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Incidental Nasal and Paranasal Findings on MRI and CT Scans-A Prospective Study

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Abstract

Objective: Morphological changes in sinuses are commonly observed through routine Magnetic Resonance Imaging (MRI) and Computed Tomography (CT) scans. The present study aims to assess the prevalence of nasal and sinus pathology in the Jordanian patients undergoing head MRI or CT scans for a non-ENT cause.

Materials and Methods: Prospective study was conducted at Alkarak hospital, Jordan. CT/MRI scan images of patients were reviewed over a period of 6-months. Data about ENT symptoms, history of allergic rhinitis, and abnormalities was also collected.

Results: Of the 600 patients (445 MRI, 145 CT Scans), sinus pathology was observed in 170 patients (28.33%). The most common sinus abnormality was mucosal thickening (n=135, 79.41%), followed by complete opacification and cysts. A significant correlation was observed between sex, sinonasal symptoms, facial pain, and asthma in both sinus pathology and nasal pathology. Nasal obstruction (p=0.000) and allergic rhinitis (p=0.000) were significantly correlated with nasal pathology.

Conclusion: A significant correlation between incidental sinonasal pathology and both facial pain and allergic rhinitis was observed. However, the incidental findings are overestimated due to lack of correlation to symptoms and underlying conditions.

Keywords: Allergic; Asthma; Facial pain; Magnetic resonance imaging; Rhinitis

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Introduction

Radiological imaging plays an important role in diagnosis, treatment choice, follow-up, and surgical planning of different paranasal sinus abnormalities [1]. Though plain X-ray is often used to investigate paranasal sinus, Computed tomography (CT) and Magnetic Resonance Imaging (MRI) are more sensitive to diagnose different paranasal sinus abnormalities [2]. Incidental mucosal paranasal sinus abnormalities usually reported during brain MRI performed to assess non-sinus associated abnormalities. CT detects bony abnormalities while MRI characterizes and delineates soft tissue modifications. MRI is superior in assessing intra-orbital and intra-cranial difficulties of paranasal sinus diseases [3]. Rhinosinusitis is often reported as nasal and paranasal sinus mucosal inflammation. Main causes of nasal and paranasal sinus mucosal inflammation are allergies, viral and bacterial infections [3]. There are chances of having symptom-free subclinical mucosal inflammation when exposure to allergens is too low to provoke symptoms. Initially, allergic rhinosinusitis might be reflected as asymptomatic incidental mucosal abnormalities prior to advancement to symptomatic stage [4].

Sinus imaging supports clinical findings and confirms diagnosis when conventional treatment fails. Symptomatic condition of the brain can be evaluated by the highly sensitive MRI, [5] which shows inherent contrast differences between various tissue structures.Paranasal sinuses imaging are performed in case of suspected mass lesion and inflammatory rhinosinusitis [6]. MRI of sinuses is usually performed in the patients with infection along with orbital and cerebral complications and mass lesions [5]. Whereas, CT is extensively used to diagnose and to follow-up patients suffering from sinus pathology [7]. However, increased cost along with the radiation dose limit its applicability.

There is an increase in the frequency of diagnostic imaging of the head and neck that may include the paranasal sinuses. The incidental opacifications like polyps, mucosal thickening, and retention cysts are commonly found near the paranasal sinuses [8]. However, these findings remain uncertain for ear, nose, and throat (ENT) surgeons, and radiologists [9]. This may lead to unnecessary concerns that are likely to cause increased hospitalization costs for the patients and healthcare system [10].

The use of MRI brain scanning to evaluate the sinus disease is limited; although, attempts have been made to evaluate the correlation between symptoms and imaging findings. Therefore, this study aims

to investigate the prevalence of nasal and sinus abnormalities in Jordanian patients. This study also examines an association between the patient symptoms and imaging findings with the objective to bridge the limitations of previous studies, specifically in the context of Jordan. To the best of author's knowledge, this is the first study evaluating incidental findings in the nasal sinuses in patients.

Materials and Methods

A prospective, cross-sectional design was adopted to assess the prevalence of nasal and paranasal sinus abnormalities in the Jordanian patients at Al-Karak hospital, Jordan. Participants were randomly selected from the elective and emergency CT and MRI list referred for head MRI or CT scan for non-ENT reasons from May 2018 to October 2018. A total of 600 patients were given an opportunity to have their sinuses evaluated clinically and have images evaluated clinically. Patients were excluded in cases of trauma involving the paranasal sinues.

The MRI scans were performed in 0.3 Tesla AIRIS VENTO HITACHI machine as per the standard protocol of the hospital. All radiological studies were evaluated twice by expert radiologists and by an ENT consultant. The radiologists assessed all MRIs for any clinically significant abnormality of the brain and the rest of the head, within two weeks of MRIs were acquired. Sinus pathology was not the prime focus of this assessment. Three months later, MRI measurements and readings of the sinuses were taken independently. The information was blinded for all patient data with respect to ENT and paranasal sinus radiology.

The questionnaire was administered at the time of the radiological imaging to collect medical history of asthma and allergic rhinitis. Demographic information such as age, sex, history of chronic medical illness, and history of allergy was recorded. Patients were asked about ENT symptoms that may result from nasal or sinus pathology as facial pain, nasal obstruction, rhinorrhea, excessive sneezing, and nose itching.

The incidental findings were categorized into sinus pathology and nasal pathology. Sinus pathology includes mucosal thickening, complete opacification, air-fluid level, cyst, and polyp. Nasal pathology includes septal deviation, hypertrophy of inferior turbinate's, and concha bullosa. Opacifications were distributed and defined as follows:

- Fluid recognized by a distinct air-fluid level on T2WI and measured from the sinus border to the air-fluid level.
- Polyps and retention cysts, recognized as homogeneous, dome-shaped, and circumscribed areas with high signals on T2WI.
- Mucosal thickening recognized by a low signal on T1WI and high signal on T2WI following the peripheral sinus border.

The opacifications were visually determined at their maximum thickness (mm) using both the T1WI and the T2WI. Then opacifications were categorized based on the thickness. All opacifications were measured independently when mucosal thickening, fluid, and polyps and retention cysts were found the same sinus. The axial images were complicated to be assessed through the walls of paranasal sinus as they were examined in the sagittal and coronal T1WI.

The data were analyzed using standard Statistical Package of Social Sciences (SPSS) version 20.0. A Chi-squared test was used for proportions of patients with opacification for each sinus such as mucosal thickening, fluid, and polyps/retention. Additionally, prevalence of participants in several sinuses with opacifications was calculated and considered statistically significant at $p \leq 0.05$.

Results

Out of 600 patients, 445 patients (74.2%) underwent CT scan and 155 patients (25.8%) underwent MRI scan. The mean age of patients were 39.5 years (range 4-80). Of the 600 patients, 310 patients (51.7%) were males and 290 patients (48.3%) were females. Sinus pathology was observed in 170 patients (28.33%) and nasal pathology was observed in 135 patients (22.5%) (Table 1).

Table 1: Demographic details of the patients.

		Sinus pathology			Nasal pathology		
		Yes	No	P-value	Yes	No	P value
Age Mean + SD	39.49 ± 19.45	39.29 ± 18.39	39.57 ± 19.87	0.964	39.04 ± 16.77	39.62 ± 20.17	0.761
Sex							
Male N (%)	310 (51.67%)	100 (58.82%)	210 (48.84%)	0.027	80 (59.26%)	230 (49.46%)	0.045
Female N (%)	290 (48.33%)	70 (41.18%)	220 (51.16%)		55 (40.74%)	235 (50.54%)	
Sinonasal symptoms							
Yes N (%)	199 (33.17%)	79 (46.47%)	120 (27.91%)	0	130 (96.30%)	69 (14.84%)	0
No N (%)	401 (66.83%)	91 (53.53%)	310 (72.09%)		5 (3.70%)	396 (85.16%)	
Facial pain							
Yes N (%)	160 (26.67%)	60 (35.29%)	100 (23.26%)	0.003	110 (81.48%)	50 (10.75%)	0
No N (%)	440 (73.33%)	110 (64.71%)	330 (76.74%)		25 (18.52%)	415 (89.25%)	
Nasal Obstruction							
Yes N (%)	95 (15.83%)	30 (17.65%)	65 (15.12%)	0.413	80 (59.26%)	15 (3.23%)	0
No N (%)	505 (84.17%)	140 (82.35%)	365 (84.88%)		55 (40.74%)	450 (96.77%)	
Allergic Rhinitis							
Yes N (%)	120 (20%)	40 (23.53%)	80 (18.60%)	0.174	85 (62.96%)	35 (7.53%)	0
No N (%)	480 (80%)	130 (74.47%)	350 (81.40%)		50 (37.04%)	430 (92.47%)	
HTN							
Yes N (%)	70 (11.67%)	20 (11.76%)	50 (11.63%)	0.962	20 (14.81%)	50 (10.75%)	0.196
No N (%)	530 (88.33%)	150 (88.24%)	380 (88.37%)		115 (85.19%)	415 (89.25%)	
DM							
Yes N (%)	50 (11.67%)	25 (14.71%)	25 (5.81%)	0	10 (7.41%)	40 (8.60%)	0.658
No N (%)	450 (88.33%)	145 (85.29%)	405 (94.19%)		125 (92.59%)	425 (91.40%)	
Asthma							
Yes N (%)	15 (2.50%)	10 (5.88%)	5 (1.16%)	0.001	15 (11.11%)	0 (0%)	0
No N (%)	485 (97.50%)	160 (94.12%)	425 (98.84%)		120 (88.89%)	465 (100%)	

A significant correlation was observed between sex, sinonasal symptoms, facial pain, and asthma in both sinus pathology and nasal pathology. Nasal obstruction (p=0.000) and allergic rhinitis (p=0.000) were significantly correlated with nasal pathology. Correlation was observed between age, and hypertension and both sinus pathology and nasal pathology, but not significant (Table 1).

About 71.7% patients had no sinus pathology (Table 2). Most patients were affected by maxillary sinus (20.0%) (Figure 1), followed by multiple sinuses (5.8%), ethmoid sinus (1.8%) (Figure 2), and frontal sinus (0.8%).

Mucosal thickening (Figure 3) was the most common reported abnormality among sinus patients (22.50%), followed by complete opacification (2.50%) (Figure 4), cyst (2.50%) (Figure 5), and calcification (0.83%). Among nasal patients, deviated septum and hypertrophy of inferior turbinate were equally reported (14.17%), followed by Concha bullosa (2.50%) (Table 3).

Table 2: Different type of sinuses suffered by the patients.

Sinus	Frequency	Percent
No	430	71.7
Maxillary	120	20
Ethmoid	10	1.7
Frontal	5	0.8
Multiple	35	5.8

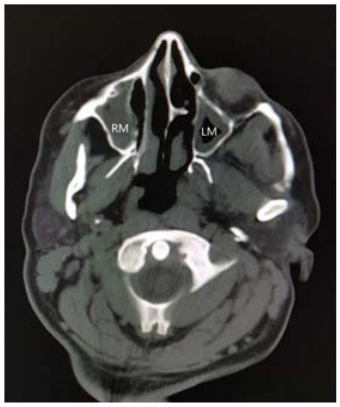

Figure 1: CT scan axial section showing complete opacification of the right maxillary sinus (RM) and mucosal thickening in the left maxillary sinus (LM) (22-year old female).

Figure 2: Axial CT scan showing mucosal thickening in both right (RE) and left (LE) ethmoidal sinuses (49-year old male).

Figure 3: Axial T1WI showing mucosal thickening in both maxillary sinuses (M) and hypertrophy of right turbinate (T) (75- year old male patient).

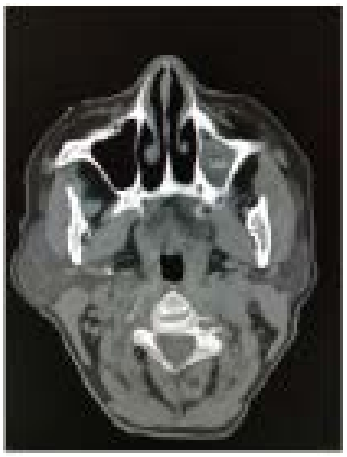

Figure 4: The axial CT scan showing complete opacification of the left maxillary sinus (LM) (55-year old male patient).

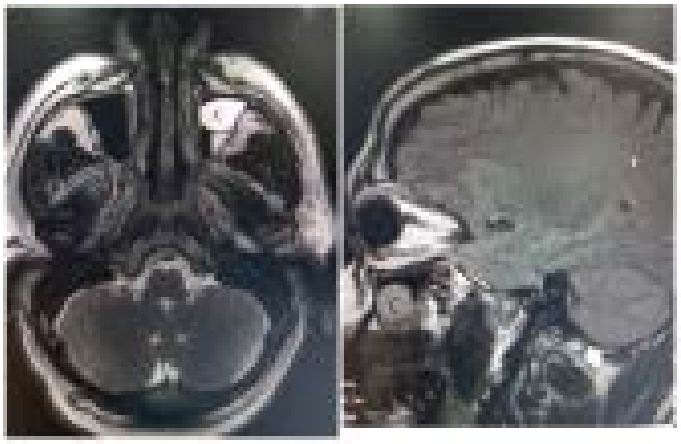

Figure 5: 39- year old male patient with vision problem, MRI brain, (a) axial T2WI (b) sagittal T2WI. Both showing a retention cyst (C) in the left maxillary sinus.

Discussion

The present study showed a significant association between the imaging findings and patient's symptoms. The symptomatic patients were at a higher risk of exhibiting the incidence of sinus abnormalities, compared to asymptomatic patients. Increased prevalence of sinus findings without any clinical symptoms was confirmed using CT

Table 3: Abnormalities related to nasal sinus.

Pathology	Frequency	Percentage
Sinus		
Mucosal thickening	135	22.50%
Complete opacification	15	2.50%
Cyst	15	2.50%
Calcification	5	0.83%
Nasal		
Deviated septum	85	14.17%
Hypertrophy of inferior turbinate	85	14.17%
Concha bullosa	15	2.50%

and MRI imaging. Nasal pathology was mostly observed among men and women, as compared to sinus pathology. Maxillary sinus was the commonest sinus type reported among patients; while, mucosal thickening was reported as commonest abnormality among sinus patients.

Pazera P, et al. (2011) a significant correlation between incidental findings and patients' symptoms were reported which is consistent with results obtained [11]. Although Pazera P, et al. (2011) observed correlation between MRI findings and symptoms but did not find a correlation between CT scan and symptoms [11]. Where as, Sun found an increased frequency of incidental findings in CT scan [12].

The present study shows an increasing prevalence of mucosal thickening in the patients with nasal symptoms, like Hansen AG, et al. (2014) The study depicted prevalence of polyps, mucosal thickening, and fluid in different sinuses (fluid-filled cysts) [10]. The increasing prevalence of mucosal thickness is also supported by Maharjan S (2016) as the most common incidental finding among sinus patients along with maxillary sinus. Frontal sphenoid and ethmoid sinuses were least reported incidental findings [4].

Additionally, Shpilberg KA, et al. (2015) found no statistical relationship between MRI paranasal findings and clinical symptoms of paranasal sinuses [13]. Therefore, sinus pathology was basically an incidental finding. The maxillary sinus is predisposed to stagnation of infections and secretions as a result of poor anatomical position drainage of fluid. Moreover, Maduforo Co, et al. (2013) observed maxillary sinus among 66.7%, followed with sphenoidal (1.7%), frontal (12.5%), and ethmoidal (34.25) sinuses [14]. The present study shown that paranasal sinuses are incidental findings to show mucosal abnormalities during the radiological evaluation of the brain. A similar retrospective study evaluated mucosal abnormalities of paranasal sinuses and findings were categorized based on imaging features and anatomic location [14]. The study showed that incidental mucosal abnormalities of paranasal sinus are common findings on MRI. Hansen AG, et al. (2014) as well determined the prevalence and size of incidental opacification using MRI without any medical indication [10].

Hanzaei FF, et al. (2016) assessed the frequency of incidental rhinosinusitis among the patients referred for MRI [15]. The results showed an increased prevalence of incidental findings of sinusitis in MRI, like our results. Another study also showed that the most involved sinus was maxilla followed by ethmoid sinus, mucosal thickness, and opacity [16]. A similar study aimed to evaluate the mucosal thickening in paranasal sinuses among the children undergoing MRI of the brain for some reason other than sinusitis showed that paranasal sinusitis and mucosal swelling were the most common incidental findings, which does not always indicate a sign of infection [17].

The study has some limitations that can be concluded as follows. The study results were limited since the paranasal sinuses were not the main objective as MRI parameters might not be imperative for this objective. All sinuses were visualized and examined on 3D Volume T1WI with axial, coronal, and sagittal reconstruction. The participants were excluded, if opacifications were observed only on T1WI, and not covered by the T2WI. The prevalence of opacification can be underestimated. Furthermore, entire population is not represented by the participants' age (range 4-80 years); therefore, results extrapolation to other age groups must be attempted carefully. However, the results obtained from this study are limited by the fact that this was not a controlled study and was subjected to MRI availability.

Conclusion

The findings of the present study showed that mucosal thickening was the most common sinus pathology followed by complete opacification and cyst in patients who presented for head MRI or CT scan for a non-ENT cause. A significant correlation was also observed between sex, sinonasal symptoms, facial pain, and asthma in both sinus pathology and nasal pathology. The maxillary sinus, frontal and sphenoid, and ethmoid sinuses are commonly reported incidental sinuses. This high prevalence of incidental sinus abnormality indicates the presence of unrecognized subtle environment allergens in the Jordanian context. This might reflect the initial findings of allergic rhinosinusitis prior to its advancement to the complete symptomatic stage. Our findings significantly contribute to the knowledge on incidental sinus and nasal findings in patients. It will help the radiologists determine the relevance of abnormal findings and consider the possibility of development of unexpected abnormalities.

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