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Original Research Article

Role of Multi detector Computed Tomography in Evaluation of sinonasal masses with their histopathological correlations

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Abstract:

Background: Computed tomography plays imported role in making diagnosis of various lesions. (CT) is the gold standard for the exact delineation of paranasal sinus (PNS) bony anatomy ,extent of disease and also helps in characterization of lesion.

Aim &Objective: To evaluate various Sino nasal masses, evaluate the sensitivity and specificity of CT in diagnosing Sino nasal masses and correlate CT findings of various Sino nasal masses with their histopathological findings.

Method: This study is a prospective correlational study that will include 51 patients evaluated over a period of 1.5 years with suspected Sino nasal masses referred to the Department of Radiodiagnosis from the ENT department via using a Siemens 128-sliceMultidetector CT scan machine at the Department of Radiodiagnosis at Gajra Raja Medical College Gwalior.

Result: PNS lesions were common in males37 (72.5%), commonest age group affected was found to be 11-20 years (21%), 21-30(19.6%) years,31-40, and 51-60 (17.6%). the benign lesion shows 97.14% sensitivity and 100% specificity with 98.04% accuracy. The malignant lesion shows 100.00% sensitivity and 93.02% specificity with 94.12% accuracy. Inflammatory/infective lesions show 62.50% sensitivity and 97.67% specificity with 92.16% accuracy.

Conclusion: CT scanning is an indispensable diagnostic modality in the detection and management of Sino nasal masses, Benign lesions are diagnosed very accurately,andthe Distinction between papilloma, haemangiomas, Sino nasal malignancies, and invasive chronic fungal sinusitis with bone destruction is still debatable.

Keywords: MDCT, CT of PNS mass, histopathology of PNS mass

1. INTRODUCTION

Sino-nasal disorders are a broad category of illnesses and syndromes that affect the paranasal sinuses and nasal passages. Most masses found in the sinuses are either non-neoplastic or neoplastic, with neoplastic masses further classified as benign or malignant. Squamous cell carcinoma, adenocarcinoma, esthesioneuroblastoma, extramedullaryplasmacytoma, and hemangiopericytoma are all malignant tumors, while inflammatory polyps, angiofibroma, invasive fungal sinusitis, inverted papilloma, capillary hemangioma, and rhinocerical are all benign tumors. In clinical practice, a variety of nonneoplastic and neoplastic disorders affecting the nasopharynx, paranasal sinuses, and

nasal cavities are frequently seen.[1] Human papillomavirus 6 and 11, allergens, air pollution, industrial carcinogens, tobacco, alcohol, and occupational exposure to heavy metal particles (such as nickel and chromium), particularly for workers in the leather, textile, furniture, and wood industries, are some of the etiological factors for the development of Sino nasal masses.[2]Sino-nasal masses can cause a variety of symptoms, including nasal obstruction, nasal congestion and discharge, headache, edema, and facial pain, as well as symptoms in the orbits and ears. The proper clinical history and examination are the first steps in the evaluation process. The view of sinonasal imaging has been drastically altered by new generations of imaging technologies. As an endoscopic sinus surgeon's necessity for better anatomic precision, computed tomography (CT) has largely superseded plain radiography in the past few years[3].

CT has become the investigation of choice for radiological diagnosis of nasal and sinus illnesses [4]. The patency of Sino nasal passageways can be evaluated by multidetector CT (MDCT), which also reveals the impact of anatomic variations and inflammatory illness on this parameter. MDCT is the study of choice for the surgeon contemplating functional endoscopic sinus surgery[5] due to its ability to reveal anatomic components that are not visible during a physical examination or diagnostic nasal endoscopy. CT is also useful for ruling out aggressive infections or neoplasms with characteristics such as extra-sinus extension, osseous damage, and local invasion. Complications from sinusitis, extra sinus malignant expansion, and the evaluation of intracranial extension are all situations when magnetic resonance imaging (MRI) can be helpful[5]. When it comes to assessing sino facial injuries, fibro-osseous lesions of the PNS, and fine bone features, CT is far superior to MRI. Determining the spread and severity of recurring or chronic Sino nasal illness is facilitated by CT, which in turn aids in its diagnosis and therapy. Because of its 3D high resolution, CT is superior to physical examination and endoscopy in characterizing the complicated Sino nasal architecture and anatomic variants[6].Among the several diagnostic tools available, CT is the gold standard for describing inflammatory sinus illness due to obstruction[7]. CT is also the examination of choice for pre-operative evaluation of the nasal cavity and paranasal sinuses. There is a high correlation between coronal CT imaging and the final surgical strategy[8]. Since CT's coronal pictures are similar to what the endoscope would see, it is the study of choice for Functional Endoscopic Sinus Surgery (FESS)[9].Patient mortality and morbidity can be decreased by using CT to diagnose anatomic abnormalities that may cause intra-operative and post-operative FESS problems. In recent years, examination of Sino nasal disorders has shifted toward the use of CT in conjunction with diagnostic endoscopy. Therefore, CT is quite helpful, and it is the gold standard for imaging Sino nasal disorders[10].This research was carried out to characterize benign and malignant Sino nasal lesions using CT parameters and to link CT findings with histological findings.

2. RESULT:

A total of 51 patients were presenting with sinonasal masses evaluatedusing CT which was further followed by HPE examination. Observations were based on CT diagnosis which is correlated with gold standard histopathological diagnosis.

Table1: Distribution of sinonasal lesions on radiology

Sinonasal lesion	**Radiological Diagnosis**
Neoplastic A. Benign B. Malignant	 34 11
Infective/ inflammatory	6
Total	**51**

Table 1 shows ,The neoplastic lesion is 45 and the infective/inflammatorylesion is 6 diagnosed on CT. Out of 45 neoplastic lesions, 34 were benign and 11 were malignant diagnosed on CT, benign lesion like AC and ethmoidal polyps comes under the inflammatory category in HPE so the most common lesions in paranasal sinuses are inflammatory and benign lesions. This is in accordance with the study done by Vikas Dhillon et al.[11]

Table2: Age Distribution

Age Group	**Frequency**	**Percent (%)**
<10	3	5.9
11-20	11	21.6
21-30	10	19.6
31-40	9	17.6
41-50	3	5.9
51-60	9	17.6
>60	6	11.8
Total	51	100.0

Table3:Gender Distribution

Gender Distribution	**Frequency**	**Percent**
Female	14	27.5
Male	37	72.5
Total	51	100.0

Table 2&3 shows the age and sex distribution of PNS lesions. The total numbers of males were 37 (72.5%) and that of females were 14 (27.5 %). We observed that PNS lesions were common in males. This correlate with the study done by Bist S et al[55].The commonest age group affected was found to be 11-20 years (21%), 21-30(19.6%) years,31-40, and 51-60 (17.6%). Most patients were in the 2nd and 3rd decades of their life which is comparable to the study done by Bist S et al.[12]

Table4: Age group and gender distribution of sinonasal masses diagnosed on CT

Age group	**Benign**		**Malignant**		**Inflammatory/ infective**		**Total (%)**
	Male (%)	**Female** (%)	**Male** (%)	**Female** (%)	**Male** (%)	**Female** (%)	
0-10	2	0	0	1	0	0	3 (5.8%)
11-20	7	2	1	0	1	0	11

							(21.5%)
21-30	4	3	1	0	1	1	10 (19%)
31-40	4	2	2	0	1	0	9 (17%)
41-50	1	0	0	1	0	0	2 (3.9%)
51-60	3	3	2	1	0	1	10 (19.6%)
61-70	2	0	1	0	1	0	4 (7.8%)
71-80	1	0	1	0	0	0	2 (3.9 %)
	24 (70%)	10 (30%)	8 (72.7%)	3 (28.3%)	4 (66.6%)	2 (36.4%)	51 (100%)

On CT examination most common age group for the benign lesion is 2nd and 3rd decade of life with malepredominance, while for malignant lesions most common age group is 4th and 6thdecade of life with male predominance,theinflammatory lesion is seen in equally distributed 2nd 3rd 4th and 6th decade of life with male predominance.

Table5: Age group and gender distribution of sinonasal masses diagnosed on gold standard HPE

Age group	**Benign**		**Malignant**		**Inflammatory/ infective**		**Total (%)**
	Male (%)	**Female** (%)	**Male** (%)	**Female** (%)	**Male** (%)	**Female** (%)	
0-10	2	0	0	1	0	0	3 (5.8%)
11-20	8	2	0	0	1	0	11(21.5%)
21-30	4	3	0	0	2	1	10 (19%)
31-40	4	2	1	0	2	0	9(17%)
41-50	1	0	0	1	0	0	2 (3.9%)
51-60	3	3	2	1	0	1	10 (19.6%)
61-70	2	0	1	0	1	0	4 (7.8%)
71-80	1	0	1	0	0	0	2 (3.9 %)
	25(71.4%)	10(28.5%)	5 (62.5%)	3(37.5%)	6(75%)	2(25%)	51 (100%)

Table-3 shows CT-diagnosed case which is sent for HPE for final diagnosis, most common age group for the benign lesion is 2nd and 3rd decade of life with male predominance, while for malignant lesions most common age group is 6thdecade of life with male predominance, inflammatory lesions are seen in 3rdand 4th decade of life with male predominance.

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Figure-1Presenting symptoms

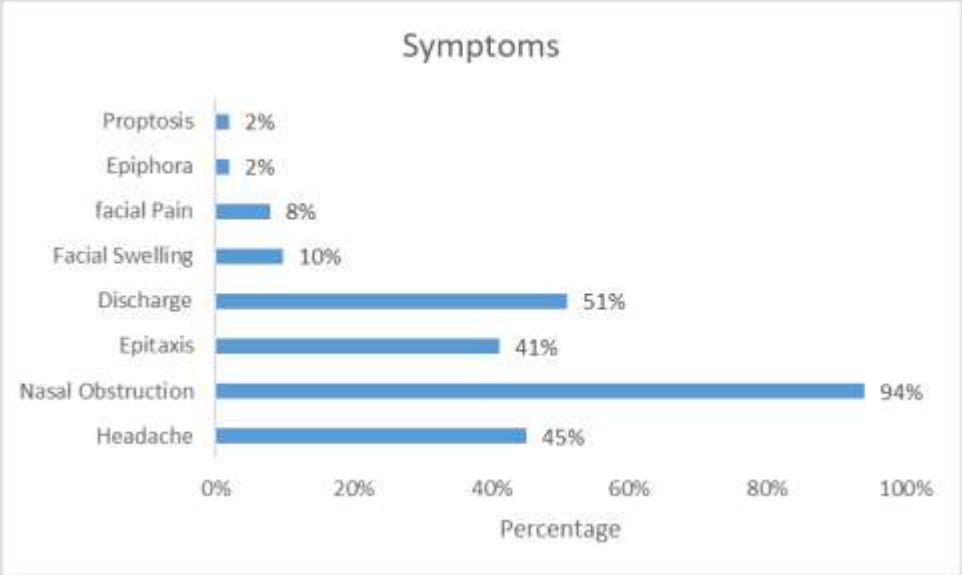


Figure-1The commonest symptoms were nasal obstruction (94.4%), discharge (40%), and headache (45.1%). This correlate to the observations of the study done by A. Lathi.[13].

Table6: Bony involvement seen on CT

Bone involvement	**No. of Cases (%)**
Remodeling	8 (15%)
Erosion	6 (11%)
Destruction	10 (19.6%)
Hyperostosis	1 (1.9 %)
No changes	26(52%)
Total	51 (100%)

Table no. 4 shows bone involvement by the lesion, 8 Cases show remodeling, 6 cases show erosion,10 cases show destruction, and 1 case shows hyperostosis. Erosion of the bony wall is seen in chronic fungal sinusitis with destruction in few cases, while destruction of the bony wall is seen in almost all malignant cases with erosion, hyperostosis, and remodeling. Remodeling has been seen in benign lesions mainly in polyps and angiofibroma. The most common bony change was bone destruction. The findings were consistent with Zimmerman et al[14].

Table 7: Distribution of radiological diagnosis with respect to gold standard HPE diagnosis

Radiological Diagnosis	**No. of cases (%)**	**HPE Diagnosis**	**No. of cases (%)**
Antrochoanal polyp	21(41.2 %)	Inflammatory polyp	21(41.2 %)

Ethmoidal polyp	5(9.8%)	• Inflammatory polyp • Respiratory hamartomatous polyp	4(7.9%) 1(1.9%)
Hemangioma	4(7.9%)	Hemangioma	4(7.9%)
Juvenile Angiofibroma	2(3.9%)	Juvenile Angiofibroma	2(3.9%)
Papilloma	2(3.9%)	• Inverted papilloma • Hemangioma	1(1.9%) 1(1.9%)
Chronic fungal sinusitis	4(7.9%)	• Chronic fungal sinusitis • Inflammatory polyp	3(6.0%) 1(1.9%)
Mucocele of frontal sinus	2(3.9%)	Mucocele of frontal sinus	2(3.9%)
Esthesioneuroblastoma	2(3.9%)	Esthesioneuroblastoma	2(3.9%)
Sinonasal malignancy	9(17.6 %)	• Epithelial sinonasal malignancy a. NK-SCC trans. Type b. NK-SCC diff. Type c. SCC undifferentiated. type d. Olfactory neuroblastoma • Chronic fungal sinusitis • Rhinosporidiosis	6(11.9 %) 1 3 1 1 2(3.9%) 1(1.9%)
TOTAL	51(100 %)		51(100 %)

On CT, we found 21 AC polyps. Out of 21 AC polyps, 20 inflammatory polyps and 1 hemangiomawerefound in histopathology.

On CT, we found 5 ethmoidal polyps. Out of ethmoidal 5 polyps, 4 were inflammatory polyps and 1 was Respiratory hamartomatouspolyps found in histopathology.

On CT, we found 4 hemangiomas. Out of 4 hemangiomas, all the hemangiomasarefound in histopathology.

On CT, we found 2 juvenile angiofibroma. Out of 2 juvenile angiofibroma, all the findings are as juvenile angiofibroma found in histopathology.

On CTwe found 2 papilloma's. Out of 2 papillomas, 1 was papilloma and 1 was hemangioma found in histopathology.

On CTwe found 4 Chronic fungal sinusitis. Out of 4 chronic fungal sinusitis, 3 were Chronic fungal sinusitis and 1 was an Inflammatory polyp found in histopathology

On CTwe found 2 mucoceles of the frontal sinus. Out of 2mucocele of the frontal sinus, all were found as a mucocele of the frontal sinus in histopathology

On CTwe found 2esthesioneuroblastomas.Out of 2 esthesioneuroblastomas, all were found as esthesioneuroblastoma in histopathology.

On CT we found 9 Sinonasal malignancy-SCC. Out of 9 Sinonasalmalignancy-SCC, 5 were NK-SCC, 1 was olfactory neuroblastoma, 2 was chronic sinusitis with papillomatosis and 1 was rhinosporidiosis found in histopathology.

Table 8:Comparison of diagnostic efficiency of CT (radiological finding) with gold standard HPE

Sinonasal lesions	Sensitivity	Specificity	PPV	NPV	Accuracy
AC Polyp	95.7%	100%	100%	96.6%	98.03%
Ethmoidal Polyp	100%	97.9%	80%	100%	98.03%
Hemangioma	80%	100%	100%	97.9%	98.03%
Epithelial Malignancy(SCC)	100%	93.3%	66.7%	100%	94.11%
Esthesioneuroblastoma	100%	100%	100%	100%	100%
Juvenile Angiofibroma	100%	100%	100%	100%	100%
Chronic fungal Sinusitis	50%	97.8%	75%	93.6%	92.15%
Mucocele	100%	100%	100%	100%	100%
Inverted papilloma	100%	98%	50%	100%	98.03%

Table9: Diagnostic efficiency of neoplastic and nonneoplasticlesions on CT after comparing with gold standard HPE

Sino nasal masses	Benign	Malignancy	Inflammatory
Sensitivity	97.14%	100.00%	62.50%
Specificity	100.00%	93.02%	97.67%
AUC	0.986	0.965	0.801
PositivePredictiveValue	100.00%	72.73%	83.33%
NegativePredictiveValue	94.12%	100.00%	93.33%
Accuracy	98.04%	94.12%	92.16%

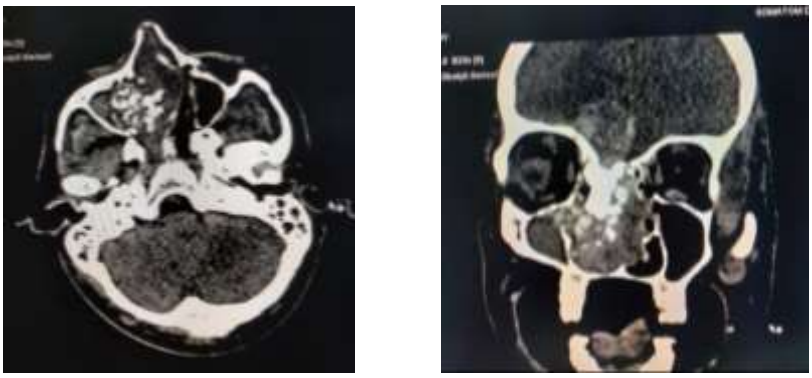
Based on the gold standard HPE, Benign lesions have 97.14% sensitivity, 100% specificity, 100% PPV, 94.12% NPV, and 98.04% accuracy on CT,Malignant lesions have 100.00% sensitivity, 93.02% specificity, 72.73% PPV, 100 % NPV, and 94.12% accuracy on CT,Inflammatorylesions have 62.50% sensitivity, 97.67% specificity, 83.33% PPV, 93.33 % NPV, and 92.16% accuracy on CT.

Table 10: Category Cross tabulation

Count		Histological			
		Benign	Inflammatory	Malignant	Total
Radiological	Benign	34	0	0	34
	Inflammatory	1	5	0	6
	Malignant	0	3	8	11
Total		35	8	8	51

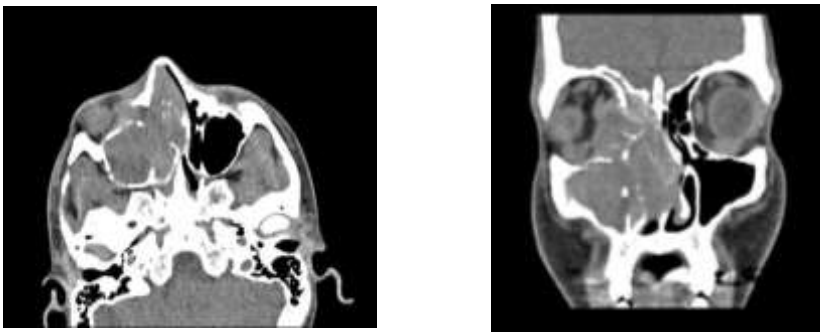
Chi-square: 67.655, df: 4, p=<0.0001

We observed that radiological diagnoses were significantly associated with histological diagnoses. (p=<0.0001)



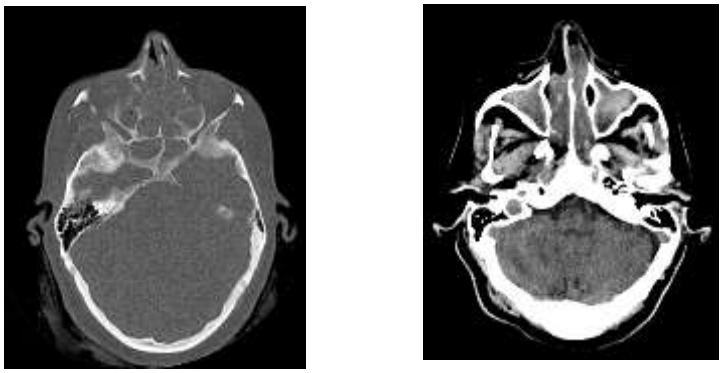
(a) (b)

(Case1) Esthesioneuroblastoma:Axial(a) and Coronal(b) images of a 40 yr male showing a large ill-defined mass lesion in extenethmoid sinus with multiple punctate foci of calcification and extended in to left nasal cavity, nasopharynx causing widening and destruction of the maxillary ostium and filling of right maxillary sinus, destruction of lamina papyracea, extension into extraconal space of right orbit, destruction of the right cribriform plate with intracranial extension into anterior cranial fossa on right side.



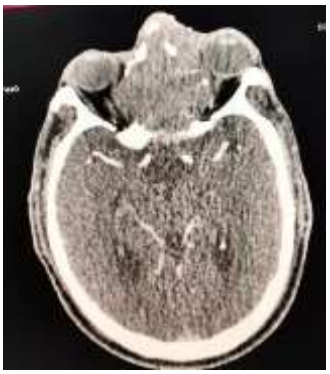
(a) (b)

(Case2) Squamous cell carcinoma: Axial(a) and Coronal(b) images showing an ill-defined heterogeneously enhancing heterodense lesion in right maxillary sinus involving right ethmoid and frontal sinus. The lesion is causing erosion and remodeling of posteriolateral wall of right maxillary sinus and destruction of floor of right orbit and extension within it

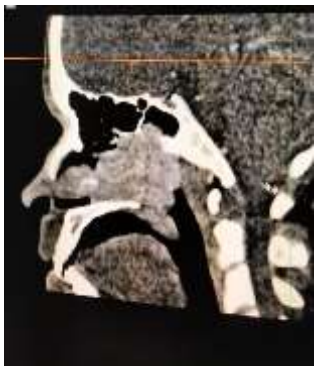


(a) (b)

(Case3) Polyposis with fungal sinusitis: Axial images (a & b) showing non-enhancing soft tissue lesion with areas of central hyperdensity within bilateral ethmoid and bilateral maxillary sinuses causing widening of bilateral maxillary ostium and rarefaction of bilateral lamina papyracea. The lesion is filling a bilateral nasal cavity.

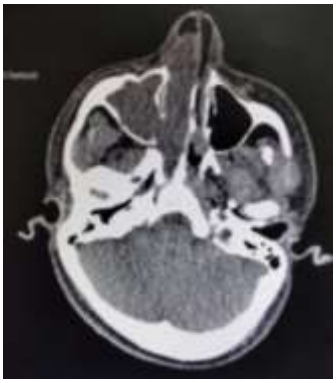


(a)



(b)

(Case4) Juvenile Nasal Angiofibroma: Axial(a) & sagittal(b) images of 16yr old male showing an ill-defined homogenously avidly enhancing soft tissue mass lesion in left nasal cavity causing widening of left sphenopalatine fossa. The lesion is extending into left ethmoid sinus superiorly, left sphenoid sinus posterosuperior and the nasopharynx posteriorly and causing obstruction of left eustachian tube.



(Case5) Anterochoanal polyp: Axial image homogenously enhancing polypoidal soft tissue mass lesion in right maxillary sinus causing smooth widening of right osteomeatal complex with extension into nasal cavity anteriorly causing its obstruction.

3. DISCUSSION

The commonest age group affected was found to be (Table 2&3) 11-20 years (21%), 21-30(19.6%) years,31-40, and 51-60 (17.6%) with male predominance 37 (72.5%)thanfemales were 14 (27.5 %). Most patients were in the 2nd and 3rd decades of their life shows the age and sex distribution of PNS lesions.

The most common age group for the benign lesion is the 2nd and 3rd(table 4)decade of life with male predominance, while for malignant lesions most common age group is the 4th and 6th decade of life with male predominance.

Bone destruction is the most common bone involvement noted in 10 (19.6%) in almost all malignant lesions (Table 4), remodeling in 8 (15%) Cases, erosion in 6(11%)cases,andhyperostosis in 1(1.9%) case. Erosion of the bony wall is also seen in

chronic fungal sinusitis with destruction in a few cases, whileremodeling has been seen in benign lesions mainly in polyps and angiofibroma.The commonest symptoms of sinonasal masses were nasal obstruction (94.4%), discharge (40%), and headache (45.1%).(Figure-1)

Diagnostic efficiency of CT with HPE in lesions like esthesioneuroblastoma, mucocele, and Juvenile angiofibroma has 100% sensitivity and specificity and PPV. AC poly has 95.7% sensitivity,100% specificity and PPV. Epithelial malignancy has 100% sensitivity but shows low 93.3% specificity and a PPV of 66.6%. Chronic fungal sinusitis shows a verylow sensitivity of 50% and PPV of 75% with good specificity of around 97.8%. Papilloma has a low PPV of 50% while haemangioma has a low sensitivity of 80%. based on HPE which is considered the gold standard CT shows 97.14% sensitivity and 100% specificity with 98.04% accuracy for Benign lesions,malignant lesionsshow100.00% sensitivity and 93.02% specificity with 94.12% accuracy and 62.50% sensitivity, and 97.67% specificity with 92.16% accuracy for infective/inflammatory lesions(table9).

In our study, polyposis was diagnosed correctly in 97.14%of cases Polyps on plane CT appeared as a bulky, soft tissue mass, associated with chronic thickening of the mucosa within the sinuses with mild irregular enhancement, cases have shown as hypodense and as an isodose lesion on plain CT

In the early stages, malignant masses often confuse radiologically with invasive/chronic fungal sinusitis this leads to decrease the specificity of epithelial malignancy and decrease in the sensitivity of chronic fungal sinusitis/invasive. Bone erosions with secondary bony fragments often confuse with primary internal hyper dense contents in chronic fungal sinusitis. The other cases which show discordance in our study were inverted papilloma with haemangioma. Esthesioneuroblastomais present in middle-aged men with typical imaging features of soft tissue mass showing heterogeneous contrast enhancement, with foci of calcification within it causing widening of ethmoidal recess and sinus, in advanced stages intracranial extension of mass seen with bone resorption. Angiofibroma presents in young males with vascular mass with typical imaging characteristics on contrast CT like lobulated nonencapsulated soft-tissue mass centered on the sphenopalatine foramen (which is often widened) and usually bowing the posterior wall of the maxillary antrum anteriorly with marked contrast enhancement following administration of contrast, reflecting the prominent vascularity leads to CT become the modality of choice for imaging evaluation of the morphology in this area. In the present study, a good correlation was noted in cases of, polyp and neoplastic lesions, as evidenced by high sensitivity and specificity values. However poor correlation was obtained in cases of fungal sinusitis, and papilloma, which was supported by low sensitivity.

4. CONCLUSION

Benign lesions are diagnosed very accurately. However, the distinction between papilloma, haemangiomas, and Sino nasal malignancies (squamous, adenocarcinoma, olfactoryneuroblastoma) and invasive/chronicfungal sinusitis with bone destruction is still debatable, and hence, histopathological correlation is necessary for definitive diagnosis. The presence of significant cervical lymphadenopathy can serve as a marker of Sino nasal malignancy but sinonasalmalignancies are more locally aggressive lesions and patients do come before the distance metastasis of lesion or involvement of cervical nodes, in the advanced lesion with extension lymphadenopathy may be helpful

Due to its unique property of Visualization of bones as well as air and advanced processing technique, CT scanning is a diagnostic modality in the detection and management of paranasal sinus lesions in the present era and many more years to come.

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