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RESEARCH ARTICLE

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

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ABSTRACT

A prospective study was conducted on 50 patients at the SGRD Institute of Medical Sciences and Research, Amritsar, suffering from paranasal sinus disease 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 that guides us toward the 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 and defines 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 the least commonly involved. The most common pattern of inflammation was sinonasal polyposis followed by osteomeatal unit pattern. On correlating CT diagnosis with the final diagnosis, chronic sinusitis had 86% sensitivity and 96.5% specificity. Polyps had sensitivity of 96.15% and specificity of 95.83%. Again for fungal sinusitis, CT had a lower sensitivity of 71.4% and specificity of 93.02%. For diagnosing benign and malignant lesions, CT had 100% sensitivity and specificity, which could be due to the small number of masses evaluated. This study proved that CT is the modality of choice for evaluating and planning the management of symptomatic patients of paranasal sinus pathologies.

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

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INTRODUCTION

Pathological lesions of the paranasal sinuses (PNSs) include a wide spectrum of conditions ranging from inflammation to benign and malignant neoplasms. 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, it provides 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 about the PNSs and is now well established as an alternative to standard radiographs.[3] Computed tomography scan has become the modality of choice for the evaluation of PNS pathologies as it optimally displays bony details and air and outlines soft tissue as well.

Infection of the PNS is one of the most common cause of patient visits 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 that guides us toward the exact diagnosis and safe intervention. Over the 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 toward opening up any restriction that might impair the natural mucociliary clearance. To perform functional endoscopic sinus surgery (FESS) effectively and safely, the surgeon must have detailed knowledge of the anatomy of the lateral nasal wall, PNSs, and surrounding vital structures.

Computed tomography proves to be the most reliable method of preoperative assessment of patients undergoing FESS as it delineates the extent of the disease and defines 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 the disease they see on CT scan.

Endoscopic techniques for PNS surgery have allowed detailed and complete visualization of sinus disease while promising minimum distress to the patient. The telescopic view shows the details 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.

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

AIMS AND OBJECTIVES

- To diagnose the various pathologies of PNSs 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 PNS disease with diagnostic endoscopy or FESS was conducted on 50 patients at the Department of Radiodiagnosis, Sri Guru Ram Das Institute of Medical Sciences & Research (SGRDIMSR), Amritsar, in conjunction with the Department of ENT, SGRDIMSR.

Patients who 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 were willing to undergo diagnostic nasal endoscopy/FESS were selected.

Slices of 1.25 mm were taken in axial planes. Coronal sections were reconstructed. Osteomeatal complex was best displayed by the coronal plane. The anatomy in the coronal plane was depicted in a way similar to what surgeons 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.

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.

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

Table 1: Lund–Mackay staging system for chronic rhinosinusitis

Sinus		*No abnormality*	*Partial opacification*	*Total opacification*
Anterior ethmoid	R	0	1	2
	L	0	1	2
Posterior 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	

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.

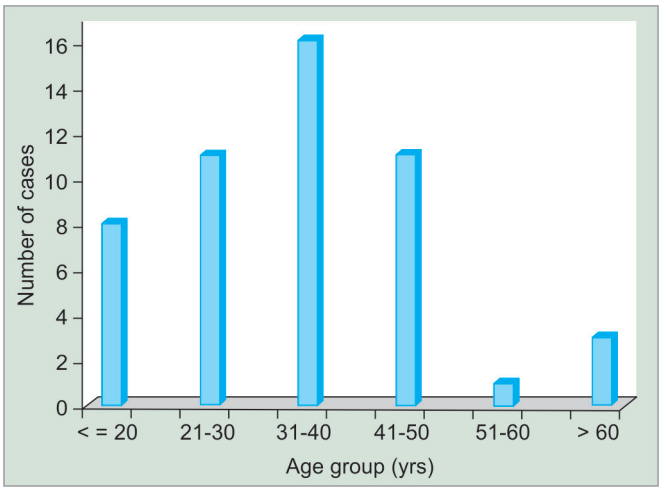
The total score was recorded to show the severity of the inflammatory disease. Task force on rhinosinusitis sanctioned by the American Academy of Otolaryngology used W Lund–Mackay CT staging system was used in our study as reference.

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. The CT 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, and 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.

In this study of 50 patients (Graph 1), 8 patients were less than 20 years of age, 11 were between 21 and 30 years, and 11 were between 41 and 50 years of age. Highest numbers of patients (20) were in the range of 31 to 40 years.



Graph 1: Age distribution of patients studied

The youngest patient was 8 years old and the oldest patient was 85 years old.

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

Table 2 shows various pathologies of PNSs on CT scan. Deviated nasal septum (DNS) 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 (OMU) obstruction was observed in 42 (84%) patients with bilateral involvement seen in 21 (42%) patients.

The most commonly diseased sinus was anterior ethmoid sinus, followed in decreasing order by maxillary, posterior ethmoid, frontal, and sphenoid sinuses.

Graph 2 shows the severity of inflammatory disease, and grading is done as per Glicklich et al's study.

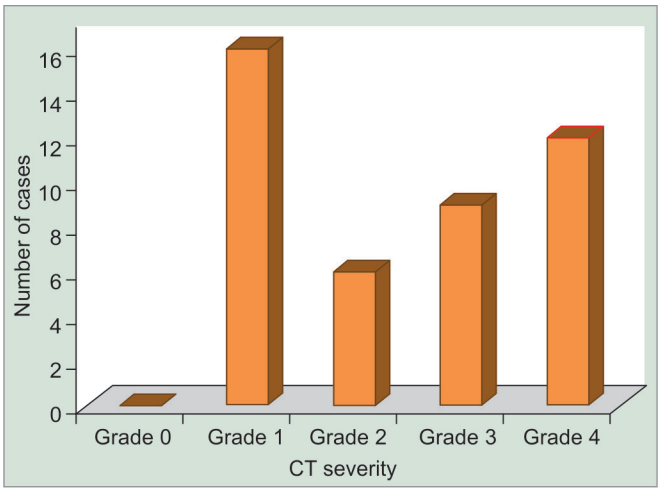
Table 2: Distribution of lesions according to CT paranasal sinus

Investigations	*Number (n = 50)*	*%*
Deviated nasal septum		
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
Osteomeatal unit obstruction		
No	8	16
Left	15	30
Right	6	12
Bilateral	21	42
Total	42	84

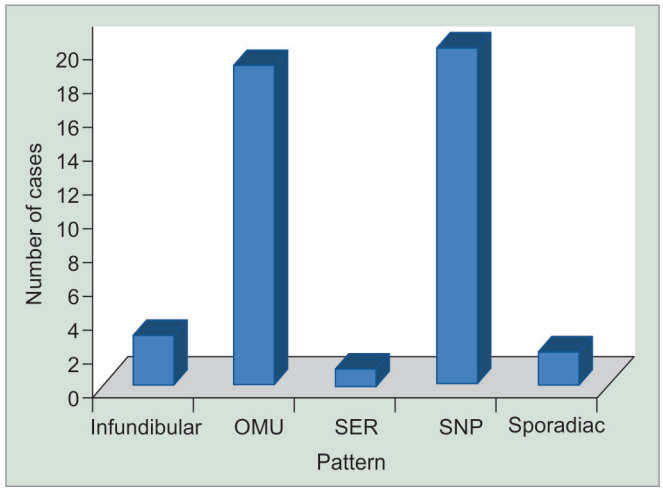
The CT severity was assessed in 43 patients who had inflammatory diseases. The maximum number [16 (37.2%)] of patients had grade 1 severity, while grade 0 severity was found in none of the patients; the least common was grade 2, seen in 6 (14%) patients.

Graph 3 shows 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. The least common was sphenoethmoid type seen in 2% of cases.

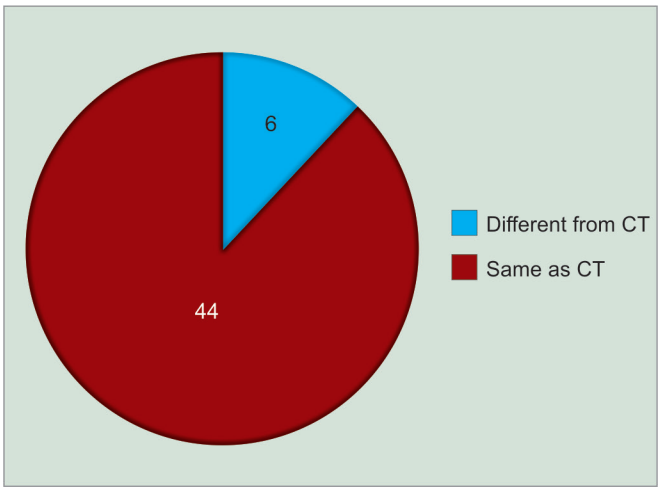
As shown in Graph 4, endoscopic/FESS findings were similar to CT findings in 44 (88%) patients and different from CT findings in 6 (12%) patients. These different findings were related to either fungal disease or inspissated secretions.



Graph 2: Computed tomography severity grading of inflammatory diseases



Graph 3: Patterns of inflammatory disease on CT



Graph 4: Endoscopy/functional endoscopic sinus surgery findings

Table 3 of patients had Lund–Mackay scores between 11 and 15 and the minimum number [6 (14%)] of patients had scores between 16 and 20 and 21 and 24.

On correlating CT diagnosis with the final diagnosis, as shown in Table 4, it was found that 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 PNSs. 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 the disease in the 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 PNSs by CT. Fifty patients were evaluated using CT who were referred after clinical assessment and then correlated with diagnostic endoscopic/FESS.

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

Deviated nasal septum was seen in 22 of 50 patients (44%). Right DNS was seen in equal number of patients as left DNS. Concha bullosa was seen in 9 (18%) patients, and in the literature, it varied between 16 and 53%.[9-11]

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

Lund–Mackay score	*Number (n = 43)*	*%*
≤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 ± standard deviation	12.09 ± 6.20	

Table 4: Correlation of computed tomography with final diagnosis

Parameters	*Sensitivity*	*Specificity*	*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

PPV: Positive predictive value; NPV: Negative predictive value

Osteomeatal unit was 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 or without concha bullosa. Similar findings were observed in the study by Maru and Gupta.[11]

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

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

The greatest pitfall in diagnosis of PNS diseases by CT is fungal sinusitis. In this study, 8 patients were studied among whom five (71.4%) were diagnosed correctly and others were not diagnosed with CT. The sensitivity was 71.4% and specificity was 93.02% for CT to diagnose fungal sinusitis. The sensitivity described in the 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%) patients and different in 6 (12%) patients. All the false positives or false negatives were related to fungal sinusitis. Except in fungal sinusitis, sensitivity and specificity of CT were high.

On correlating CT diagnosis with the final diagnosis, chronic sinusitis had 86% sensitivity and 96.5% specificity.[12,13] Polyps had sensitivity of 96.15% and specificity of 95.83%.[13] Again for fungal sinusitis, CT had lower sensitivity of 71.4% and specificity of 93.02%.[14,15] For diagnosing benign and malignant lesions, CT had 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 the small number of masses evaluated.

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

CONCLUSION

This was a prospective correlational descriptive clinical study carried out on 50 symptomatic PNS diseased patients who underwent CT PNSs 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. The most common pattern of inflammation was sinonasal polyposis followed by OMU 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 contrary, clinical assessment of these lesions was poor, indicating that CT is mandatory in the assessment of PNS diseases and also to look for any bone erosion or destruction with adjacent structure involvement.

The CT findings correlated well and were same as those of diagnostic endoscopic/FESS findings in 44 (88%) cases, which was confirmed on histopathology reports (HPR). In the 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 PNS 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. The CT evaluation of PNS in symptomatic patients helps in planning further management of the patient.

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