Sinonasal tumors require team-based approach

June 16, 2005
By Ezio Fanucci, MD [1], Giuseppe Di Costanzo, MD [2], and Giovanni Simonetti, MD [3]

A variety of neoplasms, derived from a multitude of tissue types, can develop in the sinonasal tract. Sinonasal neoplasms are classified as epithelial or mesenchymal. Epithelial tumors occur in the epithelial lining of the nasal and sinus cavities, accessory salivary tissue, neuroendocrine tissue, and the olfactory mucosa. Mesenchymal tumors are found in supporting tissues.

Neoplasms affecting the paranasal sinuses and nasal cavities are rare in comparison with sinonasal inflammatory disease. Carcinomas are by far the most common neoplasm, yet they account for only 0.2% to 0.8% of all malignant tumors and about 3% of all head and neck malignant tumors. Sinonasal carcinoma comprises two distinct types: squamous cell carcinomas and adenocarcinomas. Unlike other cancers of the oral cavity, oropharynx, larynx, and hypopharynx, these tumors are not linked to tobacco use or alcohol consumption. Adenocarcinomas are related to prolonged exposure to exotic woods and are often found in carpenters.

Treatment of sinonasal tumors is complex, involving combined therapy and multidisciplinary teams. Although surgery remains the primary treatment, combined chemotherapy and radiotherapy now play a significant role for these patients, especially those with advanced disease. The region's complex anatomy, combined with the possibility of facial deformity, prolonged morbidity, and gross dysfunction, often limits the extent of surgical resection.

Sinonasal tumors can remain clinically silent for some time. Coexisting infection can disguise clinical signs and symptoms, further delaying diagnosis. Patients with maxillary tumors may present with trismus, epiphora, orbital pain, or proptosis accompanied by gum or tooth pain. Those with ethmoid tumors may have diplopia, proptosis, nasal stuffiness, anosmia, epistaxis, and headache. Frontal sinus tumors can deform the face and extend into the orbits or intracranially, while sphenoid tumors extend into the nasopharynx.

A multidisciplinary team approach is often required for accurate tumor assessment. Improved imaging technology enables superior tumor mapping and staging, aiding "cure versus palliation" treatment decisions. Surgical techniques have also improved, and tumor extirpation is less likely to lead to morbidity or facial deformity. The evolution of numerous approaches to the skull base has extended earlier operative indications, allowing treatment of cancers that were previously considered unresectable. Multiple factors, including tumor histopathology, age, patient health, and extent of disease, determine the method of treatment. Otolaryngologists and head and neck surgeons treat the majority of cases, but neurosurgeons should participate if the anterior cranial fossa is involved. Radiologists play a critical role in determining the most appropriate clinicians to conduct the treatment.

Tumor biology and anatomic location have prognostic significance. A lesion confined to the antrum generally has a better prognosis than one located in the pterygopalatine fossa or central skull base. Certain tumors, however, are highly aggressive regardless of location and despite a noninfiltrating appearance on imaging.

TUMOR ASSESSMENT
The TNM carcinoma classification is used only for tumors of the ethmoid complex and the maxillary antrum, the most common site of primary tumors. The maxillary antrum is bounded superiorly by the orbit and ethmoid air cells and posteriorly by the pterygoid plates and pterygopalatine fossa. The inferior and medial margins of the maxillary sinus are more easily resected, and tumors in these areas have a better prognosis. Ethmoid sinuses are bounded laterally by the lamina papyracea. Tumors in this region can extend into the orbit, requiring orbital exenteration. Involvement of the cribriform plate and intracranial spread also mandate craniofacial resection. Sphenoid sinus tumors are difficult to resect completely, due to their central position.
MRI is superior to CT for assessing the extent of tumor involvement. MRI provides multiplanar reconstruction and better contrast resolution than CT. Postcontrast scans can help distinguish tumor from secretions and evaluate extent and brain involvement. Most tumors are hypointense or isointense on T1-weighted MRI. They show slightly above average signal intensity on T2-weighted images and enhance with a solid pattern after contrast administration, compared with muscle and brain. Secretions are hypointense on T1-weighted MRI and exhibit higher signal intensity than tumors on T2-weighted images. Inflammatory mucosal disease shows similar characteristics, with peripheral enhancement after contrast administration. Because the T2 relaxation of secretions depends on their water content, signal characteristics change as they become desiccated and the protein content increases. Secretions are more hyperintense on T1-weighted MRI. Small tumors are often indistinguishable from adjacent secretions and may be missed. Larger tumors are usually associated with bony changes, which may be helpful in diagnosis. Radiologists are often reluctant to diagnose a tumor in the absence of adjacent bone involvement.

The involvement of fine bone structures is best evaluated with CT because of its excellent spatial resolution (Figure 1). Multislice CT scanners greatly reduce acquisition time and, thus, movement artifacts. MSCT data can be used for multiplanar reformatting, 3D reconstruction, and virtual rhinosinus endoscopy, providing a more precise measurement of mass size, better presurgical evaluation, and a virtual assessment of the likely surgical outcome.

Aggressive changes caused by bone involvement are commonly seen in squamous cell carcinoma but may also be observed in lymphoma and metastases and in benign lesions such as sarcoidosis. Imaging reveals invasion and irregular destruction of the bone with only small fragments remaining. Slow tumor appears as bony remodeling, which typically occurs in inflammatory lesions such as mucocles and polyps but may also occur with melanoma, plasmocytoma, or olfactory neuroblastoma. The third characteristic pattern, sclerosis of marginal bone, usually occurs in chronic relapsing infection such as obstructive sinusitis or osteomyelitis, which is uncommon. It may also be found in breast or prostate metastases, however. Tumoral calcifications in the sinonasal cavities are uncommon. Discrete solitary or multiple calcifications within a mass usually signify a chronic bacterial or fungal inflammatory process. Calcifications may also be found in osteoblastoma, osteosarcoma, chondrosarcoma, and olfactory neuroblastoma.

Orbital invasion is an extremely important parameter because it radically alters surgical planning. Involvement of the periorbit requires orbital exenteration, whereas the eye can be preserved and local recurrence reduced if the periorbit is intact. The presence of bony destruction and involvement of orbital fat confirms orbital invasion (Figure 2). In the absence of these signs, CT and MRI can exclude invasion with positive predictive values of 86% and 80%, respectively. Carcinoma, lymphoma, and olfactory neuroblastoma frequently invade the skull base. MRI surpasses CT in identifying perineural spread and intracranial extension. Contrast-enhanced T1-weighted coronal and sagittal MR images show destruction of the cribriform plate and enhancement of the dural envelope, confirming intracranial invasion (Figure 3).

**ADDITIONAL INVOLVEMENT**

Childhood infections often obliterate the retropharyngeal nodes, which are the primary lymph nodes draining the paranasal sinuses and nasal cavities. Consequently, sinonasal malignancies in adults frequently metastasize to the secondary nodes in submental, submandibular, superficial, and deep laterocervical stations. These nodal metastases occur in approximately 15% of patients. The presence and extension of locoregional nodal metastases in these patients strongly influences prognosis; the five-year survival rate is less than 30% if lymph nodes are positive. Correct preoperative evaluation with imaging thus provides important prognostic information.

Nodal status also has a direct impact on therapeutic planning. Color Doppler ultrasound, CT, and MRI all provide relevant morphological data on lymph node enlargement, while PET contributes metabolic data. Lymphadenopathy can be diagnosed on imaging if a node is larger than 10 mm, has a round appearance, and is accompanied by intranodal necrosis and extracapsular diffusion. CT has a negative predictive value of 84% and a positive predictive value of 50%, according to these criteria. Comparable values for MRI are 79% and 52%, respectively. The use of superparamagnetic iron oxide particles increases the sensitivity and specificity for MR-based detection of metastatic nodes.

Ultrasound is more accurate than CT and MR in assessing lymphadenopathy, but Doppler signal is
not always detectable in metastatic lymph nodes. Contrast-enhanced ultrasound can enhance the signal in perfused vessels and improve the differential diagnosis of inflammatory and metastatic enlarged lymph nodes.\textsuperscript{16}

PET has a high sensitivity for identifying the primary tumor and locoregional lymph node metastases in patients with sinonasal tumors. Reported sensitivity for nodal detection using FDG-PET is 80\% to 96\%, while specificity is 90\% to 94\%. FDG-PET is superior to both CT and MRI for detection of cervical nodal metastases.\textsuperscript{17,18} All methods can miss micrometastases, which occur in a significant number of patients. The presence of cervical node disease is predictive of distant metastases. Cervical lymph node metastases have been discovered in 34\% of autopsied patients but are found in only 10\% of patients at presentation. Cervical lymph node metastases should prompt a chest CT as part of the staging process.\textsuperscript{19}

Recurrence rates following tumor resection depend on tumor biology and treatment planning. Patients with sinonasal tumors tend to undergo therapies that produce significant anatomic alterations. This complicates evaluation of disease persistence or recurrence with conventional imaging approaches. FDG-PET can map functional and metabolic activity before structural changes have occurred, differentiating malignant from normal tissue. The modality also shows active infection or inflammation as increased uptake.

PET can be used for primary tumor staging, including assessment of nodal involvement and distant metastases. The diagnostic potential of PET, however, is particularly evident in the follow-up phase. PET adds significantly to the accuracy of differential diagnoses of disease recurrence and hypervascular fibrosis, yielding sensitivity and specificity rates of 94\% and 85\%, compared with rates of 54\% and 46\% for conventional imaging. PET can also be used to monitor the efficacy of radiotherapy (Figure 4).\textsuperscript{20}

\textbf{MULTIDISCIPLINARY APPROACH}

The ideal diagnostic test for malignant sinonasal tumors would have high sensitivity, high specificity, local staging capabilities (primary mass extension, bone involvement, soft-tissue invasion, and perineural spread), distant staging capabilities (assessment of lymphadenopathies and metastases), and the ability to predict the likelihood of recurrence. Because no diagnostic examination meets all of these criteria, assessment of sinonasal malignancies requires a multidisciplinary team approach. Advances in diagnostic imaging have contributed substantially to the management of sinonasal tumors.\textsuperscript{21} In order for radiologists to provide appropriate tumor mapping to aid decisions about resectability and prognosis, they must know the critical areas of tumor extension that will alter a surgical or irradiation treatment plan. These areas include the floor of the anterior and middle cranial fossae, the pterygopalatine fossae, the orbits, and the palate.\textsuperscript{22} A radiological report should include details of the sinus and the precise areas in which the neoplasm is developing.

Newer software can use raw imaging data to help prepare treatment plans. But CT and MR data are rarely specifically pathognomonic. Features on cross-sectional imaging can be used to differentiate benign from malignant disease, but radiologists' primary role is to produce accurate and anatomically informed tumor maps. Final treatment planning must await pathological diagnosis.

PROF. FANUCCI is a professor of radiology, DR. DI COSTANZO is a radiology resident, and PROF. SIMONETTI is head of diagnostic imaging and interventional radiology, all at the University of Rome Tor Vergata.

\textbf{References}


Disclosures:

Source URL:
http://www.diagnosticimaging.com/articles/sinonasal-tumors-require-team-based-approach

Links: