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Anatomical variations of paranasal sinus and ethmoid roof type on computed tomography in patients admitted to the emergency department with migraine headache

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Abstract

In this study, we aimed to evaluate the anatomical variations of paranasal sinus on computed tomography (CT) in patients admitted to the emergency department due to migraine. Patients who had brain CT with a diagnosis of migraine admitted to our emergency department with a complaint of headache between June2018 and January2019 were retrospectively reviewed. Fifty-five migraine headache patients and 55 control group patients were included to this study. According to the Keros classification, the ethmoid roof height was type1 in 25, type2 in 15 and type3 in 15 of the patients with migraine. In the control group, 28 patients had type1, 14 patients type2, 13 patients type3 ethmoid roof. Anatomical variations in patients with migraine: Nasal septal deviation in 14 cases, Agger nasi cell in 6, pneumatization posterior sella turcica 1, prominent ethmoidal bulla 4, Haller cell 3, nasal septal spur 5, concha bullosa 15, pneumatized anterior clinoid process in 6, uncinate cells 4, Onodi cells 7, pneumatized crista galli 7, presence of maxillary sinus 1, frontal sinus aplasia 5, sphenoid sinus agenesis 2, frontal bulla 2, frontal sinus hyperplasia 2, paradoxical middle turbinate 1. As a result,there is no significant difference was found between the migraine patients and the control group in terms of ethmoid roof height according to Keros classification. In the control group and migrane cases,there was a significant difference in the frequency of pneumatization posterior to floor of sella turcica, nasal septal spur, uncinate cells and the presence of maxillar sinus anatomic variations.

Keywords: Anatomic variations, CT, migraine, paranasal sinus

Introduction

CT provides important information for the evaluation of the anatomy and pathology of the paranasal sinuses. Anatomic variations are common in paranasal sinuses and CT is valuable in revealing these anatomic variations[1]. Paranasal sinus pathologies are also included in the etiology of headache.[2]. The paranasal sinuses are divided into four groups: frontal, ethmoid, maxillary and sphenoid sinuses.

Common anatomical variations of the paranasal sinus;

nasal septal deviation, Agger nasi cell (Figure 1) , pneumatization posterior to floor of sella turcica , prominent ethmoidal bulla, infraorbital ethmoidal (Haller) cell (Figure 2), nasal septal spur (Figure 3) ,concha bullosa (Figure 4), pneumatized anterior clinoid process (Figure 5), uncinate cells, sphenoethmoidal (Onodi) cells, pneumatized crista galli, presence of septation in maxillar sinus (Figure 6), frontal sinüs aplasia, sphenoid sinus agenesis, frontal bulla (Figure 7), frontal sinus hiperplazi (Figure 8), paradoxical middle turbinate [1,3].

The ethmoid roof was made according to the Keros classification[3].

In the etiology of migraine, nasal mucosal pressure increase and trigeminal nerve involvement are observed [4].

In this study, we aimed to evaluate the anatomical variations of paranasal sinus on CT in patients admitted to the emergency room due to migraine.

Materials and Methods

This retrospective study was conducted in accordance with the Declaration of Helsinki and the study protocol was approved the non-invasive ethics committee of our hospital.

Power analysis during the biostatistical preliminary assessment indicated a study population of 40 patients with 80 %power.

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Study population

Patients ≥18 years old with a history of migraine admitted to our emergency department with a complaint of headache between June 2018 and January 2019 were retrospectively reviewed. Migraine diagnosis was based on the hospital medical data for all patients. CT examinations were performed in migraine patients presenting with the most severe headache of their lives. The control group included the patients who were admitted to emergency department between June 2018 and January 2019 due to cerebrovascular disease without any history of migraine. The criteria for exclusion were; <18 years of age, history of nasal or paranasal surgery, trauma to the forehead or nasal area, presence of sinusitis findings in the CT examination, inability to access the patient's history from the hospital data system and artifacts in the CT examination (patient movement, metal artifact, etc). 55 migraine patients and 55 control group patients were included in the study.

CT acquisition

Brain CT examinations were performed with 16 detector CT devices (Alexion, Toshiba Medical Systems, Japan.). CT scans were performed up to the vertex level in the cranial and to the skullbase of the caudally. The images were evaluated by one radiologist as multiplanar via our PACS system. Ethmoid roof height was evaluated according to Keros classification for each case.Anatomical variations were classified as nasal septal deviation, Agger nasi cell, pneumatization posterior to sella turcica, prominent ethmoidal bulla, infraorbital ethmoidal (Haller) cell, nasal septal spur, concha bullosa, pneumatized anterior clinoid process, uncinate cells, sphenoethmoidal (Onodi) cells, pneumatized crista galli, maxillary sinus aplasia, frontal sinus aplasia, sphenoid sinus agenesis, frontal bulla, frontal sinus hyperplasia, paradoxical middle turbinate.

Statistical analysis

The statistical analysis was performed with SPSS software (version 21.0, IBM Corporation, Armonk, NY, USA). Descriptive values of the data were given as mean, standard deviation, maximum and minimum values. Independent Student-t test was used to evaluate the differences between the averages of the independent groups.

The results were considered statistically significant when $p < 0.05$ was obtained.

Results

Of the migraine patients included in the study, 20 were male and 35 were female. 21 of the control group were male and 34 were female. The mean age of 55 patients with migraine was 50.48 (19-91 years). The mean age of the 55 patients in the control group was 60.03 (20-90 years).

According to the Keros classification, the etmoid roof height was type1 in 25 (45.45%), type 2 in 15 (27.27%) and type 3 in 15 (27.27%) of the patients with migraine. In the control group, 28 patients (50.90%) had type 1, 14 patients (25.45%) type 2, 13 patients (23.63%) type 3 ethmoid roof. There was no statistically significant difference between the patients with migraine and the control group in terms of ethmoid roof height ($p > 0.05$). Paranasal sinus variation was observed in 44 (80%) patients with migraine. In the control group, paranasal sinus variation was observed in 32 (58.18%) cases. There was a significant difference between the migraine patients and the control group in terms of the presence of anatomic variations ($p = 0.013$).

More than one anatomic variation was detected in 18 cases with migraine. Anatomical variotions in migraine patients and control group weresummarized in table 1.

Table 1. Anatomical variotions in migraine patients and control group

Anatomic variotion	Case of migraine n %)	Control Group n (%)	p value
Nasal septal deviation	14 (25.45%)	14 (25.45%)	1
Agger nasi cell	6 (10.90%)	4 (7.27%)	0.507
Pneumatization posterior to floor of sella turcica	1 (1.81%)	1 (1.81%)	1
Prominent ethmoidal bulla	4 (7.27%)	1 (1.81%)	0.17
Infraorbital ethmoidal (Haller) cell	3(5.45%)	1 (1.81%)	0.308
Nasal septal spur	5 (9.09%)	5 (9.09%)	1
Concha bullosa	15 (27.27%)	10 (18.18%)	0.255
Pneumatized anterior clinoid process	6 (10.90%)	2 (3.63%)	0.142
Uncinate cells	4 (7.27%)	2 (3.63%)	0.401
Sphenoethmoidal (Onodi) cells	7 (12.72%)	1 (1.81%)	0.028
Pneumatized crista galli	7 (12.72%)	6 (10.90%)	0.768
Presence of septation in maxillar sinus	1 (1.81%)	1 (1.81%)	1
Frontal sinüs aplasia	5 (5.45%)	1 (1.81%)	0.093
Sphenoid sinus agenesis	2 (3.63%)	0 (0%)	0.154
Frontal bulla	2 (3.63%)	1 (1.81%)	0.558
Frontal sinüs hiperplazi	2 (3.63%)	1 (1.81%)	0.558
Paradoxical middle turbinate	1 (1.81%)	1 (1.81%)	0.558

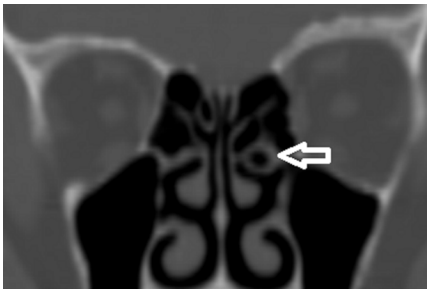

Figure 1. Agger Nazi cell in the anterior of the ethmoid air cells on the left lateral side of the nasal septum (white arrow)

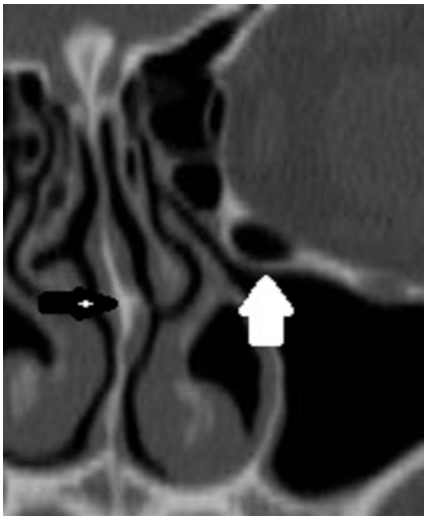

Figure 2. Coronal CT, left deviation in the nasal septum and the ethmoidal air cell in the left infraorbital region (white arrow)

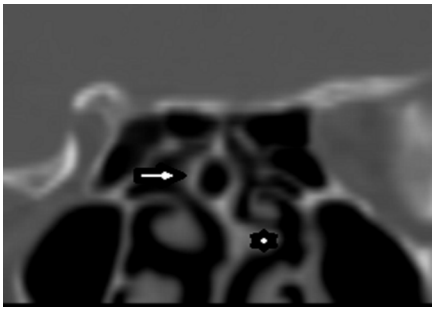

Figure 3. Coronal CT at nasal septum pneumatized (arrow), left spur formation (asterisk)

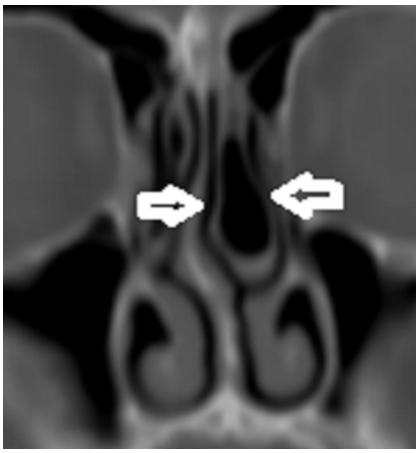

Figure 4. Concha bullosain left middle nasal concha

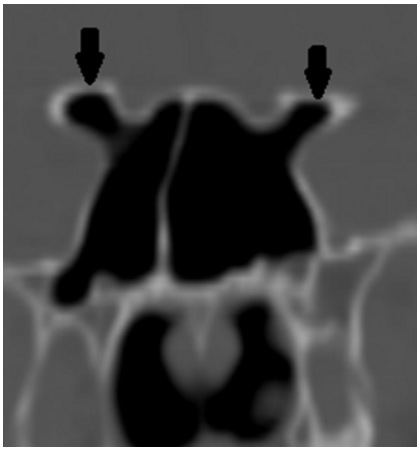

Figure 5. Bilateral pneumatized anterior clinoid process in migraine

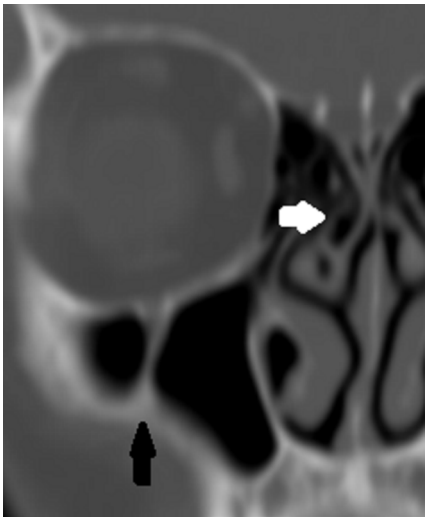

Figure 6. Presence of septation in right maxillar sinus (black arrow) ve conca bullosa (white arrow)

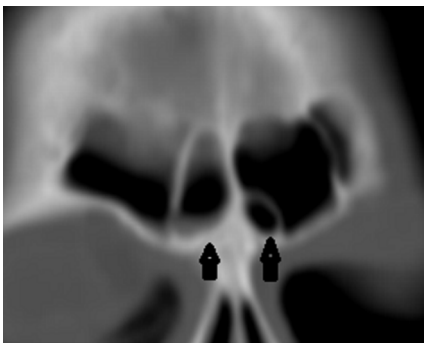

Figure 7. Bilateral frontal bulla (black arrows)

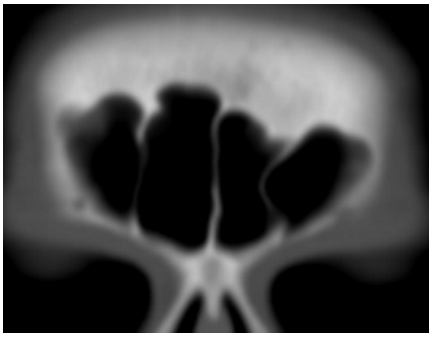

Figure 8. Frontal sinus hiperplazi without thinning of its bony walls

The most common anatomic variation was concha bullosa in patients with migraine. In the control group the most common anatomic variation was nasal septal deviation. There was a statistically significant difference in terms of the frequency of pneumatization posterior to floor of sella turcica, nasal septal spur, uncinate cells and the presence of maxillar sinus anatomic variation in the control group ($p < 0.05$). There was no statistically significant difference in nasal septal deviation, Agger nasi cell, prominent ethmoidal bulla, infraorbital ethmoidal (Haller) cell, concha bullosa, pneumatized anterior clinoid process, pneumatized crista galli, frontal sinus aplasia, sphenoid sinus, frontal sinus hyperplasia and paradoxical middle turbinate anatomic variations ($p > 0.05$).

Discussion

There are many reasons for the etiology of migraine headache. In 1943, McAuliffe and his colleagues found that in headache cases, pressure increase in nasal mucosa and electrical discharge in facial dermatomas may be the cause of headache [5]. Khader et al. reported that inferior nasal turbinate cauterization reduces headache in patients with idiopathic headache [2]. Therefore, they stated that the cause of headache may be the reduction of the trigeminal nerve innervation or the amount of brain oxygen [2].

Hammad and his colleagues found a relationship between nasal septal deviation, agger nasi cell and concha bullosa and refractory headache in their study on rhinogenic headache [6]. Hammad and his colleagues were included patients with sinusitis in their study but we excluded patients with sinusitis in our study.

We thought that the cause of pain in sinusitis patients may be due to sinusitis so we excluded from the studyIn our study, the anatomic variations as pneumatization of posterior floor of the sella turcica, nasal septal spur, uncinate cells, presence of septation in maxillar sinus were significantly more frequent in patients with migraine headache group. Differently the study of Hammad et al., We did not include sinusitis patients to our study, which may explain our finding different results.

According to Yarmohammadi and his colleagues ; in patients with concha bullosia and headache, a significant decrease in the headache was observed after surgery of the turbinate, which indicated that the decrease in pain might be associated with mucosal contact [7].

Muehlberger and collegues did not find a statistically significant difference between in migraine type headache and non-migraine headache patients in which they evaluated mucosal contact point variants such as conca bullosa and septal deviations at MRI examinations [8].

Berchtold and collegues found conditions of higher vulnerability to the supratrochlear and supraorbital nerve and consequently may contribute to frontal migraine headache. In an addition, osteofibrous channels of varying shapes were found with frontal migraine headache in their study [9].

Dean and collegues described between in migraine type headache and Pneumatized Superior Tclrbinate [10].

There are several limitations to this study. The small sample size is one of our limitations. Further studies with large sample sizes are needed to support our results. One of our limitations was retrospective study.

In the current study compared all intranasal and paranasal anatomical variants found on CT images between migraine patients and controls. We could not evaluate direct mucosal contact points. We have evaluated according to the presence of anatomical variation. In the control group and migrane cases, there was a significant difference in the frequency of pneumatization posterior to floor of sella turcica, nasal septal spur, uncinate cells and the presence of maxillar sinus anatomic variations.

Conclusion

As a result, evalution the ethmoidal roof height according to Keros classification did not different in migraine cases and control group. In the control group and migrane cases,there was a significant difference in the frequency of pneumatization posterior to floor of sella turcica, nasal septal spur, uncinate cells and the presence of maxillar sinus anatomic variations. Anatomic variations of the paranasal sinus can be investigated in patients with migraine who do not respond to medical treatment and should be evaluated for the necessity of surgical treatment warrant further study.

Acknowledgment
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Conflict of interest
We declare that we have no conflict of interest.

Financial Disclosure
This study received no financial support.

Ethical approval
This retrospective study was approved by the Kutahya Health Sciences University Institutional Review Board and Ethics Committee (Project no: 2019/06-2) and supported by the Kutahya Health Sciences University Research Fund.

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