

How much are the incidental abnormalities on brain MRI clinically significant in otolaryngology practice?

Çiğdem Kalaycık Ertugay¹, Ayça Özbal Koç², Halime Çevik³, Selim Sermed Erbek⁴

¹ENT Clinic, Istanbul Training and Research Hospital, Istanbul, Turkey

²Department of Otorhinolaryngology - Head and Neck Surgery, Başkent University Istanbul Hospital, Istanbul, Turkey

³Department of Radiology, Başkent University Istanbul Hospital, Istanbul, Turkey

⁴Department of Otorhinolaryngology - Head and Neck Surgery, Başkent University Ankara Hospital, Ankara, Turkey

Abstract

Objective: We aimed to investigate the frequency of incidental diagnosis of paranasal sinus and mastoid abnormalities on brain magnetic resonance imaging (MRI) and its correlation with symptoms of patients.

Methods: We examined 100 patients who underwent brain MRI due to several different complaints other than sinusitis and mastoiditis. The patients who had any nasal or otologic pathology in otolaryngology examination were excluded from the study. Afterwards, a total of 65 patients were included into the study. The questionnaire consisted of otological symptoms and Sino-nasal Outcome Test (SNOT-20), Lund and Mackay scoring system for rhinosinusitis were filled by all patients immediately prior to imaging. The analysis of the MRI scan in terms of rhinosinusitis according to the Lund-Mackay radiological scoring and mastoiditis was performed by the same radiologist.

Results: The mean age of 65 patients was 46.62±17.73 years. Eighteen (27.7%) of these were men and 47 (72.3%) were women. In 26 (40%) of 65 patients, MRI demonstrated mastoiditis. We could not find any statistically significant correlation between mastoiditis and upper respiratory tract infection (p=0.896). There was no statistically significant relationship between radiological scores and total sinus symptom scores (p=0.93). Additionally, we could not find any correlation between radiological scores and SNOT-20 (p=0.923).

Conclusion: Our findings demonstrated that although some of these patients had various symptoms of sinus or mastoid diseases, these symptoms had no statistically significant correlation with the radiological diagnosis. In conclusion, radiologists should advise clinical correlation of their radiologic findings rather than reporting a clinical diagnosis such as sinusitis and mastoiditis.

Keywords: Incidental findings, mastoiditis, MRI, paranasal sinus, rhinosinusitis.

Özet: Beyin MR'ında saptanan insidental bulgular otolarenoloji pratiğinde klinik olarak ne kadar önemlidir?

Amaç: Serebral manyetik rezonans görüntüleme (MRG) saptanan insidental paranasal sinus ve mastoid anomalilerinin sıklığı ve bu tanıların hastaların semptomları ile korelasyonunu araştırmayı amaçladık.

Yöntem: Sinüzit ve mastoidit harici başka şikayetler nedeniyle beyin MRG çekilen toplam 100 hasta incelendi. Otolarenoloji muayenesinde herhangi bir nazal veya otolojik patoloji saptananlar çalışmadan çıkartıldıktan sonra çalışmamıza 65 hasta dahil edildi. Tüm hastalara görüntüleme öncesi otolojik semptomlarını ve rinosinüzit şikayetleri için Sinonazal Sonuç Testi (SNOT-20) ve Lund and Mackay skorlama sistemini içeren bir anket formu uygulandı. Mastoidit varlığı ve Lund-Mackay radyolojik skorlaması not edilerek yapılan MRG analizi aynı radyolog tarafından uygulandı.

Bulgular: Çalışmamızdaki 65 hastanın ortalama yaşı 46.62±17.73'tü. Bunların 18'i (27.7%) erkek ve 47'si (72.3%) kadındı. Altmış beş hastanın 26'sında (%40) MRG'de mastoidit saptandı. Üst hava yolu enfeksiyonu ile mastoidit arasında istatistiksel olarak anlamlı bir ilişki bulunmadık (p=0.896). Radyolojik skorlar ile total sinüs semptom skoru arasında istatistiksel olarak anlamlı korelasyon yoktu (p=0.93). Ayrıca, radyolojik skorlar ile SNOT-20 arasında korelasyon bulunmadık (p=0.923).

Sonuç: Bulgularımız göstermiştir ki; her ne kadar hastaların sinüs veya mastoid hastalıkları ile ilişkili şikayetleri olsa da bu şikayetler ile radyolojik tanıları arasında istatistiksel olarak anlamlı bir korelasyon bulunmamıştır. Sonuç olarak, radyologlar sinüzit ve mastoidit gibi klinik tanı rapor etmek yerine radyolojik bulgularının klinik korelasyonunu önermelidir.

Anahtar sözcükler: İnsidental bulgular, mastoidit, MRG, paranasal sinüs, rinosinüzit.

Correspondence: Çiğdem Kalaycık Ertugay, MD. ENT Clinic, Istanbul Training and Research Hospital, Istanbul, Turkey.
e-mail: ckalaycik@gmail.com

Received: October 14, 2016; **Accepted:** November 2, 2016

Online available at:
www.entupdates.org
doi:10.2399/jmu.2016003004
QR code:



There are various definitions for incidental finding. It is defined as “asymptomatic findings that are discovered unintentionally and has potential clinical significance because they may need treatment or cause symptoms unrelated to the purpose of study” in neuroimaging research.^[1,2] The overall prevalence rates of incidental findings on brain magnetic resonance imaging (MRI) ranged from 1.7% to 10.2% in numerous studies after exclusion of incidental white matter lesions.^[3-7] Additionally, radiologists usually describe mastoiditis and sinusitis as an incidental finding on brain MRI. Reneman et al.^[8] found 5.6% of head and neck findings in 180 participants. Sandeman et al.^[9] reported 76 varied ENT problems in 700 subjects, particularly 62 of these subjects had sinus problems and 6 had mastoid problems.

Clinical mastoiditis is defined as inflammation of mastoid air cells of temporal bone by otolaryngologists and is mostly caused by middle ear infection. Symptoms include redness and swelling behind the ear. On the other hand, if radiologists detect any increased signal in the mastoid region on MRI, they define this condition as mastoiditis. The frequency of incidental diagnosis of radiological mastoiditis has been reported in a few studies.^[10-13] Clinical and radiological mastoiditis are different entities as mentioned above and clinical significance of these incidental findings in otolaryngology practice remains controversial.

Another point that differs in clinical and radiological evaluation is the sinus abnormalities on MRI scans. Previous studies showed that the prevalence of abnormal sinus mucosal thickening on MRI ranges from 30% to 50%.^[14-16] However, this definition varies between studies because there is no standardized scoring schema of MRI. Lim et al.^[17] reported sinus abnormalities in 38% of 60 children. They noted ‘more than double’ scores in the symptomatic group according to the Lund and Mackay scoring system. Similarly, McNeill et al.^[18] used the same scoring system in their study evaluating the relationship of symptoms and radiologic findings of sinus pathology in MRI scans.

Recently increased prevalence of incidental findings in the head and neck region which is documented most frequently as mastoiditis and sinus disease is observed due to neurology and other clinics’ increased usage of MRI.^[19,20] These asymptomatic patients are mostly referred to otolaryngology practice.

In this prospective study, we evaluated the frequency of incidental diagnosis of paranasal sinus and mastoid abnormalities on brain MRI and its correlation with symptoms of patients by using a questionnaire consisted of otological

symptoms and additionally using Sino-nasal Outcome Test (SNOT-20), Lund and Mackay scoring system for rhinosinusitis in patients who underwent brain MRI for reasons other than sinusitis and mastoiditis. Additionally, we aimed to determine the differences in the rate of these incidental abnormalities between Turkish people and other populations.

Materials and Methods

Study population

A total of 100 consecutive patients who underwent brain MRI due to several different complaints other than sinusitis and mastoiditis were examined. All patients have performed an otolaryngological examination. The patients who had any nasal or otologic pathology in otolaryngology examination were excluded from the study. According to these criteria, a total of 65 patients were enrolled in this study. The study was approved by the Institutional Review Board and Ethics Committee of Başkent University and all patients signed the agreement to participate in the study.

Data collection

A questionnaire was filled by all patients immediately before imaging. Age, gender, detailed history of patients’ consumption of tobacco, allergy, asthma, and upper respiratory tract infection (within the past two weeks) were recorded. Additionally, the questionnaire consisted of Lund-Mackay symptom scores,^[21] SNOT-20, and questions about otologic symptoms. Patients were asked to record the average intensity of each symptom of rhinosinusitis by using a visual analog scale (VAS) method ranging from 0 (no symptom) to 10 (severe symptom) and scoring was done by Lund-Mackay staging system. Furthermore, we also used SNOT-20 for evaluation of the symptom scores of rhinosinusitis in this study.

All the analysis of the MRI scan regarding rhinosinusitis according to the Lund-Mackay radiological scoring and mastoiditis was performed by the same radiologist. The radiologist was blinded about the patients’ otologic symptoms and SNOT-20 scores and Lund-Mackay symptom scores to avoid interobserver bias.

MR imaging parameters

Indications of MRI scans performed to the patients were various including mostly dizziness, headache, brain lesion, etc. All patients underwent MRI on a 1.5-T scanner (Siemens, Avanto, Erlangen, Germany). MR imaging of patients during the axial, coronal, and sagittal T2W sequences was

included in the evaluation. Coronal and sagittal plans specifically used to evaluate the sinuses of upper and lower walls. MRI readings of the sinuses were done blinded to all participant data by a head and neck radiologist. In the paranasal sinus wall, T2WI signal more than 1 mm was defined as mucosal thickening. The Lund-Mackay scoring system was used for evaluation. According to this, paranasal sinuses are divided into six sections; maxillary, sphenoid, frontal sinus, osteomeatal complex, anterior and posterior ethmoid cells. The severity of sinus mucosal inflammation was scored as 0 (less than 1 mm), 1 (partial) or 2 (complete). Ostiomeatal complex obstruction categorized as: 0 (not obstructed), 1 (mild) or 2 (obstructed). The mastoid cells were scored as either 1 (aerated mastoid cells) or 2 (presence of fluid in mastoid cells).

Statistical analysis

The data were presented as means \pm standard deviation. The analysis was performed using SPSS v.20.0 for Mac (SPSS Inc., Chicago, IL, USA). For the statistical analyses of data, chi-square test, and Spearman's correlation coefficient test were performed. Differences with a p-value <0.05 were considered to be statistically significant.

Results

We examined 100 consecutive patients and 65 of these with a mean age of 46.62 ± 17.73 years (between 16 and 80 years of age) were included in this study. Eighteen (27.7%) of these were men, and 47 (72.3%) were women. Six subjects (9.2%) had allergic rhinitis and asthma. Three (4.6%) subjects had symptoms of allergic rhinitis, and 12 (18.5%) subjects had a history of upper respiratory tract infection during last 15 days.

In 26 (40%) of 65 participants, MRI demonstrated mastoiditis. Four subjects had the sensation of fullness of ear, 1 had ear discharge, 6 had otalgia, 6 had hearing loss, 9 had tinnitus, and 19 had vertigo. Out of participants who had mastoiditis, five subjects had a history of upper respiratory tract infection and no statistically significant correlation was found between mastoiditis and upper respiratory tract infection ($p=0.896$). Furthermore out of participants who had mastoiditis, only one subject had allergic rhinitis. We could not find any significant relationship between the presence of allergic rhinitis and mastoiditis ($p=0.221$).

Thirty-five had Lund and Mackay score of 2 or more, and moreover, 10 of them had a score of 5 or more. There was not any mucosal abnormality on MRI of 21 subjects. Furthermore, we could not find any statistically significant correlation between Lund and Mackay scores and total

sinus symptom scores ($p=0.93$) and there was no relationship between these scores and SNOT-20 ($p=0.923$).

Discussion

In recent years, asymptomatic patients with incidental findings in the head and neck region have been mostly referred to otolaryngology clinics or general practitioners due to neurology and other clinics' increased usage of MRI.^[19,20] We generally observe the radiological diagnosis of mastoiditis and sinus disease in our otolaryngology practice. The reported prevalence of these incidental findings was 5.6% in a study of 180 participants.^[8]

The middle ear and mastoid region diseases are one of the most common conditions in otolaryngology practice. Though they are a clinical diagnosis, imaging is usually performed if the otolaryngologist should observe the relationship of surrounding tissue to rule out other complications or if advanced treatment modalities such as surgery of ear are planned.^[22] Mostly computed tomography of the temporal bone is used to confirm a clinical diagnosis of mastoiditis by the finding of the destruction of bony septa or secretions in mastoid air cells.^[22,23] However, if radiologists detect any increased signal in the mastoid region on MRI, they define this situation as mastoiditis in clinical practice.

The prevalence of radiological mastoiditis varies among studies.^[5,12,13] Orhan et al.^[12] found radiological mastoiditis in only ten patients of a series of 2700 temporomandibular joint MRIs, Mirza et al.^[13] found 5% incidence. However, concordant with these studies, a higher rate of subjects had radiological mastoiditis (40%) in our study. The reason for this difference might be the description variety of radiologic mastoiditis.

Polat et al. investigated 406 patients who have radiological mastoiditis on MRI and showed that 82% of patients did not have clinical mastoiditis and did not suggest MRI as an effective tool for mastoiditis.^[10] In our study, none of 26 (40%) subjects of mastoiditis, who were screened on brain MRI, demonstrated any otoscopic or otomicroscopic abnormality in clinical examination.

There are numerous studies about the prevalence of incidental findings, whereas there have been a few studies about the clinical significance.^[24,25] Von Kalle et al. evaluated the mucosal thickening in mastoid cells and paranasal sinuses in 147 pediatric patients' brain MRI. They concluded that 25% of patients had mucosal swelling in their mastoid cells, and 48% had in paranasal sinuses, but they found no correlation of these pathologies with a history of a headache, asth-

ma and allergies.^[24] Our results were similar with that study as we also did not find any correlation between mastoiditis and allergic rhinitis. Additionally, statistically significant correlation between mastoiditis and upper respiratory tract infection was not obtained. However, in contrast with these findings, Lee et al. evaluated 100 adults and 30 children and detected statistically significant correlation between MRI findings and clinical examination of the middle ear and a mastoid cavity in adults.^[25]

Similar to mastoid and middle ear diseases, CT is the significant imaging modality for evaluating paranasal sinuses, but otolaryngologists come across frequent consultations of patients with sinusitis due to brain MRI in clinical practice. The reported prevalence of incidental sinus problems on brain MRI varies between 31.7% to 55% in the literature.^[15,17,26,27] Lund and Mackay scoring system are usually used as a rhinological staging system of paranasal sinus CT scan, but there is no standardized scoring schema of MRI. Lim et al.^[17] used this scoring system in evaluation of the sinus abnormalities on MRI scans of children, and McNeill et al.^[18] investigated the relationship of symptoms and sinus abnormalities in MRI scans of patients by using the same scoring system. Similarly, we have also used the Lund and Mackay scoring system in the present study. Lim et al.^[17] evaluated the MRI of 60 children and observed sinus abnormalities in 38% of them. They noted 'more than double' scores in symptomatic group. In concordant with this study, McNeill et al.^[18] did not obtain a correlation between radiological scores and symptom scores which were similar to our results. Furthermore, we also investigated the correlation between SNOT-20 and radiological score and we could not find any significance. Some studies suggest the association with upper respiratory tract infections and sinus abnormalities on MRI,^[26,27] but we did not find out any association in our study.

In the present study, we found a higher rate of radiological mastoiditis concordant with other studies. Furthermore, we did not observe a correlation between radiological scores and total sinus symptom scores. The major limitation of our study was small sample size. Besides, we did not have a study group of patients whose radiological findings correlated with clinical diagnosis. Thus, further studies with larger sample size should be performed.

Conclusion

Although there have been some reports about the prevalence of radiological diagnosis of mastoiditis and sinusitis on brain MRI, clinical significance remains controversial.

Our findings demonstrated that although some of these patients had various symptoms of sinus or mastoid diseases, these symptoms had no statistically significant correlation with the radiological diagnosis. On the other hand, the occurrence of symptoms might be related to other diseases. In conclusion, radiologists should point out radiologic findings on brain MRI and advise clinical correlation of them rather than reporting a clinical diagnosis such as sinusitis and mastoiditis.

Conflict of Interest: No conflicts declared.

References

- Illes J, Kirschen MP, Edwards E, et al.; Working Group on Incidental Findings in Brain Imaging Research. Ethics. Incidental findings in brain imaging research. *Science* 2006;311:783–4.
- Wolf SM, Lawrenz FP, Nelson CA, et al. Managing incidental findings in human subjects research: analysis and recommendations. *J Law Med Ethics* 2008;36:219–48.
- Vernooij MW, Ikram MA, Tanghe HL, et al. Incidental findings on brain MRI in the general population. *N Engl J Med* 2007;357:1821–8.
- Yue NC, Longstreth WT Jr, Elster AD, Junreis CA, O'Leary DH, Poirier VC. Clinically serious abnormalities found incidentally at MR imaging of the brain: data from the Cardiovascular Health Study. *Radiology* 1997;202:41–6.
- Katzman GL, Dagher AP, Patronas NJ. Incidental findings on brain magnetic resonance imaging from 1000 asymptomatic volunteers. *JAMA* 1999;282:36–9.
- Hartwigsen G, Siebner HR, Deuschl G, Jansen O, Ulmer S. Incidental findings are frequent in young healthy individuals undergoing magnetic resonance imaging in brain research imaging studies: a prospective single-center study. *J Comput Assist Tomogr* 2010;34:596–600.
- Kim BS, Illes J, Kaplan RT, Reiss A, Atlas SW. Incidental findings on pediatric MR images of the brain. *AJNR Am J Neuroradiol* 2002;23:1674–7.
- Reneman L, de Win MM, Booij J, van den Brink W, den Heeten GJ, Freling N, Majoie CB. Incidental head and neck findings on MRI in young healthy volunteers: prevalence and clinical implications. *AJNR Am J Neuroradiol* 2012;33:1971–4.
- Sandeman EM, Hernandez Mdel C, Morris Z, et al. Incidental findings on brain MR imaging in older community-dwelling subjects are common but serious medical consequences are rare: a cohort study. *PLoS One* 2013;8:e71467.
- Polat S, Aksoy E, Serin GM, Yildiz E, Tanyeri H. Incidental diagnosis of mastoiditis on MRI. *Eur Arch Otorhinolaryngol* 2011;268:1135–8.
- Meredith JR, Boyev KP. Mastoiditis on MRI: fact or artifact? *Ear Nose Throat J* 2008;87:514–8.
- Orhan K, Nishiyama H, Tadashi S, Shumei M, Furukawa S. MR of 2270 TMJs: prevalence of radiographic presence of otomastoiditis in temporomandibular joint disorders. *Eur J Radiol* 2005;55:102–7.

13. Mirza S, Malik TH, Ahmed A, Willatt DJ, Hughes DG. Incidental findings on magnetic resonance imaging screening for cerebello-pontine angle tumours. *J Laryngol Otol* 2000;114:750–4.
14. Patel K, Chavda SV, Violaris N, Pahor AL. Incidental paranasal sinus inflammatory changes in a British population. *J Laryngol Otol* 1996;110:649–51.
15. Tarp B, Fiirgaard B, Christensen T, Jensen JJ, Black FT. The prevalence and significance of incidental paranasal sinus abnormalities on MRI. *Rhinology* 2000;38:33–8.
16. Gordts F, Clement PA, Destryker A, Desprechins B, Kaufman L. Prevalence of sinusitis signs on MRI in a non-ENT paediatric population. *Rhinology* 1997;35:154–7.
17. Lim WK, Ram B, Fasulakis S, Kane KJ. Incidental magnetic resonance image sinus abnormalities in asymptomatic Australian children. *J Laryngol Otol* 2003;117:969–72.
18. McNeill E, O'Hara J, Carrie S. The significance of MRI findings for non-rhinological disease. *Clin Otolaryngol* 2006;31:292–6.
19. Bhargavan M, Sunshine JH. Utilization of radiology services in the United States: levels and trends in modalities, regions, and populations. *Radiology* 2005;234:824–32.
20. Rao VM, Parker L, Levin DC, Sunshine J, Bushee G. Use trends and geographic variation in neuroimaging: nationwide medicare data for 1993 and 1998. *AJNR Am J Neuroradiol* 2001;22:1643–9.
21. Lund VJ, Mackay IS. Staging in rhinosinusitis. *Rhinology* 1993; 31:183–84.
22. Maroldi R, Farina D, Palvarini L, et al. Computed tomography and magnetic resonance imaging of pathologic conditions of the middle ear. *Eur J Radiol* 2001;40:78–93.
23. Migirov L. Computed tomographic versus surgical findings in complicated acute otomastoiditis. *Ann Otol Rhinol Laryngol* 2003;112: 675–7.
24. von Kalle T, Fabig-Moritz C, Heumann H, Winkler P. Incidental findings in paranasal sinuses and mastoid cells: a cross-sectional magnetic resonance imaging (MRI) study in a pediatric radiology department. *Rofo* 2012;184:629–34.
25. Lee DH, Jun BC, Park JO, Yeo SW. Magnetic resonance imaging of the mastoid cavity and middle ear: prevalence and clinical significance of incidental abnormal findings in a nonotolaryngologic adult and pediatric population. *J Otolaryngol* 2006;35:13–8.
26. Cooke LD, Hadley DM. MRI of the paranasal sinuses: incidental abnormalities and their relationship to symptoms. *J Laryngol Otol* 1991;105:278–81.
27. Manning SC, Biavati MJ, Phillips DL. Correlation of clinical sinusitis signs and symptoms to imaging findings in pediatric patients. *Int J Pediatr Otorhinolaryngol* 1996;37:65–74.

This is an open access article distributed under the terms of the Creative Commons Attribution-NonCommercial-NoDerivs 3.0 Unported (CC BY-NC-ND3.0) Licence (<http://creativecommons.org/licenses/by-nc-nd/3.0/>) which permits unrestricted noncommercial use, distribution, and reproduction in any medium, provided the original work is properly cited.

Please cite this article as: Kalaycık Ertugay Ç, Özbal Koç A, Çevik H, Erbek SS. How much are the incidental abnormalities on brain MRI clinically significant in otolaryngology practice? *ENT Updates* 2016;6(3):135–139.