

# Classification of Fungal Sinusitis

Gauri Mankekar

The classification of fungal sinusitis has gradually evolved over the past several decades. Classification is essential to choose appropriate management strategies as well as to predict prognosis. The first distinction between invasive and noninvasive sinusitis was made by Hora [1] in 1965 on the basis of clinical findings. Chronic granulomatous sinusitis was first described in Sudan in 1967, and subsequent cases were reported from Pakistan, India, and also from the USA [2–4]. In 1976, Safirstein [5] reported a combination of nasal polyposis, crusting, and *Aspergillus* species in sinus cultures similar to those seen in allergic bronchopulmonary aspergillosis (ABPA). In 1980, McGill [6] et al. reported a fulminant form of fungal rhinosinusitis with a malignant course in immunocompromised patients. Also, in 1980, Talbot et al. [7] presented a classification of invasive fungal sinusitis as (1) fulminant aspergillosis, (2) rhinocerebral mucormycosis, and (3) aspergilloma. In 1988, invasive sinusitis was classified as acute invasive and chronic invasive in a review of chronic sinusitis in normal hosts [4]. Meanwhile, several clinicians, individually [8–12] recognized cases of chronic rhinosinusitis associated with a mucosal plug in sinuses of patients with ABPA, and this led to the renaming of this type of fungal rhinosinusitis as allergic fungal sinusitis or rhinosinusitis (AFS or AFRS). Ponikau et al. [13] have proposed the term “eosinophilic fungal rhinosinusitis” to reflect the important feature “eosinophils.”

In 1997, DeShazo et al. [14], proposed diagnostic criteria and classification for invasive fungal sinusitis and in subsequent publications [15, 16], proposed two types of non-invasive fungal sinusitis: allergic fungal sinusitis and sinus mycetoma or fungal ball and three types of invasive fungal sinusitis:

1. Acute fulminant
2. Chronic invasive
3. Chronic granulomatous invasive

---

G. Mankekar, MS, DNB, PhD  
ENT, PD Hinduja Hospital, Mahim, Mumbai,  
Maharashtra 400 016, India  
e-mail: gaurimankekar@gmail.com

The diagnostic criterion for invasive fungal sinusitis was based on histopathological evidence of hyphal forms within the sinus mucosa, submucosa, blood vessels, or bone. On the other hand, in mucosa of patients with chronic bacterial sinusitis or in patients of allergic fungal sinusitis and mycetoma, there is absence of stainable hyphae [16].

Invasive fungal sinusitis is defined as acute when the duration is less than 4 weeks, while disease of more than 4 weeks duration is said to be chronic [17].

## **Acute Fulminant Invasive Fungal Sinusitis**

Acute fulminant invasive fungal sinusitis is a rapidly progressing invasive disease usually seen in immunocompromised patients [16]. The disease can have a rapid downhill course over few days to weeks. Rapid spread of the infection occurs as a result of vascular invasion by the fungus, leading to vascular thrombosis and tissue infarction.

## **Chronic Invasive Fungal Sinusitis**

Chronic invasive fungal sinusitis is a relatively rare type of invasive fungal sinusitis seen usually in diabetic or immunocompetent patients with disease progression occurring over more than 12 weeks [16].

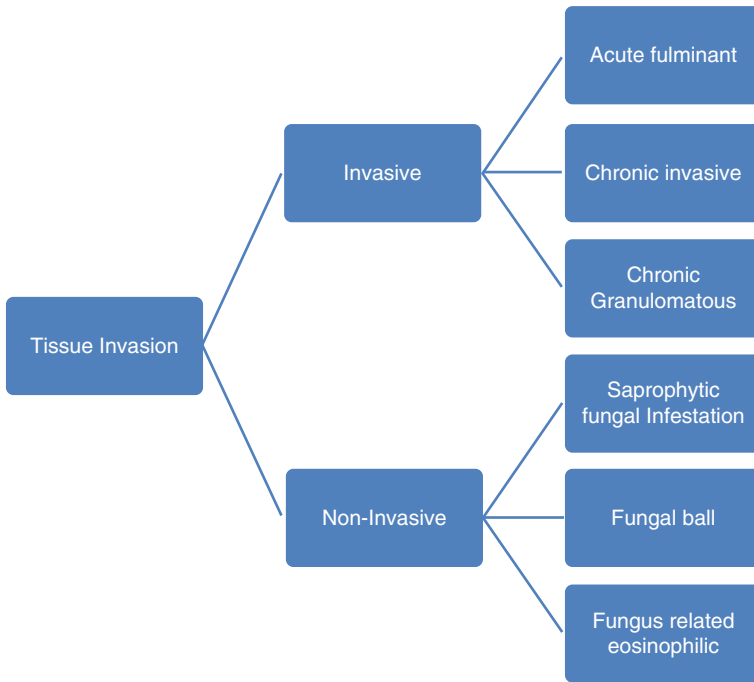
## **Granulomatous Invasive Fungal Sinusitis**

Granulomatous invasive fungal sinusitis also has an indolent course and is usually seen in immunocompetent individuals with patients usually presenting with proptosis. This type of fungal sinusitis has been reported from Sudan, India, and Pakistan [2–4, 16].

The American Academy of Otolaryngology Head and Neck Surgery and other related societies attempted a consensus of definition, classification, and suggested clinical strategies for patients with rhinosinusitis [18].

They divided rhinosinusitis into four categories: acute (bacterial) rhinosinusitis, chronic rhinosinusitis (CRS) without polyps, CRS with polyps, and allergic fungal sinusitis. The spectrum of fungal involvement in CRS was considered from benign colonization to potentially life-threatening invasive disease.

A consensus panel discussed this classification addressing the controversies in 2009 [19]. They recommended that based on histopathological evidence of tissue invasion by fungi, fungal rhinosinusitis be classified as (Fig. 1) invasive and non-invasive diseases. The invasive diseases include (1) acute invasive (fulminant) FRS, (2) chronic invasive FRS, and (3) granulomatous invasive FRS. The noninvasive



**Fig. 1** Classification of fungal sinusitis based on tissue invasion. After Chakrabarti et al. [19]

diseases include (1) saprophytic fungal infestation, (2) fungal ball, and (3) fungus-related eosinophilic FRS that includes AFRS.

*Saprophytic fungal infestation:* This is described as asymptomatic colonization of mucous crusts within the sino-nasal cavity, often in patients who have undergone previous sinus surgery. It has been predicted that this growth could lead to the formation of fungal ball [17].

*Fungal ball:* It is described as accumulation of dense conglomeration of fungal hyphae, without invasion, in one sinus cavity, usually the maxillary sinus, although the disease may affect other sinuses or rarely multiple sinuses [20]. It has been designated by various terms such as mycetoma, aspergilloma, and chronic non-invasive granuloma [17].

*Fungus-related eosinophilic FRS that includes AFRS:* The Bent and Kuhn [12] diagnostic criteria to diagnose AFRS are type I hypersensitivity, nasal polyposis, characteristic CT findings, presence of fungi on direct microscopy or culture, and allergic mucin containing fungal elements without tissue invasion. It is believed that eosinophilic rhinosinusitis (EMRS) and AFRS are differing manifestations of the same pathological process, with considerable overlap [19].

Irrespective of the controversy regarding classification of fungal sinusitis, it is extremely important to investigate all patients of chronic rhinosinusitis not

responding to standard therapy and to identify the invasive versus the noninvasive form (allergic fungal sinusitis, fungal mycetoma). Aggressive surgery and antifungal treatment is required in the invasive forms while surgery alone may suffice in the non-invasive forms [21].

## References

1. Hora JF. Primary aspergillosis of the paranasal sinuses and associated areas. *Laryngoscope*. 1965;75:768–73.
2. Chakrabarti A, Sharma SC, Chander J. Epidemiology and pathogenesis of paranasal sinus mycoses. *Otolaryngol Head Neck Surg*. 1992;107:745–50.
3. Hussain S, Salahuddin N, Ahmad I, Jooma R. Rhinocerebral invasive mycosis: occurrence in immunocompetent individuals. *Eur J Radiol*. 1995;20:151–5.
4. Washburn RG, Kennedy DW, Begley MG, Henderson DK, Bennett JE. Chronic fungal sinusitis in apparently normal hosts. *Medicine*. 1988;67:231–47.
5. Safirstein B. Allergic bronchopulmonary aspergillosis with obstruction of the upper respiratory tract. *Chest*. 1976;70:788–90.
6. McGill TJ, Simpson G, Healy GB. Fulminant aspergillosis of the nose and paranasal sinuses: a new clinical entity. *Laryngoscope*. 1980;90:748–54.
7. Talbot GH, Huang A, Provencher M. Invasive aspergillus rhinosinusitis in patients with acute leukemia. *Rev Infect Dis*. 1991;13:219–32.
8. Millar JN, Johnston A, Lamb D. Allergic aspergillosis of the maxillary sinuses. *Thorax*. 1981;36:710.
9. Katzenstein AA, Sole SR, Greenberger PA. Allergic aspergillus sinusitis: a newly recognized form of sinusitis. *J Allergy Clin Immunol*. 1983;72:82–93.
10. Allphin AL, Strauss M, Abdul Karim FW. Allergic fungal sinusitis: problems in diagnosis and treatment. *Laryngoscope*. 1991;101:815–20.
11. Manning SC, Schaefer SD, Close LG, Vuitch F. Culture positive allergic fungal sinusitis. *Arch Otolaryngol*. 1991;117:174–8.
12. Bent JP, Kuhn FA. Diagnosis of allergic fungal sinusitis. *Otolaryngol Head Neck Surg*. 1994;111:580–8.
13. Ponikau JU, Sherris DA, Kern EB, et al. The diagnosis and incidence of allergic fungal sinusitis. *Mayo Clin Proc*. 1999;74:877–84.
14. deShazo RD, O'Brien M, Chapin K, Sato-Aguilar M, Gardner L, Swain RE. A new classification and diagnostic criteria for invasive fungal sinusitis. *Arch Otolaryngol Head Neck Surgery*. 1997;123:1181–8.
15. deShazo RD, Swain RE. Diagnostic criteria for allergic fungal sinusitis. *J Allergy Clin Immunol*. 1995;96:24–35.
16. deShazo RD, O'Brien M, Chapin K. Criteria for the diagnosis of sinus mycetoma. *J Allergy Clin Immunol*. 1997;99:475–85.
17. Ferguson BJ. Definitions of fungal rhinosinusitis. *Otolaryngol Clin North Am*. 2000;33(2):227–35.
18. Meltzer E, Hamilos D, Hadley J, et al. Rhinosinusitis: establishing definitions for clinical research and patient care. *J Allergy Clin Immunol*. 2004;114(Suppl):S155–22.
19. Chakrabarti A, Denning DW, Ferguson B, et al. Fungal rhinosinusitis: a categorization and definitional schema addressing current controversies. *Laryngoscope*. 2009;119(9):1809–18.
20. Grosjean P, Weber R. Fungus balls of the paranasal sinuses: a review. *Eur Arch Otorhinolaryngol*. 2007;264:461–70.
21. Chakrabarti A, Das A, Panda NK. Overview of fungal sinusitis- guest editorial. *Indian J Otolaryngol Head Neck Surg*. 2004;56(4):251–8.