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OTORHINOLARYNGOLOGY I

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COMENIUS UNIVERSITY IN BRATISLAVA

CONTENT

FOREWORD

Dear students,

the textbook Otorhinolaryngology I is written by the author from Jessenius Faculty of Medicine Comenius University in Martin who has been teaching otorhinolaryngology for decades. He has translated his experiences into the study materials in order to facilitate, and perhaps make the study of this medical field interesting. This first part of the book consists of chapters that cover area of nose and paranasal sinuses, oral cavity, pharynx, and larynx. Emphasis is placed on practical information that can be used not only by undergraduate students when studying otorhinolaryngology but also later in their clinical practice. Many of the conditions described here can be encountered even by primary care physicians for adults and children. The most common are inflammations of the upper airways, but also tumors or suffocation. We believe that the text may be of help to general medicine and dental students to understand the etiology, symptoms, diagnosis, including ENT screening methods, differential diagnosis, treatment and prognosis of ENT diseases.

Author

1 NOSE AND PARANASAL SINUSES

1.1 CLINICAL ANATOMY AND PHYSIOLOGY

The outer nose has the shape of an irregular triangular pyramid. There are various shape anomalies, and significant racial differences in the shape and size of the nose.

The nasal cavity is divided by the nasal septum into two, often asymmetrical parts. The nasal septum is formed in the front part by cartilage, in the back part it has a bony structure. Nasal cavity is made of antrum - *vestibulum nasi* and nasal cavity - *cavum nasi proprium*. In the posterior part the nasal cavity is connected to the nasopharynx through the choans. Blood supply is provided by branches of *aa. carotis externa and interna*.

There are three nasal conchas also called turbinates (*concha nasalis inferior*, *media* a *superior*) on the side wall of the nasal cavity. The lower concha is the largest and is placed most ventrally. There is a passage between the conchae - *meatus*. Below the lower concha there is the lower passage (*meatus nasi inferior*) which contains the opening of the nasolacrimal duct (*ductus nasolacrimalis*). The middle passage (*meatus nasi medius*) under the middle concha is the spacious and clinically most significant. It contains the opening of frontal and maxillary sinus (*sinus frontalis et maxillaris*), as well as anterior and middle ethmoidal sinuses (*sinus ethmoidales anteriores et medii*). The anterior group of paranasal sinuses opens into the nasal cavity in a space called the ostiomeatal unit (OMU). It is clinically significant anatomical structure. The pathological process in this area may easily spread to the adjacent sinuses. The OMU is bounded at the front by a thin bone lamella - *processus uncinatus*. It is a first structure that is usually removed during endoscopic surgery of the paranasal sinuses. Dorsally, there is the *infundibulum ethmoidale*, which is bounded at the back by a hemispherical bulge of the anterior ethmoidal labyrinth - *bulla ethmoidalis*. There might be anatomical variations of all above-mentioned structures. Under the upper concha, which can be indistinct, or under the nasal ceiling there is an upper passage with openings of sphenoid sinus (*sinus sphenoidalis*) and the posterior part of the ethmoidal sinuses (*sinus ethmoidales posteriores*).

The nasal cavity is covered with mucosa, which is divided into the olfactory area - *regio olfactoria* and the respiratory area – *regio respiratoria*. The olfactory mucosa is located in the area of the upper concha, on the ceiling of the nasal cavity and partly on the upper part of the nasal septum. In this area, the mucosa is thinner and may be yellowish. This mucosa contains the terminal ends of the olfactory nerve. In the respiratory area, the mucosa is pale red to pink, in the area of the middle and lower conchae it contains venous cavernous plexi, important for

the air flow and heating, humidification and cleaning of the air. From a clinical point of view, *locus Kieselbachi* is important. It is the portion of mucosa prone to bleeding, located at the cartilaginous part of the septum at the height of the anterior edge of the lower nasal concha.

The paranasal sinuses are lined with a multi-layered glandular epithelium. At birth, buds of the sinuses of the ethmoid bone are developed. Development of the frontal, maxillary and sphenoid sinuses takes place later and is ready before the end of puberty. The development ends at about the age of 20. The ethmoidal sinuses form a complex of 10 to 15 cavities that are interconnected. Under physiological conditions, each paranasal sinus is connected to the nasal cavity by a natural opening. Paranasal sinuses act as resonant spaces and affect the quality of the voice. They are thought to contribute to a partial reduction in skull weight. The largest variations in the size and shape of the delivery cavities are found in the frontal sinuses. Asymmetry is a common finding, hypoplasia to aplasia are less common, but often without clinical symptomatology.

1.2 EXAMINATION METHODS

1.2.1 History, inspection, palpation

In the history it is important to find the patency of the nasal cavity, the presence of secretion, the quality of smell, spontaneous and provoked pain. For example, information about the pain in the forehead when changing the position of the head, especially when leaning forward, is an important indication, as is the feeling of "spilling of the head". During the inspection, we detect visible changes (reddening of the skin, especially in the area of the entrance to the nasal cavity, swelling, change of shape). Palpably, we can detect crepitations, especially in the area of the root of the nose (suspected fracture). An important manoeuvre is lifting the tip of the nose with the examiner's finger. It is a simple orientation examination, especially suitable in small children who are not expected to cooperate at the examination.

1.2.2 Anterior rhinoscopy

Anterior rhinoscopy is a basic examination of the nasal cavity. We use Hartmann's *nasal mirror*, which is inserted into the nasal vestibule and opens slightly. Lighting is done through light reflected from external source by a front mirror, or by a separate electrical light source or in conjunction with an optical cable. In practice, the light most often used is that reflected by the front mirror, which must be set correctly. The *front mirror* has a slightly concave shape. In the middle there is an opening through which the examiner usually looks with his/her left eye. The light source is on the left side of the examiner's point of view. It is also possible the

other way around. The principle is that the right-hander usually holds the nasal mirror in his/her "less-skilled" left hand. The physician holds the patient's head with his/her right hand and moves it as needed. The positioning of the patient's head is important for a thorough examination. If the examiner is left-handed, it is recommended to hold the nasal mirror in his/her right hand. The headlight covers the examiner's right eye and the light source is on the right. If it is necessary to manipulate in the nasal cavity (local application of medications, etc.), the procedure is performed with a more "skilful" hand, with the right hand and *vice versa*. At the end of the examination, the slightly open nasal mirror is pulled out of the vestibule. This manoeuvre avoids trapping small hairs in the vestibule and prevents pain.

1.2.3 Endoscopic examination of nasal cavity

Endoscopic examination of the nasal cavity is a more detailed examination, which is fully indicated in the case of ambiguous or pathological finding in classic anterior rhinoscopy. It is performed with or without local anesthesia. A flexible or rigid technique with different angled ends is used (Fig.1), which allows examiner to look "around the corner". The endoscopic instruments can be connected to a monitor and a recording device for subsequent archiving.

Fig. 1 Flexible rhinoscope (freely available from https://search.creativecommons.org/photos)

1.2.4 Puncture of maxillary sinus

Maxillary sinus puncture is a diagnostic-therapeutic procedure that is usually performed in adults under local anesthesia; in children under general anesthesia. The most common indication is the suspected presence of contents in the cavity. After local anesthesia, a puncture needle penetrates under the lower concha through a thin bone lamella into the maxillary cavity. When penetrating the bony lamella, it is necessary to point the needle towards the lateral corner of the eye, otherwise there is a risk of injury to the surrounding structures (eyeball). Slightly heated saline solution is instilled into the cavity. The lavage fluid flushes the contents of the cavity and flows out through the natural opening located in the

middle nasal passage. In the presence of extensive pathological process that obturates the outlet of maxillary sinus, lavage is difficult, if not impossible. During instillation, it is recommended to close the opposite nasal cavity by pressing the patient's finger on the nasal wing, while the patient "blows" his nose. This manoeuvre facilitates the emptying of the maxillary cavity. We evaluate the quality of the lavage fluid - an admixture of pus, blood, etc. In some cases, it is necessary to repeat the puncture. Lavage of the maxillary cavity can also be done through the physiological orifice, *ostium*, but due to the frequently changed anatomical conditions, this method is rarely performed. Recently, the frequency of punctures has been significantly decreasing, as the procedure is "only" relieving does not solve the problem usually at a dysfunctional ostiomeatal unit (i.e. dysfunctional communication between the nose and paranasal sinuses).

1.2.5. Sinusoscopy of maxillary sinus

Sinusoscopy is an endoscopic examination, the principle of which is similar to that of classical puncture. The difference is that the puncture needle has a larger diameter so that angular rigid optics can be inserted into it. With this technique, it is also possible to take material for histopathological examination. If a pathological process in the area of the medial wall of the maxillary sinus is suspected, the puncture through the anterior wall of the maxillary cavity in the area of the *fossa canina* is a more suitable access route. In the case of suitable anatomical conditions, i.e. with the free mouth of the cavity, a sinusoscopic examination can also be performed through this mouth.

1.2.6. Imaging methods

In the past, the most commonly used technique was the *X-ray examination* in two basic projections - anteroposterior and lateral. Currently, the frequency of these examinations is declining. The reason is the radiation exposure and the existing other possibilities of diagnostics. X-ray examination is currently used mainly for persistent acute inflammation of the sinuses and fractures of the nasal skeleton. In other indications, such as chronic inflammation of the nose and sinuses, tumors and more extensive injuries, a more detailed *CT examination* is preferred. However, indication for CT must be also carefully considered because of certain radiation exposure of this examination. *Ultrasonographic (USG) examination* is a suitable alternative to the classic X-ray examination, especially of the frontal and maxillary cavities in patients in whom it is necessary to exclude or at least minimize radiation exposure (pregnant women, children).

1.2.7. Objective assessment of function.

The basic assessment of function includes testing of smell - olfactometry and nasal patency - rhinomanometry. Depending on the instrumentation, there are various modifications to these tests. *Olfactometry* is a method of determining the quality of smell. The subject gradually inhales solutions with increasing concentration of odour substance. First, one half of the nasal cavity is examined, the other half being blocked by the pressure of patient's finger on the nasal wing. Volatile substances stimulate *n. olfactorius*; in some cases, also *n. trigeminus*, or taste endings *via chorda tympani* and *n. glossopharyngeus*. In this settings olfactometry is subjective examination that requires the cooperation of the patient. If the patient does not cooperate, or dissimulate (pretends a disease), the evoked brain potentials after nasal mucosal stimulation are examined. *Rhinomanometry* is a method for accurate measurement of the patency of the nasal cavity. A simpler examination of the patency of the nasal cavity can be done by Glatzel plate test or its modifications. The cold metal plate or mirror are placed under the entrance to the nasal cavity of the patient. The extent of the condensation on the plate is indicative of the patency of the nasal cavity.

1.3 DISEASES

1.3.1 Acute inflammation of the external nose

Common diseases of the skin of the outer nose include *lupus erythematodes*, *acne vulgaris rosacea* and others. Most of these diseases belong to the care of a dermatovenerologist. From the ENT point of view, folliculitis and the furuncle of the nasal passage and the upper lip area are particularly important.

Etiology: most common staphylococcal infection, previous injury, hair follicle infection.

Symptoms: pain, feeling of pressure, reddening of the surroundings with a central whitish-yellow purulent centre, swelling of the surrounding structures.

Diagnosis: clinical picture and local findings.

Treatment: topical antibiotic (ATB) ointment and tannin-alcohol. To eliminate mechanical manipulation (do not push out), in the case of furunculus, the surroundings are also affected and there is a risk of thrombophlebitis of *vv.angularis* and *a. ophthalmica*, with the possibility of orbital cellulitis and spread to cavernous sinus, which is a life-threatening condition.

Depending on the severity of the condition, general ATB treatment or hospitalization is also indicated.

1.3.2 Diseases of nasal cavity and paranasal sinuses

1.3.2.1 Inflammation of the nasal mucosa

Inflammation of the nasal mucosa is divided into acute and chronic.

1.3.2.1.1 Acute inflammation of the nasal mucosa

Acute inflammation of the nasal cavity (rhinitis, *acute rhinitis* or *coryza*) most often occurs as a primary, separate infectious inflammation, often with concomitant involvement of the nasopharyngeal mucosa. It occurs often and usually has an uncomplicated course.

Etiology: the most common rhinoviruses, possibly bacterial infection. Secondary symptomatic acute rhinitis occurs in some infectious diseases such as measles, scarlet fever, infectious mononucleosis, influenza and others.

Symptoms: fatigue, lack of appetite, decreased performance and concentration (*aprosexia nasalis*), itchy nose, watery and later purulent secretion, feeling full nose, headache.

Diagnosis: clinical picture and local findings.

Treatment: general - in severe conditions associated with fever - antipyretics, rehydration (lots of liquids), rest regimen, vitamins; local - rinsing the nasal cavity with saline solution (physiological solution), anemizing nasal drops - decongestants. It is important to instruct the patient on the correct application of nasal drops. The drops are applied to the lateral wall of the nasal cavity with a slight tilting of the head to the side and a backward. The drops are often applied incorrectly with the head tilted which causes them to flow into the pharynx. In children, this is usually a reason they refuse this kind of treatment. Decongestant nasal drops can be used for a maximum of 10 days at recommended dosing, due to the risk of irreversible mucosal damage - the development of chronic drug-induced rhinitis.

A special situation is an acute rhinitis in infants up to one year of age. The overall clinical symptoms are more pronounced. Under physiological conditions, the infant is able to suck, swallow and breathe at the same time during feeding. The basic condition for suction is to create a vacuum in the oral cavity. With an obstruction in the nasal cavity , the infant has to inhale through the mouth, which requires more energy when eating. This results in a child's irritability, respiratory disorders, in extreme cases even a nutritional problem. It is crucial to suction nasal passages to open the airways, followed by gentle local application of decongestants the most suitable is wiping the nose with a cotton swab.

1.3.2.1.2 Chronic inflammation of the nasal mucosa

There are several classifications of rhinitis.

One of the most used is the division according to etiopathogenesis:

1) allergic   - seasonal allergic rhinitis (*polinosis*, pollen or hay fever)

                  - perennial (year-round) vasomotor

2) non-allergic - vasomotor

                  - infectious

                  - others – drug-induced (medicamentous),,...

Division according to pathological – anatomical aspect:

- chronic rhinitis
- chronic atrophic rhinitis
- chronic atrophic rhinitis with fetor (ozaena)
- rhinitis chronic medicamentosa, pregnancy rhinits

Allergic rhinitis (*rhinitis allergica*)

Pathomechanism: Allergic rhinitis is divided into seasonal (*rhinitis pollinosa*) and perennial allergic vasomotor rhinitis. The disease is evoked by an abnormal reaction (hyperreaction) of the body during repeated contact with the antigen. IgE bound to mast cells plays an important role. After contact with the antigen they degranulate and release the mediators of the allergic reaction with involvement of the "target" organ.

Occurrence: Seasonal rhinitis occurs according to climate conditions from early March to the autumn. Allergen is pollen from various plants. Year-round vasomotor allergic rhinitis occurs throughout the year; the allergen can be food, mites, animal fur and others.

Symptoms: Itchy nose, watery secretion from the nasal cavity, tearing, swelling of the eyelids, headache, sneezing.

Diagnosis: History, local findings - swelling and livid staining of the mucosa, the presence of eosinophils in the nasal secretion, the presence of IgE - specific antibodies in the nasal mucosa, the results of a detailed allergological examination, including testing.

Treatment: Symptomatic, which leads to the elimination of the symptoms - antihistamines, topical treatment with corticosteroids (they do not resorb), decongestants, cromoglycans; causal treatment - specific pre-season desensitization (application of gradually increasing doses of antigen in the pre-season period). Treatment of underlying cause to minimize. To

minimize exposure, it is more suitable to stay outdoors in the morning and especially after the rain when the concentration of allergens is low.

Approximately one third of patients with allergic rhinitis are at risk of developing lower airway hyperreactivity with possible development of bronchial asthma. The treatment of such a patient is a multidisciplinary problem, requiring the cooperation of several specialists.

Vasomotor (non-allergic) rhinitis

Pathomechanism: Is not clearly known, neurovascular dysregulation of the nasal mucosa is presumed. The disease is elicited by various internal (e.g. stress, hormonal changes) and external causes (e.g. cold, heat).

Symptoms: A feeling of alternating obstruction of the nasal cavity, watery secretion

Diagnosis: The diagnosis is made on the basis of history and local findings. During the asymptomatic stage the mucosa is pale, mucosa is swollen and congested during the attack. A complete allergological examination is required.

Treatment: Adjustment of lifestyle, local short - term application of decongestive nasal drops, local corticosteroids are important. In some cases, surgical treatment to reduce hyperplastic mucosa may be indicated.

Rhinitis chronica *(rhinitis chronica simplex, hyperplastica)*

It is term for long term irritation , stimulationof nasal mucosa. Result is hypertophical changes of mucosa. The biggest changes are detectable on turbinates (more lower) It is typical for hyperaemia and edema, or in worse cases hypertrophy of tissue.

Pathomechanism: Alternating obstruction of half of the nasal cavity, caused by increased filling of the venous complex of the conchae. Prolonged, frequent irritationwith gradual irreversible damage to ther mucosa changes can lead to an atrophic form. Its course is uncomplicated.

Symptoms: Difficult breathing, mild mucus to purulent secretion, sometimes later a feeling of dryness, with the formation of crusts. Smell disorders may also occur.

Diagnosis: History, swelling of the mucosa detected by rhinoscopy dark red and partially red – violet. Especially is affected area around lower turbinates. Often this thrue tissue hypertrophy begins at the posteror turbinates, ussualy inferior. These changes are well visible by rhinoscopy posterior procedure or endoscopical examination of the nasopharynx. The choanas are obturated by like mulberry looks tissue.   In early stages after application of

vasoconstrictive drops the swelling subsides, later in hyperplastic form, there is no responce. There no exist sharp border.

Treatment: Conservative – elimination of suspected etiological agents. Irrigation of the nasal cavity with a saline solution, inhalation, change of the climate. It is important to prevent, if possible, avoid the contact with the triggering factor. Symptomatic medical treatment by decongestant drops intranasally (for short-term treatment), topical corticosteroids, epithelizing ointments, inhalations, climatotherapy.

Surgical – the aim is reduction of hyperplastic tissue by different ways.

Nasal polyps (*polyposis nasi*)

Nasal polyps are soft pediculate formations of grey or gravy-pink color caused by inflammation.

Etiopathogenesis: They are of allergic inflammatory origin, have different size and histologically they are benign lesions. They grow from the nasal mucosa and the mucous membrane of paranasal sinuses, based on passive congestion of submucosal tissue. They often block the natural openings of the paranasal sinuses, and also the sinuses themselves (most often the olfactory labyrinth), which leads to disorders of paranasal sinuses ventilation.

Symptoms: Clinical symptoms are dominated by nasal obstruction, hyposmia to anosmia, recurrent sinusitis and headache.

Diagnosis: History, anterior and posterior rhinoscopy, rhinoendoscopic examination, CT examination.

Treatment: Surgical - mostly endoscopic, histological examination is required.

Chronic simple atrophic rhinitis (*rhinitis chronica athrophica simplex*)

Etiopathogenesis: Atrophy of mucosa and submucosal tissue based on inflammatory changes of arterioles (periarteritis and endarteritis), epithelial metaplasia, degeneration and atrophy of submucosal glands, fibroblastic proliferation. The causative agent is dry, hot air, dust, chemical fumes and the like.

Symptoms: Dryness, itching, formation of crusts, olfactory disorders.

Diagnosis: History, local finding.

Treatment: Nasal irrigation (saline lavage), epithelizing ointments.

Chronic atrophic rhinitis with fetor/Atrophic rhinitis ozenosa *(rhinitis chronica atrophica foetida, ozaena)*

Etiopathogenesis: Extensive chronic inflammation of the mucosa causing atrophy, *Klebsiella ozaenae, Bacillus foetidus and Corynebacterium diphteriae* (mitus type) can be confirmed by culture, younger women are more affected.

Symptoms: Typical triad - unpleasant, strong odor, scar and crust formation, atrophy of mucosa and submucosal tissue. The patient is not aware of the odor due to anosmia.

Diagnosis: History, local finding - marked atrophy, enlargement of nasal cavity.

Treatment: The goal is to increase blood flow to the mucosa and submucosal tissue. Saline lavages, crusts removal, light anterior tamponade with iodglycerin (Gottstein's tamponade), administration of vitamins A, B, C, D is suitable, in some cases antibiotic treatment is indicated. Surgical procedures narrowing the nasal cavity are possible in extremely serious cases.

1.3.2.2 Deformations of nasal septum and external nose

Etiopathogenesis: Deformities of the nasal septum are relatively common in Caucasians; they occur in up to 70%. They are divided into congenital and acquired. Congenital deformities are caused by a discrepancy in the growth of the cartilage and bone skeleton of the nose. Acquired deformations are often of post-traumatic origin. A small group of patients also might have clinical symptoms. The most common is nasal breathing disorder, sometimes associated with recurrent sinusitis and headaches.

Deformations of the outer nose are less common and are also divided into congenital and acquired. The outer nose is very visible part of the human body and even minimal deformities can lead to mental health issues of the patient.

Treatment: Surgical - the correction of the nasal septum is called *septoplasty*, correction of the outer nose is *rhinoplasty*. In some cases, it is possible to adjust the shape of the nasal septum and the shape of the outer nose during one surgery. When indicating correction of the shape of the outer nose, it should be taken into the account that up to 70% of patients are not completely satisfied with the resulting final shape. Therefore, it is recommended to provide detailed photo documentation before and after the procedure. The procedure is usually considered cosmetic. There are several techniques for the surgical treatment of deformities of nasal septum and outer nose. These procedures are usually performed under general

anesthesia. Surgical treatment should be performed after finishing the skeletal growth (around 16-18 years of age). On the other hand, extensive congenital or acquired changes in the shape of the external nose are corrected even at a younger age.

1.3.2.3 Bleeding from nasal cavity – epistaxis

Nasal cavity is the most common site of bleeding within the respiratory system. Anterior nosebleeds are the most common, up to 90% of nosebleeds occur within the vascular watershed area of the nasal septum known as Kiesselbach's plexus (Fig.2).
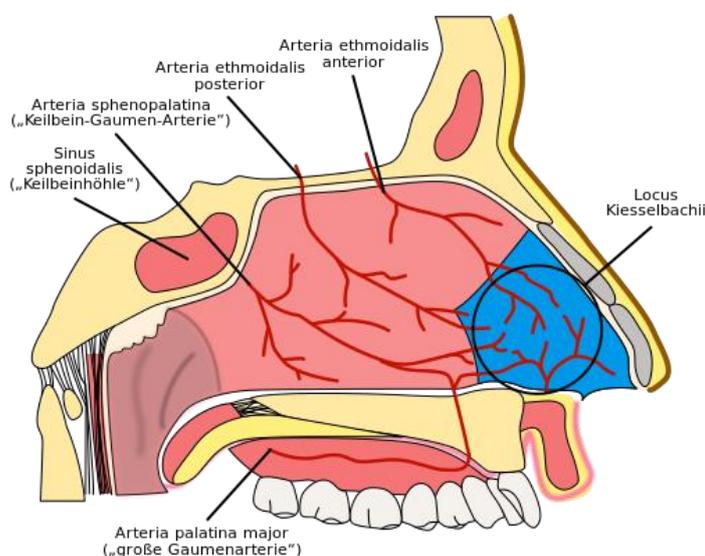
Fig.2 Kiesselbach plexus (marked in blue) ("File:Locus Kiesselbachii Schematic.svg" by FirstAdmiral iThe source code of this SVG is valid. Licensed with CC BY-SA 3.0. https://creativecommons.org/licenses/by-sa/3.0/de/deed.en)

Etiopathogenesis: The causes are local (tumor, injury, inflammation) and general (hypertensive disease, coagulo-, vasculo-, thrombocytopathy, infectious causes, renal diseases and others). Uncontrolled hypertension is the most common cause of massive nasal bleeding in patients 35 years of age and older is uncontrolled hypertension. In this case, epistaxis serves as a "safety valve", which can prevent intracranial bleeding.

The first laic help: The initial treatment consists of applying a cold - compress (vasoconstrictive benefit) on the dorsum of the nose, pressing the nasal wing on the affected side against the nasal septum, local application of decongestant nasal drops and a slight head tilt.

This maneuver minimizes the risk of swallowing fresh blood which can cause nausea and vomiting. This could potentially lead to further rise in the blood pressure and worsening of the nosebleed.

Further treatment depends on the extent and type of bleeding.

Treatment: The treatment is based on the extent and type of bleeding. Mild bleeding from the nasal septum, if bleeding source is visualized, is treated with electrical or chemical - AgNO3 solution, cauterization. If the patient is bleeding from both sides of the nasal septum, from identical sites, both methods are contraindicated. The reason is possible bilateral damage to the perichondrium. Perichondrium provides nutrition to cartilage that does not have blood vessels itself and perforation of the septum could easily occur. *Diffuse mild bleeding* should be treated by inserting trombogenic (fibrin) foam into the nasal cavity. It is recommended to drip the foam with saline solution before insertion, as dry foam will significantly reduce its volume after contact with blood. Thrombogenic foam generally does not require removal, It´s obviosly will fall apart spontaneusly. A cellulosic swab may be used, too, but dry. It is necessary to remove it, obviously after 2 days.

In case of more severe local, diffuse bleeding, or in the situation where the source of bleeding cannot be identified, we use **anterior nasal packing (anterior tamponade)**. Nasal packing can be achieved by using ribbon guauze which is impregnated with petrolatum, after anesthetizing nasal mucosa.. The length of the tamponade depends on the size of the nasal cavity and the intensity of bleeding. To insert packing, we use "layers method ", when the gauze layers one on top horizontally, or „continuos" tamponade when the cavity is gradually packed by the "back–front method" from the bottom of the cavity until the cavity is completely filled; the other way is continuous tamponade when the cavity is gradually packed by a "back-front system". The individual gauze layers must be pressed. In practice, a combination of both methods is used. The entrance to the nasal cavity is sealed by tampon inserted to the vestibulum nasi which makes the tamponade fixed. After packing, it should be checked if there is no blood flow to the pharynx. In case of a slight flow, wait about 10 minutes. If the bleeding continues, a packing has to be exchanged. Then the packing is inserted deeper into the nasal cavity and the individual layers are compressed more. If the bleeding continues after the third attempt, we can do a posterior packing and then anterior one. The rationale for of the posterior tamponade is to "close" the nasal cavity or the choana from behind. Both the anterior and posterior tamponades are usually left for 48 hours, in some cases longer. The patient with the posterior and anterior tamponade should be hospitalized.

Prophylactic antibiotic treatment is indicated in a patient with repeated or prolonged anterior tamponade and also in posterior tamponade. Epistat can also be used to stop massive bleeding. Epistat is a plastic tube with two inflatable balloons (similar to an intubation cannula). The larger balloon after instillation takes the role of anterior tamponade and obstructs the nasal cavity, the smaller one closes the choanae as the posterior tamponade. The advantage of the epistat is more thorough compression as well as the possibility to breathe through the affected part of the nasal cavity. In patients with more significant deformity of the nasal septum, it may not be possible to insert an epistat into the nasal cavity. In cases of significant blood loss, it is recommended to check blood count after volume repletion, if patient is on anticoagulation, we recommend to check coagulation factors. The internist doctor should be consulted in patients with high blood pressure.

In cases where bleeding cannot be stopped by the procedures already mentioned, endoscopic electrocoagulation in general anesthesia is indicated. If the bleeding persists, intravascular embolization is recommended, this procedure is done by our interventional radiologist.

The ligation of the supplying vessels depending on the site of the bleeding is the method of last choice. One possibility is the ligation of the external carotid artery behind the branch of *a. lingualis*. During this procedure, increased attention should be paid to the identification of the external and internal carotid arteries. There is a risk of intracranial ischemia with *a. carotis interna* ligation, especially in the elderly. An important identifying feature of the *a. carotis interna* is the fact, that it has no branches in the extracranial part.

1.3.2.4 Foreign bodies in the nasal cavity

Wedged foreign bodies in the nasal cavity are relatively common, they occur especially in young children after insertion of foreign body by the child himself. Children usually deny this for the fear of punishment. Children usually deny this for the fear of punishment.
Symptoms: Initially insignificant, difficulty breathing through the nasal cavity may occur. Later, there are manifestations of "atypical unilateral rhinitis" of a serous or even blood-tinged character.

Diagnosis: Usually simple based on the history, sometimes it is enough to lift the tip of the nose or do an anterior rhinoscopy. The foreign body is usually located in front of the nasal cavity.

Treatment: Relatively simple. Tweezers must not be used to remove a round foreign body with a smooth surface, as there is a risk of insufficient gripping and deeper insertion. In this case, the use of a hook is indicated, which is inserted behind the foreign body and then pulled in the anterior direction or you may say pulled anteriorly. In rare cases, if it is not possible to remove a foreign body (wedged body, non-cooperating child) extraction under general anesthesia is indicated. Foreign bodies of other shapes can be removed with tweezers. An example of foreign body is in Fig.3.
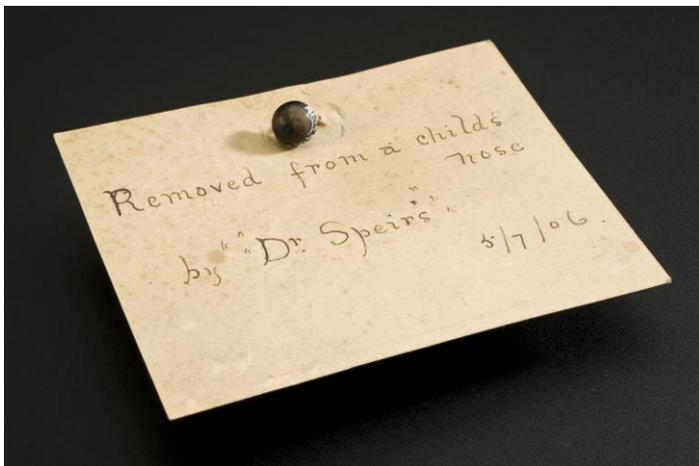
Fig.3 Foreign body ("File:Button surgically removed from a child's nose, United Kingdo Wellcome L0058148.jpg" is licensed under CC BY 4.0, freely available from https://search.creativecommons.org/photos/, not modified)

1.3.2.5 Inflammation of paranasal sinuses - sinusitis

Inflammation of the sinuses is divided into acute and chronic.

1.3.2.5.1 Acute sinusitis

Acute sinusitis often occurs as a secondary infection, in almost every infection involving nasal mucosa.The infection most often spreads from the nasal cavity - rhinogenic origin, from carious teeth - dentogenic origin, or more rarely from blood - hematogenous origin. In some cases, the infection occurs directly - primarily in the sinuses or after their injury.

Etiology: The infection is most often viral, but may also be of bacterial origin.

Pathomechanism: Swollen mucosa blocks the physiological opening of the cavity, which causes air resorption and the formation of negative pressure inside the cavity, increases the production of secretions that are secondary contaminated and that persist in it. The mucosa is irritated, swelling increases and the opening of the cavity is even more blocked.

Symptoms: Fatigue, headache, difficulty breathing through the nose, watery to purulent discharge, subfebrile temperature, smell also may be affected. Inflammation of the ethmoid complex is the most common, but patients are usually asymptomatic. Inflammation of the frontal and maxillary sinus cavities occurs with more prominent symptoms.

Diagnosis: Diagnosis is made on the basis of history, anterior rhinoscopy (swollen, reddened mucosa, presence of secretion). In the past, X-ray diagnostics - anteroposterior projections - were often used. Nowadays, X-ray examination is reserved for conditions that do not improve despite adequate treatment (Fig.4).
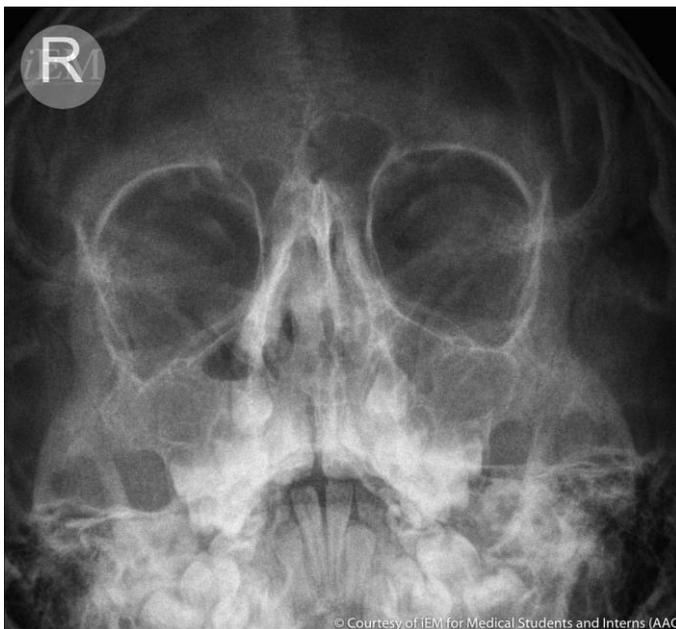
Fig.4 X-ray - acute sinusitis. Air-fluid level in the right maxillary sinus and loss of air in the left maxillary sinus. Air presence is also decreased in ethmoidal sinuses. (by iem-student.org is licensed under CC BY-NC-SA 2.0, not modified)

Treatment: The principle of the treatment is to alleviate the obstruction in the natural opening of the paranasal cavity. This manoeuvre restores the natural ventilation and drainage. Rinsing of the nasal cavity with physiological solution, decongestants nasal drops with emphasis on the method of application (see chapter 1.3.2.1.1.) or nasal spray are indicated. Oral antihistamines are suitable according to the patient's condition, combined with

decongestants (pseudoephedrine), topical corticosteroids. In case of prolonged course, if resistant bacterial flora is suspected, local and general antibiotics are indicated. If maxillary sinus infection persists despite conservative treatment measures, and air-fluid level is visible on the x-ray, the puncture of the maxillary cavity is indicated. The frequency of maxillary cavity punctures has been declining. If lavaged fluid has odor or contains pus, the dentogenic origin of sinusitis must be considered. In this case, the examination by dentist is indicated.

1.3.2.5.2 Chronic sinusitis

Chronic sinusitis *(sinusitis chronica)* (Fig.5) occurs after prolonged acute inflammation, in anatomical anomalies due to disorders in ventilation and drainage of the nasal and paranasal cavities, persists for 12weeks or more. Chronic sinusitis is related with affection of nasal cavity, we called this problem chronic rhinosinusitis. Fungal infection also plays an important role.

Symptoms: Unspecified mild headaches which progress to more severe headaches during disease exacerbation, feeling of a full nose, itching in the nasal cavity, smell disorders, postnasal drip (mucus draining into the nasopharynx).

Diagnosis: History, rhinoscopic examination, CT examination which is important for the assessment of changes in the area of the cavities opening (ostiomeatal unit).

Treatment: Surgical, with endoscopic approach being preferred (functional endoscopic surgery of the nose and sinuses, FESS). In some rare cases, it is necessary to choose an external approach. The aim of treatment is to restore physiological anatomical conditions. The endoscopic approach can be used to restore the anatomical conditions in all paranasal cavities, including sphenoidal cavity. In the postoperative period, local care is important - suction of the secretion and rinsing of the nasal cavity with saline.
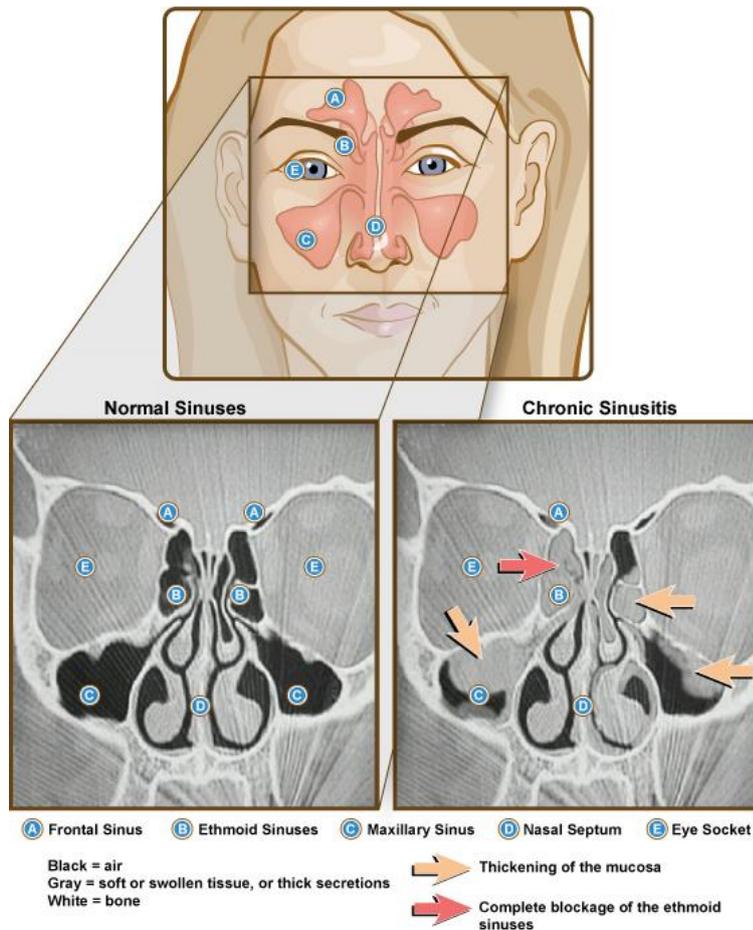
Fig. 5 Chronic sinusitis ("File:Sinuses and Sinusitis (5937085231).jpg" by NIAID is licensed under CC BY 2.0 available from https://search.creativecommons.org/photos/, not modified)

1.3.2.6 Complications of sinusitis

Complications of the sinusitis are divided into acute and chronic. Another division is for local, orbital, intracranial complications.

1.3.2.6.1 Local complications

Local complications arise from the spread of infection from the surrounding tissues, by blood - hematogenous spread (venous thrombophlebitis) or by lymphatics.

Mucocele is a late complication, which is develop when the ostium of sinus is obturated or blocked. The sinus is filled out of sterile fluid mucus, later more viscous. The fluids is to press on the sinus walls, which are thinned, leading to slow displacement of adjacent structures,

mainly orbital contents. Mucocele is more often to develove in the frontal and ethmoidal sinuses. If mucocele is infected, it is mucopyocele.

Diagnosis: Clinical picture – headache, local finding with displacement of eyeball, diplopia history, rhinoscopic examination, CT examination.

Treatment: Surgical revision with drainage os affected sinuses, antibiotics.

Osteomyelitis is rare complication due to frontal rhinosinusitis. Dangerous is due to spreading infection into diploetic bone between the inner and outer tables of skull. The firstly is affected venous system as a septic thrombosis. Intracranial complications may occur.

Diagnosis: History, local finding, rhinoscopic examination, CT examination.

Treatment: Multidisciplinary – surgery – evacuation of pus, resection of affected bone, broad spectrum and long term intravenously antibiotics, etc. .

1.3.2.6.2 Orbital complications

Preseptal cellulitis, orbital cellulits, subperiostal and orbital abscess, thrombosis of cavernous system

Paranasal sinuses are to close related with orbita, it is most commonly involved these structures in complication os rhinosinusitis. There is necessary cooperation with ophthalmologist. More often are affected children, but their symptoms are not so typical.

Preseptal cellulitis - Typical is swelling and reddening of eyelid. Important signes are good eye movement and position, intact vision and conjunctiva is normal. CT will show only diffuse thickening of the eyelids and conjunctiva. The treatment is that of sinusitis, include antibiotics. Occasional an abscess of eyelid is indicated for surgical drainage.

Orbital cellulits - It is a virulent dangerous infection which may prove quickly to death. Problem is spreading to cavernous system by thrombosis or meningitis. Typical symptoms are swelling, reddening of eyelid, but proptosis and chemosis may be present. In worse cases patients complained to pain, diplopia, vision can be intact, but failing, too. Infection is spreads in the orbital fat, around muscles, vessels and optic nerv. Diagnosis is based on history, local finding, CT. Treatment of i.v. antibiotics, nasal drainage is often enough, if there is no response indicated is surgical drainage.

Subperiostal abscess – it develops if oedema and cellulitis progress to pus formation, which one is under the orbital periosteum generally in relation to the ethmoids. Typical is dislocation of orbital structures slightly proptosed and dislocated inferio – laterally. Tension on the optic nerve can produce blindness is not properly immediately treated. Diagnosis is the same like in orbital cellulitis case. Treatment is combined   external surgical – drainage abscess and endoscopical opening ethmoid complex.

Orbital abscess, phlegmonous orbital affection – clinically is similar like subperiostal abscess. Symptoms are more prominent. Diagnosis is the same like in orbital cellulitis case.Treatment is surgical with cooperation with ophtalmologist – open and drainage abscess, with broad spectrum antibiotics.

1.3.2.6.3 Intracranial complications

Intracranial complications are currently less common. Naturally can spread infection from sinuses through natural neurovascular foramens. Posttraumatical spreading is more often, due to missing natural barriers.

Epidural abscess is a complication caused by the transition of infection from the frontal or ethmoidal sinuses. It is collection of purulent liquids between skull and the dura. The symptomatology is often mild, limited to headache, even with extensive damage. The patient may be euphoric and may respond inadequately verbally, which is typical for prefrontal symptomatology. Problem is increased intracranial pressure, fever, nausea, vomiting. With diagnosis is important ophtalomological examination (swelling of papilla), CT or MRI. Indication for treatment is vital surgical multidisciplinary - neurosurgeon - complication, otorhinolaryngologist - primary affected sinus. Broad spectrum antibiotics, corticosteroids, mannitol are indicated. The patient must be control on intensive unit care. It is life threatening health problem.

Purulent meningitis (purulent leptomeningitis) is a serious complication caused by the spread of infection through the *lamina cribrosa* into the intracranial space. The symptoms are more pronounced, characterized by persistent headaches, opposition and stiff neck. Gradually there is an increase in intracranial pressure, the finding in cerebrospinal fluid is positive (leukocytes, proteins).

Subdural abscess – can also arise from ethmoidal system. Symptoms are similar like epidural abscess case, but more serious. The patient may have impaired consciousness and may even be

comatose. The disease is immediately life-threatening, rapid diagnosis and treatment are essential. It leaves frequent neurological consequences. Mortality is relativelly highier. Diagnosis, treatment is simillar like previos problem.

Brain abscess is a complication of subacute or chronic frontal sinusitis. The infection spreads through the vascular canals or from an inflammatory altered lesion of the posterior wall of the frontal cavity. The clinical picture is dominated by headaches. The symptoms can also be atypical or insignificant. Personality disorders may predominate.

To make diagnosis is sometime difficult. It is no easy correctly recognize, mainly in the cases, that is missing information about frontal sinuses problem. CT or MRI is essential. Treatment is the same like previous problem. It is multidisciplinary problem (radiologist, ophtalomologist, neurologist and neurosurgeon, otorhinolaryngologist), cooperation is necessary. The patient must be under control on intensive care unit.

1.3.2.7 Specific inflammation of the nose

Specific inflammations include tuberculosis, syphilis and rhinoscleroma.

1.3.2.7.1 Tuberculosis is a rare specific inflammation caused by *Mycobacterium tuberculosis*. It occurs in several forms: tuberculosis, exudative-ulcerative form and lupus. The patient reports difficulty breathing through the nasal cavity, the formation of crusts, ulcers, nodules.

Diagnosis: Clinical picture (nodules, exulcerations, scars), bacteriological, serological and histological examination. The treatment is pharmacological by antituberculotics.

1.3.2.7.2 Syphilis (lues) is a venereal disease caused by a bacterium - the spirochete *Treponema pallidum*. It is in acquired and innate form. Nose involvement usually occurs in three stages as initial sclerosis, erythema and syphilitic papules, and the last stage, which is rarely seen today, is gumma. The treatment is pharmacological. The prognosis with early treatment is good.

1.3.2.7.3 Rhinoscleroma is a chronic specific inflammation of infectious origin caused by *Klebsiella scleromatis*. The disease usually begins in the nasal cavity, but can spread to other parts of the respiratory system and to the skin. The disease occurs in three stages as atrophic

catarrh, specific infiltrate and scarring. The treatment is pharmacological with antibiotics. The prognosis is uncertain for frequent recurrences.

1.3.2.8 Injuries to the face and bones of the sinuses

Injuries of the nose are the most common. Fractures of the bones of paranasal cavities are less frequent but more clinically serious, because the surrounding structures are often injured (Fig.6).
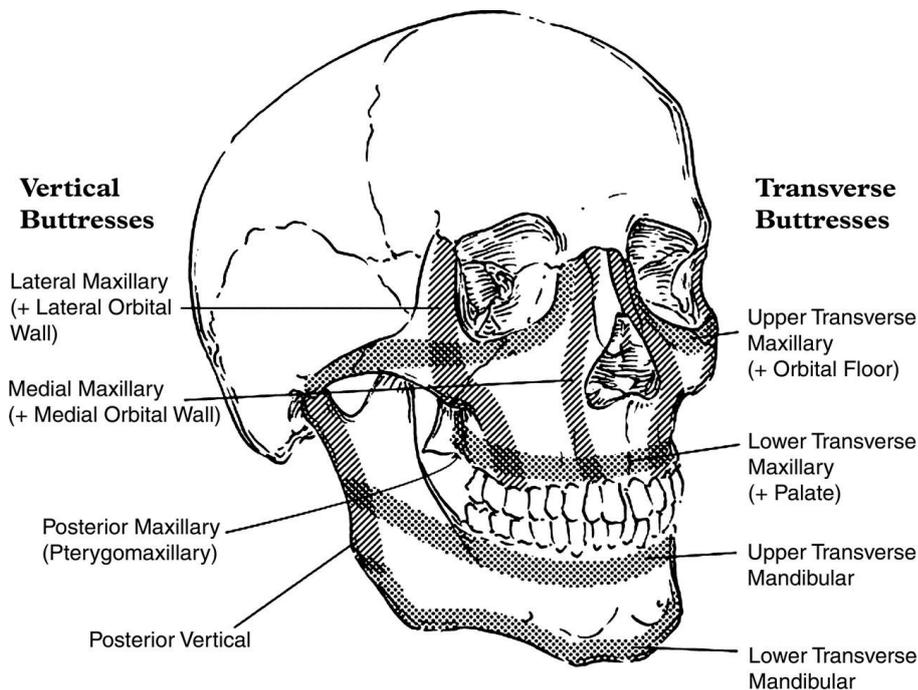
Fig.6 Drawing of the adult skull. It shows the four paired vertical buttresses and the four transverse buttresses. All buttresses exist in areas of relative increased bone thickness (from Hopper et al., 2006; with permission).

1.3.2.8.1 Fractures of the nose

The extent of nasal bone damage depends on the direction and intensity of the force applied.

Symptoms: Nasal dislocation, swelling, nasal bleeding, difficulty breathing, in rare cases emphysema (with concomitant mucosal injury).

Diagnosis: History, clinical picture, at palpation crepitations are significant sign; if a violent crime is suspected, an X-ray examination is required even in clinically negative finding

(Fig.7). If it is possible to communicate with the patient or his guide, it is useful to detect any nasal deviations prior to the injury. It helps to avoid an effort to adjust the shape of the nose after a previous injury, which is not possible in outpatient conditions.
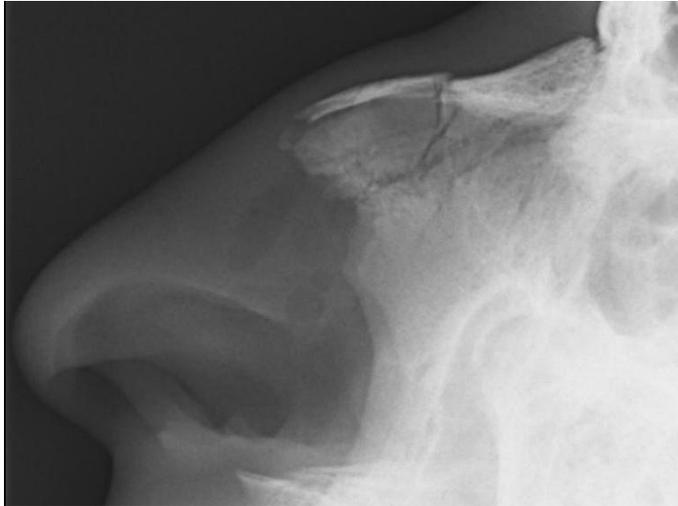
Fig.7 Fracture of the nose at X-ray ("File:Medical X-Ray imaging NJR06 Nevit nasal bone fracture.jpg" by Medical_X-Ray_imaging_NJR06_nevit.jpg: Nevit Dilmen (talk) derivative work: Nevit is licensed under CC BY-SA 3.0; freely available from https://search.creativecommons.org; not modified)

Treatment: Mechanical repair, in some cases with the need for anterior tamponade or fixation of the outer nose. The procedure should be performed with use of anesthesia intranasally, rarely from the outside. From a practical point of view, it is an advantage when the patient is lightly under the influence of alcohol, but able to cooperate. In this case, anesthesia of the affected area may not be necessary. At submucosal hematoma of the septum, its incision, glove drainage, anterior compression packing and antibiotic treatment are indicated. It is important that the patient undergoes a complete examination by other specialists before the ENT examination, to exclude other, sometimes more serious pathologies.

1.3.2.8.2 Fractures of the skeleton of the maxillary sinus and the cheekbone *(os zygomaticum)*

Frontobasal injuries

These injuries are the result of relatively frequent traffic accidents. Typical are the transverse fracture lines that are the basis for the classification of fractures: Le Forte I, II, III (Table 1, Fig.8).

Site of Fracture	CT Planes	Type of Le Fort Fracture	Sites of Confirmatory Fractures
Inferior medial maxillary buttress (piriform aperture)	Coronal	I	Inferior lateral maxillary buttress
Upper transverse maxillary buttress (inferior orbital rim)	Coronal, axial	II	Lateral maxillary buttress, orbital floor, nasofrontal junction
Upper transverse maxillary buttress (zygomatic arch)	Axial	III	Zygomaticofrontal and zygomatico-sphenoid sutures, orbital floor, nasofrontal junction

Table 1. The radiologic diagnostic criteria for Le Fort fractures (from Hopper et al., 2006; with permission)

Le Forte I - the fracture line runs transversely through the lower part of the bones of the jaw and nasal cavity, dorsally the posterior wall of the jaw up to the *fossa pterygopalatina* is usually affected. This type of fracture is relatively rare.

Le Forte II (upper subzygomatic fracture) is a more common type of fracture. The fracture line passes as an arc over the skeleton of the nose, the frontal protrusion to the back wall of the jaw.

Le Forte III (upper suprazygomatic fracture): the fracture line passes through the root of the nasal bones, above the cheekbone or to its lateral edge. The cheekbone arc (*arcus zygomaticus*) is often broken, it can also be dislocated or inverted into the maxillary cavity. It extends to the area of *fossa pterygopalatina*, thus separating parts of the sphenoidal bone from the skull base. Simply, the middle third of the facial part of the head is separated from the frontal part of the skull base. For this reason, this type of fracture belongs to so-called frontobasal injuries. For other Le Fort I and II fractures, the skull base is not injured.
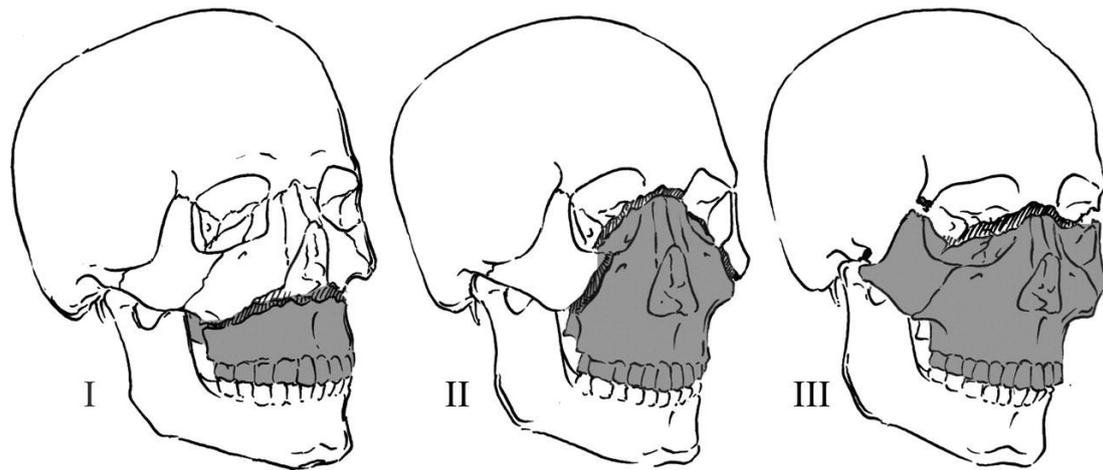
Fig.8 Common Le Fort fracture patterns. The Le Fort I pattern involves fractures through the inferior portions of the medial and lateral maxillary buttresses. The Le Fort II pattern involves fractures through the zygomaticomaxillary and frontomaxillary sutures. The Le Fort III pattern involves complete craniofacial dissociation (from Hopper et al., 2006; with permission)

Symptoms: Extensive damage, often associated with brain concussion (*commotio cerebri*) and shock. Bleeding from the nasal cavity, swelling of the soft tissues, periorbital symmetrical hematoma, liquorrhoe, subcutaneous emphysema, sight impairment and others are common.

Diagnosis: History, clinical picture and CT examination, cerebrospinal fluid analysis.

Treatment: In terms of time, immediate surgical treatment is a *vital* indication to ensure vital functions - breathing (by tracheotomy), stopping bleeding, managing intracranial hypertension. The second group of injuries has an *absolute* indication, in which a delay of several hours or days is possible. These include open injuries, developing meningitis, impressive fractures, liquorrhoe. The third – *relative* - indication group are the issues of rather cosmetic nature (shape of the nose, etc.). Intensive medication therapy (anti-shock, antibiotic, analgesic) is important. The patient's condition is usually very serious and requires the care at ICU (intensive care units). Frontobasal injuries are a multidisciplinary problem which has to be managed by various specialists.

1.3.3   Tumors of the nose and paranasal sinuses

According to the biological nature, the tumors are divided into malignant and benign ones, according to their location into tumors of the outer nose, nasal cavity and paranasal sinuses.

1.3.3.1 Benign tumors

Benign tumors of the nose and sinuses include fibroma, papilloma, osteoma, chondroma, inverted papilloma, hemangioma, rhinophyma (Fig.9), and adenoma. The symptomatology

depends on the type and location of the tumor. Diagnosis makes no major problems, treatment is usually surgical. Histopathological examination of the resected tissue is necessary. A special type of benign tumors is *inverted papilloma(Schneiderian papilloma)* . It occurs in the nasal and paranasal cavities, its growth is aggressive, often recurrent and it has the tendency to malignancy. It grows from Schneiderian membranes of the respiratory epithelium. The symptomatology is dominated by difficulty breathing through the nose, or bleeding. Macroscopically the inverted papilloma is similar to a nasal polyp. The treatment is surgical - endoscopical (FESS - functional endoscopic sinus surgery). The final diagnosis is based on histopathology. Because of biological behavior of the tumor (recurrency, malignancy), the follow-up of the patients is important.

Fig.9 Rhinophyma (freely available from https://search.creativecommons.org/photos/)

1.3.3.2 Malignant tumors
1.3.3.2.1 Malignant tumors of the outer nose

Basal cell carcinoma (ulcus rodens, basalioma)

It is the most common tumor of the outer nose. It occurs in the elderly.

Symptoms: painless, slowly growing resistance with a smooth, later non-healing exulcerated surface, rarely forms metastases.

Diagnosis: History, clinical picture, histological examination, CT, USG examination of the neck, TNM classification. Disease stage is assessed by TNM classification (T-tumor, N-lymph node involvement, M-metastases).

Treatment: Radical surgical, with a sufficient macroscopically healthy rim, reconstructive surgery should be performed over time. After treatment, a minimum of 5-year follow-up is required.

Prognosis is good, if the surgical treatment is radical.

Spinocellular carcinoma (spinalioma)

It is the second most common tumor of the outer nose.

Symptoms: are similar to basal cell carcinoma except that it often forms metastases.

Diagnosis: history, clinical picture, excision and histological examination, CT, USG examination of the neck, TNM classification.

Treatment: The therapy is combined - radical surgery, with a sufficient macroscopically healthy margin, minimal revision of the lymphatic system of the neck, with perioperative histopathological examination and subsequent actinotherapy. Reconstruction should be performed over time. After treatment a minimum of 5-year follow-up is required.

Prognosis is good with early and radical treatment.

Malignant melanoma is the most common skin tumor, which occurs more often on sun-exposed skin. People with fair skin are more often affected. Melanomas often arise from pigmented nevi. Nevi which infiltrate the deeper layers of the skin are more aggressive.

Symptoms: Growth of pigmented nevus, discoloration, bleeding.

Diagnosis: History, clinical condition, dermatological examination, TNM classification, Breslow and Clark scale. Taking small tissue biopsy is contraindicated due to possible spreading of the disease.

Treatment: Combined - radically surgical, with a sufficiently deep and macroscopically healthy margin. Perioperative biopsy from the edges of the resection is highly recommended. Lymph node revision with perioperative histological examination is indicated as a minimum condition. According to the stage, actinotherapy or chemotherapy are indicated. After treatment, a minimum of 5-year follow-up is required.

Prognosis: 5-year survival varies by stage, ranging from 30-70%.

1.3.3.2.2 Malignant tumors of nasal cavity and paranasal sinuses

Malignant tumors of nasal cavity and paranasal sinuses occur in less than 1% of all malignancies. From the histological point of view, they are divided to epidermoid ones, which

are the most common, adenocystic, adenocarcinomas, undifferentiated, sarcomas and others.

Symptoms: At the beginning they are indistinct, unilateral minor bleeding from the nasal cavity and seropurulent rhinitis, intermittent pain, feeling of pressure, difficulty breathing, swelling of the soft structures, later dislocation of the eye bulb, exophthalmos, enlarged cervical lymph nodes may be present.

Diagnosis: History, ENT and CT examination, excision and histological examination, TNM classification. In addition to TNM classification, it is also important to assess tumor differentiation - grading. The extent of infiltration is determined by the Ohngren plane, which is the plane passing through the corner of the eye and the jaw angle. It gives the so-called suprastructure (above) and infrastructure (below) the plane. The second type of classification - according to Sébileau – takes in the account the extent of the disease. The lower floor contains the bottom of the maxillary cavity, the palate and the alveolar ridges; the middle floor contains the walls of the maxillary cavity and the upper floor contains the ceiling of the maxillary cavity, the frontal cavity and the ethmoidal complex.

Treatment: Combined - surgical and actinotherapy. Chemotherapy is used less frequently. The therapy depends on the type and extent of the disease, and the overall patient´s condition. Surgical treatment is often harmful (mutilating), in some cases exenteration of the orbit is necessary. A minimum of 5-year follow-up is required.

Prognosis: 5-year survival depends on the disease stage; it ranges from 30 to 40%. In general, tumors located in the infrastructure according to the Ohngren line or in the lower floor according to Sébileau have more favourable prognosis due to better possibilities for surgical resection.

2 ORAL CAVITY AND PHARYNX

2.1 CLINICAL ANATOMY AND PHYSIOLOGY

The oral cavity or mouth (Fig.10) is bounded by the lips anteriorly, the fauces posteriorly, the cheeks laterally, the hard and soft palate superiorly and a muscular floor, called bottom, inferiorly. Arcus palatinus with the back third of the tongue form the pharyngeal isthmus (*isthmus faucium*), which forms the boundary between the middle part of the pharynx and the oral cavity. A large part of the oral cavity is filled with the tongue, formed by striated muscles. On the tongue there is the apex, body (*corpus*) and root (*radix*). The *tonsilla lingualis* is located on the root of the tongue. In rare cases, its enlargement may cause

difficulty deglutination. It is important to distinguish it from a developmental disorder - an ectopic thyroid gland, which did not descend caudally during embryonic development. Imaging of the thyroid gland in the physiological location by ultrasound rules out this suspicion. In ambiguous cases, endocrinological examination with scintigraphy, possibly biopsy is recommended. The boundary between the root and the body of the tongue is formed by the *sulcus terminalis* with the *foramen caecum linguae*. The basic taste modalities are sour, sweet, salty, bitter and umami. Sweet taste is perceived mainly at the tip of the tongue, sour and salty at the sides and bitter at the root of the tongue. The taste buds with taste receptors are distributed throughout the oral cavity including tongue and in the middle and lower pharynx.
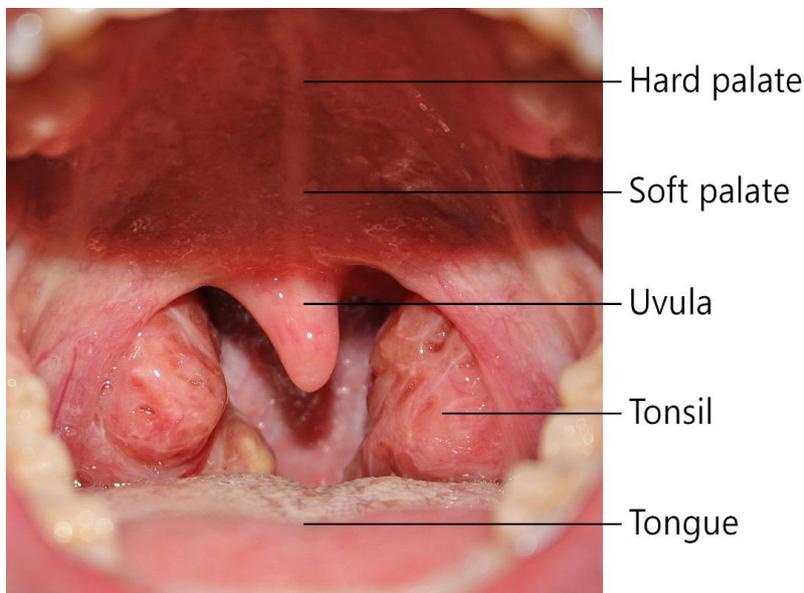
Fig.10 The oral cavity with uvula and tonsils ("File:Throat with Tonsils 0011J.jpeg" by Klem is licensed under CC BY 3.0; freely available, not modified)

At the bottom of the oral cavity there is a tongue frenulum (*frenulum linguae*), which affects the tongue mobility. A short bridle may cause nutritional problems in neonates; speech disorders, especially lisping (*sigmatism*) in the pediatric patients. Another important structure is the ridge - *caruncula sublingualis*, where the submandibular (*ductus submandibularis Whartoni*) and sublingual salivary gland (*ductus sublingualis major Bartholini*) outlets can be identified. The parotid gland outlet (*ductus parotidei Stenoni*) is located at the level of the second upper molar.

The *pharynx* (Figs.11A,B) is a tube about 14 cm long that is located in front of the cervical spine. It extends from the base of the skull to the esophagus. It consists of three parts: upper,

nasal part (*epipharynx, nasopharynx*) approximately in the level of cervical segments C1-C2; middle, oral part (*meso-* or *oropharynx*) at C_3-C_4 and lower, laryngeal part (*hypopharynx*) located behind the larynx at C_5-C_6. In the nasopharyngeal arc there is the pharyngeal tonsil (*tonsilla pharyngea, vegetationes adenoidae*), called "the nasal tonsil". On the side walls, the mouth of the auditory Eustachian tube (*ostium pharyngeum tubae auditivae*) is identified. Its posterior part is formed by a ridge (*torus tubarius*) with lymphoepithelial tissue of *tonsilla tubaria*. The Eustachian tube is described in detail in chapter 5.1.2.3. During deglutination, the nasopharynx closed by a soft palate.

The *oropharynx* (Fig.11A) extends from a soft palate to a tongue. It opens anteriorly to the oral cavity. The border is formed by the pharyngeal isthmus. The soft palate ends in the middle with a *uvula*, which plays a role in swallowing (velopalatine closure). Elongated and enlarged uvula is a relatively common problem, mainly in men, and can be the cause of snoring. On the lateral wall there are palatine arches: the anterior (*arcus palatoglossus*) with a triangular mucosal plica (*plica triangularis*) and the posterior (*arcus palatopharyngeus*). Between the arches there is *tonsilla palatina*. The oropharynx also includes the tongue root with two tongue-valve depressions (*valleculae glossoepigloticae*), separated from each other by mucosal plica.
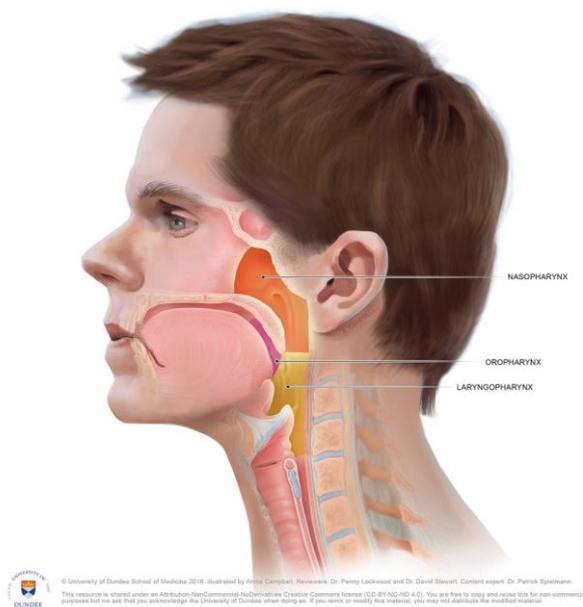
Fig.11A Anatomy of the pharynx, oropharynx and laryngopharynx by Annie Campbell (by dundeetilt is licensed under CC BY-NC-ND 2.0, not modified)

SPHENOID SINUS
NASAL SEPTUM
HARD PALATE
SOFT PALATE
BODY OF TONGUE
HYOID BONE
EPIGLOTTIS
THYROID CARTILAGE
VOCAL FOLD (CORD)
CRICOID CARTILAGE
TRACHEA
PHARYNGEAL TONSIL
SALPINGOPHARYNGEAL FOLD
PHARYNGEAL OPENING OF AUDITORY (EUSTACHIAN) TUBE
PALATINE TONSIL
LINGUAL TONSIL
ADITUS OF LARYNX
OESOPHAGUS
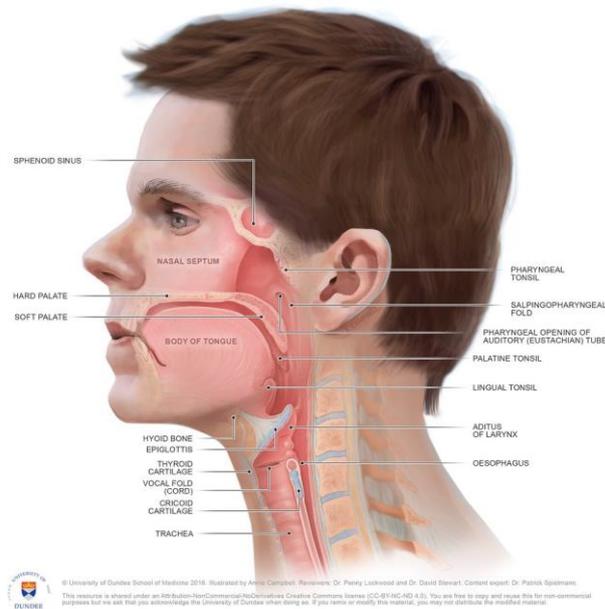
Fig.11B Anatomy of the pharynx (with labels by Annie Campbell; by dundeetilt is licensed under CC BY-NC-ND 2.0, not modified)

The *hypopharynx*, placed behind the larynx, begins at the level of the laryngeal flap (*epiglottis*). Caudally, it ends at the lower edge of the cricoid cartilage in the first physiological narrowing of the esophagus. It communicates with the larynx anteriorly. Laterally it is extended into the *recessus piriformis*, important for swallowing. Laryngeal entrance has a triangular shape, it is separated from the pharynx by a ventral flap and mucosal plicae extending dorsally (*plicae aryepiglotticae*). The epipharynx is lined with cylindrical, meso- and hypopharynx with multi-layered squamous epithelium.

The vascular supply is rich. Arterial supply is provided by the branches of external carotid artery, venous blood is drained into internal and external jugular veins.

The lymphatic system is rich, especially around the pharyngeal gate (Fig.12). Lymph nodes are organized in surface and deep system, and forms several groups according to their location. The lymphatic system is open and communicates with the thoracic lymphatic system, which enables the spread of the pathology from the tonsils to distant parts of the body.

Lymphatic tissue accumulates and forms tonsils (pharyngeal, tubal, palatine and lingual) and lateral pharyngeal strips (*plicae tubopharyngicae*) organized in so-called Waldeyer´s tonsillar ring, which is clinically important. Pharyngeal lymphatic system is significantly involved in the host defense.
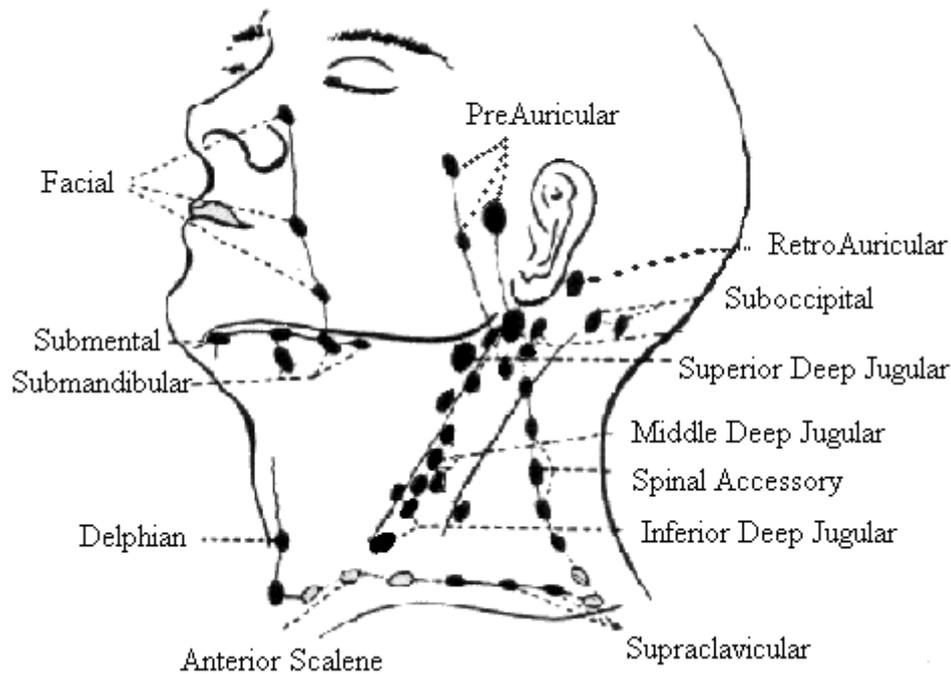
Fig.12 Lymphatic drainage of the head and neck (adapted from Baylor College of Medicine; www.bcm.edu) (from Calkovsky et al. 2008)

The pharynx is significantly related to the *retropharyngeal space*, which is located between the pharynx and the cervical spine, caudally extending into the posterior mediastinum. The *parapharyngeal space* is located on the sides of the pharynx and contains important structures (cranial nerves IX, X, XI and XII, *a. carotis externa* and *interna*, *v. jugularis interna*). The relationship of *a. carotis interna* to the lower pole of the *tonsilla palatina* is clinically important. The distance between these structures is only 10 - 17 mm and sometimes after tonsillectomy internal carotid artery is visible at the lower pole. If theese anatomical factors are not taken into the account, it can have fatal consequences for the patient. The parapharyngeal space is relatively simple pathway for the infection to spread to the intracranium and mediastinum.

2.2 EXAMINATION METHODS

2.2.1 History

In patient with pharyngeal problems we focus on general symptoms such as fever, fatigue, decrease of apetite or anorexia and local signs as difficulty swallowing - dysphagia, pain when swallowing - odynophagia, feeling of a foreign body in the throat, difficulty breathing, change of voice.

2.2.2 Physical examination

Basic physical examination methods include inspection and palpation.

It is possible "to look" (inspection) at the person or body part by eyes (direct inspection) or by means of instruments (indirect inspection). Direct inspection applies for the oral cavity and the adjacent part of the oropharynx. Epi- and hypopharynx are examined indirectly by the special instruments and light reflected from the headlight. During indirect epipharyngoscopy, we push the body of the tongue with a spatula caudally. Heated mirror (to prevent misting) at about 45° angle upwards is inserted behind soft palate and rotated slightly to the sides. It is often irritating to the patient thus local anesthetics may be used.

Indirect hypopharyngoscopy is identical to indirect laryngoscopy and is described in the section on the larynx. The direct epi or hypopharyngoscopy is moder method, performed by rigid or flexible endoscope, which one is insert through nasal or oral cavity.

We examine the tongue in the oral cavity, describe size, shape, mobility, humidity, coating. After raising the tongue, we examine the base of the oral cavity.

At suspected pathology of salivary glands, we perform their compression and quality check of the salive flowing out of the orifice. In the area of the anterior palatine arches, redness (peritonsillitis) as a sign of chronic inflammation is a common finding. We examine the size and shape of tonsills (hypertrophic, atrophic, etc.), their surface (smooth to exulcerated, coating). The size of tonsills is generally not related to extent of inflammation. Asymmetry is also common.

Compression of tonsils is another investigation manoeuvre, little bit unpleasant for the patient, but essential for diagnosis. The examiner presses the spatula on the anterior arch, while the tonsil is partially moved. The content is extruded and may be bacteriologically tested – culture swab . Bacterial culturing from the culture swab without expression may give false negative result.

Taste – we distinguish 5 basic sensations – sweet, salty, sour, bitter and umami (monosodium glutamate/5´nucleotid). Taste buds are located in the tongue, soft palate, pharynx, epiglottis and upper part of oesophagus.

In otorhinolaryngology, palpation is one of the important examination techniques. It is always necessary to compare both sides with each other and bimanual palpation is used. Palpation is indicated especially when pharyngeal tumors are suspected. Useful imaging techniques are ultrasonography, CT and magnetic resonance imaging (soft tissue imaging). Examination of taste sensitivity (gustometry) is done by application of substances at different concentrations to the tongue. It is subjective examination that requires the cooperation of the patient. If the patient does not cooperate, or dissimulate, the evoked brain potentials after stimulation of the lingual mucosa are recorded. If a tumor is suspected, cytology brush and histological evaluation of excised tissue is a rule. Eventually, the aspiration percutaneous biopsy (PAB), core biopsy, partial or completely extirpation for histological detection is used.

2.3 DISEASES
2.3.1   Acute inflammation of pharyngeal lymphatic tissue

Acute inflammation affects every part of the lymphoepithelial Waldeyer's ring, most often the palatine tonsils. This condition is commonly called acute tonsillitis (*tonsillitis acuta*) (Fig. 13). It is acute affection of lymphoepitelial tissue of the isthus faucial, palatine tonsils.

Acute tonsillitis: It is generalized inflammation of the mass of tonsils which is obviously accompained by degree of inflammation of the fauces and pharynx, therefore terms tonsillopharyngitis, adenotonsillitis can be used. Palatine tonsils are most clinically affected – enlarged, reddened, excess of secretion, can be coated by plaques. Pharyngeal mucosa is inflamed, too. Obviously patient has problem open oral cavity (trizmus), it is painfull. The disease usually begins with higher temperature, and possibility of chills, malaise especially children, swelling and painfull nech lymphonodes. Another symptoms are problem with swallowing (dysphagia, odynophagia), feeling foreign body in the throat. Irradiation pain to the ear is frequently. Inflammation is usually localized on the whole ring, with dominance in some parts *palatine tonsillitis*, nasopharyngeal tonsil – *retronasal tonsillitis*, can be affected by the lateral pharyngeal strips, lingual tonsil.

Etiology: viruses (Epstein – Barr, herpes simpex, adenoviruses...), and bacterias , most often *Streptococcus pyogenes (beta – haemolyticus), Staphylococci, Pneumococci, Haemophilus influenza,...*

Pathogenesis: tonsillitis is classified as simple and associated.
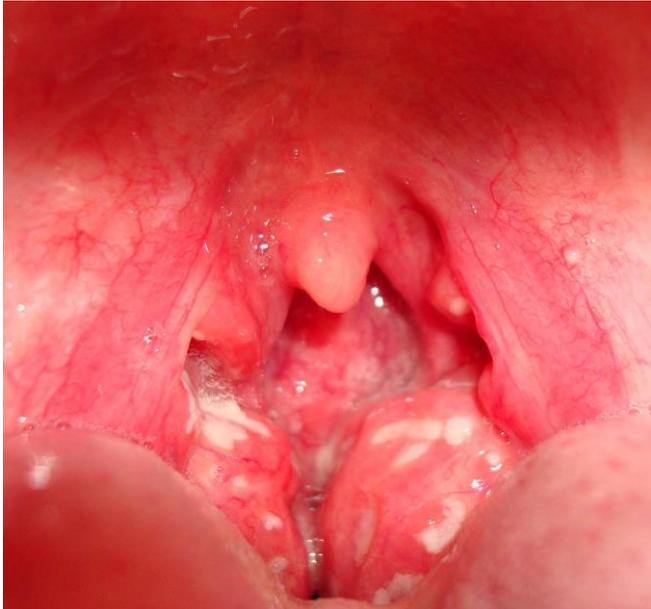
Fig.13 Acute tonsillitis ("Tonsillitis" by Spider.Dog is licensed under CC BY 2.0; freely available from https://search.creativecommons.org/, not modified)

2.3.1.1 Simple tonsillitis – purulent

Catarhal tonsillitis

It is a diffuse inflammation of the mucous membrane of the pharynx, with the maximum manifestation in the tonsils.

Symptoms: The clinical picture is dominated by fever, general weakness, fatigue, anorexia. Patients report pain and a foreign body feeling in the throat.

Objective finding: The tonsils are swollen, redish, occasionally with a fine fibrin coating.

Treatment: resting regime, fluids, vitamins, mouthwashes with common agrimony and chamomile decoction, antipyretics and antibiotics. Penicillin is primarily indicated for at least 10 days; in case of allergy to PNC, antibiotics from the macrolide series are used.

Follicular tonsillitis

It is an inflammation of the tonsillar follicles, like yellowspots and the pharyngeal mucous membrane. Symptomatology may be dominated by an image of "poppy-sprinkled tonsils", of a whitish-yellow color. Follicular tonsillitis is a transient condition between catarhal tonsillitis and lacunar .

Tonsillitis lacunaris

In this form, acute inflammation affects the palatine tonsillar parenchyma and the mucous membrane of the pharynx. Yellow spots occur over the opening of the crypts.

Symptoms: General and local symptoms are more pronounced than with previous types of tonsillits. Body temperature can reach up to 40° C. Back pain, muscle and joint pain and muscle contractions may occur.

Objective finding: Dominated by swelling, reddening of the tonsils with the formation of yellowish coatings which results from exudation into tonsillar crypts. It appears as crypts closed by whitish-yellow purulent plugs. The coating of tonsils goes from finely coated tonsils to *confluens tonsillits*. The coatings are thicker in this case, but never exceed the tonsils. Enlarged lymph nodes are a common finding. There is also edematous neighbouring structures, like uvula, pillars, base of tongue.

Treatment: Identical to angina catarrhalis.

Retronasal tonsillitis

This type of tonsillitis is an inflammation of the pharyngeal tonsil. It is more common in children. The course in adults and older children is easier. In clinical picture there is nasopharyngeal discharge, feeling of scratching, burning, difficulty nasal breathing. In infants, general symptoms such as fatigue and fever may be pronounced. As treatment, the irrigation of the nasal cavity by saline solution is important, especially the suction of secretions in infants. Free nasal breathing is a basic condition for normal food intake.

Pharyngis lateralis

It is an inflammatory disease of the lateral lymphatic strips in patients after tonsillectomy, together with involvement of the pharyngeal mucosa. The treatment is identical like classical tonsillits.

Lingual tonsillitis

It is a rare inflammatory disease of the lingual tonsil and pharyngeal mucosa. It is more common in patients after tonsillectomy.

Prognosis: With proper treatment of tonsillitis is good.

Measures: When the disease subsides, blood for inflammatory parameters and chemical urine examination are indicated. In recurrence, a culturing of tonsil culture swab is done, however not earlier than two weeks after the end of antibiotic treatment to avoid the risk of a false negative result.

Plaut – Vincenti tonsillitis (ulceromembranous) is a unilateral inflammation of the palatine tonsil.

Etiology: *Bacillus fusiformis, Spirochaetae buccalis*

Symptoms: Rise in body temperature up to 38° C, sore throat, *foetor ex ore*. The coating usually separates easily, creating an irregular ulcer beneath it. The cervical lymph nodes are enlarged.

Diagnosis: Clinical picture; necessary to differentiate from syphilis, tumors, symptomatic angina (e.g. in leukemia).

Treatment: Topical - removal of the coating, application of 3% H_2O_2, penicillin antibiotics.

Diphteria

It is rare, ulceromembranous tonsillitis that occurs with diphtheria.

Etiology: *Corynebacterium diphtheriae.*

Symptoms: Non-specific course of the disease, vomiting, weakness, increased body temperature up to 38° C, enlarged lymph nodes, hepatosplenomegaly, rate of heart can dicrease. Locally, the formation of firmly adhering membranes is typical, symmetrically on both sides, which extend beyond the boundaries of the palatine tonsils.

Diagnosis: Based on culturing.

Treatment: antidiphteric serum

Soor, Candidiasis, Mycosis (fungal tonsillitis)

It occurs in patients with immune disorders, diabetes mellitus, longterm use of wide-spectrum antibiotics, secondary to chemotherapy or radiation therapy.

Etiology: The most common fungi (*Candida albicans*).

Symptoms: Subjectively almost no patient difficulties; the local image is dominated by whitish pharyngeal coatings, extending beyond the tonsils.

Diagnosis: Clinical picture, culturing.

Differencial diagnosis : Scarlet fever, Infections mononucleosis, agrynulocytosis, leukemia,

Treatment: Local, in severe conditions systemic antifungal agents.

tuberculosis, peritonsillar abscess

2.3.1.2 Associated tonsillitis

Associated tonsillitis occurs as a symptom of another infectious or non-infectious disease. They are symptomatic and secondary.

Symptomatic, associated tonsillits occurs in scarlet fever (*angina scarlatinosa*), measles (*angina morbillosa*), abdominal epidemic typhus (*angina typhosa*). Angina in infectious mononucleosis (*angina monocytaria*, syn. *Pfeiffer's glandular fever*).

Infectious mononucleosis

Etiology: viral origin (*Epstein-Barr virus EBV*, cytomegalovirus CMV)

Symptoms: Fever, painful swelling of the cervical lymph nodes, which are enlarged, difficulty painful swallowing, weakness, hepatosplenomegaly.

Diagnosis: Clinical picture, local findings - whitish fibrin coatings of the palatine tonsils and nasopharynx, leukocytosis (especially monocytosis). In ambiguous cases, confusion with classic sore throat is possible. Serological testing, blood diferencial count (leucocytosis with lymphocytosis and monocytosis, light thrombocytopenia) , liver tests (aminotransferases, lactate dehydrogenase)

Treatment: Symptomatic - antipyretics, hepatoprotective drugs, diet. There is a high risk of developing skin rash when prescribing aminopenicilins.

Secondary tonsillitis

Secondary tonsillitis includes *tonsillitis leucaemica* and *agranulocytotica*.

Tonsillitis leucaemica occurs in acute leukemia, with necrotically decayed tonsils dominating the local picture. The diagnosis is made on the basis of histological picture and blood count.

Tonsillitis agranulocytotica typically occurs in hematopoietic disorders. It arises suddenly and has a septic course. Tonsils are coated, necrotically altered, as well as the surrounding tissue. The diagnosis is made on the basis of histology and blood count, with dramatic decrease in granulocytes being typical.

NOTE: The following laboratory investigations should be done:

1.) Culture swab test – if diagnosis is not clear, or if the previous antibiotics is not effective, to determine causative bacterias and efficient antibiotics.

2.) Urine analysis to exclude nephritis.

3.) Differencial blood count to exclude mononucleosis, or rare diphtheria.

2.3.1.3 *Pharyngitis acuta*

It is a common disease, of viral origin, secondary bacterial infection is also possible.

Symptoms: Sore throat, scratching, burning, postnasal drip (nasopharyngeal mucus flow), rarely fever.

Diagnosis: Clinical symptomatology, redness of the pharyngeal mucosa.

Treatment: Symptomatic - local disinfection (iodine preparations, herbal extracts, antibiotics), in rare cases systemic antibiotic treatment.

2.3.1.4 Complications of tonsillitis

Complications of tonsillitis can occur during the disease or during convalescence. The disease may spread *via* blood, lymphatic system or directly to the surrouning tissues. Complications may be local and systemic.

2.3.1.4.1 Local complications

The abscess of the tonsil (*intratonsillar abscess*) arises from a deep clogged crypt, usually as a complication of chronic tonsillitis. The surrounding is inflamed, later suppurates.

Diagnosis: Unilateral affected tonsil is enlarged, swollen, reddish

Treatment: Wide incision with evacuation pus, tonsillectomy is indicated after stabilization due to the risk of recurrence. In severe conditions, tonsillectomy with antibiotic parenteral treatment is primarily indicated.

The peritonsillar abscess, the phlegmon (abscessus peritonsillaris, peritonsillitis phlegmonosa) is caused by the penetration of bacteria directly from the tonsil into the tissue between the tonsil sheath and the pharyngeal muscle. It occurs in most cases unilaterally. The spread of the infection is also possible along the pharyngeal vessels. The abscess is most often (in 90%) located in the upper pole i.e. supratonsillar localization. The passage of infection is facilitated by adhesions between the tonsils and adjacent tissues.

Symptoms: Strong unilateral pain, trismus, difficulty or inability to swallow, not even fluids, constrained head position - the head is tilted to the affected side for contraction of the neck muscles because of irritation by inflamed lymph nodes. The overall condition of the patient is altered.

Diagnosis: Clinical picture, local finding in supratonsillar abscess - dropped soft palate, dislocation of tonsils in the medio-caudal direction, intense redness, pharyngeal gate is narrowed. Lymph nodes on the affected side can be enlarged, painful. At other localizations of the abscess (infra-, retrotonsillar abscess), or phlegmon, the overall symptoms are identical, the local image is dominated by marked swelling and redness. In differential diagnosis swelling of allergic origin, specific inflammation, tonsilogenic sepsis and tumors must be distinguished.

Treatment: depends on the location and extent of the pathology, the overall condition of the patient, the day time of examination (night hours, service). The incision of the abscess is indicated in a supratonsillar abscess. The incision canal must be dilated under local anesthesia in the following days. In other locations tonsillectomy is immediately done under general anesthesia. Treatment includes antibiotics, analgesics and parenteral rehydration, too. The indication of tonsillectomy in connection with peritonsillar abscess and phlegmon is widely discussed. The tonsillectomy performed in a short time may prevent future abscess and phlegmon.

Parapharyngeal abscess, phlegmon (*abscessus, phlegmona parapharyngicus*) is caused by the transmission of infection most often from the palate tonsils to the parapharyngeal space. This space caudally borders and freely passes into mediastinum. It communicates cranially with the endocranium through the appertures in the skull base. The spread of the infection from the parapharyngeal space is bilateral. It is a life-threatening condition.

Symptoms are similar to peritonsillar abscess and phlegmon. The overall alteration of the patient is more pronounced. We palpate painful bulge on the neck, the skin is inflamed.

Diagnosis: Clinical condition, local findings, USG and/or CT focused on the patency of the neck blood vessels.

Treatment: Surgical - drainage, the correction of the complications (abscess, phlegmon) and primary lesion (very often the palatine tonsils, the inflammation of the temporal bone). In thrombophlebitis of the internal jugular vein, its surgical resection is indicated. Parenteral antibiotics and analgesics are necessary.

Retropharyngeal abscess (*abscessus retropharyngicus*) occurs after colliquation of retropharyngeal lymph nodes. It is a disease of infants and young children. The clinical picture is dominated by general alteration, increased body temperature, dysphagia, snuffing voice. Locally, a smooth, reddish arch of the posterior pharyngeal wall is typical. The treatment is surgical – incision, antibiotics, analgetics, rehydratation.

2.3.1.4.2 Systemic complications

Systemic complications include tonsilogenic sepsis and sepsis after tonsillitis.

Tonsilogenic sepsis is a rare complication. Pathogens, or toxins from tonsils are flushed directly into the bloodstream and thrombophlebitis of the small tonsillar vessels occurs. The sepsis develops simultaneously with tonsillitis . The patient is septic, febrile, often shivers, and reports swallowing problems. The neck is palpably painful, there is tachycardia, muscular and joint pain is common.

Sepsis after tonsillitis (*sepsis post tonsillitis*) is a rare complication. The clinical picture is very similar to tonsilogenic sepsis, however there is a significant difference in the onset of sepsis. Sepsis after tonsillitis begins several days up to 2-3 weeks after tonsillitis due to

slower lymphogenic way of pathogen spreading. Lymphadenitis of the deep cervical nodes, which presses upon the internal jugular vein, develops. The lymph nodes may colliquate and subsequently thrombophlebitis of the jugular vein develops. At this stage of the disease, the local finding in the pharynx can already be significantly improved. The neck is swollen, the lymph nodes are enlarged and palpation is very painful.

Diagnosis is common for both diseases, based on history of tonsillitis, clinical picture, local findings, USG and/or CT with focus on the vascular system.

Treatment: As it is an urgent condition, the time factor is very important. The treatment is surgical - of the primary lesion (tonsillectomy); in sepsis after tonsillitis, revision of the cervical lymphatic system with possible resection of internal jugular vein for thrombophlebitis is necessary . Surgical treatment is supplemented by parenteral antibiotics, analgesics and rehydratation. Depending on the condition, further pharmacological (internistic) treatment is indicated. Due to the severity of the patient's state, the postoperative care is provided in the intensive care unit.

2.3.2 Chronic inflammation of the pharyngeal lymphatic system

2.3.2.1 Chronic inflammation of palatine tonsils (*tonsillitis chronica*)

Chronic inflammation can affect all parts of the Waldeyer´s lymphoepithelial ring. Clinically most significant is chronic inflammation of the palatine tonsils. This disease is one of the most discussed in otorhinolaryngology, especially on the necessity of tonsillectomy. Chronic inflammation occurrs most often secondary to previous acute tonsillitis.

Symptoms are mild, the patient complains of occasional scratching in the throat, mild increase in body temperature, anorexia, fatigue, bad - smelling breath, or skin manifestations. Tonsils are of various sizes, the surface is often scarred, furrowed, peritonsillitis is present. After the expression of tonsils, the semi-liquid to solid contents – plugs - is released. It should be emphasized that the size of the tonsils is not directly related to the severity of the chronic inflammation. Atrophic tonsils can also often cause serious health problems. Simply, every adult person with palatine tonsils has chronic inflammation. The only question is, how serious it is.

Diagnosis: Clinical picture, local findings, changes in blood counts, inflammatory parameters of blood (ASLO, CRP, RF - rheumatoid factor, ...), culture swap test from tonsils.

Complications: Frequent exacerbations – acute tonsillitis, inflammation of the lower airways, focal infection - damage to small joints (acute rheumatism), kidneys (glomerulonephritis), endo-, myo-, pericarditis.

Treatment: surgical – **tonsillectomy;** at high levels of inflammatory parameters under the antibiotic prophylaxis

Tonsillectomy is surgical removal of the tonsils. The number of tonsillectomies has recently decreased because more thorough immunoallergological examination exclude indication. The question of general or local anesthesia is often addressed and it consists in patient´s cooperation. In children, tonsillectomy is performed under general anesthesia; in adults it can also be performed with local anesthesia. The advantage of local anesthesia is a relatively short time, less blood loss (local anesthetics with adrenaline for its vasoconstriction effect) and a low overall load. The unpleasant feeling, irritability, weakness and sometimes the collapse of the patient is disadvantage. Surgery under local anesthesia is more suitable for women due to less irritability and better cooperation. The resected tissue must be examined histopathologically. Bleeding can occur immediately after the surgery (several hours) or later (5-10 days) and is a relatively common complication. An average recovery time is 2-3 weeks. *Indications for tonsillectomy.* The indication for tonsillectomy is sometimes disputable. After examination of the patient by two otorhinolaryngologists, two different opinions on whether tonsillectomy is indicated or not may arise. The most common indications are recurrent tonsillitis 3 - 4 times per year, peri- and intratonsillar abscess, phlegmon, tonsillogenic sepsis, suspected tumor, tonsillogenic infectious focus, or mechanical obstruction.

2.3.2.2 Chronic pharyngitis (*pharyngitis chronica*)

Chronic pharyngitis represents various forms of prolonged inflammation of the pharyngeal mucosa. It is a common health problem caused by long-term exposure to infectious and non-infectious factors on the pharyngeal mucosa (dry and hot air, dust, alcohol, etc.). Dry pharyngitis may also occur after tonsillectomy (*pharyngitis tonsillopriva*).
Classification of chronic pharyngitis:
- simple (*pharyngitis chronica simplex*)
- hyperplastic (*pharyngitis chronica hyperplastica, granulosa*)
- atrophic (*pharyngitis chronica atrophica*)

Diagnosis: Scratching, burning in the throat, increased production and leakage of mucus (simple form), thickening, reddening of the mucosa of the posterior wall and side cords, formation of granulations (hyperplastic), dry mucosa, viscous mucus (atrophic).

Treatment: The effect of treatment is usually good after eliminating harmful factors. Treatment is symptomatic, pharyngeal washing with common agrimony and chamomile decoction, local disinfectants.

2.3.2.3 Hypertrophy of pharyngeal tonsil (*vegetationes adenoidae, hypertrophia tonsillae pharyngicae*)

Enlarged pharyngeal tonsil (adenoideal) is a common finding in children from 2 years of age. During puberty, it gradually shrinks, and in adulthood only remnants of flat lymphatic tissue in the nasopharynx can be seen.

Symptoms: Enlarged pharyngeal tonsil may block the choans and restrict nasal ventilation, or may be a focal source of recurrent inflammation of the upper airways and middle ear. Increased secretion in the nasal cavity is also significant, exacerbating the failure of nasal ventilation. Children mostly breathe through the mouth and develop typical *facies adenoidea*. The facial expression is tired, apathetic, without interest. The child's mouth is slightly open. They snore at night and their sleep is interrupted. They are tired and may have problems with school (*aprosexia nasalis*).

Diagnosis: Based on the history, clinical picture, examination of the nasal cavity and nasopharynx. In some cases, it is necessary to perform an endoscopic examination or in the past by palpation of the nasopharynx, too. The symptomatology of pharyngeal tonsillar hyperplasia may be week. Differential diagnosis has to exclude anomalies in the nasal cavity (septal deformity, choanal atresia, foreign body, tumors).

Treatment: Surgical – adenoidectomy (Fig.14). It is performed under general anesthesia, preferably under endoscopic control. The use of laryngeal mask avoids intubation of the baby. The removed tissue must be examined histopathologically. In the past, recurrences of adenoid vegetations were frequent due to incomplete tissue removal in local anesthesia. The tissue regenerated. Adenoidectomy is one of the basic and most common surgical procedures in otorhinolaryngology.
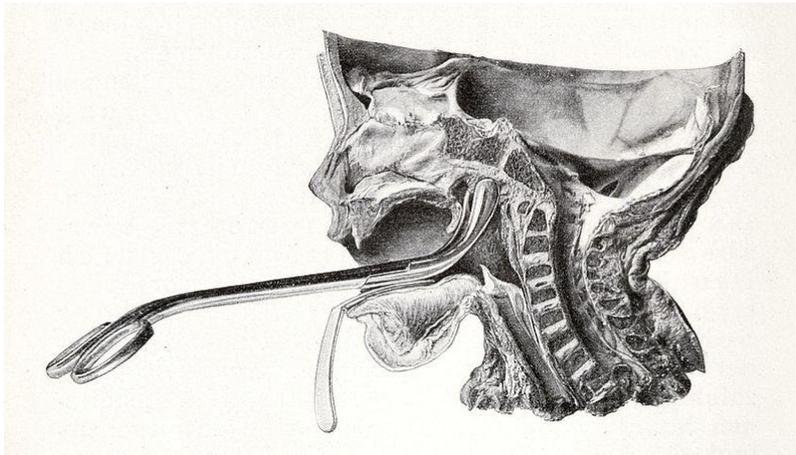
Fig.14 Adenotomy, historical view ("File:Adenotomis mit Schech'scher Loffelzange Wellcome L0033918.jpg" is licensed under CC BY 4.0 , freely available from https://search.creativecommons.org/photos/, not modified)

2.3.3 Foreign bodies in the oral cavity and pharynx

A relatively common problem is the insertion of fish bone "into the throat". The patient reports prickling, relatively well-located pain. The most common places of fish bone insertion are palate tonsils and the root of the tongue. Diagnosis is sometimes difficult as the entire bone can be embedded into the tonsil. If the site of bone insertion cannot be identified, it is recommended to see the patient next day. Small bones usually break up in the tonsil or get loose spontaneously, without significant clinical problems. Larger foreign bodies (piece of meat, coins, part of a dental prosthesis) are wedged in front of the esophageal entrance (Kilian's sphincter) or in the *recessus piriformis*.

Diagnosis is based on the history and clinical picture. If a foreign body cannot be identified by an ENT examination, native or contrast X-ray is performed. At suspected penetration injury to the esophagus, a contrast barium mass has to be replaced by iodine contrast preparations. If the foreign body cannot be removed by indirect hypopharyngoscopy, rigid hypopharyngo-esophagoscopy is indicated. Flexible endoscopical removing by gastroenterologist is indicated, too. Relatively benefit of rigid techniques is better possibility of gripping a foreign body than using flexible endoscopy.

2.3.4 Injuries to the oral cavity and pharynx

Insect bites may cause severe swelling of the tissues in the oral cavity or pharynx and lead to mechanical obstruction. Intensive anti-edematous treatment (corticosteroids, antihistamines) is indicated. Minor injuries generally do not require surgical treatment due to the good healing ability of the tissues in the area. Major injuries must be treated surgically.

2.3.5 Tumors of the oral cavity and pharynx

2.3.5.1 Benign tumors of the oral cavity

Benign tumors include hemangiomas, papillomas, fibromas, tongue root goiter, myxochondroepithelioma, lymphangiomas, neurinomas, lipomas.

The most common are **papillomas**, which grow in soft palate, especially uvula, and are often solitary. Its surface is slightly bumpy. Treatment is surgical; the tissue must be examined histopathologically. They often recur and undergo malignant transformation.

The **goiter of the root of the tongue** (*struma lingualis*) is a developmental disorder (embryological). It grows from the split thyroid embryonic tissue around the *foramen caecum*. The patient reports impaired swallowing, a feeling of a foreign body "in the throat". At the root of the tongue, smooth or slightly bumpy body is identified. Ultrasound of the neck should confirm or disconfirm thyroid gland in typical localization. Scintigraphy is usefull.

Treatment: Surgical, with histopathological examination. Hormone replacement therapy indicated by endocrinologist.

2.3.5.2 Malignant tumors of the oral cavity

The most frequent tumors of the oral cavity are carcinomas with epidermoid carcinoma (squamous cell carcinoma) being most common. Very important prognostical factor is detection of human papiloviruses (HPV), it seem paradoxicall, but HPV positive patient with cancer of oral cavity and pharynx has better prognosis, similar HPV negative with a same neoplasm.

 Of the other cancers, adenoid cystic (cylindroma) and adenocarcinoma occurs less commonly. Among mesenchymal tumors, lymphosarcoma, reticular sarcoma (retotelosarcoma), myxosarcoma and others occur. Lymphoepithelioma (Schmincke's tumor) is classified as anaplastic tumor.

Symptoms: Impaired and sometimes painful swallowing with radiation of pain in the ear, bleeding. In the later stages the clinical picture is enriched by trism and enlarged metastatic cervical lymph nodes.

Diagnosis: History, clinical picture (greyish odorous coatings, cauliflower appearance of the tumor, exulcerations), excision and biopsy examination, CT of the primary tumor and cervical lymph nodes, or USG with examination of large neck vessels.

Treatment: Combined (surgical, actino- and chemotherapy) depending on the type of tumor, its extent and the overall condition of the patient. Surgical treatment of malignant tumors in this locality, especially front two thirds of the tongue, is also domain of dentists and maxillofacial surgeons. After treatment, a minimum 5-year follow-up is needed. Initially, the patient is monitored at monthly basis or even more often, gradually the intervals extend.

Prognosis: 5-year survival is 20-40%, it depends on the extent and type of the disease, the method of treatment, and the overall condition of the patient.

2.3.5.3 Benign tumors of nasopharynx

Juvenile angiofibroma (*angiofibroma juvenile*) occurs in boys before puberty. It begins from the lower surface of the sphenoid bone (*fibrocartilago basalis*) and grows caudally into the nasopharynx. The etiology is unknown. Sometimes it involves spontaneously after puberty, thus it is associated with hormonal levels.

Symptoms: The initial symptoms are insignificant, dominated by impaired ventilation of the nasal cavity, snuffing voice, prolonged bleeding from the nasal cavity which is caused by impaired vasoconstriction in fibromatous tumor tissue. Later, Eustachian tube dysfunction and feeling of "plugged" ears may occur. Although the tumor is benign, its can aggressively grow into surroundings.

Diagnosis: History, clinical picture, endoscopic examination of the nasopharynx. The tumor has a smooth spherical to lobed surface, palpably is stiff. CT, sometimes angiography is indicated. If angiofibroma is suspected, excision biopsy is strictly contraindicated due to the risk of massive bleeding.

Treatment: Surgical (various approaches); due to the risk of major blood loss the blood preparations must be provided; occasionally preoperative embolization of the supplying vessel is performed.

2.3.5.4 Malignant tumors of nasopharynx

Nasopharyngeal malignancies include epidermoid (squamous cell) carcinomas, sarcomas, lymphoepithelial anaplastic carcinoma, and others. In general, they occur in 3-5% of tumors located in the ENT region. The highest incidence of squamous cell carcinoma of the nasopharynx is in southeast China, where it is one of the most common malignancies. The possible reasons are the anatomical feature - the depression on the skull in the area of the lateral nasopharyngeal wall (*fossa Rosenmulleri*) where the secretion may stagnate or eating habits which include specially prepared smoked fish. Undifferentiated carcinoma and Burkitt's lymphoma are thought to be of viral origin because of an increased titer of antibodies against Epstein - Barr virus. They are more common in men.

Symptoms: Depend on the type and location of tumor. They can be non-specific and easily overlooked, as the tumor can grow asymptomatically for a long time. With regard to the symptoms, the tumors are divided into:

1) lymphonodular type - the first sign is painless, enlarged, stiff, initially motile and gradually growing cervical lymph nodes. This symptom is common, but often underestimated.

2) otic type - problems result from the mechanical obturation of the Eustachian tube, the feeling of plugged ear prevails; the examination reveals the retraction of the tympanic membrane, sometimes even the serotympanum. The hearing loss is of conductive type.

3) ophthalmo-neurological type - disorder of eyebulb mobility, usually unilateral, due to impairment of *n. abducens* (n.VI) innervating *m. rectus bulbi externus*. It can manifest with non-specific headaches and signs of cranial nerves damage. The symptomatology is wide: complete ophthalmoplegia, optic nerve atrophy, facial sensitivity disorders, trigeminal neuralgia and masticatory muscle paresis. At injury to cranial nerves IX to XII and the cervical sympathetic system, impaired motility of the tongue and neck muscles results in swallowing problems.

4) nasal type - problems are usually unilateral, difficulty breathing through the nasal cavity, serosanguinous to purulent discharge, in both types also rhinophony

5) pharyngeal type - leakage of mucus, sometimes with a mixture of blood

Diagnosis: History, clinical picture, ENT examination including endoscopy, excision biopsy, CT of the primary tumor and cervical lymph nodes, or ultrasonography with assessment of large vessels of the neck. Distant metastases can be a diagnostic problem. The extent and stage of the disease are assessed by TNM classification.

Treatment is combined. Surgical treatment is used only sporadically due to tumor location. Most tumors are chemo- and radiosensitive, so these modalities are the first choice of treatment, leading to regression of the disease. When tumor persists, surgical treatment is indicated; various types of resections of the neck lymphatic system are performed. After therapy, a minimum 5-year follow-up is recommended. Initially, the patient is monitored at monthly basis or even more often, gradually the intervals extend.

Prognosis: 5-year survival is about 15-25%. It depends on the extent and type of tumor, the method of treatment and the overall condition of the patient.

2.3.5.5 Malignant tumors of oropharynx

Malignancies of the oropharynx are relatively more common than other ENT malignancies. They mostly affect men. Most frequent is epidermoid (squamous cell) carcinoma; malignant lymphoma and adenocarcinoma are less frequent. Anaplastic tumors are less common. Smoking and the consumption of concentrated alcohol play an important role in the etiopathogenesis. Tumors often form metastases in regional cervical lymph nodes and distant organs.

Symptoms: Feeling of the foreign body in the throat (Fig.15), difficulty and painful swallowing, bleeding, shooting pain in the ears, enlarged lymph nodes, loss of appetite, weight loss.


Fig.15 Malignant melanoma of the oropharynx developed within twelve days (archive of the Clinic of otorhinolaryngology and head and neck surgery JFM CU and UHM) (Calkovsky et al., 2008)

Diagnosis: History, clinical picture, ENT examination including endoscopy, excision biopsy. CT of the primary tumor and cervical lymph nodes, or ultrasonography with the assessment of large neck vessels. Finally, the stage of the disease is assessed by TNM classification.

Treatment: Combination (chemotherapy, radiotherapy and surgery). The particular type of treatment depends on the type and extent of tumor, and the general condition of the patient. Combinations are possible, e.g., induction neoadjuvant chemotherapy followed by surgery and radiation therapy.

Small and easily accessible tumors can be resected by a transoral approach, larger ones from the external approach. After extensive resection surgery it might be necessary to perform reconstruction of the defect, or to cover defect by myocutaneous lobe. Due to high tendency to metastatic spread, revision of the lymphatic system with perioperative examination of the lymph nodes is indicated. In positivity of lymph nodes, we indicate radical dissection of the lymphatic system.

After therapy, a minimum 5-year follow-up is recommended. Initially, the patient is monitored at monthly basis or even more often, gradually the intervals extend.

Prognosis: The 5-year survival time depends on the extent and type of the disease, treatment, general condition of the patient. On average, it is about 20 - 40%.

2.3.5.6 Malignant tumors of laryngeal part of pharynx (hypopharynx or laryngopharynx)

The most common tumors are carcinomas. Based on location, they are divided into two groups:

1.) Pharyngolaryngeal ones, which grow from the laryngeal entrance and spread to the hypopharynx. They infiltrate *recessus piriformis*, aryepiglottic plica, side and back walls of the pharynx.

2.) The second location is the *retrocricoid area*. Tumors grow from the lowest part of the hypopharynx, behind the larynx, in the cricoid cartilage. Through the posterior wall of the larynx, they can grow transmurally into subglottic space.

Symptoms: Feeling of a foreign body in the throat, difficulty and later painful swallowing, bleeding.

Diagnosis: History, clinical picture, ENT examination including endoscopy, excision biopsy, CT of the primary tumor and cervical lymph nodes, or ultrasonography with the assessment of

large neck vessels. Finally, the stage of the disease is assessed according to the TNM classification.

Treatment: Combination (surgical, chemo- and actinotherapy). Depending on the type of tumor, the extent and the general condition of the patient, the specific type of treatment is indicated. Combinations are possible, e.g. induction neoadjuvant chemotherapy followed by surgery and radiation therapy. At highly expanded tumors, it might be necessary to surgically remove the entire larynx (laryngectomy) with the adjacent part of the pharynx (laryngectomy and partial resection of the pharynx). Due to high tendency to metastatic spreading, revision of the lymphatic system with perioperative examination of the lymph nodes is indicated. In positivity of lymph nodes, radical dissection of the lymphatic system needs to be done.

After therapy, a minimum 5-year follow-up is recommended. Initially, the patient is monitored at monthly basis or even more often, gradually the intervals extend.

Prognosis: Despite complex treatment, very few patients survive the 5-year period. The survival time depends on the extent and type of tumor, the method of treatment and the overall condition of the patient. On average, it is about 20-40%.

3 LARYNX

3.1 CLINICAL ANATOMY AND PHYSIOLOGY

The larynx (Fig. 16) is located at level 5th to 7th cervical vertebra. The beginning of the larynx is the common place for swallowing and respiratory functions. Caudally the larynx continues into the trachea. The skeleton of the larynx is formed by cartilage, interconnected by ligaments and muscles, which ensures its mobility (functionality). One of the most important is ring cricoid cartilage (*cartilago cricoidea*). This is the only round-shape cartilage which significantly contributes to the maintenance of circular laryngeal lumen. The thyroid cartilage (*cartilago thyroidea*) is located cranially. It consists of two plates, connected at the front to the edge, which makes a bulge at the men neck called Adam's apple (*pomum Adami*). Another important cartilage is the *epiglottis*. It is attached to the inner surface of the thyroid cartilage and has a leafy shape. The paired arytenoid cartilage (*cartilago arytenoidea*) has a vocal cord protrusion for attachment of the dorsal part of the vocal cord and a lateral muscle protrusion for the attachment of phonation muscles.

The hyothyroid membrane (*membrana hyothyroidea*) connects the thyroid cartilage with the hyoid bone. Cricothyroid membrane (*ligamentum conicum*) is clinically important, because in

suffocation, in a life-threatening state, it is possible to interrupt this membrane and ensure the ventilation. The *ligamentum vestibulare* (synon. *ligamentum ventriculare*) is the basis of the vestibular/ventricular plica (*plica vestibularis* or *plica ventricularis*), also called false vocal cord. The patients with its hyperplasia, and also with an incorrectly formed voice (functional disorder) are producing so-called vestibular voice. Between the false and true vocal cords (*plicae vocales*) is the laryngeal chamber (*ventriculus laryngis seu Morgagni*). Clinically, it is very important for the long-term asymptomatic growth of malignant tumors because this area is almost inaccessible by routine examinantion methods.
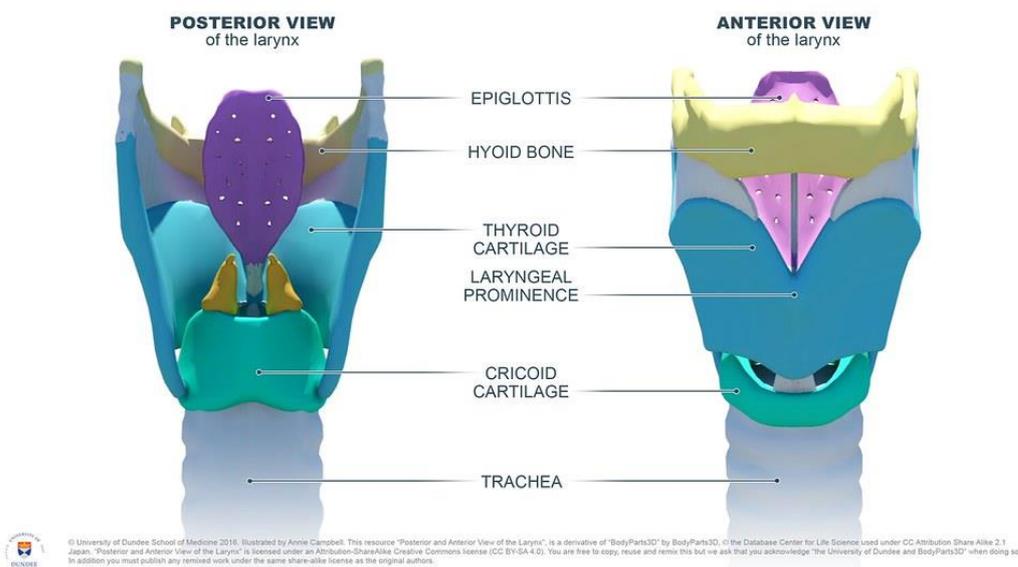
Fig. 16 Posterior and anterior view of the larynx (by Annie Campbell" by dundeetilt is licensed with CC BY-SA 2.0, https://creativecommons.org/licenses/by-sa/2.0/, freely available, not modified)

The muscles of the larynx are divided into external and internal. The external muscles fix the larynx in a certain position and are engaged in the swallowing act. The internal muscles are important in phonation and respiration. They are divided into three groups of *abductors*, *adductors* and *tensors*.

The posterior cricoarytenoid muscle (*musculus cricoarytenoideus posterior*) also called the posticus, is the only one abduction muscle. It opens the vocal cords. Its dysfunction mechanically compromisis lung ventilation, as there is not enough space between the vocal cords for air flow.

The most important adductor is *m. cricoarytenoideus lateralis*. It acts as postic antagonist and closes the vocal cord. Its dysfunction leads to phonation disorders. The closure of vocal cords

is strenghten by *m. arytenoideus*. This muscle tilts the thyroid cartilage forward bringing the vocal cords closer together.

One of the external tensor muscles is *m. cricothyreoideus*. It provides tensing of the vocal cords by pulling the thyroid cartilage to the cricoid cartilage. Internal tensor muscle m. *thyroarytenoideus* brings the vocal cords together.

The laryngeal mucosa is covered mainly by cylindrical ciliated epithelium. In places of increased load - vocal cords, ventricular plicae, laryngeal entrance with epiglottis there is more resistant non-keratinizing multilayered squamous epithelium. Metaplastic processes occur during prolonged irritation.

Vascular supply is provided by upper and lower laryngeal arteries (*a. laryngica superior et inferior)* and upper and lower thyroid arteries (*a. thyreoidea superior et inferior*). The lymphatic system is clinically very important. It is divided into upper and lower part. The border is the upper part of the vocal cords, which has minimal lymphatic drainage. Metastases from this area are very rare. The upper part is drained into the deep cervical lymphatic system, the lower part into the prelaryngeal, paratracheal system or mediastinal lymph nodes. These metastases are usually identified late, the site is difficult to access during routine examination. The laryngeal muscles are innervated with *n. laryngeus inferior (recurrens),* with the exception of the *m. cricothyreoideus*, which is innervated with *ramus externus n. laryngei superior.* Sensitive innervation is done by its ramus internus.

From the anatomical - clinical point of view, three parts are distinguished on the larynx:

1) supraglottic - upper part, including *ventriculus laryngis*

2) glottic – the area of vocal cords

3) subglottic - the area under the vocal cords

4) marginal - border area of the larynx (pharyngo-laryngeal)

Laryngeal function: *respiration* at open vocal cords, *phonation* when the vocal cords gently touch each other by medial margins and *protective* (reflex) to prevent food and pollutants from entering the lower airways.

There are four basic **positions of the vocal cords**:

1) medial (phonation) - during phonation, the vocal cords touch closely

2) lateral (respiration) - the vocal cords are as far apart as possible

3) paramedial

4) intermedial

After damage to the laryngeal structures (most often the recurrent nerve), unilateral or bilateral vocal cord movement disorder may occur. The patient´s condition depends on the type and extent of this disorder. Two ultimate problems dominate - difficulty breathing and phonation disorder. Bilateral damage is clinically more severe. Generally, we can say, the better the voice quality, the greater breathing difficulty, and vice versa. Bilateral paresis of the recurrent nerves when the vocal cords are in the medial or paramedial position is a life-threatening event. Respiratory insufficiency develops and very often a tracheotomy is required.

3.2 EXAMINATION METHODS

3.2.1 History
Patients with laryngeal diseases most often report the voice problems (dysphonia to aphonia), cough, difficulty breathing, pain, scratching. A voice change is the most typical manifestation of a laryngeal pathology. A less common symptom is bleeding, or coughing up the mucus with addition of blood (*haemoptysis*).

3.2.2 Inspection and palpation are among the basic examination methods. They are especially suitable for extralaryngeal tumor overgrowth, extensive inflammatory changes and the like.

3.2.3 Indirect laryngoscopy is an examination method of the internal larynx with help of laryngoscopic mirror, a light source and a headlamp. The mirrors are of different diameters (10 - 25 mm), they are fixed to the holder at a 45 ° angle. We examine the patient by grasping the tongue in gauze and pulling it out. Carefully insert a heated mirror (to prevent fogging), which is being hold like a pen, into the oral cavity. Its temperature is checked with the back of physician´s own hand. With the metal part of the mirror, we gently push the soft palate with uvula dorsocranially, and we turn the mirror surface caudally towards the larynx and hypopharynx. Start to examine the patient at rest and slowly change the position of the mirror for better visualization. First investigate in the so-called respiratory position of the vocal cords, when the patient breathes freely, and then in the phonation position, when he/she is asked to say "e" or "i". In some cases, the patient is examined with a head slightly tilted forward back or aside. The patient is instructed to breathe deeply through the mouth during

the examination (to suppress irritability). The patients who are significantly irritating are examined under local anesthesia. In indirect laryngoscopy, it is important to realize that the image we see in the mirror is inverted in the anteroposterior direction. This means that what appears in the picture at the front is actually at the back.

3.2.4 Direct laryngoscopy is divided into flexible and rigid according to the instruments used. The *flexible* technique is more suitable for diagnostic purposes. The flexible laryngoscope is inserted under local anesthesia directly through the nasal cavity into the laryngeal entrance area. We can use approach through the oral cavity, too. In tracheotomized patients, it is possible to perform a retrograde endoscopic examination through the tracheostomy opening, especially suitable for the diagnosis of pathology in the subglottic area.

Rigid laryngoscopy is a direct examination of the larynx by a rigid metal tube with proximal or distal lighting. The patient is in a horizontal position with his head tilted back. The examinantion procedure can be performed under thorough local, or general anesthesia. The method is used in case of ambiguous indirect findings, in case of suspicious tumor, when it is important to do biopsy for histological examination and to assess the extent of the tumor, and to assess its operability. Another form of direct laryngoscopy is laryngomicroscopy (enabling image magnification) or laryngomicrosurgical surgery used in minor changes in the vocal cords.

3.2.5 Imaging methods
Classical X-ray of the larynx is not used. The method of choice is *CT* and *MRI*. When metastases to the cervical lymphatic system are suspected, neck *ultrasonography* is reasonable method to assess the metastases extent and the condition of the neurovascular bundle of the neck (*a. carotis communis, externa*, *interna*, *v. jugularis*, *n. vagus*).

Functional examinations of the larynx include *stroboscopic examination* of vocal cord mobility using a principle of intermittent light. During phonation, the vocal cord oscillates at a high frequency, but the small changes in mobility is not possible to detect with the naked eye. If the frequency of the light interruption and the movement of the vocal cords are synchronized on both sides, the vocal cords appear not to move. Lateral asymmetry suggests a mobility disorder, which may be a sign of infiltrability tumor growth, for example. Stroboscopic examination is important to determine the extent of surgery in laryngeal tumors.

3.3 LARYNGEAL DISEASES

3.3.1 Congenital malformations of the larynx

These are relatively rare disorders. Dyspnoea, dysphonia and dysphagia predominate in the clinical picture.

Laryngomalacia or "soft larynx" (*stridor laryngicus congenitus*). Its most common cause is epiglottic hypoplasia with obturation of the laryngeal lumen.

Diaphragm of the larynx (*diaphragma laryngis*). It is a fibrous membrane that connects the vocal cords, especially in the front part. Clinical problems depend on the extent. It can also be asymptomatic.

Laryngocele (*laryngocele ventricularis*). There is outer laryngocele or inner one, which spreads into the lumen. It is caused by deficiency of laryngeal tissues and increased intralaryngeal pressure.

3.3.2 Acute inflammations of the larynx

3.3.2.1 Acute laryngitis (*laryngitis catarhalis acuta*)

Etiology: Most often viral, possibly bacterial. The disease can arise primarily, or ascend or descend from other parts of the respiratory system. Voice excess associated with concentrated alcohol consumption is often the causative agent.

Symptoms: Dominated by a feeling of dryness, scratching in the throat, dysphonia until complete voice loss, dry cough.

Diagnosis: History, clinical picture, local laryngoscopic findings - congested, edematous laryngeal mucosa with maximum changes in the vocal cords.

Treatment: Elimination of pollutants if possible, voice rest, antitussives, in case of progression also antibiotics.

Prognosis: Good.

3.3.2.2 Acute subglottic laryngitis (*laryngitis acuta subglottica, pseudocroup*)

This inflammation is clinically significant in children aged 1 to 5 years. It usually does not affect younger babies due to relatively good immunity. At an older age it is clinical course tends to be mild.

Simply said, the course depends mainly on the diameter of the subglottic part of the larynx. Thick submucosal tissue in this area has the tendency to swell. A small swelling in a baby

may lead to clinically significant narrowing at this location. In comparison with an adult, the same extent of swelling may not even be noticed, or can cause only scratching in the throat. The disease is more seasonal in nature, it occurs usually in late autumn and winter. Adenoid vegetation and less frequently palatine tonsils are a common source of infection.

Etiology: Viruses, secondary bacterial infection is also common. Significant are concurrent factors such as dry air (more frequent occurrence in connection with the overheating living and mainly sleeping places), immune status, etc.

Symptoms: The course is typical - the child wakes up at night to a persistent dry "barking" cough, feeling of a lack of air, marked inspiration stridor and dysphonia.

Diagnosis: History - the disease usually occurs at night, before the attack the child suffers from common infection of the upper airways, and the clinical picture. It is recommended to do laryngoscopy. A common problem is the child's irritability, which makes the examination impossible. However, local anesthetics are strictly contraindicated due to the increased risk of laryngospasm. After the first unsuccessful attempt to examine the child, the second attempt should not be done. An aspirated foreign body must be ruled out.

Treatment: The radicality of the treatment depends on the clinical condition. In severe course, hospitalization is indicated. As a first step, corticosteroids at high doses are given intravenously. At suspected secondary bacterial infection i.v. antibiotics are indicated. Supportive treatment consists of antihistamines, expectorants, air humidification, mild sedation. In some cases, parental sedation is also appropriate, as this condition may be very dramatic. If the child health status does not improve after pharmacological treatment, the intubation is considered. If intubation attempts are repeatedly unsuccessful or in the so-called prolonged intubation, when the child does not improve for a long time after extubation, tracheotomy is indicated. Tracheotomy in children should be considered with particular care. Disruption of growing tissues/structures leads to the risk of stenosis. The second important fact is that children breathing through tracheotomy for a long time might have problems to breath *per vias naturales*. The child seems to "forget to breathe".

Prognosis: *quoad vitam bene*, recurrences are relatively common, the child "grows up" from these problems.

3.3.2.3 *Epiglottitis acuta*

It is a relatively common inflammatory disease of the mucosal surface that affects all age groups.

Etiology: Combined (viruses, bacteria).

Symptoms: Feeling of a foreign body in the throat, difficulty, painful swallowing; breathing problems are usually not present. Urgent tracheotomy is indicated in case of severe swelling accompanied by dyspnoea.

Diagnosis: History, clinical picture, indirect or direct laryngoscopy reveals hyperemia, or more significant redness of the epiglottis, sometimes with the formation of whitish coatings, the mobility of the epiglottis may be limited.

Treatment: Oral antibiotics, sometimes intravenously according to the severity of the disease, and corticosteroids.

Prognosis: Good.

3.3.2.4 Abscess, phlegmon of epiglottis (*abscessus, epiglottitis phlegmonosa*)

It is an inflammation of deep tissues that develops gradually from a previous disease. Phlegmon is diffuse and abscess is bounded inflammation.

Symptoms: The symptomatology is similar to mucosal inflammation in epiglottitis acuta, amplified by the inability to swallow saliva, fever and fatigue.

Diagnosis: History, clinical condition; at phlegmon - direct or indirect laryngoscopy reveals intensive redness and swelling, also of the surrounding structures; the mobility of the epiglottis is significantly limited. Respiratory disorders may be caused by mechanical obstruction of the laryngeal entrance by pathologicaly changed epiglottis. In addition, in the abscess a yellowish submucosal purulent deposit is present.

Treatment: Treatment is carried out in the intensive care unit, in phlegmon intensive intravenous antibiotic treatment with corticosteroids is required, in severe cases complete parenteral nutrition is given. In an abscess, an incision is made under general anesthesia. Pharmacological treatment is identical to that in phlegmon. When is a risk of suffocation and it is not possible to intubate the patient, tracheotomy is indicated.

Prognosis: Good with adequate treatment.

3.3.2.5 Laryngeal perichondritis (*perichondritis laryngis*)

Perichondritis of the larynx is a serious, long-lasting disease. It most often occurs secondary to radiation treatment.

Symptoms: Severe, painful swallowing, dyspnoea, dysphonia to aphonia.

Diagnosis: On the outside the neck is swollen, the skin is markedly reddish, sometimes with the formation of crusts and skin defects, the mucosa may be swollen, the lumen narrowed.

Treatment: Antibiotics, in case of dyspnoe - tracheotomy.

Prognosis: Depends significantly on the triggering factor, in some cases irreversible changes occur and tracheotomy must be maintained for a long time.

3.4.3 Chronic inflammation of the larynx

Chronic laryngitis occurs after recurrent acute inflammation, or more often by the transition from acute to chronic inflammation, during long-term exposure to pollutants. The pollutants include smoking, excessive vocal effort, consumption of concentrated alcohol, fumes, dust, dry environment. "Mouth breathing" and recurrent respiratory infections also have an adverse effect.

Chronic laryngitis is divided into simple, hyperplastic and atrophic. There are gradual transitions between these types and there is no exact boundary. For this reason, the symptomatology is also gradually evolving.

Symptoms: The main common symptom for all three types of inflammation is long-lasting wheezing (dysphonia) up to complete voice loss (aphonia), associated with a dry, irritating cough, sometimes expectoration.

3.4.3.1   Chronic simple laryngitis (*laryngitis chronica simplex*)

Diagnosis: History, the laryngoscopic picture is dominated by of whitish-coated vocal cords, the vocal cords are mat, remaining mucous membrane of the larynx is hyperemic.

Treatment: If possible, to eliminate the underlying cause; inhalation.

Prognosis: Good.

3.4.3.2 Chronic hyperplastic laryngitis (*laryngitis chronica hyperplastica*)

Here, an inflammatory hyperplasia is significant sign based on an increase of connective tissue, glands, lymphatic tissue and epithelial layer. The changes are diffuse or localized, most often in mechanically stressed areas such as the vocal cords, posterior commissure, ventricular plicae. In some cases, hyperplasia occurs especially in the area of ventricular plicae, which may partially or completely touch each other. During phonation, they vibrate and form rough voice, so-called ventricular voice.

Diagnosis: History, indirect or direct laryngoscopy, at ambiguous findings, especially in progression, excision biopsy is indicated.

Treatment: Elimination of noxious substances.

Prognosis: Good, due to possible malignancy, strict follow-up is indicated.

3.4.3.3 Chronic atrophic laryngitis (*laryngitis chronica atrophica*)

It is often combined with atrophic chronic inflammation of other respiratory organs (nasal cavity, pharynx); usually occurs upon long-term exposure to a pollutant.

Symptoms: Dysphonia, dryness, scratching in the throat, occasional coughing up of dense secretions.

Diagnosis: History, laryngoscopy, the mucosa is thinned, pale, covered with dense secretions, sometimes with the formation of crusts; changes tend to be symmetrical.

Treatment: Elimination of harmful substances, inhalation, climatotherapy.

3.4.3.4 Reinke´s edema *(Oedema Reinke)*

Reinke´s edema is swelling of the vocal cords, which is more common in women smokers. It is caused by the accumulation of fluid in the so-called Reinke's space - in the superficial subepithelial layer of the vocal cord formed by thin connective tissue of *lamina propria superficialis*.

Symptoms: Gradually worsening voice, hoarsness.

Diagnosis: History, laryngoscopic examination, which reveals swelling of one or both vocal cords.

Treatment: In the initial stages conservative approach (save the voice, phoniatric exercises), in the more advanced stage laryngomicrosurgical treatment (with histopathological examination).

3.4.4 Specific inflammations of the larynx

These are currently rare diseases; include tuberculosis, syphilis (acquired and congenital), scleroma. The diagnostic problem may be caused by laryngeal tuberculosis, which has almost identical picture as squamous cell carcinoma. Biopsy has a key role in the diagnosis.

3.4.5 Laryngeal precancerous lesions

Precancerous lesions are a special chapter of laryngeal diseases. They are a transition between benign and malignant lesions. Changes are more common in men; the history is dominated by smoking, abuse of concentrated alcohol. The changes affect preferentialy the vocal cords.

There are several classifications of precancerous lesions, focusing on the histopathological picture. Clinically we define:

1) *Leukoplakia* - a type of metaplasia with pathological keratinization of squamous epithelium in unusual localities. The lesion is characterized by a thickened mucosa of the vocal cords, which have a rough surface, often with slightly whitish coating. The mobility of the larynx is fully maintained.

2) *Pachydermia* - bordered thickening of submucosal tissue, sometimes even skinny in appearance, occurring mainly in the area of the posterior commissure.

3) *Keratosis* - macroscopically almost identical change as previous lesions, with a different histopathology.

3.4.6 Laryngeal tumors

Laryngeal tumors are divided into benign and malignant. Tumors can grow from all laryngeal tissues. They are classified into epithelial and mesenchymal tumors.

3.4.6.1 Localized laryngeal cancer (*carcinoma in situ*)

Most often we find macroscopical thickening of the exposed medial surface of the vocal cords, with whitish coating. In the histological picture there is high mitotic activity, nuclear and cellular polymorphism. An important feature is well-preserved integrity of the basement membrane which means that stratification is maintained. But these are early malignant changes.

Symptoms: Prolonged voice disorder, sometimes dry irritating cough.

Diagnosis: History, indirect laryngoscopy, in indicated cases also direct laryngomicrosurgery, excision biopsy with histological examination.

Treatment: Elimination of pollutants. In patients with *carcinoma in situ*, conventional oncological treatment (surgical treatment or actinotherapy) is indicated.

Prognosis: Prognosis of a patient with hyperplastic to precancerous changes depends mainly on the histological picture of the lesion, malignant transformation of originally benign lesions is possible.

3.4.6.2 Benign laryngeal tumors

The most common cause of the growth of benign laryngeal tumors is long-term irritation.

3.4.6.2.1 Polyp of vocal cords (*polypus plicae vocalis*)

The polyp of vocal cords is the most common benign laryngeal tumor. Histologically, it is a hyperplasia of the fibrous or angiomatous structures of the mucosa, caused by excessive vocal colds strain and inflammation. Macroscopically, it is more often stalked, with smooth surface and a spherical shape. It grows mostly from the upper or medial surface of the vocal cord. It can also be symmetrical on both sides.

A relatively common problem is the **singer´s nodule** (or nodules). It typically occurs in voice professionals - teachers and singers, but also in children - "loudspeakers". It grows in the front third of the vocal cord. Macroscopically, it has a smooth surface and grows from the medial surface of the vocal cords.

Symptoms: Dysphonia of various degrees.

Diagnosis: History, laryngoscopy, eventually stroboscopic examination.

Treatment: Surgical - laryngomicrosurgical procedure; resected tissue always has to be examined histopathologically.

Prognosis: Good.

3.4.6.2.2 Laryngeal papilloma (*papilloma laryngis*)

The laryngeal papilloma is a solitary tumor lesion with the possible malignant transformation. It occurs more in adults.

Symptoms: Dysphonia.

Diagnosis: History, laryngoscopy.

Treatment: Surgical – laryngomicrosurgery; resected tissue always has to be examined histopathologically.

Prognosis: Good.

3.4.6.2.3 Laryngeal papillomatosis *(papillomatosis laryngis)*

Laryngeal papillomatosis is caused by HPV viruses. It is more common in children and can affect the whole respiratory system. The predilection site of growth is the transition of squamous and cylindrical ciliated epithelium. The masses grow in numerous clumps, often narrows the laryngeal lumen and cause the ventilation disorders, or even suffocating.

Symptoms: Dysphonia, ventilation disorders.

Diagnosis: History, laryngoscopy, excision or extirpation with histopathological examination.

Treatment: Causal treatment is ambiguous due to the viral disease background. Surgical or laser resection is indicated at mechanical obstruction. After surgery, adhesions that are difficult to manage often develop. Sometimes it is necessary to perform tracheotomy. The resected tissue has to be examined histopathologically. In many cases, spontaneous tumor regression occurs during puberty. Some authors prefer antiviral immunomodulatory therapy.

3.4.6.3 Malignant laryngeal tumors

Malignant laryngeal tumors most often grow from squamous epithelium (carcinomas), (Figs.17, 18), more rarely from mesenchymal tissue (sarcomas).

The most common malignancy in otorhinolaryngology is laryngeal carcinoma; accounts for approximately 50-60% of all tumors. It appears from the age of 40 but there are cases of carcinoma even in childhood; in 90% it affects men. Etiologically, external pollutants play a role - smoking and excessive consumption of concentrated alcohol, as well as environmental pollutants. People from lower social classes with a low educational level are more often affected; it is due to their lifestyle and the overlook of the initial symptoms. Tumor changes occur mainly in the marginal zones (vocal cords, epiglottis) at the junction of various types of epithelium.

Symptoms: Depend on location.

Dysphonia is the predominant and very early symptom at tumours in the *glottic area*. Even minimal changes lead to phonation disorders. In the *supraglottic area*, a voice disorder appears later than in the glottic area. It is caused by impaired laryngeal motility for infiltrative tumor growth. Foreign body sensation in the throat, difficulty swallowing, haemoptysis and hypersalivation may occur. At mechanical laryngeal obstruction the dyspnoea to suffocation may be present. At *subglottic involvement* the symptoms appear at late stages; they are caused mainly by mechanical obstruction (suffocation). Hemoptysis may also be present. *Marginal localization* is represented by the so-called pharyngo-laryngeal tumor, where the tumor also infiltrates the caudal part of the pharynx. The clinical picture is dominated by dysphagia, odynophagia, foreign body sensation in the throat, hypersalivation. In this case, it is sometimes difficult to determine where the tumor primarily grows, but from a practical point of view this is not essential.

Knowledge of metastases formation of malignant tumors to regional nodes is important. The onset and growth of metastases depends on the aggressiveness of the tumor (grading), the lymphatic system of the neck and the anatomical barriers of the larynx .

Fig.17 Glottic/subglottic carcinoma on the right (archive of the Clinic of Otorhinolaryngology and Head and Neck Surgery JFM CU and UHM)

Fig.18 Transglottic carcinoma (archive of the Clinic of Otorhinolaryngology and Head and Neck Surgery JFM CU and UHM)

Diagnosis: History, clinical condition, indirect or direct laryngoscopy, microlaryngoscopy, according to the patient's condition can be performed under local or general anesthesia. Excision biopsy from suspected tumor with histopathological assessment is required. Other examinations: CT of the neck, sometimes supplemented by a USG of the cervical lymphatic system with a focus on the neurovascular bundle. Following these examinations, the tumor staging is determined on the basis of the TNM classification; it is important starting point for the therapeutic procedure. In differential diagnosis rare specific inflammatory diseases (tuberculosis, scleroma) should be ruled out.

Treatment: The tumor stage, its differentiation, the general patient health status and opinion are decisive for the choice of treatment. In the initial disease stages, surgical treatment or actinotherapy is sufficient. In the advanced stages of the disease, treatment is usually a combination of surgical and radiation therapy. The treatment is very aggressive, mutilating. The use of chemotherapy, which is preferred in some countries, is long debated, depends on case by case. It is more suitable for pharyngolaryngeal localizations, rather than neoadjuvant treatment (primary, preoperative treatment). In some cases, chemotherapy, after failure or contraindications of other forms, is used as a palliative treatment. Recently, treatment with monoclonal antibodies has also been indicated in advanced stages.

Surgical treatment of laryngeal tumors is divided into classic and endoscopic depending on the type of tumor, the disease stage and the general patient´s condition. The advantage of partial endoscopic resectionsis that they are gentle, offer sufficient visualization and have minimum later complications. The question of the use of lasers in otorhinolaryngology is still open. With the classic open technique, we can perform *partial surgery* with the removal of a portion of the larynx and to preserve phonation and, if possible, also respiration. The problem with these modalities is often worse healing, and later formation of stenotic. Patients often have difficulty swallowing with numerous aspirations. In these procedures, the rule says - that the more laryngeal tissue is removed, the more problems the patient has. In some cases, after partial resection, the remainder of the larynx should be removed and the swallowing and respiratory organs definitively separated. It may happen even though the patient has been without recurrence of the underlying disease for several years, but later he/she develops significant food intake problems (repeated aspirations).

Laryngectomy is the complete removal of the larynx. The resected stump of the trachea is sewn to the skin in the form of a permanent stoma - the patient has a tracheostomy. One of the serious problems after laryngectomy is the loss of the patient´s ability to communicate verbally. The voice of laryngetomized patient can be rehabilitated in several ways. The principle of production of the esophageal voice is the suction (swallowing) of air, which is then released ("burps") through the mouth. The esophageal narrowings serve similarly to the vocal cords. Another possibility is *electrolarynx*, which electronically amplifies vibrations in the submandibular or submental (under the chin) regions. The voice sounds synthetic and may be less socially acceptable. Another option is a *voice prosthesis* (Fig. 19).

Fig.19 Inserted voice prothesis (archive of Clinic of Otorhinolaryngology and Head and Neck Surgery JFM CU and UHM).

The principle of the voice formation is the connection of the tracheostoma to the esophagus via a shunt, into which a voice prosthesis is inserted. The prosthesis contains one-way valve which enables a passage in the direction from the tracheostoma to the esophagus. One-direction by-pass valve avoid a risk of fluid aspiration. To produce the voice patient inhales, obstructs the stoma with finger, or by another one way ventil, which is fixed by glue on tracheostomy and forces the air through the prosthesis into the hypopharyngoesophageal region. Again, the effect of the esophageal narrowing forming the pseudo-vocal cord is used. In some cases, an excellent voice effect is achieved. The problem with a voice prosthesis is its limited lifespan (1 to 3 years on average).

Prognosis is relatively good. In the first stage of the disease, the 5-year survival is reported in up to 90%, in the 4th stage it decreases to approximately 20-30%. After treatment, a minimum of 5-year follow-up is required.

3.4.7 Laryngeal injuries

Due to its location and construction, the larynx is a relatively resistant organ, protected against injuries. An important protective function is also played by the mechanism by which a person protects the laryngeal structures by reflexively tilting the head. Laryngeal injuries are relatively rare. They are divided into internal and external.

3.4.7.1 External laryngeal injuries

External injuries are divided into sharp, blunt and gunshot. Sharp injuries are stabbing and cutting. Injuries can be superficial, deep, and in some cases open with the exposition of laryngeal lumen. Blunt injuries typical by an intact skin. They are caused by the clash of a foreign object on the larynx or the hit of the body (larynx) an object. The extent of the injury varies.

Commotion of the larynx (*commotio laryngis*) is a condition in which the larynx is macroscopically intact (according to external and intralaryngeal findings), but endings of vagus nerve are stimulated. So-called vagal irritation can cause sudden cardiac and respiratory arrest and lead to the death.

Contusion of the larynx (*contusio laryngis*) is a serious condition in which we detect changes in the skin, subcutaneous tissue, skeleton of the larynx as well as intralaryngeal changes in terms of swelling and hematoma. The fracture of the laryngeal skeleton (cartilage) is a special issue.

Symptoms: Dysphonia of various degrees, pain, swelling is typical for all mentioned pathologies. Subcutaneous and submucosal hematomas, crepitations occur during contusion and fracture.

Diagnosis: History, external inspection of the neck, laryngoscopy.

Treatment: Depends on the overall condition of the patient and the extent of the injury. These include anti-shock measures, respiratory protection (including intubation or tracheotomy), analgesics, antibiotics, corticosteroids, and in some cases surgical revision is indicated.

3.4.7.2 Internal laryngeal injuries

These injuries are relatively rare. They are caused by foreign bodies or can occur during medical procedures (iatrogenic), for example during endoscopy, intubation and the like. They also include burns of the mucous membranes.

3.4.8 Laryngeal paralysis

Laryngeal paralysis is divided into myopathic and neuropathic according to its origin.

3.4.8.1 Myopathic paralysis

The most common causes of myopathic laryngeal paralysis is inflammation and voice overload. These are mostly isolated lesions of individual muscles, most often the laryngeal sphincters. According to the change in the laryngoscopic image it is possible to judge which particular muscle is affected.

Symptoms: Dysphonia of various degree dominates the clinical picture.

Treatment: The basis is the elimination of the primary cause (most often inflammation), voice rest.

3.4.8.2 Neuropathic paralysis

The range of pathologies leading to neuropathic disorder of laryngeal motility is very wide. Pathological processes appear intracranially, cervically and intrathoracically, or in the mediastinal space. They are divided into *cortical*, *bulbar* and *peripheral*.

Neuropathic paralysis can be functional or organic. According to another classification which takes into the account the time factor, they are divided into temporary and permanent.

Cortical organic disorders are rare. They occur in pseudobulbar paralysis, in cerebral bleeding. A typical example of *cortical dysfunctions* is hysteric paralysis (*aphonia hysterica*). It is characteristic that the patient only whispers, but the cough and laughter are loud. The vocal cords are ajar during phonation.

In bulbar paralysis (e.g. *in multiple sclerosis*) the *bulbar nuclei* of the *vagus nerve* are often affected. Other nerves are also damaged, so the symptomatology is varied.

Peripheral damage is most common and occurs at a level corresponding to the course of the *n. vagus, n. laryngeus sup.* and in particular *n. laryngeus recurrens (inf.)*.

The *vagal nerve* lesion usually occurs in the *foramen ovale*; causes are inflammation, tumors, injuries. The lesion of *superior laryngeal nerve* is relatively rare. It is manifested mainly by impaired sensitivity of the laryngeal mucosa and dysphonia of various degrees.

The causes of lesions of *recurrent laryngeal nerve* (inf.) are pathologies in the thyroid gland, mediastinal tumors, bronchogenic carcinoma on the left (due to anatomical conditions), aortic aneurysm. Iatrogenic injury to the nerve may occur in thyroid surgery, less often in esophageal thoracic surgery.

Symptoms: The clinical picture depends on whether the damage is unilateral or bilateral. Sometimes the patient is even without significant problems, other times a sudden suffocating develops. The time interval that elapses from the damage is also important. In the case of bilateral paresis of the vocal cords, these are located in the medial, or paramedical position.

The *rima glottidis* is minimal, insufficient even for quiet ventilation and a suffocation develops. In this case tracheostomy is indicated. When iatrogenic injury of the recurrent nerve is suspected and if its integrity is preserved, we talk about mechanical damage to the perineurium. It is an indication for prophylactic treatment with corticosteroids. The recurrent nerve disorder may be temporary (several days, even weeks), but the function will gradually improve.

In permanent disorders of abductors or adductors, various types of surgeries with widening or narrowing effect on rima glottidis are indicated. These procedures may not have everlasting effect, because after a certain time the vocal cords return to their original pathological position.

Diagnosis: Diagnosis is made on the basis of history, clinical condition and ENT examination.

3.4.9 Laryngospasm *(spasmus glottidis)*

Laryngospasm is a tonic spasm of the laryngeal muscles. It occurs at every age, more often in children. The basis of a typical laryngospasm is a short-term reflex closure of the vocal cords, most often conditioned by the penetration of a foreign body (e.g. food) into the laryngeal entrance, or during endoscopy. Stimulation of sensitive fibers of *n. laryngeus superior* leads to the contraction of laryngeal adductors followed by a significant narrowing of the glottic aperture. The patient is unable to breathe, oxygen saturation of the blood decreases. Subsequently, another reflex mechanism opens the lumen of the larynx and restores ventilation.

Symptoms: Difficulty breathing to apnea, inability to breathe, suffocating.

Diagnosis: Based on history, clinical condition and laryngoscopic examination. In classical laryngospasm, the laryngoscopic picture is physiological, in most cases with preserved correct laryngeal mobility.

Treatment: After a short time, breathing usually resumes spontaneously. Sometimes, when problems persist, it is recommended to intensely irritate another part of the body. Exceptionally, it is necessary to ensure ventilation by intubation, coniotomy, or tracheotomy. In these cases, it is usually not a classic laryngospasm.

3.4.10 Suffocation *(suffocatio)*

From the point of view of otorhinolaryngology, suffocation has many causes that are specific to both children and adults. In children, the relatively most common causes are subglottic laryngitis (chapter 4.3.2.2) and foreign body aspiration into the larynx and tracheobronchial area (chapter 4.4.11). In adults, carcinomas of the larynx, deep throat infections of the pharynx and larynx, allergic reactions after insect bites or after intake of unsuitable foods predominate. To a lesser extent injuries or bilateral iatrogenic injuries of the recurrent nerves and aspirated foreign bodies might be a cause.

The suffocating patient does not tolerate the horizontal position, prefer "high under the head". A very important feature for assessing the severity of the situation is the jugular fossa (*fossa jugularis*). If the patient draws in the jugular area as well as the supraclavicular fossae during inspiration, the condition requires prompt intervention. Monitoring of blood oxygen saturation (oximetry) or an examination of blood gases by ASTRUP method is a part of patient´s monitoring. The suffocation has three stages. In the first, compensation phase, the patient is able to compensate for the problem. There is tachypnoe, deep breathing, the patient poorly tolerates the horizontal position. Blood oxygenation is sufficient or minimally changed. In the second phase, there is peripheral cyanosis and changes in blood gases. If we do not come up with a radical solution, the situation gradually worsens. The terminal stage ends with death by asphyxia.

The suffocating patient requires the care in the intensive care unit. Treatment depends mainly on the etiology. In inflammation, it is primarily conservative – pharmacological with corticosteroids i.v., antibiotics i.v., antihistamines, humidification of inhaled air and sedatives in case of excitation. If the condition does not improve, especially in children, the patient is intubated. The last option is surgical treatment - classic tracheostomy, puncture tracheostomy, or even coniotomy. In laryngeal and pharyngeal tumors, bilateral paresis of the recurrent nerves and devastating injuries, surgical treatment is primarily chosen.

3.4.10.1 Tracheostomy

Tracheostomy is a surgical opening of the trachea, the purpose of which is to provide ventilation during obstruction of the upper respiratory organs (above the tracheotomy opening), or in conditions associated with respiratory failure of various etiologies (neurological causes, polytrauma, etc.) (Fig.20). There are different classifications of the tracheostomy - according to the relation to the thyroid gland, to the place and method of

tracheal opening. Tracheostomy can be performed under local or general anesthesia. At any opening technique, the cricoid cartilage must never be damaged. When it is damaged, there is a risk of inflammation of the cartilage (perichondritis) and a scarring stenotic process leading to the collapse of the entire skeleton of the larynx. As mentioned above, cricoid cartilage is the only one circular structure of the larynx that maintains its lumen.

Fig.20 Tracheostomy (by Jonathan Rosenfeld is licensed under CC BY-NC 2.0, freely available from https://search.creativecommons.org/photos; not modified)

Depending on the emergency of the situation, the patient's condition, anatomical conditions, and certain workplace habits, we can perform puncture or classic tracheostomy.

The *puncture tracheostomy* uses the original set of instruments. The principle of the procedure is the direct penetration of the puncture needle through the patient's skin into the lumen of the trachea. The puncture canal is gradually dilated and a cannula is inserted into the trachea on a wire guide. The advantage of the method is the possibility of its implementation even in field conditions. This type is more suitable if it is an urgent procedure, when it is not possible to classically intubate the patient. Patients must be selected according to anatomical conditions (enlarged thyroid, "thick and short neck"). There is a relatively high risk of bleeding and injury to the neck structures. The most common are injuries to the thyroid gland and tracheal rings. Later tracheal stenosis can be a serious complication. When penetrating through the ring, a part of it can be pressed into the lumen of the larynx. Another reason is an injury to the cricoid cartilage.

Tracheal and laryngeal stenosis are serious complications, often requiring difficult surgical treatment, sometimes with an ambiguous perspective.

In *classical tracheostomy*, the area of the lower part of the cricoid cartilage and the upper part of the trachea is gradually made accessible. Sometimes it is necessary to resect thyroid isthmus. Depending on the anatomical conditions (patient height, neck length), the trachea, most often between the 2nd and 3rd rings, is opened by an incision of the annular ligament. If we assume the use of a tracheotomy for a short time (2 - 5 days), it is more appropriate to pull the rings by the hooks to create a slit-shaped opening into which the endotracheal cannula is carefully inserted. Before inserting the cannula into the trachea, one is used to inject 1% Mesocaine into it to reduce the patient's irritability. With the anticipated prolonged use of the tracheostomy, the second method is preferred, where we cut the anterior part of the lower ring, tilt it ventrally and fix it with a suture to the subcutaneous tissue.

The advantage of the first method is to minimize the formation of tracheal stenosis at the site of its opening. The disadvantage may be the problem of changing the cannula. Especially during the first exchange, the rings can get closer to each other, which eliminates the opening and re-insertion of the cannula is problematic, even dramatic. The second method is associated with a higher risk of stenosis, but cannula replacement should be smooth. The rule is that if we change the patient's cannula for the first time, we must be prepared for this problem. It is ideal to have a nasal speculum ready, which is inserted into the soft tissue canal. By opening it, we identify the point of entry into the trachea, into which we introduce an instrument with long branches (e.g. pean) and then open them. We insert a cannula next to them.

Canceling the cannula is easy. We remove the cannula and fix a larger tampon to the tracheotomy canal with a bandage. In some cases, it is more appropriate to cancel the channel with a suture; healing is faster and the cosmetic effect is more favorable.

Management of the patient with tracheostomy

The patient, and in particular his surroundings, should be thoroughly acquainted with the methods of using the cannula (Fig.21). The society has low tolerance for tracheostomized patients which is a serious problem. In patients, the production and expectoration of mucus through the cannula is increased, often in the most unexpected situations. Replacement of the cannula according to the patient's condition is performed on daily, in other cases on weekly basis. As the patient does not breathe through the nose, the inhaled air should be humidified and dusty environment avoided. The patient is instructed in personal hygiene. Bathing is not recommended due to the risk of aspiration. It is more suitable to shower using prosthetic devices to prevent water from flowing into the trachea. When replacing the cannula, it is

necessary to remove the dried crusts in the lumen. The patient might be able to carry out a routine cannula change himself/herself, otherwise it is appropriate to use the possibilities of nursing agencies. At difficulty breathing even after changing the cannula, a professional examination is immediately indicated.
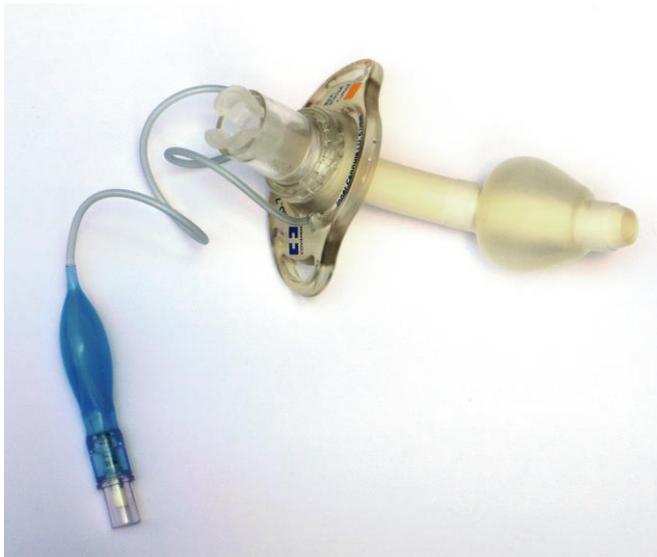
Fig.21 Cuffed inflated tracheotomy tube (by Tenbergen is licensed under CC BY-SA 4.0 , freely available at https://search.creativecommons.org; not modified)

3.4.10.2 Coniotomy

Coniotomy (also cricothyrotomy) is an urgent procedure in suffocating patient. The respiratory organs (larynx) is open between the cricoid and thyroid cartilage through the *ligamentum cricothyreoidale* (*lig.conicum*). The condition for performance is cranially localized stenosis or obturation. This procedure is relatively undemanding. After cutting the ligament, the scalpel is rotated 90 degrees and the cannula is inserted into the opening. If the situation is appropriate, the procedure can be finished by tracheostomy performed *lege artis*. A serious disadvantage of coniotomy is the possible risk of inflammation of the perichondrium (perichondritis) of cricoid cartilage with subsequent collapse of the laryngeal lumen.

3.4.11 Foreign bodies in the larynx and tracheobronchial tree

Aspiration of foreign bodies appears more often in infants; it is less common in adults (Fig. 22). The closure of the glottic area of the larynx due to irritation of its entrance is a reflex event aimed to prevent this serious situation. Wedging, inserting a foreign body into the structures of the larynx is very rare, even though the glottic area is very narrow. In infants, the most common aspirated objects are peanuts and small parts of toys. Children between the 1 and 3 years of age are a particularly risky group, as they do not have developed dentition. The foreign body is usually of solid consistency, the child cannot chew it and holds it in mouth for a long time. Moreover, small children have difficulty in maintaining balance and coordinating movements. They often fall and at the same time they deeply inspire, allowing a sudden aspiration of a foreign body. Aspiration of a foreign body usually occurs during the waking state of a child, on the contrary a suffocation in subglottic laryngitis most often occurs during sleep.
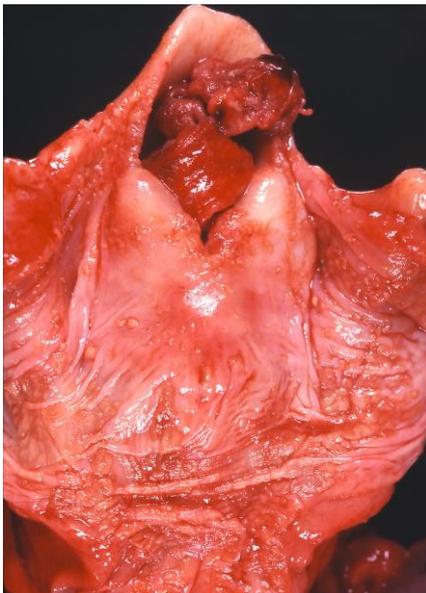

Fig.22 Larynx, aspiration of meat (by Pulmonary Pathology, licensed under CC BY-SA 2.0, freely available from https://search.creativecommons.org/, no image modification)

Classification and symptoms:

The process of aspirating a foreign body usually takes place in three phases.

1) *Stage of acute suffocation attack*. The clinical picture is dominated by persistent paroxysmal cough. It is a defensive reflex, the purpose of which is to remove (cough up) a

foreign body, often with marked dyspnoea, redness in the face, and even symptoms of a suffocating state.

2) *Stage of relative peace*. The patient is without significant subjective and objective problems.

3) *Stage of late complications*. Recurrent bronchopneumonia, atelectasis, emphysema, pneumothorax may occur. The clinical picture corresponds to the respective complication. The duration of individual intervals can vary significantly, depending on the type of foreign body, location and method of wedging. The patient may be asymptomatic for several years and the finding of a foreign body in this case is accidental (e.g. chest X-ray for another indication).

Diagnosis: History, pharyngolaryngoscopy (due to the risk of laryngospasm in a non-cooperating patient, local anesthesia is not recommended) and lung auscultation with the finding of an asymmetry and sharpened breathing. The picture is greatly influenced by the nature of the lumen closure. Closure can be complete or partial. Emphysema occur when the valve mechanism is applied. Other tests include chest/lung X-rays and analysis of blood gases.

Due to the anatomical arrangement, given the angle of the bronchi from the trachea and the higher suction pressure on the right (the volume of the right lung is larger), the foreign body is more often aspirated into the lungs on the right. In children, due to the more medial position of the heart, the differences in the branching between the right and left bronchus are not so significant. Even if the difference between affected lungs (right vs. left) is less pronounced, the lungs on the right are more prone to foreign body aspiration.

Differential-diagnosis: Possible subglottic laryngitis, tumors, post-allergic reaction, laryngospasm, paresis of recurrent nerves.

Treatment: The rule says that any suspicion of aspiration after a thorough examination of the patient is an indication for endoscopy, under general anesthesia. An open and controversial question is the choice of endoscopic technique - rigid or flexible. With minimal suspicion of aspiration, it is preferable to perform a fibroscopic examination first. If the finding is positive and this technique fails to remove the foreign body, the use of a rigid endoscopy is clearly indicated. Flexible instrumentation allows more gentle manoeuvring but has limited ability to gripp the larger foreign bodies. There is also a greater risk of foreign body loosening, especially when passing through the glottic area, with it wedging in more distal parts of the respiratory system. Rigid tools have a better gripping ability. It is sometimes possible to draw

a foreign body into the endoscope's own tube, thus minimizing the risk of its release. Laryngo-tracheo-bronchoscopy associated with the removal of a foreign body, especially a wedged one, is a high-risk procedure. Stimulation of the vagus nerve fibers may lead to the disorders of cardiac rhythm disorders, possibly to asystole. The procedure is performed in special endoscopic centres. If the foreign body repeatedly fails to be removed endoscopically, an external surgical approach is indicated.

Literature

Becker W, Naumann HH, Pfaltz CR. Ear, Nose and Throat Diseases, Georg Thieme Verlag, Stuttgart, New York 1994, 583 s.

Calkovsky V, Minarikova E, Bobrovska M, Hajtman A. Malignant melanoma of the neck: case report and review of the literature.

Hanzel P, Calkovsky V, Sinak I, Szepe P, Zelenak K, Hajtman A. Casteman´s disease mimicking carotid body tumor. Acta Med Martin 2012; 12(2): 39-44

Hopper RA, Salemy S, Sze RW. Diagnosis of midface fractures with CT: What the surgeon needs to know. RadioGraphics 2006; 26:783–793

https://www.longdom.org/open-access/an-updated-terminology-for-the-internal-ear-with-combined-anatomical-and-clinical-terms.pdf

https://www.ncbi.nlm.nih.gov/books/NBK482213/

Javorka K a kol. Lekárska fyziológia, 5. prepracované a doplnené vydanie. Martin: Osveta, 2021, 791s.

Profant M. a kol. Otolaryngológia, Bratislava, ARM 333 2000, 229 s.

Sičák M. a kol. Rinológia: Choroby nosa a prinosových dutín, Martin, Kozák – Press, 2006, 339 s.

Surova V, Slavik P, Calkovsky V, Hajtman A. Brachial plexopathy as an unusual first sign of a head and neck cancer: case report.

Šuster M. Otolaryngológia, Martin, Osveta 1975, 373 s.