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DEPARTMENT OF RADIOLOGY

**PREVALENCE OF INCIDENTAL ABNORMALITIES ON MRI DONE FOR
PATIENTS WITH OTHER CNS PROBLEMS IN PRIVATE DIAGNOSTIC
CENTERS IN ADDIS ABABA**

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List of Abbreviations

- **PNS - Paranasal sinus**
- **MRI - Magnetic Resonance Imaging**
- **CT - Computed tomography**
- **mm – Millimeter**
- **MT- Mucosal thickness**
- **TAH-Tikur anbesa hospital**
- **T2W- T2 weighted**

Abstract

Background

The PNS sinuses are air filled cavities which are extensions of the nasal cavities. Various pathological processes affect these structures but inflammatory conditions are the commonest. Even in asymptomatic patients who undergo brain imaging for other indications show one or more incidental abnormalities in their sinuses.

Objective of the study

To determine the prevalence of incidental PNS abnormalities seen among patients who undergo Brain MRI scanning in of the private diagnostic centers in Addis Ababa.

Methods

Soft copies of brain MRI studies were collected from a private diagnostic center & the images were jointly examined by the investigator & the advising senior neuroradiologists at the radiology department of AAU. T2W axial images were mainly studied but additional coronal & sagittal images were also examined whenever needed.

Result

Of the total 115 patients, 66 were males & 49 females. From all, 62.2% showed abnormalities in at least one of their sinuses. Significant paranasal mucosal thickening of more than 3mm was the commonest finding followed by presence of polyps or retention cysts. The most involved sinus groups were the ethmoid & maxillary sinuses.

Background

1.1. Introduction

Paranasal sinuses are air-filled chambers that act as extensions of nasal cavities. They are named after the bones which they are located in: frontal, sphenoid, ethmoid & maxillary. These sinuses lighten skull bones, produce mucous and resonate during sound production. The mucous secretions are released into the nasal cavities and the ciliated epithelium passes the mucos back toward the throat where it is eventually swallowed. (1)

The ethmoid sinuses are present at birth with rapid expansion occurring during ages 0 to 4 years and again with the adolescent growth spurt from age 8 to 12 years. These sinuses are usually the source of infection in childhood sinusitis. On the other hand, pneumatization of the frontal sinuses evolves from ages 4 to 8 years. Due to this, frontal sinusitis is rare before age 4 years. The maxillary antrum is also present though small at birth. Its growth continues to age 14 years, but can be influenced by dental development. The sphenoid sinus begins its pneumatization at about age 2 years, and the growth is slower and more delayed than that of the other sinuses. The ultimate size of the sphenoid sinus is quite variable. (2)

Regarding imaging of the sinuses, plain radiographs which were once widely used to detect sinus abnormalities are nowadays replaced by cross-sectional imaging techniques like CT, MRI & PET/CT. Each of these modalities offers certain advantages and has disadvantages when compared with each other. Contrast – enhance CT is the current radiologic criterion standard for the evaluation of sinus disease. MRI is generally reserved only for complex cases. Soft tissue contrast is better with MRI so, neoplasms, orbital and intracranial complications, and fungal sinusitis can be better evaluated with it. (2,3)

1.2. Statement of the problem

Of primary concern to the radiologist evaluating the paranasal sinuses and nasal fossae is identification of any osseous changes or variations, noting the presence of abnormal soft tissue disease and its possible extension beyond the sinonasal cavities, and the characterization of this disease. (4)

Among the pathologies involving the paranasal sinuses, inflammatory disease is the most common. Mild mucosal thickening, primarily within the maxillary & ethmoid sinuses, is common even in asymptomatic individuals. In contrast, acute sinusitis is characterized by the presence of air-fluid levels or foamy- appearing sinus secretions and is typically caused by a viral upper respiratory tract infection. In chronic sinusitis, changes include mucoperiosteal thickening as well as osseous thickening of the sinus walls. Soft tissue findings suggestive of sinusitis are best detected on T2WIs, as they are often high in signal. (5)

Many studies showed that incidental paranasal sinus abnormalities are common findings on brain MRI images done for other CNS problems. Among the commonly detected abnormalities, mucosal thickening involving the ethmoidal & maxillary sinuses is the highest. Up to 6mm thickness was seen in asymptomatic individuals. Hence, it is recommended that reporting such findings is unnecessary unless there are concomitant clinical symptoms. (7,8,10,11)

1.3. Significance of the study

Since incidental PNS abnormalities are common findings on brain MRI scans done for patients presenting with other CNS problems, this study shows the prevalence of these findings here in our country. In addition, it provides a baseline information for further investigations which will be conducted in this area.

Litrature Review

Previous studies on various population subsets have reported the prevalence of sinus abnormalities to range from 16% to 60%. However, it was suggested that the incidence rate on CT may not be reflective of the true rate of sinus mucosal abnormalities, due to undocumented concurrent use of antibiotics for other reasons. Diagnosis of rhino sinusitis is still primarily done clinically whereas the function of CT & MRI in these cases is supplementary usually as a pre-surgical tool. (6)

According to a study done to investigate the prevalence of incidental sinus abnormalities on CT & MRI imaging of the head & identify if there is any correlation between patient symptomatology & imaging findings, the prevalence of incidental sinus abnormalities was found to be between 14.8% and 37% for CT and 29.5% & 85.2% for MRI, depending on the Lund-Mackay grading system among 115 patients. There was no significant difference between different age groups or genders. (6)

Another Korean study done to evaluate incidentally observed thickened mucosa of paranasal sinuses on brain MRI of patients without evidence of sinusitis showed that among 82 adults aged over 20, the mean mucosal thickness at the most thickened portion of PNS regardless of their location was 3.2mm with SD of 1.5mm. The mucosal thickening was observed more commonly in maxillary (79 patients) & ethmoid (80 patients) sinuses. It was concluded that mucosal thickening of up to 6.5mm was a common finding on brain MRI of patients without evidence of sinusitis with accuracy of 95% . (7)

A similar cross sectional survey of PNS MRI findings of 24 schoolchildren aged 8-9 years who are otherwise healthy in University of Oulu, Finland showed that an abnormality was seen in half of the children & most were seen in the maxillary or ethmoid sinuses. From this result, it was concluded that abnormal sinus MRI findings are common incidental findings & should be reported as normal which do not need to be treated in children who are imaged for purposes other than sinus disease. (8)

According to a study conducted in pediatric radiology department, among 147 children aged between 0.2 to 22.7 yrs, 61% of them had one or more salient findings in their paranasal sinuses or mastoid cells while 48% had mucosal swelling in their paranasal cavities. The prevalence was higher among children below 10 years of age. No correlation was seen to history of headache, snoring, asthma and allergies or to gender or place of residence.(9)

Another retrospective study which was carried out to determine the prevalence of abnormality in the paranasal sinuses in British population having MRI scans for neurological signs & symptoms revealed that among 130 patients studied, 49.2% showed one or more abnormality. The paranasal abnormalities show as high signal on T2-weighted scans & include mucosal thickening, fluid levels, sinus opacification and retention cysts/polyps. Of these, mucosal thickening was the most common abnormality noted and the ethmoid sinuses were the most commonly affected. (10)

Similarly, a retrospective study conducted to determine the prevalence of abnormalities in the PNS of 280 Jordanian patients who had undergone MRI scans for neurologic signs & symptoms showed that 64.3% of these patients showed one or more abnormality. Mucosal thickening was the most common abnormality observed and the ethmoid sinuses were the most affected. In cases where there were more than one sinus group involvement, the commonest combination was that of the ethmoids & the maxillary groups. It also concluded that there was no significant difference between the two sexes in the pattern of incidence of abnormalities.(11)

Objective of the study

3.1. General objectives

To measure the prevalence of incidental abnormalities on MRI done for patients with other CNS problems in private diagnostic centers in Addis Ababa.

3.2. Specific objectives

- Determine the prevalence of incidental abnormalities in the paranasal sinuses of the study population
- Determine the variation with different age & sex

Materials & Methods

4.1. Study design

?Retrospective study

4.2. Study area

The study was conducted in Tikur Anbessa Specialized Hospital located in Addis Ababa .It is the largest referral hospital in the country , with over 700 beds .it is a teaching hospital ,as part of Addis Ababa university medical faculty, for both clinical and preclinical trainings of most disciplines and where specialized clinical services that are not available in other institutions are provided. The department of radiology is one of the oldest departments which has been the heart of the diagnostic service of the hospital & since recently it is also engaged in certain therapeutic interventional services. Eventhough the study was conducted at TAH, the MRI images were all brought from Afei diagnostic center which is found in Addis Ababa. It is one of the few diagnostic centers in addis where MRI scanner is available.

4.3. Study period

From April 2014 to september 2014

4.4. Study population

All patients who underwent brain MRI scanning for non PNS abnormalities in Afe diagnostic center during the specified period .

4.5. Inclusion & Exclusion Criteria

4.5.1. Inclusion Criteria

All patients who underwent brain MRI scanning during the specified period

4.5.2. Exclusion Criteria

Patients who have clinical diagnosis of acute or chronic sinusitis

Patients with severe head & facial trauma

4.6. Sample size & Sampling technique

All patients who fulfilled the inclusion criteria with brain MRI scans were included.

4.7. Variables

4.7.1. Independent variables

Age & Sex

4.7.2. Dependent variable

Paranasal sinus abnormality

4.8. Data Collection

MRI soft copy images of patients who had Brain MRI were randomly collected by the radiologists working in Afe diagnostic center & then jointly analyzed for presence of PNS abnormalities by the investigator & the

advising senior consultant radiologist. The images were performed using a 0.3 tesla scanner. The axial T2W images were mainly examined but when these were inadequate, coronal & sagittal sections were also analyzed. The abnormalities studied were mucosal thickening which in this particular study was taken to be above 3mm on T2W images after analyzing the previously done studies. The other abnormalities detected were fluid levels, complete sinus opacification & presence of polyp or retention cyst. These last two were grouped together as it is difficult to differentiate between them on MRI images.

4.9. Data Entry & Analysis

The anatomical location & type of PNS abnormalities identified were coded. Then the quantitative data was entered & analyzed using the latest version of Statistical Package Software (SPSS). By doing so, the frequency of each type of abnormality was calculated. It was also analyzed if there was any correlation between the variables.

5. Ethical Considerations

Ethical clearance was obtained from Addis Ababa University , Department of Radiology and submitted to the selected private diagnostic center. Confidentiality of the participants was secured.

6. Limitations of the study

The limitation of this study is that the sample size is not representative of the general population as it was derived from a private diagnostic center. Hence, the actual prevalence of abnormalities in the general population can't be extrapolated.

Result

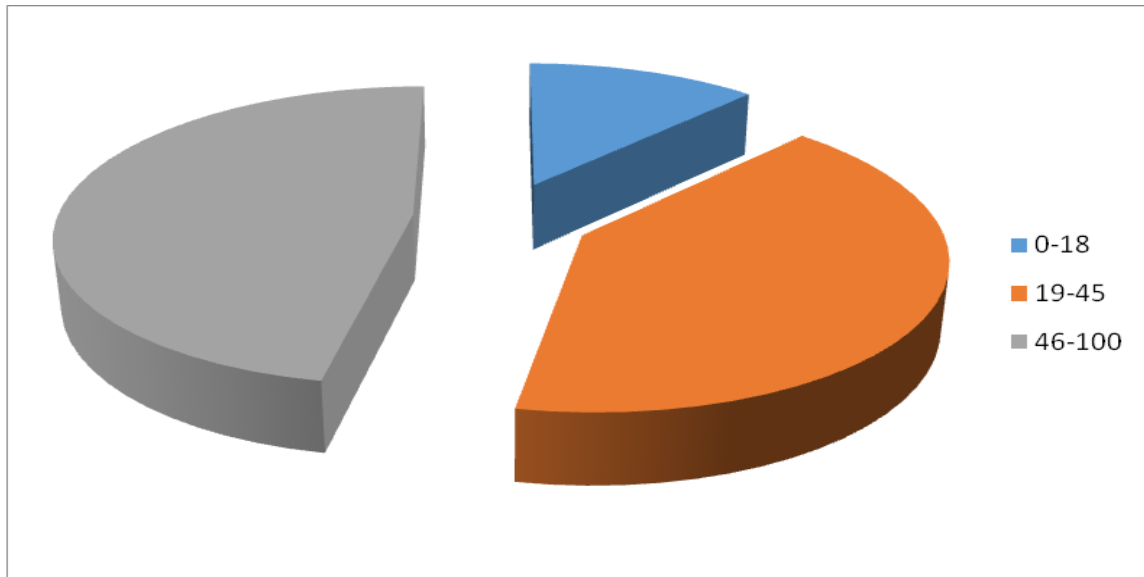
Of the total 115 patients, 66 were males & 49 were females. The ages ranged from 2years to 93years with a mean age of 44 years. From all, 72 patients showed abnormality in one or more of their paranasal sinuses. Of these, 42(58.3%) patients had abnormalities in one sinus while 16(22.2%) had involvement of two sinus groups. Only 2(2.8%) had findings in all four sinus groups while 12(16.7%) had three sinus involvement.

Table 1. sociodemographic distribution

Sex			Age	
Male	66	57.4%	Min	2years
Female	49	42.6%	Max	93years
Total	115	100%	Mean	44 years

The most commonly involved sinuses were the maxillary & ethmoidal groups as seen in 57(49.6%) & 39(33.9%) of the total patients respectively.

Fig. 1. Percentage of different age groups of the study population



Among the incidental abnormalities detected, significant mucosal thickening of more than 3mm was seen in ethmoid sinuses of 24(20.9%) patients while 17(14.8%) patients had at least one maxillary sinus involvement. The sphenoidal & frontal sinuses had this same finding in 7(6.1%) & 2(1.7%) of the total respectively.

The other commonly detected incidental abnormality was presence of a retention cyst or polyp which were grouped together. In the maxillary sinuses alone these were found in 22(19.1%) of patients while the sphenoid sinuses were least involved as only 1 patient has this finding.

Highest incidence of fluid level was seen in the maxillary sinuses as detected in 9(7.8%) patients while opacification of at least one sinus was seen equally in the ethmoid & frontal sinuses with positive findings in 3 patients for each.

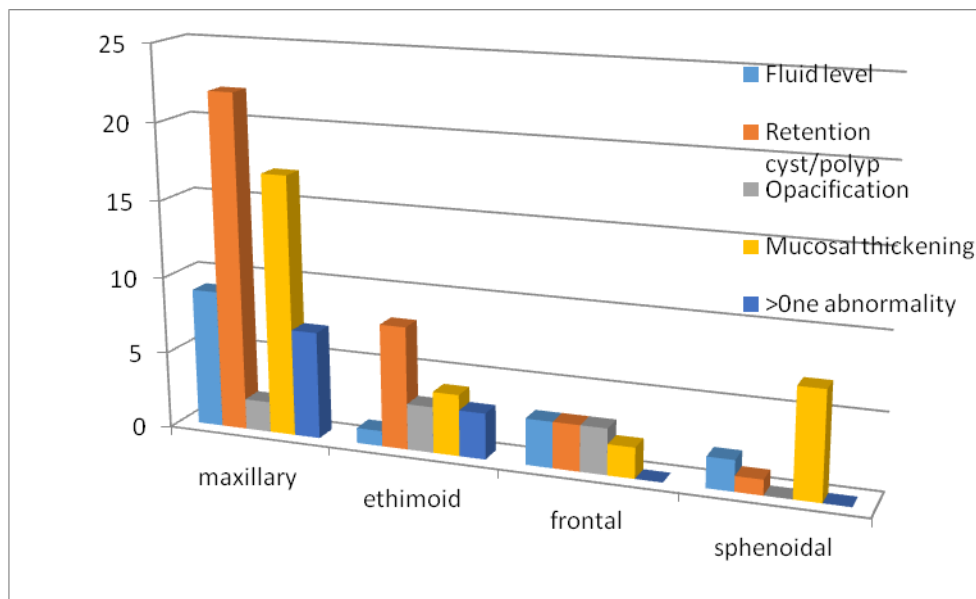
More than one type of abnormality were seen more in the maxillary, 7(6.1%) & ethmoidal 3 (2.6%) sinuses, the commonest combination being significant mucosal thickening & presence of retention cyst or polyp.

Table 2. summary of Abnormalities seen in the PNS on MRI

sinus	Mucosal thickening	Retention cyst/polyp	opacification	Fluid level	More than one abnormality
Maxillary	17	22	2	9	7
Ethmoid	24	8	3	1	3
Sphenoid	7	1	0	2	1
Frontal	2	3	3	3	0
total	50	34	7	15	11

NB. The total indicates the total number of abnormalities, not the number of patients.

Fig. 2. Frequency of incidental abnormalities in each sinus as seen on MRI



On bivariate regression analysis model , it was found that neither age or sex of the patients showed significant association with presence of incidental PNS abnormalities.

Discussion

Among the cross sectional imaging modalities MRI has superior tissue contrast. This together with its ability to take multiplanar images using different sequences makes it the preferred technique to demonstrate soft tissue abnormalities. On the other hand, CT is superior in precisely assessing bone abnormalities & detect calcifications. Therefore, in the paranasal sinuses which are structures composed of both bony & soft tissue components, these two imaging modalities can complement each other when used appropriately in evaluating patients suspected of having pathologies. Inflammatory changes in the PNS which are commonly seen even in asymptomatic individuals as easily detected on T2W MR images.

This study showed inflammatory changes in the PNS of patients scanned for other neurologic problems. Of these patients 62.6% showed abnormality in one or more sinus groups. The most common finding was mucosal thickening & the most affected sinus group was the ethmoid sinuses. Most of fluid levels & retention cysts/ polyps were found in the maxillary sinuses followed by the ethmoid sinuses. The prevalence correlates well with that of previous studies as seen in 29.5%-85.2% (6), 49.2% (10) & 64.3%(11)

This study also showed that 30(26.1%) patients had abnormalities in more than one sinus group, the ethmoid & the maxillary sinuses being the commonest combination. This value is lower than that of the study done on 280 Jordanian patients which showed prevalence of more than one sinus involvement to be 49.9%.(11) on the other hand, the combination of sinus groups is similar, i.e. the ethmoids & maxillary sinuses. This discrepancy could be due to the relatively small sample size of this study as well as lack of variation in the age of the patients included.

From the total patients included in this study, only 14(12.2%) patients were below the age of 19 years. Half of these had abnormalities at least in one of their sinuses, the commonest sinus involved being the maxillary followed by the ethmoid air cells. Again, from the incidental abnormalities, mucosal thickening & retention cysts/polyps were the highest in number. These values are comparable with that of the results found in previous studies i.e. 50%(8) & 61% (9)

There was no statistically significant correlation found between pattern of PNS abnormalities & age or sex of the study population. Except the study conducted in the pediatric radiology department among 147 children aged 0.2-22.7yrs which showed increased prevalence of abnormalities in children below 10 years(9), most of the other studies showed no significant correlation between the incidence of abnormalities & sex or age of patients.(6,11)

Conclusion

This study showed that PNS abnormalities are common findings in MRI scans done for other neurologic problems.

Of the four sinus groups the ethmoid sinuses were the commonest involved followed by the maxillary sinuses whereas the frontal sinuses were the least involved.

From the incidental PNS abnormalities detected, mucosal thickening was the highest followed by presence of retention cysts/polyps. The least frequent abnormality seen was opacification of a sinus.

Since the clinical history of these patients was not available it is difficult to conclude that all these abnormalities were truly incidental.

Recommendation

Since these paranasal sinus abnormalities detected could actually be the reasons for the indications of the Brain MRI scans in patients who otherwise do not have pertinent neurological findings on MRI, further comparative study between those having normal & abnormal brain MRI neurological findings is recommended.

Reference

1. Frederic H. Martini, Michael J. Timmons, Robert B. Tallitsch; Human anatomy , 7th edition.
2. David J. Yousem, Robert J. Grossman; The Requisites Neuroradiology, 3rd edition, Mosby Elsevier. 2010.
3. chronic sinusitis ,published online [emedicine.medscape.com /article/232791-workup](http://emedicine.medscape.com/article/232791-workup) no.1
4. Girish M. Fatterpekar, Bradley N. Delman, Peter M. Som, Imaging the Paranasal Sinuses: Where We Are and Where We Are Going, the anatomical record 2008,291(11):1564-1572.
5. William E. Brant, Clyde A. Halms, Fundamentals of diagnostic radiology 3rd edition, 2007 Lippincott Williams & Wilkins
6. Mohammed N, Shaik Ismail B, Tengku FT, Kwan-Hoong Ng, Zhongua S, Incidental detection of sinus mucosal abnormalities on CT and MRI of the head; Quant imaging med surg. 2013,3(2): 82-88.
7. Normal value of mucosal thickness of paranasal sinuses ,as seen on brain MRI, journal of the Korean radiological society.1997, vol 36,(2): 195-198.
8. Kristo A, cross sectional survey of paranasal sinus magnetic resonance imaging findings in school children ; acta paediatrica. 2003; 92(1): 34-6.
9. Von Kalle T., incidental findings in paranasal sinuses and mastoid cells: a cross sectional magnetic resonance imaging (MRI) study in pediatric radiology department: Rofo.2012;184(7):629-34.
10. Patel K, incidental paranasal sinus inflammatory changes in British population: J Laryngol Otol: 110(7): 649-51.
11. M. Hiari & M.A. Hiari, incidental paranasal sinus inflammatory changes in a Jordanian population: Eastern Mediterranean Health Journal, Vol. 4, No.2, 1998

Format for paranasal mucosal sinus incidental Abnormalities detection

No.	Age	Sex	Maxillary sinuses	Frontal sinuses	Ethmoidal sinuses	Sphenoid sinuses

