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Paranazal Sinüs Anatomik Varyasyonlu Hastalarda Alerjik Rinit Sıklığı

The Prevalence of Allergic Rhinitis in Patients with Anatomic Variations of Paranasal Sinus

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Özet

GİRİŞ ve AMAÇ: Bu çalışmanın amacı, paranazal sinüs anatomik varyasyonlu hastalarda alerjik rinit sıklığını araştırmaktır.

YÖNTEM ve GEREÇLER: En az bir paranazal sinüs anatomik varyasyonu olan 124 hasta çalışma grubunu, hiçbir paranazal sinüs anatomik varyasyonu olmayan 86 kişi kontrol grubunu oluşturdu. Gruplar hakkında bilgisi olmayan bir araştırmacı çalışmaya katılan bütün hastaların detaylı hikayesini aldı ve alerjik rinitin major bulguları açısından sorgulayıp kaydetti. Tüm hastalar kulak burun boğaz fizik muayenesinden geçirildi. Yine gruplar hakkında bilgisi olmayan başka bir araştırmacı da hastaların deri prick testlerini yaptı.

BULGULAR: Kontrol grubunda 17 hastaya (%19,8) alerjik rinit tanısı konulmuşken, çalışma grubunda 35 hastaya (%28,2) alerjik rinit tanısı konuldu. Alerjik rinitli hastalarda istatistiksel olarak anlamlı düzeyde daha sık agger nasi, hipertrofik etmoid bulla ve konka büllosa mevcuttu. Ayrıca alerjik riniti olmayanlara göre alerjik rinitli hastalarda istatistiksel olarak anlamlı düzeyde daha fazla sayıda anatomik varyasyon saptandı.

TARTIŞMA ve SONUÇ: Paranazal sinüs anatomik varyasyon sayısının artmış alerjik rinit insidansı ile anlamlı derecede ilişkili olduğu gözlendi.

Anahtar Kelimeler: Alerjik rinit, kronik rinosinüzit, paranasal sinüsler, bilgisayarlı tomografi, alerjenler, deri testleri.

Abstract

INTRODUCTION: The objective of this study is to investigate the prevalence of allergic rhinitis in patients with paranasal sinus anatomic variations.

METHODS: While the study group consisted of 124 patients who had at least one paranasal sinus anatomic variation in their paranasal sinus tomographies, the control group consisted of 86 patients without paranasal sinus anatomic variations. A blinded researcher received the detailed history and recorded related to the major symptoms of allergic rhinitis of all patients who participated in the study, and then they had physical examinations. A clinician, who was also blinded, performed the skin prick test on all patients.

RESULTS: While 17 (19.8%) cases in the control group diagnosed positive for allergic rhinitis, 35 (28.2%) cases in the study group diagnosed positive for allergic rhinitis. Participants with allergic rhinitis experienced a higher prevalence of concha bullosa, agger nasi, and hypertrophic ethmoid bulla to a statistically significant degree. In addition, participants with allergic rhinitis had a higher number of variations at a statistically significant level, compared to cases without allergic rhinitis.

DISCUSSION AND CONCLUSION: It was demonstrated that the number of paranasal sinus anatomic variations was statistically related to increased presence of allergic rhinitis.

Keywords: Allergic rhinitis, chronic rhinosinusitis, paranasal sinuses, computed tomography, allergens, skin tests.

INTRODUCTION

Paranasal sinus anatomic variations are structures that differ from the normal anatomy of the nose and paranasal sinuses. Some of these are nasal septal deviation (SD), agger nasi (AN), haller cell (HC), middle concha bullosa (MCB), uncinate anomalies (UA), hypoplastic maxillary sinus (HMS), Onodi cell (OC), paradoxical middle concha (PMC), and hypertrophic ethmoid bulla (HEB). Paranasal sinus anatomic variations forming the lateral wall of the nose are very important since they can contribute to the blockage of the osteomeatal units, which provide drainage and ventilation, and thereby increase the risk of sinus mucosal disease (1-4).

A great majority of researchers investigating the relationship between paranasal sinus anatomic variations and chronic rhinosinusitis have found that chronic rhinosinusitis is encountered more frequently in patients with paranasal sinus variations (1-4). Additionally, many studies have reported that allergic rhinitis (AR) is an important risk factor in the development of chronic rhinosinusitis (5-7). Previous studies showed the relationship between paranasal sinus anatomic variations and chronic rhinosinusitis and

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between AR and chronic rhinosinusitis. However, as far as we know, there has been no study investigating the relationship between paranasal sinus anatomic variations and AR. In this study, we tried to reveal this relationship by comparing the patients with and without paranasal sinus anatomic variations, in terms of the presence of AR.

MATERIALS AND METHODS

This multicenter study was conducted at secondary and tertiary referral centers. An approval was received from the local ethics committee (1/24/2013-10840098). Written and verbal informed consent was received from each patient who participated in the study. We have reviewed the high-resolution paranasal sinus computer tomographies which were requested for various reasons and recorded in radiology department between June 2013 and September 2013. All scans performed between these dates were retrospectively evaluated respectively and regardless of diagnosis of the patients. Scans of patients who had distinct sinusitis symptoms, underwent nasal and paranasal sinus surgeries before, had sinonasal polyposis and had pathologies that could have masked paranasal sinus anatomic variations were excluded. Additionally, patient files were reached; patients who had chronic metabolic diseases, immune system insufficiency and were older than the age 50 were also excluded from the study and patients who were included in the study were called by phone and informed about the study. Paranasal sinus tomographies that were included in the study were mainly the scans of patients who were thought to have sinus pathologies however did not have any identified sinus pathology, were thought to have concha bullosa in addition to nasal septum deviation, had headaches for unexplained reasons and were referred by neurology unit, were referred for various orbital pathologies, referred for nasolacrimal duct pathologies, etc. 210 patients in total were accepted for the study. While 124 patients who had at least one paranasal sinus anatomic variation in their paranasal sinus tomographies constituted the study group, 86 patients who did not have any anatomic variation constituted the control group. Anatomic variations were graded according to the classification proposed by Sarna et al. (8).

A blinded researcher received the detailed history and recorded the major symptoms of AR (sneezing, nasal itching, runny nose, nasal obstruction) in all patients who participated in the study. Following the physical examination, a clinician, who was also blinded, performed the skin prick test on patients who had at least two major symptoms of AR. Alyostal ST-IR (Stallegenes S.A. France) standard allergen extracts were used for the skin prick test. In order to perform the test, antihistaminic drugs were stopped 10 days before, H2 receptor blockers 24 hours before, and antidepressants 20 days before the test. After the ventral side of the forearm was cleaned with alcohol, the test was performed by a quick test applicator. Histamine hydrochloride was used as the positive control, and isotonic NaCI was used as the negative control. The results were recorded 20 minutes later. An induration, 3 mm larger than the induration of the negative control was accepted as a positive allergy test (9). The allergy panel consisted of two house dusts (dermatophagoides pteronysinnus, dermatophagoides farinea), two animal epitheliums (cockroach, cat), trees mix, weeds, grass mix, pine, hazelnut, penicillium mix, cladosporium, cacao, egg (yolk), wheat (wheat flour), alternaria (fungus). AR was diagnosed in patients who had at least two major symptoms of AR and had a positive skin prick test (10).

Statistical Examinations

NCSS (Number Cruncher Statistical System) 2007 and PASS (Power Analysis and Sample Size) 2008 Statistical Software (Utah, USA) were used to conduct the statistical analyses. We used descriptive statistical methods (Mean, Standard

Deviation, Median, Frequency, Proportion, Minimum, Maximum) to assess the study data; Student t Test in comparing the quantitative data and in binary group comparisons of parameters showing normal distribution; and Mann Whitney U test in binary group comparisons of parameters showing no normal distribution. Pearson Chi-Square test, Fisher's exact test, and Yates Continuity Correction test (Yates corrected Chi-Square) were used to compare the qualitative data. The significance was assessed at the levels of $p<0.01$ and $p<0.05$.

RESULTS

The participants consisted of a total of 210 individuals, 45.7% female (n=96), 54.3% male (n=114). The participants were between the ages of 14 and 50, and their age average was 30.72±11.95 years. Age averages and gender distributions in the groups were statistically similar ($p>0.05$).

Table 1 illustrates a comparison of the groups in terms of major symptoms of AR. Nasal itching, nasal obstruction, and runny nose were determined to be more prevalent in the study group than the control group in a statistically significant way ($p<0.05$). Sneezing was determined to be statistically similar between the two groups.

Table 2 illustrates the responses of all participants to allergens that were applied during the skin prick test. While 17 (19.8%) cases in the control group had a positive AR, 35 (28.2%) cases in the study group had a positive AR. Even though allergic rhinitis was more common among the patients in the study group, the difference was not statistically significant (p: 0,163).

Considering the study group, it was observed that 60.5% of these cases (n=75) had septum deviation (SD), 29.0% (n=36) middle concha bullosa (MCB), 35.5% (n=44) agger nasi (AN), 28.2% (n=35) uncinate pathologies (UP), 15.3% (n=19) haller cell (HC), 21.8% (n=27) Onodi cell (OC), 19.4% (n=24) paradoxical middle concha (PMC), 8.9% (n=11) maxillary sinus hypoplasia (MH), and 25.8% (n=32) hypertrophic ethmoid bulla (HEB) (Table 3).

In the study group, the prevalence of SD, UP, HC, OC, PMC, and MH did not show a statistically significant difference between cases with and without AR. However, the prevalence of MCB, AN, and HEB was higher in cases with AR in a statistically significant way compared to cases without AR (Table 4). In addition, the number of variations in patients with AR is higher in a statistically significant way compared to that of participants without AR ($p<0.01$) (Table 5).

DISCUSSION

Several authors have assessed the relationship between sinonasal anatomic variants and the incidence of rhinosinusitis (11-13). A majority of them showed that certain anatomic variations forming the lateral wall of the nose are very important because they can contribute to the blockage of the osteomeatal units, which provide drainage and ventilation, and thereby may increase the risk of sinus mucosal disease (1-4). The osteomeatal complex is a functional entity of the anterior ethmoid complex that represents the final common pathway for drainage and ventilation of the frontal, maxillary, and anterior ethmoid cells. Thus, anatomic variations that redirect nasal airflow or narrow the osteomeatal complex have been implicated in the development of chronic rhinosinusitis (14). The fact that concha bullosa, agger nasi, and hypertrophic ethmoid bulla, which showed a statistically significant correlation with AR, were the variations in the osteomeatal complex area supports the importance of the osteomeatal complex in the paranasal sinus physiology in our study.

It has been postulated that swelling of the nasal mucosa in AR at the site of the sinus ostia may compromise ventilation and even obstruct the

sinus ostia, leading to mucus retention and infection (15). Several mechanisms have been considered regarding the link between allergic inflammation of the nose and sinus disease, namely (i) direct deposition of the allergen on the sinus mucosa resulting in allergic inflammation, (ii) narrowing or obstruction of the sinus ostium secondary to allergic inflammation, (iii) exposure to the sinus mucosa of allergen by hematogenous spread, and (iv) reflex mediated by neurogenic reactions (15).

Considering the interaction between paranasal sinus anatomic variations, chronic rhinosinusitis, and AR, many previous studies revealed the relationship between paranasal sinus anatomic variations and chronic rhinosinusitis, and between AR and chronic rhinosinusitis. This study, on the other hand, showed the relationship between paranasal sinus anatomic variations and the presence of AR. Our results presented a statistically significant and strong correlation between the number of paranasal sinus anatomic variations and the presence of AR in the group with paranasal sinus anatomic variations. Namely, paranasal sinus anatomic variations were determined to occur in greater numbers in patients with AR in a statistically significant way. Additionally, considering the correlation between each paranasal sinus anatomic variation and positive AR, it is observed that those with AR had a higher prevalence of CB, AN, and HEB in a statistically significant way. It was remarkable that all the variations that were correlated with the presence of AR were in the osteomeatal complex area.

Paranasal sinus anatomic variations disturb nasal and paranasal airflow, narrow the sinus inlets and outlets, and contribute to the development of rhinosinusitis, which consequently increases the mucosal inflammation and edema, destroys the mucocilliary clearance in the sinonasal mucosa, increases the obstruction, changes the PH of the sinus mucosa, and causes hypoxia (16). Previous studies have stated that hypoxia-inducible factor-1α (HIF-1α) is a transcriptional activator mediating gene expression in response to the oxygen concentration and plays a principal role in the immune and inflammatory response (17, 18). HIF-1α should play an important role in the pathogenesis of allergic rhinitis and could be considered as a target molecule for a treatment regimen for AR (19).

Sinonasal infections may contribute to the initiation and aggravation of AR. During infections, there is an accumulation of mast cells leading to the aggravation of a concomitant allergic condition. Sinonasal infections cause damage in the sinonasal mucosa due to both the immune response by the host and the direct effect of infectious factors, which consequently makes the mucosa more susceptible to allergens triggering the AR (20, 21). Previous studies and our data demonstrated that paranasal sinus anatomic variations caused hypoxia due to blockage of the nasal and sinus mucosa, increased the susceptibility to infections, and might consequently trigger the AR in the host. İn this study, the fact that presence of AR significantly increased with increasing paranasal sinus anatomic variations and variations having significant correlations with presence of AR were present in the osteomeatal region makes us think that osteomeatal complex obstruction may have a role in the mechanism.

In our study, the sample size was small and we did not correlate healthy population. The main limitation of our study is lack of healthy population. Our study is a preliminary study considered as a proposal. Studies with larger number of patients are needed to confirm our findings.

In conclusion, although among patients with and without paranasal sinus abnormalities, there was no statistical significance in terms of presence of AR, it was demonstrated that the number of

paranasal sinus abnormalities was statistically related to increased presence of AR. In other words, the higher the number of anatomical variations, the greater presence of AR. However, further studies are required, especially those evaluating the role of surgeries performed for paranasal sinus abnormalities and their therapeutic effect in AR.

Table 1. *Evaluation of groups according to major symptoms of AR (allergic rhinitis)*

	Symptoms			
	Control Group (n=86)	**Study group (n=124)**	**Total (n=210)**	***p***
	n (%)	**n (%)**	**n (%)**	
Sneezing	32 (%37,2)	50 (%40,3)	82 (%39,0)	***[a]0,649***
Nasal obstruction	28 (%32,6)	60 (%48,4)	88 (%41,9)	***[a]0,022****
Nasal itching	20 (%23,3)	51 (%41,1)	71 (%33,8)	***[b]0,011****
Runny nose	15 (%17,4)	47 (%37,9)	62 (%29,5)	***[b]0,002****

[a]Pearson Ki-kare Test [b]Yates'Continuity Correction Test *p<0,05 **p<0,01

Table 2. *Outcomes of skin prick test*

	Control Group (n=86); *n (%)*		**StudyGroup (n=124); *n (%)***		**Total (n=210); *n (%)***	
	Negative	**Pozitive**	**Negative**	**Pozitive**	**Negative**	**Pozitive**
D.PTER.	80 (%93,0)	6 (%7,0)	110 (%88,7)	14 (%11,3)	190 (%90,5)	20 (%9,5)
D.FARINAE	81 (%94,2)	5 (%5,8)	109 (%87,9)	15 (%12,1)	190 (%90,5)	20 (%9,5)
COCKROACH	72 (%83,7)	14 (%16,3)	103 (%83,1)	21 (%16,9)	175 (%83,3)	35 (%16,7)
TREES MIX	86 (%100)	0 (%0)	114 (%91,9)	10 (%8,1)	200 (%95,2)	10 (%4,8)
WEEDS	86 (%100)	0 (%0)	114 (%91,9)	10 (%8,1)	200 (%95,2)	10 (%4,8)
GRASSES MIX	72 (%83,7)	14 (%16,3)	102 (%82,3)	22 (%17,7)	174 (%82,9)	36 (%17,1)
PINE	85 (%98,8)	1 (%1,2)	121 (%97,6)	3 (%2,4)	206 (%98,1)	4 (%1,9)
HAZELNUT	86 (%100)	0 (%0)	124 (%100)	0 (%0)	210 (%100,0)	0 (%0)
PENICILLIUM MIX	86 (%100)	0 (%0)	124 (%100)	0 (%0)	210 (%100,0)	0 (%0)
CLADOSPORIUM	85 (%100)	0 (%0)	124 (%100)	0 (%0)	209 (%100,0)	0 (%0)
CACAO	82 (%95,3)	4 (%4,7)	115 (%92,7)	9 (%7,3)	197 (%93,8)	13 (%6,2)
EGG (YOLK)	82 (%95,3)	4 (%4,7)	119 (%96,0)	5 (%4,0)	201 (%95,7)	9 (%4,3)
WHEAT	86 (%100)	0 (%0)	124 (%100)	0 (%0)	210 (%100,0)	0 (%0)
ALTERINA(Fungus)	86 (%100)	0 (%0)	120 (%96,8)	0 (%0)	206 (%98,1)	0 (%0)

Table 3. *Distributions of the paranasal sinus anatomic variations in study group*

n=124	Paranasal sinus anatomic variations	
	n	%
SD	75	60,5
MCB	36	29,0
AN	44	35,5
UA	35	28,2
HC	19	15,3
OC	27	21,8
PMC	24	19,4
HMS	11	8,9
HEB	32	25,8

Nasal septal deviation (SD), agger nasi (AN), haller cell (HC), middle concha bullosa (MCB), uncinate anomalies (UA), hypoplastic maxillary sinus (HMS), Onodi cell (OC), paradoxical middle concha (PMC), hypertrophic ethmoid bulla (HEB)

Table 4. *Assessments of each paranasal sinus anatomic variation according to presence of AR (allergic rhinitis) in study group*

	Allergy				
	Positive (n=35) n (%)	Negative (n=89) n (%)	*p*	ODDS	95% Confidence Interval
SD	25 (71,4%)	50 (56,2%)	[b]***0,174***	1,950	0,84-4,54
MCB	15 (42,9%)	21 (23,6%)	[a]***0,033****	2,429	1,06-5,56
AN	27 (77,1%)	17 (19,1%)	[b]***0,001****	14,294	5,53-36,95
UA	13 (37,1%)	22 (24,7%)	[b]***0,245***	1,800	0,78-4,16
HC	4 (11,4%)	15 (16,9%)	[b]***0,633***	0,637	0,20-2,07
OC	10 (28,6%)	17 (19,1%)	[b]***0,364***	1,694	0,69-4,18
PMC	10 (28,6%)	14 (15,7%)	[b]***0,169***	2,143	0,85-5,43
HMS	1 (2,9%)	10 (11,2%)	[c]***0,178***	0,232	0,03-1,89
HEB	15 (42,9%)	17 (19,1%)	[b]***0,013****	3,176	1,35-7,45

*[a]Pearson Chi-square Test [b]Yates' Continuity Correction Test [c]Fisher's Exact Test *p<0,05 **p<0,01*
Nasal septal deviation (SD), agger nasi (AN), haller cell (HC), middle concha bullosa (MCB), uncinate anomalies (UA), hypoplastic maxillary sinus (HMS), Onodi cell (OC), paradoxical middle concha (PMC), hypertrophic ethmoid bulla (HEB).

Table 5. *Assessments of number of variations according to presence of AR (allergic rhinitis) in study group*

Numbers of Variations	AR		
	Positive (n=35)	Negative (n=89)	Total
	n (%)	n (%)	n (%)
1	1 (2,9%)	24 (27,0%)	25 (20,2%)
2	6 (17,1%)	44 (49,4%)	50 (40,3%)
3	13 (37,1%)	16 (18,0%)	29 (23,4%)
4	9 (25,7%)	3 (3,4%)	12 (9,7%)
5	4 (11,4%)	1 (1,1%)	5 (4,0%)
6	2 (5,7%)	1 (1,1%)	3 (2,4%)
Min-Max (Median)	1-6 (3,0)	1-6 (2,0)	1-6 (2,0)
Ave±SD	1,17±3,00	0,93±2,00	1,18±2,00
p	***0,001****		

Mann Whitney U Test **p<0,01

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