ORIGINAL ARTICLE

Early Radiological Diagnosis of Chronic Sinusitis Prevents Complications

ASIM IQBAL, BASMA KHAN, MANZOOR AHMED

ABSTRACT

Aim: To prevent complications of fungal sinusitis by early and prompt radiological diagnosis.
Study design: Descriptive/ Observational.
Setting: Department of ENT Fatima Jinnah Medical College/Sir Ganga Ram Hospital, Lahore, in collaboration with Department of Diagnostic Radiology of the same Hospital from Nov 2012 to April 2013.
Methods: Patients with symptoms of chronic sinusitis fulfilling few major and associated criteria referred for diagnosis of disease and its complications to Radiology Department by CT/MRI.
Study design: Descriptive / Observational
Sampling Design: Convenient, Non Probability
Sample Size: The first 100 patients referred from ENT Department were investigated by X-Rays/CT /MRI for chronic sinusitis and its associated complications
Results: Out of 100 participants, in 70% of the cases, clinical and radiological findings were consistent and correlative, 12% were clinically positive but radiologically negative.8 % were radiologically positive but clinically had no symptoms.10% were inconclusive clinically and radiologically or were lost to follow up. All the findings were confirmed pathologically.
Conclusion: Early diagnosis of noninvasive fungal sinusitis may prevent multiple surgical procedures and lead to effective treatment. It is concluded that for proper evaluation of fungal sinusitis, clinical, radiological and histopathological evaluation should be done in all the patients, where radiology provides a road map to the endoscopic surgeons and warns of any existing or impending complications. Histopathology always gives a confirmatory diagnosis and is gold standard.
Keywords: Chronic fungal sinusitis, CT scan, MRI, Sinonasal puncture.

INTRODUCTION

Allergic Fungal sinusitis has been labeled as the Sinonasal equivalent of Allergic Bronchopulmonary Aspergillosis[1]. It contributes 6-8% of the total chronic sinusitis[2]. It is categorized into two main types; invasive and non-invasive. Invasive sinusitis includes Acute Invasive Fungal Sinusitis, Chronic Invasive Fungal Sinusitis and Chronic Granulomatous Invasive Fungal Sinusitis and is diagnosed by presence of fungal hyphae within the mucosa, sub mucosa, bone and blood vessels of the paranasal sinuses. Noninvasive sinusitis includes Allergic Fungal Sinusitis and Fungus Ball (fungus mycetomas) and is characterized by absence of fungal hyphae within the mucosa and other structures of the paranasal sinuses.

Fungal infection may be one of the most challenging forms of sinonasal pathology to manage, especially the invasive forms, which have high mortality rates. Therefore, it is essential to correctly diagnose and classify fungal disease of paranasal sinuses in order to accurately predict prognosis and implement effective therapy[3].

Functional endoscopic sinus surgery (FESS) has revolutionized the treatment of sinusitis. Imaging has also progressed with FESS, and computed tomography (CT) scanning can now demonstrate the sinus anatomy, normal bone variants and patterns of sinusitis in exquisite detail before surgery. Axial and Coronal CT imaging is the preferred initial procedure. Bone-window views provide excellent resolution and good definition of the complete osteomeatal complex and other anatomic details that play a role in sinusitis. In addition, the coronal view is best correlated with findings from sinus surgery, with anatomy and pathology visualized in a plane almost identical to that seen by the endoscopist.

There are five major criteria and six associated characteristics or minor criteria of patients with allergic fungal sinusitis.[4]The five major criteria are (1) evidence of type I hypersensitivity (IgE mediated) (2) nasal polyposis (3) characteristic CT findings (4) eocinophilic mucus and (5) positive fungal smear. The six associated criteria are (1) asthma (2) unilateral predominance (3) radiographic bone

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erosion (4) fungal culture (5) Charcot-Leyden crystals and (6) serum eocinophilia. The affected nasal mucosa no longer functions properly and a cycle of chronic edema, stasis, and bacterial super infection results. Therapy entails disrupting the inflammatory process to allow normal mucosal function to resume[5]. Invasive fungal sinusitis is discrete entity completely separate from Acute Fungal Sinusitis. Clinical presentation, imaging features and treatment differ based on types of fungal sinusitis.

The patients may present with thick, eocinophil-rich, inspissated mucus, marked nasal polyposis and nasal mucosa with eocinophils and lymphocytes predominating histologically[6,7,8].

To monitor treatment, progress and prevent recurrence an endoscopic mucosal staging system was developed[9].

Stage 0: No mucosal edema or allergic mucin

Stage I: Mucosal edema with or without allergic mucin

Stage II: Polypoid edema with or without allergic mucin

Stage III: Sinus polyps with allergic mucin.

Many patients, however, do not initially present with all five of the major criteria it may take years for an elevated serum IgE, a type I hypersensitivity reaction, or eocinophilic mucus to develop, for there to be a positive computed tomography scan, or for fungus to be found on pathologic examination.

Because the diagnosis is often delayed, many patients are diagnosed when they present with complications[10,11,12.]. Clinical features include patients usually immune competent with history of chronic rhino sinusitis, usually persistent and recurrent disease, maxillofacial soft tissue swelling, orbital invasion with proptosis, cranial neuropathies, decreased vision, invasion of cribriform plate causing headaches, seizures and decreased mental status.

Coronal and axial CT imaging gives the best overall anatomic detail of the paranasal sinuses and can be achieved either with prone direct coronal imaging or can be reformatted from thin-slice axial images. Contrast enhancement is not generally needed for routine sinus imaging. Sinus radiographs are inaccurate in a high percentage and have been supplanted by CT imaging but are done routinely of every patient undergoing CT scan.[13]Sinusitis cannot be diagnosed on the basis of imaging findings alone but should be interpreted in conjunction with clinical and endoscopic findings[14,15,16].

Magnetic resonance imaging (MRI) may be needed to fully define the extent of orbital or intracranial extension of disease or its complications. CT with contrast may be used to help define bony detail including the normal bony variants, though more accurate evaluation will be obtained with MRI without and with contrast. [17,18,19.] The fungus spreads from the affected sinuses superiorly into the orbit causing proptosis, up to orbital apex causing the orbital apex syndrome and posteriorly into the cavernous sinuses causing carotid cavernous fistula, cavernous venous thrombosis and death. Left untreated, any of the invasive forms can lead to fungal invasion of cerebral blood vessels, with ischemic infarction or direct infection of the brain or carotid artery leading to its occlusion or pseudo aneurysm. The orbital apex syndrome is characterized by decreased vision and ocular immobility resulting from a mass in the superior portion of an orbit.[20,21,22.]

Early NECT shows unilateral soft tissue thickening in the nasal cavity as most consistent (but nonspecific) finding. Hypo attenuating mucosal thickening within lumen of paranasal sinus with rapid aggressive bone destruction of sinus walls occurs as disease progresses. Often unilateral involvement of sinuses is noted. Obliteration of peri antral fat is a subtle sign of extension. Lepto meningeal enhancement indicates progression to cerebritis and abscess formation. The mass results from bony erosion and the spread of fungal material from an ethmoid sinus[23]. This condition may be misdiagnosed as inflammatory pseudo tumor and corticosteroid therapy may be initiated before appropriate orbital exploration and biopsy are performed.

PATIENTS AND METHODS

A study conducted on 100 patients of chronic sinusitis diagnosed clinically from Nov 2012 to April 2013, selected from the OPD and Inpatient department, at the Department of ENT, Fatima Jinnah Medical College/Sir Ganga Ram Hospital, Lahore in collaboration with Department of Diagnostic Radiology of the same hospital, with convenient, non-probability sampling. The study design was descriptive and observational. Detailed history and data was collected in a brief predetermined format. Samples like nasal lavages, sinus secretions, and tissue specimens were processed and examined by microbiology culture using recommended techniques. Slide culture was done to observe the microscopic morphology. Histopathological examination was done by H and E stain and PAS stain for classification.

The selection criteria was patients with at least 3 major criteria. The patients with h/o diabetes, acute sinusitis and immune suppression were excluded. A verbal consent was taken from the population selected and/or their attendants after explaining the intension of the procedure. Related demographic variables like identification, age, socio economic status and environmental exposure to fungus/ fungal

toxins[24] or repeated exposure to bacteria creating chronic inflammation were recorded.

Patients were referred to Radiology Department where X-Rays were taken and then patients underwent CT Scan on Toshiba Aquilion 4 Slice Helical CT. Patients with complications also had MRI done on closed 1.5 Tesla Toshiba MRI. The recorded variables were entered on study proforma and later transferred to SPSS-17 and analyzed through its statistical package using descriptive statistics (as percentages). Significance was kept at p-value less than 0.05. The results were compared to previous studies and percentages calculated.

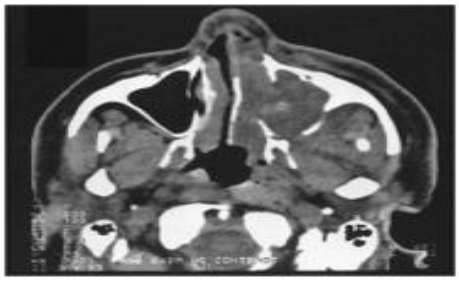


Fig. 1. Axial CT of the Sinuses showing opacification and expansion of the left maxillary sinus ,widening of osteomeatal complex and extension into left nasal cavity..

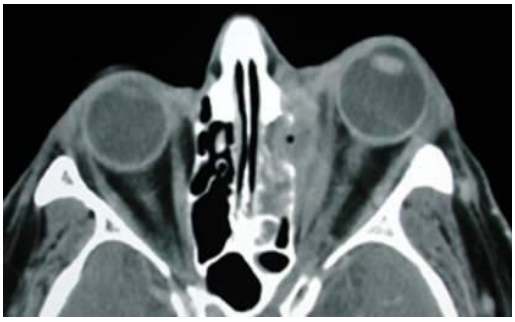
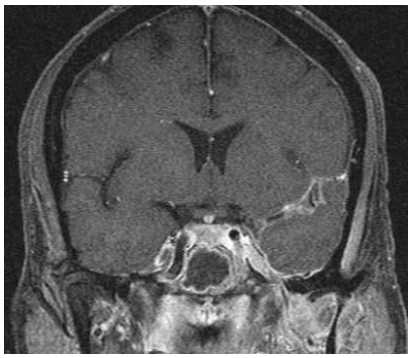


Fig. 2 Axial CT--Bilateral ethmoid involvement with destruction of lamina papyracea, intraorbital spread and proptosis.



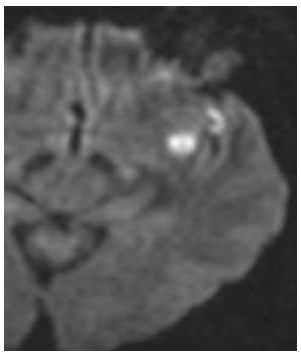
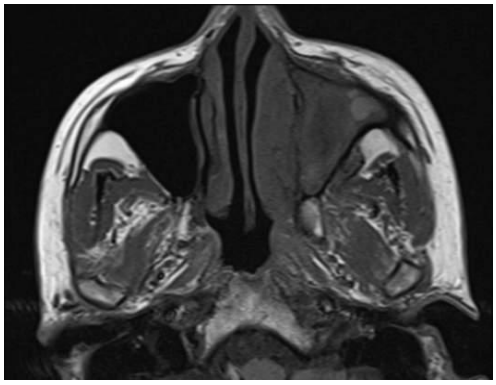


Fig. 3: MRI-Involvement of sphenoid sinus with invasion of the left cavernous sinus, thrombosis, extension to the left sylvian fissure and infratemporal fossa with cerebral infarctions.



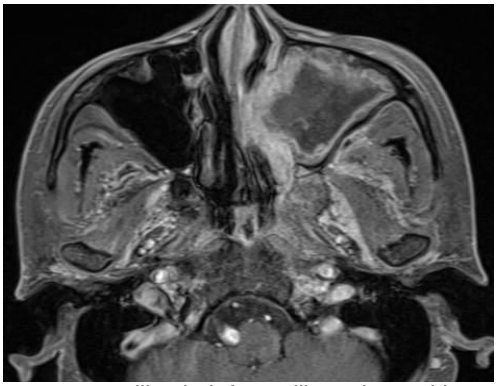
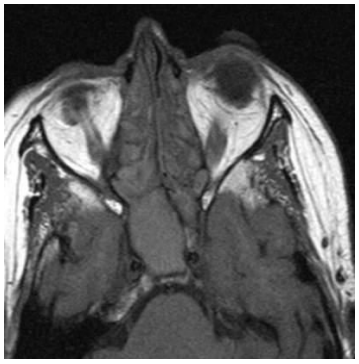


Fig. 4: MRI-Aspergillus in left maxillary sinus with extension anterior and posterior to the retroantral space and muscles of mastication. Low signal on T1WI and T2WI weighted images



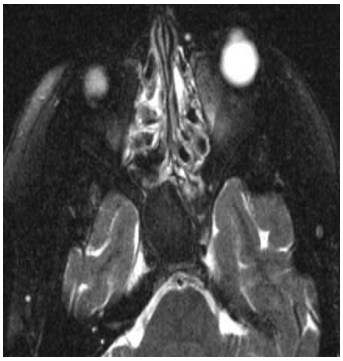


Fig. 5 CT and MRI .Hyperdense on CT (a)Allergic fungal sinusitis moderately high T1WI (b), low on T2WI with expanded sinus.

Fig. 6: High density material with thickened walls of the maxillary sinus due to chronic inflammation.

RESULTS

Maximum number of cases were found to be in the age group 31-40 years (42.86%), followed by 41-50 years (28.57%) and 21-30 years (19.05%). Male: Female ratio was approximately 1.33:1. Most of the confirmed cases were found to be in the lower socio-economic status (71.43%). 62% confirmed cases of fungal rhinosinusitis were found to be from urban areas as compared to 38% cases coming from the rural areas. Out of 100 participants, in 70% of the cases, clinical and radiological findings were consistent and correlative, 12% were clinically positive but radiologically negative.8 % were radiologically positive but clinically had no symptoms.10% were inconclusive clinically and radiologically or were lost to follow up. However the final diagnosis of allergic fungal sinusitis was established on histopathology which of course is the gold standard.

An allergy evaluation confirmed atopy through a strong history of inhalant mold allergies, an elevated total immunoglobulin E level, or a positive result of a skin test in 82 % of patients. 82% patients had nasal polyposis, and 41% had asthma. There was a unilateral predominance in 80% cases. A characteristic computerized tomography finding of serpiginous areas of high attenuation in affected sinuses was seen in 70% who were clinically positive and additional 8% who were clinically negative but radiologically positive. 68% patients had some degree of radiographic bone erosion. Pathologic examination uniformly revealed eocinophilic mucus with fungal invasion into soft tissue, Charcot-Leyden crystals and peripheral eocinophilia were each observed 41% patients. 82% patients had fungus identified on fungal smear, although 73% fungal cultures were positive.

All patients underwent CT evaluation which revealed hyper attenuated foci in the maxillary sinus in 22% patients, in the ethmoid sinus and maxillary sinus 33% patients and pansinusitis in 23% patients.

Areas of focal hyper attenuation varied in size. The smallest area measured 4 mm in diameter; the largest nearly formed a cast of the maxillary sinus and measured 2.5cm at its greatest width. Furthermore, of 68% patients with evidence of bone erosion, their CT revealed intra nasal extension in almost all cases, intracranial and intraorbital extension had an equal distribution of 15% invasion ,with extension in infra temporal fossa in 1% only. On correlative plain radiographs of all patients undergoing CT scan, the mycetomas appeared as either a homogeneous soft-tissue mass or in some cases as a well-defined attenuation similar to that seen with calcium or bone. Other CT findings included severe soft tissue edema of the nasal cavity mucosa (turbinates, lateral nasal wall and floor, and septum) in 63% patients, sinus mucoperiosteal thickening in 64%, bone erosion in 24%, orbital invasion in 24%, facial soft tissue swelling in 15%, and retroantral fat pad thickening in 6%. 8% patients had air-fluid levels. 16% out of 68% with CT evidence of intracranial, intraorbital and infratemporal fossa extension underwent MR imaging, which confirmed the CT findings which demonstrated that the fungal mass was iso to hypo intense on both T1WI compared with the normal mucosa of the turbinates. On the T2WI images the fungal mass in the involved sinus had a greater decrease in intensity in the involved sinus (the intensity being similar to that of air in the normal sinus), while the intensity of adjacent soft-tissue sinus masses and brain increased markedly. All patients with bacterial mucoperiosteal inflammation demonstrated a high T2WI signal. The neoplasm had lower signal intensity than bacterially infected mucosa, which had intermediate signal intensity. The sub acute hemorrhage present in one patient had a low signal on T2WI.

Of the 82% patients whose specimen was send for histopathology, six were unavailable for evaluation. All the patients responded to surgical debridement, and systemic antifungal therapy was not required. In all cases of chronic sinusitis, the X-ray sinuses only helped to confirm the clinical diagnosis A routine antrum washout was done as an alternative in all cases of chronic maxillary sinusitis.

DISCUSSION

Fungi are the chief aeroallergens in many areas, where airborne spore counts are a thousand times those of pollens[25]. Pathophysiology of fungal sinusitis involves compromised sinus aeration, altered immune responses to fungi, and bad luck.[26] Invasive and noninvasive syndromes of fungal sinusitis share many features radiologically. They both may extend beyond the thin walls of the sinuses into the nose, structures of the eye and the brain. Purulent, pasty, often foul-smelling material is present within affected sinuses and may contain few or many fungal elements, which often fail to grow in culture.[27] This fungal material is commonly associated with dense polyposis and calcification that results in areas of focal or diffuse radio density on CT imaging of the sinuses[28] and decreased signal intensities on T1WI and T2WI MRI imaging. The flocculent calcifications in the sinus are common in fungal sinusitis, with values on CT densitometry ranging from 1870 to 3070 Hounsfield units (HU--average, 2868).

Biopsy of the diseased mucosa usually shows vascular invasion by hyphae and a diagnosis of invasive fungal sinusitis is easily made. Cultures subsequently grew *Aspergillus fumigates.* Despite vigorous treatment, patients usually end up with complications. Clinical evaluation combined with early radiological investigations yields better results than clinical diagnosis alone. Computed tomography (CT) is the imaging method of choice for the paranasal sinuses and MRI for its complications[29]. Our results were consistent with the study of Bent and Kuhn[2]. In the study of Pillsbury and Young up to 40% of asymptomatic adults have abnormalities on NECT as do more than 80% of those with minor upper respiratory tract infections[30,31]. Our study was only restricted to patients with clinical suspicion of chronic sinusitis but 70% of our patients had radiologically proven disease which is comparable to the study of both Pillsbury and Young where it was 80%.

Fungal sinus disease may first be seen as a slowly progressing extra mucosal fungus ball, a slowly invasive disease in immune compromised patients or a fulminant infection with vascular invasion. Fulminant disease has more typically been attributed to mucor mycosis and benign extra mucosal disease to Aspergillus species. In our case, 82% patients proved positive pathologically with fungal smears. A review of the literature, however, shows that appraisal of the aggressiveness of the disease on the basis of the organism alone is incomplete and invalid[32,33].

At plain radiography and multidirectional tomography of the sinuses, fungal disease is described as having nodular mucoperiosteal thickening, absence of air fluid levels, clouding of sinuses, sinus wall destruction and focal increased attenuation. These characteristics, however, are sufficiently nonspecific that distinction between chronic sinusitis and neoplasm remains difficult as shown in the study of Beck-Mannagetta and Necek[34].

Stammbenger and Kopp et al[35,36] stated that the focal hyper attenuation seen on plain radiographs represents calcium phosphate and calcium sulfate

deposits within necrotic areas of the mycelium giving increased attenuation in CT which was present in 75% of the cases. In half of these patients the increased attenuation was similar to that of a soft-tissue inflammatory mass and in the other half, discrete, very dense areas were observed. In our study it was 80%.

The MR imaging findings proved more specific than those at CT Bony erosion and extra-sinus infiltration was found in 15 of 46(33%) patients on imaging[37]. Even though a smaller number of patients were examined with this modality (16% out of 68%), the outcome was identical in all cases. Several factors might decrease the signal intensity on the T1WI and T2WI MRI images including the presence of calcium, air, magnesium, manganese or ferromagnetic elements which explain the decrease in signal intensity seen. Iron, magnesium and manganese were chosen by Gwaltney and Holbrook for analysis because these elements are known to be essential in fungal amino acid metabolism[38,39]. ur specimens also stained positive in almost all cases (10% cases had an inadequate specimen).

It has been suggested to delete X-Rays carried out as a routine, in all cases of chronic sinusitis in view of the heavy radiation and cost involved. X-rays of the maxillary sinuses are of course, positively indicated in clinically doubtful cases presenting serious complications in whom it is of utmost importance to rule out any sepsis in the maxillary sinuses at the earliest moment. Antrum washout was done as alternative procedure which has a diagnostic as well as therapeutic value, is a minor surgical technique, it involves no extra cost and is perfectly safe in trained hands.

CONCLUSION

Early diagnosis of noninvasive fungal sinusitis may prevent multiple surgical procedures and lead to effective treatment. All these forms of invasive fungal sinusitis are associated with reasonable rates of response if diagnosed and treated early. It is concluded that for proper evaluation of fungal sinusitis, clinical, radiological and histopathological evaluation should be done in all the patients, where radiology provides a road map to the endoscopic surgeons and warns of any existing or impending complications. Histopathology always gives a confirmatory diagnosis and is gold standard.

Understanding the different types of fungal sinusitis and knowing their particular radiologic features allows the radiologist to play a crucial role in alerting the clinician to use appropriate diagnostic techniques for confirmation. Prompt diagnosis and initiation of appropriate therapy are essential to avoid a protracted or fatal outcome.

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