knowledge.
Recommended literature:

- Meyer/Friesacher/Lange, Handbuch der Intensivpflege
- Institut für Umweltmedizin und Krankenhaushygiene, Hygienestandard
- Kinderkrankenpflege und Gesundheitsförderung, Thieme Verlag
- Thiemes Pflege, Professionalität erleben
- www.stiftung-noah.de
- www.anint.de
- Anästhesie und Intensivmedizin für die Fachpflege, Springer Verlag
- Pflegerische Intervention, Annette Laube und Petra Schmalstieg, Thieme Verlag
- Anatomie und Physiologie für Krankenschwestern und andere Medizinalfachberufe, Gustav Fischer Verlag