



Management of fungal sinusitis: A retrospective study in a medical college hospital

Sudhir M Naik ¹, Ravishankar S ¹, Deekshith R M ¹, Sherry J ¹, Pooja N ¹, Shashikumar T ¹, Shankarayan Bhat ², Navya R ³, Aishwarya K C ⁴.

1 Department of ENT -HN surgery, KVG Medical College, Sullia, Karnataka.

2 Department of Anaesthesia, KVG Medical College, Sullia, Karnataka.

3 Department of Pathology , KVG Medical College, Sullia, Karnataka.

4 Department of Radiology , KVG Medical College, Sullia, Karnataka.

ABSTRACT

Background/ objectives: Fungus balls are extra-mucosal collections of fungal elements, usually localized to a single sinus cavity, commonly the maxillary sinus. They appear as partial or complete heterogeneous opacification of the involved sinus with occasional metal dense opacities on CT scan. Here we report a case series of fungal sinusitis with multiple sinus involvement.

Materials and methods: We report a case series analysis of 46 cases of fungal sinusitis managed in our department for the past 3 years. Mean age in our study group was 32.45 years, with 15 males (mean age – 35.46 yrs) and 31 females (mean age –31 yrs). All were operated with endoscopic sinus surgery after CT findings positive of fungal sinusitis.

Result: Fungal ball was seen in 36 (78.26%) cases and invasive fungal sinusitis were seen in 8 (17.39%)cases. 4 cases did not yield any growth and only secondary bacterial infection were seen on bacterial culture. 34 cases had disease in the maxillary sinus. 9 cases had bilateral growth and the rest unilateral only. 16 cases had disease in the sphenoid while 6 cases had both maxillary and sphenoid disease. 2 cases had ethmoidal disease.

Conclusion: Endoscopic sinus surgery is treatment of choice for non-invasive fungus ball. Local or systemic antifungal therapy are reserved for extensive and invasive fungal diseases.

Introduction:

Fungus ball of the paranasal sinuses is defined as the non-invasive accumulation of dense fungal debris in sinus cavities, most often the maxillary sinus.¹⁻⁶ They are extramucosal collections of fungal elements, usually localized to a single sinus cavity.¹⁻⁶ They are usually of the noninvasive variety, and commonly seen in immunocompetent hosts.⁵ Occasionally a waning of the immunity can cause them to turn invasive.⁵ Most of the controversy regarding its management has been resolved.⁷ Endoscopic surgery is a safe and effective treatment for paranasal sinuses fungus ball.⁷ Fungus ball of the paranasal sinuses is the terminology used to describe a dense mass of noninvasive matted fungal hyphae within a paranasal sinus.^{1.}

Fungus ball has replaced the misnomer 'mycetoma' which was used to describe this condition.⁸ Mycetoma is a chronic local invasive infection of the subcutaneous tissue that may extend to contiguous structure such as fascia or bone.⁸ A true 'mycetoma' is a suppurative and granulomatous subcutaneous infection with draining sinus tracts.⁸ The term 'aspergilloma' or 'sinus aspergillosis' should not be used for fungal balls as other fungal species have also been isolated.⁵ Fungus balls are found in just one paranasal sinus, most frequently in the maxillary sinus and occasionally in the sphenoid sinus.⁹ The host is immunocompetent, but if during the infection the host is immunocompromised, then this noninvasive fungal infection may become invasive and life-threatening.⁹

Materials and methods:

We report a case series analysis of 46 cases of fungal sinusitis managed in our department for the past 3 years. Mean age in our study group was 32.45 years, with 15 males (mean age – 35.46 yrs) and 31 females (mean age – 31 yrs). No cases of immunodeficiency were seen in our cases and cases with HIV infection excluded from the study. 12 cases of type 2 diabetes mellitus were seen in the study. All the hyperglycemic levels were controlled by human regular insulins and oral hypoglycemic at the time of surgery. Coexisting comorbidities were not significant in our cases. All the cases who had headache and sinus tenderness resistant to medical line of treatment were imaged with CT scan of the paranasal sinuses coronal, axial and saggital cuts.(fig 1,2) The cases suspected to be fungal with heterogeneous opacity with occasional presence of metal density opacifications were included in the study. The maxillary sinus was the most common sinus involved 42(91.3%), sphenoid sinus in 14 (30.43%) ethmoid in 2 (4.34%) cases and no frontal sinus involvement were seen.

All the cases were operated under general anesthesia using hypotensive anesthesia for extensive disease. The surgery was performed classically with middle meatal antrostomy and cleaning the sinus with suction and curette.(fig 3) Similarly ethmoids were cleared and frontal drainage was done. Sphenoids were explored if disease seen on CT scans.

All the curetted and collected material were analyzed microscopically and after bacterial and fungal cultures. All the patients had uneventful recovery with most of the cases showed *Aspergillus flavus* as isolate. (fig 4) Superadded bacterial infection were seen in 14 (30.43%) cases. Invasion into the mucosa was seen in 8 (17.39%) cases. Rest of the mucosal curettes showed only chronic inflammatory cells. The patient was put on postoperative antibiotics, anti-inflammatory analgesics & antihistamines for 1 week in cases with limited disease. 6 cases of extensive diseases and 2 cases with invasion were given oral itraconazole for 2 weeks along with antibiotics and anti-inflammatory treatments. Review was done after one week with a normal saline douche and antihistamine and mast cell stabilizer was continued for 4 – 8 weeks.

Results:

A diagnosis of fungal ball was made in 36 (78.26%) cases and invasive fungal sinusitis were seen in 8 (17.39%) cases. 4 cases did not yield any growth and only secondary bacterial infection were seen on bacterial culture. 34 cases had disease in the maxillary sinus. 9 cases had bilateral growth and the rest unilateral only. 16 cases had disease in the sphenoid while 6 cases had both maxillary and sphenoid disease. 2 cases had ethmoidal disease. No fungal lesions were seen while frontal sinus were explored in 12 cases with CT findings of fungal sinusitis. 14 cases had ethmoidal sinus disease while 9 was bilateral. All the cases with ethmoidal disease were explored with anterior and posterior ethmoidectomy wherever required. All the maxillary and sphenoid sinuses were flushed with 40mg triamcinolone acetonide 1ml in each maxillary sinuses and 1 ml into the sphenoid sinuses. The cases were followed up weekly with endoscopy and douching.

Discussion:

Fungus balls are known to occur in normal immunocompetent individuals.^{1,2,3} While treating routine cases of chronic bacterial rhinosinusitis fungus balls may be coincidentally diagnosed.^{1,2,3} They are usually seen to occur in middle and older age groups.^{1,2,3} Predominance is seen in the 5th & the 6th decade.^{1,2,3} They usually present with nonspecific symptoms of chronic rhinosinusitis such as nasal obstruction, postnasal discharge and facial pain.^{1,2,3} No cases have been reported in children, the youngest being a female of 18 years.^{1,2,3} There is a considerable female preponderance with almost all studies reporting a female incidence of approximately 60-65%.^{1,2,3}

Fungus balls follow a slow, benign course.⁵ Patients may have symptoms for months or years before a diagnosis is confirmed.⁵ For a fungus ball to form, fungal hyphae and spores must get trapped in a paranasal sinus and conditions must support their growth.⁵ Sinus hypoventilation secondary to ostial dyspermeability plays an important role in trapping fungal spores and providing anaerobic conditions for the development of sinus fungal ball.^{3,10} Here the pathology disrupts the normal mucociliary clearance and obstructs the sinus ostium as seen in acute or chronic rhinosinusitis.^{3,10} When this occurs, the fungal spores germinate within the sinus cavity and the growth of hyphae further impairs clearance of the fungi and growth proceeds within the sinus cavity.^{3,10}

The patients with fungus balls are immunocompetent.⁵ Also no history of atopy is seen to explain the development of this condition in these patients.⁵ They occur most commonly in the maxillary or sphenoid sinuses.⁵ However, they are also reported to occur in the frontal or ethmoid sinuses in literature.⁵ They usually affect a solitary sinus but, may occasionally involve two contiguous sinuses.⁵

Symptoms are similar to those seen in chronic rhinosinusitis secondary to inflammation or bacterial infection.^{1,2,3} These include nasal obstruction, nasal discharge, cacosmia, facial pain with a history of these symptoms being refractory to medication.^{1,2,3} Symptoms are usually of long duration occasionally the patient may present with unusual symptoms such as epistaxis, visual disturbances, convulsions, fever, cough, and proptosis.^{1,2,3} Sometimes, the patient may be asymptomatic and the fungus ball may be an incidental finding.^{1,2,3} 10% of patients have associated nasal polyps which are in fact, a nonspecific response to a variety of inflammatory condition.^{1,2,3} Fungus balls are rarely known to cause bone remodelling with widening of the affected sinus and distortion of anatomy.^{1,2,3} They may also cause bone erosion.^{1,2,3} Rarely, if during the infection, the immunity of the host declines, a fungus ball may become invasive.^{1,2,3}

Characteristic imaging findings and histopathologic examination confirms the diagnosis.^{2,11} At surgery, thick inspissated debris forms a mass which fills the sinus cavity.^{2,11} On histopathologic examination, the debris found in a fungus ball consists of dense tangles of hyphae with calcifications and oxalate crystal. However, fungal cultures are usually negative.^{2,11} It usually does not invade tissue; however acute or chronic inflammatory infiltrate may be present in the adjacent mucosa but, granulomas are absent.^{2,11} Fungus balls are essentially noninvasive and extramucosal fungal infestations without any granulomatous reaction.^{2,11} Routine hematoxyline and eosin stains can demonstrate the presence of fungus but, special stains such as the gomori methanamine silver are helpful in diagnosis the *Aspergillus* species.¹¹

Intraoperatively, the gross appearance of the fungus is gritty or cheesy and caly like, breaking up into fragments, the color of which ranges from brown to black to green to yellow.¹¹ The causative fungi include *Aspergillus fumigates*, *Aspergillus flavus*, *Alternaria Sp* and *P Boydii*. Only 23-50% cultures result in fungus growth.¹¹ When based on the history or endoscopic findings mentioned above, a patient is suspected of having a fungal ball a CT scan of the sinuses should be performed.^{11,12} Blood examination is usually not contributory.^{11,12} In particular no peripheral eosinophilia can be detected.^{11,12} CT however 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.^{11,12} A single sinus is involved in 94 % of the cases & unilateral involvement is seen in almost 99 %.^{11,12} Exceptionally, distinct and bilateral involvement of bilateral sinuses may occur.¹³

The maxillary sinus is by far the most frequently involved sinus (94 %) followed by the sphenoid sinus(4-8%).^{3,13} The ethmoid sinus is involved in about 3 % most often as a continuous involvement from the maxillary sinus.⁴ The frontal sinus alone is implicated only in about 2%.³ Very rarely a fungus ball in the concha bullosa has been described.⁴ The most common CT finding observed in about 90% of the cases is partial or often complete heterogeneous opacification of the involved sinus.⁴ Only in 10 % of the cases homogenous opacification is observed. microcalcifications or "metallic dense" spots, sometimes combination are each seen in about 1/3 rd of the cases in both homogenous and heterogeneous opacifications.⁴

The sensitivity and specificity of CT imaging, using sinus opacification the presence of areas with hyper attenuation as diagnostic criteria for fungus ball, were calculated to be 62 and 99% respectively.^{4,15} In addition, the central calcification of the sinus is usually separated from the bony sinus wall by a thin zone of lower attenuation material.^{4,15}

Sclerosis of the bony wall of the involved sinus is common and observed in about 60 % of the cases. ^{4,15} As a matter of fact the association of radiodense bodies or calcifications with sclerosis of the bony wall of an opacified sinus, although not pathognomonic, strongly suggests the diagnosis of a fungal ball. ^{4,15} Central areas of hyperattenuation within the fungal ball correspond to fungal debris or hyphae and calcifications. ^{4,15} Sclerosis or bony thickening of the sinus wall is commonly seen & bony erosion of the sinus wall may occur. ^{4,15} However, here is minimal or no sinus expansion. ^{4,15} Clinicopathological criteria for the diagnosis of paranasal fungus ball include: (a) radiological evidence of sinus opacification with or without calcifications (b) mucopurulent cheesy or clay like materials within the sinus (c) dense conglomeration of hyphae (fungus ball) separate from the sinus mucosa. (d) non specific chronic inflammation (lymphocytes, plasma cells eosinophils) of the mucosa. (e) no predominance of eosinophils, no granuloma, no allergic mucin (f) no histological evidence of fungal invasion of mucosa, blood vessel or bone visualized microscopically after special stains for fungus.¹

The goal of treatment for a fungus ball is surgical removal of the hyphal mass with re-establishing the drainage from the affected sinus.^{3,16} Endoscopic sinus surgery is always indicated in symptomatic patients with CT of paranasal sinus showing opacification of the sinus and bone erosion.^{3,16} If bronchial asthma is present in a patient with a fungus ball, the endoscopic surgery is a definite indication to prevent exacerbation of asthmatic attacks due to the fungal antigen.^{3,16}

Endoscopic sinus surgery to remove the fungus ball is a treatment of choice today as it gives an absolute cure to the individual.^{3,16} Irrigation of the sinus is performed to clear the sinus of all the fungal debris.^{3,16} The maxillary sinus is cleared by widening the natural ostium (middle meatus antrostomy) and a canine puncture will help in visualizing the entire sinus cavity as well as serve the purpose of irrigation. ^{3,16} Sphenoid sinus fungus balls are also approached endoscopically by widening the natural ostium.^{3,16} The sinus is irrigated to remove old debris thus preventing damage to the important structures.^{3,16} Patients with sphenoid sinus fungus balls are at a risk of life threatening complications if there is a bony dehiscence of the lateral sphenoid wall (as seen in 8 % individuals) or if seeding occurs during aggressive endoscopic removal since the sphenoid sinus is surrounded by important intracranial structures (cavernous sinus, carotid artery etc). ^{3,7} In patients who demonstrate bony lateral sphenoid dehiscence radiologically pre-operatively, we start systemic antifungal agents such as oral itraconazole 200 mg twice daily prior to surgery and continue it for 4 weeks post operatively till healing is complete ^{3, 16}

Endoscopic sinus surgery to remove the fungus ball is a treatment of choice today as it gives an absolute cure to the individual.^{3,16} Irrigation of the sinus is performed to clear the sinus of all the fungal debris.^{3,16} The maxillary sinus is cleared by widening the natural ostium (middle meatus antrostomy) and a canine puncture will help in visualizing the entire sinus cavity as well as serve the purpose of irrigation.^{3,16} Sphenoid sinus fungus balls are also approached endoscopically by widening the natural ostium.^{3,16} The sinus is irrigated to remove old debris thus preventing damage to the important structures.^{3,16}

Patients with sphenoid sinus fungus balls are at a risk of life threatening complications if there is a bony dehiscence of the lateral sphenoid wall (as seen in 8 % individuals) or if seeding occurs during aggressive endoscopic removal since the sphenoid sinus is surrounded by important intracranial structures (cavernous sinus, carotid artery etc).^{3,7} In patients who demonstrate bony lateral sphenoid dehiscence radiologically preoperatively, we start systemic antifungal agents such as oral itraconazole 200 mg twice daily prior to surgery and continue it for 4 weeks post operatively till healing is complete.^{3,16} Frontal sinus fungal balls are rare.^{3,16} Endoscopic clearance of the sinus with ostium dilatation and irrigation of the sinus is the treatment of choice.^{2,3} Also Caldwell-luc puncture of the maxillary sinus anterior table is an alternate method of sinus irrigation.³

Regular follow up is important as many of these recurrences can be addressed with simple irrigation or suctioning in the outpatient department or conservative endoscopic surgeries.³ In two different studies recurrence rate of 4% and 7% have been reported over a 2 year follow up period.³ Surgical treatment most often results in definitive cure.³ Persistent disease is most likely to occur in cases of major inflammatory reaction surrounding the fungus ball thus preventing adequate removal of fungal debris.³ Recurrent or persistent disease is most often detected during investigations for persistent or recurrent symptoms such as postnasal discharge and is most often diagnosed in the first 2 -4 years after surgery.^{2,3} 50% of these cases a closure of the sinusotomy is observed.^{2,3}

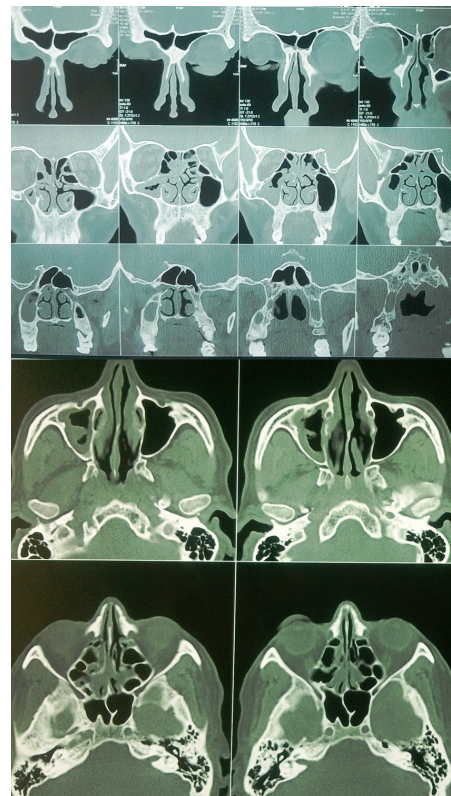
Resolution can usually be achieved with a minimally invasive surgical procedure (reopening of the sinusotomy, suctioning and washing of the fungal debris).^{2,3} Other authors propose a Caldwell luc approach for recurrence of a maxillary fungus ball.^{2,3} Follow up should be both clinically and endoscopically as most patients with persistent or recurrent disease have symptoms or abnormal findings on nasal endoscopy.^{2,3} The patency of the middle antrostomy as well as the maxillary sinus cavity and mucosal lining can be visualized using rigid angulated telescopes or the flexible fibre optic endoscope.^{2,3} In more than 86 % of the patients treated the mucosa of the involved sinus returned to normal and in a minority endoscopic signs of inflammation or edema remained.^{2,3} Imaging studies should not routinely be performed during follow up as they provide less information than nasal endoscopy.^{2,3}

Complications are occasionally seen in untreated paranasal sinus fungal ball.¹⁷ The most frequent is recurrent bacterial sinusitis, which may be explained by the fungal debris acting as a foreign body.¹⁷ Mucoceles, pyoceles and neurological complications like optic neuritis, ophthalmoplegia & seizures are all rare complications reported.¹ Fungal ball which is a non invasive fungal colonization may turn invasive fungal infection if immunodeficiency develops in the patient.^{16,18}

Fungal ball progression to invasive fungal disease in immunocompetent patients is rarely seen.¹⁹ Complications rates of the surgical treatment fungal ball are the same as those described in ESS for other diseases.^{2,3} Minor transitory tooth ache and postnasal drip is often reported in postoperative patients but most of the patients recover completely in 1 year time.^{3,20} The diagnosis of fungus ball should be considered in any case of recurrent or refractory sinusitis, especially when unilateral.^{3,20} The presence on the CT imaging of an opacified sinus with central metal dense spots, in the absence of previous history of foreign body, strongly suggests the diagnosis.^{3,20} Definitive diagnosis, however, is based chiefly on the characteristic macroscopic image and histopathology, as cultures are frequently negative.^{2,3}

Conclusion:

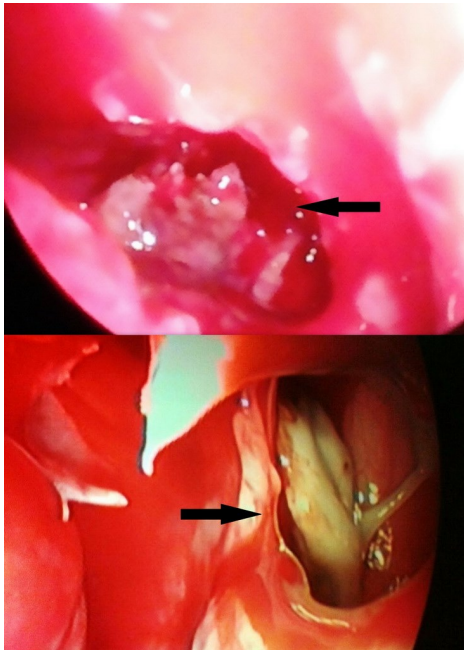
Fungus ball should be suspected in resistant or recurrent unilateral sinusitis. CT scan is the imaging procedure of choice with typical although not pathognomonic findings include heterogeneous opacification of sinus, usually the maxillary sinus associated with hyperdense foci and less frequently sclerosis of the sinus bony frame. Endoscopic sinus surgery is now a days the treatment of choice allowing excellent results with limited morbidity negating the need of local or systemic anti-fungal therapy in earlier cases. Close follow up is mandatory in immunodepressed patients.



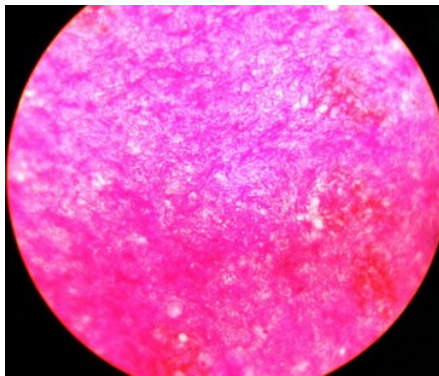
CT scans showing heterogenous shadows with irregular opacities in the right maxillary sinus.



:CT scan showing irregular heterogenous opacities in the left maxillary sinuses



Fungal debris seen in the maxillary sinuses



Aspergillus flavus isolate seen on microscopy

References:

1. Deshazo rd, o'brien m, chapin k, soto-aguilar m, swain r, brayar wc, alsip s 1997 criteria for the diagnosis of sinus mycetoma. J allergy clin immunol 99:475-485
2. Ferreiro ja, carlson ba, carlson ba, thane cody iii d (1997) paranasal sinus fungus ball. Head neck 1997:481-485.
3. Klossek jm, serrano e, peloquin l, et al. Functional endoscopic sinus surgery & 109 mycetomas of the paranasal sinuses. Laryngoscope 1997; 107:112-17
4. Dhong hj, jung jy, park jh (2000) diagnostic accuracy in sinus fungus balls: ct scan and operative findings. Am j rhinol 14:227-231
5. Ferguson bj. Fungus balls of the paranasal sinuses. Otolaryngol clin north am 2000;33:389-98
6. Walsh tj, dixon dm. Spectrum of mycoses, in baron s (ed): medical microbiology (3rd ed). New york, churchill livingstone 1991;75:951-57
7. Piero nicolai, davide lombardi, tomenzoli et al. Fungus ball of the paranasal sinuses: experience in 160 patients treated with endoscopic surgery: laryngoscope, 2009.
8. Mahgoud es (2000) agents of mycetoma. In: mandell, douglas, and bennett's principles and practice of infectious diseases, 5th edn. Churchill livingstone, philadelphia, pp 2702-2706

9. Gungor a, adusumilli v corey jp. Fungal sinusitis: progression of disease in immunosuppression: a case report. *Ear nose throat j* 1998; 77:207-15
10. Eloy p, bertrand b, rombeaux p, et al. Mycotic sinusitis. *Acta otorhinolarygol belg* 1997;51:339-52
11. Brandwein m. Histopathology of sinonasal fungus disease. *Otolaryngol clin north am* 1993;26:949-81.
12. Barry b, topeza m, gehanno p(2002) aspergillosis of the paranasal sinus and environmental factors. *Ann otolaryngol chir cervicofac* 119:170-173
13. Ting –kuang chao (2004) triple discrete fungus balls of the paranasal sinuses. *Otolaryngol head neck surgery* 131:1014-1015.
14. Dufour x, kauvmann- lacroix c, ferrie jc, klossek jm, rodier mh, karkas a, klossek jm (2005) paranasal sinus fungus ball and surgery: a review of 175 cases *rhinology* 43:34-39.
15. Som pm, dillon wp, curtin hd, fullerton gd, lidov m (1990) hypointense paranasal sinus foci. Differential diagnosis with mr imaging and relation to ct findings. *Radiology* 176:777-781.
16. Simmen d, briner hr, schar g, schuhkecht b (1998) chronische mykosen der nasennebenhohlen - stellenwert der endonasalen nasennebenhohlenchirurgie. *Laryngorhinootology* 77:445-453.
17. Swoboda h, ullrich r (1992) aspergilloma in the frontal sinus expanding into the orbit. *J clin pathology* 45:629-630.
18. Muller t, wolf sr, velten i (2001) beidseitiger, progredienter, visusverlust. *Hno* 49:406-407
19. Thiagalingam s, fernando gt, tan k, o'donnell ba, weeks k, branley m 2004 orbital aoe syndrome secondary to pseudallescheria boydii fungal sinusitis in an immunocompetent patient. *Clin exp ophtalmo* 32:545-547.
20. Senocak d, kaur a (2004) what's in a fungus ball? Report of a case with submucosal invasion and tissue eosinophilia. *Ear nose throat j* 83:696-698.