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ROLE OF COMPUTED TOMOGRAPHY IN EVALUATION OF PARANASAL SINUS PATHOLOGIES

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ABSTRACT

Aim: The objective of the present study was to evaluate the role of computed tomography in the evaluation of paranasal sinus pathologies.

Methods: The Cross-Sectional Study was conducted at Dr. D. Y. Patil Medical College and Hospital and Research Centre, Pimpri, Pune from August 2020 to September 2022. 50 patients were included in the present study.

Results: Highest number of patients was males in his study accounting for 30 (60 %). In this study, majority of patients (20%) were in the range of 21-30 years followed by 9% patients in the range of 51-60 years. The youngest patient was 9 years old, while the eldest was 78 years old. 27 patients (54%) had midline nasal septum. 23 patients (46%) had deviated nasal septum with right side deviation seen in 12 patients (24%) and left side deviation seen in 11 patients (22%). Concha bullosa was seen in 11 patients (22%) with 5 patients having bilateral concha bullosa and 6 patients having unilateral concha bullosa. Osteomeatal unit obstruction was seen in 33 patients (66%). Most involved sinus in this study was anterior ethmoid sinus (86%), followed by maxillary sinus (84%), posterior ethmoid sinus (84%), sphenoid sinus (54%) and frontal sinus (50%).

Conclusion: As a conclusion, CT of paranasal sinuses has enhanced the ability to visualize the anatomical structures of the sinuses and increased the accuracy of diagnosing paranasal sinus diseases. A credible pre-operative road map is provided by the accurate delineation of disease and microanatomy by CT scan.

Keywords: paranasal sinus, computed tomography

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INTRODUCTION

Diseases of paranasal sinuses are a major health problem. Most of the times physical examination is nonspecific and radiological evaluation has been relied upon as an aid in confirming the diagnosis. Traditionally, plain radiographs were the modality of choice in evaluation of paranasal sinuses. In recent years, because of technologic advancements in imaging, Computed Tomography (CT) has supplanted conventional radiography as the primary diagnostic modality and has also contributed in the change in therapeutic approach. The refinement of CT technology has resolved the traditionally difficult problem of identifying lesions of the paranasal sinuses. It has also allowed improved accuracy in evaluating the soft tissues about the sinuses.[1]

The paranasal sinuses are a grouping of 4 pairs of air-filled cavities in the skull and facial bones that surround the nasal cavity. They are connected to the nasal cavity by small openings and are named in accordance to the bones in which they are stationed. Development starts by 25-28 weeks of gestation and the paranasal sinuses attain adult size by adolescence.[2] The important functions served by paranasal sinuses include humidification of inspired air, increasing resonance of voice, decreasing relative weight of skull, immunological defence, etc. There are lot of pathologies involving the paranasal sinuses ranging from anatomical variants like deviated nasal septum to a broad array of inflammatory as well as neoplastic conditions, both benign and malignant. A wide variety of these diseases affect millions of people and radiological evaluation has been used primarily to diagnose these conditions.[3]

Plain film radiography used to be the main modality for evaluation of paranasal sinuses as it is quick and non-invasive. However, because it vividly depicts air spaces, opacified sinuses, and the bony architecture, computed tomography (CT) has superseded conventional film radiography as the radiological investigation of choice for diagnosis of paranasal sinus disorders. The accuracy of determining the aetiology and extent of inflammatory and neoplastic illnesses of the paranasal sinuses has improved thanks to CT, which can effectively image both soft tissues and bones. An outstanding and exhaustive evaluation will be provided by a full set of axial and coronal CT scans. Additionally, it outperforms MRI in assessing fine bone features and paranasal sinus fibro-osseous diseases.[4,5] By evaluating the distribution and extent of the disease, CT aids in the diagnosis and subsequent management of chronic and recurrent paranasal sinus disorders. Because of its 3D high resolution, CT is particularly effective at defining the complicated anatomy and anatomic variations that are challenging to assess by physical examination or endoscopy.[6]

The paranasal sinuses and nasal cavity can be accurately assessed with CT imaging prior to surgery, and it is regarded as the gold standard for describing inflammatory sinus pathology brought on by blockage to drainage pathways. Coronal CT images have been shown to closely match the surgical approach. As a result, it is very useful in functional endoscopic sinus surgery (FESS), as the coronal images replicate how the sinonasal cavity appears when viewed through an endoscope.[7-9] The detection of anatomical variations that may result in intra-operative and post-operative difficulties in FESS is another beneficial use of CT, which lowers patient

mortality and morbidity. The mainstay in the assessment of paranasal sinus disorders is now a combination of CT and endoscopy. Consequently, CT offers substantial relevance in the assessment of paranasal sinus disorders.[10]

The objective of the present study was to evaluate the role of computed tomography in the evaluation of paranasal sinus pathologies.

MATERIALS AND METHODS

The Cross-Sectional Study was conducted at Dr. D. Y. Patil Medical College and Hospital and Research Centre, Pimpri, Pune from August 2020 to September 2022. 50 patients were included in the present study.

Method of diagnosis:

Philips Ingenuity Core (128 Slice CT)

Institutional Ethical Committee (IEC) approval was obtained before the start of the study.

Informed consent and written consent were obtained from all the patients and from parents/guardian of the minor patients.

INCLUSION CRITERIA

1) Patients with suspected/diagnosed sinonasal pathology.

EXCLUSION CRITERIA

1) All patients with trauma.
2) Patients with previous history of sinonasal surgery
3) Pregnant women

CT TECHNIQUE

All patients underwent CT-PNS examination in both axial and coronal planes.

Machine Used: Philips Ingenuity Core, 128 Slice CT

CT-PNS Protocol:

-Patient position: Prone (in coronal),
Supine (in axial).

-Angulation: In coronal sections, perpendicular to infra-orbito-meatal line,
In axial sections, parallel to infra-orbito-meatal line.

-Thickness: 5 mm with 5 mm incrementation in coronal,
5 to 10 mm axial sections,
2 mm sections were taken especially at osteo-meatal complex and frontal recess

-Exposure: 120 kV, 300 mA, 1.5 second scans.
Window width (approx.) 2500-3000
Window level 250-300
Soft tissue window width- 80
Soft tissue window level- 40

Extent of study: From anterior most aspect of nasal cavity to the posterior margin of the sphenoid sinus in coronal section and from frontal sinus through hard palate in axial sections.

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Patient Preparation:

-All patients were advised to fast for 4 hours prior to CT scan.

-Contrast agent: Was used if indicated, as a single intra-venous (I.V.) bolus injection following serum creatinine value estimation.

-Informed consent was obtained from the patient if I.V. contrast administration was necessary.

Data was analysed with appropriate statistical tests.

RESULTS

Table 1: Patient characteristics

Gender	**Number (%)**
Female	20 (40)
Male	30 (60)
Age (years)	
≤20	8 (16)
21-30	10 (20)
31-40	8 (16)
41-50	8 (16)
51-60	9 (18)
≥60	7 (14)
Chief complaints	
Change in voice	1 (2)
Epistaxis	2 (4)
Headache	18 (36)
Nasal discharge	3 (6)
Nasal obstruction	21 (42)
Pain	2 (4)
Swelling	3 (6)
Bone involvement	
Yes	24 (48)
No	26 (52)

Pattern	
Infundibular	7 (14)
Osteomeatal Unit	2 (4)
Spheno ethmoid recess	2 (4)
Sino nasal polyposis	34 (68)
Sporadic	5 (10)

Highest number of patients was males in his study accounting for 30 (60 %). Females accounted for 20 (40%). The Male: Female ratio was found to be 1.5:1. In this study, majority of patients (20%) were in the range of 21-30 years followed by 9% patients in the range of 51-60 years. The youngest patient was 9 years old, while the eldest was 78 years old. Nasal obstruction (43%) was the most common patient complaint, then headache (37%). Pain (4%), epistaxis (4%), and change in voice (2%) were the least frequent symptoms. In this study, out of 50 patients, 24 patients (48%) had bone involvement in the form of erosion, thinning or destruction. Maximum number of patients had sinonasal polyposis pattern- 34 (68%), followed by infundibular pattern- 7 (14%), sporadic pattern- 5 (10%). Least common patterns were osteomeatal unit pattern- 2 (4%) and sphenoethmoid recess pattern- 2 (4%).

Table 2: CT findings and sinus involved in the study

Investigations		**Number of patients (%) n=50**
DNS	Left	11 (22)
	Midline	27 (54)
	Right	12 (24)
Concha Bullosa	Bilateral	5 (10)
	Left	3 (6)
	Normal	39 (78)
	Right	3 (6)
Osteomeatal unit	Blocked	33 (66)
	Normal	17 (34)
Sinus involved		
Maxillary	Bilateral	22 (44)
	Left	9 (18)
	Normal	8 (16)
	Right	11 (22)

Anterior ethmoid	Bilateral	21 (42)
	Left	10 (20)
	Normal	7 (14)
	Right	12 (24)
Posterior ethmoid	Bilateral	20 (40)
	Left	10 (20)
	Normal	8 (16)
	Right	12 (24)
Frontal	Bilateral	14 (28)
	Left	4 (8)
	Normal	25 (50)
	Right	7 (14)
Sphenoid	Bilateral	10 (20)
	Left	12 (24)
	Normal	23 (46)
	Right	5 (10)

27 patients (54%) had midline nasal septum. 23 patients (46%) had deviated nasal septum with right side deviation seen in 12 patients (24%) and left side deviation seen in 11 patients (22%). Concha bullosa was seen in 11 patients (22%) with 5 patients having bilateral concha bullosa and 6 patients having unilateral concha bullosa. Osteomeatal unit obstruction was seen in 33 patients (66%). Most involved sinus in this study was anterior ethmoid sinus (86%), followed by maxillary sinus (84%), posterior ethmoid sinus (84%), sphenoid sinus (54%) and frontal sinus (50%).

Table 3: Agreement between clinical diagnosis and final diagnosis

Final diagnosis	**Clinical diagnosis**				Total (%)
	Polyp	Sinusitis	Fungal sinusitis	Others	
Polyp	8	5	0	1	14 (28)
Sinusitis	0	13	0	0	13 (26)
Fungal sinusitis	1	5	3	0	9 (18)
Others	4	6	0	4	14 (28)
Total (%)	13 (26)	29 (58)	3 (6.0)	5 (10)	50

Fleiss kappa =0.372(0.366- 0.377)

Table 4: Agreement between CT diagnosis and final diagnosis

Final diagnosis	**CT diagnosis**				Total (%)
	Polyp	Sinusitis	Fungal sinusitis	Others	
Polyp	14	0	0	0	14 (28)
Sinusitis	0	13	0	0	13 (26)
Fungal sinusitis	0	0	9	0	9 (18)
Others	0	0	0	14	14 (28)
Total (%)	14 (28)	13 (26)	9 (18)	14 (28)	50

Fleiss kappa = 1.000 (0.995- 1.005)

From the above tables (4 and 5), we observed that Kappa coefficient for CT diagnosis as compared clinical diagnosis is significantly higher. CT diagnosis has perfect agreement with final diagnosis.

DISCUSSION

The varied etiology of the diseases of paranasal sinuses (PNS) forms the basis of their evaluation. The lack of specificity in clinical examination and the imprecise result of conventional radiography renders computed tomography as the modality of choice other than Magnetic Resonance Imaging (MRI). Recently, it has become widely acknowledged that CT is the ideal imaging technique for identifying everything from paranasal sinus neoplasms to mild inflammatory diseases. Below par correlation of plain X-ray with CT has been established by previous studies. Plain radiographs are insufficient and are no longer commonly used to assess paranasal sinus diseases. Clinical examination can be used to evaluate acute sinusitis, while CT can be used to further investigate persistent and chronic sinusitis that is resistant to medical treatment. CT makes evaluation of osteomeatal complex anatomy possible, which is unattainable with plain radiographs. The fundamental goal of FESS is to eliminate disease in the osteomeatal complex region, which is best seen on a CT scan.

In present study, patients' age ranged between 9-78 years which was in line with study done by Gliklich RE[11] and Prabhakar S[12]. Majority of patients were aged between 21-30 years. About 2/3rd patients were males and 1/3rd patients were females. The incidence of neoplasms increases sharply after age of 40 years. There is another peak in teen age due to increase in incidence of angiofibroma, rhabdomyosarcoma at this age. Acute sinusitis was diagnosed when there was air fluid level, enhancing mucosal thickening. This was different compared with the study by Gliklich RE[11], likely due to the demographics of the patients taken in the present study.

Maxillary sinus was most commonly involved and sphenoid sinus was least involved in inflammatory conditions. In the study conducted by Smith and Brindley[13], maxillary sinus was involved in 55.5 % of cases, ethmoidal air cells were involved in 46.5 % of cases, frontal sinus in 30 % and sphenoid in 20%. Kopp et al[14] in his study of 105 cases of aspergillosis of paranasal sinuses or nasal fossa detected the characteristic CT features of foci of increased attenuation in affected paranasal sinuses. On the basis of similar findings we were able to diagnose one case of fungal sinusitis involving maxillary sinus.

23 out of 50 patients, or 46% of them, had DNS. More patients had right sided DNS than left sided DNS. 11 out of 50 patients had concha bullosa, constituting 22% and in various literature it varies between 16-53%.[15-17] Osteomeatal unit involvement was seen in 33 out of 50 patients constituting 66%. According to Mackay and Lund[19], the ostiomeatal complex acts a drainage pathway for maxillary, anterior ethmoids and frontal sinuses. Posterior ostiomeatal unit was considered as part of the sphenoid sinus. In several areas of the ostiomeatal complex, two mucosal layers contact with each other, thus increasing the likelihood of local impairment of mucociliary clearance.

There were characteristic findings of bilateral hyperdense polypoidal masses with expansion, remodeling and thinning of bony walls of sinuses. Mukherji et al[18] emphasized upon similar findings. He studied 43 patients of allergic fungal polyposis and concluded that it is more common in young male patients and commonly has bilateral involvement. The present study shows that inverted papilloma and angiofibroma are more common. Study by Narayana Swamy et al[20] showed that angiofibroma was most common followed by inverted papilloma, thus making our study comparable. The difference in incidence between the present study and other studies may be due to the variation in the number of cases taken up for study.

When the comparison table is viewed, the CT diagnosis and final diagnosis are almost perfectly in agreement, but the clinical diagnosis and final diagnosis are only moderately in accord. Thus, CT has a prominent role in diagnosis and also provides crucial additional findings which contribute to better management of the patients having paranasal sinus diseases. CT is diagnostic of osseous and fibroosseous lesions. One case of fibrous dysplasia, two of Inverted papilloma and two of ossifying fibroma were diagnosed. Frontal sinus was involved in both the osteomas and is the most common site of osteoma as studied by Fu Y-S et al..16.

LIMITATIONS

The major limitation of this study is that there was no correlation between CT and MRI in the evaluation of paranasal sinus lesions, the most frequently encountered question which is the best modality among them. But according to literature, compared to MRI, CT is more time- and cost-efficient, making it the modality of preference. However, CT and MRI provide complementary information with each having its own advantages and potential drawbacks.

CONCLUSION

As a conclusion, CT of paranasal sinuses has enhanced the ability to visualize the anatomical structures of the sinuses and increased the accuracy of diagnosing paranasal sinus diseases. A

credible pre-operative road map is provided by the accurate delineation of disease and microanatomy by CT scan. Its value comes from its capacity to identify bone erosion. In order to check areas that are not accessible for endoscopy, it is increasingly utilized in conjunction to endoscopy. We can get 1 mm collimation images and then high-quality multiplanar reformations thanks to recently developed multi-detector CT (MDCT). It is currently referred to be the gold standard imaging for paranasal sinus pathology because CT is now required for the diagnostic evaluation of paranasal sinus disease and for planning optimal therapy.

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