Original Research Article

Comparative validity evaluation of para-nasal sinus diseases using conventional radiography and computed tomography in a tertiary care hospital of Madhya Pradesh

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ABSTRACT

Background: Sinonasal diseases include a wide spectrum ranging from inflammatory conditions to neoplasms, both benign and malignant and with the advancement in medical sciences and technology, and the ability to detect and control most illnesses, time has witnessed a momentous evolutionary change in medical practice. Objectives of the present study was to assess the demographical profile of sinonasal diseases patients and to compare the role of X-ray and computed tomography (CT) in the diagnosis of sinonasal diseases.
Methods: The study was conducted on 100 cases presenting in the ENT OPD, patients admitted in ENT ward and cases referred from medical and surgical departments of G. R. Medical College and J. A. Group of Hospitals, Gwalior, who had chronic sinonasal symptoms. All the collected data was analyzed using SPSS15.0 and frequencies, validity of both the modalities were compared.
Results: The mean age was 33.75 years with youngest patient of 5 years and oldest being 85 years of age. CT had a good sensitivity and specificity for bacterial sinusitis (95.1%, 93.2%), fungal sinusitis (80%, 97.9%), single nucleotide polymorphism (90%, 88.6%), benign lesions (75%, 97.7%), malignant lesions (78.6%, 98.8%) respectively with a p value of <0.001, reflecting a highly significant level.
Conclusions: Present study proves the significance of CT in diagnosing sinonasal pathologies and guiding their management. However, the importance of X-ray as a preliminary investigation, especially in acute or chronic cases which cannot be ignored.

Keywords: Paranasal sinus, X-ray, CT scan, Validity, Gwalior

INTRODUCTION

Paranasal sinuse (PNS) diseases commonly affect the varied range of population, which range from inflammatory conditions to neoplasms, both benign and malignant.[1,2] Their clinical assessment is hampered by the surrounding bony structures, hence for confirmation of their diagnosis, the role of radiology is of paramount importance.[3] Imaging of the sinuses is usually done to approve the clinical findings when history and physical examinations are suggestive of PNS lesions, but the patient is not responding to conventional treatment. Plain radiography is the commonly used imaging modality for diagnosis of PNS diseases as it is economical, simple, and widely available. overview of the anatomy and underlying pathology. Plain radiography could not display the three-dimensional structures in a two-dimensional plane. It can provide limited views of the anterior ethmoid cells along with the upper two-thirds of the nasal cavity.[4] Computerized tomography (CT) is

considered as the gold standard for preoperative evaluation of PNS diseases for appropriate patient selection for functional endoscopic sinus surgery (FESS). It is mandatory to evaluate the PNS and nose by CT before planning for FESS. It can provide a "road map" to direct the surgical approach to otolaryngologist. CT has some medico-legal importance as well.[5,6] Conventional radiography is often the initial examination performed in patients with clinical presentation of sinonasal disorders. However, it lacks sensitivity and specificity and radiographic based evaluation can either overestimate or underestimate soft tissue changes in the paranasal sinus cavities, and often fails to accurately demonstrate the extent of lesion.[7]

Newer imaging techniques are really a boon for surgeons which has given a new dimension for management of the diseases. The potential value of CT in diagnosis of diseases of paranasal sinuses was recognised early.[8] CT is accepted as the gold standard for pathological and anatomical evaluation of paranasal sinus diseases.[9] In comparison to conventional radiography, CT provides better soft tissue discrimination while simultaneously visualising the bone and determining the resectability of the of the tumour by permitting 3-dimensional mapping of the tumour. The present study is being undertaken to assess the role of plain radiographs and CT as a diagnostic tool for early and proper detection of nasal and paranasal pathology, so as to get better management of these diseases.

METHODS

The present study was carried out on patient presenting with chronic sinonasal symptoms in the ENT OPD, patients admitted in ENT ward and cases referred from medical and surgical departments of G. R. Medical College and J. A. Group of Hospitals, Gwalior (MP) from February 2016 to February 2017.

After getting the ethical approval from the medical college ethical committee 100 participants were included in the study.

Inclusion criteria

Participants who have given the consent, all patients presenting with sinonasal symptoms of >3 weeks duration with minimal or no response to medical treatment were included.

Exclusion criteria

Participants who have not given the consent, all cases of trauma, evidence of previous sinonasal surgery, pregnant women, patients with history of contrast allergy were excluded.

Evaluation of patients

History

The study was done on patients presenting with sinonasal symptoms like nasal obstruction, nasal discharge, headache, recurrent sneezing, anosmia, parosmia, hyposmia, epistaxis or bleeding from the nose, pressure/pain over face, postnasal drip, nasal deformity, nasal mass etc.

Also, history of previous surgery, use of nasal drop instillation in the past, history of recurrence, history suggestive of asthma, aspirin sensitivity and allergy taken.

Detailed personal and occupational history along with any family history suggestive of allergy, asthma, polyps, etc. elicited. A pre-structured proforma used to collect data.

Examination

General and systemic examination was done. The main examination included anterior rhinoscopy, posterior rhinoscopy. Endoscopy was done in cases where required.

Investigations

Relevant investigations were done to obtain proper diagnosis amongst which histopathological examination (for nasal masses) was the most significant one. Nasal swab for staining and culture was sent in some cases. Also, fungal staining and fungal culture was also done in few cases.

Imaging

Informed consent was taken from the patient and radiation risk of diagnostic imaging was informed. X-ray PNS (Water's view, Caldwell view, lateral view, submentovertical view, right and left oblique views) using Allengers MARS-50 machine.

All patients were subject to CT examination using CT (Siemens somatom definition as 128 slice computed tomography) scan machine.

Coronal, axial and sagittal sections were taken as required. Non contrast scans were obtained and contrast enhanced scans were obtained after administration of intravenous iodinated contrast media whenever required.

Coronal sections scans were taken from posterior margin of sphenoid sinus to anterior margin of frontal sinus. The axial plane was kept parallel to the inferior orbitomeatal plane and scans were taken from superior wall of frontal sinus to hard palate.

The axial images were viewed at 3 mm slice thickness and the coronal and sagittal images at 3 mm with reconstruction interval of 1.5 mm in bone and soft tissue algorithms.

All CT scans were then analysed for site, extent and type (soft tissue or mucoid or hypo/iso/hyperattenuation) of involvement or opacification, homogencity or heterogenecity of contents, contrast enhancement, anatomic variations drainage pathway of sinuses, bony remodelling (thinning or sclerosis or expansion), bone destruction, calcification and loco-regional spread of the disease process.

The X-ray and CT findings were taken then compared with findings on other investigations if done and correlated with cytohistopathology or FESS or peroperative findings or clinical findings and course.

Data analysis

All the data have been entered in Microsoft excel and later on transported to SPSS 15.0 and sensitivity, specificity, predictive values, and p value calculated and difference of significance has established.

RESULTS

A total of 100 patients who presented to the ENT OPD with complains referring to nose and paranasal sinuses of >3 weeks duration with no or minimal response to medical treatment were included in the study. All these patients were subjected to X-ray PNS and CT scan PNS after thorough clinical examination and preliminary investigations. Further necessary investigation was tailored wherever required. Diagnostic nasal endoscopy was done in few cases. Endoscopic sinus surgery was tailored according to the CT scan and was carried out mainly concentrating on sinus drainage, collection of mucopus, destruction of bones, presence of anatomic variations. Any polypoidal or mass lesions were debrided or biopsy taken for histopathological examination and fungal culture in selected cases. Collected data was collected in Microsoft excel and file was transported to SPSS 15.0 and appropriate statistical test like sensitivity and specificity were calculated.

The majority (25%) of the participants were in the age group of 11-20 yrs. Males outnumbered females with male:female ratio being 1.6:1. The mean age was 33.75 years (SD- 18.59) within range of 5-85 yrs.

Table 2 shows that majority of patients were from upper middle class (27%) and upper lower (27%) followed in descending order by upper (22%), lower middle (18%) and lower (7%).

Unilateral disease was found to be more common than bilateral with 35% being right sided and 27% left sided. Bilateral involvement was seen in 38%.

Table 1: Distribution of age and sex of the participants.

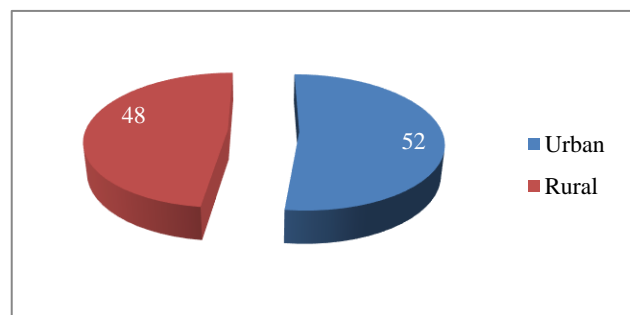| Age (in years)	Male N	Male %	Female N	Female %	Total N	Total %
<10	1	1	6	6	7	7
11-20	20	20	5	5	25	25
21-30	10	10	8	8	18	18
31-40	10	10	7	7	17	17
41-50	8	8	7	7	15	15
51-60	6	6	3	3	9	9
61-70	4	4	2	2	6	6
71-80	0	0	0	0	0	0
81-90	3	3	0	0	3	3
Total	62	62	38	38	100	100

Figure 1: Distribution of rural and urban participants.

Table 2: Distribution according to socioeconomic class.

Classes	No. of patients	%
Upper (I)	22	22
Upper middle (II)	27	27
Lower middle (III)	17	17
Upper lower (IV)	27	27
Lower (V)	7	7

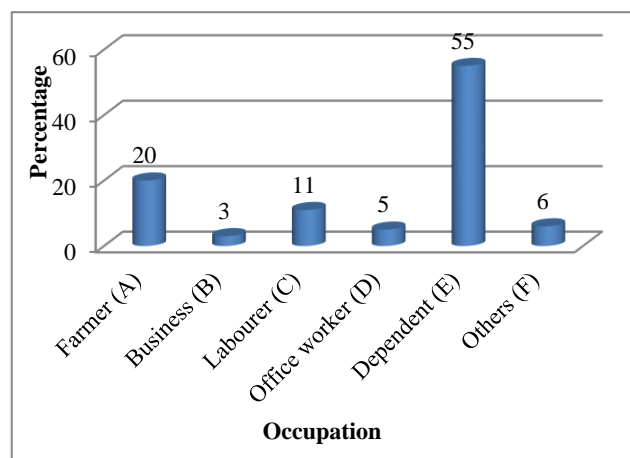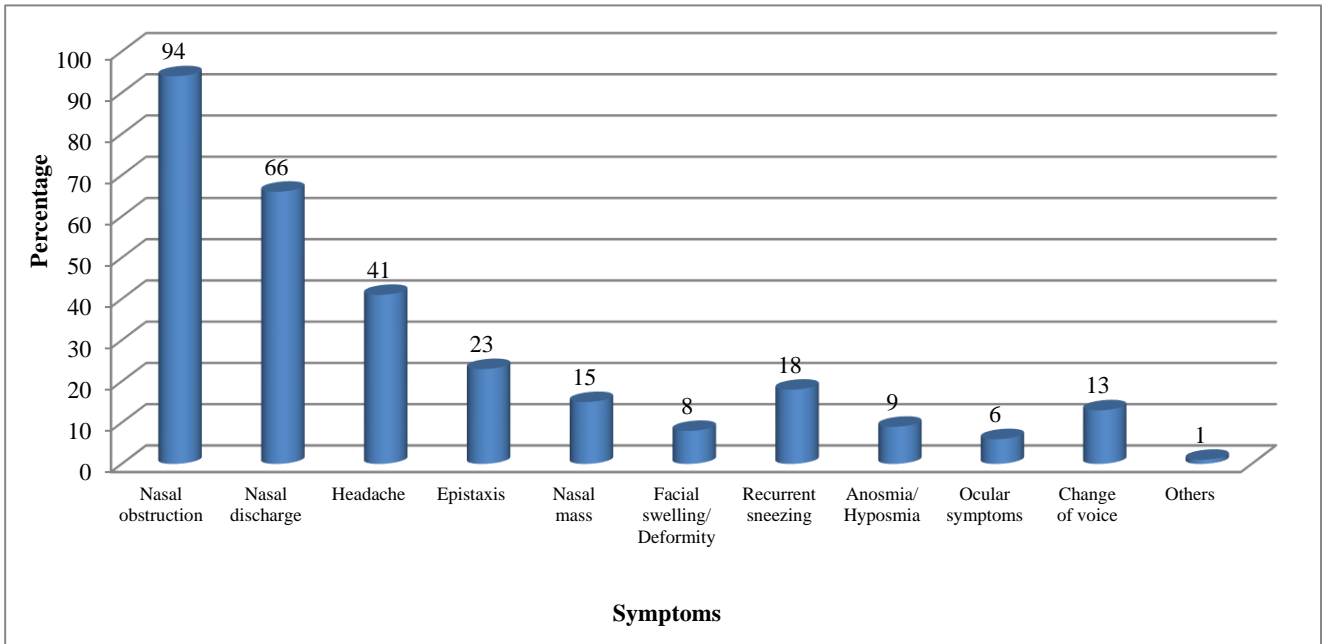**Figure 2: Distribution of participants according to their occupation.**

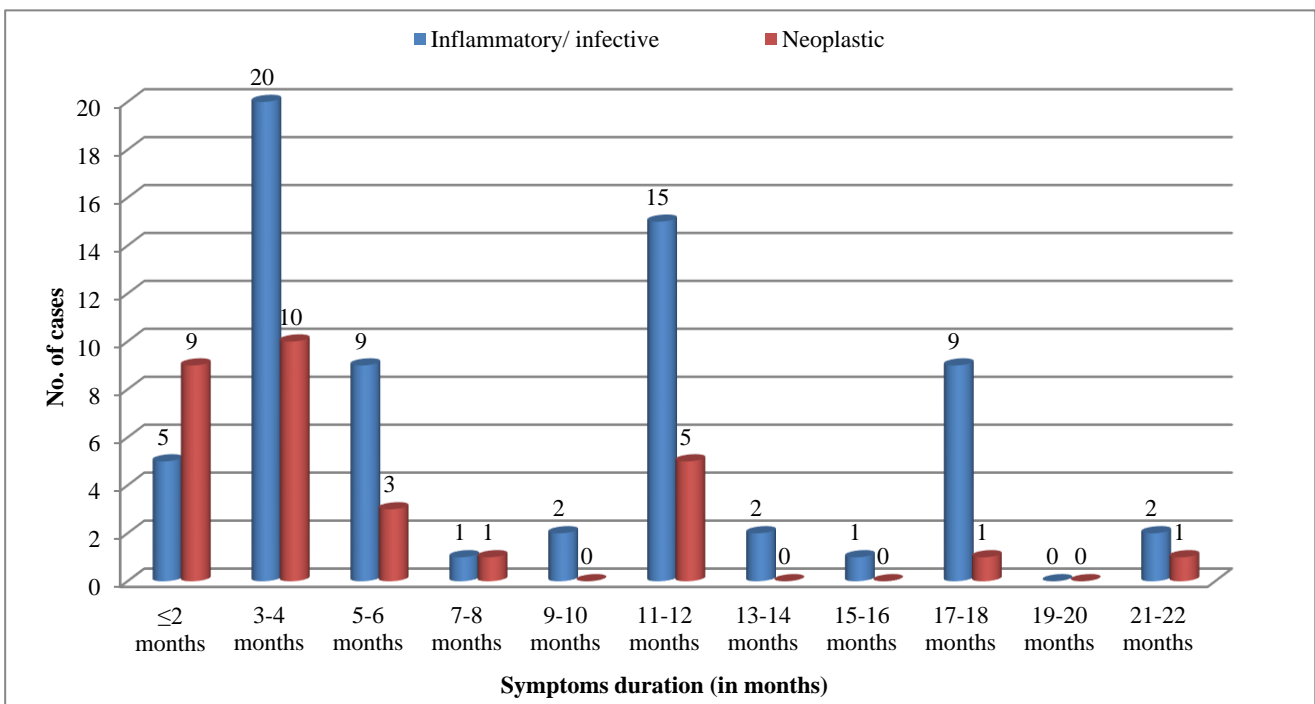**Figure 3: Distribution of sinonasal disease symptoms among participants.**

Figure 3: Distribution of duration of disease among the participants.

Table 3: Distribution of sinonasal disease by laterality.

Class	No. of patients	Percentage (%)
Right	35	35
Left	27	27
Bilateral	38	38

Sinus haziness was the most common finding on radiograms seen in 78% cases followed by nasal haziness (64%) and mucosal thickening (42%). However, nasal haziness was the most common X-ray finding in neoplastic diseases.

Mucosal thickening was the most common CT findings in inflammatory diseases seen in 74.3% followed by mass in nose and sinus seen in 37.1% cases. Nasal was seen in 56.75 neoplastic disease cases followed by bone erosion seen in 46.7% cases.

Table 4: X-ray imaging features in sinonasal pathologies.

Imaging features	Inflammatory or infective					Neoplastic		
	Bacterial sinusitis	Fungal sinusitis	Sinonasal polyposis	Granulomatous disease	Total	Benign	Malignant	Total
Mucosal thickening	27	2	12	2	36	5	1	6
Nasal haziness	12	5	29	4	39	13	12	25
Bony changes								
Sclerosis	0	0	1	0	1	0	0	0
Hyperostosis	0	0	0	0	0	2	0	2
Destruction	0	0	0	1	1	2	6	8
Sinus haziness or opacification	33	4	32	3	59	6	14	19
Air-fluid level	4	0	1	0	4	0	0	0

Table 5: CT imaging features in sinonasal pathologies

Imaging features	Inflammatory or infective					Neoplastic		
	Bacterial sinusitis	Fungal sinusitis	Sinonasal polyposis	Granulomatous disease	Total	Benign	Malignant	Total
Anatomical variations	8	1	1	0	10	1	0	1
Mucosal thickening	38	2	16	4	52	5	4	9
Fluid in sinus	10	1	3	0	13	0	0	0
Mass in sinus	1	0	0	0	1	0	1	1
Mass in nose	0	0	1	3	4	12	5	17
Mass in nose and sinus	8	3	26	0	26	3	8	11
Mass in surroundings								
Intracranial	0	0	0	0	0	2	3	5
Extracranial	0	0	0	0	0	4	8	12
Bony changes								
Thickening	0	1	1	0	1	1	0	1
Thinning or rarefaction	0	1	1	0	2	2	0	2
Destruction or erosion	0	2	1	2	4	3	11	14

Table 6: Distribution of sensitivity, specificity, positive predictive value, negative predictive value and accuracy of X-ray versus CT scan.

Parameters	Sensitivity		Specificity		PPV		NPV		Accuracy		P value	
	X-ray	CT	X-ray	CT	X-ray	CT	X-ray	CT	X-ray	CT	X-ray	CT
Bacterial sinusitis	90.2	95.1	61	93.2	61.7	95.1	90	96.5	73	94	<0.001	<0.001
Fungal sinusitis	20	80	98.9	97.9	50	66.7	95.9	98.9	95	97	0.189876	<0.001
Sinonasal polyposis	76.7	90	88.6	88.6	74.2	77.1	89.9	95.4	85	89	<0.001	<0.001
Benign	18.8	75	98.8	97.7	75	85.7	86.5	95.3	86	94	0.009623	<0.001
Malignant	42.9	78.6	98.8	98.8	85.7	91.7	91.4	96.6	91	96	<0.001	<0.001

PPV: positive predictive value; NPV: negative predictive value.

DISCUSSION

In our study, the age of the patients ranged from 15 to 85 yrs while the mean age of presentation being 33.75 yrs. The patients presenting in the age group of 10-20 yrs were 25% and those in 21-30 yrs were 18% i.e., majority (43%) patients were in the age group of 11-30 yrs. Chaudhary et al reported maximum disease incidence in 20-29 yrs of age from their study on 75 patients.[10] The study carried out by Verma et al on 50 cases reported 16-

34 yrs (36%) as the commonest age group for sinonasal disease incidence.[11] The study of 110 cases conducted by Bagul reported 11-30 yrs (50%) to be the commonest age group for incidence of sinonasal diseases.[12] A prospective study on 50 cases of sinonasal diseases conducted by Kushwah et al had shown patients to be affected in the 8 yrs to 75 yrs range with majority of patients in the 2nd and 4th decade.[13] Ranjan et al conducted a study on 30 cases with age ranging from 8 yrs to 68 yrs and maximum incidence in the 2nd decade.[14] Kandukuri et al reported maximum disease incidence in 2nd and 3rd decade in their study of 50 patients.[15]

The incidence of sinonasal disease is found to be more in males which may be due to the more prevalence of these diseases among males or merely a reflection of the overall higher male attendance in the hospital, illiteracy and lack of health consciousness among the females. The sinonasal diseases were found to be slightly more prevalent among urban population (52%) as compared to rural (48%). Bisht et al from his study of 110 cases of sinonasal masses found a 1:1 rural-urban ratio.[16] The slightly increased prevalence of sinonasal disease in urban population can be ascribed to the increased exposure to specific inhalants/pollution implicated in the causation of allergic and/or inflammatory diseases, better awareness of health and diseases in the urban population as compared to rural. Majority of patients belonged to upper middle (27%) and upper lower class (27%). Bisht et al from a study on 110 cases found majority of patients to have been belonging to lower middle-class group (32.7%).[16]

Humayun et al, in their study found majority of patients from lower class.[17] The increased incidence of sinonasal disease in upper middle can be attributed to the higher prevalence of allergic or atopy conditions. Sinonasal masses were common in lower socio-economic patients because of infection, overcrowding, exposure to dusty environment and exposure to allergens. In this study, majority of the patients (55%) belonged to the dependent on unemployed group comprising mainly homemakers and students. Farmers were the 2nd most common group (20%). Businessmen were the least common group (3%).

In a study of 110 cases of sinonasal masses conducted by Bisht et al, maximum number of patients were found to be homemakers and students (44.54%).[16] Such high incidence of the disease in homemakers could be ascribed to the fact that; women are exposed to dust and smoking from home cleaning and cooking more than men and these lead to allergic rhinitis which is a causative factor in sinusitis. The most common symptom in our study was nasal obstruction (94%) followed by nasal discharge (66%), headache (41%), epistaxis (23%), recurrent sneezing (18%) and nasal mass (16%).

In a 50 cases study by Verma et al, the common symptoms observed were nasal obstruction (82%), nasal discharge (66%), nasal mass (56%), headache and allergic symptoms (in 52% cases).[11] Kushwah et al conducted a study on 50 cases and reported headache to be the most common symptom (58%) followed by nasal obstruction (16%).[13] Kandukuri et al reported nasal obstruction and nasal discharge to be the most common presenting symptoms from study on 175 cases of sinonasal diseases.[15] Unilateral involvement was more common in our study. Among the unilateral disease cases, right sided disease was more common (35%) than the left (27%). Bilateral involvement was seen in 38%. Verma et al reported unilateral involvement of nose and PNS to be more common.[11] Bisht et al observed left sided disease to be common followed by right sided and bilateral involvement.[16] In the present study, significant number of bilateral disease can be ascribed to the presence of a good number of inflammatory cases which tend to have bilateral involvement. The mean duration of symptoms at which patients presented was found to be 7.7 months with majority of the patients presenting within 4 months duration of symptoms. Sinus haziness on X-ray was the most common finding observed in our study (78%) followed by nasal haziness (64%) and mucosal thickening (42%). However, nasal haziness was the most common X-ray finding in neoplastic diseases. Verma et al observed sinus haziness to be the most common finding on X-ray (76%), nasal haziness was seen in 54% and mucosal thickening in 32% cases.[11] The observation of sinus haziness being the most common finding in the present study can be attributed to the fact that sinonasal polyposis cases comprised a good number among the inflammatory disease cases. In this study, mucosal thickening was the most common CT findings in inflammatory disease seen in 74.3% followed by mass in nose and sinus seen in 37.1% cases. Nasal mass was seen in 56.7% neoplastic disease cases followed by bone erosion in 46.7% cases. CT could detect bone erosion in 25 cases out of 30 cases of neoplastic disease (83.3%). Extracranial and intracranial complications could be detected in 12 and 5 out of 30 cases of neoplastic disease. Bone erosion and thinning were also observed in fungal sinusitis and long-standing single-nucleotide polymorphism (SNP) cases. Verma et al from their study of 50 patients, found sinus involvement to be the commonest CT finding.[11] X-ray had 90.2% sensitivity (Sn), 61% specificity for bacterial sinusitis with a 61.7% positive predictive value (PPV) and 90% negative predictive value (NPV). CT had a higher sensitivity and specificity for bacterial sinusitis (95.1% and 93.2% respectively). The sensitivity of X-ray for fungal sinusitis was quite low (20%). CT had 80% Sn and 97.9% specificity for fungal sinusitis. The sensitivity and specificity of CT for SNP was 90% and 88.6% respectively while that of X-ray for SNP were 76.7% and 88.6% respectively. The sensitivity of X-ray for neoplastic diseases was 18.8% for benign and 42.9% for malignant. The sensitivity and specificity of CT for benign diseases were 75% and 97.7% while that for malignant was 78.6 and 98.8%. Hussein et al observed the sensitivity and specificity of water's view technique for polyps, fungal sinusitis, mucocele, tumors (33%,

99%; 0%, 100%; 66.7%, 100% and 30.8%; 99.1%).[18] The sensitivity and specificity of diagnosis of chronic sinusitis by X-ray was 60.7% and 61.4% respectively. Kushwah et al observed sensitivity of CT in chronic sinusitis to be 100%, specificity 93.8%, PPV 96.9%, NPV 96.9%, and diagnostic accuracy was 97.9% with a significant p level (p<0.001).[13] The sensitivity of polyp of CT over HPR was 100%, specificity 93.8%, PPV 75%, NPV 100% and diagnostic accuracy was 94.7% with a significant p level (p<0.001). Chaitanya et al reported 98.2% sensitivity and 96% specificity of CT in the diagnostic of chronic sinusitis.[19] Polyp had sensitivity of 96.9% and specificity of 98.6%. For fungal sinusitis, CT had lower sensitivity of 62.5% and specificity of 97.9%. For diagnosing benign and malignant lesions, CT had 100% sensitivity, specificity, PPV and NPV value with 100% accuracy. P value in all these instances was <0.05 i.e., <0.01, indicating the significance of the findings.

Kandukuri et al reported 98.3% sensitivity, 97.8% specificity, 96.77% PPV, 98.91% NPV, 98.05% accuracy of CT in the diagnosis of chronic sinusitis (p value 0.0001).[15] The value of these parameters for fungal sinusitis and polyp were 60% sensitivity, 93.3% specificity, 75% PPV, 98.67% NPV, 98.05% accuracy, p value 0.0001 and 94.4% sensitivity, 98.1% specificity, 94.44% PPV, 98.31% NPV, 97.4% accuracy, p value 0.0001. For the diagnosis of benign neoplasms, 90.3% sensitivity, 99.2% specificity, 95.24% PPV, 98.5% NPV, 98.05% accuracy with a p value of 0.0001. 94.1% sensitivity, 99.3% specificity, 94.12% PPV, 99.27% NPV, 98.7% accuracy with 0.001 p value was observed in malignant neoplasm. Hence, the sensitivity was found to be low in fungal sinusitis. Patel et al observed the sensitivity of CT scan as compared with nasal endoscopy to be 69.69%, specificity was 54.38%, PPV was 46.93% and NPV was 75.6%.[20] The results of our study is comparable to those observed in previous studies. The sensitivity of X-ray for bacterial sinusitis is high but the specificity and PPV are low which could be due to the involvement of maxillary sinus in majority of cases for which X-ray has a good sensitivity. CT has a good sensitivity and specificity for bacterial sinusitis. X-ray has a very poor sensitivity for fungal sinusitis. CT also has a low sensitivity for fungal sinusitis with a low PPV. Also, CT was observed to over diagnose few cases as fungal sinusitis. CT had a good sensitivity for SNP but with a low PPV. In our study, CT showed a very high level of significance (p<0.001) for the diagnosis of bacterial sinusitis, fungal sinusitis, SNP, benign and malignant diseases of the nose and PNS. X-ray showed a significant level for the diagnosis of bacterial sinusitis, SNP, malignant disease of the nose and PNS.

CONCLUSION

CT has a significant sensitivity and specificity for the diagnosis of inflammatory and neoplastic diseases. However, CT was found to overdiagnose fungal sinusitis in few cases. Also, CT cannot accurately differentiate between dense inspissated secretions and fungal sinusitis, and also between dense secretions and SNP in few cases. The type of neoplastic lesion could not be diagnosed by CT alone. Cytohistopathology gave a confirmatory diagnosis, and HPE was the gold standard investigation in all cases of nasal masses. Hence, CT is the imaging modality of choice in evaluating chronic sinonasal diseases and its complications, evaluating bony changes, extent of lesion, assessing the clinically relevant anatomical variations of the sinonasal regions thus aiding in guiding the endoscopic surgeon for a tailored and precise surgical approach in the management of these diseases.

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