

## Incidental Paranasal Sinus Abnormalities on MRI Brain and Association with Symptomatic and Asymptomatic Patients

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### ABSTRACT

**Objective:** To evaluate the incidental paranasal sinus findings on magnetic resonance imaging Brain and the association of these findings to the presence of any sinus-related symptoms at the time of scan.

**Study Design:** Comparative cross-sectional study.

**Place and Duration of Study:** Combined Military Hospital, Lahore Pakistan, from Jan to May 2021.

**Methodology:** A total of 135 patients who underwent magnetic resonance imaging of the brain were evaluated for the presence of incidental paranasal sinus abnormalities. The frequency of these abnormalities and their relation with the presence or absence of symptoms was evaluated.

**Results:** One hundred and thirty-two (97.7%) had one or more paranasal sinus abnormalities. Mucosal thickening of 4 mm or more and the presence of polyps are significantly related to the presence of sinus-related symptoms ( $p$ -value=0.02).

**Conclusion:** Incidental paranasal sinus abnormalities are a frequent finding on MRI Brain. Mucosal thickening of 4 mm and the presence of polyps appear to be significantly related to the presence of relevant symptoms, while mucosal thickening of less than 3 mm and mucus retention cysts are insignificant.

**Keywords:** Incidental findings, Magnetic resonance imaging, Mucosal thickening, Mucus retention cyst, Paranasal sinuses, polyp.

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### INTRODUCTION

Magnetic resonance imaging (MRI) Brain is advised mostly to rule out intracranial pathologies. Since paranasal sinuses are usually included in most MRI Brain protocols, incidental findings are now found increasingly on MRI brain,<sup>1,2</sup> including mucosal thickening, retention cysts, polyps and fluid levels. Indications for MRI Brain are usually not related to sinus pathology. Hence, the significance of these incidental findings is not clear to radiologists or requesting physicians. On the other hand, such findings can be a source of anxiety for patients. Hospital-based studies in adults,<sup>3,4</sup> and paediatric age groups have been carried out to evaluate the frequency of incidental paranasal sinus pathologies.<sup>5,6</sup> Prevalence ranging from 14-60% has been reported for sinus abnormalities in different populations,<sup>7,8</sup> however, local studies on the subject are not available. The purpose of our study is to see the frequency of these incidental findings in the local population. We also aim to group our cases into symptomatic and asymptomatic according to symptoms related to sinus problems. The rationale of

the study was to examine the clinical relevance of incidental sinus findings by correlating in symptomatic and asymptomatic groups.

### METHODOLOGY

The comparative cross-sectional study was conducted at CMH Lahore Pakistan, from January to May 2021 after approval from the Ethical Review Board (ERBC certificate number 278/2021). Sample size was calculated using Open Epi sample size calculator with a reference population proportion of 14%.<sup>9</sup>

**Inclusion Criteria:** Patients referred for MRI brain for non-paranasal sinus pathology were included.

**Exclusion Criteria:** Patients who had previously undergone head, neck or sinus surgery were excluded.

A study sample of 135 patients was collected using non-probability consecutive sampling. Informed consent was obtained from all patients. All patients were asked questions related to ENT symptoms. Based on answers to these questions, patients were categorized as symptomatic when one or more symptoms were present. Subjects with no sinus-related symptoms were labelled as asymptomatic. Age and gender were recorded. MRI brain was carried out on 1.5 T Siemens Magnetom Sola.

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Paranasal sinus findings of MRI Brain were recorded. Sinus problems were categorized into mucosal thickening, retention cysts, polyps, fluid collection and miscellaneous (Figure-1). Mucosal thickening was divided into three subcategories, namely  $\leq 2$  mm, 2.1–4 mm and  $>4$  mm. Location of findings in maxillary, ethmoid, frontal or sphenoid sinuses were recorded. The size of the involved area, laterality and category of sinus pathology were mentioned.

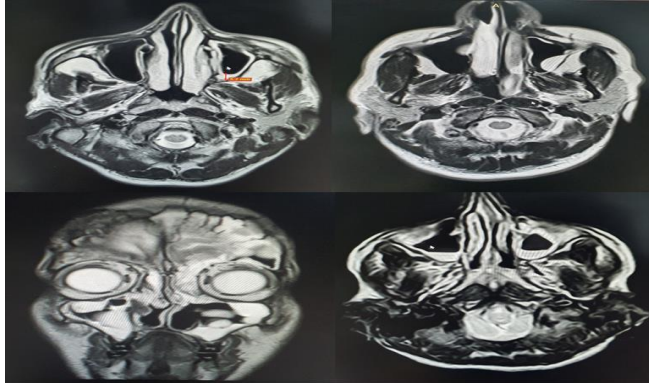


Figure-1: a,b. (a) Mucosal thickening  $> 4$  mm in right maxillary sinus. (b) Mucus retention cyst in right maxillary sinus. (c) Bilateral maxillary, frontal and ethmoid polyposis. (d) Bilateral maxillary fluid levels

Statistical Package for Social Sciences (SPSS) version 25.0 was used for the data analysis. Quantitative variables were expressed as Mean $\pm$ SD and qualitative variables were expressed as frequency and percentages. Chi-square test was applied to explore the inferential statistics. The  $p$ -value of  $\leq 0.05$  was set as the cut-off value for significance.

**RESULT**

A total of 135 subjects were included in the study, comprising 90(66.7%) men and 45(33.3%) women with a Mean $\pm$ SD (44.9 $\pm$ 17.34). Patients showed at least one incidental paranasal sinus abnormality on diagnostic imaging. Two or more abnormalities were detected in 27(20.0%) patients.

At least one symptom was present in 62 patients (45.9%), while 73(54.1%) subjects had no sinus-related complaint at the time of imaging. Normal paranasal sinuses were observed in 3 of the asymptomatic patients, as all symptomatic subjects had at least one finding in the MRI. The frequency of incidental paranasal sinus abnormalities in the symptomatic and asymptomatic patients is given in Table.

The most common abnormality was mucosal thickening (97.0%), while the least common was

polyps (4.4%). The frequency of mucosal thickening reduced to 42.9% when thickening less than 2mm was excluded and to 25.9% when only  $>4$  mm thickening was included. Retention cysts were noted in 17.0% of the subjects, and fluid levels were noted in 8.1%. Only one patient had mucocele, which was categorized in miscellaneous findings. Mucosal thickening of more than 4 mm and the presence of polyps were seen more in the symptomatic population.

Table: Incidental Paranasal Sinus Abnormalities in Asymptomatic and Symptomatic Groups (n=135)

		Asymptomatic Group (n=73)	Symptomatic Group (n=62)	$p$ -value
Retention Cyst		14(19.2%)	09 (14.5%)	0.47
Polyp		0	6 (9.6%)	0.01
Mucosal thickening		69(94.5%)	62(100%)	0.51
Fluid levels		7(9.6%)	4(6.5%)	0.51
Severity of mucosal thickening	$\leq 2$ mm	43(58.9%)	30(48.4%)	0.22
	2.14mm	13(17.8%)	10(16.1%)	0.79
	$>4$ mm	13(17.8%)	22(35.4%)	0.02

The evaluation of  $\leq 2$  mm and 2.1 mm–4 mm mucosal thickening and mucus retention cysts did not reveal any statistical significance between symptomatic and asymptomatic groups with  $p$ -values of 0.22, 0.79 and 0.47, respectively. However, the presence of mucosal thickening of more than 4mm and polyps was significantly higher in symptomatic patients with  $p$ -values of 0.01 and 0.02, respectively. Mucosal thickening was most frequently seen in the left ethmoid sinus (74.1%), followed by the right ethmoid (69.6%) and right maxillary sinuses (69.6%)(Figure-2).

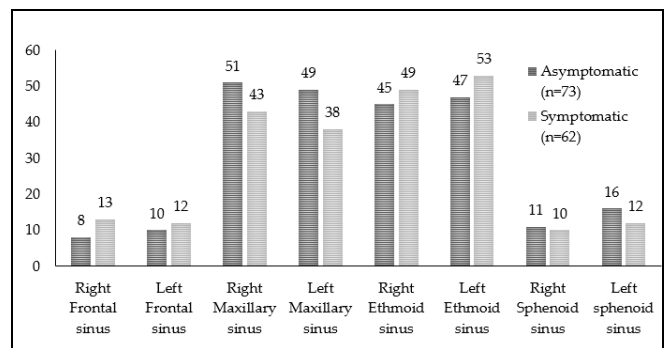


Figure-2: Distribution of Mucosal Thickening according to Paranasal Sinuses (n=135)

**DISCUSSION**

Owing to its lack of radiation exposure and sensitivity to soft tissue changes, MRI is now being more commonly utilized in clinical as well as research settings. With continual improvements and advances in imaging protocols, MRI is considered essential for

the comprehensive evaluation of intra-cranial pathologies as shown by Gibson *et al.*<sup>8</sup> and Kamio *et al.*<sup>9</sup> The rapid increase in intracranial imaging has resulted in a greater frequency of incidental findings being detected, including sino-nasal inflammatory changes.<sup>10</sup>

Our study demonstrated that 97.0% of patients undergoing brain imaging had mucosal thickening in one or more sinuses. The same abnormality rate among the asymptomatic group was 94.5%. This is considerably higher than the incidence of 58.1% and 54.9%, respectively, reported in a study conducted in Australia by del Rio *et al.*<sup>11</sup> However, they have included mucosal thickening of 3 mm or greater only in their study. The frequency of mucosal thickening in our study reduced to 42.9% when thickening less than 2mm was excluded. The frequency of incidental sinus abnormalities in the literature ranges from 14-66%,<sup>12-16</sup> with 45.5% in Turkey shown by Özdemir *et al.*<sup>17</sup> We postulate that this variation may be due to the regional climate and atmospheric changes that affect sinonasal mucosal inflammation.

When evaluating the presence of abnormalities in asymptomatic and symptomatic populations, a statistically significant difference was found in those subjects with mucosal thickening of more than 4 mm. Similar results were observed in a previous study by Rak *et al.* that reported the association of more than 4 mm mucosal thickening with the presence of symptoms.<sup>12</sup> Based on our results, mucosal thickening of 4 mm or less is clinically insignificant and may be seen in a population without any ENT-related symptoms.

Based on the finding of all six cases of polyps in the symptomatic group, it was found to have a significant correlation with the presence of symptoms. Fluid levels were found to be present in 8.1% of our subjects, which was relatively less than the previously mentioned frequency of 49.1%.<sup>17</sup> Mucus retention cysts were found to have a comparable frequency in both groups, which was consistent with the study by Rak *et al.*<sup>12</sup> and del Rio *et al.*<sup>11</sup> The frequency in our study was 17.0%, which was consistent with the previously reported frequency of 12.4% to 35.6%.<sup>18,19</sup>

Maxillary and ethmoid sinuses were more commonly affected than frontal and sphenoid sinuses, according to our results. It has previously been shown that the mucosal proliferation rate and secretion of immunomodulatory cytokines is much higher in maxillary and ethmoid sinuses relative to other sino-nasal regions by Cho KS *et al.*<sup>20</sup> Our study was consistent with this observation.

The current study was performed at a single site. The limitations of the study included a relatively small number of cases and the characterization of our patients into symptomatic and asymptomatic groups strictly on the basis of clinical history. Further studies may be needed to evaluate seasonal, demographic and environmental factors in the detection of incidental paranasal sinuses and their clinical significance.

## CONCLUSION

Incidental paranasal sinus abnormalities are a frequent finding on MRI Brain. Mucosal thickening of more than 4 mm and the presence of polyps appear to be significantly related to the presence of relevant symptoms. Mucosal thickening of less than 4 mm and mucus retention cysts have no correlation to the presence or absence of symptoms. Therefore, clinical correlation must be sought to avoid unnecessary ENT referrals based solely on the presence of imaging findings.

**Conflict of Interest:** None.

## Authors' Contribution

Following authors have made substantial contributions to the manuscript as under:

NA & YK: Data acquisition, critical review, approval of the final version to be published.

KK & AI: Concept, data analysis, drafting the manuscript, approval of the final version to be published.

SW & KF: Study design, data interpretation, drafting the manuscript, critical review, approval of the final version to be published.

Authors agree to be accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated & resolved.

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