



Clinical pattern of fungal balls in the paranasal sinuses: our experience with 70 patients

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Received: 13 May 2018 / Accepted: 17 December 2018 / Published online: 3 January 2019
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Abstract

Purpose Many physicians recommend endoscopic sinus surgery (ESS) even when an asymptomatic paranasal sinus (PNS) fungal ball is detected incidentally. The aim of this study was to investigate the natural behavior of PNS fungal balls via sinus imaging techniques.

Methods A follow-up study of 74 pathologically confirmed fungus balls was conducted in 70 patients who underwent multiple head and neck computed tomography (CT) scans or magnetic resonance imaging (MRI). We investigated the changes in symptoms and lesion size, as well as any new occurrences.

Results Of the 74 fungus balls detected in 70 patients, we observed the renewed formation of a fungal ball in 21 patients, which was not present on initial imaging conducted over a period of 2–162 months. The fungal ball was already present in 53 patients on the initial screening, and the longest follow-up was 197 months (range 1–197 months). Of these 53 lesions, 29 lesions showed an increase in size (29/53, 54.7%), whereas 12 lesions were not associated with any clinical symptoms (12/53, 22.6%). In the 21 newly formed fungal balls, further development was observed in 10 lesions, with 4 lesions showing an increase in size. Thus, size increment occurred in 33 of the 57 fungus balls.

Conclusions The fungal balls can exist without local tissue invasion for up to 17 years and new formation of the fungal balls was observed even within 2 months, especially when accompanied by initial clinical symptoms of sinusitis.

Keywords Fungal ball · Fungal sinusitis · Clinical course · Treatment plan

Introduction

Fungal balls are chronic non-invasive accumulations of fungal hyphae in the paranasal sinus (PNS) of immunocompetent patients. They are predominantly caused by *Aspergillus* species [1, 2]. Clinical presentations of fungal balls are non-specific, with various rhinologic symptoms such as nasal obstruction, purulent rhinorrhea, facial pain, chronic cough, and foul odor and many patients do not present with

symptoms [1, 3]. Therefore, the diagnosis of fungal balls is difficult and physicians occasionally make incidental identifications using computed tomography (CT) or magnetic resonance imaging (MRI). Scoring of T1/T2 weighted MRI images showed low and very low signals, respectively, although the signal can be heterogeneous depending on the contents [4, 5]. Fungal balls may be suspected if CT scans reveal focal hyperattenuated lesions of variable sizes in the isolated PNS. The diagnostic values of these CT findings for sensitivity and specificity were 62% and 99%, respectively [6]. Among the four PNSs, the maxillary sinus is the most commonly affected site followed by the sphenoid sinus [5].

Treatment of fungal balls involves the endoscopic opening of the affected sinus and removal of all the fungal material. Nicolai et al. reported the complete removal of fungal debris through endoscopic sinus surgery (ESS), with no recurrence [7]. Many physicians recommend the ESS when the fungal sinus ball is found incidentally on image taken for another purpose, due to the aggravation of the lesion.

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However, literature supporting this clinical judgment cannot be found. Furthermore, according to the diagnostic criteria, even if the inflammation of PNS is detected on the CT or MRI images, it is not diagnosed as chronic paranasal sinusitis unless symptoms are observed [8]. In this report, we investigated the clinical pattern of fungal balls in the paranasal sinus by a retrospective review of medical records.

Materials and methods

From November 1994 to December 2017, 1152 patients were treated for fungal sinusitis at our institution. A retrospective review of their medical records was performed in this study. Pathologic confirmation of the condition was performed following ESS in all cases. Among the 1152 patients, we only included those who had undergone repeated head and neck CT scans or MRIs before their surgeries. Initial imaging was typically performed for other head and neck symptoms, followed by treatment after incidental discovery of a fungal ball. The last image is typically taken for treatment purposes. While radiologists might have overlooked the initial lesions in the case of incidentally identified fungal sinusitis, if we detected the lesion on CT, surgery was recommended to all patients. Finally, we conducted a retrospective study of 74 lesions in 70 patients with fungal balls in their PNSs. We investigated the change in size and new occurrence of fungal balls and accompanying symptoms. The change of fungal balls was analyzed by combining coronal, axial, and sagittal cuts of CT or MRI scans. The types of changes of fungal balls were classified into three categories as follows: (1) no evidence of disease initially and new formation of a fungal ball in another image (Fig. 1a). (2) Non-fungal sinusitis initially and new formation of a fungal ball in another image (Fig. 1b). (3) Fungal ball as observed on an initial image (Fig. 1c). The accompanying symptom was assessed based on medical records and endoscopic findings at the initial visit to our departmental clinic. This study protocol was reviewed and approved by the Institutional Ethics Committee at the Samsung Medical Center (IRB number: SMC 2017-11-049).

Results

The baseline characteristics of all the study subjects are shown in Table 1. The mean age at diagnosis of the patients was 61.16 (range 31–86) and the study population was predominantly female (49/74, 66.2%). The mean follow-up period for all patients was 60.69 months (range 0.5–198 months). Fifty-nine lesions with fungal balls were found in the maxillary sinus, 14 lesions were found in the sphenoid sinus, and one lesion was found in the left frontal sinus. Of

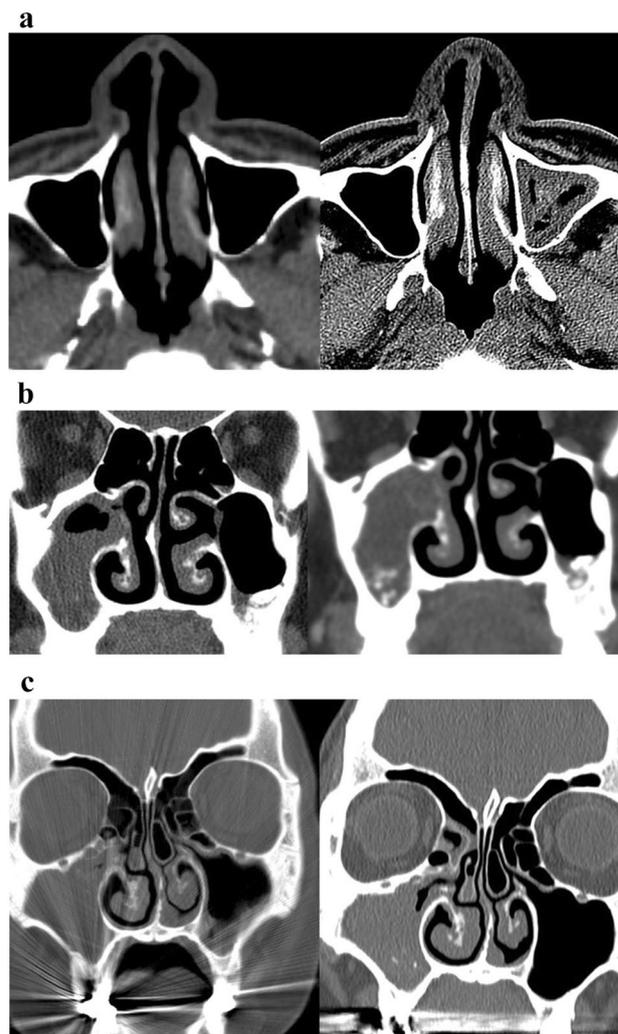


Fig. 1 Initial and follow-up images of fungal sinusitis. **a** This patient showed no initial evidence of disease (left side) and a new formation of fungal ball in the follow-up image (right side). **b** This patient showed non-fungal sinusitis initially (left side) and new formation of fungal ball in the follow-up image (right side). **c** Fungal ball as observed at initial and follow-up images did not show any change of the lesion (left side)

the 59 lesions with maxillary sinus fungal balls, the lesions were on the left side in 29 patients, on the right side in 28 patients, and one patient had fungal balls on both sides. In 14 patients with sphenoid sinus fungal balls, nine patients had fungal balls on the right side and five patients had fungal balls on the left side.

The clinical patterns of fungal balls are shown in Table 2. In the 74 lesions with fungal balls, we observed new formations of the fungal balls in 15 lesions that did not present at initial examinations. It was observed that the new formation of fungal balls occurred within 27 months (range 27–162 months). Among these 15 lesions, five (33.3%) were not accompanied by clinical symptoms. We observed

Table 1 Baseline characteristics of study subjects

Variables	Values
Age (range, year-old)	61.16 ± 12.23 (31–86)
Gender (female)	49 (66.2%)
Mean follow-up duration (range, months)	60.69 ± 55.43 (0.5–198)
Location of fungal ball	
Maxillary sinus	
Right	28
Left	29
Both	1
Ethmoid sinus	
Right	0
Left	0
Both	0
Sphenoid sinus	
Right	9
Left	5
Both	0
Frontal sinus	
Right	0
Left	1
Both	0

Demographic characteristics are presented as mean ± SD or as numbers and percentages

six lesions with the new formation of the fungal ball that only manifested as non-fungal sinusitis at initial examination. This change was observed in the period ranging from 2 to 120 months. Among the six lesions with mild initial sinusitis, four lesions (66.6%) were accompanied with no symptoms. The fungal ball was observed in 53 lesions upon initial examination, and the longest follow-up period was 197 months (range 1–197 months). In these 53 lesions, size increments were observed in the case of 29 (29/53, 54.7%) lesions, and no symptoms were observed in 12 lesion cases (12/53, 22.6%) were not accompanied with any symptoms. Of the 21 lesions associated with new formation of fungal balls, further follow-up images were taken for ten lesions over the course of 5 to 90 months. We noted size increments

in the case of four lesions. Overall, our final analysis showed size increments in 33 of the 57 lesions (33/57, 57.9%). We also observed that, of the 70 patients with a fungal ball in the PNS, 21 showed no symptoms (21/70, 30%) at the time of surgery.

Discussion

To the best of our knowledge, this study represents the first evaluation of the natural course of paranasal sinus fungal balls with multiple serial head and neck images. We investigated the natural course and clinical features of fungal balls with repeated radiographic evaluations. In cases where a fungal ball was found at the initial examination, we found an increase in size in about two-thirds of the lesions and confirmed that the size increment was present within five months. Furthermore, although we could not confirm the exact timing of the occurrence of a fungal ball, our study showed the rapid formation of a fungal ball within two months in cases with initially only sinusitis. Ponikau et al. reported that fungi have been cultured in more than 95% of patients with chronic sinusitis [9]. Therefore, the formation of a fungal ball may be considered to be faster in the case of sinusitis identified at the initial exam than in the absence of sinusitis.

Based on the above-mentioned results, we consider that most of the fungal balls progressed and, in some cases, a rapid progression of lesions was observed. However, no case of local invasion was observed during the follow-up period of more than 17 years in this study. Therefore, it is difficult to offer a definitive answer about whether an operation should be performed when a fungal ball is observed. However, a sphenoid sinus fungal ball located adjacent to the cavernous sinus may cause problems without local invasion findings, because of the impact on nearby structures. Leroux et al. reported that, even in the case of non-invasive fungal balls, sphenoid sinus lesion did lead to recurrent central nervous system complications in several patients [10]. Therefore, the need for an immediate operation to excise a fungal ball located in the sphenoid sinus should not be

Table 2 Clinical pattern of fungal balls

Variables	Fungal ball (+) at initial image (n = 53)		Fungal ball (–) at initial image (n = 21)	
	Size increment of the lesion (n = 29)	No change of the lesion (n = 24)	New formation of the fungal ball	
			No lesion at initial image (n = 15)	Mild sinusitis at initial image (n = 6)
Symptom (+)	21	20	10	2
Symptom (–)	8	4	5	4
Follow-up duration (range, months)	1–182	1–197	27–162	2–120

questioned. However, in the case of a fungal ball located in the maxillary sinus without any symptom (in our 13 in 74 cases), whether it is essential to immediately perform surgery is controversial. Although Nicolai et al. [7] suggested that ESS is a safe and effective treatment modality for fungal ball removal, all surgeries are associated with risks for complications. As for all surgeries, patients who are candidates for ESS receive local or general anesthesia tailored to their general health and individual characteristics. In our study population, the mean age of the initial diagnosis was greater than 60. We should consider the side effects of anesthesia such as cognitive dysfunction and cardiopulmonary dysfunction in the elderly [11, 12]. Although the possibility of the natural disappearance of the fungus ball is not known, careful observation of the fungal ball lesion located in the maxillary sinus may be possible in asymptomatic immunocompetent patients.

We also consider treatment of fungal balls in immunocompromised hosts such as patients with uncontrolled diabetes mellitus (DM), individuals with several diseases affecting individual neutropenic status, and individuals known to have used steroids for a long time. Although no reports can be found on the observation of sinonasal fungal balls in an immunocompromised host, Akimoto et al. reported a case involving a serial chest radiograph observation of pulmonary *Aspergillus* fungal balls in a patient receiving corticosteroid treatment over 2 months. They reported that pulmonary fungal balls rapidly increased during steroid therapy [13]. Therefore, we suggest that fungal balls in immunocompromised patients should be surgically removed.

This study has several limitations. First, the study design involved a retrospective review of medical records. Although the randomized controlled trial is the most effective method to determine a result, we only performed the retrospective review of the medical record for analysis for ethical issues. Thus, the results of this study are limited since only suggesting an opinion rather than a clinical guideline.

In our cases, an increase in the size of the fungal ball was seen in two-thirds of the lesions of our study group. We suggest that the time of surgery should be determined according to the location, clinical features of symptoms, change of lesion and the immunocompetence of patients. If a fungal ball is suspected, even if no symptoms are observed, we believe that surgery will be necessary in the following situations. (1) Expected immunosuppressive status due to chemotherapy for malignancy or in the case of bone marrow transplantation. (2) Immunocompromised patients such as DM, long-term steroid use or HIV/AIDS cases. (3) Individuals scheduled for dental implantation. (4) Sphenoid sinus lesion. We suggest another option i.e., close follow-up without surgery of the maxillary sinus may be warranted for asymptomatic patients.

In summary, fungal balls can exist without local tissue invasion for up to 17 years and new formation of the fungal ball was observed even within 2 months, especially when accompanied by initial clinical symptoms of sinusitis. The time of surgery should be determined according to the location, clinical features of symptoms, change of lesion and the immunocompetence of the patient.

Compliance with ethical standards

Conflict of interest All authors declare that they have no conflict of interest.

Research involving human participants and/or animals This study protocol was reviewed and approved by the Institutional Ethics Committee at the Samsung Medical Center (IRB number: SMC 2017-11-049).

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