Original Article

X-Ray & CT Scans in Sinusitis Patients

To Assess the Correlation of Imaging Studies X-ray and CT-Scan of Para Nasal Sinuses in Clinically Selected Sinusitis Patients from Outpatient Department of ENT at Civil Hospital Karachi

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ABSTRACT

Objective: Objective of this study is to assess the correlation of imaging studies X-ray and CT-Scan of Para nasal sinuses in clinically selected sinusitis patients from outpatient department of ENT at Civil Hospital Karachi.

Study Design: Observational study

Place and Duration of Study: This study was conducted in the department of ENT at Civil Hospital Karachi from 01 Aug 2009 to 31 July 2010.

Materials and Methods: After taking a inform consent sinusitis patients initially thoroughly clinically examined in ENT out patients department than referred to radiology department for imaging evaluation at Civil Hospital Karachi. This study comprises of 95 patients of both sexes who presented with acute and chronic sinusitis.

Results: In our study we assessed 95 patients of both sex with acute and chronic sinusitis, selected on clinical basis and finally correlated by radiologically. Out of 95 patients 43 patients who clinically suspected of having acute sinusitis sent to radiology department to correlate our finding both by X-ray PNS and CT-Scan. X-ray PNS showed imaging findings of acute sinusitis in 26(60%) patients while 17 patients were having normal X-ray PNS. When CT-Scan was performed to correlate the findings, it showed 30(69%) patients were having acute sinusitis while 13 patients had no imaging findings of acute sinusitis. When clinically suspected of chronic sinusitis of 52 patients were radiologically investigated, out of those, in whom X-ray PNS shows chronic sinusitis in 26(54%) patients and 22 patients are having normal X- ray PNS. But when CT-Scan performed in these patients it depicted 33(68%) patients were having chronic sinusitis and 15 patients were having normal imaging. Out of these 52 patients, 4 patients refused for any radiological investigation.

Conclusion: Previously X-ray of nose and Para nasal sinuses was considered mainstay to rule out of various pathologies but now have been replaced by high-resolution CT scan and MRI. Plain radiographs of various angles can be used as a useful tool for diagnosis of acute and chronic sinusitis patients which are difficult to rule out clinically where the CT- scan facility is not available whereas CT-Scan is the only modality of choice and considered as a "gold standard" imaging of nose and Para nasal sinuses in acute and chronic sinusitis and guides the surgeon with important information of the osteomeatal complex, sphenoid, ethmoid sinuses status and other normal anatomical landmark or any variations, preoperatively.

Key Words: CT- scan of nose and PNS, X-rays PNS, Para nasal sinuses, Sinusitis

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INTRODUCTION

Imaging studies of nose and Para nasal sinuses play a vital role in management of various pathologies. Advance imaging studies like CT-Scan and MRI have further facilitated their role to deal with Para nasal sinus diseases more accurately than the conventional X-rays of Para nasal sinuses (PNS). Advent of functional endoscopic sinus surgery in ENT is great hallmark. CT-Scan of nose and Para nasal sinuses guides surgeons for pertinent anatomical landmarks with its variations and extends of disease preoperatively.

Para nasal sinuses are air filled cavities, which plays very important role for resonance of voice and other physiological changes of inspired air to compatible of lower airway. Infective diseases like acute and chronic sinusitis basically diagnosed on history and physical examination but in difficult and complicated cases radiology of nose and Para nasal sinuses plays a

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remarkable role in diagnoses of Para nasal sinus diseases. The most common diseases that affect the nose and Para nasal sinuses are inflammatory[1], and advent of diagnostic and therapeutic role of nasal endoscopy has revolutionized the management of nose and Para nasal sinuses diseases. The advent of functional endoscopic sinus surgery has replaced the various types of conventional surgical procedures like Caldwell-Luc surgery of maxillary sinus and different types of nasal polypectomies and septoplasty. CT scan and MRI are more value able radiological modalities which help to rule out early nose and Para nasal sinuses infective diseases and accurate tumor staging

Plain radiographs are still be using as a diagnostic tool even being a limited role to highlight some important areas like osteomeatal complex, ethmoidal groups of sinuses in developing countries. Other confine role of conventional radiology includes difficulty in differentiating between infection, tumour[2] and polyp in an opaque sinus[3]. Advance radiology like CT-Scan provides much better information about normal anatomical landmarks and variations of nose and paranasal sinuses.[4] CT-Scan has very marvellous role to appreciate pathologies in difficult areas especially within ethmoid group and sphenoid sinuses. [5,6]Studies has revealed the radiological finding of X-ray PNS could be mucosal thickness, air fluid level in maxillary sinuses and partial or complete opacification[7,8]. Nevertheless mucosal thickening is observed in greater than 90% of sinusitis cases, it is a nonspecific finding[9,10] Complete opacification and air fluid level are more specific finding of acute sinusitis of about 60% of cases[9].there is also false negative results observed in interpretation of plain radiograph in different observer. [3,11]

Advance radiology like high resolution CT-Scan provides excellent detail of bone involvement [12]. CT-Scan highlights very nicely inflammatory diseases of paranasal sinuses. If facility of CT-Scan would be available should performed before functional endoscopic sinus surgery. [13,14] Prior to surgery this also helps to notice involve sinuses by inflammatory disease and to assess important anatomic landmarks and their variations.. CT-Scan is more sensitive than plain radiography for detecting sinus pathology, especially within the sphenoid and ethmoid sinuses. The fundamental role of CT-Scan besides diagnosis and management of sinusitis is also to define the anatomy of the sinuses prior to surgery[15].

Complete study of CT-Scan of PNS is required in pathological conditions before surgical intervention. Coronal CT-Scan view is preferred. Axial view of CT-Scan should be obtained to supplement the coronal view for lesions involving the roof of the maxillary antrum and hard palate and for the detection of orbital and cranial invasion[16]. Bone window provides excellent information about bone involvement. The complete study of the Para nasal sinuses and nasal fossae is obtained by a combination of axial and coronal studies of 3mm cuts.[17] Intravenous contrast in advance radiology is used to see enhancement of soft tissue masses.

MATERIALSAND METHODS

The study was conducted in the ENT and Head and Neck Surgery department and radiology department of Civil Hospital Karachi, from 01 Aug 2009 to 31 July 2010. In this study 95 patients of both sexes who presented with symptoms of acute and chronic sinusitis were examined and referred to radiology department for X-rays PNS and CT-Scan PNS according to clinical findings to correlate radiologically.

In radiology department X-ray Para nasal sinuses were performed by Toshiba machine of 1000 mA. CT-Scan was also performed by Toshiba Asteon spiral scanner.

Radiological finding of X-ray and CT-Scan were correlated in both acute and chronic sinusitis presented patients.

Statistical Analysis: Data was analyzed using SPSS version 10. The data from study was evaluated by correlating finding of X-ray and CT-Scan of Para nasal sinuses, considering CT-Scan as a gold standard. Percentages were used to describe the data. Sensitivity, specificity, positive & negative predictive values and accuracy of X- ray and CT-Scan of Para nasal sinuses evaluated.

RESULTS

In this study, 95 patients were selected from 1st of August 2009 to 31st July 2010. Initially these patients were examined in outpatients department of ENT than referred to radiology department for X-ray and CT-Scan PNS to correlate their findings. Out of these Patients there were 56 males and 39 were females, with a mean age of45 years (range, 20–60 years) (Graph 1).

Out of 43 clinically suspected of having acute sinusitis patients, X-ray PNS findings of acute sinusitis were observed in 26 (60%) while 17 patients were notice with no radiological positive findings. Among these 27 patients of positive finding 6 patients noticed with mucosal thickening, 9 patients with haziness and 11 patients with partial or complete opaque of maxillary sinus. (Table 1) When CT-Scan was performed to correlate the findings in same 43 patients it showed 30(69%) patients were having acute sinusitis while 13 patients have no radiological findings of sinusitis, as shown in (Table 2). X-ray Para nasal sinuses were wrongly diagnoses in 8 patients among those two were false positive and 6 were false negatively diagnosed. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated using SPSS and according to the formula in data analysis. X-ray PNS has low sensitivity (80%), specificity (84%) and accuracy (81%) for diagnosis of

acute sinusitis than CT-Scan (Graph 2). Among these 4 patients refused for their CT-Scan imaging.

Out of 48 patients clinically suspected of chronic sinusitis, sent for radiological evaluation. X-ray Para nasal sinuses depicted finding of chronic Sinusitis in 26(54%) patients while in 22 patients were having normal X-ray Para nasal sinuses. Among these 26 patients 13 patients noticed with mucosal thickening, 7 patients with haziness and 6 patients with complete or partial opacity (Table 1). When CT-scan was performed in similar 48 patients of clinically suspected chronic sinusitis, it showed 33(68%) patients were having chronic sinusitis while 15 patients have no imaging findings of chronic sinusitis (Table 2). X-ray Para nasal sinuses wrongly diagnosed 21 patients, 7 patients with false positive and 14patients with false negative results. Sensitivity, specificity, positive predictive value, negative predictive value and accuracy were calculated using SPSS and according to the formula in data analysis. X-ray Para nasal sinuses has low sensitivity 57%,specificity 53% and accuracy 56% for diagnosis of chronic sinusitis because of the inadequate evaluation of the sphenoid and ethmoid sinuses and their overlapping anatomic structures (Table 3). Most of false positive and false negative results were due to wrong diagnosis of chronic ethmoid and sphenoid sinusitis which were picked up and diagnosed on CT-Scan.

Table No.1: Showing X-ray abnormalities in acute and chronic sinusitis

x-ray PNS	Acute Sinusitis (60%)	Chronic Sinusitis (54%)
Normal	17	22
Mucosal thickness	6	13
Haziness	9	7
Opacity total/partial	11	6
Total	43	48

Table No.2: Statistical evaluation of imaging findings of acute sinusitis in X-ray & CT PNS (n=43)

Imaging findings of Acute Sinusitis in CT PNS				
X-Ray PNS		Present	Absent	Total
	Present	True Positive 24	False Positive 2	26
	Absent	False Negative 6	True Negative 11	17
		30	13	43

Key: TP= True positive cases, FP= False positive, FN= False negative, TN= True negative cases.
Sensitivity = a / a + c x 100 or TP / TP + FN x 100 = 80 %
Specificity = d / d + b x 100 or TN / TN + FP x 100 = 84 %
Positive Predictive value = a /a+bx100 or TP/TP + FP x 100 = 92 %
Negative Predictive value = d/d + c x100 or TP/TP+FP x 100 = 64 %
Accuracy = Total n – (FN + FP) / n = 81%

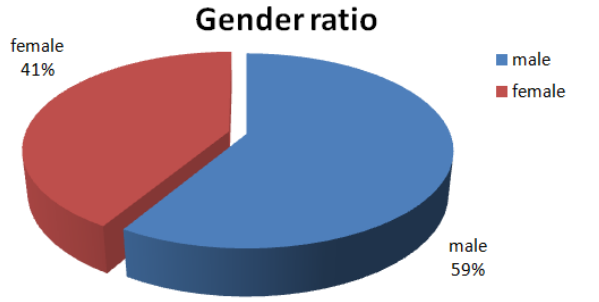
Table No.3: Statistical evaluation of imaging findings of chronic sinusitis in x- ray & CT PNS (n=48)

Imaging findings of Chronic Sinusitis in CT PNS				
X-Ray PNS		Present	Absent	Total
	Present	True Positive 19	False Positive 7	26
	Absent	False Negative 14	True Negative 8	22
		33	15	48

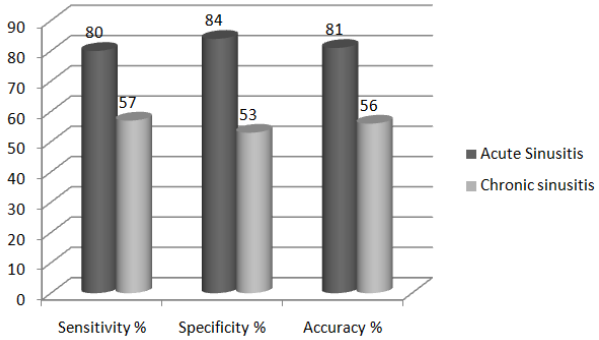
Sensitivity = a / a + c x 100 or TP / TP + FN x 100 = 57 %
Specificity = d / d + b x 100 or TN / TN + FP x 100 = 53 %
Positive Predictive value = a/a + b x 100 or TP/TP+FP x 100 = 73%
Negative Predictive value = d/d + cx100 or TP/TP + FP x 100 = 36 %
Accuracy = Total n – (FN + FP) / n = 56%

Table No.3: Sensitivity, specificity, positive predictive value, negative predictive value and accuracy of X- ray Para nasal sinuses for diagnosing Para nasal sinus diseases.

Diagnosis	Sensitivity %	Specificity %	Positive Predictive value %	Negative Predictive value %	Accuracy %
Acute Sinusitis	80	84	92	64	81
Chronic sinusitis	57	53	73	36	56



Graph No.1: Male to female ratio for imaging findings in acute and chronic sinusitis.



Graph No.2: Diagnostic performance of X-ray PNS for predicting imaging findings in acute and chronic sinusitis

DISCUSSION

Many anatomical variations of nose exist which may be missed clinically but recognize clearly by imaging especially like CT-Scan. These variations may narrow the some areas of nasal cavity which impair nasal airflow and drainage of Para nasal sinuses leads to sinusitis. Sinusitis can be subdivided into acute, subacute and chronic sinusitis depending on duration of mucous membranes inflammation. Acute sinusitis defined as diseased lasting less than one month, sub acute less than three months and chronic sinusitis disease lasts more than three months[18]. Acute sinusitis can be because of viral, bacterial or fungal infections. Chronic sinusitis can be because of recurrent episodes of acute sinusitis or other condition like asthma, immune disorders and structural abnormalities such as deviated nasal septum or polyps.

In our study we selected 95 patients of sinusitis in ENT outpatient department on clinical ground than correlated radiologically by X-ray and CT-Scan PNS.

In this study 56 are males and 39 are females. Our observation regarding the increase frequency in males due of excessive use of smoking, which may impair mucocilliary mechanism leads to sinusitis. In contrast to our study an international study conducted in KSA showed predominantly female involvement about 57.7%.[25]

In this study we also observed various findings on X-ray PNS in both acute and chronic sinusitis patients like mucosal thickening, haziness and opacity of maxillary sinus. Mucosal thickening best seen in the lateral wall of maxillary sinus separates the air from bony wall in waters view. In contrast to our results a study reflects that mucosal thickening found more than 90% of cases in sinusitis, though a nonspecific finding **[9,10]**and also showed the air fluid level or complete opacification in 60% which is more specific finding. **[9]**These finding are also consistent with an international study by Varonen et al. **[19]**

Interpretation of plain radiograph can vary widely among different observers and there is high chances of false negative results. **[3,11]**Plain radiograph cannot distinguish between acute inflamed and chronic scarred mucosa. However contrast enhanced CT shows the mucosal enhancement in active inflammation. On plain radiographs the sphenoid sinus often appears normal even in presence of maxillary disease and 50% of sphenoid sinuses cases remains undetected. **[20]**. However CT-Scan consistently detect these cases.

Out of 43 clinically suspected of acute sinusitis patients in our study shows positive X-ray PNS in 26 patients and normal X-ray PNS in 17 patients. When CT-Scan performed in these patients to correlate finding, 30 patients found positive and 13 patients negative radilologically. In our study X-ray PNS shows 80% sensitivity, 84% specificity and 81 % accuracy for diagnosing acute sinusitis which is compatible with an international study by Thomas et al.

In our study patients presented with chronic sinusitis were having large number with mucosal thickening on X-ray PNS. Plain radiograph do not allow adequate exposure of osteomeatal complex, sphenoid and ethmoid sinuses because of overriding bone shadows. These findings are consistent with an international study by Brook et al.**[22]**

High resolution CT-Scan provides excellent bone detail and accurate soft tissue mapping. **[12]** We observed by our study that CT-Scan modality is modality of choice for imaging of inflammatory disease of sinuses and osteomeatal complex.CT-Scan is used routinely before endoscopic sinus surgery nowadays**[13]** to evaluate extend of inflammatory diseases and to assess the important anatomical landmark and its variations. CT-Scan showed mucosal thickening, sinus opacification and sclerotic reactive sinus walls of maxillary sinuses. These findings are consistent with our study by Rosenfeld
et al. **[23]**

In correlation of X-ray PNS and CT-Scan in chronic sinusitis patients in our study of 48 patient 26(54%) patients having positive finding of disease and 22 patients found negative on X-ray PNS while when performed CT-Scan in similar number of patients we noticed positive finding in 33(68%) patients and 15 patients negatively marked. So, in this study X-ray PNS shows 66% sensitivity, 50% specificity and 62% accuracy for diagnosis of chronic sinusitis which is favorably comparable with an international study by Steward et al.**[24]** Most of false positive and false negative cases were due to wrong diagnosis of chronic sinusitis which were picked by CT-Scan.

CONCLUSION

We concluded that imaging studies have definite supportive role in the management of sinusitis patients along with clinical assessed patients despite of some extend of their false positive and false negative results. X-ray PNS though helpful in certain cases but could not be able to evaluate in high index of suspicious cases like chronic sinusitis, polyps, mucocele and fungal sinusitis. CT-Scan PNS is genuinely not only having supportive role in diagnosing sinusitis patients but also provide road map to follow the disease and provide excellent information about normal anatomy and variations of various structures in surgical cases preoperatively.

Conflict of Interest: The study has no conflict of interest to declare by any author.

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