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Clinico-Histopathological Evaluation of Sinonasal Mass Lesions: A Retrospective Observational Study

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Abstract

Background: Sinonasal mass lesions comprise a heterogeneous spectrum of non-neoplastic and neoplastic conditions with considerable overlap in clinical presentation. Histopathological examination is essential for definitive diagnosis, particularly in uncommon and diagnostically challenging lesions. The present study aimed to evaluate the clinico-histopathological profile of sinonasal mass lesions in a tertiary care hospital.

Methods: A retrospective observational study was conducted in the Department of Pathology, Osmania Medical College, Hyderabad, Telangana, India, over a three-year period. All sinonasal biopsy and surgical resection specimens with adequate tissue and complete clinical records were included. Demographic, clinical, radiological, and histopathological data were retrieved from institutional records. Routine hematoxylin and eosin staining was performed, while special stains and immunohistochemistry were used wherever indicated for further diagnostic characterization.

Results: A total of 507 sinonasal mass lesions were evaluated. Males predominated, with 310 (61.14%) cases, while females accounted for 197 (38.86%). The 21-40-year age group was most frequently affected, comprising 205 (40.43%) cases. Non-neoplastic lesions constituted the majority, with 317 (62.52%) cases, followed by benign neoplasms in 117 (23.08%) and malignant neoplasms in 73 (14.40%). Inflammatory/allergic sinonasal polyps were the predominant non-neoplastic lesions, accounting for 233 (73.50%) cases. Among benign neoplasms, capillary hemangioma was most frequent with 43 (36.75%) cases, followed by sinonasal papilloma with 40 (34.19%) cases. Among malignant neoplasms, sinonasal squamous cell carcinoma was predominant, comprising 21 (28.77%) cases. Several uncommon entities, including pituitary neuroendocrine tumour, amelanotic melanoma, malignant solitary fibrous tumour, olfactory neuroblastoma, rhabdomyosarcoma, and metastatic deposits, were also identified.

Conclusion: Sinonasal mass lesions demonstrate a broad histopathological spectrum. Histopathology remains the cornerstone of diagnosis, with special stains and immunohistochemistry providing valuable diagnostic support in challenging cases.

Categories: Pathology
Keywords: benign, histopathology, immunohistochemistry, malignant, sinonasal mass

Introduction

Sinonasal mass lesions comprise a heterogeneous group of pathological entities involving the nasal cavity and paranasal sinuses, including lesions that extend into these regions from adjacent anatomical sites such as the nasopharynx, oropharynx, and intracranial compartment. These lesions encompass a broad spectrum of inflammatory and infectious conditions, congenital anomalies, benign neoplasms, and malignant tumours [1]. Despite their diverse aetiologies and biological behaviour, many sinonasal lesions present with overlapping clinical manifestations, which can make clinical diagnosis challenging [2].

The sinonasal tract contains a wide variety of epithelial, mesenchymal, neuroectodermal, vascular, and glandular tissues, accounting for the considerable histopathological diversity encountered in this region [1,2]. Inflammatory polyps constitute a major proportion of sinonasal masses, whereas neoplastic lesions, particularly malignant tumours, are relatively uncommon. Nevertheless, sinonasal malignancies are associated with substantial morbidity and mortality due to their locally aggressive behaviour and proximity to critical anatomical structures [3].

Radiological investigations, particularly computed tomography (CT) and magnetic resonance imaging (MRI), play an important role in evaluating sinonasal lesions by providing information regarding their anatomical site, extent, bone involvement, and local invasion [4]. However, considerable overlap may exist in the radiological appearance of different pathological entities. Histopathological examination therefore remains the definitive method for establishing the diagnosis. In selected cases, special stains and

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immunohistochemistry may be required to identify infectious lesions and differentiate morphologically similar entities. A comprehensive assessment of the clinical and histopathological spectrum of sinonasal mass lesions is consequently important for accurate diagnosis, appropriate treatment planning, and prognostication.

The wide spectrum of sinonasal lesions and the overlap in their clinical and radiological manifestations highlight the importance of systematic histopathological evaluation in establishing an accurate diagnosis. Evaluation of the demographic profile, clinical presentation, and histopathological pattern can also provide useful information regarding the relative frequency of individual lesions in a tertiary care setting. Therefore, the present study aimed to evaluate the clinico-histopathological profile of sinonasal mass lesions in a tertiary care hospital over a three-year period.

Materials And Methods

Study design and setting

A retrospective observational study was conducted in the Department of Pathology, Osmania Medical College, Hyderabad, Telangana, India. The study included cases of sinonasal mass lesions diagnosed during a three-year study period from July 2023 to July 2026. The study was undertaken to evaluate the clinical and histopathological spectrum of sinonasal mass lesions and to assess the distribution of non-neoplastic, benign neoplastic, and malignant lesions.

Ethical considerations

The study was conducted after obtaining approval from the Institutional Ethics Committee of Osmania Medical College, Hyderabad (IEC No. IEC/OMC/M.NO (18)/P-193; dated 4 August 2023). As this was a retrospective study based on existing medical and pathology records, no additional intervention was performed on the patients. Patient confidentiality was maintained throughout the study, and data were analyzed in a manner that preserved patient anonymity.

Study population

The study population comprised all patients with sinonasal mass lesions who underwent biopsy or surgical excision and whose specimens were received in the Department of Pathology during the study period. Cases were included when an adequate tissue specimen was available for histopathological evaluation along with relevant clinical information and pathological records.

Inclusion and exclusion criteria

The study included all sinonasal mass biopsy and surgical excision specimens received during the study period, adequately preserved tissue specimens suitable for histopathological examination, and cases with complete or adequate clinical and histopathological records for evaluation. Repeat biopsies from previously diagnosed cases were excluded unless the specimen was submitted for evaluation of recurrence. Inadequate or autolyzed tissue specimens and cases with incomplete clinical records were also excluded from the study.

Data collection

Clinical and demographic information was retrospectively obtained from medical records and pathology requisition forms. The variables assessed included age, gender, anatomical site of the lesion, diagnostic nasal endoscopy (DNE) findings, radiological findings including CT and/or MRI, and previous histopathological findings, where available. The relevant histopathological diagnosis and other available clinical information were recorded for each case. All collected information was handled confidentially, and patient identifiers were not used for analysis.

Histopathological evaluation

The biopsy and surgical excision specimens were fixed in 10% neutral buffered formalin, routinely processed, and embedded in paraffin wax. Sections measuring approximately 3-5 µm in thickness were prepared from formalin-fixed paraffin-embedded (FFPE) tissue blocks and stained with hematoxylin and eosin (H&E). The stained sections were examined under light microscopy for assessment of the morphological features and classification of the lesions. Based on the histopathological findings, sinonasal mass lesions were broadly classified into non-neoplastic lesions, benign neoplasms, and malignant neoplasms. In selected cases where routine H&E examination was insufficient to establish a definitive diagnosis, appropriate special stains and/or immunohistochemical investigations were performed as required. The final histopathological diagnosis was established by integrating the microscopic findings with the available clinical and radiological information.

Statistical analysis

The collected data were entered and analyzed using Microsoft Excel (Microsoft Corporation, Redmond, Washington). Descriptive statistical methods were used to summarize the study variables. Categorical

variables, including age group, gender, clinical presentation, and histopathological diagnosis, were expressed as frequencies and percentages (n (%)). The distribution of sinonasal lesions was presented according to their clinical and histopathological characteristics. As the study was primarily descriptive and retrospective in design, the analysis focused on summarizing the clinicopathological spectrum of the lesions.

Results

A total of 507 cases of sinonasal mass lesions were included in the study. There were 310 males and 197 females. The largest proportion of patients belonged to the 21-40 years age group, comprising 205 (40.43%) cases, followed by the 41-60 years age group with 182 (35.90%) cases. Patients aged 61-80 years accounted for 61 (12.03%) cases, while 56 (11.05%) patients were aged 0-20 years and 2 (0.39%) were aged >80 years (Table *1*).

Age group (years)	Male	Female	Total
0–20	27 (5.33%)	29 (5.72%)	56 (11.05%)
21–40	141 (27.81%)	64 (12.62%)	205 (40.43%)
41–60	102 (20.12%)	81 (15.98%)	183 (36.09%)
61–80	38 (7.50%)	23 (4.54%)	61 (12.03%)
>80	2 (0.39%)	0 (0.00%)	2 (0.39%)
Total	310 (61.14%)	197 (38.86%)	507 (100.00%)

TABLE 1: Age and Gender Distribution of Sinonasal Mass Lesions

Data are presented as n (%).

The most common presenting symptom was nasal obstruction, reported in 430 (84.81%) patients, followed by nasal mass in 423 (83.43%). Nasal discharge was present in 178 (35.11%) cases, while epistaxis and headache were reported in 53 (10.45%) and 48 (9.47%) cases, respectively. Facial swelling was observed in 36 (7.10%) patients, whereas decreased vision was reported in 12 (2.37%) patients. Overall, symptoms related to nasal obstruction and mass effect predominated among the study participants (Table *2*).

Clinical presentation	Number of cases, n (%)
Nasal obstruction	430 (84.81%)
Nasal mass	423 (83.43%)
Nasal discharge	178 (35.11%)
Epistaxis	53 (10.45%)
Headache	48 (9.47%)
Facial swelling	36 (7.10%)
Decreased vision	12 (2.37%)

TABLE 2: Clinical Presentation of Sinonasal Mass Lesions

Data are presented as n (%). Multiple clinical presentations could be present in the same patient; therefore, percentages do not total 100%.

Histopathological examination showed that non-neoplastic lesions constituted the majority of sinonasal mass lesions, accounting for 317 (62.52%) cases. Benign neoplasms comprised 117 (23.08%) cases, whereas malignant neoplasms accounted for 73 (14.40%) cases (Table *3*).

Histopathological category	Number of cases
Non-neoplastic lesions	317 (62.52%)
Benign neoplasms	117 (23.08%)
Malignant neoplasms	73 (14.40%)
Total	507 (100.00%)

TABLE 3: Histopathological Classification of Sinonasal Mass Lesions

Data are presented as n (%).

Among the 317 non-neoplastic lesions, inflammatory/allergic sinonasal polyps were the most common, accounting for 233 (73.50%) cases. Fungal rhinosinusitis was identified in 55 (17.35%) cases. Rhinoscleroma and Hansen's disease were each observed in 5 (1.58%) cases, while rhinosporidiosis was present in 4 (1.26%) cases. Seromucinous hamartoma accounted for 3 (0.95%) cases. Respiratory epithelial adenomatoid hamartoma, chondro-osseous respiratory epithelial hamartoma, fibrous dysplasia, mucocele, and viral wart were each identified in 2 (0.63%) cases. Nasal glial heterotopia and meningocele were each observed in 1 (0.32%) case (Table 4).

Histopathological diagnosis	Number of cases
Inflammatory/allergic sinonasal polyp	233 (73.50%)
Fungal rhinosinusitis	55 (17.35%)
Rhinoscleroma	5 (1.58%)
Hansen's disease	5 (1.58%)
Rhinosporidiosis	4 (1.26%)
Seromucinous hamartoma	3 (0.95%)
Respiratory epithelial adenomatoid hamartoma (REAH)	2 (0.63%)
Chondro-osseous respiratory epithelial hamartoma (CORE)	2 (0.63%)
Fibrous dysplasia	2 (0.63%)
Mucocele	2 (0.63%)
Viral wart	2 (0.63%)
Nasal glial heterotopia	1 (0.32%)
Meningocele	1 (0.32%)
Total	317 (100.00%)

TABLE 4: Distribution of Non-neoplastic Sinonasal Lesions

Data are presented as n (%). REAH: respiratory epithelial adenomatoid hamartoma; CORE: chondro-osseous respiratory epithelial hamartoma.

Among the 117 benign neoplasms, capillary hemangioma was the most common lesion, accounting for 43 (36.75%) cases, followed by sinonasal papilloma with 40 (34.19%) cases and angiofibroma with 18 (15.38%) cases. Schwannoma and neurofibroma were each identified in 3 (2.56%) cases. Pituitary neuroendocrine tumour, solitary fibrous tumour, and ossifying fibroma accounted for 2 (1.71%) cases each. Pleomorphic adenoma, glomangioma, clear cell hidradenoma, and fibrous histiocytoma were each observed in 1 (0.85%) case (Table 5).

Benign lesions	Number of cases
Capillary hemangioma	43 (36.75%)
Sinonasal papilloma	40 (34.19%)
Angiofibroma	18 (15.38%)
Schwannoma	3 (2.56%)
Neurofibroma	3 (2.56%)
Pituitary neuroendocrine tumour	2 (1.71%)
Solitary fibrous tumour	2 (1.71%)
Ossifying fibroma	2 (1.71%)
Pleomorphic adenoma	1 (0.85%)
Glomangioma	1 (0.85%)
Clear cell hidradenoma	1 (0.85%)
Fibrous histiocytoma	1 (0.85%)
Total	117 (100.00%)

TABLE 5: Distribution of Benign Sinonasal Neoplasms

Data are presented as n (%).

Among the 73 malignant lesions, sinonasal squamous cell carcinoma was the most common, accounting for 21 (28.77%) cases, followed by adenoid cystic carcinoma with 16 (21.92%) cases. Sinonasal adenocarcinoma was observed in 6 (8.22%) cases and sinonasal mucosal melanoma in 5 (6.85%) cases. HPV-associated multiphenotypic sinonasal carcinoma and malignant transformation of sinonasal papilloma were each identified in 4 (5.48%) cases. Sinonasal undifferentiated carcinoma accounted for 3 (4.11%) cases. Other malignant lesions included nasopharyngeal carcinoma, meningothelial meningioma, inflammatory myofibroblastic tumour, non-Hodgkin lymphoma, olfactory neuroblastoma, malignant solitary fibrous tumour, chondrosarcoma, osteosarcoma, rhabdomyosarcoma, giant cell tumour, and metastatic deposits (Table *6*).

Malignant lesions	Number of cases
Sinonasal squamous cell carcinoma	21 (28.77%)
Adenoid cystic carcinoma	16 (21.92%)
Sinonasal adenocarcinoma	6 (8.22%)
Sinonasal mucosal melanoma	5 (6.85%)
HPV-associated multiphenotypic sinonasal carcinoma (HMSC)	4 (5.48%)
Malignant transformation of sinonasal papilloma	4 (5.48%)
Sinonasal undifferentiated carcinoma	3 (4.11%)
Nasopharyngeal carcinoma	2 (2.74%)
Meningothelial meningioma	2 (2.74%)
Inflammatory myofibroblastic tumour	2 (2.74%)
Non-Hodgkin lymphoma	1 (1.37%)
Olfactory neuroblastoma	1 (1.37%)
Malignant solitary fibrous tumour	1 (1.37%)
Chondrosarcoma	1 (1.37%)
Osteosarcoma	1 (1.37%)
Rhabdomyosarcoma	1 (1.37%)
Giant cell tumour	1 (1.37%)
Metastatic deposits	1 (1.37%)
Total	73 (100.00%)

TABLE 6: Distribution of Malignant Sinonasal Neoplasms

Data are presented as n (%). HMSC: HPV-associated multiphenotypic sinonasal carcinoma.

The representative histopathological images, including H&E-stained sections, special stains, and immunohistochemical findings of selected sinonasal mass lesions, have been added to the manuscript as Figures *1*-*3* to support the corresponding diagnoses and highlight diagnostically challenging and uncommon entities.

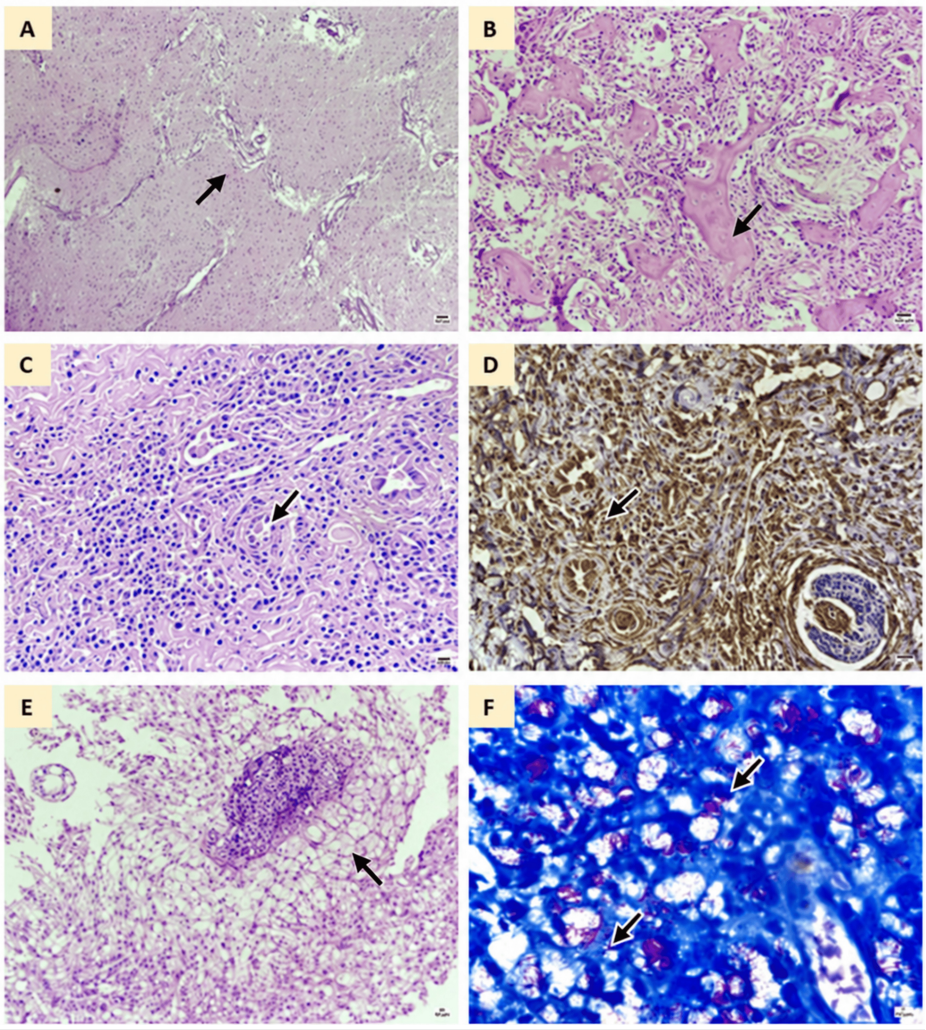


FIGURE 1: Histopathological features of selected sinonasal mass lesions

(A) Nasal glial heterotopia, H&E, 10×; arrow indicates the representative glial tissue. (B) Fibrous dysplasia, H&E, 10×; arrow indicates the characteristic irregular woven bone trabeculae. (C, D) Glomangioma, H&E, 20× and vimentin immunohistochemistry, 20×, respectively; arrows indicate the representative tumour areas. (E) Clear cell hidradenoma, H&E, 20×; arrow indicates the characteristic clear-cell component. (F) Hansen's disease, Fite-Faraco stain, 100×; arrows indicate acid-fast bacilli.

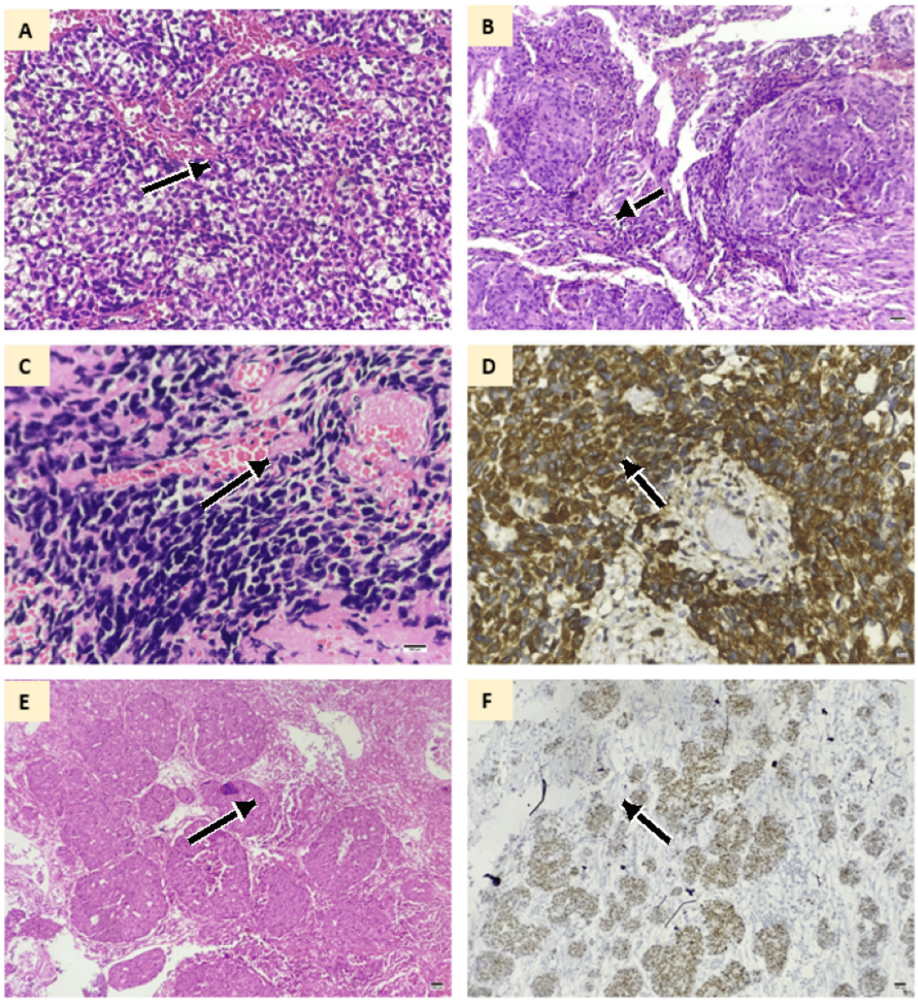


FIGURE 2: Histopathological and immunohistochemical features of selected sinonasal lesions

(A) Pituitary neuroendocrine tumour (PitNET), H&E, 20×; arrow indicates the tumour cells. (B) Meningothelial meningioma, H&E, 10×; arrow indicates the characteristic whorled pattern. (C, D) Rhabdomyosarcoma, H&E, 40×, and desmin immunohistochemistry, 40×, respectively; arrows indicate the tumour cells and desmin-positive tumour cells, respectively. (E, F) Metastatic breast carcinoma, H&E, 10×, and estrogen receptor (ER) immunohistochemistry, 4×, respectively; arrows indicate the metastatic tumour deposits and ER-positive tumour cells, respectively.

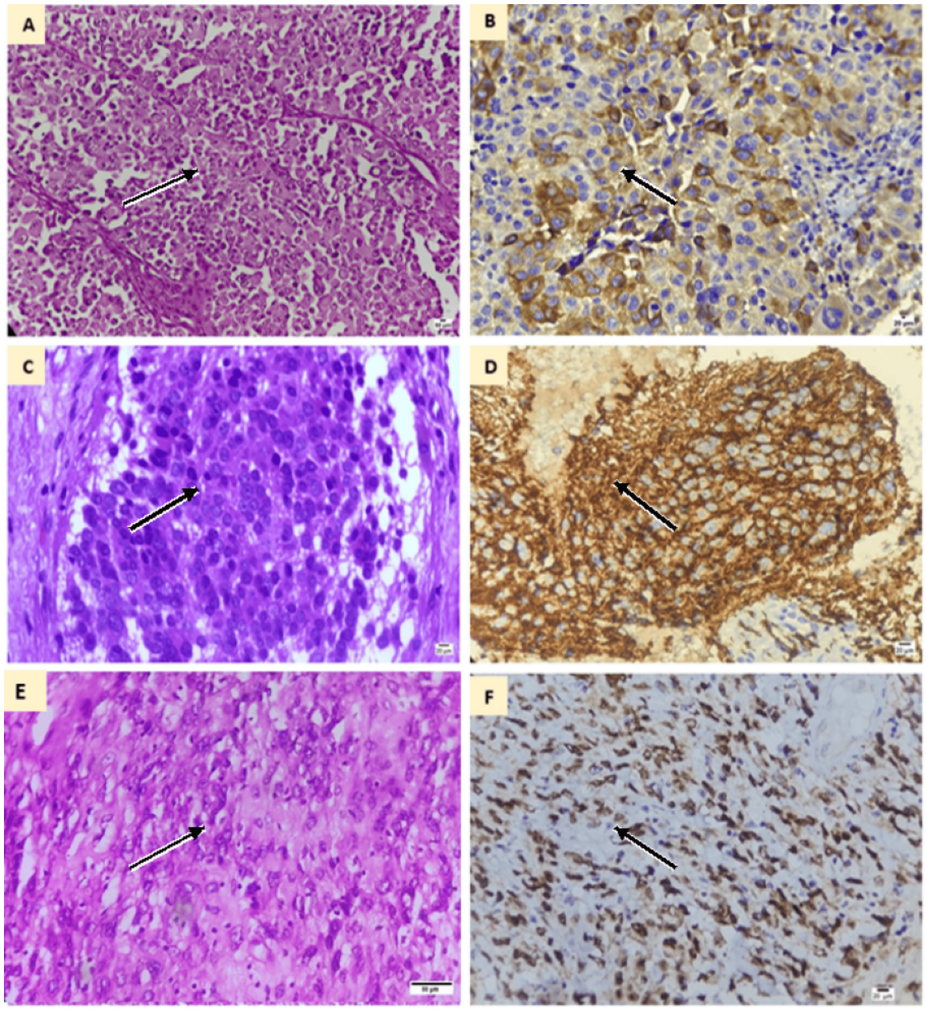


FIGURE 3: Histopathological and immunohistochemical features of selected malignant sinonasal lesions

(A, B) Sinonasal mucosal amelanotic melanoma, H&E, 20×, and chromogranin immunohistochemistry, 40×, respectively; arrows indicate the representative tumour cells. (C, D) Olfactory neuroblastoma, H&E, 40×, and synaptophysin immunohistochemistry, 40×, respectively; arrows indicate the tumour cells and synaptophysin-positive cells, respectively. (E, F) Malignant solitary fibrous tumour, H&E, 10×, and STAT6 immunohistochemistry, 40×, respectively; arrows indicate the representative tumour cells and STAT6-positive nuclei, respectively.

Discussion

In the present study, 507 cases of sinonasal mass lesions were evaluated retrospectively over a three-year period. A predominance of young and middle-aged adults was observed, with the largest proportion of patients belonging to the 21-40-year age group, followed by those aged 41-60 years. There was also a male predominance. These findings are comparable with those reported by Rawat DS et al., who also observed a predominance of sinonasal masses among young and middle-aged adults with a male predominance [5]. Clinically, nasal obstruction was the most frequent presenting symptom, followed by the presence of a nasal mass. Similar findings were reported by Lute S et al., in whom nasal obstruction was the predominant presenting complaint [6]. The predominance of symptoms related to obstruction and mass effect in the present study is consistent with the anatomical location of these lesions and their tendency to produce symptoms following progressive local expansion.

Histopathologically, non-neoplastic lesions constituted the largest category in the present study, followed by benign and malignant neoplasms. Non-neoplastic lesions accounted for 317 (62.52%) cases, benign neoplasms for 117 (23.08%) cases, and malignant neoplasms for 73 (14.40%) cases. The predominance of non-neoplastic lesions is comparable with the findings reported by Zafar et al., supporting the observation that sinonasal masses encountered in routine pathology practice are not predominantly neoplastic [7]. Among the non-neoplastic lesions, inflammatory/allergic sinonasal polyps were the most frequent, comprising 233 (73.50%) cases, followed by fungal rhinosinusitis in 55 (17.35%) cases. Korata R et al. similarly reported inflammatory polyps as the predominant group [8]. The high frequency of inflammatory

polyps in the present study may reflect the important contribution of chronic inflammatory and allergic processes to sinonasal disease. Fungal rhinosinusitis represented the second most frequent non-neoplastic lesion, while several uncommon entities, including rhinoscleroma, rhinosporidiosis, REAH, CORE, nasal glial heterotopia, meningocele, fibrous dysplasia, and Hansen's disease, were also identified, demonstrating the broad histopathological spectrum of sinonasal masses.

Among the benign neoplasms, capillary hemangioma was the most common lesion, accounting for 43 (36.75%) cases, followed by sinonasal papilloma in 40 (34.19%) cases and angiofibroma in 18 (15.38%) cases. This distribution was comparable with the findings reported by Agarwal P et al. [9]. The predominance of vascular lesions among benign neoplasms highlights the importance of careful clinicopathological evaluation, particularly in lesions presenting as polypoidal or bleeding masses [9]. Sinonasal papillomas are of particular clinical significance because of their propensity for recurrence and their potential association with malignant transformation, particularly in inverted papilloma [10]. Other benign lesions encountered included schwannoma, neurofibroma, PitNET, solitary fibrous tumour, ossifying fibroma, pleomorphic adenoma, glomangioma, clear cell hidradenoma, and fibrous histiocytoma. An unusual case of PitNET was identified in a 64-year-old male presenting with a right nasal cavity mass, headache, and decreased vision, with imaging demonstrating extension of a pituitary macroadenoma into the nasal cavity. Histopathology and immunohistochemistry supported the diagnosis. A similar presentation was reported by Basheer JI et al., emphasizing the importance of considering lesions extending from adjacent anatomical compartments when evaluating sinonasal masses [11].

Malignant neoplasms constituted 73 (14.40%) cases in the present study, with sinonasal squamous cell carcinoma being the most frequent malignant tumour, accounting for 21 (28.77%) cases, followed by adenoid cystic carcinoma in 16 (21.92%) cases. Sinonasal adenocarcinoma and sinonasal mucosal melanoma accounted for 6 (8.22%) and 5 (6.85%) cases, respectively. The predominance of squamous cell carcinoma is consistent with published literature, in which it is recognized as the most common malignant tumour of the sinonasal tract [12]. The relatively substantial representation of adenoid cystic carcinoma in the present study reflects the diverse contribution of salivary gland-type malignancies to sinonasal pathology. A range of uncommon malignant lesions was also encountered, including HPV-associated multiphenotypic sinonasal carcinoma, sinonasal undifferentiated carcinoma, olfactory neuroblastoma, lymphoma, rhabdomyosarcoma, inflammatory myofibroblastic tumour, malignant solitary fibrous tumour, meningothelial meningioma, and metastatic deposits. Such morphological diversity can create considerable diagnostic challenges, particularly when lesions show overlapping microscopic and immunophenotypic features. Appropriate immunohistochemical evaluation therefore remains important for accurate classification of diagnostically challenging sinonasal malignancies [13,14].

Several diagnostically challenging and unusual lesions in the present series further illustrate the value of an integrated clinicopathological approach. A case of sinonasal mucosal amelanotic melanoma in a 43-year-old female was confirmed by diffuse strong S100 expression with negative PanCK and p40 expression and patchy HMB45 positivity, similar to the case reported by Mochel MC et al. [15]. A malignant solitary fibrous tumour was identified in a 52-year-old male with a left maxillary sinus mass, with diffuse CD34 and Bcl-2 expression and strong nuclear STAT6 positivity supporting the diagnosis. Nuclear STAT6 expression, a surrogate marker of the NAB2-STAT6 fusion, is a valuable diagnostic marker in the evaluation of solitary fibrous tumours and assists in distinguishing these lesions from other spindle-cell neoplasms [16]. A rhabdomyosarcoma was identified in a 36-year-old female with an extensive sinonasal mass and orbital involvement, with desmin, vimentin, and CD56 positivity supporting the diagnosis; a similar case has been reported by Lo W et al. [17]. Another clinically important finding was metastatic invasive ductal carcinoma of the breast presenting as a sinonasal mass in a 52-year-old female with a previous history of breast carcinoma. Diffuse nuclear positivity for ER and PR supported the diagnosis of metastatic breast carcinoma involving the sinonasal tract [18]. These unusual presentations emphasize the importance of correlating clinical history, imaging findings, morphology, and ancillary investigations when evaluating sinonasal mass lesions.

Strengths and limitations

The strengths of the present study include its relatively large sample size, three-year study duration, and comprehensive clinico-histopathological categorization of sinonasal mass lesions, including both common and uncommon non-neoplastic, benign, and malignant entities. However, the study has certain limitations, including its retrospective design, dependence on the completeness of existing clinical and histopathological records, lack of long-term follow-up data regarding recurrence and survival, and limited availability of molecular investigations, which may have restricted further characterization of selected lesions.

Conclusions

Sinonasal mass lesions comprise a diverse spectrum of non-neoplastic, benign, and malignant conditions, with non-neoplastic lesions constituting the majority in the present study. Inflammatory/allergic sinonasal polyps were the most common non-neoplastic lesions, while capillary hemangioma and sinonasal papilloma were the predominant benign neoplasms, and sinonasal squamous cell carcinoma was the most frequent

malignant tumour. The observed male predominance and concentration of cases in the 21-40-year-old age group highlight the demographic variation of these lesions. Histopathological examination remains essential for definitive diagnosis and accurate classification, particularly in uncommon and morphologically overlapping lesions, with ancillary immunohistochemistry being valuable in selected cases. Overall, comprehensive clinicopathological evaluation is crucial for appropriate diagnosis and management of sinonasal mass lesions.

Additional Information

Author Contributions

All authors have reviewed the final version to be published and agreed to be accountable for all aspects of the work.

Concept and design: Sai Bhavishya Govindu, M Mamatha, Naval Kishore Bajaj, R P Sushma Kumari, Syed Allauddin Khadri

Acquisition, analysis, or interpretation of data: Sai Bhavishya Govindu, M Mamatha, Naval Kishore Bajaj, R P Sushma Kumari, Syed Allauddin Khadri

Drafting of the manuscript: Sai Bhavishya Govindu, M Mamatha, Naval Kishore Bajaj, R P Sushma Kumari, Syed Allauddin Khadri

Critical review of the manuscript for important intellectual content: Sai Bhavishya Govindu, M Mamatha, Naval Kishore Bajaj, R P Sushma Kumari, Syed Allauddin Khadri

Disclosures

Human subjects: Informed consent for treatment and open access publication was obtained or waived by all participants in this study. The Institutional Ethics Committee of Osmania Medical College, Hyderabad, issued approval IEC/OMC/M.NO (18)/P-193. **Animal subjects:** All authors have confirmed that this study did not involve animal subjects or tissue. **Conflicts of interest:** In compliance with the ICMJE uniform disclosure form, all authors declare the following: **Payment/services info:** All authors have declared that no financial support was received from any organization for the submitted work. **Financial relationships:** All authors have declared that they have no financial relationships at present or within the previous three years with any organizations that might have an interest in the submitted work. **Other relationships:** All authors have declared that there are no other relationships or activities that could appear to have influenced the submitted work.

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