

# Nose

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## Comments on Nose Embryology

Nasal placodes are formed in the third week on the frontal prominence (the olfaction area), which deepens and forms the olfaction sockets and olfaction vesicles.

- The frontal prominence is divided by 3 notches into 2 medial and 2 lateral prominences. Medial prominences deepen and turn caudally, so they separate olfaction socket from primitive oral cavity – membrana buconasalis.
- Cranial prominences (the upper jaw) grow together with lateral prominences of the nose and with medial prominences (the entrance to the olfaction socket is formed and a primitive nose entrance is circumscribed)
- After that both medial prominences grow together and they are the base of philtrum. Lateral prominences form lateral parts of the nose and medial parts of the face.
- Dorsum nasi develops from an unpaired area triangularis located above the medial nose prominences. The flat middle part of the face, formed in this way, rises with the subsequent growth. Simultaneously, prominences of the first branchial arch for the upper and lower jaw grow together and consequently, the eyes are moved medially.
- The buconasal membrane rips in the 4<sup>th</sup> week so primitive choans are formed. All the olfaction sockets cause in advance prominences in the form of the sulcus vomeronasalis jacobsoni, which later closes itself into the canal inserted into the nose septum.

## Clinical Anatomy and Physiology of the Nose

The nose is divided into the external nose and the nasal cavity. The nose is connected with the system of paranasal sinuses, functionally and anatomically.

### External Nose

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The external nose has the shape of a three-sided pyramid. It is formed by a bone and cartilaginous skeleton.

- The bone skeleton is formed by the processus frontales maxillae and ossa nasalia
- The cartilaginous skeleton is formed by alae nasi, crus mediale cartilaginis alaris, cartilage alaris major, cartilage nasi lateralis

The skin of the nose typically has a high number of sebaceous glands. In the bone part, it is mobile, while in the cartilaginous part it is strongly connected to cartilages. Nose muscles work as sphincters and openers of nostrils.

- Muscles innervation: n.facialis
- Vascularization: the external part of the nose is perfused by a.facialis, blood is drained away by v.facialis and v.angularis (without valves), which leads to the inner canthus and is connected with the intracranial vascular system. During inflammations of the external nose and the upper lip (trigonum mortis) there is a risk of infection spreading to the cavernous sinus.

### Nasal Cavity

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It is divided by septum into two single cavities. It is covered by mucus with the respiratory epithelium. Mucosa of nasal cavities is very resistant and adaptable against bacterial or viral infection as well as against physical and chemical agents. Secretion glands and calyciform cells form a two-layer film: inner (serous), where cilia oscillate and outer (mucous), where dust and dirt are captured. Dust from frontal part of the nasal cavity is moved by ciliary oscillation into choans in 20 minutes .

Sensitive innervation in the nasal cavity is maintained by I. and II. branch of n.V.

Vascularization is from a.ethmoidalis anterior and posterior and from a.sphenopalatina.

- The medial wall is formed by the nasal septum, which has a cartilaginous character in the frontal part (cartilage alaris major, cartilage septi nasi) and a bone character in the posterior part /lamina perpendicularis ossis ethmoidalis, vomer)

- The lower wall is formed by the hard (processus palatines maxillae, lamina horizontalis ossis palatinae) and the soft palate
- The lateral wall: there are 3 nasal conchae protruding from it – the lower, middle and upper concha. They divide nasal cavity into 4 nasal meatuses – the upper, middle, lower and common. Ductus ethmoidalis leads to the lower meatus. The duct from the maxillary and frontal sinuses and from the frontal ethmoids lead to the middle meatus. The sphenoidal sinus and posterior ethmoids lead to the upper meatus. It is formed by processus frontalis maxillae, facies nasalis maxillae, os lacrimale, os ethmoidale, lamina perpendicularis ossis palatinae, processus pterygoidei ossis sphenoidalis.
- The upper wall is formed by the sphenoidal bone (corpus ossis sphenoidalis) and the skull base – lamina cribiformis ossis ethmoidalis. Through it goes filla olfactoria from region olfactoria into the intracranium.

### Paranasal Sinuses

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- Frontal group: maxillary, frontal, and anterior ethmoids lead to the middle nasal meatus.
- Posterior group: posterior ethmoids and sphenoids lead to the upper nasal meatus.

The mucosa of sinuses is formed by the ciliary epithelium. Cilia oscillate towards the cavity entrance and maintain cleanliness of the cavity. The size and extent of pneumatization is very individual. The development of paranasal sinuses starts in the fetal stage. Newborn babies have ethmoids, subsequently with the children's growth other sinuses form (maxillary by the 2nd year, frontal by the 6th year, sphenoidal around 10th year). The definite shape and size are completed in the adult age.

### Function of the Nose and Paranasal Sinuses

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- **Immunologic:** the mucosa contains lysozyme, secretion immunoglobulins, heparin cells. The nasal mucosa removes noxious agents by displacement, dilution, neutralization and isolation. Cleaning starts in the nasal entrance where bigger particles are captured on nasal hairs (vibrissae) and smaller particles are adsorbed on the mucosal layer and by the ciliary motion they are moved towards the nasopharynx. The transfer from the nasal entrance to the choans lasts physiologically about 20 minutes. The secretion from glands and calyciformis cells dilute the captured noxious agents and they are neutralized by enzymes as well. Plasmatic cells producing antibodies are contained in lamina propria mucosae. They can be incorporated by macrophages together with antigens. Other cells are histiocytes producing vasoactive substances. Immunoglobulins play an important role for the nasal mucosal defence, especially the IgA secretion ones.
- **Regulating:** warming up, moistening and removing filth from the inhaled air. 70% of the inhaled air goes through the lower nasal meatus. The inhaled air is warmed up in the nasal cavity, saturated by vapor and solid particles are captured. Warming up is

done by the countercurrent system (vascularization of the nasal mucosa and cavernous system). Moistening is provided by a plentiful secretion of serous glands and by vaporization from mucin and tears. Saturation (by vapor) is about 80%.

- **Protective:** sneezing is a reflex from nV irritation by endogenous vasoactive substances or by an external chemical or physical stimulation. The nasopulmonary reflex is caused by the irritation of olfactory and trigeminal nerves and its effector is n.X and respiration muscles innervation. The response is a cough or glottis closure. Nose blowing is non-physiological process which replaces natural self-cleaning ability of the nasal mucosa in case of pathological affliction. Respiratory epithelium of airways is impenetrable for common bacteria if natural defense mechanisms are functioning. Previous mucosal damage is necessary for bacterial infection, usually by viruses.
- **Articulatory:** as a part of the resonant space they are part of the human physiognomy.
- **Olfactory and reflective:** the peripheral olfactory analyzer is located in the anterior upper part of the nasal cavity vault – regio olfactoria. It receives stimulations in the form of smells and stenches – it has a protective value in differentiating the noxious agents. Humans are able to differentiate more than 10 000 smells and stenches.

Breathing through the nose goes physiologically against the resistance which is important in childhood for forming of the oral cavity, muscle and pectoral skeleton development. Therefore it is very important that children breathe through the nose correctly.

## Examination Methods of the Nose

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### Sight, palpation

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We assess: nose configuration, line of nasal dorsum, possible deviations, crepitations, emphysema, skin color, exanthema, hemangiomas, pigment naevi, ulcers or other pathologies. We have to be aware of the nose size and development deviations.

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### Rhinoscopy

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- **Anterior rhinoscopy:** with the help of Hartmann's mirror we can assess the nasal entrance, septum, mucosa (pink, reddish, livid), secretion (clear, mucous, turbid, suppurating, bloody, with crusts), configuration of the lower and middle concha. The upper concha is inapproachable by direct sight.
- **Middle rhinoscopy:** in the past – by Killian's mirror (after topical anaesthesia and anemization of mucosa). At present, the endoscopy of the nasal cavity is used.

- Posterior rhinoscopy: an indirect examination of the posterior parts of the nasal cavity, choans, nasopharynx. It is done with a mirror or at present endoscopy is performed.

#### Examination of nose patency

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- By Glatzel's plate for guidance
- Insertion of sound or catheter into mesopharynx through the nasal cavity (exclusion of choanal atresia in newborns)
- Rhinomanometry – measures intranasal pressure during inspiration and expiration
- Acoustic rhinometry – ultrasound-based examination
- Endoscopy

#### Examination of mucociliary activity

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It is examined by a saccharine test – after saccharine application on mucosa of the nasal entrance, the patient senses a sweet taste in the throat after 15-20 minutes (the time of the substance transfer by mucociliary transport into choans and onto the taste buds).

#### Examination of olfaction

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Olfaction disorders are divided into quantitative (anosmia, hyposmia) and qualitative (parosmia, phantosmia, specific anosmia)

- Quantitative (subjective) olfactometry – the patient inhales different smells and odors and determines them. Used substances are vanilla, coffee, lemon,...
- Qualitative olfactometry – according to Bornstein with the help of 3 groups of substances:
  - Irritating only n.olfactorius (stearine, soap, camphoric spirit, lavender oil)
  - Stimulating n.V (menthol, ammonia)
  - Caused sense of taste (chloroform, pyridine)

## Examination of paranasal sinuses

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- X-ray examination – in frontal, semiaxial, axial and lateral projection. Conmeatusional X-ray gives information only about massive pathological mucosal changes (cysts, hyperplasia, polyps)
- CT (coronary projection – in the frontal plane, axial projection – in the transversal plane, possibly reconstruction) – displays mainly bones
- MRI displays soft tissues very well
- Frankel's test – anemization of nasal mucosa with a tampon with adrenalin or sanorin (5-10 min.) – leads to decongestion of mucosa and loose paranasal sinuses entrances open (the presence of suppurating or serous-suppurating secretion under middle concha marks paranasal sinuses inflammation)
- Puncture of maxillary sinus – is indicated in case of cavity empyema. The needle is guided through the lower nasal meatus, it goes towards the lateral canthus
- Sinusoscopy – endoscopic examination. The maxillary sinus is examined through a hole in the maxilla created by trocar via fossa canina (caution – risk of teeth germs damage in young children) or the lower nasal meatus. The frontal sinus is examined after the communication creation in the medial edge of eyebrow (Beck's puncture). Sphenoidal sinus is examined through the nasal cavity.

## Congenital Anomalies of Nose

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### Nose agenesis

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Usually, only one nasal cavity is developed, even sinuses are missing on the afflicted side

**Therapy:** surgical in cooperation with the plastic surgeon

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### Double nose

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There are 2 noses with 4 nasal entrances

**Therapy:** surgical in cooperation with the plastic surgeon

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### Proboscic lateralis

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A creation of dermal and muscle protuberance in the shape of proboscis, which is located in the inner canthus. It is blind and usually contains sebaceous glands and a cartilage.

**Therapy:** surgical in cooperation with the plastic surgeon

## Medial or lateral rhinoschisis

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Left and right half of the face are joined together during embryogenesis.

- Medial rhinoschisis is often combined with cheiloschisis. Incomplete rhinoschisis expresses itself as a: fissure of the apex nasi, medial fissure of nasal top wall, double nasal septum, fistulae nasi
- Lateral rhinoschisis is rare – it afflicts ala nasi, the lateral wall of nose. They are rarely combined with eye or ear abnormalities

**Therapy:** surgical according to extent of rhinoschisis during first year of age

## Dermoid cyst

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If the slot between the frontal prominence and the nasal bones is not closed, dermoid cyst is formed. It is usually located in the glabella area and in the upper part of dorsum nasi or on the nasal septum. It contains a yellow pulpy substance, sometimes even with hair. A connection with the intracranial space is possible.

**Therapy:** surgical, operation timing depends on the size and possible inflammatory complications

## Stenosis and atresia of nasal entrance

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Unilateral or bilateral. Stenosis (nasal entrance narrower than 4mm) of the nasal entrance is often found in patients with cheiloschisis.

**Therapy:** surgical in cooperation with the plastic surgeon

## Choanal atresia

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It develops during the 5th embryonal week when the oropharyngeal membrane does not rupture. The incidence is 1:5000, more frequently in girls, hereditary incidence is rare. It is often combined with other congenital anomalies (perceptive hearing loss, eye defects, polydactylia, etc.). It can be unilateral or bilateral, bone or cartilaginous.

**Symptoms:** It depends on the type of affliction. Bilateral atresia causes asphyxia immediately after the birth. Newborn babies get better during the crying (open mouth) and get worse during the feeding (worsening of breathing). Unilateral atresia stays hidden until a later age; it causes paranasal sinus inflammations and rhinocleisis.

**Diagnostics:** ventilation test, sounding with nasogastric sound, endoscopy, CT, MRI

**Therapy:** bilateral congenital atresia demands an urgent surgical intervention with the endonasal endoscopic technique

## Meningocele, encephalocele

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It is a prolapse of velamentum or brain during the intrauterine development around the 20th day. It manifests around the 1st year of age. It is divided into outer and inner. Outer ones deform the nasal area and orbits, inner ones go through lamina cribiformis into the nose. They look like soft, glazy and sometimes pulsating formations.

**Symptoms:** worsened nose ventilation, liquorrhea (risk of intracranial infection)

**Diagnostics:** CT, endoscopy, beta-2-transferrine for liquor prove

**Differential diagnostics:** nasal polyps, tumor

**Therapy:** surgical, ATB

## Diseases of External Nose

### Seborrhoea nasi

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Excretion disorder of sebaceous glands

**Therapy:** dermatological

### Rosacea

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Blood circulation defect – the skin is red, the number of teleangiectasies is increasing. The etiology is unclear. Known causes include the influence of alcohol, coffee and hormonal changes.

**Therapy:** dermatological

### Rhinophyma

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Based on long lasting rosacea (massive thickening of the skin on the apex and alae nasi)

**Therapy:** surgical

### Herpes simplex and zoster

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It is caused by a viral infection and cause circumscribed erythema, later vesicles and crusts. Neuralgic pain in n.V area can be present as well.

**Therapy:** symptomatic, in case of the recurrence in combination with general therapy (Herpesin, Zovirax).



## Erysipel

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Infectious disease of the skin caused by Streptococcus. It looks like painful, circumscribed red spot.

**Therapy:** penicillin, ATB with wide spectrum

## Eczema of the nasal entrance

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It develops after the skin irritation with a pathological secretion during acute and chronic rhinosinusitis, in case of foreign body in the nasal cavity or paranasal sinuses, physical or chemical agents or bad hygienic habits.

**Therapy:** removing of the primary cause, chamomile compress, Jarish solution, unguents and oil softening, in case of dry eczema even corticosteroid unguents.

## Folliculitis vestibule

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Staphylococcal infection of hair follicle. It causes a swelling and erythema with strong pain.

## Furunculus nasi

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It is a disease with possible life threatening complications. It is a staphylococcal infection of the hair follicle or sebaceous gland. The infection does not only occur in the follicle area, but also spreads into the surrounding tissue and can cause flegmona or abscess. The disease is often followed by headache, strong pain, fever, a regional lymphatic nodes swelling. The most severe complication is thrombosis of cavernous sinus, followed by sepsis and meningitis (the infection spreads through the venous system which has no valves: v.facialis – v.angularis – v.ophtalmica).

**Therapy:** ATB against Staphylococci and drainage of suppurating focus. Removing by pressure is strictly forbidden!

# Diseases of the Nasal Cavity and Paranasal Sinuses

## Rhinosinusitis

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### Terminology:

- Rhinosinusitis: an inflammation of the nasal mucosa and the paranasal sinuses. The nasal cavity and paranasal sinuses form a functional and anatomical unit. If natural orifices of paranasal sinuses are patent, the inflammation afflicts the mucosa of the nasal cavity as well as the mucosa of the paranasal sinuses.
- Rhinitis: an inflammation of the nasal mucosa. An inflammation of the nasal cavity without the paranasal sinuses is possible only when natural orifices of paranasal sinuses

are impassable. In practice, rhinitis usually means a viral infection of the nose and the paranasal sinuses.

- Sinusitis: an inflammation of the paranasal sinuses mucosa. An isolated inflammation of the paranasal sinuses is possible only when natural orifices of the paranasal sinuses are impassable. In practice, sinusitis usually means a bacterial or mycotic infection of the nasal cavity and the paranasal sinuses. The most frequently afflicted sinus in adults is the maxillary one, next is ethmoidal and frontal one. The most frequent in children is an ethmoidal inflammation. The inflammation can afflict only one sinus – monosinusitis, or more sinuses together – polysinusitis, or all sinuses – pansinusitis. If the frontal group of paranasal sinuses is afflicted, it causes pain in the face, forehead or nose base. If the posterior group is afflicted, it causes pain in the back of the neck. The pain is increased during coughing and forward bend. Children can have different symptoms - local symptoms are not expressed, but general problems are bigger.

**Definition:**

recurrent 3 of followed symptoms: nose discharge, nose obstruction, sneezing, itching, cough.

**Classification:**

- Allergic:
- Seasonal
- Perennial
- Infectious
- Acute (viral, bacterial)
- Chronic (bacterial, mycotic)
- Other

**Allergic rhinosinusitis**

- Seasonal – watery secretion, sneezing and nose itching, it appears especially in the time of pollen season, eye symptoms are present as well. Typical allergens: pollen, grass, molds
- Perennial – dominant is nose obstruction for the whole year, eye affliction is uncommon. Typical allergens – acarids, dust, parasites, furs, cockroaches

**Diagnostics:** rhinoscopy: serous secretion, mucosal swelling, livid color of mucosa or erythema, nasal polyps. Allergologic tests.

**Therapy:** nasal corticosteroids, antihistaminics, surgery in case of polyps.

**Acute rhinosinusitis**

**Etiology:**

- viral (rhinovirus, adenovirus, RS virus, picornavirus)

- bacterial superinfection (s.pneumoniae, H.influenzae, S.aureus, M.catarrhalis, etc.) usually after 5-7 days from viral infection

#### **Pathogenesis:**

- inner causes: nose patency restriction, congenital or gained predisposition, infection focus in the nose or paranasal sinuses
- outer causes: climate, working environment

The inflammation can develop by spreading from teeth, after a long nasal intubation, in tampon insertion, after an injury, by infected water in the swimming pool, in defects in the nasal cavity. In sucklings, the symptoms more severe because the fed baby has problems with swallowing due to nose breathing restriction.

**Diagnostics:** rhinoscopy – serous secretion in viral infections (changes into mucous), suppurating secretion in bacterial superinfection, erythema and mucosal swelling.

#### **Therapy:**

- nasal corticosteroids (no systemic effects)
- antihistaminics: 1.generation (promethazin, dithiaden) – suitable in young children (sedation), 2.generation (Claritine, cetirizine) – with no sedative effect
- nasal decongestion drops (contain antihistaminics and pseudoefedrine derivates – Clarinase, Disophrol)
- anemization nasal drops: better distribution if a spray is used
- Salt solutions, Vincentka: suitable for after-treatment, in children and as a premeatusion
- ATB – in bacterial superinfection

#### **Chronic rhinosinusitis**

**Definition:** symptoms last at least 12 weeks, or 6 emeatuss of acute rhinosinusitis per year in children or 4 in adults, or the presence of permanent changes on CT. Inflammatory chronic mucosal hyperplasia can be cause of cysts and polyps

**Etiology:** bacterial or mycotic

- Rhinosinusitis chronica atrophica – mucosal congestion, hyposmia, crusts, stench from nose. It is divided into: primary atrophic rhinosinusitis (ozaena) and secondary atrophic rhinosinusitis (after radiotherapy, surgery or injury)

**Therapy:** Vincentka, mucosal moistening, ATB, surgery

- Rhinosinusitis chronic simplex – the most simple form with an increased nose secretion and temporary nose obstruction (reversible hypertrophy). It is caused by a conchal congestion.

**Diagnostics:** rhinoscopy: erythema and swelling of mucosa, dense secretion. Mucosal swelling disappears after vasoconstriction therapy. Imaging methods (CT) are indicated before surgical intervention.

**Therapy:** medication (corticosteroids, antihistaminics), if it is unsuccessful – surgery (FESS)

- Rhinosinusitis chronica hypertrophica – permanently worsened patency of nasal cavities (irreversible hypertrophy), dense mucous secretion, hyposmia

**Diagnostics:** rhinoscopy: erythema and swelling of mucosa, dense secretion. After vasoconstriction therapy, no effect can be seen. Imaging methods (CT) are indicated before a surgical intervention.

**Therapy:** surgical (FESS, nasal mucosa ablation)

### **Other rhinosinusitis**

- NARES – non-allergic rhinitis with eosinophilia syndrome. Perennial flu with sneezing, itching and discharge
- Professional
- Hormonal – pregnancy, adolescence, climax, endocrinopathy (thyroid gland, hypophysis)
- Induced by medication – sanorin, contraceptives, reserpine, chlorpromazine
- Psychic etiology – stress, sexual arousal – influenced by autonomous stimulation
- Alimentary – food, conservation agents, colors
- Idiopathic – (vasomotoric rhinitis) is nasal hyperactivity on non-specific trigger factors (warmth, cold)

### ***Specific rhinosinusitis***

- Rhinoscleroma of nose

It is a chronic granulomatous inflammation of the nasal mucosa caused by *Klebsiella rhinoscleromatis*. The infection enters the organism via the nose into the airways. Scleroma is formed at first in the nose and from there it spreads into the pharynx, trachea, larynx and lower respiratory tract. It can afflict even the nose and face skin.

**Therapy:** ATB, surgery

- Rhinitis gonorrhoeica neonatorum

It is caused by a gonococci infection during the birth. It is a severe form of suppurating necrotic rhinosinusitis with otitis of the nasal skeleton, often with a lethal end.

**Therapy:** ATB

- Rhinitis syphilitica neonatorum

It manifests in the 3rd week of life by a stench secretion from the nose, ulcer and fissures formation in the nose entrance, lymphatic nodes enlargement. Morphologic changes in the oral cavity are often present.

**Therapy:** ATB

### **Nasal polyps and cysts**

Developing on the base of chronic inflammation or allergy.

- Polyps are mucosal duplications – pedunculated formations formed by an edematous bindweb and covered by a gray mucosa. Meningocele, tumor or chronic foreign body must be excluded.

Antrochoanal polyp grows from the maxillary sinus. Due to the mucociliary transport, it grows into choans.

Multiple polyps grow from ethmoids.

- Thin-walled cysts are usually in the maxillary sinus, they are filled with serous or mucous content. Exit form mucous gland is closed. Pressure of bigger cysts on the cavity wall causes headache, but does not cause any nose symptoms. Diagnostics – with X-ray in semiaxial projection.

**Therapy:** surgical (sinoscopy, polypectomy, FESS), corticosteroids

### **Disease of Septum Nasi**

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#### **Deviatio septi nasi**

It appears separately or in combination with deformities of the whole nose. It can be congenital or can develop in adolescence as a result of asymmetric growth of cartilaginous and bone skeleton of the face or as a result of injury.

**Symptoms:** difficult unilateral nose breathing, compensatory hypertrophy of lower concha on the other side, snoring, sleep-apnoe syndrome, olfaction disorders. The risk of inflammations is increased because of bad ventilation.

**Therapy:** septoplasty after end of growth

#### **Perforatio septi nasi**

Develops after a septum operation, chemocautics on both sides of nasal septum, in rhinitis sicca anterior, after abscess of septum, in specific inflammations of septum (TBC, syphilis), after cocaine or other addictive substances application, during work with chemicals. Septum perforation can be a sign of tumor or other serious disease.

**Symptoms:** increased crusts formation, whistling murmur during nose breathing

**Therapy:** surgical (transposition of surrounding mucosa, implantation of autologous cartilage, prosthesis)

### **Bleeding polyp of septum**

It can be a source of recurrent epistaxes, the therapy is surgical.

### **Synechia**

It develops most frequently after an injury, operation in the nasal cavity, mucosa burn. We can see fibrous and mucosal bridges between the septum and the lateral wall of the nasal cavity during anterior rhinoscopy.

**Symptoms:** they depend on the localization and the extent – the cause of mucus stagnation, difficult nose breathing

**Therapy:** surgical – synechia disruption with local treatment (fat tampons) into epithelization of the mucosa.

### **Epistaxis**

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It develops from local as well as from general causes. It often develops in patients with hypertension, hematologic disease, tumors of nasal cavity, paranasal sinuses and epipharynx, venectasia of septum. Epistaxis follows nose injury or damage to the nasal mucosa (foreign body, repeated suction). The most frequent is bleeding from locus Kiesellbachii – venous plexus in the anterior part of the nasal septum. Woodruff's plexus is located on the posterior part of the lower concha.

**Diagnostics:** rhinoscopy, nose endoscopy, hematologic and internal examination

**Therapy:** according to the extent and bleeding localization.

- First aid: the head must be bent forward, everything must be blown out of the nose. Press alae nasi into septum, cold compress, anemization
- In case of recurrent bleeding, use chemocaustics (silver nitrate, chromic acid, hemostyptics, electrocaustics)
- In case of stronger bleeding:
- Frontal package: by absorbable material (Gelaspon, Spongostan) or fat package. If the frontal package is in the nose for more than 48 hours, ATB are necessary as a premeatousion of infection.
- Posterior package: tampon insertion into the nasopharynx in case of bleeding localized dorsally in the nasal cavity or nasopharynx. It is done by a thin catheter inserted into the nose. The catheter is pulled out of the mouth and the tampon is fixed on it. By

pulling the nasal end of catheter, the tampon is fixed in the nasopharynx, fibres are fixed to the face. The anterior package usually follows. ATB are necessary.

#### PCD – primary ciliary dyskinesia

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It is a genetically conditional autosomal recessive disease. Cilia movement of ciliary epithelium is insufficient and uncoordinated – patients have problems caused by increased mucus production and stagnation in airways.

**Symptoms:** persistent suppurating rhinosinusitis, recurrent otitis, chronic cough, atelectatic focuses, chronic bronchitis. The majority of boys suffer from sterility in adulthood as a result of structural defect of sperms. About 50% of patients with PCD have dextrocardia (Kartagener's syndrome – recurrent sinusitis, bronchiectasiae, dextrocardia)

**Diagnostics:** electron microscope examination of nasal mucosa, saccharide test or isotope examination.

**Therapy:** symptomatic – early ATB therapy of lower airways inflammation, mucolytics, climate therapy

#### Postnasal drip (sinobronchial syndrome)

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Secretion from upper airways flows during rhinosinusitis into the lower airways and causes bronchitis.

**Symptoms:** persistent cough, headache

**Diagnostics:** chronic rhinosinusitis during bronchitic auscultation finding

**Therapy:** rhinosinusitis therapy, ATB

#### Cystic fibrosis

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**Symptoms:** bronchial obstruction by viscous mucus, rhinosinusitis, nasal polyps.

**Diagnostics:** endoscopy, electron microscope examination of mucosa

#### Wegener's granulomatosis

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Vasculitis combined with granulomatosis on autoimmune base.

##### **Classification:**

1. grade – ulcers in the nasal cavity
2. grade – multifocal affliction with systemic symptoms
3. grade – systemic affliction with significant symptoms and multiorgan failure

**Symptoms:** nose obstruction with serosanquiolent secretion, crusts in the nasal cavity, atrophic rhinitis, increased temperature, pain in the middle part of the face. In later stages infiltrates are present in the nasal cavity and lungs, in the 3rd stage – fever, hemoptysis, renal insufficiency.

**Therapy:** corticosteroids with cyclophosphamide, cotrimoxazolum, reconstruction of the external nose (rhinoplasty).

## Tumors of nose in children

### Parameningeal rhabdomyosarcoma

Most frequent soft tissue malignant tumor of the head and the neck in children (40% of all RMS)

**Symptoms:** painless swelling of paranasal sinuses, orbits, nasopharynx, fossa pterygopalatina and fossa infratemporalis. Symptoms result from the damage to the surrounding tissues. Nose obstruction, epistaxis, proptosis, OMS, head nerves disorders. The destruction of the anterior part of the skull base can rarely cause pain. Almost all patients have metastases at the time of diagnostics.

**Diagnosis:** CT, MRI, biopsy, bone marrow, X-ray of bones, examination of liver, spleen, liquor, Ca, P, other blood tests.

**Therapy:** chemotherapy – vincristine, actinomycine, cyclophosphamide. Radiotherapy – main complications are face growth defects and X-ray induced tumors. Surgery – diagnostics from biopsy, resection of residual tumor after 12 months.

*See also: Rhabdomyosarcoma in Tumors and expansive processes in children.*

### Angiofibroma

It is found only in adolescents – boys. It grows from foramen sphenopalatinum (upper edge) towards nasopharynx, through choans into the nasal cavity, fossa infratemporalis. It grows to the paranasal sinuses, orbits and middle excavation. The tumor is usually white, spherical, nodulated, uncoated and covered by mucosa with big submucous vessels. Histologically it is formed from vascular and stromal components. Vessels are regularly placed and miss contractive elements (a risk of strong bleeding, which can be stopped only with difficulties)

**Symptoms:** nose obstruction, epistaxis, rhinophonia causa, swelling of the face, proptosis, diplopia, vision disorders, local bone destruction. Recurrences are common after operation.

#### Staging:

- 1A nose and nasopharynx
- 1B paranasal sinuses
- 2A foramen sphenopalatinum
- 2B fossa pterygopalatina
- 2C fossa infratemporalis
- 3A intracranium



**Diagnostics:** nose endoscopy, CT, MRI, angiography, excision is contraindicated – a risk of great bleeding

**Therapy:** surgery (preoperative embolization of tumor vessels during angiography), radiotherapy in case of intracranial spreading – it can cause an X-ray induced tumor in the irradiated area. Surgical approaches: most frequently endonasal surgery, transpalatal, lateral rhinotomy, midfacial degloving. Controlled hypotension during the operation.

### **Carcinoma of nasopharynx**

It is probably the most frequently misdiagnosed tumor of the head and neck. It includes 0,25% of all tumors in North America, but 18% in China (antigens HLA-A2, HLA-B-sin2 loci). The risk is increased by eating salty fishes (nitrosamine), exposure to tobacco smoke and dust, chronic infections of the nose and the paranasal sinuses, EBV, bad hygiene and insufficient ventilation. It occurs at any age, the average age is 51 years. It includes 1/3 of tumors in the nasopharynx in children, without any difference between genders.

**Symptoms:** metastases in lymphatic nodes, hearing loss, nasal obstruction and secretion, epistaxis, headache, neuropathy – especially growing into foramen lacerum.

**Diagnostics:** epipharyngoscopy, CT, MRI, biopsy, immunology (antibodies against EBV)

**Therapy:** radiotherapy 6.500 – 7.000 cGy + prophylactic irradiation of neck lymphatic nodes, neck dissection, resection of the residual or recurrent tumor. In case of dissemination, adjuvant chemotherapy is used. A five year survival in children is 40%.

## **Nose injuries**

Injuries of face are very common. They develop during the birth in sucklings in case of fall on head, during the development of movement abilities of children, in older children during sports etc. They can be irrelevant (surface scratches, hematomas), but also very serious where eye brain and jaws can be damaged and even cosmetic impact is important.

### **Injury of facial soft tissues**

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Surface injuries of nose are relatively frequent, contusion or laceration injuries combined with fractures of nasal bones and the nasal septum

**Therapy:** suture, ATB

## Fracture of the nose

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Open or closed

**Symptoms:** nose deformation, bleeding, impaired nose ventilation, swelling, hematoma, pain

**Diagnostics:** sight, palpation (crepitations in case of fracture), rhinoscopy, X-ray

**Therapy:** cold compress, nasal drops, suture of the skin, anterior package. Reposition of nasal bones should be performed up to 7 days after injury and in children in addition in general anaesthesia.

## Hematoma and abscess of septum

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It develops during a blunt punch so that blood flows between perichondrium and mucosa of the nasal septum. It is usually bilateral. In case of an infection, an abscess can develop. The risk of this disease is a possible development of meningitis, sepsis and thrombophlebitis of the cavernous sinus (via v. angularis and v. ophthalmica).

**Symptoms:** difficult nose breathing, soft bulge of septum with fluctuation

**Diagnostics:** rhinoscopy

**Therapy:** incision, drainage, anterior package, ATB

## Fractures of facial skeleton

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### Le Fort classification

- Le Fort I – avulsion of maxillary alveolar process (swelling of the lower parts of the face, occlusion disorders, pathological mobility of the dental arch)
- Le Fort II – fracture line goes from the nasal base to the foramen infraorbitale, dorsally on tuber maxillae and to processus pterygoideus (swelling, hematoma, epistaxis, pathological occlusion, step on the lower edge of orbit)
- Le Fort III – separation of the facial skeleton from the skull base – craniofacial avulsion (bleeding from nose and mouth, hematoma, concave deformation of the face, pathological occlusion, liquorrhea, anosmia, eye complications)
- Therapy: ATB, stomatosurgery. Operation is indicated after stabilization of state.

### Other fractures

- Isolated fracture of processus zygomaticus – concave deformation and painful movement of temporomandibular joint

- Injury of the temporomandibular joint – luxation – occlusion disorders
- Fracture of zygomatic complex – asymmetry of the face, enophthalmus, pain of temporomandibular joint, eyelids hematoma, diplopia, hypesthesia of 2.branch of n.V
- Isolated fracture of orbit base (blow out) – by a blunt punch to the eye (e.g. tennis ball) – lower wall of the orbit is broken because the wall is architectonically the thinnest.

**Symptoms:** diplopia, restricted movement of the eyeball (caused by eyeball muscles incarceration), eyelid hematoma, enophthalmus, disorders of n.V

**Diagnostics:** CT, eye examination

**Therapy:** ATB, surgery in case of eyeball movement restriction

- Fractures of anterior wall of frontal sinus – impressions are caused by fragments dislocation into the cavity

**Diagnostics:** CT, eye examination

**Therapy:** ATB, surgery with fixation and elevation of fragments and with control of sinuses exits

- Frontonasoethmoidal fractures – if force acts in the middle of the upper etage. It causes fracture of superciliary ridge, medial wall of ethmoids, nasal bones or lamina cribrosa. Liquorrhea must be excluded. Damage of 1.branch of n.V and lacrimal pathways.

**Diagnostics:** CT, eye examination

**Therapy:** premeaturation of infection and brain edema (ATB, corticosteroids), surgery – close dura mater defect and stop bleeding

#### Foreign bodies in the nose

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More often on the right side (majority of right-handed) – peas, beans, stones, beads, paper, toys, polystyrene, etc. In case of injury or bullet wound, a foreign body can get to the paranasal sinuses. Parts of food can get to the nasal cavity during sneezing or vomiting

**Symptoms:** difficult ventilation, unilateral nose secretion, in case of chronic foreign body is present unilateral nose and paranasal sinuses inflammation.

**Diagnostics:** rhinoscopy, examination of nose patency, X-ray

**Therapy:** removing by hook, stuck bodies have to be removed in general anaesthesia. Tweezers are absolutely an unsuitable tool.

## Inflammatory complications of nasal diseases

## Local complications

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### **Empyema of paranasal sinus**

Usually in the maxillary sinus during obstruction of the natural orifices

**Symptoms:** pain (increased if patient bend forward), swelling and erythema of the face

**Diagnostics:** X-ray semiaxial projection, CT, Frankel's test, rhinoscopy

**Therapy:** ATB, nasal corticosteroids, antihistaminics, puncture, sinuscopy, supratubinal antrostomy

### **Osteomyelitis**

**Symptoms:** swelling above the afflicted bone, swelling of eyelid, pain, fever

**Diagnostics:** rhinoscopy, CT

**Therapy:** surgical removal of the afflicted bone, long term treatment with ATB

### **Mucocele, mucopyocele**

Rare in children. It afflicts especially the frontal sinuses. It develops in case of inflammation, injury or surgery if the opening of the sinus is permanently closed. The result is a long lasting mucus and mucous retention inside the cavity, which causes a pressure increase and bone deformation. According to the content, they can be divided into mucocele (mucus), pyocele (pus), mucopyocele, hydrocele (watery content).

**Symptoms:** a bulge near the inner canthus or on the forehead, eyeball dislocation if mucocele causes pressure on the orbital wall

**Diagnostics:** X-ray, CT. In differential diagnostics is necessary to differentiate meningocele and dacryocystitis.

**Therapy:** surgical

## Orbit complications

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They are the most frequent. The cause is usually ethmoiditis and less often an inflammation of the frontal, maxillary or sphenoidal sinus or odontogenous inflammations. Inflammations of orbits can develop after an injury or inflammation of the eyelids or conjunctivas, after insect bites, etc.

### **Classification:**

Important is the relation to the so called orbital septum (periorbit + tarsal plates of eyelids)

- Chandler (1970):
  - 1. Inflammatory edema – inflammation (flegmona) localized between the orbital septum and the bone wall of orbit
  - 2. Orbital cellulitis – inflammation (flegmona) in the orbit (spreads through the orbital septum)

- 3. Subperiosteal abscess – inflammation (abscess) in the orbit (spreads through the orbital septum)
- 4. Orbital abscess – inflammation (Abscess) localized in the orbit (spreads through the orbital septum)
- 5. Thrombophlebitis of the cavernous sinus – the most frequent complication of the orbital inflammation
- Moloney (1987):
  - 1. Epiperiorbital flegmona – same as 1. according to Chandler
  - 2. Epiperiorbital abscess – same as 3. according to Chandler
  - 3. Orbital flegmona - same as 2. according to Chandler
  - 4. Orbital abscess

**Symptoms:** erythema and eyelids swelling, especially in the medial parts, chemosis of conjunctivas, protrusion, deviation, dislocation and eyeball movement disorders, function disorders of II-VI head nerves, impaired sight or even sight loss, ptosis of the upper eyelid, pain, panophthalmia

**Diagnostics:** CT, MRI, ENT and eye examination, neurology

**Therapy:** conservative in case of flegmona – ATB, therapy of rhinosinusitis. Surgical if the patient does not improve in 48 hours or in case of abscess. Surgical approach is endonasal, external or a combination of both.

#### Intracranial complications

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- Meningitis
- Abscesses: epidural, subdural, brain (headache, nausea, bradycardia)
- Thrombophlebitis of intracranial sinuses: sinus cavernosus (clinical symptoms are same as in case of bilateral orbit inflammation), sinus sagittalis superior

**Diagnostics:** CT, MRI

**Therapy:** ATB, surgery (neurosurgical craniotomy and abscess extirpation), hematological treatment (thrombolysis in case of thrombosis of sinuses)

#### Distant complications

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Infection focus develops during chronic inflammation of paranasal sinuses. Bacterial toxins spread out of cavity into blood and cause allergic-hyperergic reactions. They can afflict the heart, joints, kidneys, skin, eyes and vessels. Symptoms worsen if acute sinusitis is present.

**Diagnostics:** prove of chronic rhinosinusitis, bacteriology, allergology

**Therapy:** rhinosinusitis treatment

## Basics of nose surgery

### Endonasal surgery

Surgical interventions performed with endoscopy with the help of special instruments. Operation is less radical in comparison with classical surgery, however, it is technically more difficult. We try to spare physiological mechanisms (mucociliary transport). At present, it is important in the therapy of inflammations, with a limited value in tumors.

### Terminology:

Used abbreviations: in literature the following abbreviations and terms are used, their meaning is practically the same:

- FES (functional endonasal surgery)
- FESS (functional endonasal sinus surgery)
- EES (endoscopic endonasal surgery)

For simplicity reasons we will use the abbreviation FES in the text.

### Principles of FES:

FES states that mucosa of the nose and paranasal sinuses has a great regeneration ability if those conditions are preserved:

- Sufficient ventilation
- Mucociliary transport

The most frequent surgical interventions:

- Sinusoscopy (sinoscopy)
- Supratubinal antrostomy – enlargement of sinus maxillaris opening in middle nasal meatus. Anterior edge of hiatus semilunaris forms processus uncinatus ossis ethmoidalis. It is so called “unicnatectomy” (comment: os turbinale – lower nasal concha)
- Ethmoidectomy anterior – opening of the anterior group of ethmoids
- Ethmoidectomy posterior - opening of the anterior group of ethmoids
- Sphenoidectomy – opening and operation of sinus sphenoidalis

## Septorhinoplasty

- **Septoplasty:** it is made in case of nasal septum deformations and is usually performed after the end of growth (16 years of age), earlier only exceptionally. The principle of the operation is to remove the deformed parts of cartilaginous or even bone skeleton of septum with returning part of cartilage.
- **Rhinoplasty:** from cosmetic reasons in case of external nose deformations

## Classical surgery of nose and paranasal sinuses

At present, it is usually performed in case of tumors, sometimes even for inflammation therapy

The most frequent operations:

Sinus maxillares:

- **Sec. Caldwell-Luc:** resection of the anterior wall of maxillary sinus (antrum Higmore – AH) from vestibulum oris superior, removing AH mucosa, communication formation into the lower nasal meatus

Sinus frontalis:

- **Sec. Beck:** an approach by opening formation in the anterior wall of frontal sinus in the medial ridge of the eyebrow
- **Sec. Jansen-Ritter:** an approach by resection of the lower wall of the frontal sinus
- **Sec. Killian:** an approach by resection of the lower and part of the anterior walls of the frontal sinus. The bone in the supraciliary ridge is spared.
- **Sec. Riedl:** an approach by resection of the lower and anterior wall of the frontal sinus. A cosmetic defect is inevitable.
- **Osteoplastic operation:** skin incision in the upper edge of the frontal bone with lifting off the skin lobe and the anterior wall of the frontal sinus and returning them back at the end of the operation.

Ethmoids, sinus sphenoidalis, nasopharynx:

- **Sec. Moore (lateral rhinotomy):** skin incision on the lateral wall of the nose, resection of the lateral parts of nasal bones, ethmoidectomy

- **Midfacial degloving: approach** – incision in vestibulum oris sup., stalling skin of the upper lip and the nose cranially