The spectrum of imaging findings in sinonasal tumors

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Learning objectives

1-Description and illustration of clinical, histological and imaging findings seen with the spectrum of sinonasal tumors.

2-Recognise the role of imaging in the pre-treatment assessment and post-treatment follow-up of sinonasal tumors.

Background

Tumor and tumor-like lesions of the sinonasal tract may be classified as benign or malignant, as carcinoma, sarcoma, adenocarcinoma, or lymphoma, according to the tissue of origin (eg, epithelial, bone, lymphoid, or mesenchymal), or as a combination of above. Malignant sinonasal tumors are the most frequent facial malignancies in adults. Assessment of these tumors requires a multidisciplinary approach and imaging plays a major role to define the precise tumor location, volume and extension and to plan post-treatment follow-up.

Findings and procedure details

Sinonasal neoplasms are rare, Despite their infrequency, they represent both a diagnostic and therapeutic challenge because the presenting signs and symptoms may be indistinguishable from benign or inflammatory disorders :

- **Sinus symptom**: nasal obstruction, rhinorrhea, blood stained nasal discharge, epistaxis, oral symptoms, facial swelling.
- **Symptoms of local spread**: orbital symptoms (ocular dysfunction, diplopia, proptosis), loosening of upper teeth, trismus etc.

Sinonasal (1)masses can be divided into two main categories: Non-neoplastic and neoplastic, which in turn, is further divided into benign and malignant. Various pathologies ranging from non-neoplastic lesions to malignant sinonasal tumor may mimic a simple nasal mass. Advanced imaging techniques like computed tomography (CT) and magnetic resonance imaging (MRI) help us to reach at a presumptive diagnosis. Classically, benign neoplasms expand and remodel bone and aggressive malignancies destroy and invade adjacent tissues, causing ill-defined margins. (2)
Radiologic menu of tests:

CT: modality of choice for both inflammatory and neoplastic processes

The true value of CT scanning is its ability to detect bone erosion. Key areas include the bony orbital walls, cribiform plate, fovea ethmoidalis, posterior wall of the maxillary sinus, pterygopalatine fossa, the sphenoid sinus, and the posterior table of the frontal sinus.

Limitations:

• Hard to distinguish tumor from soft tissue swelling and secretions because of their similar densities.
• It cannot always determine whether tumor has invaded or just approached the periorbita (3).
• Radiation exposure

MRI: gives superior soft tissue delineation in the adjacent infratemporal fossa, masticator space, and in evaluation of perineural, intra-orbital, and intra-cranial spread

Typically, edema of inflamed tissue and retained secretions would be of low intensity on T1 and high intensity on T2 secondary to increased water content. However, because of the often chronic nature of these secretions at the time of diagnosis a certain amount of free water will have been absorbed and a variable pattern of intensity may be seen. On the other hand, 95% of sinonasal tumors are highly cellular with less water content giving low to intermediate signal intensity on both T1 and T2 imaging. Intravenous injection of gadolinium provides additional information. Most sinonasal tumors enhance in a diffuse fashion to an intermediate degree, whereas inflamed mucosa enhances more intensely and in a peripheral fashion.(3)

Benign Lesions (Fig 1)

1. papilloma: (Fig 2,3)

Histologically: the papillomas can be divided in three types:

• fungiform or exophytic: which stems from the anterior septum and has the macroscopic aspect of a common wart,
• the columnar: which stems from the lateral nasal wall and the middle meatus,
• the inverted papilloma: with three fold higher chance for malignization if compared to the columnar papilloma(4).
CT scan: suggest inverted papilloma when there is an image of soft tissue present from the middle meatus all the way to the adjacent maxillary antrum, through an enlarged maxillary ostium. (Fig.)

Medial maxillectomy via lateral rhinotomy is the gold-standard to which all forms of therapy are measured. Recently, many authors have advocated endoscopic excision for control of lesions that are accessible and easily followed postoperatively (5).

2/Antrochoanal polyps (Fig 4): represent only approximately 3-6% of sinonasal polyps.

- CT: Typically, antrochoanal polyps have the following features:

  Defined mass with mucin density is seen arising within the maxillary sinus

  Widening of maxillary ostium and extending into nasopharynx

  No associated bony destruction but rather smooth enlargement of sinus

  Classic treatment is intranasal snare polypectomy (6)

3/Juvenile nasopharyngeal angiofibromas (Fig 5, 6): is a rare benign but locally aggressive vascular tumour. Occur almost exclusively in males and usually in adolescence (~15 years). Imaging plays an important role in diagnosis, as biopsies should be avoided due to the risk of brisk haemorrhage, as well as staging. Although these masses are thought to arise from the region of the sphenopalatine foramen, they are usually sizeable at diagnosis, frequently with extension medially into the nasopharynx, laterally into the pterygopalatine fossa and over time beyond, into the orbit, paranasal sinuses, intracranial cavity and infratemporal fossa (7).

- CT: Typically a lobulated non encapsulated soft tissue mass is demonstrated centred on the sphenopalatine foramen (which is often widened) and typically bowing the posterior wall of the maxillary antrum anteriorly. There is marked contrast enhancement following administration of contrast, reflecting the prominent vascularity.

  Extensive bony destruction is usually not a feature, but rather bone is remodelled or resorbed. This feature may be helpful in differentiating from other more aggressive lesions. Intracranial extension can however occur.

- MRI is excellent at evaluating tumour extension into the orbit and intracranial compartments.
T1 - intermediate signal

T2 - heterogeneous signal: flow voids appear dark.

**T1 C+ (Gadolinium)** - shows prominent enhancement

The presence of prominent flow-voids lead to a **salt and pepper appearance** on most sequence are characteristic.

- **Selective angiography** identifies the feeding vessels and allows the option of pre-operative embolization for vascular control.

4/*meningioma*(Fig7): Primary meningioma of nasal cavity or sinus of the face is rare.

- **CT**: shows limited Mass, iso or more evocative spontaneously slightly hyperdense containing calcifications, enhanced after injection of contrast. Associated with an evocative hyperostosis

- **MRI**:

**T1**: isointense, somewhat hypointense

**T1 C+ (Gadolinium)**: usually intense and homogenous enhancement

**T2**: isointense, or hyperintense: usually correlates with soft textures and hypervascular tumours

5/*Osteomas*(Fig8): These are benign slow-growing tumors of mature bone. In order of frequency, they occur in the frontal, ethmoid, and maxillary sinuses. They are extremely rare in the sphenoid sinus. They are very often discovered incidentally but can block sinus drainage leading to mucocele formation or invade the orbit leading to proptosis. Treatment if necessary is by local excision with a margin of normal bone(8).

Very rarely osteomas may be associated with Gardner's syndrome.

6/*fibrous dysplasia* : Is a benign pathologic condition of the bone in which fibrous tissues gradually expand and replace the normal bone(9). Malignant transformation is rare (0.5%) and is usually seen only in polyostotic cases. Following the ribs and long bones, craniofacial bones are the second most common site of involvement and comprise 25% of the cases. Most commonly, fibrous dysplasia is asymptomatic.

**CT**: shows the "groundglass" bone appearance with
Malignant Lesions (Fig9)

Nasosinusal malignant tumors are rare, representing less than 3% of head and neck cancers and 0.8% of all human cancers. Approximately 55% originate in the maxillary sinuses, 35% in the nasal cavity, 9% in the ethmoid and 1% in the frontal and sphenoid sinuses. With the exception of non-epithelial tumors, nasosinusal cancer is a disease that affects adults, being more frequent in men above 50 years of age(12). Squamous cell carcinoma (SCC) is the most prevalent histology comprising >50% of malignant sinonasal tumors. Other histologies include adenocarcinoma, melanoma, adenoid cystic carcinoma, esthesioblastoma and sarcomas of bone or soft tissue(12). The prognosis of these tumors largely depends on tumor location, histology and stage. Imaging plays an important role to help the skull base team differentiate malignant tumor from benign disease, map the anatomical extent of the disease and to detect lymphadenopathy. Although predicting tumor types with imaging alone is not always reliable, radiological features that increase the likelihood of malignancy include patients having a unilateral process, bony involvement, the presence of an extensive soft tissue component, soft tissue necrosis and/or lymphadenopathy(13).

1/ Squamous Cell Carcinoma(Fig10) : the most common tumor affecting the maxillary and ethmoid sinuses. It has been said to account for up to 80% of the tumors in this area. The maxillary sinus is involved 70% of the time followed by the nasal cavity in 20% of the cases with the ethmoids comprising the remainder. Primary lesions from the frontal and sphenoid sinuses are uncommon. It is primarily a disease of males and presents most commonly in the sixth decade. Spread outside the sinuses is almost the rule at presentation. More than 90% will have invaded through at least one wall of the involved sinus when discovered. If metastasis does occur, the maxillary tumors spread to the submandibular nodes and the ethmoidal tumors often are seen in the jugulodigastric and subdigastric nodes. The extent of disease is more important than the degree of differentiation of the tumor.(14)

2/olfactory neuroblastoma : (also known as an esthesioneuroblastoma)(Fig11) is a tumour arising from the basal layer of the olfactory epithelium The tumours are slow growing They begin as masses in the superior olfactory recess and initially involve the anterior and middle ethmoid air-cells on one side. As they grow, they tend to destroy surrounding bonecess of the nasal cavity(15).

CT : is the radiologic exam of choice, which shows a homogeneous mass in the nasal cavity, of soft tissue density
and uniform and moderate contrast uptake. It is important to assess a possible erosion of the lamina papyracea, lamina cribosa and ethmoidal fovea.

**MRI**: is useful to determine intraorbital or intracranial tumor extension.

Treatment usually involves combined chemotherapy and/or radiotherapy with surgical excision. Prognosis is significantly affected by presence of distant metastases.

3/ **Adenocarcinoma (Fig12)**: This is the second most common malignant tumor in the maxillary and ethmoid sinuses accounting for 5 to 20% of cases. These tend to be more superiorly located with the ethmoid sinuses most commonly involved. Most are related to occupational exposures as it is believed that dust particles will travel along the middle turbinate and the larger particles will be deposited there. They present similarly to squamous cell carcinoma and are divided histologically into high and low grades (8).

**Images for this section:**

![Diagram showing classification of lesions](image_url)
**Fig. 2:** axial and coronal CT: Benign soft tissue masses projecting from nasal cavity into ethmoid and maxillary sinuses: inverted papilloma

**Fig. 3:** coronal MRI (T2): Inverted papilloma
Fig. 4: coronal CT/Antrochoanal polyp
Fig. 5: Axial and coronal MRI: Juvenile nasopharyngeal angiofibromas
Fig. 6: axial and coronal CT: Juvenile nasopharyngeal angiofibromas
Fig. 7: axial and coronal CT:Meningioma of maxillary sinus.evocative hyperostosis
**Fig. 8:** axial CT: osteoma in the frontal sinus

**Fig. 9**

- Malignant tumors
  - Epithelial
    - Squamous Cell Carcinoma (most common)
    - Adenoid cystic carcinoma
    - Adenocarcinoma, olfactory neuroblastoma
    - Melanoma, Mucoépidermoid carcinoma
  - non Epithelial
    - Chondrosarcoma, Osteogenic sarcoma
    - Lymphoma, Plasmocytoma
    - Metastatic.....
Fig. 10: axial and coronal CT and MRI:Squamous Cell Carcinoma of the left maxillary sinus with important bone erosion and intra orbital extension.
Fig. 11: coronal CT:esthesioneuroblastoma
Fig. 12: axial and coronal MRI: Adenocarcinoma located in the ethmoidal sinus with intraorbital extension
Conclusion

Tumors and tumor-like lesions are rare diseases in the paranasal sinuses. There is a great variety of histological types. This article discusses the role of CT and MRI in the assessment of the dignity and spread of paranasal tumors and tumor-like lesions in consideration of necessary therapeutic information.

Personal information

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