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Original Research Article

Study of Pattern and Significance of Infiltration of Eosinophil and Mast Cells in Nasal Polyp

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Abstract:

Introduction: Nasal polyps are hypertrophied, oedematous mucosa of the nasal cavity and paranasal sinuses, commonly classified as bilateral nasal polyposis (B/L polyposis) or antrochoanal polyps (ACP). Inflammatory cells such as eosinophils and mast cells play a key role in their pathogenesis.

Aims: To evaluate eosinophil and mast cell infiltration in nasal polyps, compare infiltration between B/L polyposis and ACP, and correlate tissue eosinophilia with systemic eosinophil levels.

Materials and Methods: This cross-sectional observational study was conducted in the Department of Pathology at Nil Ratan Sarkar Medical College and Hospital, Kolkata and Department of ENT at IPGMER & SSKM Hospital, between January 2024 and June 2025. The study included 50 cases of nasal polyps—both bilateral nasal polyposis and antrochoanal polyps—encompassing patients of all ages and both sexes. Participants were enrolled after obtaining written informed consent and Institutional Ethics Committee approval, resulting in a final sample size of 50 cases.

Results: Of 50 cases, 36 (72%) had B/L polyposis and 14 (28%) had ACP. Median eosinophil count/HPF was 40 in B/L polyposis versus 11 in ACP ($p<0.05$). Mast cells in epithelium: median 2.5/10 HPF in B/L polyposis, 0 in ACP; in stroma: 23 versus 7.5 (both $p<0.05$). Tissue eosinophilia (>5/HPF) was present in all cases, while only 5 patients had blood eosinophilia. Tissue and blood eosinophil counts showed no significant correlation ($r=0.224$, $p>0.05$).

Conclusion: Local eosinophil and mast cell infiltration is significantly higher in B/L polyposis compared to ACP, suggesting their key role in pathogenesis. Anti-inflammatory therapy should be considered the mainstay in managing bilateral nasal polyposis.

Keywords: Bilateral Nasal Polyposis, Antrochoanal Polyp, Eosinophil, Mast Cell.

Introduction

Nasal polyps are benign, hypertrophied, oedematous mucosal growths arising from the lining of the nasal cavity and paranasal sinuses. They represent a common cause of nasal obstruction, rhinorrhea, and anosmia in adults. The overall prevalence of nasal polyposis in the general population is estimated to be around 2%, although prevalence varies geographically and with the presence of associated conditions such as asthma or allergic rhinitis.[1] Despite their frequency, the precise aetiology of nasal polyps remains unclear, and multiple factors, including chronic inflammation, allergy, infection, and genetic predisposition, have been implicated. Although all nasal and paranasal polyps share similar gross morphologic characteristics, there are clinically and microscopically distinct subtypes. Nasal polyps are broadly classified into two main categories: bilateral nasal polyposis (B/L polyposis), which typically arises from the ethmoid sinuses,[2] and choanal polyps (ACP), which originate from one of the paranasal sinuses. Choanal polyps can be further subdivided depending on their site of origin into antrochoanal polyps, sphenochoanal polyps, and ethmoidochoanal polyps.[3] Clinically, B/L polyposis often presents as diffuse polyps causing bilateral nasal obstruction, while ACP usually presents unilaterally with obstruction, nasal

discharge, and sometimes snoring or sleep disturbances due to their choanal extension. Histologically, nasal polyps are characterized by a loose oedematous stroma containing mucous glands and are covered by respiratory epithelium, which may show squamous metaplasia in chronic cases. The stroma is infiltrated by various inflammatory cells, including eosinophils, mast cells, lymphocytes, and plasma cells. The extent and composition of these inflammatory infiltrates are highly variable, and their relative contribution to polyp growth and persistence remains an area of active research. Eosinophils and mast cells, in particular, are considered central to the pathogenesis of nasal polyps due to their roles in chronic inflammation, tissue remodeling, and modulation of the local immune response.[4,5]

The present study was undertaken to evaluate the degree and pattern of eosinophil and mast cell infiltration in nasal polyp tissue and to determine their significance in different polyp types. Additionally, it aimed to explore the correlation between tissue eosinophilia and systemic eosinophil counts. Specifically, the study involved counting the mean number of eosinophils per high-power field (HPF) in polyp tissue, correlating absolute peripheral blood eosinophil counts with tissue infiltration, and quantifying mast cells per 10 HPFs in both the epithelial and stromal compartments of nasal polyps. By elucidating these patterns, the study seeks to enhance understanding of the inflammatory mechanisms underlying nasal polyp formation and provide insights relevant to therapeutic strategies, particularly the rationale for targeted anti-inflammatory treatment.

Materials and Methods

Study design: This was a cross-sectional observational study.

Place of study: The study was conducted at the Department of Pathology, Nil Ratan Sarkar Medical College and Hospital, Kolkata, West Bengal 700014 and Department of ENT, IPGMER and SSKM Hospital, Kolkata, West Bengal 700020.

Period of study: January 2024 to June 2025.

Study Population: A total of 50 cases of nasal polyps, including bilateral nasal polyposis (B/L polyposis) and antrochoanal polyps (ACP), were included. Patients of all age groups and both sexes were selected after obtaining written informed consent and approval from the Institutional Ethics Committee.

Sample size: A total of 50 cases of nasal polyps

Inclusion Criteria:

1. Bilateral nasal polyposis
2. Antrochoanal polyp

Exclusion criteria:

1. Neoplastic polypoidal masses
2. Rhinosporidiosis
3. History of steroid intake within one month prior to surgery

Study Variable:

- Dependent/Outcome variable: Magnitude of eosinophil infiltration in nasal polyp tissue
- Independent variables: Age, sex

Parameters Assessed:

- Gross and microscopic examination of polyp specimens
- Patient history for relevant clinical information
- Quantification of eosinophils and mast cells in tissue sections
- Estimation of absolute blood eosinophil counts
- Reference to existing data from prior studies in this field

Study Tools:

- Case record forms and consent forms (Annexure I & II)
- Standard pathological instruments: scalpels, forceps, knives, vials, 10% formalin, alcohol grades, xylene, paraffin, incubator, microtome, water bath, slides, cover slips, Koplin jars, and various stains
- For blood eosinophil counts: improved Neubauer counting chamber, test tubes, capillary pipettes, Dunger's fluid, Olympus CH20i binocular microscope

Study Technique:

- Specimens were examined grossly for size, shape, surface, and dimensions, with photographs taken.
- Tissue sections were prepared using routine paraffin embedding and stained with Hematoxylin and Eosin (H&E) for eosinophil identification. Ten high-power fields (HPF, 400×) were examined per section, and the mean eosinophil count per HPF was calculated.
- Mast cells were identified using Toluidine Blue staining in separate sections. Ten HPFs were analyzed manually under light microscopy, and mast cells were counted based on metachromasia.
- Absolute blood eosinophil counts were determined preoperatively by diluting blood with Dunger's fluid and counting manually using a Neubauer chamber under 400 × magnifications.

Statistical Analysis: For statistical analysis, data were initially entered into a Microsoft Excel spread sheet and then analyzed using SPSS (version 27.0; SPSS Inc., Chicago, IL, USA) and GraphPad Prism (version 5). Numerical variables were summarized

using means and standard deviations, while Data were entered into Excel and analyzed using SPSS and GraphPad Prism. Numerical variables were summarized using means and standard deviations, while categorical variables were described with counts and percentages. Two-sample t-tests were used to compare independent groups, while paired t-tests accounted for correlations in paired data. Chi-square tests (including Fisher's exact test for small sample sizes) were used for categorical data comparisons. P-values ≤ 0.05 were considered statistically significant.

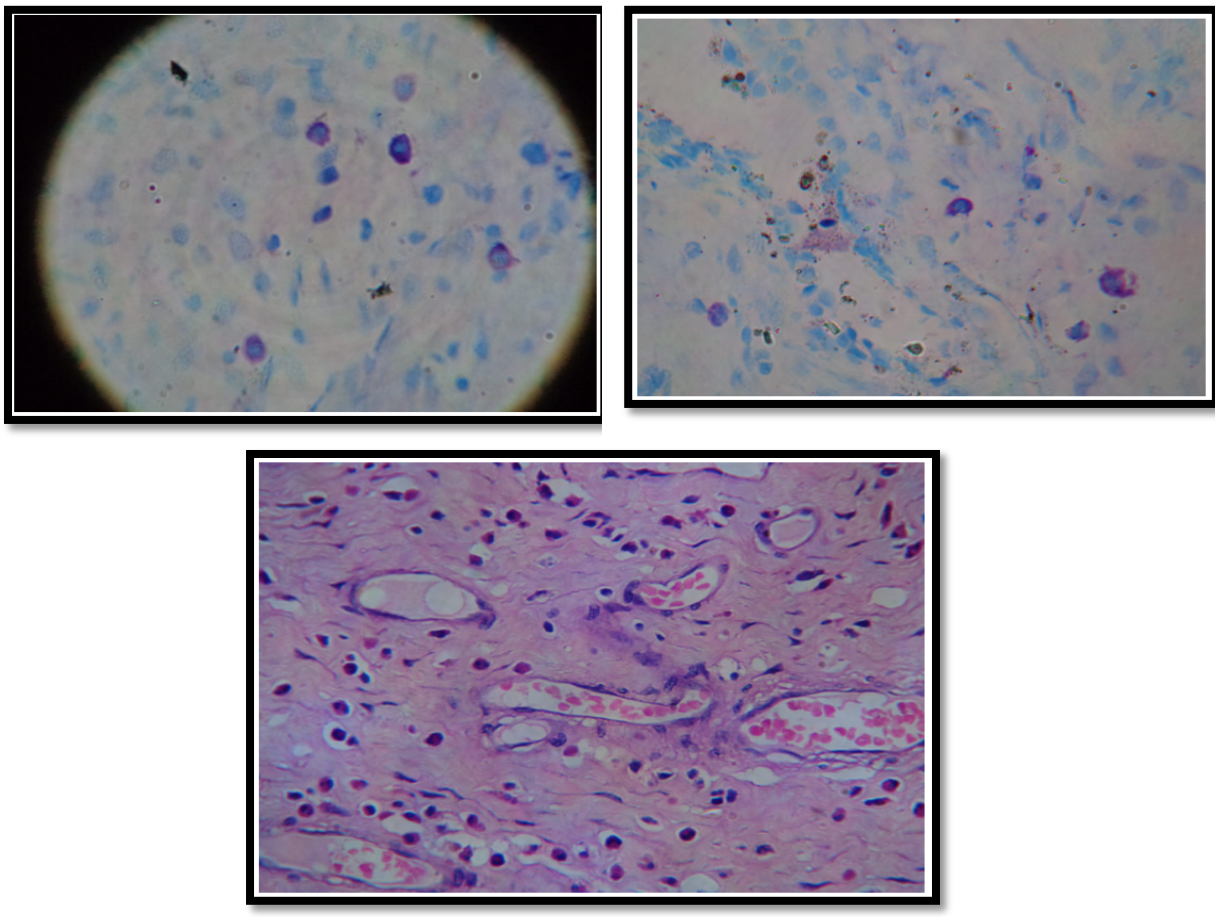

Figure 1: Microscopic picture (nasal polyps) under 400 × magnifications

Result

Table 1: Mean no. of eosinophil per Field ×400 in Group with B/L Polyposis and in the Group with ACP

Mean no. of eosinophils / HPF ×400	B/L Polyposis: No. of cases (%)	ACP: No. of cases (%)
<5	0 (0%)	0 (0%)
5–19	4 (11.1%)	12 (85.7%)
20–50	22 (61.1%)	2 (14.3%)
>50	10 (27.8%)	0 (0%)

Table 2: The number of mast cells (MC) per 10 fields at ×400 in absolute terms were counted and results were classified into 3 groups- (0-5) , (6-10), (>10)

No. of mast cells / 10 HPF	ACP: No. of cases (%)	B/L Polyposis: No. of cases (%)
0–5	14 (100%)	33 (91.7%)
6–10	0 (0%)	3 (8.3%)
>10	0 (0%)	0 (0%)

Table 3: The number of mast cells per 10 field at ×400 in absolute terms were counted and results were classified into following groups- (0-10) , (11-20), (21-30), (31-40) , (41-50), (>50).

No. of mast cells / 10 HPF (stroma)	ACP: No. of cases (%)	B/L Polyposis: No. of cases (%)
0–10	11 (78.57%)	5 (13.89%)
11–20	2 (14.29%)	10 (27.78%)
21–30	1 (7.14%)	12 (33.33%)
31–40	0 (0%)	5 (13.89%)
41–50	0 (0%)	2 (5.56%)
>50	0 (0%)	2 (5.56%)

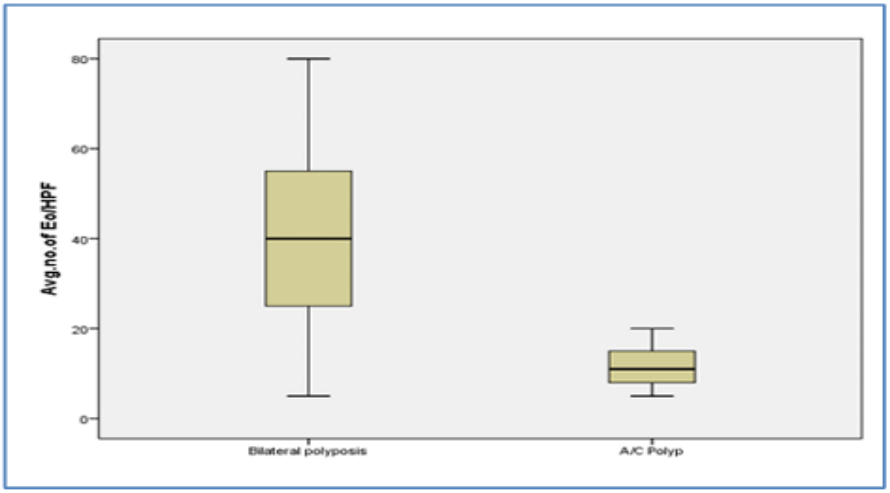

Figure 2: Infiltration of mast cells in epithelium of nasal polyp

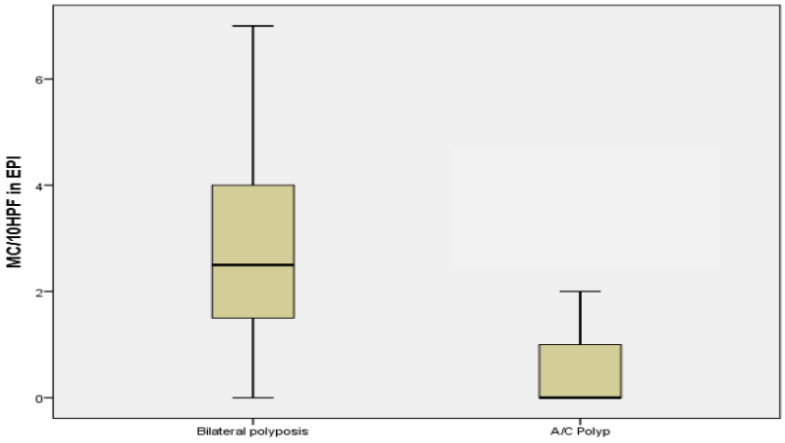

Figure 3: Infiltration of mast cells in stroma of nasal polyp

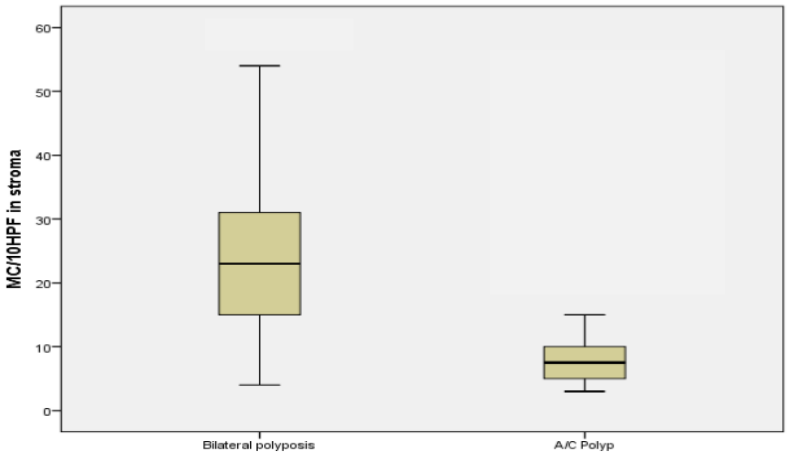

Figure 3: Absolute blood eosinophil count (AEC)

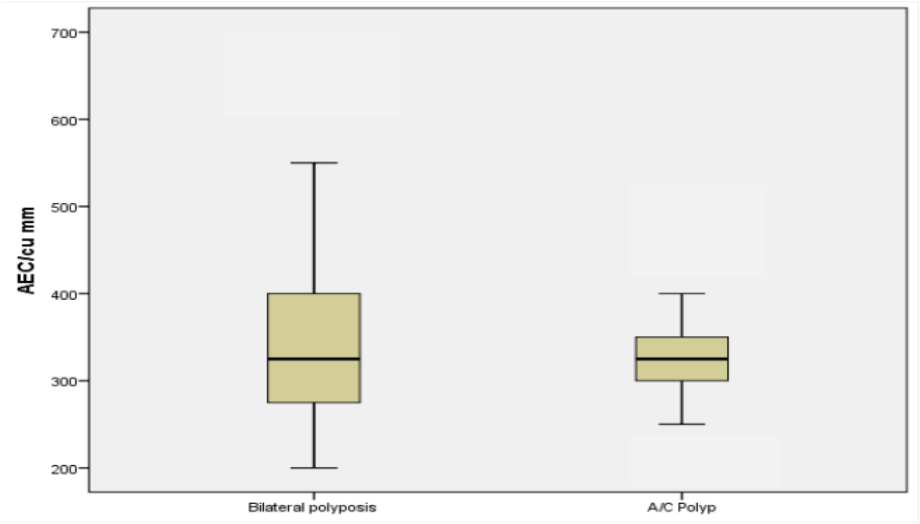

Figure 4: Correlation between eosinophil counts in tissue and absolute blood eosinophil counts of 50 cases (n=50)

After the histological evaluation, 50 cases were selected from total 57 received tissue samples, which were diagnosed clinically as bilateral or unilateral nasal polyp. 7 cases were excluded from the study as histopathological examination of these polypoidal masses showed diagnosis other than nasal polyp. Out of total 50 cases (30 male & 20 female) 36 cases (72%) had bilateral polyposis and 14 cases (28%) had antrochoanal polyps. The age range of the patients was 7 71 years, with mean age 27.34. (SD ± 14.95).In case of B/L polyposis Median value of age was28.5 and in case of ACP Median value of age were12.5.

The mean number of eosinophil per field at magnification of ×400 in absolute terms was counted and results were classified into 4 grades: Grade 0: < 5/HPF; Grade 1: between 5-19/HPF; Grade 2: between 20-50/HPF; Grade 3: > 50/HPF. We observed no cases in Grade 0 (< 5/HPF) of eosinophilic infiltration. In case of B/L polyposis 4 cases (11.1%) were in Grade 1(5-19/HPF), 22 cases (61.1%) were in Grade 2 (20 50/HPF) and 10 cases (27.8%) were in Grade 3 (>50/HPF).In case of ACP 12 cases (85.7%) were in Grade 1(5-19/HPF), 2 cases (14.3%) in Grade 2 (20-50/HPF) and no cases were found to be in Grade 3.

Infiltration of eosinophil in both types of polyp found to be statistically significant (Pearson Chi-Square test; df =2, p =<0.05) Median value of number of eosinophil/HPF in B/L polyposis was 40 and in ACP it was 11. Difference in number of eosinophil/HPF among B/L polyposis and ACP found to be statistically significant (Mann Whitney U tests showed p value =<0.05) The Box-and-whisker plot showing range of distribution of eosinophil /HPF in B/L polyposis an ACP.

We observed that, out of 36 B/L polyposis cases 33 cases (91.7%) show number of mast cells between 0-5/10HPF , 3 cases (8.3%)) show number of mast cells between 6-10/10HPF in epithelium. All 14 cases (100%) of ACP show number of mast cells between 0-5/10HPF.

Median value of number of Mast cells/10HPF in epithelium in B/L polyposis is =2.50.Median value of number of Mast cells/10HPF in epithelium in ACP is =.00 (as minimum number is 0 and maximum number is 3 in ACP).

Difference in number of Mast cells/10HPF in epithelium among B/L polyposis and ACP found to be statistically significant. (Statistical analyses performed by the Mann Whitney U test showed p value = <0.05)

we observed that in stroma of B/L polyposis , 0-10 mast cells per 10 HPF were seen in 5 cases(13.89%), 11-20/10HPF in 10cases (27.78%), 21-30/10HPF in 12 cases (33.33%), 31-40/10HPF in 5cases (13.89%), 41-50/10 HPF in 2 cases (5.56%) and >50 /10HPF in 2 cases (5.56%). In stroma of ACP, 0-10 mast cells per 10 HPF were seen in 11 cases (78.58%), 11-20/10HPF in 2cases (14.28%), 21-30/10HPF in 1case (7.14%).

Median value of number of mast cells/10HPF in stroma of B/L polyposis is =23.Median value of number of mast cells/10HPF in stroma of ACP is = 7.5. Difference in average number of mast cells/10HPF in stroma among B/L polyposis and ACP found to be statistically significant. (Statistical analyses performed by the Mann Whitney U test showed p value = <0.05)

Absolute blood eosinophil count was estimated by collecting the patient's blood preoperatively. Cut off value for blood eosinophilia was considered to be 500/cumm. Out of total 50 cases of nasal polyp only 5 cases had blood eosinophilia. All of these 5 cases had B/L polyposis. Median value of AEC/cumm in blood in B/L polyposis was = 325 Median value of AEC/cumm in blood in ACP was = 325 statistically no significant difference was found in value of AEC/cumm in blood among B/L polyposis and ACP. (Statistical analyses performed by the Mann Whitney U test showed p value = 0.510)

The Pearson correlation analysis is applied to evaluate the statistical significance between the patient's absolute eosinophil count in blood and the number of eosinophils/ HPF in patient's polyp tissue.

It is found that the absolute eosinophil count in blood is not significantly correlated with the number of eosinophil/ HPF in nasal polyp tissue (Pearson Correlation r=.224, p value= >0.05).

Discussion

Fifty patients (30 males, 20 females) with nasal polyps, including bilateral nasal polyposis (B/L polyposis) and antrochoanal polyps (ACP), were included in this prospective study from April 2012 to March 2014 at R.G. Kar Medical College and Midnapore Medical College, West Bengal. Polyp tissues were histologically examined for eosinophils (per HPF ×400) and mast cells (per 10 HPF) in epithelium and stroma, and peripheral blood eosinophil counts were measured. Statistical analysis compared cellular infiltration between polyp types and correlations with systemic eosinophilia.

Prevalence and Polyp Distribution: Out of 50 cases, 36 (72%) were B/L polyposis and 14 (28%) were ACP. All ACPs presented as unilateral polyps, consistent with the literature; Sirola[6] (1965) reported ACPs account for 4–6% of all nasal polyps, and P. Frosini [7] (2009) reported rare bilateral cases of ACP. B/L polyposis prevalence in other studies ranges from 1–4% in the Caucasian population (Settipane, [8] 1987; Montague et al.[9], 2004).

Sex Distribution: A male predominance was observed in both types of polyps: 61% of B/L polyposis and 57% of ACP cases were male. This aligns with previous reports (Settipane & Chaffee, [10] 1977; Frosini et al., [7] 2009), although some studies reported no gender predilection for ACP (Chen et al [11]., 1989; Orvidas et al., [12] 2001).

Age Distribution: The age range of patients was 7–71 years (mean 27.34 ± 14.95 years). The median age for B/L polyposis was 28.5 years, whereas for ACP it was 12.5 years, indicating ACP is more frequent in children. Other studies also report younger age at presentation for ACP compared to B/L polyposis (Larsen & Tos,[13] 1991; Chen et al.,[11] 1989; Schram VL, [14]1980).

Clinical Presentation: Nasal obstruction was the most common symptom, present in all cases (100%) of B/L polyposis (bilateral) and ACP (unilateral). Nasal discharge occurred in 33.3% of B/L polyposis and 7.1% of ACP cases, while nasal bleeding was more frequent in ACP (57.7%) than B/L polyposis (22.2%). These findings are consistent with prior reports describing unilateral obstruction as typical for ACP (Kamel, [15]1990).

Microscopic Findings: Squamous metaplasia was observed in 27.7% of B/L polyposis and 28.6% of ACP cases, supporting findings by Larsen & Tos[16] (1990) and Mygind et al.[17] (2000). Basement membrane thickening was present in 11.1% of B/L polyposis and 7.1% of ACP. Oedematous stroma predominated in B/L polyposis (97.2%), while ACP showed more fibrotic stroma (71.4%). Garín et al. [18](2008) emphasized that eosinophilic infiltration and stromal edema are characteristic histological features of nasal polyps.

Eosinophilic Infiltration: Eosinophil infiltration was consistently higher in B/L polyposis compared to ACP. In B/L polyposis, 100% of cases showed tissue eosinophilia: 61.1% had 20–50

eosinophils/HPF ×400 and 27.8% had >50/HPF ×400, similar to Garín et al. [18](2008) and Seiberling et al.[19] (2001). ACP cases also showed eosinophilia, but predominantly 5–19 eosinophils/HPF ×400 (85.7%) with none exceeding 50/HPF ×400, consistent with Min et al.[20] (1995).Eosinophils contribute to the inflammatory process by releasing cytotoxic proteins such as major basic protein (MBP), eosinophil cationic protein (ECP), eosinophil-derived neurotoxin (EDN), and eosinophil peroxidase (EPO) (Mygind, 1982[21]; Stoop et al., [22]1993).

MBP can alter ionic transport in nasal polyps (Bernstein, 2005),[23] while IL-5 produced by activated eosinophils promotes eosinophil survival, migration, and accumulation (Simon et al.,[24] 1997; Denburg, [25]1997). High IL-5 expression in nasal polyps, especially B/L polyposis, has been reported by Bachert et al. [26](2000), Rudack et al.[27] (1998), and Bachert & Van Cauwenberge [28](1997), whereas ACPs show increased IL-6 expression, reflecting a more acute inflammatory profile (Maldonado, 2004)[29].

Mast Cell Infiltration: Mast cell counts were evaluated in both epithelium and stroma. In B/L polyposis epithelium, 91.6% of cases had 0–5/10 HPF, and 8.4% had 6–10/10 HPF. All ACP cases had 0–5/10 HPF. Stromal mast cell infiltration was more pronounced: 33.3% of B/L polyposis cases had 21–30/10 HPF, while 78.6% of ACP cases had 0–10/10 HPF. These results support prior observations that mast cells are more abundant in subepithelial regions and contribute to polyp pathogenesis (Ruhno et al.,[30] 1990; Otsuka et al.,[31] 1993; Kitapci et al.,[32] 2006; Park et al.[33], 1998; Okayama et al.,[34] 1997).

Correlation with Peripheral Blood Eosinophilia: Despite tissue eosinophilia in all cases, only 5 of 36 B/L polyposis patients showed peripheral blood eosinophilia. This lack of correlation aligns with prior reports suggesting local eosinophil recruitment is largely independent of systemic eosinophilia (Pradhananga et al., [35]2008; Wong et al., [36]1992).

Conclusion

In this study of 50 patients with nasal polyps, bilateral nasal polyposis showed significantly higher eosinophilic and mast cell infiltration in both epithelium and stroma compared to antrochoanal polyps, indicating a stronger underlying inflammatory reaction.

Eosinophil counts per HPF and mast cell density per 10 HPF were both markedly elevated in bilateral polyposis, with statistical significance demonstrated by Pearson Chi-square and Mann–Whitney U tests ($p < 0.05$).

Although a small proportion of patients exhibited peripheral blood eosinophilia, systemic eosinophil levels did not correlate significantly with tissue eosinophil infiltration ($r = 0.224$, $p > 0.05$), suggesting that local tissue inflammation is independent of peripheral eosinophil counts. Overall, the study highlights that bilateral polyposis represents a more pronounced eosinophilic and mast-cell–mediated inflammatory process than antrochoanal polyps, underscoring the importance of histopathological evaluation in understanding the pathogenic patterns of nasal polyps.

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