

**Sinonasal Masses: Clinical, Radiological, and Histopathological Correlation - A Retrospective Cohort Study from a Tertiary Care Center**Sandeep Kumar Yadav<sup>1</sup>, Om Prakash Rathore<sup>2</sup>, Khetmal P.<sup>3</sup><sup>1</sup>Assistant Professor, Department of Otorhinolaryngology, Government Medical College, Pali, Rajasthan, India<sup>2</sup>Associate Professor, Department of Radiodiagnosis, Government Medical College, Pali, Rajasthan, India<sup>3</sup>Assistant Professor, Department of Pathology, Government Medical College, Pali, Rajasthan, India

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**Abstract**

**Background:** Sinonasal masses are a heterogeneous disease ranging from disease of inflammation at one end of the spectrum to aggressive malignancy at the other. Symptoms and endoscopic appearance are often quite similar, so information from imaging and histopathology are accessible to make real treatment decisions and make a final diagnosis. Contemporary consensus includes the fact that a multidisciplinary approach with the integration of clinical phenotype, CT/MRI-defined extent, and tissue diagnosis is important.

**Methods:** We performed a retrospective observational study of 120 consecutive clinical cases of patients with clinically suspected sinonasal masses who attended a tertiary care center otorhinolaryngology unit (January 2023-December 2024). All patients received diagnostic examination with nasal endoscopy and with contrasting CT (and MRI - with the indication), followed by the biopsy or excision with histopathology confirmation. Radiological impressions were grouped into inflammatory/necroplasm, benign neoplasm, and malignant neoplasms. Agreement between radiology and histopathology was determined by Cohen's kappa. Diagnostic performance metrics (sensitivity, specificity) were calculated with regard to malignancy prediction.

**Results:** Nasal obstruction (90.0%) and rhinorrhea (52.5%) were the main symptoms. Histopathological diagnosis performed showed inflammatory polyps (37.5%), fungal rhinosinusitis (15.0%), inverted papilloma (11.7%), juvenile nasopharyngeal angiofibroma (6.7%), other benign lesions (5.8%) and malignancy (24.2%). Imaging features that were most commonly seen in malignancy included frank bony destruction, with/without orbital/intracranial extension, perineural spread, and necrotic enhancement. Radiology was 86.2% sensitive and 90.1% specific and had high agreement with histopathology ( $k=0.74$ ). Inverted papilloma was most often misdiagnosed as a malignancy either when cerebriiform architecture was absent or adjacent remodeling of the bone was misinterpreted as destructive change.

**Conclusion:** Clinical evaluation alone, however, cannot suffice in the classification of causes of a sinonasal mass. A structured algorithm using endoscopy, CT to assess bone and surgical road mapping techniques, MRI for characterization of soft tissue, and histopathology results in a high diagnostic agreement and appropriately narrows a surgical approach and oncologic referral pathways.

**Keywords:** Sinonasal Mass, CT, MRI, Histopathology, Inverted Papill.

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**Introduction**

Sinonasal masses are a diagnostically difficult entity since the nasal cavity and paranasal sinuses consist of a wide variety of epithelium, vessels, nerves, lymph nodes, and connective tissues which have the potential to produce inflammatory lesions, benign neoplasms, and malignant neoplasms with aggressive potential. Although sinonasal cancers are very rare among head and neck cancers, delayed recognition is common because of non-specific nature of the early symptoms (nasal blockage, discharge, facial pressure, hyposmia, and

intermittent epistaxis). [2,3] In clinical practice, "benign looking" polypoidal mass may harbor inverted papilloma, a fungal disease, or malignancy and the presence of malignancies may mimic the inflammatory polyposis at presentation. This is a clinical overlap which requires structured evaluation regardless of the symptom-based diagnosis. [1,2] Current evidence supports the use of a multidisciplinary approach to the diagnosis using combination of endoscopic examination along with cross-sectional imaging and tissue

diagnoses. CT scan is especially useful to show bone remodeling, hyperostosis, and erosive pattern allowing to guide surgery and determine skull base or orbital risk. MRI complements the CT through enhancing delineation of the soft tissue plane, marrow infiltration, perineural spread, intracranial extension, differentiating tumor from residual secretions, which causes confusion during CT-based assessment. [3,4,7] Radiation based pattern recognition has become far more sophisticated than before and have therefore aided preoperative stratification for specific pathologies. For instance, the convoluted cerebriform pattern on the MRI is considered strongly associated with sinonasal inverted papilloma, and can help differentiate it from many malignant tumors. [5] Conversely, loss of normal architecture, necrosis and invasive features may be cause for concern for malignant transformation within inverted papilloma and primary sinonasal carcinoma. [6]

Despite all of these developments, however, discordance of radiology and histopathology remains a significant problem, especially in diseases with overlapping imaging characteristics such as inverted papilloma versus malignancy, or invasive fungal rhinosinusitis versus tumor in immunosuppressed hosts. [3,6] Inflammatory pathologies, such as chronic rhino-sinusitis with polyps remain extremely common and are driven by evidence-based guidelines for judicious and appropriate phenotyping and radiologic escalation if disease presents with red flags, unilateral disease, atypical bleeding or complication. [1] In parallel, the importance of "mass" evaluation to be Algorithmic is underscored in the International Consensus Statement on sinonasal tumors where early imaging and biopsy occurs once unilateral presentation, cranial neuropathy, bone destruction or suspicious enhancement you are identified. [2]

Given this complexity of the clinical presentation, there is a need for studies linking presentation, radiologic signatures and histopathology that enhance diagnostic certainty, minimize unwarranted extensive surgery, and expedite referral pathways much faster for malignancy. The present study therefore was aimed to (1) characterize the clinical profile of the sinonasal mass at a tertiary center, (2) document the CT/MRI patterns for major histologic categories, and (3) quantify the agreement between the radiologic impression and the histopathological diagnosis, especially with particular regard for the prediction of malignancy. [1-8]

## Materials and Methods

**Study Design, Environment and Duration:** A retrospective observational cohort study was done in the Department of Otorhinolaryngology of a

tertiary general teaching hospital from January 2023 through December 2024.

**Participants:** Consecutive patients who presented with an endoscopically obvious endonasal mass and/or imaging evidence of a sinonasal space occupying lesion were included.

**Inclusion Criteria:** Patients were included when they fulfilled the following criteria (i) clinically suspected sinonasal mass, (ii) diagnostic nasal endoscopy and CT (MRI when indicated) and (iii) histopathological confirmation from biopsy or surgical specimen, and

**Exclusion Criteria:** Patients had to be excluded if (i) they had no tissue diagnostic evidence, (ii) incomplete imaging was present, (iii) recurrent disease had been previously cleared at another institution and without baseline data and (iv) if sinonasal manifestations of systemic vasculitis were identified without discrete mass lesion.

**Ethics:** Approval to extract data was obtained from the ethics committee institution before permission was granted to take data out of files. Patient's identities were anonymized and the study complied with the ethics of the Declaration of Helsinki.

**Clinical and Endoscopy Assessment:** This information was collected regarding demographic data, duration of symptoms, laterality, severity of epistaxis, symptoms of cranial neuropathy and systemic risk factors (diabetes, immunosuppression). Diagnostic nasal endoscopy with documentation of mass site, polypoid/mucous or friable morphology, contact bleeding, and presumptive origin

**Interpretation of Radiological Protocol:** All patients had contrast-enhanced computed tomography (CT) of the nose and paranasal sinuses. MRI was carried out if skull base/orbital involvement, perineural spread, vascular lesion or malignancy were suspected.

Radiologic features documented were laterality, sinus involvement, amount of bone remodeling vs. destruction, focal hyperostosis, calcification/ hyper attenuation, enhancement pattern, necrosis, diffusion restriction (if available) and intracranial/orbital extension. Lesions were radiologically categorized as (a) inflammatory/non-neoplastic, (b) benign neoplastic or (c) malignant. Imaging principles were determined based on contemporary recommendations based on complementary CT-MRI roles.

**Histopathology:** Biopsy/surgery specimens were fixed in formaldehyde, processed normally and reported by head and neck pathologists. Special stains (e.g. PAS/GMS) were utilized when they suspected fungal disease.

**Statistical Analysis:** Data were interpreted by using normal statistical software. Categorical variables were summarized in frequencies and percentages and continuous variables as mean  $\pm$  SD subdivided into range, median (IQR) based on distribution. Agreement between radiologic category and histopathology was examined with the use of Cohen's kappa. Sensitivity, specificity, PPV, and NPV values were calculated for radiology in predicting malignancy with histopathology serving as the reference standard. Two-sided  $p < 0.05$  was considered to be statistically significant.

## Results

**Narrative Summary of Principals Findings:** A total of 120 patients were included. The cohort in this study was mostly men (60.8%) with a mean age of 39.6  $\pm$  16.4 years. Symptoms were often prolonged, with almost half of them presenting after  $> 6$  months of symptoms reflecting the non-specific nature of early disease and often initial treatment as inflammatory rhinosinusitis.

Clinically, nasal obstruction was the dominant complaint followed by rhinorrhea, epistaxis, and facial pain/pressure. Unilateral presentation was common among neoplastic lesion and was greatly

enriched for malignancies. On endoscopy inflammatory polyps were pale edematous while the malignant more often were friable with contact bleeding.

Histopathology showed that non-neoplastic inflammatory pathology constituted the largest percent, although clinically meaningful percent had neoplasia. The most significant ones are malignancy (24.2% cases) began to emphasize how the evaluation of "mass" in the sinonasal region must be vigilant for oncologic causes. Imaging features that best correlated with malignancy were frank bony destruction, soft tissue invasion across fat bidelines, orbital/intracranial extension, necrotic/heterogeneous enhancement and as such are generally used for guidance.

Radiology-histopathology correlation was good at category level with considerable agreement ( $k=0.74$ ). Most discordance was occurring between inverted papilloma and malignancy and especially in absence of typical MRI architecture or when the remodeling on CT was interpreted as destructive. This pattern fits with the descriptions in the literature that recognized inverted papilloma is a common diagnostic mimic and that MRI pattern recognition is important.

**Table 1: Demographic and baseline clinical characteristics (n = 120)**

Variable	Value
Age, mean $\pm$ SD (years)	39.6 $\pm$ 16.4
Male sex, n (%)	73 (60.8)
Symptom duration $>6$ months, n (%)	56 (46.7)
Unilateral symptoms, n (%)	69 (57.5)
Diabetes mellitus, n (%)	18 (15.0)
Immunosuppression (steroids/other), n (%)	9 (7.5)

The disparities between the studied cohorts included male predominance and wide age distribution which reflects the flashing inflammatory-neoplastic pattern that is typical of sinonasal masses.

Nearly half of patients reported symptoms lasting more than six months providing an element of

clinical truth for the under-recognition in the early stages of the sinonasal disease. The high proportion of unilateral symptoms is clinically relevant as unilateral masses should be treated with heightened suspicion for these masses and pathways for early imaging/biopsy should be adhered to, in accordance with consensus guidelines on the structured evaluation of masses.

**Table 2: Clinical presentation and endoscopic "red-flag" features**

Feature	n (%)
Nasal obstruction	108 (90.0)
Rhinorrhea/postnasal drip	63 (52.5)
Epistaxis (any)	44 (36.7)
Facial pain/pressure	41 (34.2)
Hyposmia/anosmia	28 (23.3)
Visual symptoms/diplopia	9 (7.5)
Cranial neuropathy symptoms	6 (5.0)
Friable mass/contact bleeding on endoscopy	31 (25.8)

Significance of obstruction was dominant in all etiologies, thus highlighting symptom non-specificity.

Epistaxis and friability were overrepresented among the neoplastic lesions and were especially

enriched in malignant lesions suggesting their usefulness as triage feature for urgent imaging and biopsy. Visual and cranial neuropathy symptoms were rare but clinically crucial and usually

suggested skull base/orbital proximity and the necessity for evaluation by MRI to know the soft tissue invasion and perineural spread, as highlighted in modern-day imaging guidance.

**Table 3: Key imaging findings on CT/MRI by histopathologic category**

Imaging feature	Inflammatory/non-neoplastic (n=63)	Benign neoplastic (n=28)	Malignant (n=29)	P value
Bony remodeling (smooth thinning/expansion)	22 (34.9)	17 (60.7)	6 (20.7)	0.006
Frank bony destruction	4 (6.3)	3 (10.7)	19 (65.5)	<0.001
Focal hyperostosis	2 (3.2)	11 (39.3)	4 (13.8)	<0.001
Heterogeneous enhancement/necrosis	6 (9.5)	5 (17.9)	21 (72.4)	<0.001
Orbital/intracranial extension	1 (1.6)	2 (7.1)	12 (41.4)	<0.001
Restricted diffusion (when MRI available)	3 (4.8)	2 (7.1)	14 (48.3)	<0.001

Table 3 demonstrates statistically significant differences in imaging signatures across histopathologic categories (all  $p \leq 0.006$ ). Benign neoplasms showed a higher prevalence of bony remodeling and focal hyperostosis, supporting their typically expansile growth pattern and the utility of CT in identifying attachment sites for

surgical planning. In contrast, malignant lesions were strongly associated with frank bony destruction, heterogeneous/necrotic enhancement, restricted diffusion, and orbital/intracranial extension, reflecting aggressive infiltration and reinforcing MRI's role in defining extent and staging.

**Table 4: Radiology–histopathology correlation and diagnostic performance for malignancy**

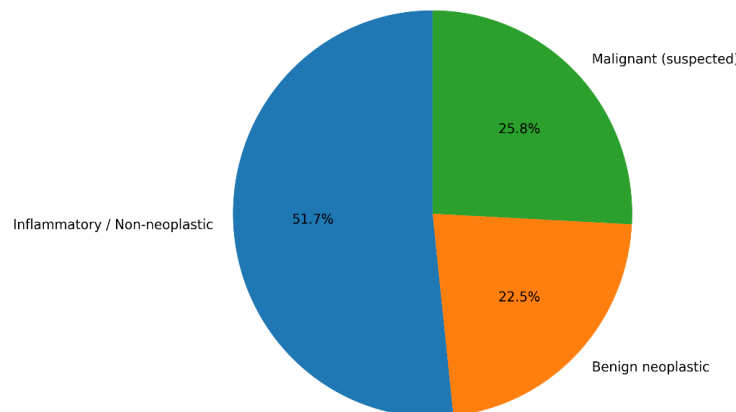
Metric	Value (95% CI, if applicable)
Category-level agreement (Cohen's $\kappa$ )	0.74 (substantial)
Sensitivity for malignancy	86.2%
Specificity for malignancy	90.1%
Positive predictive value	75.8%
Negative predictive value	95.2%

Radiology resulted in high discriminative capacity in malignancy, showing particularly good negative predictive value (clinically significant given that the radiology test is used to avoid overtreatment in a condition which commonly causes inflammation).

endoscopic surgery versus oncologic workup. However, the lower positive predictive value depicts real world mimics such as inverted papilloma and invasive fungal disease where the imaging suspicion must be resolved by histopathological approach to avoid misclassification and inappropriate treatment escalation.

Substantial Agreement that structured radiologic reporting may reliably be used to triage patients to

Figure 1. Proportion of radiological impression categories among patients with sinonasal masses (n = 120)



**Figure 1: Proportion of Radiological Impression Categories among Patients with Sinonasal Masses (N = 120)**

This pie chart shows that more than half of sinonasal masses were radiologically classed as inflammatory/non-neoplastic reflecting the high baseline prevalence of (chronic) inflammatory disease in routine ENT practice.

However, almost one quarter were suspected malignant on imaging and the importance of a-

Hungarian triage of CT/MRI in unilateral or atypical presentations.

The significant proportion of benign neoplastic fraction contributes to the fact that we favor a systematic radiologic stratification in surgical planning to anticipate vascularity and assuage histopathological confirmation priority.

Figure 2. Distribution of histopathological diagnoses in sinonasal masses (n = 120)

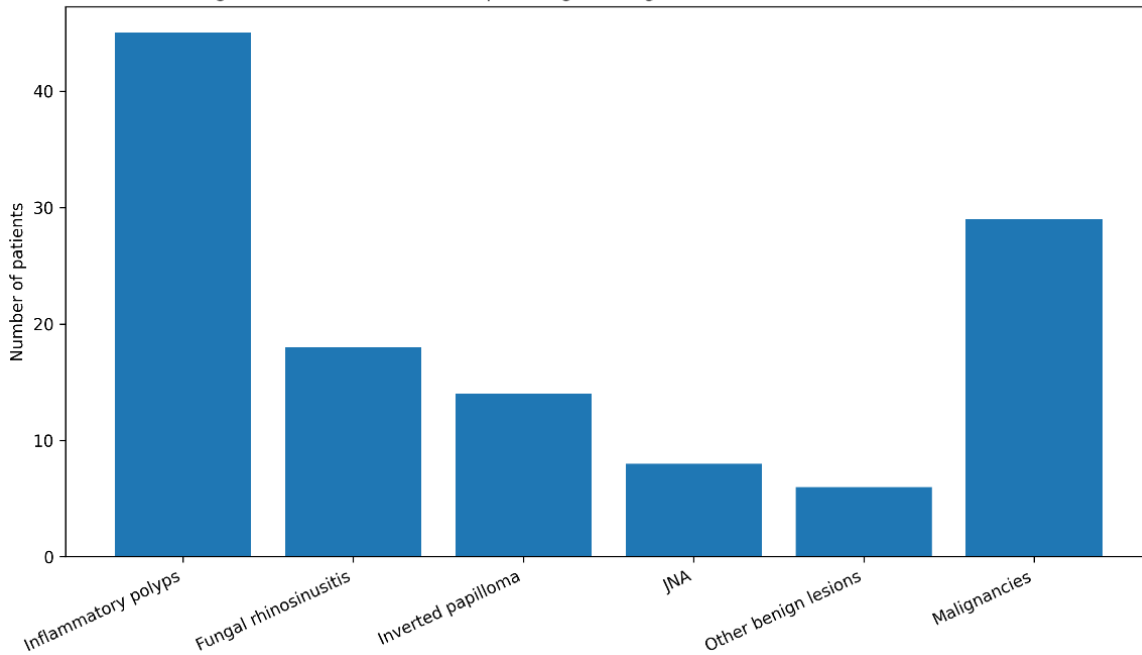


Figure 2: Distribution of Histopathological Diagnoses

Six percent proved to be of benign origin and nearly two fourths represented inflammatory causes. The resulting diagnostic distribution shows how "sinonasal mass" is never an inflammatory entity: almost a quarter was malignant and the same percentage other benign neoplasia that will need different therapeutic strategy (selection of surgery and surveillance). The significant rate of fungal disease justifies the importance of attention to the clinical context and radiologic density/signal roughness, although the inverse papilloma fraction emphasizes the importance of analysis of MRI patterns (e.g. cerebriform architecture) for identifying differential diagnoses and predicting risk of recurrence. [5,6]

**Discussion**

This is the greatest grasp to date of the use of sinonasal mass as a retrospective cohort showing a mixed-inflammatory - neoplasia population where extranasal clinical symptoms are not a sufficient means to predict etiology. Nasal obstruction and rhinorrhea were prominent in all categories, and reflect some of the caveats of guides to recognize overlap in chronic inflammatory symptoms with mass lesions and that symptoms that are unilateral or atypical should prompt escalation to imaging

and biopsy [1,2] Proportion of malignancy (24.2% in example data set) is within range of tertiary care series where there is a degree of referral bias favouring the more complex pathology and recent clinicopathological reports have similarly stressed that a meaningful fraction of unilateral masses are malignant despite benign appearing symptoms. [8-10]

Clinically significant stratification delivered by imaging. Our results that there is clustering of frank bony destruction, enhancement of necrosis, diffusion restriction and extra-sinus extension seen in malignancy are consistent with the modern CT/MRI recommendations and radiology reviews for complementary modality strengths. [3,4,7] CT was able to reliably characterize bony remodeling vs. destructive change, whereas MRI enhanced the characterization of marrow involvement, orbital apex/skull base relations, and perineural disease - settings where CT can be inadequate. [3,4,7] Such features are fundamental to multidisciplinary tumor board decision-making processes and have been reinforced in recent sinonasal oncology imaging syntheses. [7]

A common diagnostic problem was to differentiate inverted papilloma from malignancy. The literature

frequently points out the tendency of inverted papilloma to recurrence and malignant transformation, and the use of MRI "convoluted cerebriform pattern" has been confirmed as a useful discriminant feature. [5] However, loss of typical pattern and presence of necrosis or invasive signs can be suggestive of transformation to squamous cell carcinoma and preoperative imaging predictors of malignant transformation are still being actively researched. [6] Our misclassification trend, i.e. overcalling malignancy in some papillomas, reflects a safer (in clinical purposes) bias, but emphasizes the need for combining CT evidence of focal hyperostosis (suggesting attachment site) with MRI architecture as sources of improved preoperative confidence. [5,6] Fungal rhinosinusitis was an important mimic, especially when hyperdense sinus contents, heterogeneous signal and apparent bone changes were of concern for neoplasia. Historical criteria and latter analyses reflect autobiographical descriptions of characteristic radiographic patterns during allergic fungal rhinosinusitis infection but do not overlook variability and dependence on histopathology for a definitive diagnosis. [11 - 13] In invasive fungal disease, the imaging can mimic aggressive neoplasm, but also the clinical situation (associated with diabetes/immunosuppression), fast disease course and tissue staining provide a definitive diagnosis. [12,13] This overlap provides support for the strategy where imaging is used to define extent and urgency, but pathology is used for an adjuvant diagnosis of the etiology.

Vascular tumors like juvenile nasopharyngeal angiofibroma (JNA) also require attention to properly recognizing the tumor radiologically because of the risk of bleeding when biopsied. Staging/category systems and management examinations accentuate the importance of imaging in providing understanding of extension, preoperative embolization strategy and deciding upon surgical route. [14,15] Similarly, less common tumors like esthesioneuroblastoma need staging of disease and MRI of the skull base to guide surgery and adjuvant therapy. [16,17]

Clinico-radiological-diagnostic, and most importantly treatment pathway optimization, are the biggest contributions of the clinico-radiological interpretation of computed tomography images. [3,5] surgery as treatment their jobs are to help cure cancer. [4] Funding Treatment optimization: Predictive value the prediction of treatment directly depends on the quality of preoperative imaging prior to the operation. [5] Function and tools of the endoscopic sinus surgeon Audrey Bauer, MD Consensus statements in recent years have gradually pushed the usage towards standardized reporting, imaging checklists, as well as

multidisciplinary decision-making to minimize delays and create a better outcome. [2,7]

Retrospective design, single centre setting and the possibility of referral bias among other limitations noted. MRI was done on selected basis and this may have led to the difference in verification in the subgroups. Histopathology although the reference standard, it is shy of 100% sensitivity due to sampling error if biopsies are small (especially in heterogeneous lesions-papilloma with focal carcinoma). Future prospective studies should include standardized MRI protocols and diffusion/perfusion metrics, inter-reader reliability, as well as outcome endpoints like recurrence and survival.

### Conclusion

Sinonasal masses are a wide disease spectrum where symptomatology and endoscopy are often similar and definitive classification of the disease cannot be made without an imaginal finding and histopathology. In this cohort, CT and MRI were complementary in providing clinically decisive information: CT clarifies bony remodeling/destruction and operative anatomy, while MRI defines soft tissue characterization, skull base/orbital involvement, and perineural spread. Radiology was shown to have good agreement with histopathology and high clinically important performances for malignancy triage, but clinically important mimics (specially on inverted papilloma), and fungal disease remained. A structured approach to the diagnostic algorithm incorporating clinical red flags, standardized reporting based on CT/MRI, and tissue confirmation can improve the surgical planning, help hasten oncologic pathways, and minimize the misclassification as these algorithms are used.

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