e-ISSN: 0976-822X, p-ISSN:2961-6042

Available online on http://www.ijcpr.com/

International Journal of Current Pharmaceutical Review and Research 2026; 18(3); 1169-1177

Original Research Article

Histopathological Study of Lesions of Nasal Cavity in Western Rajasthan

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Received: 01-12-2025 / Revised: 15-01-2026 / Accepted: 21-02-2026
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Conflict of interest: Nil

Abstract

Introduction: The clinical presentation of nasal cavity lesions often mimics chronic inflammatory conditions, making definitive histopathological examination the gold standard for accurate diagnosis and management. This study aimed to analyze the histopathological spectrum, compare neoplastic versus non-neoplastic incidence, and evaluate the age and sex distribution of these lesions at a tertiary care center in Bikaner, Rajasthan.

Methodology: This hospital-based cross-sectional study was conducted at the Department of Pathology, Sardar Patel Medical College, Bikaner, from January 2024 to December 2025. A total of 98 tissue specimens from the nasal cavity and external nose were analyzed using standardized processing and hematoxylin and eosin (H&E) staining. Data were processed using descriptive statistics and the Chi-square test.

Results: The cohort ranged from 2 to 87 years (mean age: 38.08 years), with the highest incidence in the 41–60 age group (31.6%). A male predominance was observed with a ratio of 1.65:1. The nasal cavity was the most frequent site (74.49%), followed by mass excised post-FESS (9.18%) and nasal skin (7.14%). Non-neoplastic lesions accounted for 51.02% () of cases, while neoplastic lesions comprised 48.98%. Inflammatory polyps were the most common (64%), followed by allergic polyps (18%). Malignant tumors significantly outnumbered benign ones (81.25% vs. 18.75%). Moderately differentiated Squamous Cell Carcinoma (SCC) was the dominant malignancy (43.59%). Hemangiomas (Capillary and Lobular) were the most frequent, each representing 22.22% of benign cases.

Conclusion: The study reveals a diverse spectrum where non-neoplastic inflammatory polyps remain the most frequent overall lesion. However, the high proportion of malignancies (81.25%) among neoplastic cases—predominantly Squamous Cell Carcinoma in older males—highlights the critical role of a regional cancer center in early diagnosis. The significant age-related distribution serves as a vital clinical guide for differential diagnosis in this geographic region.

Keywords: Nasal cavity, Histopathology, Squamous Cell Carcinoma, Inflammatory Polyp, Western Rajasthan.

DOI: 10.25258/ijcpr.18.3.188

Introduction

The nose represents one of the most delicate yet functionally significant features of the human face, serving both aesthetic and physiological purposes [1]. Structurally, the nose exhibits a pyramidal configuration with the base oriented inferiorly and the root superiorly. The upper third comprises bony structures formed by paired nasal bones articulating with the frontal process of the maxilla, while the lower two-thirds consist of cartilaginous framework [2].

The sinonasal tract encompasses the nasal cavity and four paired paranasal sinuses: maxillary, ethmoid, sphenoid, and frontal sinuses. This anatomical complex is embryologically distinct from the nasopharynx. Although both regions are lined by ciliated respiratory epithelium, the sinonasal tract epithelium derives from ectoderm, whereas nasopharyngeal epithelium originates from endoderm. This embryological difference contributes to the development of region-specific pathologies, such as schneiderian papilloma in the sinonasal tract and nasopharyngeal carcinomas [3]. The nose performs multiple critical functions including respiration, conditioning of inspired air, protection of lower airways, voice resonance, nasal reflex actions, and olfaction.

Airflow regulation occurs through cyclical congestion and decongestion of nasal mucosa approximately every 2.5 to 4 hours [4]. The paranasal sinuses serve to humidify and filter inspired air, house specialized olfactory receptors, function as resonating chambers for speech, and reduce the relative weight of the skull [5]. These diverse physiological functions expose the

sinonasal region to numerous infectious agents, allergens, chemical irritants, and environmental factors. Such exposures predispose individuals to a wide spectrum of inflammatory disorders, infections, and neoplasms [6]. Despite occupying a relatively small anatomical space, the nasal cavity and paranasal sinuses harbor some of the most histologically diverse tumors in the human body, including neoplasms derived from mucosal epithelium, seromucinous glands, soft tissues, bone, cartilage, neural and neuroectodermal tissues, hematolymphoid cells, and the odontogenic apparatus [7].

The clinical presentation of sinonasal lesions often mimics chronic inflammatory conditions, creating diagnostic challenges. Simple nasal polyps, infectious polypoidal granulomatous lesions, benign tumors, and malignant neoplasms can present with similar symptomatology, making histopathological examination essential for accurate diagnosis, prognosis, and management [8]. Modern imaging modalities including computed tomography and magnetic resonance imaging assist in preliminary diagnosis, but definitive classification requires thorough histological investigation [9].

The incidence of sinonasal lesions varies geographically and demographically. Previous studies have reported incidence rates ranging from 10 to 17.4 cases per year per institution, representing approximately 1.5% of surgical pathology specimens [10]. Non-neoplastic lesions, particularly inflammatory polyps, constitute the majority of cases, while neoplastic lesions account for approximately 3% of head and neck tumors [11].

Western Rajasthan, characterized by its arid climate and unique environmental conditions, presents a distinctive epidemiological setting. However, comprehensive data on the histopathological spectrum of sinonasal lesions from this region remains limited. This study aims to bridge this knowledge gap by providing detailed clinicopathological analysis of sinonasal lesions encountered at a major tertiary care center in Bikaner, Western Rajasthan.

Aims and Objectives

1. To study the histopathological spectrum of lesions in the nasal cavity.
2. To compare the incidence of non-neoplastic and neoplastic lesions in the nasal cavity.
3. To analyze age and sex-related distribution of various lesions in the nasal cavity.

Materials and Methods

Study Design and Setting: This hospital-based cross-sectional study was conducted in the Department of Pathology, Sardar Patel Medical College and Associated Group of Hospitals, Bikaner, a tertiary care regional cancer center in Western Rajasthan, India.

Study Duration: The study period extended from Jan 2024 to Dec 2025, encompassing 24 months of continuous data collection.

Study Population: The study included all tissue samples presented to the Department of Pathology with lesions of the nasal cavity, and external nose irrespective of age or gender. Patients were referred from the Ear, Nose, and Throat (ENT) department and other clinical departments.

Inclusion Criteria

- All tissue specimens of nasal cavity, and external nose lesions submitted to the Department of Pathology
- Specimens from patients of all age groups and both genders
- Specimens with adequate clinical information

Exclusion Criteria

- Autolyzed or extensively necrosed tissue specimens precluding histopathological interpretation
- Inadequate tissue specimens insufficient for definitive diagnosis

Data Collection: Clinical data including patient age, gender, presenting symptoms, anatomical site of lesion, and relevant clinical history were obtained from hospital records and requisition forms accompanying tissue specimens.

Tissue Processing: All specimens underwent standardized processing following established protocols:

Fixation and Grossing: Specimens were fixed in 10% neutral buffered formalin for 4-24 hours. Gross examination was performed systematically, documenting specimen dimensions, color, consistency, and any distinctive features. Representative sections were obtained from all specimens.

Block Preparation: Processed tissues were embedded in paraffin wax using metal molds.

Section Cutting: Sections of 2–4-micron thickness were cut using a rotary microtome and mounted on albumin-coated glass slides. Slides were incubated at 66°C for one hour to ensure proper tissue adhesion.

Staining: Routine hematoxylin and eosin (H&E) staining was performed on all sections. Special stains including Periodic Acid-Schiff (PAS) and reticulin stains were employed when clinically indicated for specific pathological conditions.

Microscopic Examination: All stained sections were examined systematically under light microscopy by experienced pathologists. Histopathological features were documented, and diagnoses were established according to World Health Organization (WHO) classification criteria.

Statistical Analysis: Data were entered into Microsoft Excel spreadsheets and analyzed using SPSS software version 23.0. Descriptive statistics including frequencies, percentages, mean, standard deviation, and range were calculated. Chi-square test was employed to assess associations between categorical variables. A p-value less than 0.05 was considered statistically significant.

Results

Age Distribution: The study cohort comprised 98 patients with ages ranging from 2 to 87 years. The mean age was 38.08 years with a standard deviation of 22.38 years. The maximum number of cases occurred in the 41-60 years age group (n=31, 31.6%), followed by the 1-20 years group (n=24, 24.5%). The least number of cases was observed in the 81-100 years age group (2.0%). Male predominance was evident throughout the study population with the male to female ratio was 1.65:1, indicating significantly higher incidence in males. [Table no. 1]

Table 1: Age and gender wise distribution of study population

	Sex					
Age Groups	**Female**		**Male**		**Total**	
1 - 20	7	29.2%	17	70.8%	24	24.5%
21 - 40	9	45.0%	11	55.0%	20	20.4%
41 - 60	12	38.7%	19	61.3%	31	31.6%
61 - 80	7	33.3%	14	66.7%	21	21.4%
81 - 100	2	100.0%	0	0.0%	2	2.0%
Total	37	37.8%	61	62.2%	98	100.0%

Lesions were distributed across various anatomical sites. The nasal cavity was the most common site (n=73, 74.49%), followed by the mass excised post fess (9.18%) and nasal skin (7.14%). Other sites included dorsum of the nose and sinonasal area. [Table 2]

Table 2: Distribution of lesions according to anatomical site

SITE	Frequency	Percent
Dorsum Of Nose	4	4.08%
Mass Excised Post Fess	9	9.18%
Nasal Cavity	73	74.49%
Nasal Skin	7	7.14%
Nasal Cavity (Junction)	5	5.10%
Total	98	100.00%

Non-neoplastic lesions slightly outnumbered neoplastic lesions, accounting for 51.02% of all cases.

Non-neoplastic lesions showed predominance in younger age groups, while neoplastic lesions were more prevalent in older age groups. This difference was statistically significant (p-value = 0.0001).

However, gender distribution showed no significant difference between non-neoplastic and neoplastic lesions (p-value = 0.839).

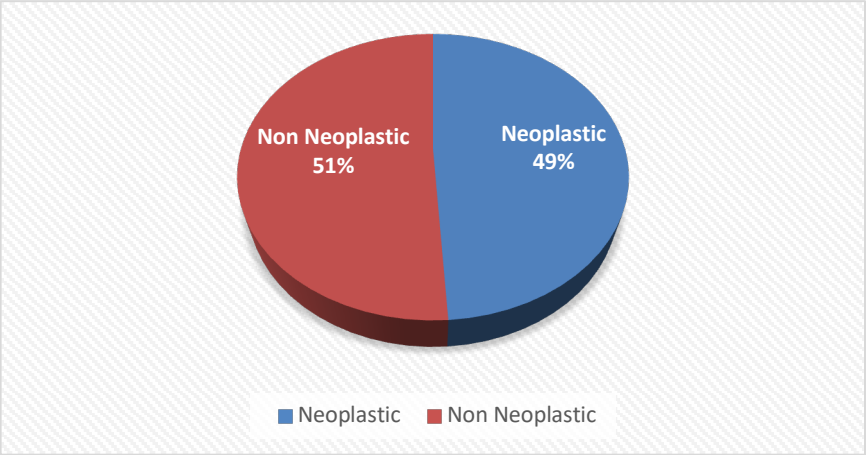

Figure 1: Distribution of cases based on neoplastic and non-neoplastic lesions

Table 3: Distribution of neoplastic and non-neoplastic cases according to age groups

Age Groups	Neoplastic	Non-Neoplastic	Total
1 - 20	4	20	24
21 - 40	7	13	20
41 - 60	18	13	31
61 - 80	17	4	21
81 - 100	2	0	2
Total	48	50	98

P-value < 0.0001

Among 50 non-neoplastic lesions, Inflammatory polyps were the most common non-neoplastic lesion (n=32, 64%), followed by allergic polyps (n=9, 9.18%). Two cases of inflammatory polyp demonstrated mucous gland hyperplasia. Among 48 neoplastic lesions, malignant lesions significantly outnumbered benign lesions (81.25% versus 18.75%). [Table no. 4]

Table 4: Distribution of benign and malignant neoplasms

Type of Neoplasm	Number of Cases	Percentage
Benign	9	18.75%
Malignant	39	81.25%
Total	48	100.0%

Among Benign Neoplasms, Hemangiomas collectively constituted the most common benign lesions, followed by inverted papilloma and angiofibroma. Juvenile Nasopharyngeal Angiofibroma, capillary hemangioma, hemangiomas, and inverted papilloma were each observed in 2 cases, (22.22%) of the total benign cases for each condition. Spiradenoma was recorded in 1 case, (11.11%) of the total benign cases.

The distribution of Malignant Neoplasms in our study is shown in table no. 5.

Table 5: Distribution of malignant neoplastic lesions

Diagnosis	Number of Cases	Percentage
Basal Cell Carcinoma	3	7.69%
Carcinoma In Situ In Squamous Lining Epithelium	1	2.56%
Moderately Differentiated Squamous Cell Carcinoma	17	43.59%
Non-Keratinizing Undifferentiated Carcinoma	1	2.56%
Poorly Differentiated Squamous Cell Carcinoma	2	5.13%
Small Round Cell Neoplasm	5	12.82%
Undifferentiated Malignant Neoplasm	6	15.38%
Well Differentiated Squamous Cell Carcinoma	4	10.26%
Total	39	100.0%

Moderately differentiated Squamous cell carcinoma was the predominant malignant lesion, with 17 cases (43.59%) followed by undifferentiated malignant neoplasms with 6 (15.38%) cases.

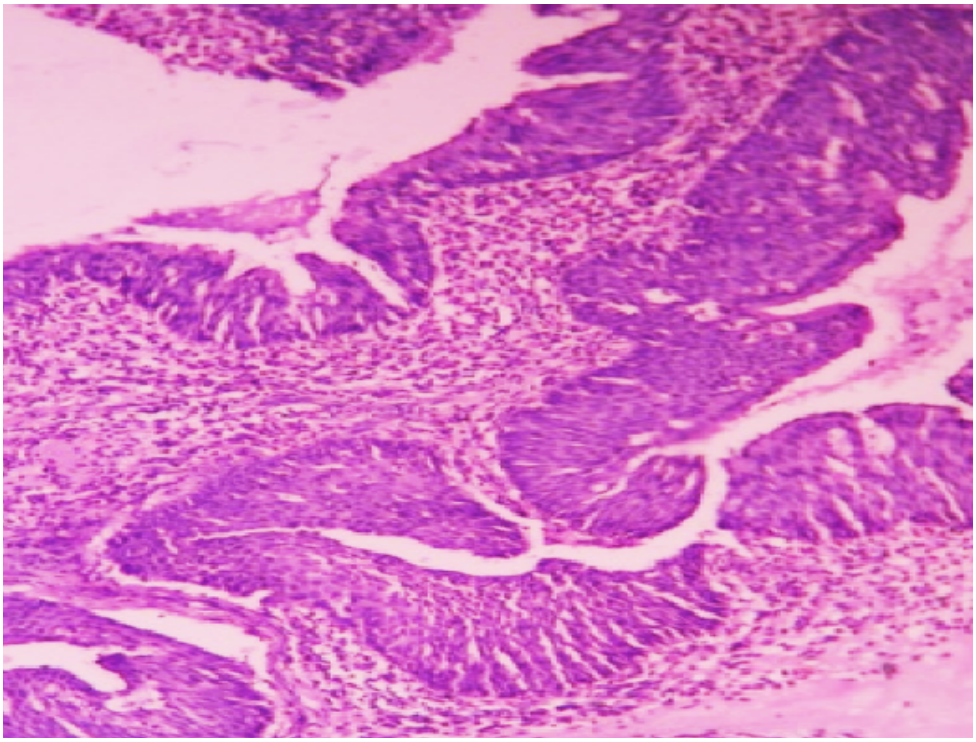

Figure 2: Section showing Inverted Papilloma (H&E, 40x)

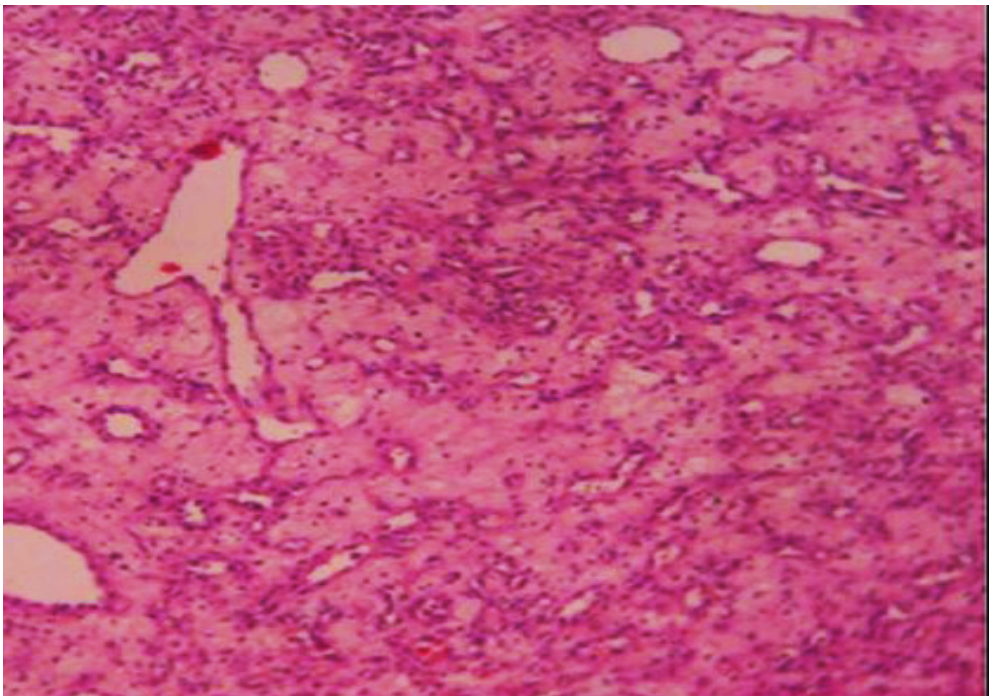

Figure 3: Section showing capillary hemangioma of nasal cavity (H&E, 10x)

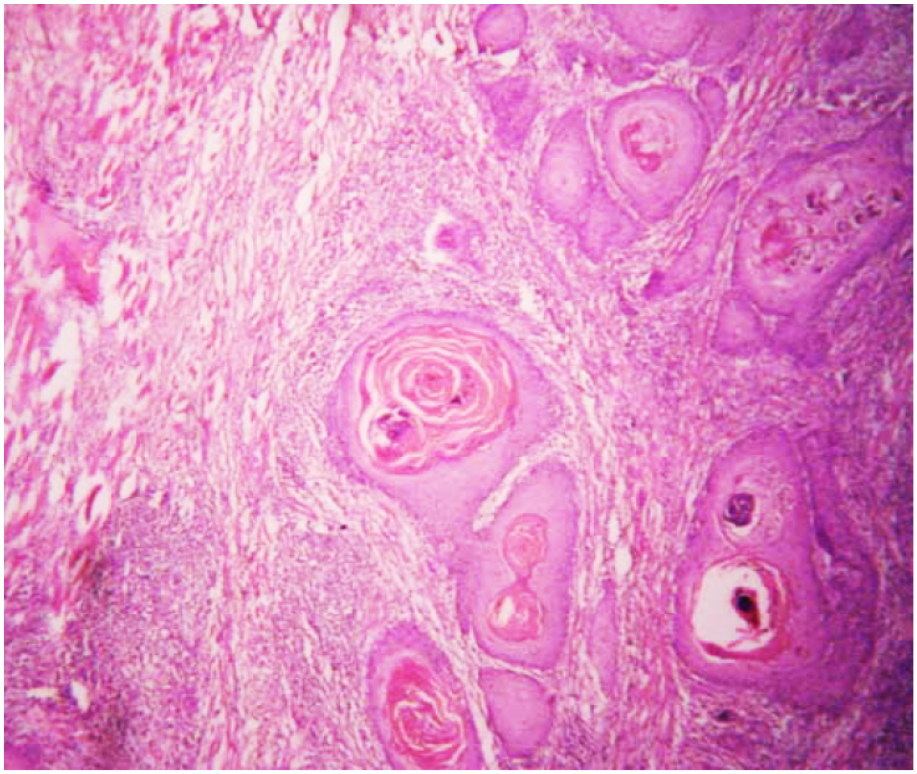

Figure 4: Section showing well differentiated squamous cell carcinoma with keratin pearl formation (H&E, 10x)

Discussion

The nasal cavity demonstrates a wide spectrum of pathological entities ranging from simple inflammatory lesions to aggressive malignant tumors. Clinically, many of these lesions present as polypoid masses or obstructive nasal symptoms, making it difficult to distinguish benign from malignant processes without histopathological examination. Therefore, histopathology remains the gold standard for accurate diagnosis and appropriate therapeutic planning. [12]

Demographics: In the present study, 98 cases were analyzed with ages ranging from 2 to 87 years and a mean age of 38.08 years. The maximum number of cases was observed in the 41–60 years age group (31.6%), followed by the 1–20 years group (24.5%). This age distribution reflects the tendency of nasal cavity lesions to occur across a broad age spectrum but with a higher frequency in middle-aged individuals, possibly due to cumulative environmental exposures and chronic inflammatory processes [15].

A male predominance was observed in this study, with males accounting for the majority of cases and a male-to-female ratio of approximately 1.65:1. Similar gender distributions have been reported by Kulkarni et al. and Jagannadham et al., who also documented a higher incidence of sinonasal lesions in males [13][14]. This predominance may be related to increased occupational exposure to environmental irritants, dust, and pollutants among males.

Anatomical Site Distribution: The nasal cavity was the most commonly involved site in the present study, accounting for the majority of cases. This finding is consistent with previous studies by Regmi et al. and Jagannadham et al., which also reported the nasal cavity as the predominant location for sinonasal lesions [14][16]. The higher frequency of lesions in the nasal cavity may be attributed to its extensive mucosal surface area and direct exposure to environmental allergens, pollutants, and infectious agents. Other sites such as post-FESS excised masses, nasal skin, and dorsum of the nose were less frequently involved. The distribution of lesions across different anatomical locations reflects the complex structure and varied epithelial lining of the sinonasal tract.

Non-Neoplastic versus Neoplastic Lesions: In the present study, non-neoplastic lesions constituted 51.02% of cases, slightly exceeding the proportion of neoplastic lesions. This finding differs somewhat from several earlier studies that reported a greater predominance of non-neoplastic lesions. For example, Kulkarni et al. reported 86.32% non-neoplastic lesions, Garg et al. reported 73.6%, and Regmi et al. reported 66.08% [17][18][16].

The relatively higher proportion of neoplastic lesions observed in our study may be attributed to the tertiary referral nature of the institution, where

patients with suspected tumors are more frequently referred for specialized evaluation and treatment.

Non-Neoplastic Lesions: Among the 50 non-neoplastic lesions in the present study, inflammatory polyps were the most common, accounting for 64% of cases. Allergic polyps represented the second most frequent lesion. Similar findings have been reported by Jagannadham et al., who identified nasal polyps as the most common non-neoplastic lesion, and Jaison et al., who also observed inflammatory polyps as the predominant lesion [14][19].

Histologically, inflammatory polyps typically show edematous stroma with inflammatory cell infiltration, particularly eosinophils, along with mucous gland hyperplasia and dilated glands. In the present study, mucous gland hyperplasia was observed in two cases of inflammatory polyps [20].

The pathogenesis of inflammatory polyps is closely associated with chronic inflammation resulting from allergies, infections, or immune-mediated mechanisms. Environmental factors such as exposure to dust, allergens, and pollutants may further contribute to the development of these lesions [21]. Climatic conditions and environmental exposures specific to certain regions may also influence the prevalence of inflammatory nasal cavity lesions [22].

Benign versus Malignant Neoplasms: Among the 48 neoplastic lesions identified in this study, malignant tumors accounted for 81.25% of cases, while benign tumors constituted only 18.75%. This finding contrasts with several previous studies that reported a higher proportion of benign neoplasms. For instance, Kulkarni et al. reported 54.17% benign tumors, Jagannadham et al. reported 61.22%, and Regmi et al. reported 54.4% benign lesions among sinonasal neoplasms [13][14][16]. The higher prevalence of malignant tumors in the present study may be explained by referral bias, as tertiary care centers and cancer referral hospitals often receive a greater number of patients with suspected malignancies requiring specialized oncological management.

Benign Neoplasms: Hemangiomas constituted the most common benign lesion in our study (lobular hemangioma 22.22%, capillary hemangioma 22.22%), concordant with Kulkarni et al (2019) who reported hemangioma as the commonest benign lesion (46.16%) [13]. Inverted papillomas and angiofibromas followed in frequency. These findings align with established understanding that vascular tumors and schneiderian papillomas represent the most frequent benign sinonasal neoplasms [23].

Inverted papillomas, though benign, warrant special attention due to their locally aggressive behavior and malignant transformation potential (5-15%) [24]. Both our cases arose from the lateral nasal wall in the fourth decade, consistent with typical clinical presentation. Juvenile nasopharyngeal angiofibromas, exclusively affecting adolescent males, demonstrated characteristic histology with hypocellular fibrous stroma and prominent vascularity [25].

Malignant Neoplasms: Squamous cell carcinoma (SCC) was the most common malignant tumor identified in the present study, with moderately differentiated SCC being the predominant histological subtype. This observation is consistent with global epidemiological data indicating that SCC accounts for approximately 60–80% of sinonasal malignancies [26].

The occurrence of SCC predominantly in older age groups supports the concept of multistep carcinogenesis, where prolonged exposure to carcinogens and progressive accumulation of genetic mutations contribute to malignant transformation [27].

Undifferentiated malignant neoplasms constituted the second most common group of malignancies in the present study. These tumors often pose significant diagnostic challenges due to their poorly differentiated morphology and frequently require immunohistochemical studies for accurate classification [29].

Clinical Implications: The high proportion of malignant lesions in our series underscores the importance of early diagnosis and prompt histopathological evaluation of persistent sinonasal symptoms.

Nasal obstruction, discharge, and epistaxis, though commonly associated with benign inflammatory conditions, warrant thorough investigation in older patients and those with risk factors including tobacco use, occupational exposures, and previous radiation therapy [34]. The significant age-related distribution, with benign lesions predominating in younger patients and malignancies in older age groups, provides valuable clinical guidance for differential diagnosis. However, the occurrence of malignancies even in younger patients emphasizes that age alone cannot exclude malignancy [35].

Geographic and Environmental Considerations: Western Rajasthan's unique environmental characteristics, including arid climate, high dust exposure, and specific occupational patterns, may influence the epidemiology of nasal cavity lesions. Previous studies from Western Rajasthan have documented high incidence of fungal rhinosinusitis, attributed to environmental dust and agricultural activities [36]. Our findings contribute to the growing body of literature characterizing regional patterns of nasal cavity pathology.

Limitations: As a hospital-based study at a tertiary referral center, selection bias affects the relative proportions of different lesion types, particularly the high rate of malignancies. The study design does not permit calculation of true population-based incidence rates. Additionally, the limited use of immunohistochemistry and molecular studies in some cases may have affected precise classification of certain undifferentiated malignancies.

Future Directions: Future research should focus on population-based epidemiological studies to determine true incidence rates, molecular characterization of tumors to identify targetable mutations, correlation with environmental and occupational exposures specific to Western Rajasthan, and long-term follow-up studies to assess treatment outcomes and prognostic factors.

Conclusion

This comprehensive two-year study from Western Rajasthan reveals a diverse histopathological spectrum of nasal cavity lesions. Non-neoplastic lesions, particularly inflammatory polyps, constitute the majority of cases, reflecting chronic environmental exposures and inflammatory responses. Among neoplastic lesions, the high proportion of malignancies (81.25%) likely reflects the tertiary referral nature of our regional cancer center.

Squamous cell carcinoma emerges as the dominant malignancy, predominantly affecting older males. The significant age-related distribution pattern, with benign lesions in younger patients and malignancies in older age groups, provides valuable clinical guidance.

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