Basic and Clinical Sciences
ISSN 1309-5102
DOI: dx.doi.org/10.12808/bcs.v4i3.5000149953
dergipark.ulakbim.gov.tr/bcs Basic Clin Sci 2015; 4: 116-131

Original Article / Orijinal Araştırma

Incidental diagnosis of abnormalities of nasal structures, paranasal sinuses, and mastoid cells on MRI of the head in adult patients with chronic headache

Kronik başağrısı olan erişkin hastalarda nasal yapılar, paranasal sinüsler, ve mastoid hücrelerdeki patolojilerin MRG ile insidental tanısı

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Abstract

Aim. The purpose of this study to evaluate retrospectively the incidental abnormalities of nasal structures, paranasal sinuses, and mastoid cells on MRI of the head in adult patients with chronic headache. **Methods.** We collected the presence of abnormalities of nasal structures, paranasal sinuses, and mastoid cells, diagnosed incidentally, from the existing MRI reports by qualified radiologists in a population of 3200 adult patients examined for the differential diagnosis of chronic headache. **Results.** There were no significant differences among the study groups with regard to the rates of types of chronic sinusitis, mastoiditis, nasal structural abnormalities, and multiple sinusitis ($p>0.05$). The rates of nasal septum deviation were significantly higher in patients with chronic maxillary and ethmoid sinusitis ($p<0.05$). The rate of retention cyst was significantly higher in patients with chronic maxillary sinusitis ($p<0.05$).

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Conclusions. MRI scans reveal chronic inflammatory changes as chronic paranasal sinusitis and mastoiditis as well as nasal congenital and acquired abnormalities that may be related to sinusitis and mastoiditis in the adult patients. MRI may provide valuable information for otorhinolaryngological and neurological workup of chronic headache in the adult patients, otherwise it is not possible to detect clinically.

Keywords: Nasal structures, paranasal sinuses, mastoid cells, magnetic resonance imaging, chronic headache

Özet

Amaç. Bu çalışmanın amacı, kranial MRG yapılmış kronik baş ağrısı olan erişkin hastalarda, nazal yapıların, paranazal sinüslerin ve mastoid hücrelerinin tesadüfen saptanan anormaliklerinin geriye dönük olarak değerlendirilmesidir. **Yöntem.** Kronik baş ağrısının ayırıcı tanısı için yapılmış olan, nazal yapılarda, paranazal sinüslerde ve mastoid hücrelerinde rastlantısal olarak anormal yapılar saptanan 3200 yetişkin hastanın radyoloji uzmanı tarafından yazılmış MRG raporları toplandı. **Bulgular.** Mastoidit, nazal yapısal anormallikler, diğer sinüzitlerin birlikteliği ve kronik sinüzit tipinin oranına göre çalışma gruplarının arasında önemli fark yoktu ($p>0.05$). Nazal septum deviasyonunun oranı, kronik maksiller ve etmoid sinüzitli hastalarda anlamlı olarak yüksek saptandı ($p<0.05$). Kronik maksiller sinüzitli hastalarda retansiyon kist oranı anlamlı olarak yüksek saptandı ($p<0.05$). **Sonuç.** MRG yapılması, kronik paranazal sinüzit ve mastoidit'e ek olarak yetişkin hastalarda sinüzit ve mastoidit ile ilişkili olabilecek doğumsal ve sonradan kazanılan kronik inflamatuvar değişiklikleri gösterir. MRG ile, klinik olarak saptanması zor, kronik baş ağrısı olan yetişkinlerde kulak boğaz burun ve beyin yapıları için önemli bilgiler sağlayabilir.

Anahtar sözcükler: Nazal yapılar, paranazal sinüsler, mastoid hücreler, manyetik rezonans görüntüleme, kronik baş ağrısı

Introduction

The decision to use magnetic resonance imaging (MRI) as a screening or diagnostic tool for headache is a common dilemma facing clinicians. There are several factors determining the use of MRI in the differential diagnosis

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of headache: in some patients with intracranial pathology, there is only a mild headache; and in some patients with brain tumor and the delay of diagnosis with refraining from the use of MRI may be a subject of litigation; on the other end, in migraine patients, there may be some sinus fullness leading the use of MRI with normal findings (1). Since headache has a broad spectrum of abnormalities that may be from functional to organic and neurologic and related to other systems, there is a need to keep the rate of MRI us at a reasonable level in the headache patients with a perspective of cost-effectiveness that changes from country to country. In fact, in most of the headache patients, MRI is not required. From the literature, 27% of all computed tomography (CT) and 13% of all MRI scans for the head were assumed to include an indication of headache (2).

In accordance with the increased preference of MRI of the head, there is parallel increase in the number of incidental diagnosis of abnormalities of nasal structures, paranasal sinuses, and mastoid cells. The identification of these abnormalities and gaining information about their nature may cause considerable anxiety in patients (3). In population studies, the rate of these abnormalities ranges from 0.6% to 2.8% (4-7). In specific clinical settings, these rates can be higher; for example, a recent study of patients with headache who were referred by general practitioners for CT gave a 10% rate of incidental findings in in imaging studies (8).

During MRI of the head, a wide range of abnormalities of nasal structures (i.e., retention cyst, nasal septum deviation, choncal hypertrophy, and concha bullosa), paranasal sinuses (sinusitis of maxillary, frontal, and ethmoid), and mastoid cells (mastoiditis) is detected and they have a wide range of clinical implications in the neurological and otorhinolaryngological practice.

As stated in the guideline (2000) related to migraine headache by the American Academy of Neurology, American Academy of Family Physicians, American College of Physicians-American Society of Internal Medicine, and four other groups as a consortium, information related to neuroimaging data are insufficient to make clear the relative sensitivity of MRI compared to CT in patients undergoing an imaging study (9). According to our knowledge, there is no study assessed the incidental findings related to the nasal structures, paranasal sinuses, and mastoid

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cells on MRI of the head in adult patients with chronic headache. The purpose of this study to evaluate retrospectively the incidental abnormalities of nasal structures, paranasal sinuses, and mastoid cells in adult patients with chronic headache from the existing MRI reports of the head assessed by qualified radiologists.

Material and methods

In this study, 3200 MRI scans of the head performed at our Radiology Service from February 2006 to February 2012 were reviewed retrospectively from existing reports to identify abnormalities of nasal structures, paranasal sinuses, and mastoid cells. These MRI scans were requested by neurologists for the differential diagnosis of chronic headache in the adult patients. We included reports of MRI scans that were evaluated by qualified radiologists. Of 3200 MRI scans, 324 revealed no abnormality and 2293 resulted in a diagnosis of intracranial abnormalities. In the remaining 583 MRI scans, we found the abnormalities of nasal structures (i.e., retention cyst, nasal septum deviation, conchal hypertrophy, and concha bullosa), paranasal sinuses (chronic sinusitis of maxillary, frontal, and ethmoid sinuses), and mastoid cells (chronic mastoiditis).

We recorded the presence of chronic sinusitis of frontal, maxillary, and ethmoid sinuses, chronic mastoiditis, and retention cyst of maxillary sinus, nasal septum deviation, conchal hypertrophy, and concha bullosa. Cases (n=583) were divided into three groups according to the age: 18-29 (n=180), 30-49 (n=283), and 50+ (n=120) year-old groups. According to our experience, there may be differences among these study groups with regard to the etiology of chronic headache.

MRI examination

MRI examinations were performed using a 1.5 T MRI machine (Excelart, Toshiba, Tokyo, Japan) using standard head coils. The MRI examination included axial and sagittal spin-echo (SE) T1-weighted [repetition time (TR) 550 ms, echo time (TE) 15 ms, flip angle 90°], axial and coronal T1-weighted (TR 550 ms, TE 15 ms, flip angle 90°), axial fast SE (FSE) T2-weighted (TR 5000 ms, TE 94 ms, flip angle 90°), and axial fluid-attenuated inversion recovery (FLAIR; TR 7500 ms, TE 94 ms, TI 2200,

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flip angle 90°) images. Mucosal swelling in paranasal sinuses is defined as sinusitis on T2-weighted MRI. Increased fluid signal in the mastoid cells is defined as mastoiditis on T2-weighted MRI. The presence of more than one type of sinusitis was defined as multiple sinusitis including frontal, ethmoid, and maxillary sinusitis and mastoiditis. No contrast material was used in MRI examinations.

Statistical analysis

Data were expressed as percentage or mean ± SD as appropriate. The data were analyzed with chi-square test. Significance was determined at the $p<0.05$ level.

Results

The mean age of 18-29, 30-49, and 50 plus year-old groups were 24.3 ± 3.2 (18-29), 38.7 ± 5.7 (30-49), and 58.9 ± 7.7 (50-81), respectively. The gender ratio (F/M) of 18-29, 30-49, and 50 + year-old groups were 109/71, 204/79, and 73/47, respectively. The number of female cases is higher in all the study groups; in addition, the ratio of female cases of 30-49 year-old group was significantly higher than those of the other groups ($P<0.05$).

Figures 1 presents the rates of types of chronic sinusitis of frontal, maxillary, and ethmoid sinuses, and chronic mastoiditis respectively, in the 18-29, 30-49, and ≥ 50 year-old groups. There were no significant differences among the study groups with regard to the rates of types of chronic sinusitis of frontal, maxillary, and ethmoid sinuses and chronic mastoiditis ($P>0.05$).

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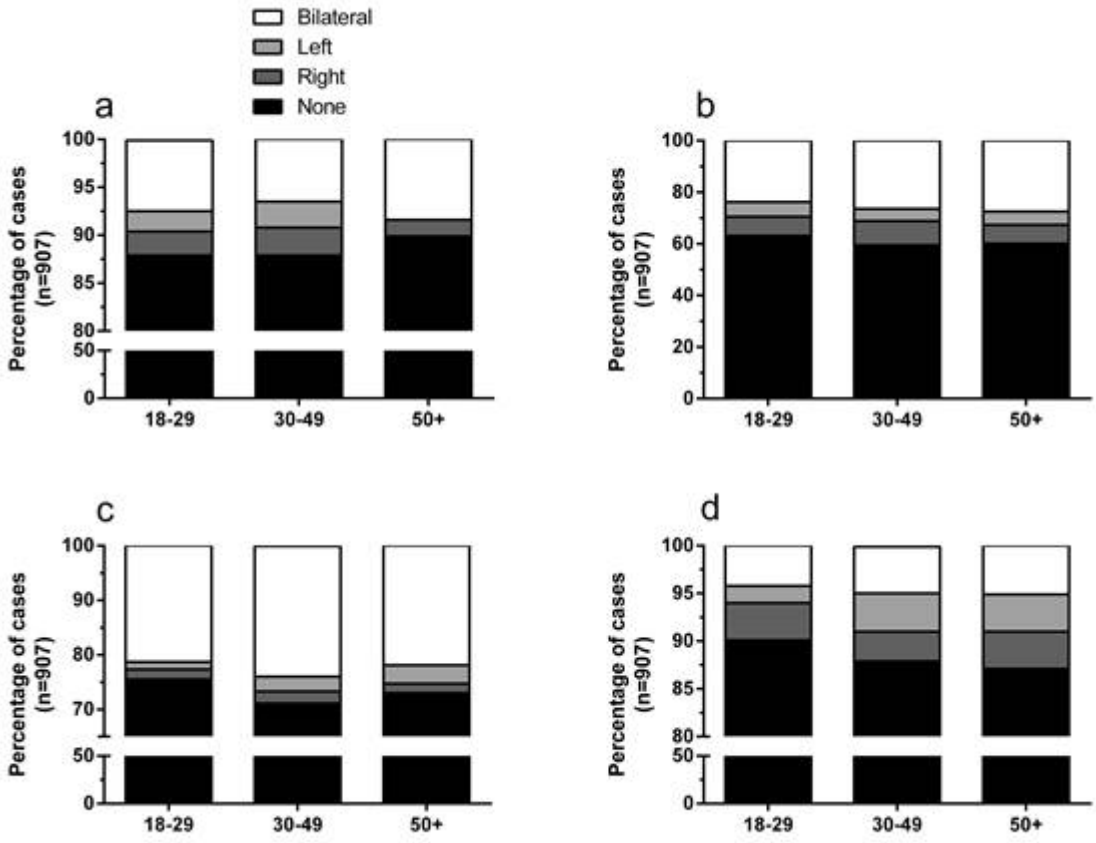

Figure 1. Rates of types of chronic sinusitis of frontal (a), maxillary (b), and ethmoid (c) sinuses, and chronic mastoiditis (d) in 18-29, 30-49, and ≥50 year-old groups.

Figure 2 shows the rates of types of retention cyst, nasal septum deviation, conchal hypertrophy, and concha bullosa, respectively, in the 18-29, 30-49, and ≥ 50 year-old groups. There were no significant differences among the study groups with regard to the rates of types of retention cyst, nasal septum deviation, conchal hypertrophy, and concha bullosa (P>0.05).

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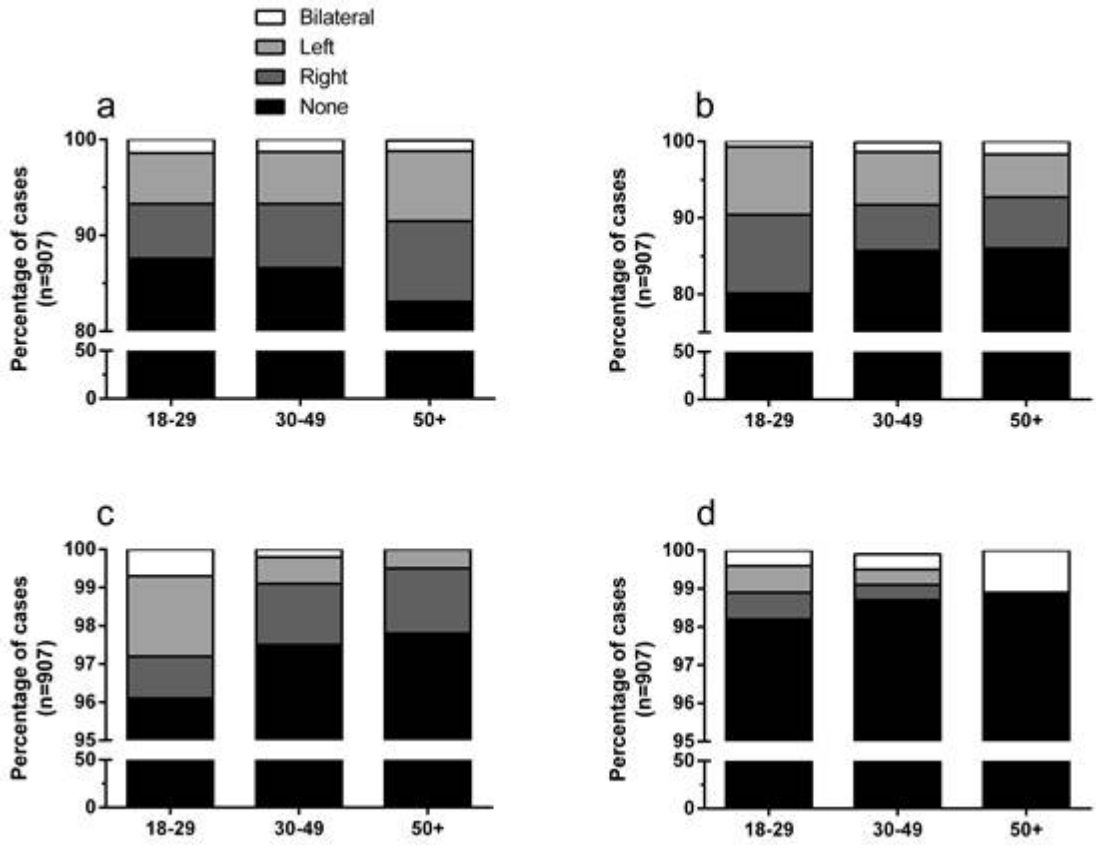

Figure 2. Rates of types of retention cyst (a), nasal septum deviation (b), conchal hypertrophy (c), and concha bullosa (d) in 18-29, 30-49, and ≥50 year-old groups.

Figure 3 displays the rates of types of multiple sinusitis in the 18-29, 30-49, and ≥ 50 year-old groups. There was no significant difference among the study groups with regard to the rates of types of multiple sinusitis (P>0.05).

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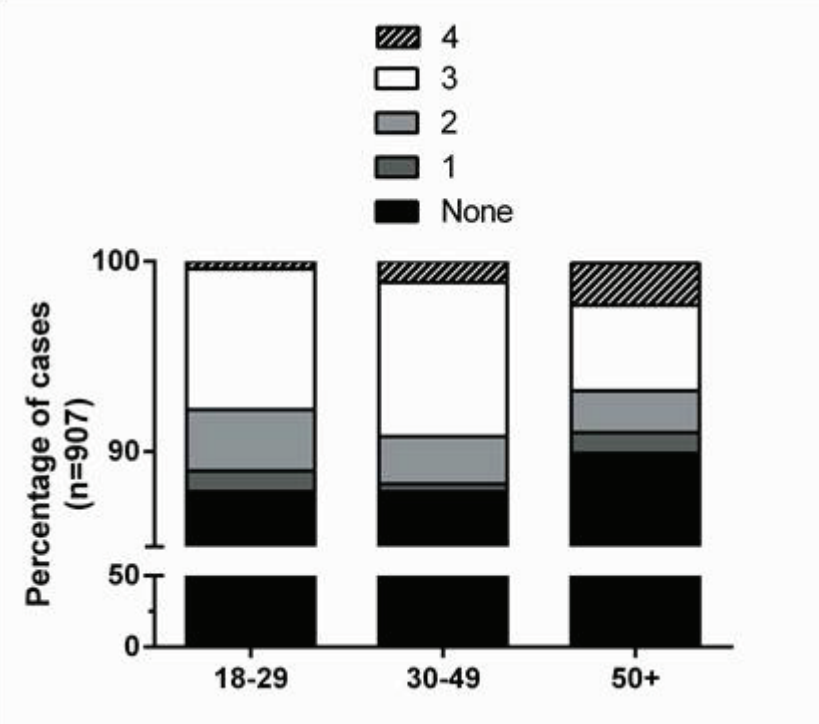

Figure 3. Rates of multiple sinusitis in 18-29, 30-49, and ≥50 year-old groups.

Table 1 presents the presence of nasal septum deviation, retention cyst, conchal hypertrophy, and concha bullosa according to type of chronic sinusitis. The rates of nasal septum deviation were significantly higher in patients with chronic maxillary and ethmoid sinusitis ($P < 0.05$). The rate of retention cyst was significantly higher in patients with chronic maxillary sinusitis ($P < 0.05$). There were no significant differences among the patients with sinusitis types with regard to conchal hypertrophy and concha bullosa ($P>0.05$).

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Table 1. Presence of nasal septum deviation, retention cyst, conchal hypertrophy, and concha bullosa according to type of sinusitis.

	Frontal		Maxillary		Ethmoid	
	Absent, n (%)	Present, n (%)	Absent, n (%)	Present, n (%)	Absent, n (%)	Present, n (%)
Nasal septum deviation						
Absent	669 (88)	93 (12)	482 (63)	280 (37)	571 (75)	191(25)
Present	132 (91)	13 (9)	69 (48)	76 (52)[a]	90 (62)	55 (38)[b]
Retention cyst						
Absent	692 (88)	90 (11)	457 (58)	325 (42)	569 (73)	213 (27)
Present	109 (87)	16 (13)	94 (75)	31 (25)[c]	92 (75)	33 (26)
Choncal hypertrophy						
Absent	780 (88)	101 (11)	531 (60)	350 (40)	641 (73)	240 (27)
Present	21 (81)	5 (19)	20 (77)	6 (23)	20 (77)	6 (23)
Chonca bullosa						
Absent	790 (88)	104 (12)	540 (60)	354 (40)	652 (73)	242 (27)
Present	11 (85)	2 (15)	11 (85)	2 (15)	9 (69)	4 (31)

[a,b]P<0.05 vs. absent septum deviation.
[c]P<0.05 vs. absent retention cyst.

Discussion

According to findings of our study, in female patients, MRI of the head was more commonly ordered for the differential diagnosis of chronic headache. Overall, the rate of chronic frontal sinusitis was higher in the 18-29 and 30-49 year-old groups, although this was not reached statistical significance. The study groups were found similar with regard to the rate of chronic maxillary sinusitis. The rate of chronic ethmoid sinusitis and chronic mastoiditis were higher in the 30-49 and 50 + year-old groups, although this was not reached statistical significance. The rate of retention cyst was higher in the 30-49 and 50 + year-old groups, although this was not reached statistical significance. The rate of nasal septum deviation, conchal hypertrophy, and concha bullosa were lower in the 30-49 and 50 + year-old groups, although this was not reached statistical significance. The rate of multiple chronic sinusitis as well as chronic mastoiditis was higher in the 18-29 and 30-49 year-old groups, although this was not reached statistical significance. Sinusitis develops when the passages of sinuses are narrowed or obstructed by congenital and acquired lesions of nasal structures such as nasal septum deviation, concha bullosa, and conchal

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hypertrophy. We analyzed overall rates of presence of abnormalities of nasal structures according to types of sinusitis. There is meaningful association between nasal septum deviation and chronic maxillary and ethmoid sinusitis and between retention cyst and chronic maxillary sinusitis. There was no association between the types of sinusitis and conchal hypertrophy and concha bullosa.

Headache types are seen approximately one-half of the adult population worldwide (10). The International Headache Society classification and diagnostic criteria (11) is useful to differentiate primary and secondary headache types. Primary headache disorders are classified as i) tension-type headache, ii) migraine, iii) cluster headache, and iv) other primary headaches (11). Unlike primary headache disorders, secondary headaches disorders are attributed to an underlying medical condition (e.g., those caused by infection or vascular disease) (12). Although primary headache types are considerably frequent than secondary ones, there is generally an increasing trend to use neuroimaging modalities such as CT and/or MRI scans to rule out uncommon causes of headache and often to relieve patient anxiety (13). For most other dangerous causes of headache except intracranial hemorrhage, MRI or CT is acceptable (10). Neuroimaging is not necessary routinely to accomplish a diagnosis of primary headache. Physicians must be careful for not creating morbidity with the use of uncovered incidental and non-significant findings obtained by imaging studies. However, patients who present danger signs on medical history and examination need the use of neuroimaging for exclusion of secondary etiologies. For the differential diagnosis of other headache types, such as the trigeminal autonomic cephalalgia, MRI is generally required (14).

Data of several studies did not support that there was a considerable difference in the frequency of pathological and incidental findings in common headache patients compared with the general population (14). The differential diagnosis of headache is important to administer an appropriate therapy, and during laboratory workup, history and examination is used by physicians to determine the indication for neuroimaging (10, 15). Patients with any of the danger signs for serious lesions require neuroimaging. In the remaining patients, there are not enough data about the requirement of neuroimaging, and in the future, there will not be such trials as blinding and randomization can cause

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ethical problems. Considering these facts, the decision about scanning in headache may continue to require a sound clinical judgment (16, 17)

Simpson et al. (18) evaluated the effect of direct access to computed tomography (CT) for investigation of chronic daily headache by general practitioners. They suggested that direct-access CT was the preferred choice of management for patients with chronic daily headache in primary care in Glaskow in the UK. They noted that patients and general practitioners were reassured by a normal scan in the majority of cases, although there was a need for the confirmation of its cost-effectiveness. Hopcroft and Davenport (19) evaluated the overall contribution of the study by Simpson et al. (18) and in their comments they noted that the findings of that study has many drawbacks in the clinical practice and emphasized the importance of education of patients and physicians for a logical primary care approach during the differential diagnosis of headache. Jones (20) reviewed clinical value of the term “sinus headache”. As mentioned in that review, contrary to popular belief, headache is not related to sinusitis in most of the situation. Incidental presence of both sinusitis and migraine together causes confusion about their relationship and there is no clear association between them. In general, chronic recurring headache is frequently related to migraine than to chronic rhinosinusitis (21, 22).

Chronic sinusitis is one of the common chronic illnesses, affecting persons of all age groups as an inflammatory process involving the paranasal sinuses and persists more than 12 years (23). The literature has supported that chronic sinusitis is frequently found with concurrent nasal airway inflammation and nasal airway anomalies. CT scan is widely considered as the method of choice in evaluating the paranasal sinuses, and the use of cone-beam CT scan is gaining popularity among endodontists to evaluate the disorders of adjacent structures (24). The advantages of CT scan of sinuses are usually show areas with chronic inflammatory changes. Maillet et al. (24) found 37 sinusitis from nonodontogenic causes in their 135 patients. In a recent review related to maxillary sinusitis, early investigation with CT scan was recommended with the use of MRI scan as preferred in cases requiring additional evaluation of soft tissue structures. On imaging studies, retention cysts are one of the frequent incidental finding, with an incidence between 12.4 and 35.6%. Maxillary retention

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cysts are prevalent in nonrhinitic patients and are not a manifestation of rhinosinusitis. There is no need for sinus surgery in the presence of retention cysts (25, 26).

Cağlayan and Tozoğlu (27) conducted a study assessing the location, nature, and occurrence of incidental maxillofacial findings on cone beam computed tomography scans performed in dental patients for maxillofacial diagnostic purposes. They found that the overall proportion of the incidental findings in the nasal area was 51.8% and their subtypes were the following: mucosal thickness (21.3%), deviation of the nasal septum (12.6%), conchal hypertrophy (11.1%), bullous concha (3.9%), and retention cysts (2.9%).

Nazri et al. (28) the prevalence of incidental findings of sinus abnormalities on CT and MRI scans in all age groups, who were requested for non-otorhinolaryngological indications in a tertiary medical center. They collected imaging and clinical symptomatology together. They concluded that the frequency of incidental sinus abnormalities might not be directly related to gender or age. They stated that MRI detects incidental sinus abnormality at a higher prevalence when compared to CT imaging, indicating the superiority of MRI and that MRI findings were meaningfully related to the symptomatology.

Mastoiditis is an inflammation of the mucosal lining of the mastoid air cell system, usually caused by untreated middle ear infection. Chronic mastoiditis is most commonly associated with chronic suppurative otitis media and particularly with cholesteatoma formation and develops in individuals with long-standing middle-ear disease. CT scan of the temporal bone provides important advantages for the evaluation of mastoiditis. MRI scan is not typically recommended as the radiographic study of choice; however, MRI scan provides an important opportunity evaluation of inflammatory processes and contiguous soft tissue, particularly the intracranial structures (29). Polat et al. (30) evaluated the MRI reports of patients diagnosed with mastoiditis by radiologists according to fluid signal in the mastoid on T2-weighted MRI images. They did not confirm the MRI diagnosis of mastoiditis with clinical findings during otological examination in 82% of their patients. They concluded that middle ear and mastoid disorders should be diagnosed clinically and imaging procedures

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should be used as supportive. It may be a result of difficulties of clinical diagnosis of several diseases including mastoiditis. In our series, rate of mastoiditis was 11.6%, overall, most commonly bilateral. von Kalle et al. (31) evaluated the mucosal thickening in the paranasal sinuses and mastoid cells of children with MRI of the head, for ruling out of other diseases. They found one or more salient findings in their paranasal sinuses or mastoid cells in 61% of children; and in 48% and 25% of them, they observed a mucosal swelling in their paranasal cavities and mastoid cells, respectively. They reported the mucosal swelling in paranasal sinuses and in mastoid cells as one of the common incidental findings. They concluded that although sinusitis and "mastoiditis are observed commonly in radiological reports, medical management should be preferred after confirmation of sinusitis or mastoiditis with clinical findings. Meredith and Boyev (32) discussed the diagnostic criteria of mastoiditis on MRI scan and noted that its clinical value was less than expected.

In conclusion, in a setting of differential diagnosis of chronic headache in the adult patients, a considerable rate of the MRI scans reveals chronic inflammatory changes as chronic paranasal sinusitis and mastoiditis as well as nasal congenital and acquired abnormalities that may be related to the development of sinusitis and mastoiditis in a variable degree. According to findings of our study, in carefully selected patients, MRI may provide valuable information for otorhinolaryngologic and neurologic workup, otherwise it is not possible to detect clinically. In MRI report, the view, location, and other important features of these incidental findings need to be described in detail for the long-term follow-up and management of these benign lesions that are most commonly asymptomatic but in some cases present with severe symptoms.

Conflicts of interest

The authors declare that there is no conflict of interest with regard to the publication of this manuscript.

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