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ORIGINAL PAPER

CT and MRI Evaluation of Sino Nasal Mass

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ABSTRACT

CT and MRI play complementary roles in the assessment and staging of these malignancies by determining the presence or absence of extension of disease into the skull base and its foramina, the orbit and the intracranial compartment.

This study was conducted for the evaluation of sinonasal masses with the aims to study the incidence of sino-nasal masses and their clinical features, to diagnose accurately the site and extension of lesion into the surrounding structures and to assess bony involvement and to characterize the mass on CT & MR and to correlate with histopathological diagnosis. Statistical analysis was done over 50 patients with various age groups with CT and MRI Evaluation of Sino Nasal Mass. Computed Tomography and Magnetic resonance Imaging can define the character of the Sinonasal mass, thus differentiating benign from malignant.

***Keywords**: CT, MR, Sino Nasal Mass*

INTRODUCTION

Even though the existence of the Paranasal sinuses may be unexplained, their susceptibility to disease is a common source of suffering for patients and a focus of attention for clinicians.

Malignant neoplasm of the sinonasal tract is rare, since they account for only 1% of all malignancies,[1] with an annual incidence of 0.5-1 new cases/1000000 inhabitants. Although infrequent, sinonasal neoplasm includes a variety of histotypes, a distinctive feature that reflects the peculiar density in this area of different anatomic structures. In India, the upper aero digestive tract cancer that includes the sinonasal tract, etc., constitutes nearly 30-35 of all cancers in the body.[2]

Dramatic improvements in radiologic imaging in recent years have, as a corollary, dramatically improved our understanding of sinonasal tumors. Modern imaging modalities depict sinonasal tumors and their metastases in detail, radiologic examination is commonly employed as a precise "map" for implementation of therapy, and imaging studies are essential in the follow up evaluation for tumor residual or recurrence.

CT and MRI play complementary roles in the assessment and staging of these malignancies by determining the presence or absence of extension of disease into the skull base and its foramina, the orbit and the intracranial compartment. Staging of these lesions has been closely monitored by dependence on computerized tomography (CT) scan and now in small proportion with MRI.

The radiologist must describe in detail the sinus and the precise area within each sinus that are apparently affected by tumor. The paranasal sinuses are best evaluated by computerized tomography in the axial and coronal planes. Somin 1982 commented that the value of CT lies not only in its ability to evaluate clinically known disease but also to image clinically silent disease. The latter can occur in two ways. First, the CT scanner can image tumors in areas that are inaccessible or very difficult to examine clinically. In sinonasal cavities primarily only the anterior lower nasal vault is exposed to direct physical observation. Secondly, the tumor may be sub mucosal and not clinically appreciated, but can be visualized on CT.

As CT scan technology evolves, the role of the CT scanning evaluating sinonasal tumor is increasing. High resolution and thin sectioning CT scan depicts bone erosion best. Critical areas to be assessed include the bony orbital walls, cribriform plate, fovea ethmoidalis, and posterior wall of the maxillary sinus with its attached pterygoid plates, pterygopalatine fossa and sphenoid sinus.[3]

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CT excels in the evaluation of disorders that primarily affect air spaces or cortical bone. However, soft-tissue characterization is much more limited than with MR imaging. In contrast, MR imaging provides poor information about the air spaces and bone, but excellent soft-tissue contrast resolution.

One of the major imaging problems of precise tumor mapping is distinguishing tumor from adjacent inflammatory disease. Basing this distinction on routine CT attenuation values is fraught with inaccuracies. Contrast-enhanced CT can improve the results; however, MR imaging is superior in making this distinction. Inflammatory secretions and tissues have high water content and thus have high T2-weighted signal intensities. By comparison, virtually all sinonasal tumors are highly cellular, with relatively little intracellular and intercellular water, and the majority of these tumors have intermediate signal intensity on T2-weighted images.[4, 5] Thus, the mainstay of the MR imaging distinction between tumor and adjacent inflammatory tissues is the T2-weighted MR sequence. It is rare for sinonasal tumors to have inherently high T2-weighted signal intensities, which may be seen with benign or low-grade minor salivary gland tumors, schwannomas, rare hemangiomatous lesions, and polypoid tumors such as inverted papillomas. Therefore these tumors may not be as amenable to accurate T2- weighted tumor mapping.

METHODS

The study was carried out on 50 patients who underwent Computerized Tomography imaging of the Nose and Paranasal sinuses in the department of Radiology Guwahati Medical College and Hospital from May 2006 to September 2007. CT evaluation was carried out using a SIEMENS SOMATOM AR STAR spiral CT scanner.

The two major indications for CT scanning was either evaluation of patients affected with chronic and recurrent rhino sinusitis or for the evaluation of Sinonasal mass.

Patient preparation: At least 3 weeks of adequate medical treatment (Oral antibiotics, nasal steroids and antihistamines) was ensured before CT examination in patients evaluated for chronic sinusitis. Additionally the patients were asked to clear their nose just before undergoing the examination.

CT protocol in cases of sinusitis and nasal polyposis: In the setting of sinusitis and nasal polyposis, the radinonale of imaging was to obtain detailed information on patency / occlusion of mucous drainage pathways, on bone changes (particularly in critical areas such as the skull base and orbit), intrasinusal content (air, fluid, solid, calcifications) and on anatomic variants. Scanner computation algorithms were selected to favor the demonstration of soft tissue. Window widths were usually at 2,000, and the window was centered to-200.

Direct coronal scanning: The coronal plane was the preferred plane for direct scanning. Each patient was positioned prone with the head hyperextended on the scanner bed. Images were acquired as perpendicular to the hard palate as permitted by gantry tilting and patient cooperation. The examination area extends from the anterior frontal sinus wall to the posterior border of the sphenoid sinus.

Axial scanning: Axial scans were acquired as a complement to the coronal study. It was basically focused on anatomical areas inadequately demonstrated in the coronal orientation. Additionally this scan plane is valuable for the detection of Onodi cells. The patient lies in supine position and direct scans are obtained parallel to the hard palate from the upper border of frontal sinuses to the alveolar process of maxillary bones.

CT protocol in neoplastic lesions: CT protocol consists of native and post contrast scanning in both axial and coronal planes. Contrast was administered as a single bolus and the examination was first done in the axial plane followed by the coronal scans. Spiral techniques were used as they are faster and require lower doses of contrast agent.

A high contrast resolution is mandatory, therefore a higher radiation dose is required and both soft tissue and bone algorithms are adopted for images reconstruction. The true value of CT lies in its ability to detect bony changes.

RESULT

Age incidence: The age-wise distribution of the patients was shown in **Table 1**. Maximum numbers of case were in the age group of 11–20 years (36%). Out of the 50 cases 41 patients were male and 9 patients were female.

Table 1 Distribution of the cases according to their age

Age in year	No of Cases	Percentage
1-10	2	4
11-20	18	36
21-30	3	6
31-40	3	6
41-50	11	22
51-60	7	14
>60	6	12

Age and sex incidence of the lesions: Maximum numbers of benign cases were seen in the younger age group, while malignant lesions were prevalent in the older age group. Both benign (24 cases) and malignant lesions (17 cases) were more prevalent in male populations **(Table 2)**.

Table 2 Relative incidences of Sinonasal masses with age and sex distribution

Sinonasal Mass	No. of Cases		Total
	Male	Female	
Benign	24	5	29
Malignant	17	4	21
Total	41	9	50

Clinical presentations: The nasal obstruction, nasal discharge, intranasal mass, headache and epistaxis are the most common presenting symptoms of sinonasal lesions (**Figure 1**).

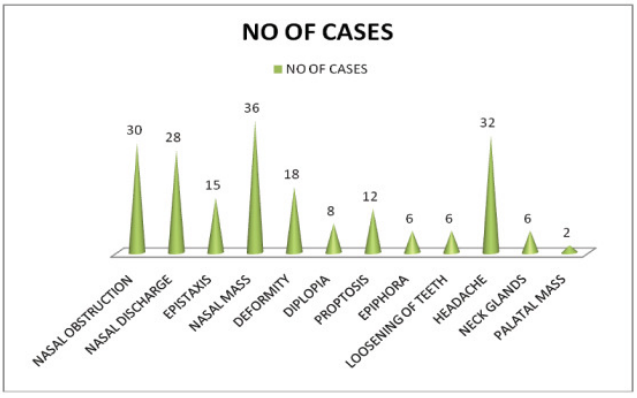

Figure 1 Clinical presentation of the cases

Anatomical location and extension: In the present study, it appears that benign sinonasal masses most commonly occupied the nasal cavity and the nasopharynx. While the malignant lesions occupied the maxillary sinus most commonly this was followed by nasal cavity and ethmoid sinus. Most of the malignant lesions showed extension to the orbital cavity (**Figure 2**).

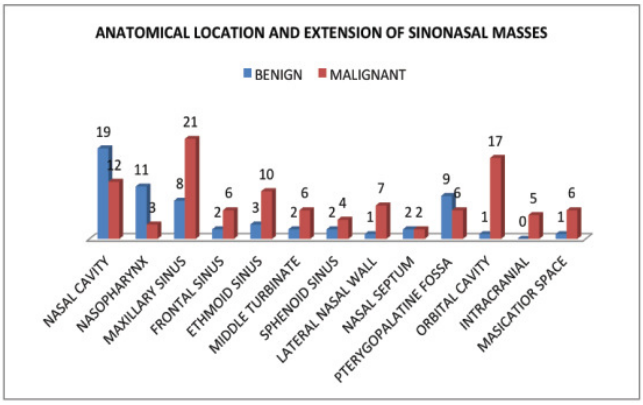

Figure 2 Anatomical location and extension of sinonasal masses

Histological Diagnosis of Benign and Malignant Sinonasal Masses: Out of the 29 benign lesions, most of the lesions were papilloma (38%) and angiofibroma (31%) whereas of the 21 malignant lesions, most of the lesions were squamous cell carcinoma (38%) followed by malignant lymphoma (24%).

CT characteristics of the lesions: Out of 30 cases evaluated with CT, 18 cases found benign and 12 were having malignant lesions.

Density of benign and malignant sinonasal masses in CT: Out of 18 benign masses 13 cases showed soft-tissue density, 2-bone density, 1 purely cystic and 2 mixed density. Out of 12 malignant masses 5 cases showed heterogeneous soft-tissue density, 5 mixed density and 2-showed homogeneous soft-tissue density. Mixed density encompasses the lesions showing an admixture of soft-tissue density, cystic density with or without calcifications.

Bone changes in Sinonasal mass-lesions in CT: The bony changes observed were remodeling, sclerosis; destruction and expansion were shown in **Table 3**.

Table 3 Bone changes in Sinonasal mass-lesions in CT

Bone Changes	Benign	Malignant
Remodeling	11	0
Sclerosis	1	0
Destruction	3	9
Expansion	3	3

MRI characteristics of the lesions: A total of 20 cases were evaluated with computerized tomography, out of which 11 cases turned out to be benign lesions and 9 were malignant lesions.

Signal characteristics of the malignant Sinonasal masses: Out of the 9 malignant masses, 8 lesions showed intermediate signal intensities on T1 weighted images. On T2-weighted images, the lesions showed predominantly intermediate signal intensity followed by hypo intense signal intensity.

Bony involvement in MR: Benign lesions in MR revealed remodeling predominantly (8 cases), whereas, malignant lesions (9 cases) showed cortical invasion as suggested by loss of hypo intense cortical signal intensity on T1WI and altered marrow signal intensity which is best demonstrated on T2 fat suppressed sequences.

Enhancement pattern of benign Sinonasal mass lesions: Out of 29 benign masses 12 cases showed significant enhancement, 7 moderate enhancement, 7 minimal enhancements and 3 showed no enhancement.

Enhancement pattern of malignant Sinonasal mass lesions: Majority (67%) of the malignant Sinonasal masses revealed heterogeneous enhancement **(Figure 3)**.

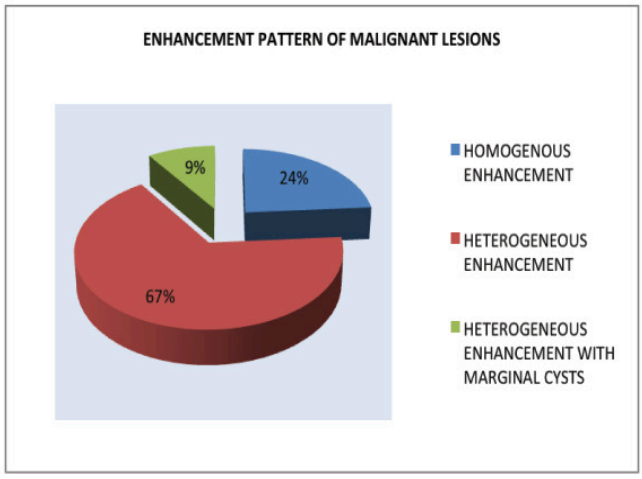

Figure 3 Enhancement pattern of the malignant lesions

DISCUSSION

The benign lesions occurred most frequently in the second decade of life numbering 18 well tallied with the study by Barnes L[6] and for malignant lesions findings are tallied with Sakai as most of the patients belonged to 5th, 6th and 7th decades of life. Bimodal age distribution was seen in case of Sinonasal lymphoma

correlates with the observation of **Batsakis J.**[7] Barnes L[6] also observed the diseases of the nose and Paranasal sinuses with a male predominance.

Nasal mass, nasal obstruction and nasal discharge which was seen in 72% of patients was the commonest presenting symptoms also observed by Spiro R, Koss L, Hajdu S in their studies.[8]

In this study 11 benign lesions to have originated from lateral nasal wall and 9 from pterygopalatine fossa. This correlates well with the study by L Loyd G, Lund V and Phelps PD.[4]

In the present study, bone density of the lesion was similar to the findings of the study conducted by Som P, Shapiro M, Biller H, Sasaki C, Lawson W.[5]

Yousem[9] in a series of 10 cases found that inverted papillomas had intermediate signal intensity on T1-weighted sequences and ISO or slightly hypointense to fat on T2- weighted sequences similar to the present study.

Juvenile angiofibromas on MR imaging in the present study reveal intermediate signal intensity on TI-weighted and T2-weighted sequences, with multiple-flow voids similar to the study of Herman.[10]

In this study, the only case of scwannoma showed hyperintense signal on T2-weighted imaging, which tallied with the studies of L Loyd G, et al.[4] Papillomas in this study reveal patchy areas of moderate enhancement which correlates well with study by Yousem et al.[9]

Soft tissue mass extending beyond the areas of origin were seen all the cases of malignant Sinonasal tumors. Chow J[3] has commented about the propensity of maxillary sinus and ethmoid sinus malignancies to involve adjacent sinuses nasal cavities, orbits, pterygopalatine fossa, infratemporal fossa and the anterior cranial fossa. In the present series that included maxillary, ethmoid and nasal malignancies, orbital involvement was noted in bulk of the patients (80%). Intracranial extension could be well demonstrated in 24% of cases.

Cortical destruction is detected at CT as a break of the mineralized bone through its whole thickness. Aggressive benign neoplasms such as juvenile angiofibroma and malignant tumors have shown cortical destruction in our study as has been mentioned by Som.[5] Cortical destruction in MR is best demonstrated on T1-weighted sequences as loss of normal hypointense cortical signal intensity.

Permeative destruction with extensive replacement of the medullary bone even in the absence of evident cortical erosion was seen in 5 cases of sinonasal lymphoma. Permeative destruction with or without sclerosis is a peculiar pattern observed mostly in lymphomas and in adenoid cystic carcinoma also observed by SYasumoto.[11]

Bony abnormality most commonly seen in case of malignant sinonasal tumors was destruction. Evidence of bone destruction has been mentioned as one of the characteristic findings of malignant sinonasal tumor in various studies.[12,13] Som P[5] in 1982 commented that if bone remodeling was present squamous carcinoma itself should not be present and a plasmacytoma, lymphoma, one of the low grade sarcomas or enthesioneuroblastoma should be considered.

Recent evidence in the surgical literature supports a conservative approach even in the presence of bone erosion on condition that periorbita is not invaded.[4]

Thus, imaging of the periorbita is crucial. Prediction of orbital invasion has been based on the detection of the positive findings graded through progressive steps: tumor contacting the periorbita (Sensitivity of CT and MR 90%); fat obliteration (Positive predictive value CT 86% and MR 86%); extra ocular muscle involvement (Positive predictive value of MR 100%). CT proves to be more accurate for assessing the periorbita invasion than MR.

Like in the invasion of orbital walls, CT better demonstrates bone destruction of skull base, the goals of imaging focus on establishing the depth of skull base invasion. The main goals of imaging are to provide a precise map deep tumor extension in all those areas blinded at fiber optic examination, especially anterior cranial fossa, orbit and pterygopalatine fossae.

The Paranasal sinus malignancies are treated by radiotherapy and surgeries. CT and MR altered the entire pattern of management of the patients with sinonasal malignancy involved in the study. CT and MR also helped differentiate benign and malignant disease in our study.

CONCLUSION

Anatomical location of the sinonasal masses and their extension can be defined accurately by using Computed Tomography and Magnetic Resonance Imaging. Computed Tomography and Magnetic resonance Imaging can define the character of the Sinonasal mass, thus differentiating benign from malignant. Computed Tomography and Magnetic resonance permits a more detailed evaluation of bony structure and soft-tissue contents including those of sinuses and nose. Computed Tomography allows easy appreciation of bony abnormalities and detection of calcification**.** Computed Tomography and Magnetic resonance are helpful in planning treatment procedure and follow up studies.

Conflict of interest: None declared.

Ethical clearance: Taken.

Contribution of Authors: We declare that the authors named in this article did this work and all liabilities pertaining to claims relating to the content of this article will be borne by the authors.

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