Nasal Fossa and Paranasal Sinuses

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DES – 16 Novembre 2012
COMPOSITION

- **Nose and nasal fossa**
  - Nose
  - Nasal cavities
  - Turbinates and meatus
  - Ostiomeatal unit (OMU)

- **Paranasal sinuses**
  - Maxillary
  - Frontal
  - Sphenoid
  - Ethmoid
DEVELOPMENT

- Nasal fossa is a pyramidal structure
- Paranasal sinuses are formed by means of an evagination of the nasal mucosa into adjacent bones
- At birth: ethmoid air cells and a rudimentary maxillary sinus
- At 1 to 3 years old: beginning of sphenoid sinus
- Paranasal sinus development continues during childhood until adolescence.
- Frontal sinuses are the last to be formed, they are inconstant
DEVELOPMENT
DEVELOPMENT

6 years old

16 years old
1 month

9 years old

24 years old
Failure to develop or hypoplasia are normal variants

Sinus diseases with limited aeration could also lead to sinus hypo development (ex: cystic fibrosis)

Focal hyperaeration could occur (lateral sphenoid, supraorbital ethmoid)
CILIARY DYSKINESIA
**MEATUS**

- **Superior meatus drains**
  - Posterior ethmoid air cells
  - (Sphenoid sinus)

- **Middle meatus drains**
  - Frontal sinus
  - Maxillary sinus
  - Anterior ethmoid air cells

- **Inferior meatus drains**
  - Nasolacrimal duct
- It is a complex anatomical region
- It includes the infundibulum, uncinate process, hiatus semilunaris, ethmoid bulla and middle meatus
ANATOMICAL VARIANTS

- Anatomy varies from patient to patient but there are specific variations that occur frequently
The clear deviation of the nasal septum reduces the nasal cavity volume with possible consequences on the middle meatal ventilation.
CONCHA BULLOSA

- It is an aerated turbinate, most commonly the middle.
- Middle > inferior > superior
- It can lead to a meatal obstruction with inflammatory consequences (obstructed OMU at middle meatus)
- Its development can be the cause of maxillary, frontal and anterior ethmoid sinusitis
The pneumatisation of the unciform process can be responsible of infundibulum, with development of secondary inflammatory process.
Inversion of the curvature of the middle turbinate is favored by a marked deviation of the nasal septum.

It could consequently reduce the middle meatal space.
The hyperaeration of the bulla system can lead to ventilation compromise of the middle meatus.
- It is an infraorbital ethmoid cell
- It is inferolateral to the orbit and lateral to maxillary infundibulum
- Its development can be the cause of maxillary sinusitis
They are an extension from the anterior ethmoidal cells in the unguis and in the frontal apophysis of the superior maxillary.

- Lateral to lamina papyracea, adjacent to frontal recess.
- Its exaggerated development to the top can be the origin of frontal sinusitis due to compromised drainage of this sinus.
The bulging (herniation) in the sphenoidal sinus from:
- internal carotid artery backward
- optical nerve in front

Or the bulging of the Onodi cell can have severe surgical consequences.

Onodoni cell is a posterior ethmoid cell extending into the sphenoid bone, adjacent to the optic nerve.
ONODI CELL

Imaging in treatment planning for sinonasal diseases
Maroldi, Nicolai, Springer
ANATOMICAL VARIANTS

Pneumatised crista galli apophysis by an unusual extension of the frontal sinus
Figure 1. Schematic representation of the three types of olfactory fossae according to the Keros classification: A, type I; B, type II; C, type III. (Modified from Stammberger).
CRIBRIFORM PLATE
DEHISCENCE OF THE LAMINA PAPYRACEA
ANATOMICAL VARIANTS

Maxillary sinus horizontally divided but the two parts are drained in the same meatus by different ostia

Accessory ostium of the maxillary sinus
## SUMMARY BOX 3.5

Reported Prevalences of Anatomic Variations

<table>
<thead>
<tr>
<th></th>
<th>Agger Nasi Cell</th>
<th>Enlarged Ethmoid Bulla</th>
<th>Haller Cells</th>
<th>Pneumatized Uncinate Process</th>
<th>Deviated Uncinate Process</th>
<th>Paradoxic Middle Turbinate</th>
<th>Concha Bullosa</th>
<th>Nasal Septal Deviation</th>
<th>Onodi Cells</th>
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<tr>
<td>Zinreich et al.</td>
<td>Nearly all</td>
<td>8%</td>
<td>10%</td>
<td>0.4%</td>
<td>3%</td>
<td>15%</td>
<td>36%</td>
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<td>Bolger</td>
<td>98.5%</td>
<td>45.1%</td>
<td>2.5%</td>
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<td>Lloyd</td>
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<td>Lebowitz</td>
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<td>Scribano et al.</td>
<td>18%: combination of pneumatization and deviation</td>
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<td>Driben et al.</td>
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<td>Tonai &amp; Baba</td>
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<td>Weinberger et al.</td>
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<td>Perez-Pinas et al.</td>
<td>Nearly all</td>
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<td>3%</td>
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<td>10%</td>
<td>73%</td>
<td>80%</td>
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Som and Curtin, Head and Neck imaging, 4th edition
PHYSIOLOGY : MUCOSA

- **Nasal fossa**
  - NF are lined by ciliated epithelium
  - Contains both serous and mucinous glands
  - Mucosa is very adherent to underlying periosteum

- **Paranasal sinuses**
  - Mucosa similar to NF but thinner, less vascular and less firmly attached to the periosteum
  - Cilia movement pushes the mucous toward the natural sinus foramina
• Soft tissues lining the nasal cavities: N 2 to 3 mm thick
• Variation in the volume of the turbinates < nasal cycle every 20 to 40 minutes
NASAL FOSSA

- Respiration: transition area between ambient air and nasopharynx
- Defense: role in filtration and warming of inhaled air
- Olfaction
- Major crossroad for sinus/ nasal fossa/ nasopharynx/ endocranium and adjacent structures
IMPORTANT ANATOMIC LANDMARKS

- Lateral wall of the nasal fossa: turbinates, ostia, nasal meati, orifice of lacrymonasal canal
- Connection with PPF via the sphenopalatine foramen in posterior part of the lateral wall
- PPF: connects 5 surroundings areas
  - Cribriform plate
  - Lamina papyracea (orbital plate of the ethmoid)
INFLAMMATORY PATHOLOGY

- Normally: mucosa not seen
- However: thickening up to 3 mm often present in normal subject
- Due to nasal cycle: often unilateral swelling of middle/ inferior turbinates + minimal in ethmoid and maxillary sinus
- Signal of sinonasal secretions varies with water/ protein content
SIGNAL SECRECTIONS

- Normally: 95% water and 5% solid/proteins → Hypo T1 and hyper T2

From PH. Som and HD. Curtin
INFLAMMATORY PATHOLOGY

- Rhinosinusitis
- Allergic sinusitis
- Fungal sinusitis
- Complications
Inflammation of the mucosa of the nose and paranasal sinuses

- Acute (< 4 weeks), subacute (4-12) and chronic (> 12 weeks)

- Inflammation → oedema → obstruction

- Sometimes < dental problem, tumor, trauma
Obstruction

- Worsening of inflammatory changes
- Retention
- O₂ lowering
- Modification of bacterial flora
- Further mucosal thickening

30.01.13
sinusite

fistule

fistule

sinusite
CHRONIC RHINOSINUSITIS

- Result from persistent/repeated acute inflammation
- Atrophic, sclerosing or hypertrophic polypoid mucosa
- Thickening and sclerosis of the adjacent bony walls, rarely solitary polyp.
- Bacterial, allergic, fungal or vasomotor
- Most frequent complications: polyps and cysts
ACUTE RHINOSINUSITIS

- Clinical and endoscopic diagnosis
- Initially: viral rhinitis
- Bacterial secondary infection
- Maxillary sinus: 10 à 20 % secondary to dental infection/extraction
- Thickened and inflamed mucosa with submucosal accumulation of fluid
- Large amount of surface secretions/possibility of an air/fluid level
ACUTE RHINOSINUSITIS
ACUTE RHINOSINUSITIS

- Imaging: only if a complication is suspected
- Complication: rare since use of AB
- Infectious propagation via osteomyelitis, via neurovascular foramina or via diploic/emissary veins
- Children > Adult
ACUTE RHINOSINUSITIS: COMPLICATIONS

- Subcutaneous abscess
- Orbital abscess
- Cerebral
  - Empyema
  - Meningitis
  - Encephalitis
  - Cerebral abscess
  - Veinous sinus thrombosis
  - Cavernous sinus thrombosis
POTT’S PUFFY TUMOR
ETHMOIDITIS
PARTIAL THROMBOSIS OF CAVERNOUS SINUS
FUNGAL SINUSITIS

- Allergic mycotic sinusitis (may represent 5 to 10 % of patient with chronic sinusitis)
- Noninvasive mycotic colonization (mycetoma, fungus ball)
- Chronic invasive infection
- Acute invasive infection
FUNGAL SINUSITIS

Diagnostic Imaging, Head and Neck
Harnsberger, Amirsys
MUCORMYCOSIS
MUCORMYCOSIS
MUCORMYCOSIS

30.01.13
MUCOCELE

- Collection of mucoid secretions surrounding by epithelium
- Most common expansile lesion developed in the paranasal sinuses
- Secondary to the obstruction of a sinus ostium
- Sinus filled with remodeling and expansion of bony walls
MUCOCELE
GRANULOMATOUS DISEASES

- Nasal fossa lesions prior to paranasal sinus lesions
- Focal thickening of the nasal septum
- Cartilage destruction
- Sinus involvement: mucosal thickening, bony reactions (destruction, sclerosis)
GRANULOMATOUS DISEASES
PEDIATRIC RHINOSINUSITIS

- In young children, normal mucosa could be thickened
- Especially under 2 years
- ! Nasal polyposis and persistent sinusitis : cystic fibrosis ?
CYSTIC FIBROSIS, PYOMUCOCCELE
TUMOURS

- Sinonasal tumour: extremely rare
- Most common: squamous cell carcinoma: 0.2 to 0.8% of all malignancies, 3% of H and N malignant tumors
- Clinical and endoscopic examination
- Imaging
- Serious evolution
- Advanced stage: 40%
- Dysfunction, morbidity, deformity
TUMOUR EVALUATION IN MRI

- Differentiation between tumour and inflammation
- Size of the lesion
- Precise determination of the tumour extension
- Better resolution in contrast
TUMOUR EVALUATION IN MRI

- MRI is the technique of choice
- MRI > CT
- CT limited to
  - Patient sent for screening by general practitioner
  - Patient with contraindications to MRI
  - Patient «restless» in the MRI scan
PSEUDOTUMOURS : CHILDREN

- Nasal encephalocele
- Nasal dermoid
- Nasal glioma

Anomalies of nasofrontal development
NASAL GLIOMA
TUMOURS : CHILDREN

- **Benign:**
  - Hemangioma
  - Juvenile nasopharyngeal angiofibroma
  - Nerve sheath tumors
INFANTILE HEMANGIOMA
JUVENILE ANGIOFIBROMA
TUMOURS : ADULT

- Benign:
  - Inverted papilloma
  - Antrochoanal polyp
  - Nerve sheath tumor
  - Juvenile nasopharyngeal angiofibroma
  - Benign bony tumor
INVERTED PAPILLOMA WITH RETENTION CHANGES
ANTROCHOANAL POLYP
Juvenile angiofibroma
WHEN TO DO AN MRI?

- Aggressive inflammatory/ infectious lesions
  - Invasive Mycosis (mucor, aspergillus)
  - Wegener granulomatosis
- Benign and malignant tumour evaluation
- No indication in chronic sinusitis or nasal polyposis
CONCLUSIONS

- Type of exams and its conduct depends on the suspected pathology
- Multiplanar study
- Take into account the limitations of this type of exam and the possible contraindications
- Check the important anatomic landmarks