R. Zojaji MD[1]
M. Mirzadeh MD[2]
S. Naghibi MD[3]

Comparative Evaluation of Preoperative CT Scan and Intraoperative Endoscopic Sinus Surgery Findings in Patients with Chronic Rhinosinusitis

Background/Objective: Chronic rhinosinusitis (CRS) is a common condition in medical practice. The diagnosis generally relies on clinical judgment, but computed tomography (CT) together with sinonasal endoscopy, provide the majority of the objective data.

This study was carried out to determine the agreement between preoperative CT findings and intraoperative endoscopic sinus surgery (ESS) findings in patients with CRS.

Patients and Methods: Statistical analysis of collected data from paranasal sinus CTs of 51 patients aged between 15 and 77 who subsequently underwent ESS for CRS at two training hospitals during a 2-year period, was performed.

The agreement between CT and ESS findings was assessed by Kappa statistics, Chi-square and t test were also used for data analysis.

Results: The most common co-morbidity found among the patients with chronic sinusitis was allergy in 18 (35%) patients. Hypertrophy of the inferior turbinate was the most obvious finding in CT (71%) and during endoscopic evaluation (69%). No significant correlation was found between clinical symptoms and gender or the length of disease. In 8 unusual patients (one with choanal atresia, one with bone wax in nasal cavity, and 6 with small polyposis), CT could not show the problem. There are good to excellent agreements between the two diagnostic procedures, except for the choanal atresia, which showed no agreement (κ=0).

Conclusion: The results of nasal fossa findings obtained by nasal endoscopy are more conclusive in the elucidation of diagnosis than those obtained by paranasal sinus CTs. In spite of a good agreement between CT and ESS findings in most patients, it seems in some unusual cases, CT may miss many patients.

Keywords: Chronic Rhinosinusitis, Paranasal Sinuses, Computed Tomography, Endoscopic Sinus Surgery

Introduction

The impact of chronic rhinosinusitis (CRS) has been well documented. It is a common condition in medical practice, which affects many people worldwide and its prevalence is rising.[1,2]

The diagnosis of CRS relies on clinical judgment based on a number of subjective symptoms and few findings in physical examination. These symptoms and signs are inherently vague and because of the uncertainty associated with the diagnosis of CRS, it is necessary to have data that are more objective about the extent of the disease.[1,3]

When combined with sinonasal endoscopy, computed tomography (CT) provides the majority of objective data used to diagnose CRS. It has high sensitivity and provides objective findings regarding the condition of the nasal mucosa, paranasal sinuses and the presence of fluid or polyps. Furthermore, CT findings are an integral part of several severity staging systems that are used for CRS.

1. Assistant Professor, Department of Otolaryngology, Islamic Azad University, Mashhad, Iran.
2. Assistant Professor, Department of Pediatrics, Islamic Azad University, Mashhad, Iran.
3. Assistant Professor, Department of Radiology, Islamic Azad University, Mashhad, Iran.

Corresponding Author:
Morteza Mirzadeh
Address: Department of Pediatrics, 22 Bahman Teaching Hospital, Kuye Tollab, Mashhad, Iran.
Tel: +98511-844-6163
Fax: +98511-257-3500
E-mail: mirzadeh44@gmail.com

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However, because studies have failed to correlate these staging systems to disease severity, many authors have advocated the use of CT as a tool in evaluating anatomy and for preoperative planning only.[2]

Endoscopic sinus surgery (ESS) has evolved as an effective treatment option, and indeed, is the treatment of choice for medically refractory CRS with excellent success rates.[4] Sinonasal endoscopy provides many useful objective data regarding the sinonasal disorders.[5]

Technical developments in computer-assisted tomography such as multidetector CT (MDCT) and CT virtual reality techniques can help the surgeon and increase the diagnostic accuracy.

Virtual CT endoscopy is a novel three-dimensional reconstruction technique that is characterized by strong magnification and distortion of perspective. It simulates true optical endoscopy with the view restricted to the target organ. Axial MDCT with secondary multiplanar reformation (MPRs) provides the necessary preoperative information regarding the extent of the disease and sinus anatomy.[6] Furthermore, MDCT of the paranasal sinus possesses the potential for a reduction in the radiation dose by 20%.[7] Given this finding and the fact that low-dose MDCT delivers a radiation dose not higher than that delivered by a four-view radiographic examination, low-dose MDCT should be considered as the imaging method of choice in patients with suspected chronic sinusitis.[8]

Planned endoscopic paranasal sinus surgical sites can be easily and reliably highlighted using CT virtual reality techniques with respect to the patient's normal endoscopic anatomy.[9]

In spite of these, little is known about the agreement or discrepancy between findings of CT scan and ESS in sinonasal disorders. One of the studies showed that the result of nasal fossa findings obtained by nasal endoscopy were more conclusive in the elucidation of diagnosis than those obtained by CT of the paranasal sinuses.[10]

This study was carried out to determine the level of agreement between preoperative CT and intraoperative ESS findings in patients with CRS.

Patients and Methods

This cross-sectional study consisted of 51 patients aged from 15 to 77 years who were presented to the ENT department at two training hospitals in Mashhad, northeastern Iran.

At the time of presentation, a careful history was taken. It included current medications used, allergy status, asthma, and previous surgical procedures. All patients were asked to complete a preoperative questionnaire inquiring subjective CRS symptoms including nasal obstruction, rhinorrhea, postnasal discharge (PND), headache, facial pain/pressure, and/or olfactory disturbances, and CRS-related symptoms such as cough and asthma.

The diagnosis of CRS was made using the American academy of otolaryngology, head and neck surgery definition, which describes typical symptoms persisting for 12 weeks or more. All patients had previously failed medical management for their CRS, including topical nasal steroids, systemic decongestants, and extended courses of antibiotics, so they were candidates for functional endoscopic sinus surgery (FESS).

Preoperative coronal and axial paranasal sinus CT scans were obtained on all patients with high resolution and slice thickness of five mm (Spiral CT Scan, Philips, model RX8000, dual slice, kV = 140, MAS = 450, Pitch = 1, slice thickness = 3 mm, thickness interval = 5 mm) (Figs. 1A-D). The results were evaluated in details by an expert radiologist who also completed an objective questionnaire, which included septum deviation, hypertrophy of inferior turbinate, concha bullosa, sinus involvement, mucosal thickness, narrowing or partial obstruction of ostiomeatal complex (OMC), presence of polyps, cysts or masses for each patient.

Patients then underwent FESS by one of the authors (RZ) using the Messerklinger technique. He also completed an objective questionnaire for patients. All surgeries were performed using an Olympus–otolaryngologist–A7594.

Informed consent was obtained from each patient before surgery.

Statistical Analysis

The data from data collection forms were tabulated in a Microsoft Excel® spreadsheet. Data were then exported to SPSS, ver 10.0 for statistical analysis. The level of agreement between CT and ESS findings was determined by calculating kappa statistics. Chi-square

Table 1. Background Information in 51 Patients Who Underwent Sinus Endoscopy

Concerning Factors	No. of Patients	Percents
CRS Symptoms		
Nasal obstruction	51	100
Facial pain / Headache	37	73
Rhinorrhea	46	90
Hyposmia	15	29
CRS-Related Symptoms		
Cough	11	22
Asthma	6	12
Previous Sinus Surgery		
Yes	5	10
No	46	90
Co-morbidities		
Allergy	18	35
History of trauma	8	16
Smoking		
Yes	11	22
No	40	78

and *Student's t* tests were used for statistical analyses. P value <0.05 was considered statistically significant.

Results

Fifty-one patients with a mean age of 33 (range: 15–77) years were enrolled in this study, which was performed during a 20-month period from 2003 to 2005. There were 35 male (69%) and 16 female (31%) patients.

As mentioned previously, in all patients, CRS was diagnosed when the symptoms and signs were present for at least 12 weeks, according to the criteria established by the rhinosinusitis task force of the American academy of otolaryngology, head and neck surgery.

Rhinorrhea and PND were the most common clinical symptoms which were observed in all patients.

More than half of the patients had a comorbidity that may potentially influence sinus-related diseases. The most common comorbidity among our patients was allergy observed in 18 (35%) patients. Furthermore, the frequency of asthma and a history of head and/or face trauma was six (12%) and eight (16%), respectively.

Table 1 presents background information regarding our patient population. Over 60% of the patients mentioned the history of their symptoms back to more than one year before referral.

CT and ESS Findings

Paranasal sinus CT scanning was obtained for all of the patients. The involvement of various sinus groups is listed in Table 2. Overall, 47 (92%) patients showed abnormality in one or more sinus groups. The maxillary sinuses were most commonly affected, with changes seen in 42 (82%) patients, followed by the ethmoidal sinuses with changes seen in 28 (54%) patients; the least affected sinuses were the frontal and sphenoid sinuses, with 10 (20%) and 13 (25%) patients, respectively (Table 2). Twenty-seven (53%) patients had abnormalities in more than one sinus group; the maxillary and ethmoid were the most common combination (n=11; 22%). Forty percent of the sinus involvements were unilateral; in 6% the involvemnent was bilateral. Six (12%) patients showed bilateral pansinusitis (Table 3).

The incidence of abnormal findings shown by sinus CTs and those observed during ESS are listed in Table 4. Hypertrophy of the inferior turbinate was the most common abnormal finding in both techniques.

Agreements between CT and ESS were computed for each of the pathologic findings separately (Table 4). There are good to excellent agreements between the two diagnostic procedures, except for the choanal atresia, which showed no agreement (κ=0).

Table 2. The Involvement of Various Sinus Groups Demonstrated by CT Scan

Sinus Group Involvement	No. of Patients	Percents
Maxillary	42	82
Ethmoidal	28	55
Sphenoidal	13	25
Frontal	10	20

Table 3. Patterns of the Simultaneous Involvement of Various Sinus Groups, Shown by CT Scan

Numbers of Simultaneously Involved Sinus Groups	No. of Patients	Percents
None	4	8
One	20	39
Two	13	25
Three	8	16
Four	6	12
Total	51	100

In eight unusual cases, ESS demonstrated abnormalities that CT could not detect. They included one case of choanal atresia, a patient with "bone wax" which remained in the nasal cavity from a previous surgery (dacryocystorhinostomy (DCR) done by an ophthalmologist), and six with small polyposis.

No significant associations were found between clinical symptoms and gender or length of the illness (all p values > 0.05).

Discussion

CT has become the standard diagnostic tool in the evaluation of paranasal sinuses. When coupled with nasal endoscopy, it provides most of the objective data needed for diagnosing CRS.[11,12] Despite the widespread use of CT, its true accuracy in diagnosing CRS is less clear.[2]

The aim of this study was to determine the agreement between preoperative CT and intraoperative ESS findings in patients with CRS. The results of our study indicated that although for most of the findings, there was a good to excellent level of agreement between the results of the two methods, some discrepancies existed in eight of the patients. Seven of these patients had normal CT imaging based on the radiologist's report, while six of them demonstrated nasal polyps during ESS evaluation and one was diagnosed as choanal atresia (Table 4). In the eighth case, a mass reported by the radiologist turned out to be a "bone wax" left in place from a previous ophthalmologic surgery. Similar findings were reported by other studies, in which patients who had negative CT scans, showed endoscopic exams with nasal polyposis and septum deviation.[1,13]

According to the present results, the finding of hypertrophic concha was more evidenced in CT scan compared to sinus endoscopy (86% *vs* 82%). This result is contradictory to the previous study, in which 16 (80%) out of 20 patients showed turbinate hypertrophy evidenced by nasofibroscopy and only nine (45%) of 20 patients showed the same affection at CT scan.[1] In 36 (70%) of 51 patients we found mucosal thickness evidenced by CT; only 31 (60%) of 51 patients had the same problem in ESS. This discrepancy may be due to the fact that up to 40% of asymptomatic individuals have incidental opacification of the pa-

Table 4. Agreements between CT and ESS in Patients with Chronic Rhinosinusitis

Finding	ESS Positive		ESS Negative		kappa
	CT scan Positive	CT scan Negative	CT scan Positive	CT scan Negative	
Choanal atresia	0	1	0	50	0
Mass	4	0	1	46	0.88
Cyst	7	0	0	44	1.00
Hypertrophy of the inferior concha	33	1	3	14	0.88
Hypertrophy of the middle concha	7	1	1	42	0.85
Septum deviation	27	4	1	19	0.81
Polyp	9	4	0	38	0.77
Mucosal thickness	29	2	5	15	0.70
Left OMC patency	33	2	0	16	0.84
Right OMC patency	32	3	0	16	0.87
Concha bullosa	4	0	3	44	0.70

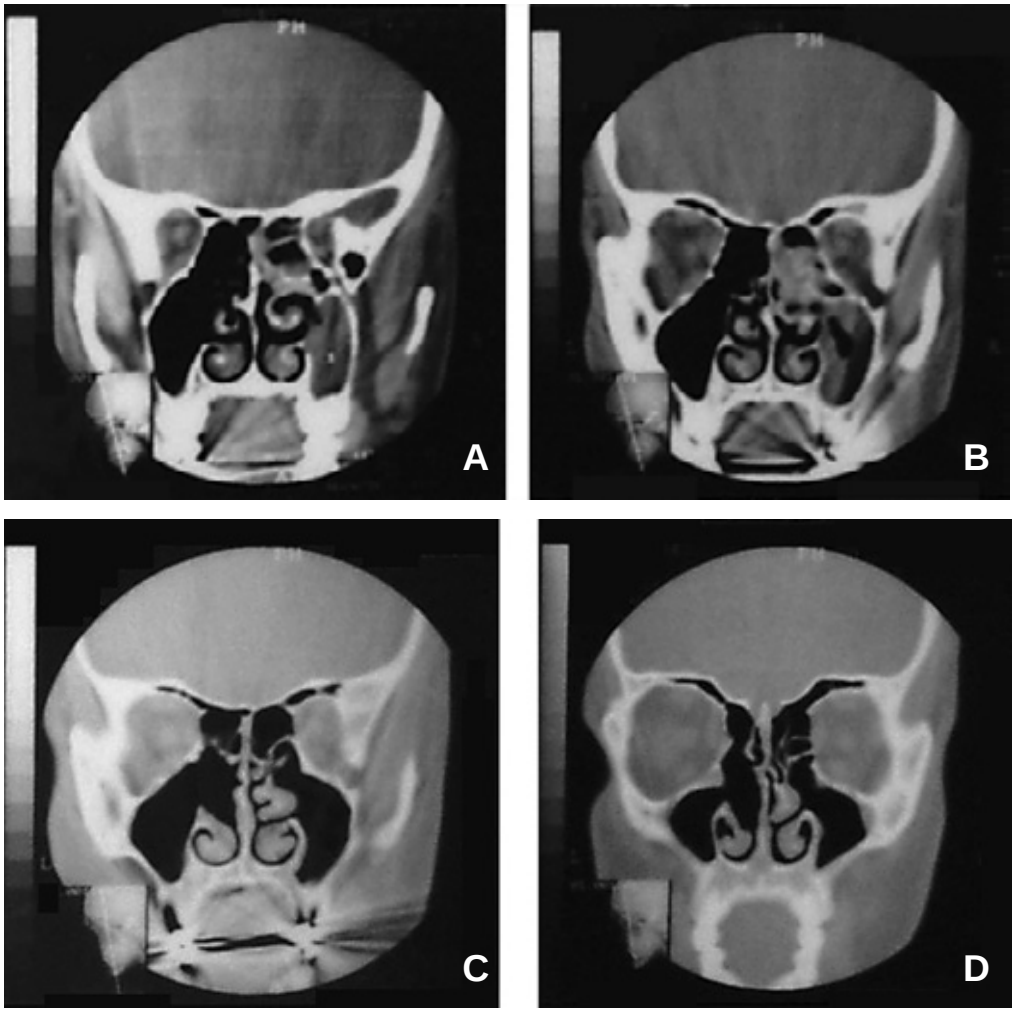

Fig. 1. Periorbital cellulitis due to right pansinusitis in a 22 y male.
A and B. Before surgery.
C and D. After FESS.

ranasal sinuses on CT.[10,11] In children, the prevalence of mucosal change is even larger.[12] A study by Jiannetto and Pratt found that operative findings are better consistent with the surgeon's CT scan interpretation than with the radiologist's CT report. Therefore, surgeon rated-CT scans form an important and reliable objective assessment tool for patients undergoing surgery for CRS.[13]

History remains the most important factor in predicting patients undergoing CT. No single intervention, questionnaire, or radiologic study is sufficient to make the diagnosis alone. If CT findings were not interpreted in the light of symptoms, many people who have incidental changes like a mass reported by CT scan turn out to be a bone wax in ESS, will be labeled as having sinus disease and will inadvertently undergo unnecessary surgery.[2] When combined with a directed and thoughtful history, endoscopy can yield valuable information regarding anatomic location and severity of the disease.[14] According to Morra, sinus endoscopy and CT can be considered complementary techniques for effective demonstration of nasal anatomy and paranasal sinuses.[15] Such statement is added to the theory that CT would be more specific for the assessment of paranasal sinuses and can serve as an anatomic map for the surgeon.[2]

In conclusion, the results of nasal fossa findings obtained by nasal endoscopy were more conclusive in the elucidation of diagnosis than those obtained by paranasal sinus CT. In spite of a good correlation between CT and ESS findings in most of the patients, it seems that CT may miss many patients.

Therefore, the results of CT scan should be interpreted in the light of medical history and the surgeon should note any specific diagnosis he has in mind when requesting paranasal sinus CTs.

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