

Correlation between symptoms and radiological findings in patients of chronic rhinosinusitis: a modified radiological typing system*

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SUMMARY

Background: CT scan and nasal endoscopy are increasingly being used in diagnosing and treating patients of chronic rhinosinusitis. Though CT scan accurately depicts the sinus pathology its use as a proxy in assessing the symptom severity of patients is debatable. In this study the symptom severity of chronic rhinosinusitis was correlated with the author's modified CT scan score.

Methods: The study involved the examination of symptom severity and CT scan scores of a series of 240 adult patients with chronic rhinosinusitis. The CT scans were evaluated and scored as per author's modified CT scan staging. The pathology at ostiomeatal complex was analysed for its association with severity of symptoms.

Results: The mean CT score of group B patients (8.35) was found to be significantly higher than patients of group A (3.22). In maxillary and frontal sinus there was a statistically significant association of group B patients (moderately severe and severe symptoms) with stage IV of CT scan stage. Although the symptom score of patients with pathology at the ostiomeatal complex on CT scan was found to be higher in group B there was no correlation with anatomical variations at the ostiomeatal complex.

Conclusions: The study group showed a statistically significant increase in the sinus involvement and CT scan scores with increasing symptom severity. The study indicates a strong association between the symptom severity of chronic rhinosinusitis patients with CT scan scores, with the scores calculated using modified CT scoring criteria. These criteria would help the clinician to accurately predict symptom severity by CT scan scores.

Key words: CT scan scores, chronic rhinosinusitis

INTRODUCTION

Rhinosinusitis despite its high incidence, potentially serious effects on quality of life, and major economic impact, still poses a challenge in its diagnosis and treatment. The diagnosis of chronic rhinosinusitis (CRS) is based on physical examination and clinical criteria as per Task Force on Rhinosinusitis⁽¹⁾. Due to the subjective nature of these criteria, computed tomographic (CT) scan with nasal endoscopy has become a useful adjunct in the diagnosis and management^(1,2). To provide an objective analysis of disease severity various CT scan scoring systems are in use.

The patients of CRS usually present with varying degrees of disease and symptom severity, which have been graded in the literature as per various symptom scores. The association between symptom severity and CT scan findings has been a matter of debate with studies providing conflicting reports⁽³⁻⁶⁾.

In this study the association of symptom severity of CRS with the authors modified CT scan score has been analysed.

MATERIAL AND METHODS

Study design

The study involved the examination of symptom severity and CT scan scores of a series of 240 adult patients who attended the out-patient department with symptoms of CRS. Standard demographic information including age, sex and medical comorbidities were collected. Eligibility criteria for inclusion were 1) established clinical criteria for diagnosis of CRS, 2) confirmatory radiographic findings of CRS, 3) age > 16 years and 4) no history of nasal and paranasal surgery in the past.

The exclusion criteria were pregnancy, significant psychological problems, inability to comply with the study protocol, age less than 16 years, previous nasal and paranasal surgery, systemic diseases preventing participation in the study and medical and/or surgical treatments influencing the study.

Patients who were clinically diagnosed as per major and minor symptom criteria for rhinosinusitis underwent detailed clinical and physical examination followed by diagnostic nasal endoscopy using rigid nasal endoscope. The clinical findings included nasal obstruction, discharge, polyps in nasal cavity and eliciting paranasal sinus tenderness in rhinological examination. The endoscopic examination indicating CRS were presence of oedema, mucopus in the meatus and polyps obstructing the drainage of sinus. Each patient completed a questionnaire, which catalogued the severity of disease as mild, moderate, moderately severe and severe symptoms in a scale of 1 to 4.

CT scan

The patients with clinically and endoscopically proven rhinosinusitis underwent a sinus protocol CT scan in true coronal and axial plane. The CT scans were evaluated and scored as per authors modified CT scan staging. The modified CT scan staging scores each sinus (maxillary, frontal, ethmoids and sphenoid) in a stage of I to IV with points 0, 1, 2 and 3. Left and right sides were staged separately and the total scores ranged from 0 to 24 (Table 1).

As the ostiomeatal complex (OMC) is a vital area of sinus drainage and pathology at this site can lead to involvement of multiple sinuses the author has considered the disease at the OMC on CT scan separately. The pathology at OMC was analyzed with the degree of severity of symptoms for its significance. The anatomical variations at the OMC were also evaluated for its association with pathology at OMC on CT scan.

The study population was divided into two groups; patients with mild and moderate symptoms in group A and patients with moderately severe and severe symptoms affecting their daily routine and quality of life in group B. The various parameters compared between group A and group B were symptom severity, CT scan findings of involvement of sinus (maxillary, frontal, ethmoid and sphenoid), involvement of OMC and the CT scan scores. All patients of group B who did not improve with maximal medical therapy were advised surgery.

Statistical analysis

The data was tabulated in an excel spreadsheet which was then exported to SPSS Ver 10.0 for analysis. Statistical analysis of the data was performed using the student t-test to compare the patients of both groups. The correlation coefficient between

Table 1. Authors modified CT scan scores.

Stage	Findings on CT scan	Points
I	No opacity	0
II	Mucosal thickening and opacity less than 25 % of sinus	1
III	Mucosal thickening and opacity more than 25 % and less than 50 % of sinus	2
IV	Mucosal thickening and opacity more than 50 % of sinus	3

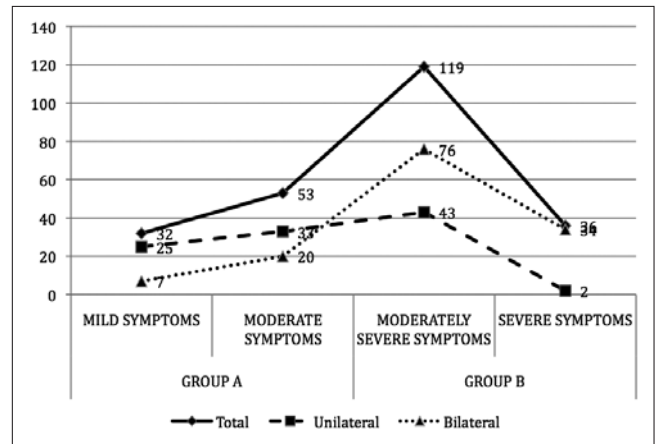


Figure 1. Sinus involvement in CT scan.

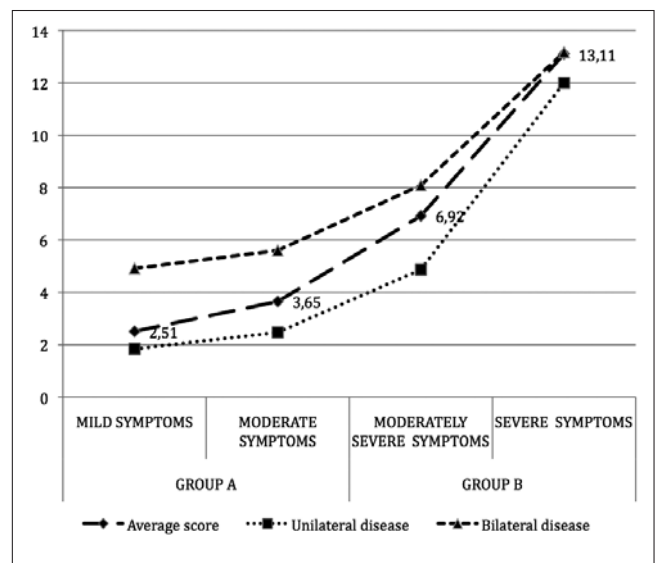


Figure 2. Average CT scan scores.

the symptom severity and the CT scan scores were performed to analyze the statistical significance. The statistical significance was set to $p < 0.05$.

RESULTS

The severity of symptoms of 240 patients of CRS was analyzed with respect to their CT scan scores as per the authors modified scoring system. The study group included 94 males and 146 females with a male-female ratio of 1: 1.5. The age of the patients ranged from 18 to 61 years with a mean age of 32.2 years.

Among the patients, 32 (13.3%), 53 (22.1%), 119 (49.6%) and 36 (15%) had mild, moderate, moderately severe and severe symptoms respectively. Eighty-five (35.4%) patients were of group A and 155 (64.6%) patients were of group B who had symptoms, which restricted their daily routine or sleep and affected their quality of life (Figure 1).

On analysis of the CT scans 103 (42.9%) patients had unilateral and 137 (57.1%) had bilateral disease. Among patients with

Table 2. Sinus involvement in CT scan as per symptom severity.

		Group A		Group B	
		No of patients (%)		No of patients (%)	
		Mild symptoms	Moderate symptoms	Moderately Severe symptoms	Severe Symptoms
Maxillary sinus	Unilateral	08 (32%)	23 (69.7%)	36 (83.7%)	02 (100%)
	Bilateral	03 (42.9%)	11 (55%)	60 (78.9%)	32 (88.9%)
Frontal Sinus	Unilateral	05 (20%)	09 (27.2%)	30 (69.7%)	02 (100%)
	Bilateral	0	04 (20%)	52 (68.5%)	30 (88.4%)
Ethmoid sinus	Unilateral	18 (72%)	19 (57.6%)	30 (69.8%)	02 (100%)
	Bilateral	04 (57.2%)	13 (65%)	44 (57.9%)	28 (77.8%)
Sphenoid sinus	Unilateral	04 (16%)	04 (12.2%)	12 (27.9%)	02 (100%)
	Bilateral	0	02 (10%)	34 (44.7%)	26 (72.3%)

Table 3. Involvement of sinus as per CT scan stages.

Sinus		Group A				Group B			
		Stage I	Stage II	Stage III	Stage IV	Stage I	Stage II	Stage III	Stage IV
Maxillary sinus	Unilateral	27 (46.6%)	21 (36.2%)	8 (13.8%)	2 (3.4%)	7 (15.6%)	8 (17.8%)	9 (20%)	21 (46.7%)
	Bilateral	13 (48.2%)	8 (29.7%)	4 (14.9%)	2 (7.5%)	18 (16.4%)	12 (10.9%)	15 (13.6%)	65 (59%)
Frontal sinus	Unilateral	44 (75.9%)	12 (20.7%)	2 (3.5%)	0	13 (28.9%)	4 (8.9%)	7 (15.6%)	21 (46.6%)
	Bilateral	23 (85.2%)	0	4 (14.9%)	0	28 (25.4%)	9 (9.2%)	26 (23.6%)	47 (42.7%)
Ethmoid sinus	Unilateral	21 (36.2%)	22 (37.9%)	9 (15.5%)	6 (10.3%)	13 (28.9%)	8 (17.8%)	13 (28.9%)	11 (24.4%)
	Bilateral	10 (37.1%)	4 (14.9%)	7 (25.9%)	6 (22.2%)	38 (34.6%)	11 (10%)	16 (14.5%)	45 (40.9%)
Sphenoid sinus	Unilateral	50 (86.2%)	6 (10.3%)	2 (3.4%)	0	31 (68.9%)	3 (6.7%)	7 (15.5%)	4 (8.8%)
	Bilateral	25 (92.6%)	0	0	2 (7.4%)	50 (45.5%)	11 (10%)	15 (13.6%)	34 (30.9%)

unilateral disease 58 (68.3%) were of group A and 45 (29.1%) were of group B. In bilateral disease 27 (31.9%) and 110 (70.9%) patients were of group A and B respectively. The patients of group B had a higher involvement of bilateral sinuses, which was found to be statistically significant ($p < 0.05$) (Figure 1).

Maxillary sinus was the most commonly involved sinus in 175 (72.9%) patients followed by ethmoids 158 (65.8%), frontal sinus 132 (55%) and sphenoid sinus 84 (35%). The CT scans showed a statistically significant involvement of sinuses with increase in symptom severity with patients of group B showing a higher involvement as compared to group A ($p < 0.05$) (Table 2).

Among the various CT stages it was observed that group A patients had a correlation with stage I of CT score whereas group B patients were significantly associated with stage IV of maxillary and frontal sinus (Table 3).

The mean CT scores of patients with mild, moderate, moderately severe and severe symptoms were 2.51, 3.65, 6.92 and 13.11

respectively. Group B patients (8.35) demonstrated a significantly higher mean CT scores than group A (3.22) (Figure 2).

The pathology at OMC on CT scan was observed in 182 (75.8%) patients. In these patients, 8 (25%) patients had mild symptoms, 30 (55.5%) patients had moderate symptoms, 108 (91.5%) patients had moderately severe symptoms and 36 (100%) patients had severe symptoms. The patients of group B demonstrated a statistically significant correlation with pathology at the OMC as compared to group A.

Concha bullosa in 77 (32.1%) patients was the commonest anatomical abnormality observed at the OMC in this study. Among the patients with anatomical abnormalities, pathology at the OMC on CT scan was seen in 31 (40.2%) patients with concha bullosa, 18 (50%) patients with abnormalities of uncinate process (medially everted blocking OMC, atelectatic, pneumatized and polypoidal) and 10 (37.1%) patients with large agger nasi cell. The above findings failed to demonstrate an association between anatomical abnormalities and pathology at the OMC (Table 4).

DISCUSSION

Chronic rhinosinusitis (CRS) is a term that has been used to describe a number of entities characterized by chronic symptoms of nasal and sinus inflammation or infection. It is a common health problem that leads to frequent visits to primary care physicians and to the otolaryngologist⁽⁷⁾. As CRS encompasses a spectrum of diseases, there has been a lack of consensus regarding diagnosis, staging, pathophysiological features, medical and surgical management. A significant advance in the diagnosis of CRS came with the American Academy of Otolaryngology's Task Force on CRS, with the delineation of clinical criteria for the diagnosis of CRS^(1,2). Though the diagnosis of CRS as per the Task Force criteria is based on clinical grounds, the use of nasal endoscopy and CT scan helps in making specific diagnosis and treatment^(1,2).

The manifestations of CRS and its effect on the physical, psychological and quality of life have been studied extensively using various subjective indices (Rhino sinusitis Symptom Inventory, SNOT 20, Rhino sinusitis Disability Index, SNOT 16 etc). As CRS includes a spectrum of diseases and symptoms, each patient may have a different perspective of the symptoms, its severity and its effect on the quality of life. Also patients usually have one or more symptoms that are clearly more bothersome affecting their quality of life than the complete diagnostic symptom criteria for CRS. In view of the social and educational background of our patients we found that these indices used for staging symptom severity were difficult for the patients to comprehend and were not repeatable. So in this study the author has used a simple staging system to grade symptom severity in a scale of 1 to 4 based on the affect of CRS on the patient's daily routine and sleep.

CT scan for CRS is extensively used by the clinician for delineating the anatomy of sinus, identifying anatomical abnormalities, judging disease severity and as a road map for surgery^(2,8). To provide an objective data for disease severity several CT scan staging score like Lund Mackay, Kennedy, Edward etc are in vogue with the preferred system being Lund Mackay score^(8,9). In an initial analysis of CT scan of patients of CRS in our institute, the symptom severity failed to demonstrate a correlation with the recognized CT scoring systems. The first area of bias with the recognized CT scoring system were high CT scan scores in patients with presence of mucosal thickening and isolated polyps in the sinus with no symptoms of CRS. These incidental findings on CT scan were commonly found in patients with allergy and also are a feature of common cold⁽¹⁰⁾ and asymptomatic individuals⁽¹¹⁾. So these findings in patients without complaints of CRS had led to question the specificity of these objective CT scores in detecting CRS^(12,13). In view of the above the author in this study has proposed a modified CT scan score in the scale of I to IV, which reduces the weight of such incidental findings and improves the sensitivity of CT findings with respect to symptom severity. The second area of

bias with the high CT scan scores of the ethmoids was due to inter observer variability both with ENT surgeons and radiologists in clearly delineating anterior and posterior ethmoids⁽¹⁰⁾ as well as the ethmoids and the OMC⁽¹⁴⁾. Hence to eliminate the observer bias the author has considered both ethmoids as one entity for scoring disease in CT scan. Due to the importance of the OMC, the pathology at this site on CT scan has been considered separately and assigned significant weightage in predicting symptom severity.

Various studies have attempted to determine an association between the subjective scores of symptom severity and the objective CT scan data with conflicting reports. Basu et al., Holbrook et al., and Liu et al. have analyzed the symptom score by SNAQ, VAS and Sinusitis outcome score with the CT score of Lund Mackay and found no correlation between CRS symptoms and objective examinations⁽¹⁴⁻¹⁶⁾. The above studies lack correlation due to the absence of symptoms of CRS in a large number of patients with CT scan findings as well as symptomatic patients with minimal sinus disease on CT scan. Contrary to the above findings Wabnitz et al. and Arango et al. in their analysis have found a statistically significant correlation between symptoms and CT score^(4,6). In this study a statistically significant association was found between the symptom severity and the author's modified CT scan scores. The patients in the group B who had symptom severity affecting their daily routine and sleep had a statistically significant increase in the CT scan scores.

On analysis of the individual sinus, involvement of maxillary and frontal sinus was associated with increased symptom severity. Group B patients showed a significant association with stage IV of maxillary and frontal sinus. These findings are contrary to report of no association of complete opacification of sphenoid and frontal sinus with symptom severity⁽¹⁷⁾.

As the ostiomeatal complex (OMC) is a key anatomical area leading to drainage of major sinuses, so anatomical variations that redirect nasal airflow or narrow the OMC have been implicated in the development of CRS⁽¹⁸⁾. In this study patients with pathology at OMC had involvement of multiple sinuses and were found to have an association with increased symptom severity and group B. These findings reiterate the rationale of clearance of disease in the OMC for better results and lesser recurrence (Table 4).

Table 4. Anatomical abnormalities at the ostiomeatal complex.

Anatomical abnormalities	Study group	Pathology at OMC on CT scan
Concha bullosa	77 (32.1%)	31 (40.2%)
Abnormal uncinate process	36 (15%)	18 (50%)
Large agger nasi	27 (11.2%)	10 (37.1%)

Table 5. Authors criteria for symptom severity by CT scan scores.

Group A (Mild and Moderate symptoms present but not interfering with work or daily routine)	Group B (Severe symptoms present interfering with daily routine or sleep)
Score of < 5 for unilateral and < 8 for bilateral disease (without Stage IV in any sinus)	<ul style="list-style-type: none"> • Score of > 5 for unilateral, >8 for bilateral disease.
	OR
	<ul style="list-style-type: none"> • Stage IV in maxillary OR frontal sinus.
	OR
	<ul style="list-style-type: none"> • Pathology at OMC

The anatomical abnormalities seen on CT scan and nasal endoscopy in this study were concha bullosa (pneumatized middle turbinate), paradoxically angulated middle turbinate, abnormalities of the uncinate process, large pneumatized agger nasi and pneumatized and polypoidal uncinate process. The relative importance of anatomical variations is still a matter of contention with studies showing variable reports. Kim et al., Lerdlum et al., and Stallman et al. have shown in their studies no specific association of anatomical variations in CRS and have described local, systemic, environmental factors or intrinsic mucosal disease to be more significant in the pathogenesis of CRS⁽¹⁹⁻²¹⁾. Calhoun et al. have described a causal association of concha bullosa with CRS⁽²²⁾. In this study there was absence of association between anatomical abnormalities and pathology at the OMC on CT scan.

In view of the above findings the author proposes a criterion for predicting the symptom severity by CT scan in patients with CRS (Table 5).

CONCLUSIONS

CRS includes a spectrum of disease with multiple symptoms and manifestations. The use of CT scan in diagnosing CRS as well as an aid in treatment is widely accepted. Though logically there should be a strong association between symptom severity staging and CT scan scoring systems, a large number of studies in literature have shown no association between them. The rationale may be due to the fact that both the subjective symptom staging and the objective CT scan scores have been designed or formulated separately for different outcomes. So to find an association between the two systems may not be appropriate.

The objective of this study was to evaluate a modified combined scoring system for symptom severity and CT scan scoring which would have an association with each other as well as a criterion to aid the clinician in positively predicting the disease severity.

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OBITUARY

Professor Alexandros Coyas 1925-2009

It is with great regret that we announce the death of Alexandros Coyas who made a most significant contribution to rhinology both at home in Greece and on the wider international stage. Alexandros was born in Alexandria, Egypt on 18/3/1925 and subsequently undertook his medical degree at Athens University between 1946 and 1952. He undertook his ENT training in Athens, Paris and Salisbury, UK and returned to Athens in 1955 where he worked in the University ORL Clinic until 1974, ultimately as Associate Professor. His excellent teaching abilities contributed to his appointment as Director of the ORL Clinic, Athens General Hospital from 1974 until his retirement Dec 1992.

Professor Coyas was well-known to rhinologists worldwide, representing Greece on the ERS boards for many years and becoming ERS president for the 1986-88 period, during which he ran a very successful meeting in Athens. In addition he was a member of the Collegium ORLAS from 1964 and president of the Panhellenic ORL Society in 1969. He conducted a number of important studies on allergic rhinitis, published many works in Greek and international journals and was invited to give many international lectures. He was a cultured and considerate man, always polite, calm and eager to interact intellectually with colleagues and trainees alike. Indeed he trained a whole generation of ENT surgeons in Greece.



He always behaved like a real '*gentleman*' throughout his social and professional life and as a consequence, this was the affectionate nickname which he was given by his friends.

He died on the 26th of February 2009 and will be missed by family, friends and colleagues.