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Topographic relationship; sinusitis and paranasal sinus computed tomography

O. Kemal[1], *T. Müderris*[2], *G. Kutlar*[1] *and F. Gül*[2]

[1]Otolaryngology Department, Ondokuz Mayıs University, Faculty of Medicine, Samsun/Turkey; [2]Otolaryngology Department, Ankara Atatürk Education and Research Hospital, Ankara/Turkey

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Abstract. *Topographic relationship; sinusitis and paranasal sinus computed tomography. Background*: The association between the symptoms of chronic rhinosinusitis (CRS) and computed tomography (CT) findings is controversial, especially the topography of the symptoms and CT findings.
Objective: To determine the relationship between topographic and overall paranasal CT findings with topographic and overall symptoms.
Methods: This was a two-center study comprising 166 patients diagnosed with chronic sinusitis. All patients underwent CT scans and completed a questionnaire. The symptom scores and CT findings were compared.
Results: A correlation between anterior ethmoid sinusitis and hyposmia was found. Blockage of the osteomeatal complex and posterior ethmoid sinusitis was associated with halitosis. There were also correlations between maxillary and sphenoid sinusitis and tooth pain. The total visual scale score was not associated with any of the symptoms. No association was seen between facial pain or facial pressure and paranasal sinus CT scores. No correlation was found between the topographic correlation of sinus pain and topographic paranasal sinus CT findings.
Conclusions: No relationship exists between symptoms and paranasal sinus CT findings in patients with chronic rhinosinusitis.

Introduction

Chronic rhinosinusitis (CRS) is one of the leading causes of chronic illness, affecting a large number of the general population.[1,2] Patients with CRS have many symptoms such as nasal discharge, postnasal drip, headache, hyposmia, anosmia, and the feeling of pressure in the head and neck region. There are various ways to diagnose CRS. Physical and endoscopic examinations and radiological studies are essential to diagnose and treat CRS. Paranasal sinus computed tomography (CT) is one of the most useful radiological examinations for diagnosis and treatment, especially when surgery is required. Current views consider mucosal thickening on CT an objective diagnostic criterion for CRS.[3,4] A CT scan is also used to determine the severity of the disease and decide on a surgical approach. There are various CT scoring systems to improve correlations between medical centers and doctors, and scoring systems are also useful for objective documentation of the disease. The most commonly used of these systems are the Kennedy, Lund-Mackay, and Harvard staging systems.[5,6]

Paranasal sinus CT has become a very useful tool to diagnose, stage, and plan surgery for CRS.[7] Many studies have attempted to define the relationship between the symptoms and paranasal CT scores. Several studies using the staging systems found no solid correlations between symptoms and CT findings, whereas others have found that certain sinonasal symptoms do correlate with CT scan stages in selected populations.[8,9,10] Whether or not topographic differences on CT scans are associated with different symptoms has not yet been fully clarified. Many clinicians use paranasal CT scans to confirm the diagnosis and severity of the disease or prior to performing surgery. Therefore, clinicians should understand the relationship between the severity of the disease and the CT findings, and the

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Table 1

Major and minor criteria for adult rhinosinusitis

Major Criteria
Nasal obstruction or blockage Postnasal drainage Facial pressure or pain Hyposmia or anosmia Cough
Minor Criteria
Headache Fever Halitosis Fatigue Dental pain Ear pain, pressure, fullness

associated correlation between paranasal CT findings and localization (pain, pressure in facial locations) or type of symptoms.

The aim of this study was to determine the relationship between topographic and overall paranasal CT findings with topographic and overall symptoms.

Materials and methods

This was a two-center study comprising 166 Caucasian patients who received paranasal sinus CT scans after unsuccessful medical treatment for CRS at Ankara Atatürk Research Hospital and Samsun Medicana Hospital between May 2013 and May 2014. Approval for the study was granted by the Local Ethics Committee of Yıldırım Beyazıt University and informed consent was obtained from all patients. A diagnosis of chronic sinusitis was made according to the American Academy of Otorhinolaryngology Head and Neck Surgery criteria (Table 1). Inclusion criteria were two or more major criteria or one major and two minor criteria ongoing for at least 3 months, which were defined as chronic sinusitis. The exclusion criteria were systemic diseases that increased the risk of sinusitis (i.e., cystic fibrosis, immunsupressive diseases) and patients who used immunosuppressant drugs. The paranasal CT scans were evaluated according to the Lund-Mackay system by Dr. Kemal and Dr. Muderris.

All patients completed a questionnaire (Table 2) that included questions about facial pain and pressure and its localization, headache, nasal obstruction, nasal discharge, tooth pain, anosmia, hyposmia, halitosis, postnasal drip, and cough. The questions regarding facial pain were asked with respect to left and right maxillary pain, left and right periorbital pain, and left and right frontal pain. The topography of these pain areas were compared with the paranasal CT scores. All the questionnaire parameters were compared with paranasal CT parameters.

The statistical analysis was performed using SPSS software (version 15.0; SPSS Inc., Chicago, IL USA). After calculating the descriptive statistics, all the parameters were examined and it was determined whether they were parametric or non-parametric using the Kolmogorov Smirnov test. If they were non parametric, Spearman's test was used for the analysis.

Results

The study comprised 166 patients with chronic sinusitis; 66 (39.76%) females and 100 (60.24%) males with a mean age of 37.21 ± 11.43 years. The mean total visual scale score was 12.24 ± 4.82. The mean value of the total Lund Mackay score was 7.73 ± 4.82 (Table 3). All parameters of the questionnaire were compared with the paranasal sinus CT scores (Table 4).

No correlation was found between septal deviation, concha bullosa, frontal sinusitis, and the patient complaints ($p > 0.05$). A correlation was determined between anterior ethmoid sinusitis and hyposmia. Blockage of the osteomeatal complex and posterior ethmoid sinusitis was associated with halitosis. There were also correlations between maxillary sinusitis, sphenoid sinusitis, and tooth pain. The total visual scale score was not associated with any of the symptoms.

According to the results of this study, there was no association between facial pain, facial pressure, and paranasal sinus CT scores. No correlation was found between the topographic correlation of the sinus pain and topographic paranasal sinus CT findings.

Discussion

Chronic sinusitis is a significant reason for patients to consult physicians worldwide, with 2% of all patients in the US diagnosed with chronic sinusitis.[11] Routine diagnosis of sinusitis is made from the patient's history, physical examination, and CT findings.[12] Although most sinusitis diagnoses are

Table 2
Questionnaire completed by the patients

Pan-facial pain or pressure	Yes		No	
Right cheek pain	Yes		No	
Left cheek pain	Yes		No	
Right periorbital pain	Yes		No	
Left periorbital pain	Yes		No	
Right frontal pain	Yes		No	
Left frontal pain	Yes		No	
Difficulty breathing through the nose	I cannot breath through both nostrils	I cannot breath through my right nostril	I cannot breath through my left nostril	I can breath normally
Pain in the upper teeth	Yes		No	
	0 (None)	1 (Mild)	2 (Moderate)	3 (Severe)
Headache				
Facial pressure				
Difficulty breathing through the nose				
Nasal discharge				
Tooth pain				
Sense of odor reduction				
Fever in past three months				
Halitosis				
Postnasal drip				
Cough (past 3 months)				

made by primary care physicians, these physicians do not usually have the equipment to perform diagnostic nasal endoscopy or paranasal sinus CT scans. It would be useful in clinical practice to determine possible relationships between paranasal CT scans and patients' complaints. The classification of the American Academy of Otorhinolaryngology Head and Neck Surgery specifies the major and minor criteria for the disease, which are helpful to primary care physicians in the diagnosis. Another question that arises concerns the relationship between patients' complaints and the severity and topography of the disease. It is not clear if the topography of sinus diseases is directly related to the complaints. The aim of this study was to determine the topographic relationship between symptoms and paranasal sinus CT findings.

Previous studies have evaluated the relationship between the complaints by patients with sinusitis and paranasal sinus CT findings, with conflicting results.[13] Most of the studies showed no correlation or a limited correlation between paranasal sinus CT findings and patients' complaints.[14,15] In a study by Bonfils *et al*. of 474 patients with chronic sinusitis, the only areas where a relationship was determined between sinusitis and paranasal sinus CT findings were for anosmia and loss of taste.[15] Bhattacharyya studied 115 patients with sinusitis and found no relationship between the CT findings and patients' quality of life. In that study, only the pathological severity of the Total Lund Mackay score was found to be statistically significant.[14] Kenny *et al*. reported that high symptom severity scores for fatigue, sleep disturbance, nasal discharge, nasal blockage, or decreased sense of smell were associated with the severity of CT imaging scores, but isolated headache and facial pain or pressure were less likely to be predictors of CT findings.[10] Javadrashid *et al*. found a positive correlation between sinusitis and septum deviation and a negative correlation with concha bullosa and sinusitis.[16]

In the current study, the association between CT scans and patients' symptoms was compared and the relationship between the symptoms and topographic CT findings. No relationship was found between the paranasal sinus CT findings and facial pain, facial pressure, nasal blockage, nasal discharge, ear fullness, major symptom scores,

Table 3

Descriptive values

	Minimum	Maximum	Mean	Std. Deviation
Age	15.00	69.00	37.20	11.43
Right maxillary pain	0	1.00	0.17	0.38
Left maxillary pain	0	1.00	0.20	0.41
Right periorbital pain	0	1.00	0.48	0.50
Left periorbital pain	0	1.00	0.49	0.50
Right frontal pain	0	1.00	0.35	0.48
Left frontal pain	0	1.00	0.36	0.48
Pan-facial pain	0	3.00	1.76	1.09
Pan-facial pressure	0	3.00	1.41	1.00
Nasal blockage	0	3.00	1.43	0.93
Nasal discharge	0	3.00	1.24	1.04
Tooth pain	0	3.00	0.48	0.72
Hyposmia	0	3.00	1.19	0.98
Fever in past 3 months	0	3.00	0.43	0.74
Halitosis	0	3.00	0.93	0.89
Postnasal drip	0	3.00	1.65	0.99
Ear fullness	0	3.00	0.87	0.88
Total visual scale score	3.00	27.00	12.24	4.82
Major symptom number	1.00	4.00	3.13	0.87
Minor symptom number	1.00	7.00	2.67	1.57
Concha bullosa	0	2.00	0.54	0.82
Right anterior ethmoid	0	2.00	0.88	0.65
Left anterior ethmoid	0	2.00	0.86	0.68
Right posterior ethmoid	0	2.00	0.69	0.66
Left posterior ethmoid	0	2.00	0.72	0.72
Right maxillar sinus	0	11.00	0.95	1.28
Left maxillar sinus	0	2.00	0.84	0.65
Right frontal sinus	0	2.00	0.42	0.59
Left frontal sinus	0	2.00	0.57	0.67
Right sphenoid sinus	0	2.00	0.23	0.45
Left sphenoid sinus	0	2.00	0.28	0.55
Right osteomeatal complex	0	2.00	0.72	0.97
Left osteomeatal complex	0	2.00	0.75	0.97
Total Lund Mackay score	0	22.00	7.73	4.82

minor symptom scores, or total visual scale score. However, a correlation was found between the paranasal sinus CT findings and hyposmia, halitosis, and tooth pain.

A comparison was also made of the topographic paranasal CT findings with the topographic symptoms. All the parameters were compared with each other, but particular attention was paid to the relationships between:

- Right maxillary sinus disease – right maxillary region pain;
- Left maxillary sinus disease – left maxillary region pain;

Table 4

The p values between parameters

Paranasal sinus findings	RMP*	LMP*	RPoP*	LPoP*	RFP*	LFP*	PFPa*	PFPr*	NB*	ND*	TP*	Hyposmi	Fever in past 3 months	Halitosis	PD*	Ear full-ness	TVSS*	MajSN*	MinSN*
Septum deviation	0.388	0.796	0.49	0.587	0.609	0.666	0.83	0.411	0.807	0.656	0.06	0.873	0.163	0.882	0.142	0.135	0.07	0.838	0.225
Concha bullosa 0=none 1=unilateral 2=bilateral	0.173	0.153	0.207	0.409	0.446	0.402	0.075	0.618	0.411	0.816	0.46	0.453	0.695	0.08	0.472	0.486	0.833	0.801	0.726
Right anterior ethmoid	0.051	0.902	0.254	0.723	0.764	0.564	0.153	0.34	0.835	0.264	0.052	0.041 (r=0.38)	0.477	0.218	0.989	0.831	0.177	0.517	0.886
Left anterior ethmoid	0.577	0.13	0.904	0.062	0.544	0.082	0.456	0.807	0.948	0.474	0.699	0.047 (r=0.42)	0.628	0.09	0.479	0.3	0.085	0.463	0.841
Right posterior ethmoid	0.524	0.228	0.972	0.218	0.156	0.18	0.751	0.96	0.239	0.246	0.06	0.12	0.496	0.031 (r=0.52)	0.978	0.75	0.189	0.91	0.743
Left posterior ethmoid	0.443	0.528	0.266	0.346	0.679	0.323	0.946	0.995	0.608	0.671	0.852	0.116	0.422	0.017 (r=0.61)	0.052	0.731	0.385	0.841	0.562
Right maxillary sinus	0.423	0.626	0.747	0.184	0.368	0.358	0.689	0.181	0.525	0.784	0.006 (r=0.64)	0.382	0.052	0.221	0.929	0.371	0.25	0.943	0.241
Left maxillary sinus	0.543	0.925	0.365	0.598	0.07	0.191	0.297	0.843	0.916	0.471	0.049 (r=0.30)	0.428	0.209	0.073	0.339	0.185	0.64	0.889	0.754
Right frontal sinus	0.851	0.938	0.444	0.516	0.892	0.773	0.664	0.629	0.868	0.837	0.063	0.054	0.176	0.198	0.421	0.482	0.23	0.403	0.438
Left frontal sinus	0.872	0.41	0.866	0.069	0.816	0.574	0.439	0.08	0.936	0.381	0.087	0.456	0.734	0.48	0.479	0.71	0.34	0.861	0.986
Right sphenoid sinus	0.656	0.824	0.58	0.273	0.762	0.681	0.505	0.864	0.214	0.241	0.001 (r=0.55)	0.204	0.322	0.058	0.051	0.119	0.814	0.814	0.672
Left sphenoid sinus	0.385	0.101	0.901	0.061	0.546	0.058	0.516	0.164	0.769	0.338	0.017 (r=0.42)	0.156	0.73	0.264	0.15	0.387	0.187	0.984	0.158
Right osteomeatal complex	0.559	0.583	0.823	0.495	0.632	0.236	0.805	0.207	0.747	0.095	0.296	0.577	0.11	0.015 (r=0.22)	0.944	0.06	0.07	0.446	0.063
Left osteomeatal complex	0.764	0.406	0.256	0.822	1	0.814	0.336	0.245	0.696	0.067	0.106	0.063	0.051	0.02 (r=0.35)	0.489	0.225	0.509	0.21	0.615
Total Lund Mackay score	0.356	0.605	0.356	0.605	0.975	0.585	0.058	0.415	0.158	0.083	0.72	0.01 (r=0.52)	0.191	0.002 (r=0.45)	0.278	0.528	0.483	0.489	0.434

*RMP: Right maxillary pain; LMP: Left maxillary pain; RpoP: Right periorbital pain; LpoP: Left periorbital pain; RFP: Right frontal pain; LFP: Left frontal pain; PFPa: Pan-facial pain; PFPr: Pan-facial; NB: Nasal blockage; ND: Nasal discharge; TP

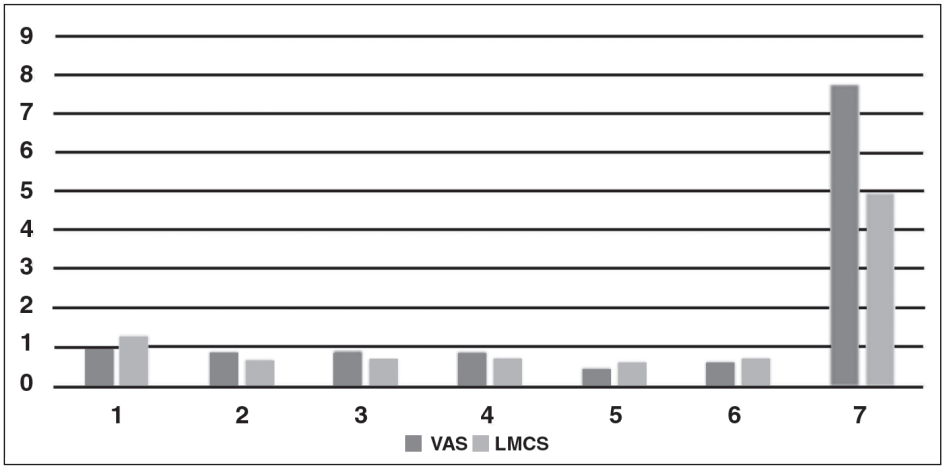

Figure 1
Relationship between the topographic visual scale score and topogaphic CT findings. VAS- visual scale score – LMCS –Lund Mackay Score. The numbers on the x axis correspond to the following: 1: right maxilla; 2: left maxilla; 3: right ethmoid; 4: left ethmoid; 5: right frontal; 6: left frontal; and 7: total VAS – total LMCS.

- Right frontal sinus disease – right frontal region pain;
- Left frontal sinus disease – left frontal region pain;
- Right sphenoid sinus disease – right periorbital region pain;
- Left sphenoid sinus disease – left periorbital region pain;
- Right anterior ethmoid and posterior ethmoid disease – right periorbital region pain;
- Left anterior ethmoid and posterior ethmoid disease – left periorbital region pain;
- Right anterior ethmoid and posterior ethmoid disease – right maxillary region pain; and
- Left anterior ethmoid and posterior ethmoid disease – left maxillary region pain (Figure 1).

However, no association was found between the topography of the disease and topographic paranasal CT scores.

According to these findings, hyposmia, tooth pain, and halitosis were notable parameters when dealing with a chronic sinusitis patient.

Conclusion

According to our study, patients with hyposmia should be examined to rule out anterior ethmoid sinusitis; patients with halitosis to rule out osteomeatal complex problems and posterior ethmoid sinusitis; and patients with tooth pain to rule out maxillary sinusitis and sphenoid sinusitis. However, there was no valuable relationships between topographic symptoms and paranasal sinus findings.

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Ozgur Kemal, M.D.
Yesildere mah. Alaçam cad. Mimoza evleri c blok 75/41
55200 Atakum, Samsun/Turkey
Tel.: +90 5326843221
E-mail: drozgurkemal@gmail.com