ORIGINAL ARTICLE

Computed Tomography of Paranasal Sinus Pathologies with Functional Endoscopic Sinus Surgery/Nasal Endoscopy Correlation

Kiran Rao

ABSTRACT

A prospective study conducted on 50 patients in Sri Guru Ram Das (SGRD) Institute of Medical Sciences and Research, Amritsar, India, suffering from paranasal sinus diseases correlating the findings of computed tomography (CT) using Siemens somatom emotion 6 slice CT machine with diagnostic nasal endoscopy or functional endoscopic sinus surgery (FESS).

Infection of the paranasal sinuses is very common. Surgical clearance of these chronically infected sinuses while maintaining their ventilation and drainage is the treatment of choice. To achieve this goal, there should be some diagnostic modality which guides us towards exact diagnosis and safe intervention. Computed tomography proves to be the most reliable method of preoperative assessment of patients undergoing FESS as it delineates the extent of the disease, define any anatomical variants and relationship of the sinuses with the surrounding important structures. Thus, providing a road map for sinus surgery.

In our study, most patients were in the 3rd and 4th decades of their life with equal disease incidence in males and females. The most common sinus involved was anterior ethmoid sinus while sphenoid sinus was least commonly involved. Commonest pattern of inflammation was sinonasal polyposis followed by osteomeatal unit pattern. On correlating CT diagnosis with final diagnosis, chronic sinusitis has 86% sensitivity and 96.5% specificity. Polyps have sensitivity of 96.15% and specificity of 95.83%. Again for fungal sinusitis CT has lower sensitivity of 71.4% and specificity of 93.02%. For diagnosing benign and malignant lesions CT has 100% sensitivity, specificity, could be due to small number of masses evaluated. This study proved that CT is the modality of choice for evaluation and planning the management of symptomatic patients of paranasal sinus pathologies.

Keywords: Computed tomography scan, Functional endoscopic sinus surgery, Paranasal sinus pathology.

Associate Professor

Department of ENT, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, Punjab, India

Corresponding Author: Kiran Rao, Associate Professor Department of ENT, Sri Guru Ram Das Institute of Medical Sciences and Research, Amritsar, Punjab, India, Phone: 0183-2870200, e-mail: drkiranrao25@yahoo.com

INTRODUCTION

Pathological lesions of the paranasal sinuses include a wide spectrum of conditions ranging from inflammation to neoplasms both benign and malignant. These sinuses are in close anatomical relationship with orbit, cranial fossa and pterygopalatine fossa. Hence, early involvement of these areas is an important feature. Since clinical assessment is hampered by the surrounding bony structures, diagnostic radiology is of paramount importance.[1]

While conventional plain radiography readily demonstrates maxillary and frontal sinus disease they provide limited views of the anterior ethmoid cells, the upper two thirds of the nasal cavity and the frontal recess.[2]

Computed tomography (CT) imaging provides detailed information of the paranasal sinuses and is now well established as an alternative to standard radiographs.[3,4] Computed tomography scan has become modality of choice for evaluation of peripheral nervous system (PNS) pathologies as it optimally displays bony details, air and outlines soft tissue as well.

Infection of the paranasal sinuses is one of the commonest cause of patients visit to the otorhinolaryngologist. Surgical clearance of these chronically infected sinuses while maintaining their ventilation and drainage is the treatment of choice. To achieve this goal, there should be some diagnostic modality which guides us towards exact diagnosis and safe intervention. Over past decade, both CT and nasal endoscopy have been used successfully as diagnostic modality in sinus disease.

The principle of the surgery should be oriented towards opening up any restriction which might impair natural mucociliary clearance. To perform functional endoscopic sinus surgery effectively and safely, the surgeon must have detailed knowledge of the anatomy of the lateral nasal wall, paranasal sinuses and surrounding vital structures.

Computed tomography proves to be the most reliable method of preoperative assessment of patients undergoing functional endoscopic sinus surgery (FESS) as it delineates the extent of the disease, define any

anatomical variants and relationship of the sinuses with the surrounding important structures—thus providing a road map for sinus surgery. As a rule, surgeons individualize their surgical approach according to the amount and location of disease they see on CT scan.

Endoscopic techniques for paranasal sinus surgery have allowed detailed and complete visualization of sinus disease while promising minimum distress to the patient. The telescopic view shows detail of the sinus anatomy and its disease. It has been possible to see areas of the cribriform plate and orbital wall that are at risk to produce cerebrospinal fluid rhinorrhea and orbital complications during the surgery.

Combination of diagnostic endoscopy and systematic understanding of the lateral nasal wall with CT in the coronal plane has become the corner stone in the evaluation of the PNS disease. This is the basis of the new concept of FESS.

AIMS AND OBJECTIVES

- To diagnose the various pathologies of paranasal sinuses, like inflammatory disease, neoplasms and other miscellaneous conditions.
- To correlate the findings of CT with those of FESS/ diagnostic endoscopy.

MATERIALS AND METHODS

A prospective study correlating findings of CT in paranasal sinus diseases with diagnostic endoscopy or FESS was conducted on 50 patients in the Department of Radiodiagnosis, Sri Guru Ram Das Institute of Medical Sciences and Research (SGRDIMSR), Amritsar in conjunction with Department of ENT, SGRDIMSR.

Patients attended the ENT outpatient department with symptoms, like postnasal discharge, nasal obstruction, heaviness in the head or dull ache over sinus, anosmia, constitutional symptoms, like malaise, mental apathy, sore throat, cough, hoarseness, eustachian tube dysfunction, etc. and who were willing to undergo diagnostic nasal endoscopy/FESS.

Slices of 1.25 mm were taken in axial planes. Coronal sections were reconstructed. Osteomeatal complex was best displayed by coronal plane. The anatomy in coronal plane was depicted in a way similar to what surgeon saw as the nasal vault was approached with an endoscope. Contrast agent omnipaque was used if indicated, at a calculated dose of 300 mg/kg weight as a single intravenous bolus injection after serum creatinine level was estimated.

As per Glicklich et al graded the severity of sinus disease on CT-PNS findings. It is classified as:

- *Grade 0*: Less than 2 mm mucosal thickening on any sinus wall.

- *Grade 1*: All unilateral disease or anatomic abnormalities.
- *Grade 2*: Bilateral disease limited to the ethmoid or maxillary.
- *Grade 3*: Bilateral disease with involvement of at least one sphenoid or frontal sinus.
- *Grade 4*: Pansinus disease.

In this study, CT findings were entered in the patient proforma. Lund-Mackay scoring as shown in Table 1, was done for comparison in case of inflammatory lesions.

0 Point	No abnormality
1 Point	Partial opacification
2 Points	Total opacification

Total score recorded to show the severity of inflammatory disease.

Tasks force on rhino sinusitis sanctioned by the American Academy of Otolaryngology used Lund-Mackay CT staging system (Table 1) by scoring method.[4] This same staging system was used in our study as reference.

Endoscopic sinus surgery tailored according to the CT scan, was carried out. Any polypoidal or mass lesions were debrided or biopsy taken for histopathological examination and fungal culture in selected cases. Computed tomography PNS findings were correlated with diagnostic endoscopic/FESS findings. Sensitivity and specificity of CT findings were calculated using FESS findings as standard with reference to mucosal thickening, polypoidal mass lesions, involvement of adjacent bones and soft tissue.

OBSERVATIONS

A prospective correlational descriptive study of 50 patients who underwent CT-PNS was done and correlated with the final diagnosis after diagnostic endoscopy/FESS.

Table 1: Lund-Mackay staging system for chronic rhinosinusitis

Sinus		No abnormality	Partial opacification	Total opacification
Ant. ethmoid	R	0	1	2
	L	0	1	2
Post ethmoid	R	0	1	2
	L	0	1	2
Maxillary	R	0	1	2
	L	0	1	2
Frontal	R	0	1	2
	L	0	1	2
Sphenoid	R	0	1	2
	L	0	1	2
		Not obstructed	Obstructed	
Osteomeatal Complex	R	0	2	
	L	0	2	

In this study of 50 patients, (Graph 1) 8 patients were less than 20 years of age. Eleven patients were between 21 and 30 years. Eleven patients were between 41 and 50 years of age. Highest number of patients were in the range of 31 and 40 years. Youngest patient was 8 years and eldest patient was 85 years old.

In present study, 24 (48%) of total patients were females and 26 (52%) of patients were males. Most of the patients had nasal obstruction (60%) followed in decreasing order by headache (56%), nasal discharge (52%). The least common complaint was swelling in facial region.

Table 2 is showing various pathologies of paranasal sinuses on CT scan. Domain name system was seen in 22 (44%) patients with equal number of cases showing deviation on either side. Concha bullosa was noted in 9 (18%) patients with unilateral left sided predominance. Osteomeatal unit obstruction was observed in 42 (84%) patients with bilateral involvement seen in 21 (42%) patients.

Most commonly diseased sinus was anterior ethmoid sinus, followed in decreasing order were maxillary, posterior ethmoid, frontal and sphenoid sinuses.

Graph 2 is showing severity of inflammatory disease and grading is done as per Glicklich et al study. Computed tomography severity was assessed in 43 patients who had inflammatory diseases. Maximum number 16 (37.2%) of patients had grade 1 severity while grade 0 severity was found in none of the patients, least common was grade 2 seen in 6 (14%) of patients.
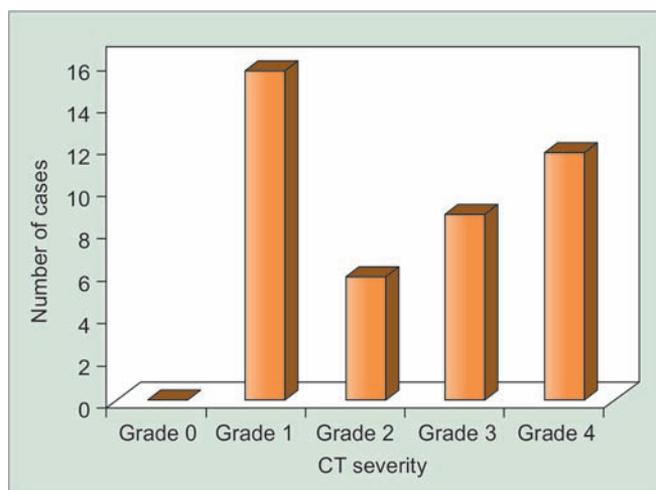
Graph 3 showing patterns of inflammatory disease on CT. Sinonasal polyposis was the most common type of pattern involved (40%), followed by OMU, infundibular, sporadic and sphenoethmoid recess patterns in decreasing order of involvement. Least common was sphenoethmoid type seen in 2% of cases.

As shown in Graph 4, endoscopic/FESS findings were similar to CT findings in 44 (88%) patients and different from CT findings in 6 (12%) patients. These different findings were related to either fungal disease or inspissated secretions.
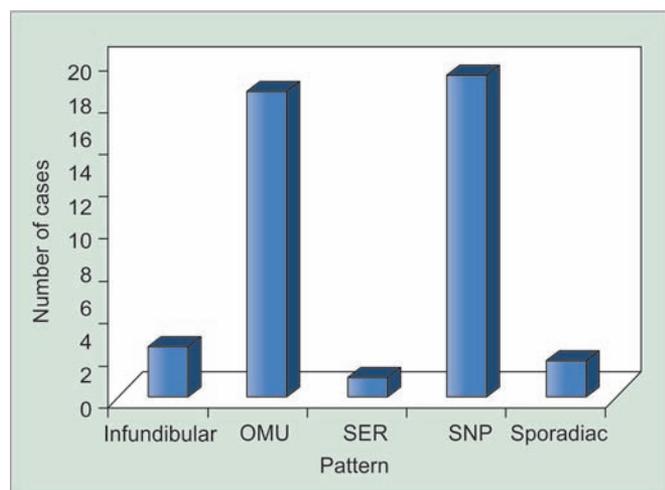
Table 3 is showing Lund-Mackay scores of inflammatory diseases maximum number 14 (32.6%) of patients had Lund-Mackay scores between 11 and 15 and minimum
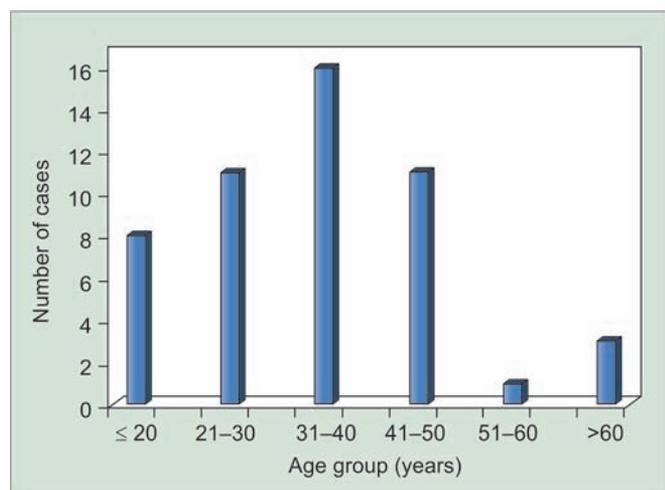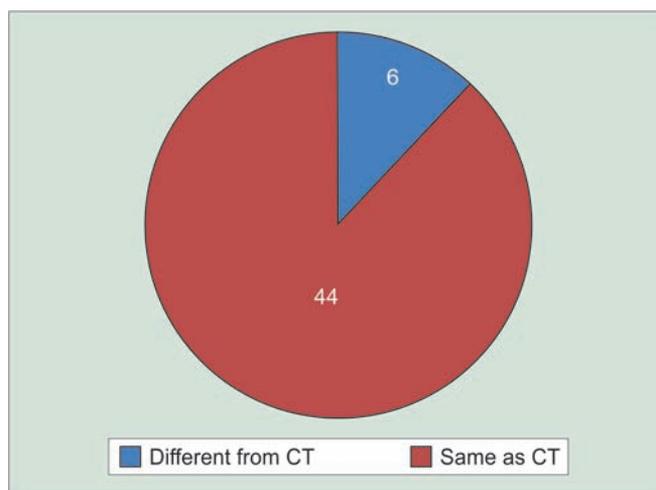

Graph 1: Age distribution of patients studied

Graph 2: Computed tomography severity grading of inflammatory diseases

Graph 3: Patterns of inflammatory disease on CT

Graph 4: Endoscopy/FESS findings

Table 2: Distribution of lesions according to CT-PNS

Investigations	Number (n = 50)	Percentage
DNS		
No	28	56
Left	11	22
Right	11	22
Total	22	44
Concha bullosa		
No	41	82
Left	5	10
Right	1	2
Bilateral	3	6
Total	9	18
OMU obstruction		
No	8	16
Left	15	30
Right	6	12
Bilateral	21	42
Total	42	84

Table 3: Lund-Mackay score showing severity of inflammatory diseases PNS

Lund-Mackay	Number (n = 43)	Percentage
Score		
≤ 5	7	16.3
6–10	10	23.3
11–15	14	32.6
16–20	6	14
21–24	6	14
Total	43	100
Mean ± SD	12.09 ± 6.20	

Table 4: Correlation of CT with final diagnosis

Parameters	SEN	SP	PPV	NPV	Accuracy
Chronic sinusitis	86	96.5	94.7	90.32	92
Polyps	96.15	95.83	96.15	95.83	96
Fungal sinusitis	71.4	93.02	62.5	95.23	90
Others	100	100	100	100	100

number 6 (14%) each of patients had scores between 16 to 20 and 21 to 24.

On correlating CT diagnosis with final diagnosis as shown in Table 4 chronic sinusitis has 86% sensitivity and 96.5% specificity. Polyps have sensitivity of 96.15% and specificity of 95.83%. Again for fungal sinusitis CT has lower sensitivity of 71.4% and specificity of 93.02%.

DISCUSSION

It is now generally accepted that CT is the optimum imaging method of demonstrating simple inflammatory disease to neoplasms in the paranasal sinuses. Clinical assessment can be used to evaluate acute sinus infection and CT is used for the investigation of persistent and chronic sinus disease refractory to medical therapy. Computed tomography evaluates the osteomeatal complex anatomy which is not possible with plain radiographs. Removal of disease in osteomeatal complex region is the basic principle of FESS which is best appreciated on CT scan.

This study was carried out to evaluate the pathological lesions of the paranasal sinuses by CT. Fifty patients were evaluated with CT who were referred after clinical assessment and, then correlated with diagnostic endoscopic/FESS.

In present study, the patients age ranged between 8 and 85 years which was consistent with study done by Prabhakar et al Maximum number of patients were aged between 31 and 40 years.[5-7] In present study, 48% patients were females and 52% patients were males which was consistent with the study by Kirtane et al.[8]

Domain name system was seen in 22 of 50 patients constituting 44%. Right DNS was seen in equal number of patients as left DNS. Concha bullosa was seen in 9 (18%) patients and in literature it varied between 16 and 53%.[9-11] Osteomeatal units were involved in 42 (84%) patients and bilateral involvement was seen in more number of patients than unilateral involvement. Hence, the overall incidence of inflammatory disease in the osteomeatal complex in symptomatic patients was no different with and without concha bullosa. Similar findings were observed in study by Maru and Gupta Y.[11]

Most common sinus involved was anterior ethmoid sinus in 38 (76%) pts, followed by maxillary, posterior ethmoid, frontal and sphenoid sinuses in decreasing order. Studies in literature observed involvement of anterior ethmoid sinus and maxillary sinus more commonly.[7] Present study correlates well with former study, where the number of patients studied were 60 and all patients underwent FESS. In all the studies sphenoid was least involved, which is also observed in this study (48%). Sinonasal polyposis was the most common type of pattern involved, followed by osteomeatal unit, infundibular, sporadic and sphenoethmoid recess patterns in decreasing order of involvement.

The CT severity assessed for 43 patients with inflammatory diseases showed highest number of patients with grade 1, i.e. 16 (37.2%) patients and lowest with grade 0, i.e. 0 (0%) patient. Lund-Mackay score between 11 and 15 was observed in most number of patients 14 (32.6%). The mean LMKS score observed was 12.09 ± 6.20.

Greatest pitfall in diagnosis of PNS diseases by CT is the fungal sinusitis. In this study, eight patients were studied among which five (71.4%) were diagnosed correctly and others were not diagnosed on CT. The sensitivity was 71.4% and specificity was 93.02% for CT to diagnose fungal sinusitis. The sensitivity described in literature was 76% by Zenreich et al which was a retrospective study.

Endoscopic findings were almost all correlated with CT findings except in Fungal sinusitis. The findings of CT were similar to diagnostic endoscopy/FESS findings in 44 (88%) of patients and different in 6 (12%) patients. All the false positives or false negatives were related to fungal sinusitis. Except the fungal sinusitis, sensitivity and specificity of CT was high.

On correlating CT diagnosis with final diagnosis, chronic sinusitis has 86% sensitivity and 96.5% specificity.[12,13] Polyps have sensitivity of 96.15% and specificity of 95.83%.[13] Again for fungal sinusitis CT has lower sensitivity of 71.4% and specificity of 93.02%.[14,15] For diagnosing benign and malignant lesions CT has 100% sensitivity, specificity, positive predictive value and negative predictive value with 100% accuracy.[16] This high sensitivity and specificity for benign and malignant masses could be due to small number of masses evaluated.

Thus, CT plays an important role in diagnosing and also adding important findings for the better management of the patients with paranasal sinus diseases. It is cost effective and less time consuming modality compared to MRI, CT is the modality of choice.[17]

CONCLUSION

This was the prospective correlational descriptive clinical study carried out on 50 symptomatic paranasal sinus diseased patients who underwent CT paranasal sinuses in both coronal and axial sections. Most patients were in the 3rd and 4th decades of their life with equal disease incidence in males and females. The most common complaint with which they presented was nasal obstruction followed by headache and nasal discharge. On evaluating patients with CT PNS, the most common sinus involved was anterior ethmoid sinus while sphenoid sinus was the least involved. Commonest pattern of inflammation was sinonasal polyposis followed by osteomeatal unit pattern. Sensitivity and specificity of CT in diagnosing fungal sinusitis was 71.4 and 93.02% respectively. But sensitivity and specificity for detection of mucosal abnormality was very good. Computed tomography had best statistical results in evaluating benign and aggressive lesions, which was 100% in this study attributable to the less number of aggressive or malignant lesions studied. On the other hand, clinical assessment of these lesions was poor, indicates that CT is mandatory in assessment of paranasal sinus diseases and also to look for any bone erosion or destruction with adjacent structure involvement.

Computed tomography findings correlated well and were same as those of diagnostic endoscopic/FESS findings in 44 (88%) cases which was confirmed on histopathology report (HPR). In remaining 6 (12%) cases, CT findings were different from those of diagnostic endoscopy/FESS. All these cases were related to fungal sinusitis as confirmed on HPR later. To conclude, this study proved that CT is the modality of choice for evaluation and planning the management of symptomatic patients of paranasal sinus pathologies. Fungal sinusitis and dense secretions are potential pitfalls on CT to differentiate them. But, CT may suggest fungal sinusitis in whom it is not suspected. It is the modality of choice in evaluating the bone erosion or destruction. Computed tomography evaluation of PNS in symptomatic patients helps in planning the further management of the patient.

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