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RESEARCH ARTICLE

ROLE OF COMPUTED TOMOGRAPHY IN DIAGNOSIS OF NEOPLASTIC SINONASAL DISEASES

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ABSTRACT

Computed Tomography plays a major diagnostic role in evaluation of patients with neoplastic sinonasal diseases and determines the mode of management. The purpose of the present study is to assess the role of CT in diagnosis of neoplastic sinonasal diseases by correlating CT diagnosis with final histopathological diagnosis and evaluating the sensitivity and specificity of CT. This study was a retrospective hospital based study executed in the Department of Radiodiagnosis, Acharya Vinobha Bhave Rural hospital (AVBRH) attached to Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha. Study included 175 patients with symptomatic sinonasal diseases who were evaluated by 16 slice MDCT and final diagnosis was obtained. Out of 175 patients 38 had neoplastic histopathological diagnosis in ehich the findings were correlated with CT diagnosis. Then sensitivity and specificity of CT was evaluated. Statistical analysis was done by descriptive and inferential statistics using Test statistics (sensitivity, specificity, ppv, npv and accuracy) and Z test for single proportions (Z value > 1.96 is considered significant). Software used in the analysis was SPSS 17.0 version and graph pad prism 6.0 version and $p < 0.05$ is considered as level of significance. On correlating CT diagnosis with final diagnosis, Benign neoplasms had sensitivity of 95.24% and specificity of 99.35%, positive predictive value 95.24%, negative predictive value with 99.35% and accuracy of 98.86%. Malignant neoplasms had sensitivity of 88.89% and specificity of 99.36%, positive predictive value 94.12% and negative predictive value 98.73% with 98.29% accuracy. P value in all instances was < 0.05 i.e. <0.0001, indicating the significance of the findings.

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INTRODUCTION

Sinonasal neoplastic lesions can be classified as benign or malignant, as carcinoma, sarcoma, adenocarcinoma, or lymphoma or according to the tissue of origin or as a combination of above (Gomaa *et al*., 2013). Sinonasal tumors are usually accompanied by underlying or superimposed chronic inflammatory or allergic disease, because of which tumors may be easily overlooked. A sino nasal tumor can be distinguished from associated inflammatory disease by CT but differentiation may be difficult (Som, 1990). Nasal cavity masses can be diagnosed using CT and MRI. These diagnostic modalities may help in differentiating the contents, contrast enhancement patterns of the lesions and localize the tumour, thus these cross sectional imaging modalities are being used frequently to differentiate the nasal cavity masses (Yildirim, 2012). *Bony erosion* is highly suspicious of malignancy and is the typical pattern of involvement in squamous cell carcinoma but may also be observed in inflammatory conditions. In particular, inflammation involving the bones of the skull base frequently mimics malignancy (Madani and Beale, 2009) Few conditions like, Wegener's granulomatosis and fungal infections such as Mucormycosis show aggressive imaging appearances and mimic malignancy. Bony erosion and sclerosis is characteristic and diagnostic feature of Wegener's granulomatosis but these are also observed in fungal infections, adenoid cystic carcinoma and in some cases where chronic infection is superimposed over malignancy. Brown's tumor of hyperparathyroidism, inverted papillomas, and Ameloblastoma are other benign lesions that may mimic malignancy by causing bony erosion (Madani and Beale, 2009). Computed tomography (CT) plays a major role in diagnosis of neoplastic lesions of sinonasal tract as it clearly show airs spaces, opacified sinuses and fine structural architecture of bony anatomy (Janet Cochrane Miller, 2009). CT plays a significant role in differentiating aggressive infections and neoplasms. Characteristics that are suggestive of malignancy include extra-sinus extension, osseous destruction, and local invasion. MRI can be done in cases of complications of sinusitis, extra sinus extension of malignancy and to evaluate intracranial extension (Janet Cochrane Miller, 2009). Both CT and MRI complement each other in diagnosis of various bioplastic lesions of sinonasal tract. The majar advantage of CT over MRI is in assessment of the presence and extent of bony involvement.

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MATERIALS AND METHODS

Aim: To assess the role of CT in the diagnosis of neoplastic sinonasal diseases.

Objectives: To retrospectively analyse the patients with suspected sinonasal pathologies in whom final histopathological diagnosis was obtained. To correlate findings of CT with final histopathological diagnosis and evaluate sensitivity and specificity of CT in the diagnosis of various neoplastic sinonasal diseases.

Study design and setting: This study was a retrospective hospital based study executed in the Department of Radiodiagnosis, Acharya Vinobha Bhave Rural hospital (AVBRH) attached to Jawaharlal Nehru Medical College, Sawangi (Meghe), Wardha.

Study period: August 2013-July 2016

Sample size: The sample size was calculated by the formula

$n_{Se} = Z^2_{\alpha/2}$ Sen (1-Sen) ÷ d^2 × Prev

For α= 0.05, $Z_{\alpha/2}$ is inserted by 1.96; Sen and Prev are the pre-determined values of sensitivity and prevalence of disease respectively and d as the precision of estimate (i.e. the maximum marginal error) is pre-determined by clinical judgment of investigators (Hajian-Tilaki, 2014). The pre-determined values of Sensitivity are 89.4% (the overall sensitivity of CT obtained in previous study (Chaitanya and Raviteja, 2015) and prevalence of disease 20.8 (prevalence of sinonasal diseases in AVBRH hospital, Wardha). Marginal error d = 0.10)

1.96x 1.96 x .894 x.106/ 0.10x 0.10 x .208 = 175

Collection of data: Case records of various patients with suspected sinonasal pathologies between August 2013-July 2016 were evaluated and 175 patients were selected for the study who had undergone CT and final diagnosis was obtained after further investigations like FESS, diagnostic nasal endoscopy or open surgery etc. final histopathological diagnosis was obtained in 38 patients which were further correlated retroscpectively with CT diagnosis.

Radiological Investigation carried out in the study: CT scan was carried out in a Philips 16 Slice BRILLIANCE 190P MDCT machine in all patients and images were acquired in the axialplane and coronal reformations were done. Post contrast study was done in those who required further evaluation. Patient position was supine. Raw slice thickness was 3mm thickness and Increment 1.5mm. Reconstructed slice thickness was 1mm and Increment 0.5mm. Extent for axial sections was from hard palate to upper margin of the frontal sinus and Coronal reformations were performed perpendicular to the plane of hard palate through the maxillary sinuses. Exposure factors used were 120 kvp and 150mAs. Scan time was 10sec. Soft tissue window level and width (60/370) and bone window level and width (500/1500). Omnipaque 350 wasused if indicated, at a dose of 1ml/kg weight as a single intravenous bolus injection after estimation of serum creatinine level.

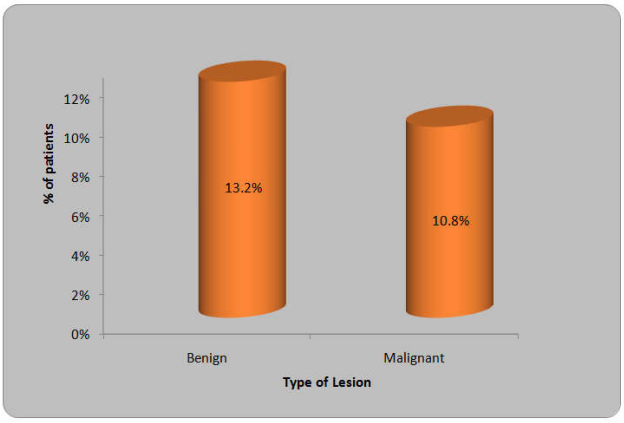
Statistical analysis: Statistical analysis was done by using descriptive and inferential statistics using Test statistics (sensitivity, specificity, PPV, NPV and accuracy), chi square test and Z test for single proportions (Z value > 1.96 is significant). Software used in the analysis was SPSS 17.0 version and graph pad prism 6.0 version and $p < 0.05$ is considered as level of significance.

RESULTS

Out of 175 patients 114 males (65.14%) and61females (34.85%) aged between 5 and 80 years. Among the neoplastic cases 42(24%) the benign cases 23 (13.2%) were more common than malignant cases 19 (10. 8%) as shown in [Table 1].Nasopharyngeal angiofibroma was the most common benign pathology (8 cases = 19%) as shown in [Table 2] which is statistically significant as z value > 1.96. There were 5 cases (11.9%) of inverted papilloma which second most common benign pathology as shown in [Table 2]. In our study the most common malignant pathology found was maxillary carcinoma (9 cases = 21.4 %) followed by nasal carcinoma and nasopharyngeal carcinoma as shown in [Table 3]. The findings are statistically significant as z value > 1.96. In our study 27 patients had bone involvement in the form of erosion or destruction on endoscopy / FESS. CT detected bone involvement in all the patients and therefore had 100% sensitivity and specificity as shown in [Table 7].

Table 1. Distribution of neoplastic cases

Type of lesion	Number of cases N=175	Percentage (%)
Benign	23	13.2.
Malignant	19	10.8
Total	42	24



Graph 1. Distribution of neoplastic cases

Table 2. Distribution of cases of benign neoplasms

Type of lesion	Number of cases N=42	Percentage (%)
Nasopharyngeal angiofibroma	8	19%
Inverted papilloma	5	11.9%
Fibrous dysplasia	4	9.5%
Capillary hemangioma	4	9.5%
Ivory osteoma	1	2.3%
Squamous papilloma	1	2.3%

Table 3. Distribution of cases of malignant neoplasms

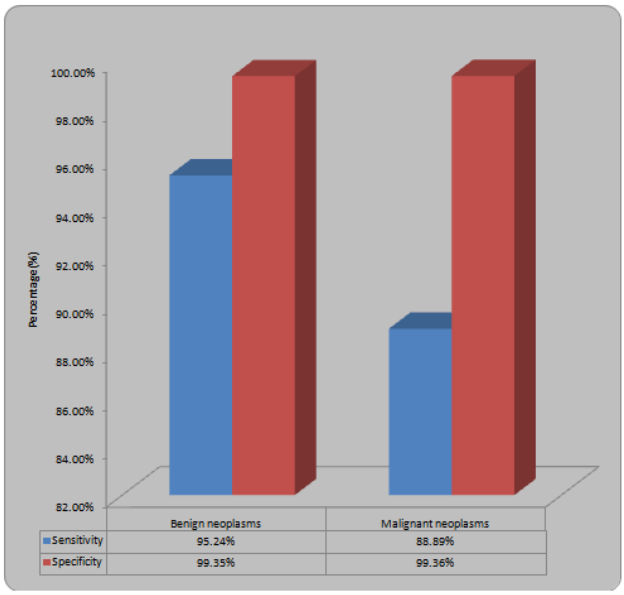
Type of malignancy	No of cases N=42	Percentage
Maxillary carcinoma	9	21.4
Nasal ca	6	14.2
Nasopharyngeal carcinoma	4	9.5

Table 4. Histopathological reports (Benign cases)

HPR	Number
Inflammatory polyps	2
Angiofibroma	6
Capillary hemangioma	3
Fibrous dysplasia	4
Inverted papilloma	4
Neurofibroma	1
Rinoscleroma	2
Squamous cell papilloma of nose	1
Retention cyst	1
Ivory osteoma	1

Table 5. Histopathological reports (malignant cases)

HPR	Number
Squamous cell carcinoma of nasal vestibule	1
Pleomorphic adenoma of left nostril	1
Squamous cell carcinoma of maxillary sinus	8
Poorly differentiated squamous cell carcinoma of left nostril	1
Adenoid cystic nasal carcinoma	1
Non keratising nasopharyngeal carcinoma	2
Cylindrical cell nasal carcinoma	1
Poorly differentiated nasopharyngeal carcinoma	2
Total	18



Graph 2. Correlation of CT with Final Diagnosis -an evaluation

Sinonasal pathology	Present Study	Khan *et al*. (2006)	Chopra *et al*. (2008)
Benign neoplastic lesions	13.2%	23.3%	11%
Malignant lesions	10.8%	16.7%	5%

The most common benign pathology in our study was nasopharyngeal angiofibroma which was also seen in study done by Mohammed A. Gomaa *et al*. (2013), Shanker *et al*. (1994) stated that juvenile nasopharyngeal angiofibroma affects adolescent males. These findings coincide with our studies, as there were seven patients with nasopharyngeal angiofibroma; all were males and their ages were between 10 and 18 years old. Pradhananga *et al*. (2008) reported 9 cases of angiofibroma over a period of two years in Nepal. The most common malignant pathology was squamous cell carcinoma of maxillary sinus which was also seen in studies done by Azzam Salami *et al* study (2009), Mohammed A. Gomaa *et al*. (2013) and Chow *et al*. (Zimmer and Carrau, 2006). Zimmer *et al*. (2006) stated that malignancy of sinonasal tract is rare while Fasunla *et al*. (2007) in their study stated that maxillary sinus is the most common site of origin and Weymuller *et al*. (2005) stated that the most common histological type is squamous cell carcinoma. Svane-Knudsen *et al*. (1998) have similarly reported squamous cell carcinoma to be the most commonly encountered malignancy of sinonasal tract in his study. On correlating CT diagnosis with final diagnosis, Benign neoplasms had sensitivity of 95.24% and specificity of 99.35%, positive predictive value 95.24%, negative predictive value with 99.35% and accuracy of 98.86%. Malignant neoplasms had sensitivity of 88.89% and specificity of 99.36%, positive predictive value 94.12% and negative predictive value 98.73% with 98.29% accuracy. P value in all instances was < 0.05 i.e. <0.0001, indicating the significance of the findings. The findings can be compared with the study done by Chaitanya *et al*. (2015) Thus, CT plays an important role in diagnosing of various neoplastic sinonasal diseases.

Limitations

CT has certain limitations and disadvantages like complex projections, artifacts induced by very high density structures in and around sinonasal complex. Increased exposure to radiation also limits frequent use of CT especially in children and pregnant women. Other disadvantages of CT include motion artifact and limited soft tissue resolution. The complication of sinonasal pathologies like intra orbital or intra cranial extension of the disease process is better assessed by MRI. However, CT has its own unique abilities in diagnosing various sinonasal diseases like determining the extent, invasiveness and involvement of bone by disease process. Both CT and MRI can complement each other in cases of aggressive, invasive and complicated sinonasal pathologies.

Table 6. Correlation of CT with Final Diagnosis -an evaluation

Parameters	Sensitivity	Specificity	PPV	NPV	Accuracy	P value	Result
Benign neoplasms	95.24%	99.35%	95.24%	99.35%	98.86%	0.0001	Significant
Malignant neoplasms	88.89%	99.36%	94.12%	98.73%	98.29%	0.0001	Significant

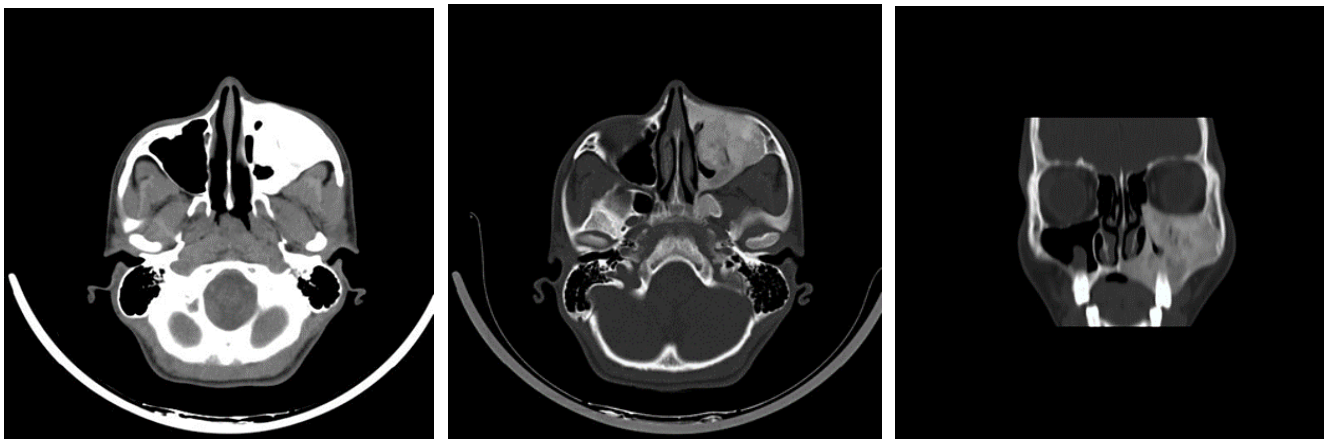
Table 7. Bone destruction/erosion

Bone destruction/erosion	Number (n= 42)	Sensitivity	Specificity
CT Diagnosis	27	100%	100%
Final diagnosis	27	-	-

On correlating CT diagnosis with final diagnosis the sensitivity and specificity of CT was higher in all cases. P value in all instances was < 0.05 i.e. <0.0001, indicating the significance of the findings.

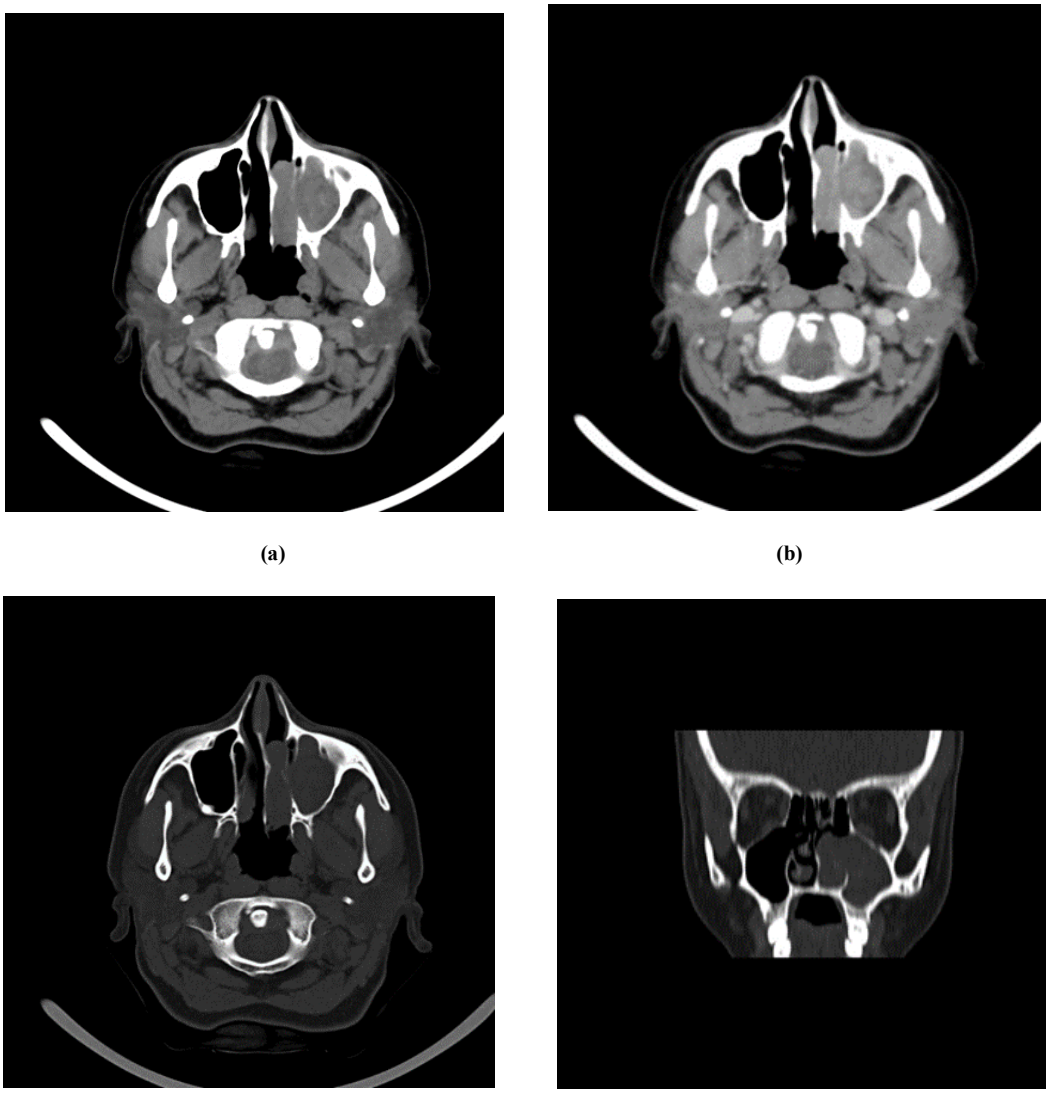
DISCUSSION

The benign neoplastic (13.2%) and malignant lesions (10.8%) found in our study can be correlated with studies done by Khan *et al*. (2006), Chopra *et al*. (2008), Vijay Prabhu *et al*. (2015)



(a) (b) (c)

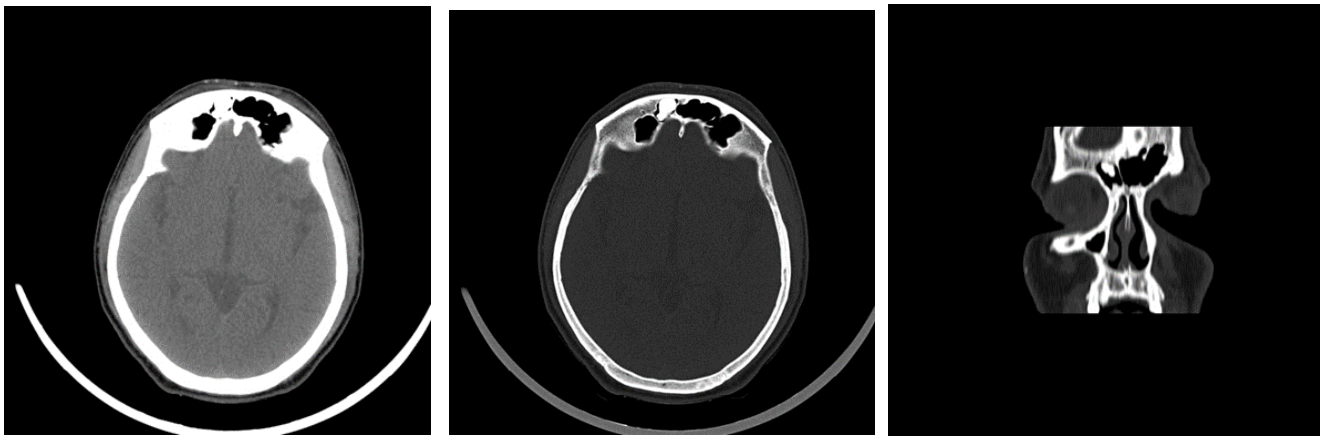
CASE 1 Axial (a, b) and coronal (c) CT images show dense homogeneous ground glass pattern and expansion of left maxillary sinus, left zygomatic process, left sphenoid and left squamous temporal bone with obliteration of left maxillary sinus and narrowing of left nasal cavity. CT features suggests diagnosis of FIBROUS DYSPLASIA. It is histologically proven



(a) (b)

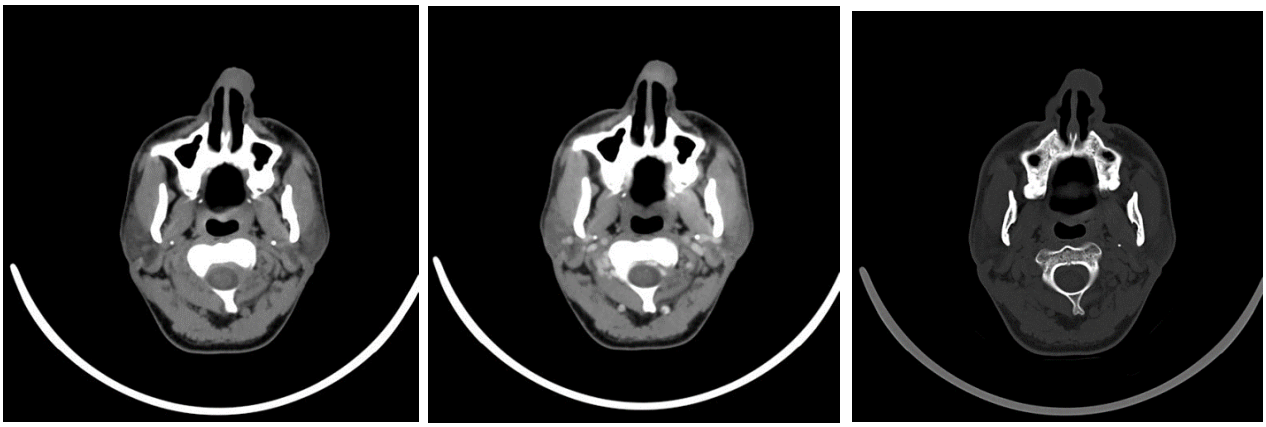
(c) (d)

CASE 2: Axial pre (a) and post contrast (b) with axial (c) and coronal (d) bone window CT images show soft tissue attenuating moderately enhancing mass occupying left nasal cavity and left maxillary sinus with sclerosis of adjacent bone and enlargement of left osteomeatal complex. It is CT diagnosed and histologically proven case of INVERTED PAPILLOMA



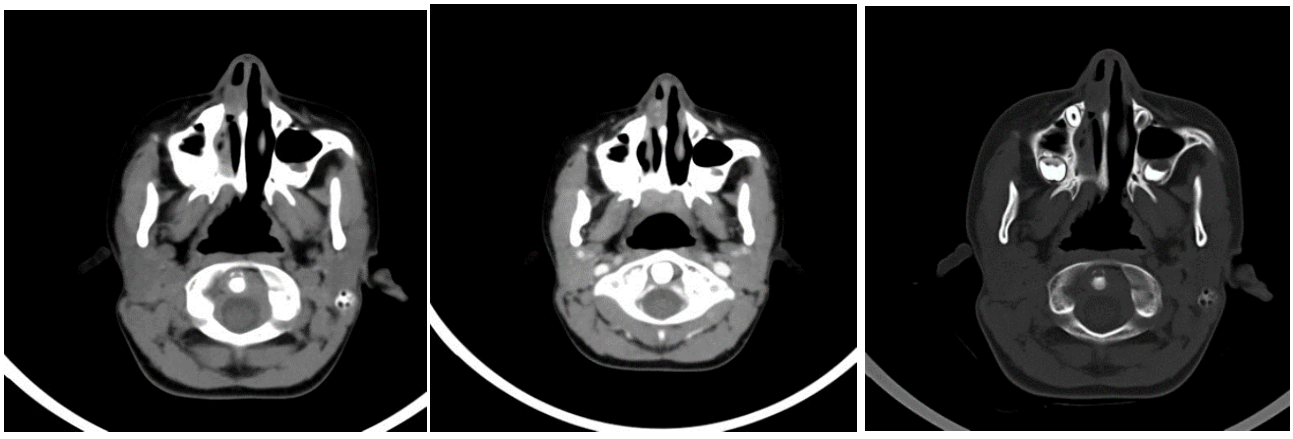
(a) (b) (c)

CASE 3: Axial soft tissue window (a), axial (b) and coronal (c) bone window CT images show RIGHT FRONTAL IVORY OSTEOMA



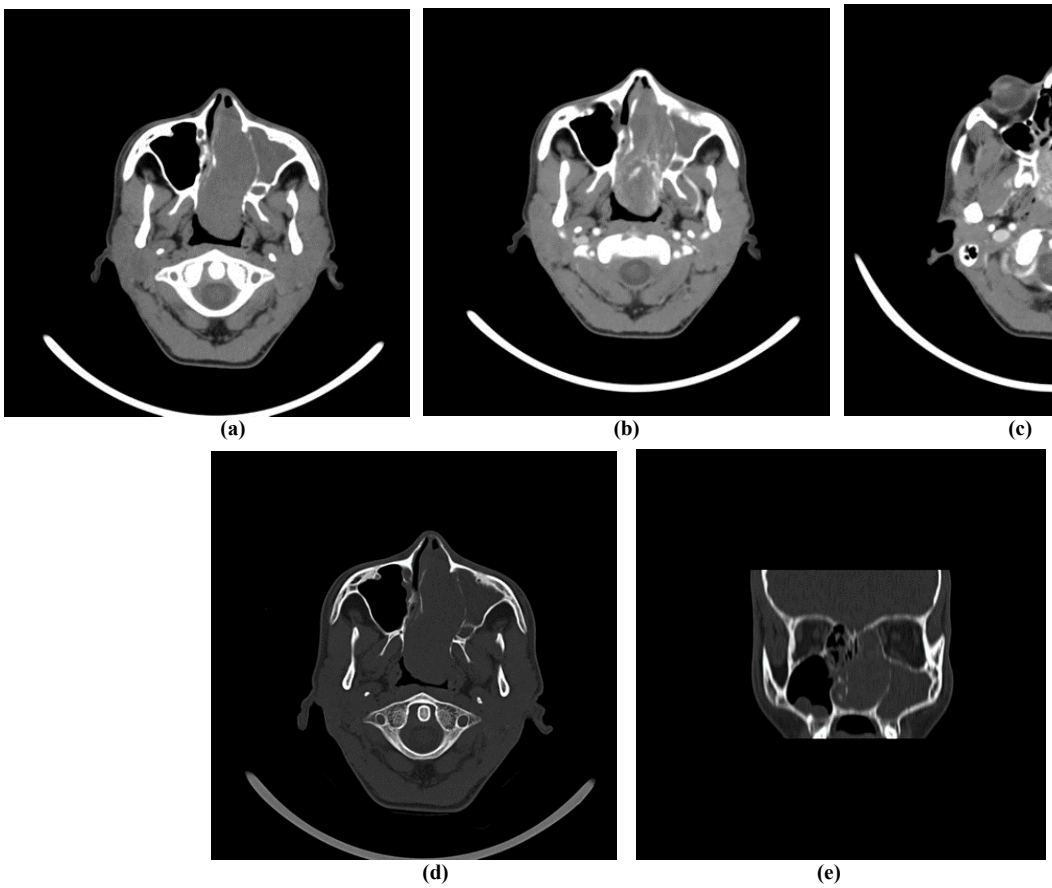
(a) (b) (c)

CASE 4: Axial pre (a) and post contrast (b) with axial bone window (c) CT images show well defined delayed enhancing soft tissue mass lesion in the subcutaneous plane involving left nasal vestibule and the tip of nose. It is CT diagnosed and histologically proven case of SQUAMOUS CELL PAPILLOMA

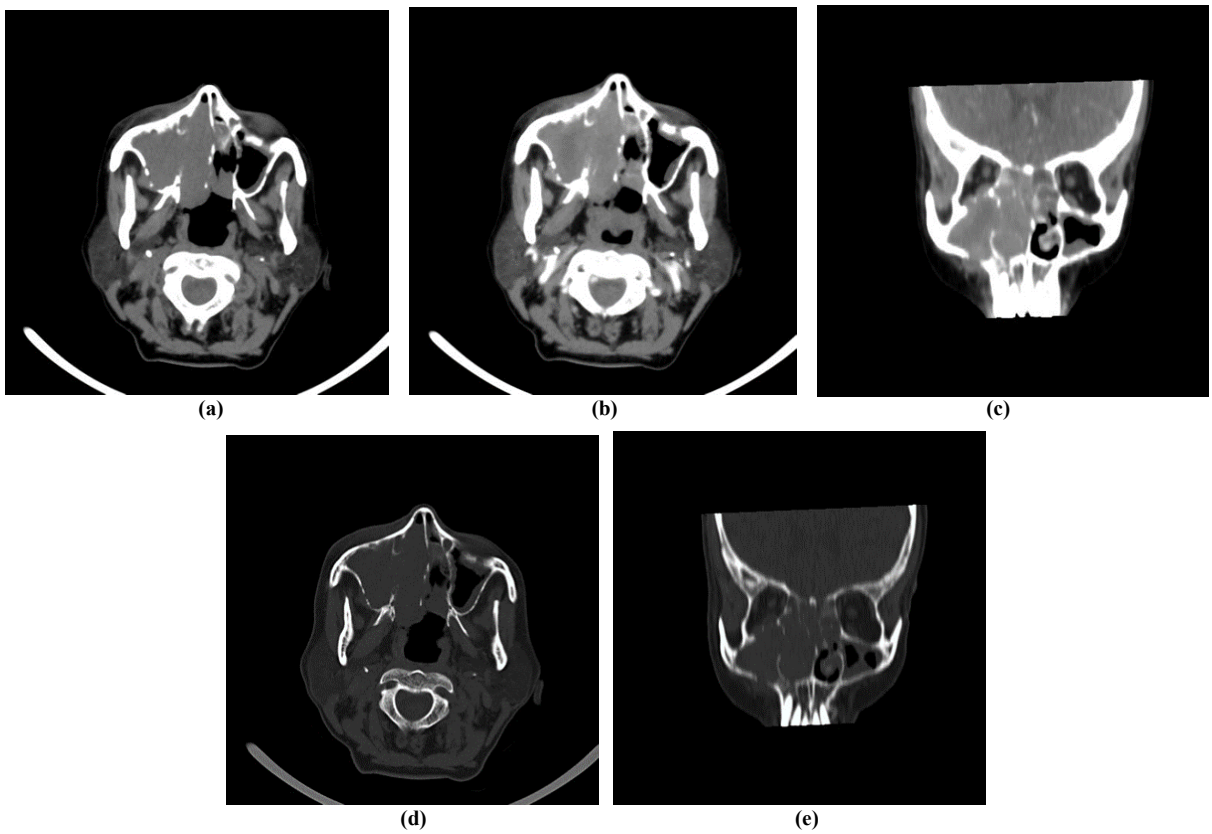


(a) (b) (c)

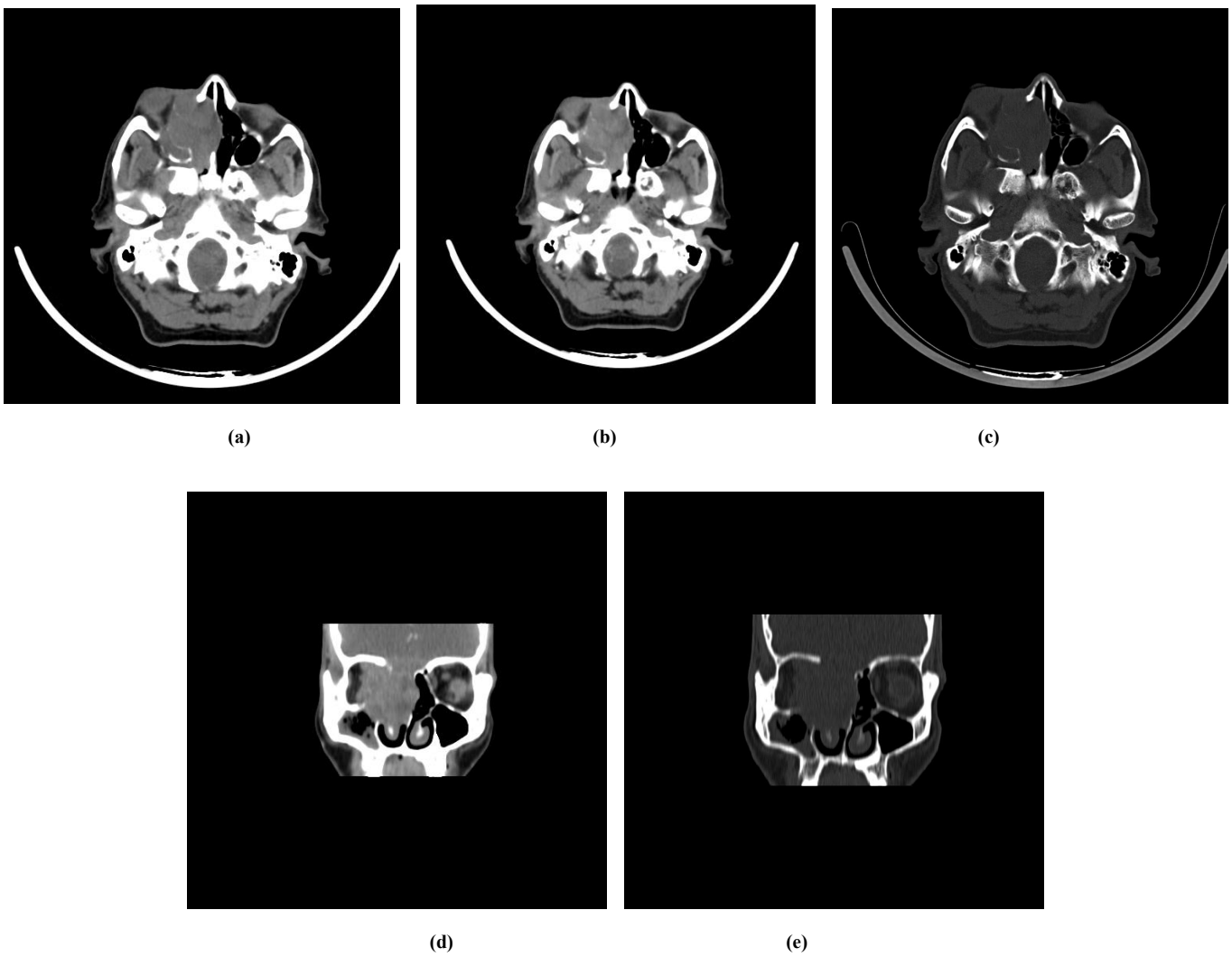
CASE 5: Axial pre (a) and post contrast (b) with axial bone window (c) CT images show well defined round to oval heterogeneously enhancing soft tissue lesion seen in the right nasal cavity with no erosion of the adjacent bony septum. It is CT diagnosed and histologically proven case of CAPILLARY HEMANGIOMA



CASE 6: Axial pre (a) and post contrast (b, c) with axial (d) and coronal (e) bone window CT images showing intensely enhancing soft tissue attenuating mass lesion in left nasal cavity causing widening of left nasal cavity (a, b) with deviation of nasal septum towards right side (d,e). Posteriorly the mass is extending into nasopharynx (b,c) and laterally it is compressing upon the medial wall of left maxillary sinus (d,e) with blockage of osteomeatal complex. There is mucosal thickening in left maxillary sinus, frontal sinus, ethmoidal air cells and sphenoid sinus and also in the right maxillary sinus representing left Pansinusitis and right maxillary sinusitis. CT features suggests the diagnosis of NASOPHARYNGEAL ANGIOFIBROMA with left pan sinusitis. It is histologically proven



CASE 7: Axial pre contrast (a), axial and coronal post contrast (b,c) with axial and coronal bone window (d,e) CT images show ill-defined heterogeneously enhancing soft tissue attenuating mass lesion noted in right maxillary sinus. Medially The mass is causing destruction of medial wall of right maxilla and widening of the antral foramina and extending into right nasal cavity. The nasal septum is eroded with partial extension of mass into left nasal cavity. Superolaterally the mass is eroding inferior and medial orbital wall and extending into right orbit and Superomedially the lesion is extending into bilateral ethmoidal cells. Anteriorly the mass is eroding anterior wall of maxillary sinus and extending into subcutaneous plane. Laterally the mass is eroding lateral wall of maxillary sinus and Inferoposteriorly extending into nasophrynx. There is mucosal thickening in left maxillary sinus. CT features suggests diagnosis of RIGHT MAXILLARY SINUS CARCINOMA. It is histological diagnosis was SQUAMOUS CELL CARCINOMA OF MAXILLARY SINUS.



CASE 8 : Axial pre contrast (a), axial and coronal post contrast (b,d) with axial and coronal bone window (c,e) CT images show heterogeneously enhancing soft tissue attenuating lesion is noted in right nasal cavity extending into right orbit, anterior cranial fossa, right maxillary, frontal, ethmoidal and sphenoidal sinuses. The lesion is causing destruction of roof, medial and inferior wall of right orbit, base of anterior cranial fossa, lamina papyracea, medial wall of right maxillary sinus and nasal septum. CT features suggest diagnosis of NASAL CARCINOMA. Histopathological diagnosis was CYLINDRICAL CELL NASAL CARCINOMA

Conclusion

The purpose of our study is to assess the role of CT in evaluation of various neoplastic sinonasal diseases by correlating CT findings final histopathological diagnosis. CT plays an important role in the pre-operative evaluation of patients with malignant sinus tract pathology and is the best modality for evaluating complex osteomeatal anatomy and anatomical variations. CT is excellent at evaluating fine bone details, sinonasal osseous lesions. It is the investigation of choice for assessing bony changes in various sinonasal diseases in the form of bony remodelling, erosions or destruction. The present study proves that CT has better sensitivity and specificity in evaluation of various neoplastic sinonasal pathologies in symptomatic patients for the diagnosis, determining the extentand thereby better planning of management. To conclude, CT is the best modality of choice for evaluating various neoplastic lesions of sinonasal tract and for assessing bony changes.

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