Original Research Article

Role of computed tomography in evaluation of paranasal sinus diseases

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Abstract

Background: Various inflammatory, benign, malignant neoplastic conditions affect the paranasal sinuses. CT scan helps in diagnosing all inflammatory, neoplastic lesions in paranasal sinuses. This helps in reducing morbidity and mortality in patients with paranasal sinus diseases. **Aim and objective:** 1.To study the various pathologies affecting the paranasal sinuses on Computed Tomography 2.To study the Computed Tomographic features of diseases of paranasal sinuses. **Methodology:** Present study is a prospective study carried out at a tertiary health care center on patients with paranasal sinus disease. Total 110 patients were studied. Data collected was sociodemographic data, clinical history and clinical examination. CT scan was taken in Corona and axial plane. Confirmatory diagnosis was done by histopathology. Data was analysed with appropriate statistical tests. **Results and discussion:** The etiologic distribution of the lesions of paranasal sinuses was Inflammatory (60 %)Neoplastic (32.7 %) and Miscellaneous (7.3 %). Maxillary sinus was the most frequently involved sinus (86.36%) followed by ethmoid (53.63%). Infratemporal and intraorbital extension was found in 50 % of cases. Intracranial extension was found in 25% of cases.

Key Word: paranasal sinus diseases.

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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. The improvement in tissue resolution that CT offers over plain films and pleuridirectional tomography allows for the evaluation of subtle changes of soft tissues, bones and air containing spaces. The ability of CT to image the bony details as well as soft tissues is the greatest advantage over previous radiographic modalities. The development of spiral CT in the past few years has allowed a shorter examination time and thinner sections, with the capability of three-dimensional reconstruction. Most recently, multi–detector row CT with increased spatial resolution, with a section thickness as small as 0.5 mm and acquisition capabilities of 16 images per second, has been developed. CT has become an important imaging modality and aided the development of functional endoscopic sinus surgery (FESS). The application of CT in the head and neck has allowed the detail assessment of

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inflammation, cysts, and benign and malignant tumors. Tumor staging has increased in accuracy, and surgical planning achieved greater precision, with a consequent decrease in morbidity and mortality. The purpose of this study is to determine the role and efficacy of CT scan in diseases of paranasal sinus.

Aim and objective: 1.To study the various pathologies affecting the paranasal sinuses on Computed Tomography 2.To study the Computed Tomographic features of diseases of paranasal sinuses.

MATERIAL AND METHODS

The present prospective study was carried out at a tertiary health care centre in department of radiodiagnosis. Total 110 patients of varied age group presenting with symptoms and signs of paranasal sinus diseases referred from department of ENT were studied.

Inclusion criteria: 1. Patients referred for CT of paranasal sinuses who were suspected to have paranasal sinus disease. 2. Patients who were suspected to have some paranasal sinus pathology on conventional radiographs and were then referred for CT of paranasal sinuses.

Exclusion criteria: 1.Patients presenting with trauma to face. 2. Patients with contrast allergy.3. Patients who were lost to follow up without a definite diagnosis.

Study was approved by ethical committee of the institute. A valid written consent was taken from the patients after explaining study to them. Data was collected with pretested questionnaire. Data included sociodemographic data and clinical history. All patients recruited in the study were examined in detail with complete history and physical examination. Routine hematological tests other relevant investigations were obtained in all patients. Whenever possible the diagnosis was confirmed by FNAC/ Biopsy and operative findings. In cases where no further evaluation was advised by the clinician, response to therapy was taken as confirmatory. Contrast (2ml/kg) was injected intravenously with concentration of 300mg/ml and injection rate of 3ml/s. scan was taken at 30-35 sec after start of injection. CT scan of PNS requires imaging of the anatomy into planes: coronal and axial. A lateral 256 mm scout scan was first obtained at 120 kVp and 100 mA. Routinely axial scanning was done in supine position. Reformatting in coronal and sagittal planes was done using software provided. Direct coronal imaging was done whenever deemed necessary either by referring physician or by the radiologist. For direct coronal imaging the patient was kept in prone position or in supine position with head of the patient free leading edge of the table of the scanner. The gantry angle used in case of coronal imaging was perpendicular to the plane of hard palate. 3 mm sections from anterior margin of nose to the posterior margin of sphenoid sinus were taken Diagnostic images were stored on computer in jpeg version after converting the DICOM file to jpeg file using an e –film software. Final diagnosis was made with histopathological confirmation and / or treatment response Data was analysed with appropriate statistical tests.

RESULTS

Total 110 patients of varied age groups presenting with symptoms and signs of paranasal sinus diseases were scanned by multidetector spiral CT. In our study it was observed that maximum numbers of patients were in age group of 11 to 20 years and 21 to 30 years followed by 51 to 80 years. Male outnumbered females in all age groups. In present study, majority of the patients were male (74). The gender ratio was found to be 2.05: 1 (Male: Female). Table 2 shows etiological distribution in male and females. Total 60 % of inflammatory pathologies, 32.7 % of neoplastic pathologies and 7.3% of miscellaneous pathologies were found. In almost all the age groups inflammatory pathologies (66) were more than neoplastic lesions (36). Neoplastic pathologies were high in age group 51 to 80 years and 11 to 20 years. Figure 1 reveals that maxillary sinus was the most frequently involved sinus (86.36%) followed by ethmoid (53.63%), frontal (30.9%) sinuses. Sphenoid sinus was least involved (20.9%) Both neoplastic and inflammatory pathologies most commonly affected maxillary sinus followed by ethmoid and frontal sinuses. Sphenoid sinus was near equally affected by inflammatory and neoplastic conditions. In our study we found that neoplastic lesions extend into adjacent areas. Infratemporal and intraorbital extension was found in 50 % of cases. Intracranial extension was found in 25% of cases.

Table 1: Distribution of patients according to age group

AGE GROUP	NO OF PATIENTS	PERCENTAGE
1 to10	2	1.82%
11 to 20	25	22.72%
21 to 30	25	22.72%
31 to 40	18	16.37%
41 to 50	16	14.55%
51 to 80	24	21.82%
GRAND TOTAL	**110**	**100%**

Table 2: Distribution of patients according to etiology and gender

ETIOLOGY	FEMALE	MALE	TOTAL	%
INFLAMMATORY	21	45	66	60 %
SINUSITIS	14	26	40	
POLYPOSIS	06	12	18	
OTHER	01	06	07	
NEOPLASTIC	12	24	36	32.7%
MISCELLANEOUS	3	5	8	7.3 %
Grand Total	**36**	**74**	**110**	**100 %**

Table 3: Distribution of patients according to etiology and age group

AGE RANGE	INFLAMMATORY	NEOPLASTIC	MISCELLANEOUS
1 to10	0	1	1
11 to 20	14	8	3
21 to 30	19	3	3
31 to 40	13	5	0
41 to 50	8	8	0
51 to 80	12	11	1
Grand Total	**66**	**36**	**8**

Table 4: Distribution of patients according to sinuses involved and etiology

SINUS INVOLVED	INFLAMMA-TORY	NEOPLASTIC			MISCELLANOUS
		BENIGN	MALIGNANT	TOTAL	
MAXILLARY	59	6	23	29	7
ETHMOIDAL	33	8	16	24	2
FRONTAL	21	4	7	11	2
SPHENOIDS	10	5	6	11	2

Table 5: Distribution of patients according to extension of neoplastic lesions in adjacent areas

AREA	NUMBER	PERCENTAGE
INFRATEMPORAL FOSSA	18	50 %
INTRACRANIAL	9	25 %
INTRAORBITAL	18	50 %
INTRAORAL	4	11.1 %
EXTERNAL SOFT TISSUE	16	44.4 %

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). In present study 110 patients were evaluated for their various symptoms pertaining to PNS. The gender ratio in this study was 2.05: 1 (Male: Female). The etiologic distribution of the lesions was Inflammatory (60%). Neoplastic (32.7 %) and Miscellaneous (7.3 %). Thus the inflammatory disease was found to be the most frequently occurring pathology affecting the PNS. 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. Chronic sinusitis showed decrease in sinus size with sclerosis and thickening of the walls. Maxillary sinus was most commonly involved and sphenoid sinus was least involved in inflammatory conditions. In the study conducted by Smith and Brindley[1], 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.*.[2] 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. He also found that mycosis was always unilateral and the maxillary sinus was infected in almost all cases. On the basis of similar findings we were able to diagnose one case of fungal sinusitis involving maxillary sinus. Airless sinus filled with mucoid density material, expanding the sinus with thinning of sinus walls is diagnostic of mucocele. One case of frontal mucocele, one case of frontoethmoid and two cases of maxillary mucocele were observed in our study. Zizmor J *et al.*.[3] found that mucocele most

commonly occur in frontal sinus (60 to 65 %) followed by ethmoid sinuses. In present study, frontal and maxillary sinus involved in equal proportion; this may be due to less number of cases of mucoceles. We were able to diagnose allergic fungal sinusitis in two young male patients. There were characteristic findings of bilateral hyperdense polypoidal masses with expansion, remodeling and thinning of bony walls of sinuses. Mukherji *et al..*[4]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. In present study, 36 cases of neoplastic lesions were diagnosed. 24 of them were detected and confirmed to be malignant in nature depending upon the enhancement pattern of the lesion, the nature of bony destruction and finally the extension of the lesion into various adjacent vital anatomical structures. We were able to demonstrate the precise location and extension of the tumors. Histological types could not be discriminated on imaging in most of the cases. Graber *et al..*[5] used similar criteria to detect malignant tumours in 15 patients. He characterized malignant tumours in paranasal sinuses on CT scan by their nonhomogenous structure, destructed bony margins of the sinuses and infiltration into neighbouring regions. Graber depicted the precise location and extension of the tumours. Thus helping in their exact staging and finally in the management of these tumors. However, as emphasized by many authors including Peter Som *et al..*[6], it is not possible to diagnose tumor in absence of bone destruction. Also with few exceptions, tumor characterization on imaging is limited. An interesting case of myxoid chondrosarcoma of ethmoid in an infant was diagnosed by us. There were tiny calcifications in the mass and it showed characteristic septal enhancement. To the best of our knowledge, this is probably the only case of sinonasal chondrosarcoma reported in an infant. Considering the involvement of sinuses by various neoplasms in the present study, maxillary sinus was involved in 80.5 % of cases, ethmoids in 66.6 %, frontal in 30.5 % and sphenoid in 30.5 % of cases. In a study conducted by Dolan KD *et al..*[7] they noted similar findings, wherein maxillary sinus was the most frequently involved sinus affected by intrinsic or nearby or metastatic neoplasms, as seen in our study. Regarding the extension of neoplasms into adjacent anatomic vital structures other than the sinuses themselves, following were the areas involved in descending order of their incidence. Infratemporal Fossa (18), Intraorbital (18), External Soft Tissue (16) , Intracranial (9) and Intraoral (4) According to the study conducted by Parsons C and Hodson N[8], the tumour extension was most commonly into the region of orbit and into the pterygoid region. The two authors studied 15 cases of histologically proven malignancy, in order to evaluate their extension into adjacent anatomic structures. This was similar to our study where intraorbital and infratemporal fossa extension of the neoplastic lesions was found to be most common. Metastases to sinonasal cavities are infrequent and most often the primary is renal cell carcinoma. One of our patients, a diagnosed case of follicular thyroid carcinoma presented with metastasis in the frontal sinus. Thyroid carcinoma metastatic to paranasal sinuses is rare as observed by Cinberg JZ *et al..*[9.] Two cases of inverted papilloma were diagnosed; CT showed middle meatus involvement along with extension of the lesion to maxillary sinus, eroding the turbinates on the same side. Thus we reemphasized the findings quoted by Lund VJ, Lloyd GA[10]. They studied 60 patients of histologically proved inverted papilloma retrospectively and concluded that mass in the middle meatus of nasal cavity extending into adjacent maxillary antrum is highly suggestive of the tumour. Total six cases of histologically proven angiofibroma were studied by us. All of them were males of age group between 15- 25years and presented with epistaxis. It is similar to Barnes L *et al..*[11] who stated that angiofibroma occurs almost exclusively in young males. Typical site of origin near pterygopalatine fossa and sphenopalatine foramen with widening of pterygopalatine fossa and strong contrast enhancement were the diagnostic criteria used by Som P *et al..*[12]. We found these criteria to be diagnostic. However in one of our patient the pterygopalatine fossa was not widened. Many of these angiofibromas extended into infratemporal fossa (66.6 %) and sphenoid sinus (66 %). Apostol JV *et al..*[13] observed that sphenoid sinus is involved in 61 % of the cases. Intracranial extension into middle cranial fossa was found in one patient (16.6 %); similar was observed by Barnes L *et al..*[11]. The differential diagnosis of angiofibroma includes fibrosed antrochoanal polyp and angiomatous polyp. It was possible to diagnose two cases of angiomatous polyp confidently and differentiate it from angiofibroma. We used the criteria those proposed by Som P *et al..*[14]; like nasal mass than nasopharyngeal mass, not involving pterygopalatine fossa, not protruding into sphenoid sinus and not strong enhancement. James *et al..*[15] observed that many of the maxillary sinus pathologies are related to dental disease. In present study, four cases related to dental pathologies were encountered. All of them involved maxillary sinus. We observed two bony walls in the posterior maxillary sinus in cases of dentigerous cyst and dental cyst as discussed by P. Som and M. Brandwein[12]. CT is diagnostic of osseous and fibro-osseous lesions. Four cases of fibrous dysplasia, two of osteomas and one 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]. Both fibrous dysplasia and ossifying fibroma

showed expansion and ground glass appearance. Because there is overlap in imaging appearance of Fibrous dysplasia and ossifying fibroma, Commins DJ *et al.*.[17] suggested the term benign fibro-osseous lesion. Thus, in our study we could correlate the various pathologic lesions occurring in paranasal sinuses with their relevant CT features. This included inflammatory, neoplastic and few other conditions. This study thus was beneficial for the management of these diseases and above all helped the patients immensely.

CONCLUSION

The males were the predominantly affected sex in all the etiologic lesions studied occurring in paranasal sinuses. The inflammatory lesions were most common. The most common sinus to be involved in inflammatory as well as neoplastic lesions was maxillary sinus and least one to get involve was sphenoid. In present study, it was possible to diagnose malignant neoplasms by studying the contrast enhancement pattern, bone erosions and / or destruction. The extension of these lesions was accurately depicted on CT; infratemporal fossa and intraorbital extension was found to be most common.

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