

**REVIEW ARTICLE**

## **Paranasal Sinus Fungus Balls: our Experience of 19 Cases and Review of Literature**

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### **ABSTRACT**

**Introduction:** Fungal sinusitis is a common disease and increasingly getting high incidence. It forms approximately 10 % of the patients requiring surgery for the nose and the sinuses. Fungal sinusitis can be mainly categorized into invasive and non-invasive types.

**Objectives:** Sinus fungus ball is the most common form of fungal sinusitis. The aim of this study is to share our experience on patients diagnosed with fungus ball.

**Materials-Methods:** The epidemiological data, clinical presentations, radiology, mycology and histology results of 19 patients (6 males and 13 females, age between 22 to 67) diagnosed with a fungus ball sinusitis who underwent functional endoscopic sinus surgery at the Department of Otorhinolaryngology, Inonu University Medical Faculty between 2012 and 2016 have been reviewed. All patients underwent preoperative computed tomography and were evaluated with rigid endoscopy. Paranasal CT scan was performed in all patients and various opacities were observed.

**Results:** In 47 % the maxillar sinus (9 patients), in 15 % the ethmoidal cells (3 patients), in 32 % the sphenoid sinus (6 patients) and in 6 % concha bullosa (1 patient) were affected. FESS was performed under general anaesthesia. The diagnosis is based on histological examination of surgically removed material. Surgically removed materials were sent to the bacteriology/mycology laboratory and the histopathology laboratory for fungal cultures and histological examination.

**Conclusion:** By reviewing 19 patients diagnosed with fungus ball after endoscopic surgery during the past 5 years, we report the clinical features along with a literature review.

**Keywords:** Fungus ball, rhinosinusitis, paranasal sinuses.

## INTRODUCTION

A fungus ball (FB) of the paranasal sinuses can be described as a non-invasive fungal rhinosinusitis especially formed in the immunocompetent host. The pathophysiology of fungus ball has not been clarified enough. The overfilling of dental cavities has been asserted as a risk factor in the previous studies. The maxillary and the sphenoid sinuses are the most frequent localizations declared.<sup>1</sup> Fungal rhinosinusitis was reported first in the 1980s. The increased incidence of FB can be attributed to the increase in the use of broad-spectrum antibiotics, metabolic diseases such as diabetes mellitus, chemotherapies for cancer patients and the number of immunocompetent patients due to steroid abuse.<sup>2</sup>

*Aspergillus*, *Alternari*, *Pseudallescheria boydii*, *Bipolaris* and *Rhizopus* are the most commonly accused species for fungal sinusitis. The typical clinical presentations includes nasal

obstruction, purulent nasal discharge, cough, post nasal drip, fetid odor of nose, olfactory dysfunction, headache, facial pain and/or pressure and epistaxis. Approximately ten percent of patients have polyps.<sup>1,3-6</sup>

CT imaging is the gold standard for giving both information on the usual surgical landmarks for an endonasal surgical approach and a extent and nature of the disease. An opacified sinus with central metal dense spots, on the CT imaging firmly supports the diagnosis.<sup>7,8</sup>

We analyzed the epidemiological data of the 19 patients diagnosed with fungus ball confirmed by mycology and/or histological exams. Epidemiological data, clinical presentation, CT scan data, mycological and histological results are discussed. Therefore, by reviewing 19 patients diagnosed with fungus ball after endoscopic surgery during the past 5 years, we report the clinical features along with a literature review.

## MATERIALS AND METHODS

We retrospectively reviewed the clinical records of patients diagnosed with sinus fungus ball who underwent functional endoscopic sinus surgery (FESS) at the Department of Otorhinolaryngology, Inonu University Medical Faculty between 2012 and 2016. Human Ethics Committee approval has not been given for retrospective studies at Inonu University. Due to the retrospective nature of this study, it was granted an exemption in writing by Inonu University Medical Faculty. Medical records of patients were reviewed retrospectively, including the pre-operation clinical symptoms (facial pain /pressure, rhinorrhea, nasal obstruction, hiposmia/cacosmia, postnasal discharge, headache, cough, asymptomatic) past history, laboratory findings, nasal endoscopic findings, computed tomography (CT) scanning, intraoperative findings, pathological examination, location of fungus balls, follow-up time, major

complications. The inclusion criteria were as follows: a) histologically confirmed fungus balls and b) fungus balls found in the paranasal sinuses or nasal cavities.

Paranasal CT scan was performed in all patients and various opacities were observed. The diagnosis is based on histological examination of surgically removed material. Surgically removed materials were sent to the bacteriology/mycology laboratory and the histopathology laboratory for fungal cultures and histological examination. On microbiological evaluation, the samples were cultured on Sabouraud dextrose agar (Plasmatec UK, Bridport UK) with gentamicin and potato dextrose agar (Oxoid England, Hampshire, UK). Plates were incubated at 30<sup>0</sup> C temperature.

All patients underwent preoperative computed tomography and were evaluated with rigid endoscopy. FESS was performed under general anaesthesia. For fungus ball of the maxillary sinus, an uncinectomy,

finding and enlargement of maxillary sinus ostium were performed. This is necessary especially in case of a large and well-pneumatized maxillary sinus completely filled with fungal concretions. We used 0°, 45° and 70° endoscopes to verify complete removal of the fungal ball. For the sphenoid and ethmoid localizations, we performed endonasal sphenoidotomy and partial or complete ethmoidectomy respectively. And in one patient, fungus ball was located in concha bullosa (CB). The FB was removed completely after resection of the lateral and inferior wall of the CB. A sample of mucosa of the involved sinus was sent for pathological examination.

Patients were treated with broad spectrum systemic antibiotics for 7 days as a prophylaxis for postoperative infection. Nasal irrigations with saline solution were recommended for at least 3 weeks. An

antimycotic treatment was not conducted. The follow up period after surgery ranged from 6 to 42 months, with an average of 28 months. All patients were followed with endoscopic control.

## RESULTS

We included 19 patients (6 males and 13 females, age between 22 to 67) diagnosed with a fungus ball sinusitis who underwent functional endoscopic sinus surgery at the Department of Otorhinolaryngology, Inonu University Medical Faculty between 2012 and 2016. The average age was 41.7 years, ranging from 22 to 67 years. There were 6 males (31%), and 13 (69%) females. The gender, age, and clinical symptoms reported by patients were presented in Table 1

Gender	Number	Age Range/Mean Age	Affected Side	
			Right	Left
Male	6 (31%)	28-52/39	2	4
Female	13 (69%)	22-67/43	6	7
Total	19 (100%)	22-67/41,7	8 (42%)	11 (58%)

Table 1. Characteristic of patients

In 47 % the maxillar sinus (9 patients), in 15 % the ethmoidal cells (3 patients), in 32 % the sphenoid sinus (6 patients) and in 6 % concha bullosa (1 patient) were affected. All patients had a unilateral involvement. 11 patients (58 %),

suffered from left side, 8 patients (42 %), from right side. The maxillary sinus alone was the most commonly involved sinus by fungus ball 47 %. The distribution of fungus balls within paranasal sinuses among the 19 patients were presented in Table 2.

Table 2. Paranasal Sinus Localizations of Fungus Ball

Localizations	Number %
Maxillary Sinus	9 (47%)
Sphenoidal Sinus	6 (32%)
Ethmoidal Sinus	3 (15%)
Concha Bullosa	1 (6%)
Total	19 (100%)

Symptoms were different according to the paranasal sinus involved. The most frequent maxillary fungus ball clinical manifestations was facial pain followed by rhinorrhea, nasal obstruction and hiposmia/cacosmia. Sphenoidal localisation was characterised by recurrent retro-orbital pain,

associated to visual disturbances. Headache and nasal obstruction are commonest clinical presentations in the ethmoidal fungus balls. Endodontic treatment with intracanal or dental fillings was found in 3 (15 %) out of 19 patients. Complaints reported by the patients were presented in Table 3.

Table 3. Complaints Reported by the Patients

Complaint	Number %
Facial pain/pressure	14 (70 %)
Rhinorrhea	13 (68%)
Nasal obstruction	12 (63 %)
Hipoosmia/Cacosmia	10 (52 %)
Postnasal discharge	9 (47 %)
Headache	8 (42 %)
Cough	5 (26 %)
Asymptomatic	3 (15 %)

All patients received preoperative oral or topical nasal steroids. The most common presenting symptoms at the initial visit were nasal discharge, nasal obstruction and facial pain. The average follow-up time was 28 months with range from 6 to 42 months. In the follow-up period, we

performed endoscopic examination routinely for postoperative observation in every patient.

Paranasal CT scan was performed in all patients and various opacities were observed. The most common observation was a completely opacified sinus cavity

containing calcification or metallic densities surrounded by spiculated or linear microcalcifications. Evidence of bone erosion or remodelling was present in 5 (26% ) patients. Histopathologically, a dense concrement of fungal hyphae without mucosal, vessel or osseous infiltration was apparent in all cases. Histological examination of the specimens demonstrated a large amount of fungal hyphae in all cases. In only 5 cases (26%) fungal growth could be verified by microbiologic culture. In four of the positive cultures *Aspergillus fumigatus* and in one culture *Aureobasidium* species were diagnosed. There was no mucormycosis.

All of the patients underwent functional endoscopic sinus surgery. The aim of surgery was to completely remove the bulks of fungus and detritus and to ensure the drainage and ventilation of the affected paranasal sinuses. No recurrence was observed in follow-up period. No patient needed further sinus surgery.

## DISCUSSION

Fungal sinusitis is a frequent disease and increasingly getting high incidence. It forms about 10 % of the patients requiring surgery for the nose and the sinuses. Fungal sinusitis can be mainly classified into invasive and non-invasive types, according to the fungal hyphae existence within the tissues, including mucosa, blood vessels and bone. The invasive type includes; chronic invasive sinusitis, granulomatous invasive sinusitis and acute fulminant (necrotizing) sinusitis, and the non-invasive type consists of allergic fungal sinusitis, fungus ball sinusitis and saprophytic fungal infestation.<sup>9</sup>

Little is known about the pathogenesis of fungus ball. In 1969, Mlosev asserted the aerogenic theory. According to this theory, the inhaled spores of fungus accumulate in the sinus, mainly the ethmoid, becomes pathological if the conditions of the sinuses turn into anaerobic.

Another theory put forwarded that; functional obstruction of sinus ostium, can play as a negative factor, and the fungal growth may induces hypoxia and/or anaerobic conditions. By the decreased ventilation, the pH decreases and this induces growth of fungal hyphae. Bacterial or viral superinfections may exacerbate the conditions. In 1986, Beck. Mannogetta reported the negative effect of dental amalgam from tooth apex together with the anaerobic habitat of the sinus. According to this theory this condition may promote the growth of fungal elements.<sup>10,11</sup> The permeation of dental sealers containing zinc oxide into the maxillary sinus was reported by some authors.<sup>10,12-14</sup> This was accepted as a significant factor in inducing inflammatory and necrotic circumstances of the mucosa which promote fungus proliferation. Also sinus perforation, especially during endodontic treatment may be responsible for the passage of inhaled spores.<sup>10</sup> In this study

such endodontic treatment was present in only 3 of 19 cases.

Fungal sinusitis is prevalent among middle-aged and elder females.<sup>7</sup> The age of patients in our study ranged from 22 to 67 years, with the youngest case being a 22 year-old lady. Female predominance has been consistent (69%). The high prevalence of female cases can be explained by the reason that fungus ball are met more frequent in older population and older women outnumber older men.<sup>2,3,15,16</sup> Kim was reported that the most affected age group was 50-60 years in 2005.<sup>1,3,16</sup> In our study the mean age was 41.7. Ferguson attributed the female predominance to the longer life expectancy of women in Western populations.

Insufficient mucociliary transport is another subject among ageing population. By aging, insufficient mucociliary transport within the sinus causes decreased drainage of discharge, that favor the fungus ball formation. Maxillary sinus is the most

affected sinus ( 89 %) and sphenoid sinus (10 %) , which are highly affected by gravity. (Figure 1-2).<sup>2</sup> Similar to the

literature, maxillary sinus was the most affected sinus in our study (47 %) (9/19).



Figure 1. Computed tomographic scan. Coronal view showing a heterogeneous opacity with metal dense foreign body of the right maxillary sinus cavity.



Figure 2. Computed tomographic scan. Coronal view showing a heterogeneous opacity with metal dense foreign body of the left maxillary sinus cavity.

Fungus balls have never been reported in children before puberty.<sup>1</sup> Hormonal factors may be responsible for the female predominance.<sup>1,10,17</sup> Dufour et al. declared an indirect hormonal influence on the FB formation, that could explain absence of FB in children before puberty. In the present series, there were no patients under the age of 19. Endodontal treatments are rare in young population and FB frequency may be lower for this factor<sup>10,18</sup> FB frequently includes only one sinus, most frequently the

maxillary sinus, followed by sphenoid, ethmoid, and frontal sinus.<sup>1,5,10,18,19</sup>

In our study, the maxillary sinus was also the most frequent localization, with 9 patients (47%), sphenoid sinus was the second frequent localization with 6 patient (32%), ethmoid sinus was third with 3 patients and a rare localization in concha bullosa (CB) with 1 patient (6%). Fungal ball in CB was reported in only a few cases previously in the literature.<sup>8,20</sup>

In our study FB was located in CB, in one patient, a 22 year-old woman (figure 3). Little is known about the middle concha FB. In a similar way, mentioned before; the ostial closure of mucociliary transport system of CB due to inflammation provides

an anaerobic habitat for FB. This can cause a destruction in the conchal wall. The conchal wall destruction may facilitate the fungal spores trapping, and maintains anaerobic environment for the FB formation in the CB cavity.<sup>20</sup>

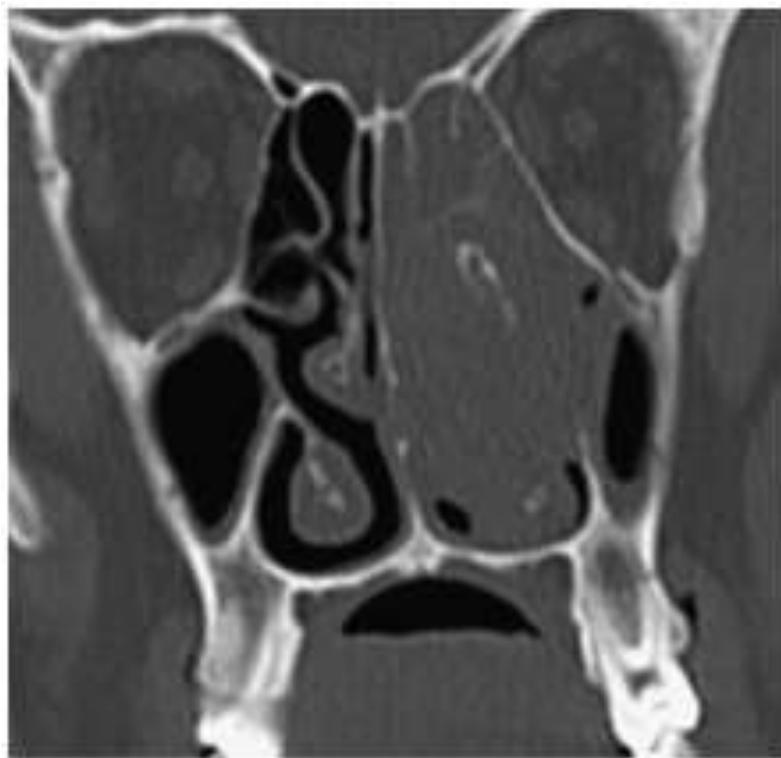


Figure 3. Computed tomographic scan. Minimal calcifications, no bone erosion sign, and soft tissue density in the concha bullosa on CT.

FB frequently develop slowly and can remain asymptomatic for a long time. For this reason the diagnosis may be delayed. Headache, facial pain, postnasal

drip, with or without nocturnal cough, and anosmia are the most frequent symptoms can be seen in FB. The repeated superimposed bacterial infection should be

reminded. The clinical presentation can differ according to the FB localization. For sphenoid fungus ball, headache (characteristically retro-orbital, at the vertex), post-nasal discharge, and cough are the most frequent symptoms. Rarely epistaxis, proptosis, neurological complaints, dysphasia can be seen. In our series, the most frequent symptoms were nasal discharge, nasal obstruction, facial pain, headache, hipoosmia, and cacosmia.

The typical endoscopic appearance, intraoperative examination and the pathohistological or microbiological proof of fungus provides the definitive diagnosis. Characteristical CT or MRI imaging may point out a frequently unilateral, almost complete opacity of the affected sinus, possibly surrounded by thickened bone. Frequently a radiopaque area may be seen in the centre of the opacity called 'iron-like signal' due to the crystallization of fungus calcium or due to the displaced dental fillings.<sup>21</sup> MRI, is not required in most cases

, except for a differentiation a fungus ball from a mucocele.<sup>8</sup>

Exact diagnosis of FB is based on histopathologically. A high number of hyphae and mycotic colonization is confirmed by culture of specimens. It is difficult to have fungal culture positive. In-vitro- molecular biological examination should be recommended for identification of the fungal balls that can not be cultured.<sup>7</sup>

The most common causative fungus was *Aspergillus* species, that was reported as previous studies. Culture survey had extremely low sensitivity of 16.7 %, as reported in previous studies ranging from 20.3 % to 31.0 % (5,10,15,18). In our study only 26 % (5/19) of cultures were positive. In one patient *Aureobasidium* species was diagnosed (Figure 4 ). This low rate can explain by the lack of viability of the fungus ball.<sup>3,15</sup> FB treatment is based on surgery, that removes fungal debris from the affected sinus and maintains adequate



Figure 4. Microscopic findings of the specimen of fungus ball located in concha bullosa, showed dark brown arthroconidia-like cells with small hyaline conidia or clustered conidia (Aureobasidium species )

The characteristic surgery is called functional endoscopic sinus surgery (FESS) and the recurrence rate is very low.<sup>2,18</sup> FESS also provides high success and low morbidity. Mainly it is necessary to obtain a wide opening of the affected sinus or sinuses and complete removal of all the fungal conglomerate by the help of cured suctions and forceps. An uncinectomy and a wide middle meatus antrostomy is required for FB of the maxillary sinus. Endonasal sphenoidotomy and partial or complete

ethmoidectomy, respectively can be performed for a successful sphenoid and ethmoid localizations.

No adjavent local or systemic antimycotic treatment is required for true sinus fungus ball, the bone destruction does not change the treatment. Surgical clearance most often enough to obtain an exact cure.<sup>8</sup> In our study all patients were treated with FESS, the technique used depended on the localization (middle antrostomy,

sphenoidotomy, ethmoidectomy). There were no complications.

Fungal sinusitis is a common disease with an increasing incidence among immunocompetent population over the past decade. <sup>1</sup>Han et al. underlined the most common concomitant disease, accompanying FB, was diabetes mellitus. <sup>9,22</sup>

Our study included 5 patients with uncontrolled diabetes mellitus and 3 patients with controlled diabetes mellitus. 3 patients had hypertension. Hypertension was reported as a risk factor of sinus fungal ball. Hypertension causes peripheral resistance of the vessels. Increased resistance can lead to hyperperfusion of the sinus mucosa, which results in inadequate drainage and increased risk a fungal ball formation. This mechanism should be studied more. <sup>2</sup>

The fungus ball has a good prognosis. The recurrence rates ranges 0 % - 3.7 % according to the studies reported previously. <sup>1,5,10,15</sup> In our series no patient had recurrence. Patients were treated with broad spectrum systemic antibiotics for 7 days as a prophylaxis for postoperative infection. Nasal irrigations with saline solution were recommended for at least 3 weeks. An antimycotic treatment was not conducted. The follow up period after postoperative ranged from 6 to 42 months, with average 28 months.

## CONCLUSIONS

In conclusion more studies are required to clarify the true incidence, pathophysiology, risk factors and treatment modalities of fungus balls.

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