

Incidental mucosal abnormalities of paranasal sinus in patients referred for MRI brain for suspected intracranial pathology in Eastern Nepal

Mukesh Kumar Gupta¹, Raj Kumar Rauniyar², Kaleem Ahmad³, Sajid Ansari⁴, Ashok Raj Pant⁵

^{1,3}Associate Professor, ²Professor and Head, ⁴Assistant Professor, ⁵Senior Resident, Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Sciences, Dharan, Nepal

Submitted: 10-12-2013

Revised: 21-12-2013

Published: 10-03-2014

ABSTRACT

Background: Mucosal abnormalities of the paranasal sinuses are frequently encountered as incidental findings during MRI evaluation of brain, however, little is known about their magnitude and spectrum in the Nepalese population. The purpose of this study was to analyze the spectrum of incidental mucosal abnormalities of paranasal sinuses in patients who had undergone MRI of brain for suspected intracranial pathologies. **Methods:** A retrospective cross-sectional study was conducted on 600 consecutive patients referred for brain MRI with suspicion of intracranial pathologies over a period of two years. The mucosal abnormalities of paranasal sinuses were evaluated and the findings were categorized according to the anatomic location and the imaging features of the abnormality seen on MRI. **Results:** Of total 600 cases, sinus abnormality was seen in 349(58.2%) patients. The spectrum of sinus abnormalities in 349 patients was as follows: mucosal thickening - 313(89.7%), polyp/retention cyst - 139(39.8%), sinus opacification - 114(32.7%), and fluid level - 23(6.6%). Maxillary sinus was involved in 291(83.4%) followed by ethmoid in 257(73.6%), frontal in 169(48.4%) and sphenoid sinus in 115(33.0%) cases. **Conclusion:** Incidental mucosal abnormalities of paranasal sinus are common findings on MRI performed for evaluation of intracranial pathologies. Mucosal thickening is the commonest abnormality and the maxillary sinus is the most commonly affected sinus. Such a high prevalence of incidental abnormality suggests some unidentified subtle environmental allergens in this part of Nepal and the condition may reflect initial findings of allergic rhinosinusitis before it progresses to the full-fledged symptomatic stage.

Key words: Abnormalities, Incidental, MRI, Paranasal sinus

Access this article online

Website:
<http://nepjol.info/index.php/AJMS>

INTRODUCTION

Incidental mucosal abnormalities of the paranasal sinus are frequently observed during MRI scan of brain performed for evaluation of non-sinus related pathologies. Radiological imaging plays crucial role in diagnosis, deciding the treatment option, surgical planning and follow-up for various paranasal sinus pathologies. Although plain x-ray is still frequently used tool to investigate paranasal sinus, CT and MRI are more sensitive and informative in yielding various PNS abnormalities. CT has the added advantage in demonstrating bony abnormalities while MRI is better in delineating and characterizing soft tissue changes. MRI

is currently considered superior to CT for evaluation of various intracranial and intraorbital complications of paranasal sinus diseases.¹⁻⁴ Rhinosinusitis is a frequently encountered abnormality defined as inflammation of nasal and paranasal sinus mucosa which develops from an interaction of agent, host and environmental factors. The common causes are viral infections and allergies with bacterial infection occurring as a secondary event. A symptom-free subclinical inflammation of the mucosa can occur when exposure to allergens is too low to provoke symptoms.⁵ Asymptomatic incidental mucosal abnormalities may reflect the initial findings of allergic rhinosinusitis before it progresses to the full blown

Address for Correspondence:

Dr. Mukesh Kumar Gupta, Department of Radiodiagnosis and Imaging, B.P. Koirala Institute of Health Sciences, Dharan, Nepal.

E-mail: mukeshgupta148@yahoo.com; Phone: +977-9842025813.

© Copyright AJMS

symptomatic stage in late course of the disease. Detection of allergic rhinosinusitis in initial stage, early treatment strategy, awareness and patient's education on avoidance of allergens can prevent the disease manifestation to its full-fledged state. The purpose of this study was to analyze the spectrum of incidental mucosal abnormalities of paranasal sinuses in patients who had undergone MRI of brain for suspected neurological pathologies.

METHODS

A hospital based retrospective cross-sectional study was carried out on 600 consecutive patients at B.P. Koirala Institute of Health Sciences, Dharan, Nepal over a period of two years from October 2011 to September 2013. All the patients referred for MRI brain with suspected intracranial pathologies were included in the study. Patients referred with suspicion of sinus problems were excluded. As it was a time bound study, sample size comprised of all the cases referred during the study period and who fulfilled the inclusion criteria. This study had no influence on the treatment of the patients or execution/ indication of MRI. All the scans were performed on 0.35 tesla MRI scanner (Siemens) with permanent magnet. The abnormalities studied were mucosal thickening, sinus opacification, fluid level, and retention cyst/polyp. Retention cysts and polyps were grouped together as it is often difficult to differentiate the two entities on MRI scan. Clinical correlation with paranasal symptom was not available as it was a retrospective study. Statistical analysis was performed using SPSS software.

RESULTS

Of total 600 cases studied, 330 (55%) were male and 270 (45%) were female. The ages ranged from 14 to 72 years with mean age of 41.6 years. Of total 600 patients, abnormalities in one or more of the sinus groups were found in 349 (58.2%) subjects, 54.4% of which were male and 45.6% were female. The spectrum of sinus abnormalities (Table 1) among 349 patients was as follows: mucosal thickening- 313(89.7%), polyp/retention cyst- 139(39.8%), sinus opacification- 114(32.7%), and fluid level- 23(6.6%). Out of total 349 abnormal cases, 217 (62.2%) had more than one abnormalities; mucosal thickening and polyp/retention cyst being the most common combination seen in 103(29.5%) patients. Combined mucosal thickening and sinus opacification was seen in 91(26.1%) and combined mucosal thickening, sinus opacification and fluid level was seen in 23(6.6%) patients. Anatomical distribution of sinus abnormalities (Table 2) were as follows: maxillary- 291(83.4%), ethmoid- 257(73.6%), frontal- 169(48.4%), and sphenoid- 115(33.0%). Of total 349 cases, 230 (65.9%) showed bilateral mucosal abnormalities and 292(83.7%)

had abnormalities in more than one sinus group; the maxillary and ethmoid being the commonest combination seen in 145(41.5%) patients. Pansinus abnormalities were seen in 83(23.8%) patients.

Mucosal thickening: Mucosal thickening (Figure 1) was the commonest abnormality, observed in 313(89.7%) patients, of which 168(53.7%) were males and 145(46.3%) females, with male to female ratio of 1.15:1. Maxillary sinuses were most commonly affected with changes seen in 193 of the 349 patients, followed by ethmoid sinus in 185, frontal sinus in 107, and sphenoid sinus in 97 patients (Table 3). Of the 313 patients with mucosal thickening, 185 patients showed

Table 1: Spectrum of paranasal sinus abnormality among 349 patients

Abnormality	Frequency	Percentage
Mucosal thickening	313	89.7
Polyp/retention cyst	139	39.8
Sinus opacification	114	32.7
Fluid level	23	6.6
Combined abnormalities of paranasal sinuses		
Mucosal thickening and polyp	103	29.5
Mucosal thickening and opacification	91	26.1
Mucosal thickening, opacification and fluid level	23	6.6

Table 2: Anatomical distribution of paranasal sinus abnormalities among 349 patients

Sinus	Frequency	Percentage
Maxillary	291	83.4
Ethmoid	257	73.6
Frontal	169	48.4
Sphenoid	115	33.0
Combined involvement of paranasal sinuses		
Maxillary and Ethmoid	145	41.5
Maxillary, Ethmoid, Frontal, and Sphenoid	83	23.8
Maxillary and Frontal	26	7.4
Frontal and Sphenoid	13	3.7
Maxillary, Frontal, and Sphenoid	10	2.9
Maxillary, Ethmoid, and Sphenoid	9	2.6
Maxillary, Ethmoid, and Frontal	6	1.7

Table 3: Distribution pattern of paranasal sinus abnormalities among 349 patients

Sinus	Mucosal Thickening	Polyp/Retention cyst	Sinus opacification	Fluid level
Maxillary	193	99	78	23
Ethmoid	185	0	72	0
Frontal	107	40	26	0
Sphenoid	97	33	9	0
Total*	582	172	185	23

*The total denotes the total number of the abnormalities, not the number of patients

combined mucosal thickening in more than one sinus group; maxillary and ethmoid sinus being the most common combination seen in 78 patients. Combined ethmoid, frontal and sphenoid sinus mucosal thickening was seen in 83 patients. Combined frontal and sphenoid sinus mucosal thickening was seen in 14 patients and combined ethmoid and frontal sinus mucosal thickening was seen in 10 patients.

Polyp/retention cyst: Of the 139 patients with polyp/retention cyst, 77(55.4%) were male and 62(44.6%) female, with male to female ratio of 1.24:1. The highest number of polyp/retention cyst (Figure 2) was seen in maxillary sinus i.e. in 99 patients, followed by frontal in 40 and sphenoid in 33 patients (Table 3). Combined maxillary and sphenoid sinus polyp/retention cyst was seen in 20 patients and combined frontal and sphenoid sinus polyp/retention cyst was seen in 13 patients. No polyp/retention cyst was seen in ethmoid sinus.



Figure 1: Coronal T2-weighted MR image shows hyperintense thickened mucosa in bilateral maxillary, ethmoid and frontal sinuses with retained secretions in left maxillary antrum

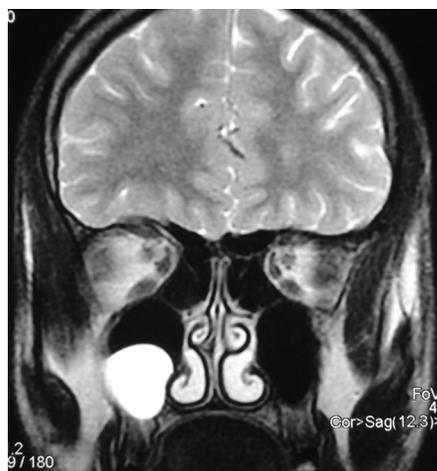


Figure 2: Coronal T2-weighted MR image shows a convex hyperintense lesion in right maxillary antrum suggestive of retention cyst/ polyp

Sinus opacification: Of the 114 patients with sinus opacification, 66(57.9%) were male and 48(42.1%) were female with male to female ratio of 1.37:1. The maximum number of opacification (Figure 3) was seen in maxillary sinus in 78 patients, followed by 72 in ethmoid, 26 in frontal, and 9 in sphenoid sinus (Table 3). Combined maxillary and ethmoid opacification was seen in 36 patients, combined maxillary and frontal opacification in 26 patients, and combined ethmoid and sphenoid opacification in 9 patients.

Fluid level: Incidental fluid level was noticed in maxillary sinus only in 23 patients, of which 11 were male and 12 were female.

DISCUSSION

Various previous studies have reported the prevalence of paranasal sinus abnormality to range from 16% to 60%.⁶ Many CT and MRI studies have shown the high prevalence of incidental sinus findings without initial clinical symptoms. Havas et al⁷ reported radiological abnormalities in one or more of the paranasal sinuses in up to 42.5% of MRI and CT scans of asymptomatic patients with an average age of 55 years. Lim et al⁶ found 32.3% sinus abnormalities in non-ENT MRI of children below the age of 16 years. Our study showed inflammatory changes in one or more sinus group in 349(58.2%) patients out of total 600 patients scanned for non-sinus pathology.

Up to 2 mm of ethmoid sinus mucosal thickening may not be due to inflammatory disease but may reflect the normal intermittent congestion of nasal cycle which is cyclical passive congestion and decongestion of each side of nasal turbinate, nasal septum, and the ethmoid air cells mucosa



Figure 3: Axial T2-weighted MR image shows opacification of right maxillary sinus

over a 50-minute to 6-hour period in human.^{8,9} Considering the physiological mucosal congestion, we chose a cut-off value of more than 2 mm for mucosal thickening in ethmoid sinus in our study.

When asymptomatic patients are evaluated with MRI for sinus inflammatory changes, approximately 13-63% of patients have abnormalities in the paranasal sinuses and the maxillary (27-39%), ethmoid (6-25%), or combined maxillary and ethmoid (43%) sinus inflammatory disease predominates. Although mucosal thickening is the most common incidental finding, polyp and/or mucus retention cyst may often be found. Air-fluid level or total sinus opacification may be found in approximately 3-5% of asymptomatic patients.¹⁰⁻¹³ The commonest abnormality in our study was mucosal thickening in 313(89.7%) patients followed by polyp/retention cyst in 139(39.8%), sinus opacification in 114(32.7%), and fluid level in 23(6.6%) patients. The most commonly affected sinus was maxillary followed by ethmoid, frontal and sphenoid in decreasing order of frequency in our study. The limitation of our study was that the clinical correlation with paranasal symptoms was not available due to retrospective nature of the study, however all the patients underwent MRI evaluation of brain for non-ENT pathology.

Retention cysts and polyps are usually asymptomatic, incidental findings in the paranasal sinuses and are regarded as complications of inflammatory sinusitis. Mucous retention cysts are more common than serous retention cysts and are caused by the obstruction of a seromucinous gland, while serous retention cysts are due to the accumulation of fluid in the submucosal layer. Retention cysts are common in the maxillary sinuses and are seen in 9-35% of the patients on imaging studies. Sporadic polyps of the paranasal sinuses are common asymptomatic finding and are reported in one third of the autopsies.^{3,14-18} Mucous retention cyst, serous retention cyst and polyp cannot be clearly differentiated from one another on imaging modalities, and this is of little consequence because all three are regarded as common benign entities.¹⁹ We grouped retention cyst and polyp together as it is difficult to differentiate these entities on MRI. Polyp/retention cysts were seen in 139(39.8%) patients out of 349 abnormal cases in our study and maxillary sinus was most commonly affected followed by frontal and sphenoid sinus.

CONCLUSION

Incidental mucosal abnormalities of the paranasal sinuses are common findings on MRI performed for evaluation of non-sinus related pathologies. Mucosal thickening is the commonest abnormality followed by polyp/retention

cyst, sinus opacification and fluid level in decreasing order of frequency. Maxillary sinus is most commonly affected followed by ethmoid, frontal and sphenoid sinuses. Such a high prevalence of incidental sinus abnormality as shown by this study suggests some unidentified subtle environmental allergens in this part of Nepal and the condition may reflect initial findings of allergic rhinosinusitis before it progresses to the full-fledged symptomatic stage.

REFERENCES

1. Mafee MF, Chow JM and Meyers R. Functional endoscopic sinus surgery: anatomy, CT screening, indications, and complications. *AJR* 1993;160(4):735-744.
2. Mafee MF. Modern imaging of paranasal sinuses and the role of limited sinus computerized tomography: considerations of time, cost and radiation. *Ear Nose Throat J* 1994;73(8): 532-546.
3. Hasso AN and Lambert D. Magnetic resonance imaging of the paranasal sinuses and nasal cavities. *Top Magn Reson Imaging* 1994;6(4):209-223.
4. Zinreich SJ. Paranasal sinus imaging. *Otolaryngol Head Neck Surg* 1990;103(5):863-869.
5. Canonica GW and Compalati E. Minimal persistent inflammation in allergic rhinitis: implications for current treatment strategies. *Clin Exp Immunol* 2009;158(3):260-271.
6. Lim WK, Ram B, Fasulakis S and Kane KJ. Incidental magnetic resonance image sinus abnormalities in asymptomatic Australian children. *J Laryngol Otol* 2003;117(12):969-972.
7. Havas TE, Motbey JA and Gullane PJ. Prevalence of incidental abnormalities on computed tomographic scans of the paranasal sinuses. *Arch Otolaryngol Head Neck Surg* 1988;114(8): 856-859.
8. Zinreich SJ, Kennedy DW, Kumar AJ, Rosenbaum AE, Arrington JA, et al. MR imaging of normal nasal cycle: comparison with sinus pathology. *J Comput Assist Tomogr* 1988;12(6): 1014-1019.
9. Kennedy DW, Zinreich SJ, Kumar AJ, Rosenbaum AE and Johns ME. Physiologic mucosal changes within the nose and ethmoid sinus: imaging of the nasal cycle by MRI. *Laryngoscope* 1988;98(9):928-933.
10. Conner BL, Roach ES, Laster W and Georgitis JW. Magnetic resonance imaging of the paranasal sinuses: frequency and type of abnormalities. *Ann Allergy* 1989;62(5):457-460.
11. Cooke LD and Hadley DM. MRI of the paranasal sinuses: incidental abnormalities and their relationship to symptoms. *J Laryngol Otol* 1991;105(4):278-281.
12. Moser FG, Panush D, Rubin JS, Honigsberg RM, Sprayregen S and Eisig SB. Incidental paranasal sinus abnormalities on MRI of the brain. *Clin Radiol* 1991;43(4):252-254.
13. Rak KM, Newell JD, Yakes WF, Damiano MA and Luethke JM. Paranasal sinuses on MR images of the brain: significance of mucosal thickening. *Am J Roentgenol* 1991;156(2):381-384.
14. Rogers JH, Fredrickson JM and Noyek AM. Management of cysts, benign tumors, and bony dysplasia of the maxillary sinus. *Otolaryngol Clin North Am* 1976;9(1):233-247.
15. Jacobs M and Som PM. The ethmoidal "polypoid mucocele". *J Comput Assist Tomogr* 1982;6(4):721-724.
16. Fascenelli FW. Maxillary sinus abnormalities. Radiographic evidence in an asymptomatic population. *Arch Otolaryngol* 1969;90(2):190-193.

17. Som PM and Curtin HD. Inflammatory diseases. In: Som PM, Brandwein MS, eds. Head and neck imaging. St Louis: Mosby; 2003. p.193-260.
18. Larsen PL and Tos M. Origin of nasal polyps: an endoscopic autopsy study. Laryngoscope 2004;114(4):710-719.
19. Nyberg E, Nour SG, Lewin JS, Hsu D and Lanzieri CF. Sinonasal Cavity, Nasopharynx, and Oropharynx. In: Haaga JR, Dogra VS, Forsting M, Gilkeson RC, Ha HK, Sundaram M, eds. CT and MRI of the whole body. 5th edition. Philadelphia: Mosby 'Elsevier; 2009.p.567-638.

Authors Contribution:

MKG – Concept and design of the study, data collection and analysis, statistical analysis, write up, literature search and review, manuscript preparation, critical review and editing; **RKR** – Concept and design of the study, literature review, interpretation of data, statistical analysis, manuscript preparation, review and editing; **KA** – Concept and design, data collection and analysis, literature review, manuscript preparation, review and editing; **SA** – Study design, data analysis and interpretation, statistical analysis, literature review, manuscript review and editing; **ARP** – Study design, data collection and analysis, literature review, manuscript preparation, review and editing.

Teaching points: Incidental mucosal abnormalities of paranasal sinus are common findings on MRI performed for evaluation of intracranial pathologies. Mucosal thickening is the commonest abnormality followed by polyp/retention cyst, sinus opacification and fluid level.

Source of Support: This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors, **Conflict of Interest:** None declared.