Imaging Approach to Sinonasal Neoplasms

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KEYWORDS

• CT • MR imaging • Sinonasal • Tumors • Neoplasms

KEY POINTS

- Imaging of sinonasal neoplasms is critical to map the entire extent of the lesion for management.
- A systematic approach is required to evaluate involvement of the critical areas related to the sinonasal space as well as nerves.
- Computed tomography and MR imaging complement each other in a complete evaluation of a sinonasal neoplasm.

INTRODUCTION

Sinonasal neoplasms are rare and account for 3% of all head and neck cancers.[1] A large variety of neoplasms are possible, mainly of epithelial and mesenchymal origin; malignant lesions are more common than benign ones. Squamous cell carcinoma is by far the commonest, accounting for 80% of all the neoplasms in this region, and the maxillary sinus most frequently involved.[2]

The closely apposed and communicating air-filled spaces allow for clinically silent tumor progression within the sinonasal tract. The clinical symptoms (commonly nasal congestion, epistaxis, and nasal obstruction) are so akin to the ubiquitous inflammatory and infective conditions, that the treating physician is often caught unawares. Occasionally, the neoplasm coexists with the inflammatory pathology, leading to misdiagnosis. Hence, most lesions are large at presentation and palliative options can only be offered. Many of the pathologies in this region are very aggressive, further contributing to poor prognosis. The small, restricted sinonasal space with its rich lymphatic supply as well as proximity to vital anatomic structures like orbits, skull base, palate and pterygopalatine fossa (PPF) account for early extracompartmental disease extension. There is a paucity of pain in sinonasal neoplasms until late in the disease, another important factor that leads to delayed diagnosis (**Fig. 1**). Bony destruction, which is an important imaging feature, rarely causes pain. When there is pain, it usually is a sign of nerve or skull base involvement and heralds a poor prognosis.

The optimal assessment and treatment of sinonasal neoplasms require a multidisciplinary approach. Both surgery and radiotherapy have contributed to the management of these conditions. When curative surgery is possible, there is significant cosmetic deformity and functional morbidity. Plastic surgical reconstruction procedures are often undertaken for cosmesis. An often ignored feature of these advanced lesions and potentially morbid management options is the patient's inability to eat, leading to early onset of cancer cachexia, which significantly contributes to poor outcome.

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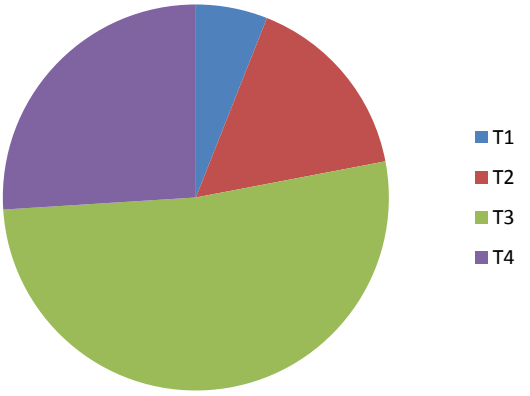

Fig. 1. Stage at presentation of sinonasal carcinomas at the authors' institution.

Both computed tomography (CT) and MR imaging have complimentary roles in the management of sinonasal tumors. The radiologist is called upon not only to detect the disease, but also to map the entire extent of surgical margins as well as radiotherapy planning.

COMPUTED TOMOGRAPHY AND MR IMAGING

Only the superficial extent of a sinonasal neoplasm is visible on clinical examination and nasal endoscopy. The complete investigation of a sinonasal neoplasm mandates cross-sectional imaging. Both CT and MR imaging have played synergistic roles in the assessment of neoplasms of the sinonasal space.

COMPUTED TOMOGRAPHY

CT is usually the first radiologic modality to investigate a sinonasal neoplasm. It provides excellent anatomic detail of the sinonasal skeleton. CT is superior to MR imaging in evaluating matrix of fibroosseous lesions, which can aid in specific histologic diagnosis. Bony destruction of sinuses and orbital walls, as well as involvement of the anterior and middle skull base are precisely depicted in the newer multidetector CT scanners, with reconstruction in different planes. Neural foraminal widening owing to perineural spread (PNS) can be observed on thin sections and reconstructions. Fat is easily depicted on CT. Hence, for lesions that are invading the orbits, coronal CT images are reliable. All these features are of paramount surgical consideration and CT is usually a mandatory requirement from the surgical stand point. CT sections are generally reconstructed at 1- to 1.25-mm sections in the axial, coronal, and sagittal planes. When contrast is administered, the sections are taken 80 to 90 seconds after the initiation of the contrast bolus to achieve good tumor to nontumor interface as well as good visualization of the vessels of the neck. Rate of contrast injection generally is 1.5 to 2.0 mL/s. Both narrow and wide window settings need review for the soft tissue lesion as well as bone changes.

Radiation issues for CT continue to stimulate debate around the world. The new, sensitive multidetecter scanners are significantly dose efficient, with resultant low mAs scans reducing the radiation dose delivered, yet maintaining spatial resolution. Because the coronal reconstructions from axial scans in multidetector CT allow the required quality, there is no need for the direct coronal scans, thereby reducing radiation dose further. Of particular concern has been the dose delivered to the lens and thyroid gland. It has been shown conclusively that, even after multiple scans, patients have a negligible risk for premature cataract formation and thyroid cancer.[3]

MR IMAGING

MR imaging has excellent soft tissue resolution and is accepted widely as the best radiologic modality to evaluate the extent of soft tissue component of tumors in the sinonasal space. The multiparametric capabilities, contrast administration, and multiplanar sequences make MR imaging a potent tool. The extension of tumors along the nerves contiguously or as skip lesions are best evaluated on contrast MR imaging. The orbital fat involvement, dural involvement, reactive changes in dura, and brain involvement are some of the areas where MR imaging plays a decisive role in formulating management options.

The protocol for MR imaging of the sinonasal space includes high resolution T1-weighted, T2-weighted, and diffusion-weighted images as well as T1-weighted, fat-suppressed, contrast-enhanced images. The sections are generally taken at 3-mm thickness with interslice gap of 0.3 mm. Axial and coronal planes are routine, but sagittal sequences are preferred when anterior skull base needs evaluation. The plane of imaging in axial sequences should be parallel to hard palate. Sagittal T1- and T2-weighted images are also indicated when evaluation of anterior skull base is required.

For evaluating PNS, high-resolution images with a small field of view of 16 to 18 cm are preferred. Thin section T1- and T2-weighted axial and coronal images with and without fat saturation are required that cover the entire course of the nerve. Contrast images are acquired in axial and coronal planes, both with and without fat suppression.[4]