ORIGINAL ARTICLE

Diagnostic Accuracy of CT Scan Paranasal Sinuses (Fess Protocol) in Fungal Sinusitis with Operative Findings as Gold Standard

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ABSTRACT

Background: Para nasal fungal sinusitis is classified in two categories, invasive and non-invasive pathogens. The noninvasive is again divided into allergic and fungal ball (myocetoma) and invasive is divided into acute fulminant fungal sinusitis and granulomatous and chronic invasive mycosis. The most common pathogens are from Aspergillus and Mucor species.

Aim: To assess positive predictive value of CT scan (FESS Protocol) in fungal sinusitis with operative findings as gold standard.

Study design: Cross-sectional survey.

Methods: This study is conducted in the Department of Radiology in collaboration with ENT Department, Shaikh Zayed Hospital, Lahore with a study period of six months from 01-06-2012 to 30-11-2012. 120 patients fulfilling the inclusion criteria are selected for this study. CT scan is done on a GE VCT light speed 64 slice multidetector CT scanner with imaging protocol of axial and coronal studies with 3-5mm contiguous sections. Presence of fungal balls associated bony erosion, intra orbital and intracranial extension were noted if present. Patients were followed for intra-operative findings for comparisons.

Results: The mean age of the patients was 31.6±14.7 years with age range of 10 to 70 years. There were 90(75%) male and 30(25%) female patients. There were 80(66.7%) patients had fungal sinusitis on CT scan and 70(58.3%) patients had fungal sinusitis on per operative finding. The sensitivity of CT scan was 80%, specificity 77%, diagnostic accuracy 79%, the positive predictive value was 86% and negative predictive value was 70%.

Conclusion: It is concluded that the CT scan in diagnosis of sinusitis has acceptable sensitivity and specificity, and positive predicative value. CT scan has lesser cost and accurate diagnosis in comparison with per operative finding.

Keywords: Fungal sinusitis, CT scan finding, per operative finding, positive predictive value.

INTRODUCTION

Sino-nasal disease is a most common cause of illness in local population due to a various allergens and environmental pollution. Chronic sinusitis most frequently overlooked is a significant source of morbidity and economic loss[1]. Rhinosinusitis is a common disease approximately 20% of people suffer from it sometimes in their lives[2]. Amongst patients who underwent surgery for chronic sinonasal disease, approximately 6% to 9%[3] are found to have allergic fungal sinusitis. This incidence is reported upto 51% in patients belonging to northern India suggesting geographic variation[4].

On the basis of disease pattern fungal sinusitis is divided into two types, invasive and non-invasive. Non-invasive is further divided into allergic and fungal ball (myecetoma) and invasive is divided into acute fulminant fungal sinusitis and granulomatous and chronic invasive mycosis. Aspergillus and mucor are most frequent causative organisms former can cause both pattern of disease while later results in invasive pattern of disease[5,6]. On imaging Invasive infections present as soft tissue opacification of sinuses with osteolysis of sinus walls with or without intracranial or intraorbital extensions Non-invasive infection results in opacification of sinus on imaging without osseous destruction[6].

Fungus may be characterized by its radiological and operative gross findings. Plain radiography and CT scan are two frequently used imaging modalities. Plain radiography fails to image individual ethmoid air cells, ostiomeatal complex. Or exact extent of mucosal disease Magnetic resonance imaging is indicated and helpful when there is suspicious of intracranial extension but it provides limited evaluation of osseous destructions. Therefore, CT scan of the sinuses remains the imaging modality of choice. The diagnostic criteria for allergic fungal sinusitis include air fluid levels, mucosal thickening, polyps formation, homogeneous opacification,

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osseous erosion, intraorbital, intracranial, retroantral and overlying facial superficial soft tissue extension[8].

The calcification in the lesion is usually featured as characteristic manifestation of fungal sinusitis. While fungus balls shows partial or complete heterogenous opacification of the sinus. However, there is minimal or no sinus expansion.it has been observed that the sensitivity and specificity of CT scan for evaluation of sinusitis was 95% and 92.5% respectively with positive predictive value 96.2% and negative predictive value 90.2[7]. However, the sensitivity, specificity, positive and negative predictive values of preoperative CT imaging of fungal ball was 83%, 94%, 56% and 98% respectively[8].

The rationale of this study is that although reported sensitivity and specificity of CT are high in the detection of sinonasal disease but no such published data is available in our population. So first aim of the study as to evaluate these in our population

MATERIAL AND METHODS

Sample size of 120 cases is calculated with 95% confidence level, 9% margin of error and taking positive predictive value of CT scan (FESS Protocol), which is 56% in the diagnosis of fungal ball by taking intraoperative findings as gold standard. Non-probability purposive sampling technique. All male and female patients clinically suspected for fungal sinusitis and positive on CT scan for fungal sinusitis were included in the study. Patients with sinonasal tumour, already diagnosed cases underwent surgery and patients with acute rhino sinusitis including mocumycosis were excluded.

Data collection procedure: 120 patients fulfilling the inclusion criteria were selected from Department of ENT/Radiology, Shaikh Zayed Hospital Lahore. Informed consent was taken. Detailed demographic features were obtained. CT scan was done on a GE VCT light speed 64 slice multidetector CT scanner with imaging protocol of axial and coronal studies with 3-5mm contiguous sections. Images were obtained with soft tissue window setting before and after administration of contras ultravist with dose of 50ml 2.5 flow rate (1mg/kg). The cases were reported by me. Presence of fungal balls (hyper-dense or soft tissue density areas within mucosal thickening) associated with osseous erosion, intra orbital retroantral and intracranial extension if present were noted. Patients were followed for intra-operative findings i.e., presence of fungus ball with or without complications was noted for comparison

Data analysis: Quantitative variable including age was presented as mean and standard deviation, while qualitative variables like gender, fungal ball were described as frequency and percentages. Positive predictive value of CT scan in the diagnosis of fungal sinusitis by taking per operative findings as gold standard was calculated and presented in the forms of frequency and percentages.

RESULTS

The mean age of the patients was 31.6±14.7 years (Table 1). There were 90(75%) male and 30(25%) female patients (Table 2). There were 90(75%) patients had fungal ball and 2(25%) patients had no fungal balls, 80 (66.7%) had bony erosions and 40(33.3%) patients had no bony erosions, 64(53.3%) patients had intracranial extension and 56(46.7%) patients had no intracranial extension and 70(58.3%) patients had intra orbital invasion and 50(41.7%) patients had no intra orbital invasion (Table 3). Peroperative findings showed there were 80(66.7%) patients had fungal ball and 40(33.3%) patients had no fungal balls, 70(58.3%) had bony erosions and 50(41.7%) patients had no bony erosions, 46(38.3%) patients had intracranial extension and 74(61.7%) patients had not intracranial extension and 60(50%) patients had intra orbital invasion and 60(50%) patients had no intra orbital invasion (Table 4). In the distribution of patients by diagnosis of fungal sinusitis on CT scan, there were 80(66.7%) patients had fungal sinusitis on CT scan and 40(33.3%) patients had no fungal diagnosis on CT scan (Table 5). There were 70(58.3%) patients had fungal sinusitis and 50(41.7%) patients had not fungal sinusitis (Table 6). There were 60(50%) patients true positive, 10(8.3%) patients false positive, 15(12.5%) patient false negative and 35(29.2%) patients true negative (Table 7). The sensitivity of CT scan by taking per operative findings as gold standard was 80%, specificity 77% and diagnostic accuracy was 79%. The positive predictive value of CT scan by taking per operative findings as gold standard was 86% and negative predictive value was 70%.

Table 1: Distribution of patients by age (n=120)

Age (Years)	n	%age
10-20	26	21.7
21-20	42	35.0
31-40	24	20.0
41-50	14	11.7
51-60	04	3.3
61-70	10	8.3
Mean±SD	31.6±14.7	

Table 2: Distribution of patients by sex

Sex	n	%age
Male	90	75
Female	30	25

Table 3: Distribution of patients by CT scan finding

CT finding	n	%age
Fungal balls	90(75%)	25(25%)
Bony erosions	80(66.7%)	40(33.3%)
Intracranial extension	64(53.3%)	56(46.7%)
Intra orbital invasion	70(58.3%)	50(41.7%)

Table 4: Distribution of patients by per operative finding

Peroperative findings	Yes	No
Fungal balls	80(66.7%)	40(33.3%)
Bony erosions	70(58.3%)	50(41.7%)
Intracranial extension	46(38.3%)	74(61.7%)
Intra orbital invasion	60(50%)	60(50%)

Table 5: Distribution of patients by fungal sinusitis on CT scan

CT scan finding	n	%age
Yes	80	66.7
No	40	33.3

Table 6: Distribution of patients by fungal sinusitis on per operative

Per operative finding	n	%age
Yes	70	58.3
No	50	41.7

Table 7: Comparison of CT scan versus per operative finding for fungal sinusitis

	Per operative findings (Gold Standard)		Total
	Positive	Negative	
Positive	60 (TP)	10 (FP)	70
Negative	15 (FN)	35 (TN)	50
Total	**75**	**45**	**120**

DISCUSSION

Early detection of sinusitis is very important so that serious complications of disease like cellulitis, osteomyelitis and intraorbital and intracranial extensions can be avoided[9] Plain radiographs, such as Caldwell or Water's views, due to low diagnostic accuracy are no more useful in detailed evaluation of sinusitis.[10] Therefore, currently CT scan of paranasal sinuses is the imaging of choice for sinusitis.[11] Standard CT scan of PNS consists of coronal and axial sections. Coronal sections are composed of contiguous slices of 5mm thickness from the frontal sinuses to the sphenoid sinuses, and axial sections are composed of contiguous slices of 5mm thickness from the maxillary sinuses to the frontal sinuses. For further details in the coronal sections, slices of 3mm thickness through ostiomeatal complex can be taken.[12] Because of these multiple slices, paranasal sinuses spiral. CT has a high patient x-ray absorption dose[13]. In our study sensitivity and specificity of CT scan was 80% and 77% respectively for detection of sinusitis. The limited method had the sensitivity in the range of 84% to 97% in detection of sinusitis in various sinuses, with the highest sensitivity for ethmoidal sinusitis and lowest sensitivity for frontal sinusitis. Specificity of limited CT scan varies between 94% and 100%[7].

For instance Goodman et al used screening coronal CT scan method with 4 sections and, the sensitivity was 93% and specificity was 89%.[12] In another study with the 4-slice technique, sensitivity, specificity, NPV and PPV were 81%, 89%, 74% and 92%, respectively[13], however, due to the more sections in our proposed CT scan method, these variable in our study were 80%, 77%, 86% and 70%.

Partial volume averaging was the major cause of a false diagnosis of sinusitis in the CT scan method. False negative reports were due to the slight mucosal thickening, which was ignored on noncontiguous sections. Given that approximately 10% of patients with sinusitis need a complete diagnostic work-up and surgery, applying the limited method seems cost effective[12]. In our study the mean age of the patients was 31.6±14.7 years with age range of 10 to 70 years. As compared with the study of Tezer et al[14] the mean age of the patients was 29.1±1.2 years, which is comparable with our study.

In our study there were 75% male and 25% female patients. As compared with the study of Tezer et al[14] there were 58% male and 42% female patients, which is comparable with our study. In this study sensitivity and specificity of CT scan was found 80% and 77% respectively. As compared with the study of Sharifian et al[7] the sensitivity and specificity of CT scan was found 95% and 92.5% respectively, which is comparable with our study. In the current study positive predictive value and negative predictive value of CT scan was found 86% and 70% respectively. As compared with the study of Sharifian et al[7] the positive predictive value and negative predictive value of CT scan was found 96.2% and 90.2% respectively, which is also comparable with our study.

Fungus may be characterized by its radiological and operative gross findings. Plain radiography and CT scan are two frequently used imaging modalities. Plain radiography fails to image individual ethmoid air cells, ostiomeatal complex or exact extent of mucosal disease. Magnetic resonance imaging is indicated and helpful when there is suspicious of intracranial extension but it provides limited evaluation of osseous destructions. Therefore, CT scan of the sinuses remains the imaging modality of choice The diagnostic criteria for allergic fungal sinusitis include air fluid levels, mucosal thickening, polyps formation, homogeneous opacification, osseous erosion, intraorbital, intracranial, retroantral and overlying facial superficial soft tissue extension polyp.[8] CT scan

has lesser cost and accurate diagnosis in comparison with per operative finding.

CONCLUSION

It is concluded from this study that the CT scan in diagnosis of sinusitis has acceptable sensitivity and specificity, and positive predicative value. CT scan has lesser cost and accurate diagnosis in comparison with per operative finding.

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