ORIGINAL ARTICLE

ACCURACY OF COMPUTED TOPOGRAPHY IN CHARACTERIZING THE PARANASAL FUNGAL INFECTION

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ABSTRACT

Background: To determine the diagnostic accuracy of CT in characterizing the Paranasal fungal Infection

Methods: All patients suspected of having Paranasal fungal infection underwent CT scan examination on 4 slice Toshiba Asteion multislice CT scanner. Final diagnosis was based on smear analysis for fungal culture which was done subsequently. Statistical analysis was performed by SPSS version-17.

Results: Out of 65 patients, 48 were confirmed having fungal sinusitis and remaining 17 were negative on the gold standard culture analysis. While on CT, 44 patients were positive for fungal sinusitis and four patients had a normal scan (false negative). Out of 17 patients, 14 patients were also negative on CT and three were positive for fungal infection (false positive). Sensitivity of CT was 93.6% and accuracy was 89.2%.

Conclusion: CT scan is highly accurate in diagnosing and characterizing paranasal fungal infection. CT scan also guides in defining disease extent as well as aids in deciding the surgical approach to be used.

KEY WORDS: Paranasal Sinuses. Computed Tomography. Culture Analysis. Magnetic Resonance Imaging

INTRODUCTION

Fungal infection is emerging as an increasingly encountered medical malady.[1] The fungi can imitate the whole range of bacterial pathology from acute pyogenic to chronic granulomatous infection and they may not reveal their presence until identified by laboratory methods.

The factors that predispose to fungal infection are apparently becoming more common. These factors include increasing incidence of immunodeficient states, uncontrolled diabetes and patient on prolonged antibiotic or long term cortisone therapy

The most common pathogens are from Aspergillus and Mucor species. Aspergillosis can cause non-invasive or invasive infections. Invasive infections are characterized by dark, thick, greasy material found in the sinuses. Invasive infections can cause tissue invasion and destruction of adjacent structures (e.g. orbit, CNS, ICA).[2,3] Non-invasive infections cause symptoms of nasal obstruction, nasal discharge facial pain with history of these symptoms refractory to medications, and the sinus involved is opacified on radiographic studies.[4] Fungal infections of the paranasal sinus can manifest as 2 distinct entities. The more serious infection commonly occurs in patients with diabetes or in individuals who are immunocompromised and is characterized by its invasiveness, tissue destruction, and rapid onset. Early detection and treatment are vital for these infections because of the high mortality rate. CT scanning is currently the imaging modality of choice for visualizing the paranasal sinuses for most of the pathologies.

CT has the advantage of directly visualizing the sinuses. CT not only just images the pathology but also the nature, severity and extent of the disease. CT with its inherent high contrast resolution allows for excellent demonstration of bone architecture, air in the sinuses, and soft tissue masses in the paranasal sinuses and nasal cavities. In addition to reviewing the scan to determine the presence of disease, CT scans of the sinuses can also be reviewed to evaluate potential areas of occlusion and variations of the patient's sinus anatomy in the setting of surgical planning.[5]

The introduction of spiral CT has opened the opportunity to scan in single breath hold. This combined with a better resolution and elimination of breathing and mis-registration artifacts has contributed immensely to the efficacy of CT examination. Spiral CT is widely available and can be performed rapidly and relatively easily.[6]

Properly performed and accurately interpreted imaging study can significantly influence clinical management.[5]

Similar study has not been conducted in Pakistan. The results were evaluated statistically and the comparison with several standard previous studies was made in terms of outcome.

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METHODS

Over a one year period, 65 patients suspected of Paranasal fungal infection were presented in the Diagnostic department of Liaquat National Hospital for CT scan of Paranasal sinuses. This was a cross-sectional study. The sample technique used was nonprobability, purposive type.

The study was performed in collaboration with ENT department. In and out patients between 10-70 yrs. of age with a mean age of 36 years were taken. After the informed consent and explaining the study's purpose, procedure and approval of the ethical committee was given. CT scan of suspected paranasal sinuses was performed on 4 slice TOSHIBA ASTEION multislice CT scanner without contrast. CT was performed in the coronal and axial planes with the patient lying prone and supine. The scanning values were 3mm section thickness; 5- seconds scan time, 3mm reconstruction interval, 450 mAs and 125 kVp.

Images were analyzed by a senior radiologist on the console. The same senior radiologist assessed all patients included in the study.

Relevant patient data was collected on the proforma regarding their biodata, presenting complaints, provisional clinical diagnosis along with radiological findings and analyzed through SPSS version 10.0

Regardless of CT scan results suggestive of presence or absence of fungal disease, all patients in study underwent culture which was taken as gold standard in the study. Culture results were then followed from the medical record and recorded on proforma.

Descriptive statistics and percentages were computed for variables including gender, age, presenting symptoms, CT findings and culture results. After analyzing the data, sensitivity, specificity, negative and positive predictive values and diagnostic accuracy of CT for fungal sinusitis were calculated taking culture analysis as the gold standard reference.

RESULTS

During the one year period, 69 patients turned up for CT paranasal sinuses with clinical suspicion of fungal sinusitis. Majority of the patients were females with average age between 10-70 years and a mean of 36 years. Out of these, four patients were excluded from the study because two were being treated for fungal sinusitis and other two had surgical history of paranasal sinusitis. Therefore, the final number of patients comprising the study was 65 who underwent CT of paranasal sinuses.

After CT, cultures of the paranasal sinuses were obtained to confirm the diagnosis. Out of 65 patients, 48 patients were confirmed having fungal sinusitis on culture analysis and remaining 17 patients was true negative.

On CT examination 44 patients were given positive for fungal sinusitis (true positive) while 04 patients had normal scan (false negative). Out of 17 patients; 14 patients were negative on CT as well (true negative) while 3 were positive for fungal infection (false positive).

For culture results the sensitivity of CT was 93.6%, specificity was 77.7%, positive predictive value was 91.6%, negative predictive value was 82.3% and accuracy was 89.2% (Table 1).

Concerning etiology no specific finding was registered as being particularly able to differentiate between different paranasal fungal infections.

Table 1: Sensitivity, positive and negative predictive values of CT scan.

	CULTURE RESULTS		
CT RESULTS	Positive (+ve)	Negative (-ve)	TOTAL
Positive (+ve)	44	04	48
Negative (-ve)	03	14	17
	47	18	65

Sensitivity	93.6%
Specificity	77.7%
Positive Predictive Value	91.6%
Negative Predictive Value	82.3%
Accuracy	89.2%

DISCUSSION

The incidence and prevalence of fungal rhinosinusitis, broadly defined as any kind of sinusonasal pathology related to the presence of fungi, are increasing, as is the diversity of pathogenic organisms.7 It has been estimated

that fungal rhinosinusitis is encountered in about 10% of the patients requiring surgery for the nose and the sinuses and that between 13.5 and 28.5% of all maxillary sinusitis is fungal or mixed fungal and bacterial infections.8,9 Furthermore recent and somewhat controversial reports suggest that fungi may play a major role in chronic sinusitis, since they can be cultured using sensitive methods in more than 95% of patients .As a matter of fact the possibility of a fungal infection should always be considered in the differential diagnosis of intractable diseases of the paranasal sinuses.[10]

In addition to an absolute increase in the number of cases, diagnostic methods have significantly improved and are more subtle. Earlier diagnosis with timely antifungal therapy may lead to greater therapeutic success than has been recognized to date.[11]

Since the disease usually requires surgical intervention, accurate radiological diagnosis is important for the clinician. CT is the imaging procedure of choice giving both information on the usual surgical landmarks for an endonasal therapeutical approach and on extent and nature of the disease. CT scans are usually performed on patients with chronic sinusitis who have failed to respond to antibiotic therapy.

There are several diseases to be distinguished from fungal sinusitis, such as chronic bacterial sinusitis, benign and malignant neoplasm, tuberculous sinusitis, osteomyelitis and Wegener's granuloma. While the CT appearances of fungal sinusitis are not pathognomonic, they are sufficiently characteristic to suggest the possibility of disease.

The major CT feature of fungal sinusitis in the study was the presence of soft tissue mass within the involved sinus, seen on unenhanced studies. The various patterns of sinus involvement included a diffuse homogenous mass of moderate attenuation with or without intervening areas of lesser density, polypoid or nodular masses, a linear interlacing pattern and denser central masses of calcium surrounded by thin zone of lower attenuation. Combinations of these patterns were also appreciated occasionally. Stammberger et al. (1984) found that 27 of59 patients had dense concretions of calcium phosphate or calcium sulfate in the sinus fungal masses.[12] In another study by Jung Hwan Yoon published in AJNR April 1999, concluded that calcification was central within maxillary sinus in 95% of the patients. In contrast, in non-fungal sinusitis, the intra-sinus calcification was located at the periphery near the sinus wall in 81% of the patients.[13] Calcification may occur with other pathologic processes, such as bacterial sinusitis, mucoceles, and neoplasms, but it is uncommon in non-fungal inflammatory sinonasal disease. The other CT features in the study were the expansion of the sinus with thinning and erosions of the bony margins, bony sclerosis and remodeling and intra-orbital and/or intracranial extension. The bony erosion is reversible in sinonasal fungal infections and seems to be mainly related to the inflam-

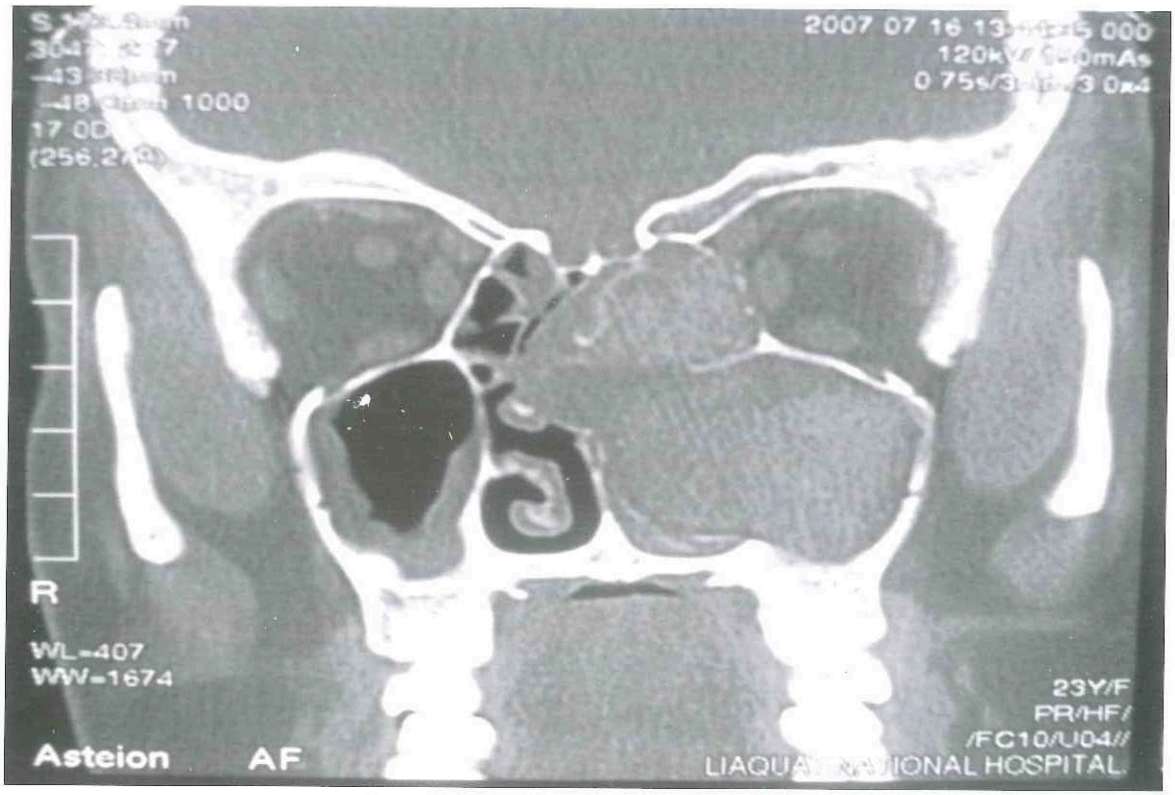

Figure 1. CT scan of Paranasal sinus.

matory process induced by the growing fungus and possible superimposed bacterial infection. The osteomeatal mucociliary drainage pathways of the involved sinuses were almost always blocked.

In the literature, the maxillary and ethmoid sinuses are most commonly involved, followed by the sphenoid sinus. Unilateral involvement is more common and involvement of frontal sinus is rare.[14] In our series of 65 suspected cases, bilateral involvement was slightly more common while the ethmoid and sphenoid were as frequently involved as the maxillary sinuses. Intracranial extension occurred in two cases, intra orbital extension occurred in four cases and a combined intra orbital and intracranial extension occurred in one case. The lowest representative CT

number in our patients was 89.0 HU and the highest was 211.4 HU and the mean was 122.2 HU.

A wide spectrum of fungi may involve in the pathogenesis of sinuses but mostly Penicillium and Aspergillus species were cultivated in the study.

In a study done by Zinreich S J et al. published in Radiology 1988, 1,251 patients underwent CT examination for chronic sinusitis between July 1, 1985 to December 31, 1987. Fungal sinusitis was diagnosed in the surgical specimens of 25 of the patients. 19 of these patients demonstrated focal hyper attenuation in the soft tissue sinus masses on the CT examination. Three patients were incorrectly suspected of having fungal sinusitis (false positive). In addition, three patients were not diagnosed with CT (false negative) and were only identified as having fungal sinusitis after pathological findings proved positive. Thus in this group of 25 patients with a pathological diagnosis of fungal sinusitis with or without suspicion at CT, 19 (76%) were correctly diagnosed, with three (12%) false positive and three (12%) false negative diagnosis.[15]

Lanza D C, Dhong H J et al had done a study on 11 cases of chronic paranasal sinusitis in which pathologic examination failed to confirm fungal hyphae, despite clinical suspicion of a fungus ball based on operative or CT findings. During the same period, they also experienced another 52 patients who were diagnosed with fungus ball at pathologic examination. To evaluate the diagnostic accuracy of CT scans and operative gross findings in sinus fungus balls, they reviewed the medical records of those 63 patients and also reviewed CT scans and operative records of another 1127 patients who received endoscopic sinus surgery for chronic rhinosinusitis. The sensitivity of CT evaluation was 62%, and specificity was 99%. The false-positive and false-negative rate were 22% and 2%, respectively. With regard to operative findings, such as clay-like inspissated mucus, the sensitivity, specificity, and predictive value positive rate were 100%, 99%, and 83%, respectively.[16]

In a study by Dr. Florian Dammann from the University Hospital of Tuebingen, Germany, that included 60 patients; he used both CT and MRI for paranasal sinuses. He concluded that MRI can replace CT for preoperative planning in patients with paranasal sinus disease. But CT with its inherent high contrast resolution allows for excellent demonstration of bone architecture, air in the sinuses, and soft tissue masses in the paranasal sinuses and nasal cavities.[17]

With modern and more sophisticated technology the results of my study with a larger sample were better than the studies done many years back.

CONCLUSION

The study shows the sensitivity 93.6% specificity 77.7% and accuracy of 89.2 %. CT scan is highly accurate in diagnosing and characterizing Paranasal fungal infection. Use of this rapid non operator dependent and highly accurate examination may decrease delays in appropriate management and also guides in defining the disease extent as well as aids in deciding the surgical approach to be employed.

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