

## Paranasal sinus fungus ball and surgery: a review of 175 cases\*

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### SUMMARY

**Objective:** To analyze the surgical results after Functional Endoscopic Sinus Surgery (FESS) in patients with paranasal sinus fungus ball.

**Material and methods:** Retrospective analysis of the results of FESS performed in 175 patients suffering from paranasal sinus fungus balls.

**Results:** All maxillary (n=150), sphenoidal (n= 20), and ethmoidal (n = 4) locations have been treated exclusively by FESS to obtain a wide opening of the affected sinuses, allowing a careful extraction of all fungal material without removal of the inflamed mucous membrane. No major complication occurred. Postoperative care was reduced to nasal lavage with topical steroids for 3 to 6 weeks. Only 1 case of local failure have been observed (maxillary sinus, n = 1), and 6 cases of persisting of fungus ball (maxillary sinus, n = 4; frontal sinus, n = 2) with a mean follow-up of 5 years. No medical treatment (antibiotic, antifungal) was required.

**Conclusion:** Surgical treatment of a fungus ball consists in opening the infected sinus cavity at the level of its ostium and removing fungal concretions while sparing the normal mucosa. No antifungal therapy is required. Finally, through this 175 patients study, FESS appears a reliable and safe surgical treatment with a low morbidity.

**Key words:** fungus ball, endonasal surgery, *Aspergillus*, endoscopic surgery, chronic sinusitis

### INTRODUCTION

Fungus ball of the paranasal sinuses is a non invasive chronic fungal rhinosinusitis occurring in immunocompetent patients. Since many years, fungal rhinosinusitis has been divided into invasive and non-invasive forms, based on histopathology depending on the presence or absence of a fungal agent in the mucous membrane, bone or vessels [1-4]. Non-invasive infections include fungus ball and allergic fungal rhinosinusitis [3, 5, 6]. Several clinical presentations were reported from acute infection of the sinus cavities to an asymptomatic form [7, 8]. Nevertheless, the most frequent clinical presentation is not specific with various symptoms such as nasal obstruction, purulent nasal discharge, facial pain, and chronic cough. Only unilaterality may alert the clinician.

Endoscopic examination is most often normal but edema or purulent secretions may be observed.

The characteristic computed tomography (CT) scan presentation includes typically heterogeneous opacities associated with a metal dense spot in the involved sinus cavity [5, 9]. The most commonly infested sinus is the maxillary sinus followed by the sphenoid, but frontal, ethmoid and pansinus localizations are also available.

*Aspergillus fumigatus* is the most frequent fungus reported to cause fungus balls [6-8, 10]. We report on a total of 175 cases of fungus balls identified either by histopathology or by mycological cultures and treated by Functional Endoscopic Sinus Surgery (FESS) with a mean follow-up of 7 years. Postoperative care was reduced to nasal lavage with a saline solution. No complication has been noted and recovery of the sinus cavity has been observed after a few weeks for almost all patients. Through our experience, we analyze the different available approaches and problems which may occur during this surgical procedure.

## MATERIALS AND METHODS

The current retrospective series was based on analysis of medical files, operative charts, and follow-up evaluation reports of 175 patients suffering from paranasal sinus fungus balls confirmed by histopathology or mycological culture. Patients were managed at our tertiary care center from January 1st, 1989 to December 31st, 2002. Most patients were treated since 1991. All patients appeared clinically immunocompetent.

Several data have been collected including pre-operative symptoms, CT scan results, the operative technique, postoperative symptoms and the endoscopic aspect of the involved sinus.

Clinical long-term evaluation (5 years and more) was made through a questionnaire sent by mail in 2002 to the patient, or an interview with the general practitioner in charge of the patient when the questionnaire was not returned by the patient.

The questionnaire included three "requests" to the patient:

- Do you still have nasal symptoms as the pre-operative symptoms?
- Have you been re-operated on for the same problem?
- Do you consider yourself as cured?

*The goal of this questionnaire was reduced to collect relapse or complications.*

Endoscopic follow-up in the absence of a specific problem was performed at days 8, 15, 30, and 60. The final control was performed from 6 to 12 months for the maxillary localization. For all other localizations, endoscopic follow-up was extended to 2 years.

## RESULTS

### *Clinical presentation*

The average age reported in this retrospective study including 175 patients was 49 years, ranging from 14 to 87 years. There was a significant female predominance, with 106 female patients (60.6%) and 69 male patients (39.4%).

Less than half of all patients lived in urban areas (53 patients). Most patients suffered from purulent nasal discharge (n = 90), facial pain (n = 65) and chronic nasal obstruction (n = 54).

All cases were clinically immunocompetent and none had a previous or concomitant history of pulmonary aspergillosis.

Paranasal localizations of fungus balls in the 175 patients are shown in Table 1. As in other published series, the maxillary sinus is the most commonly involved sinus (150 cases, 85.7%) followed by the sphenoid sinus (20 cases, 11.4%).

Preoperative endoscopy was performed in all patients; it revealed a swollen mucosa and purulent nasal discharge in 77 and 74 patients, respectively. Nasal endoscopy was normal in 30 patients.

### *Pre operative CT scan exam*

Preoperative CT scan was performed for all patients to analyze the anatomic structures and confirm the possibility of an endonasal approach. Heterogeneous opacities, homogeneous

Table 1. Paranasal localizations of fungus balls.

Paranasal localizations	N
Maxillary sinus (unilateral)	143 (81.7%)
Maxillary sinus (bilateral)	7 (4%)
Sphenoidal	20 (11.4%)
Ethmoidal	4 (2.2%)
Frontal	4 (1.1%)
Pan sinus involvement	3 (1.1%)
Concha bullosa	2 (1.1%)
<b>Total</b>	<b>183*</b>

\*patients with simple or multiple localizations

opacities, and a metal dense image were seen in 133, 28, and 100 patients, respectively. Bone lysis was seen in 4 patients. For some patients (sphenoidal localization and pansinusitis), MRI was performed to analyze eventual connection with orbital and brain structures.

### *Surgical procedure*

All these noninvasive cases of fungal sinusitis have been operated on through an endoscopic endonasal surgery. The technique included wide opening of the infected sinus cavity associated with removal of the fungus ball. The mucous membrane was conserved, only a mucosal biopsy was made to eliminate invasion by fungus if suspected. All procedures were performed under local or general anesthesia according to local anatomic conditions, extension of the fungus ball and patient's request. In both cases, duration of the hospital stay was not modified whatever the technique applied.

All 150 maxillary sinuses were treated exclusively with middle antrostomy (53/150) or a combination of middle and inferior antrostomies (97/150). Sphenoid sinus localizations were managed by simple sphenoidotomy. Frontal sinus involvement was treated by a combination of infundibulotomy and intra-operative frontal sinus catheter placement and irrigation. The catheter was left in place for a few days postoperatively to allow further irrigation. Ethmoid sinus involvement was managed with partial or complete ethmoidectomy associated with middle antrostomy according to fungal extension (Figures 1 and 2). For pansinus location (Figure 3), complete sphenoidectomy associated with frontal sinus irrigation was carried out (Figure 4).

The intra-operative endoscopic view showed an inflammatory or normal mucosa in 152 and 23 cases respectively.

### *Histopathology and mycological culture*

As depicted in Table 2, histological examination is more sensitive than mycological culture. Histological examination of the fungus ball (Gomori methenamine silver) showed numerous entangled hyphae with 45° branching in 163 of the 175 cases (93.1%).



Figure 1. Patient A: Pre-operative coronal CT scan view showing a complete opacity of the right ethmoid sinus with a partial bone lysis (black arrow), and a partial opacity of the right maxillary sinus.

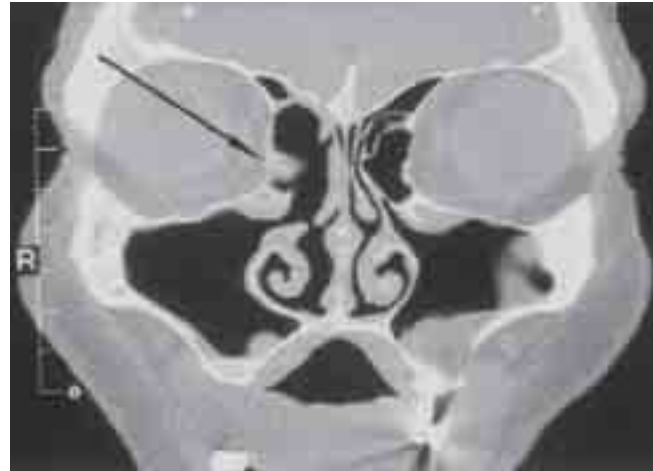


Figure 2. Patient A: Post-operative coronal CT scan view showing bone reconstruction (black arrow), and ethmoid, maxillary sinuses free of disease.

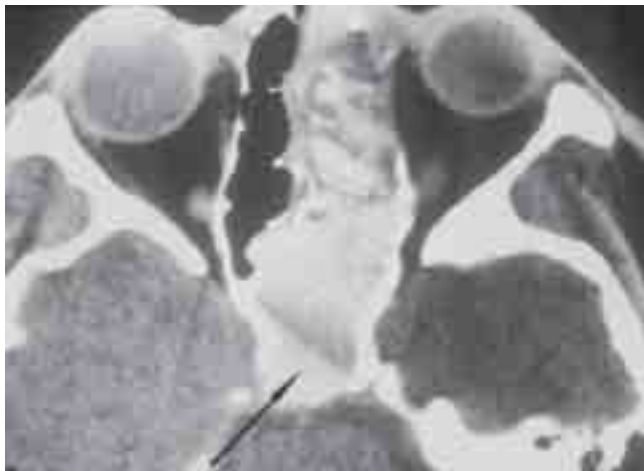


Figure 3. Patient B: Pre-operative axial CT scan view of a left pan sinus involvement, with a partial bone lysis of the posterior wall of the left sphenoid sinus (black arrow).

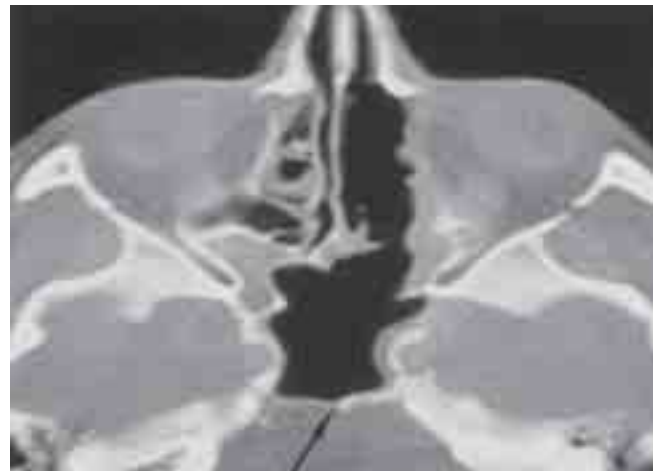


Figure 4. Patient B: Post-operative axial CT scan view after removal of fungus ball showing clear cavities.

Direct smears were positive for moniliaceous fungi in 115 cases and fungal culture grew out *A. fumigatus* in 50 cases. Positive cultures were associated with a positive direct smear or histological examination.

The other fungus found was *Scedosporium apiospermum* in 4 cases.

Table 2. Comparison between histopathology, mycological direct smear, and fungal culture.

	Histology positive	Histology negative
<b>Direct smear</b>		
Positive	108	7
Negative	34	6
Indeterminate	22	0
<b>Fungal culture</b>		
Positive	45	5
Negative	102	8
Indeterminate	17	0

#### Follow up

No major complications were observed. Postoperative broad-spectrum antibiotics were prescribed only in those rare cases of super infection observed after surgery. A spray form of topical steroids was given bid until obtaining a complete recovery of the mucous membrane which occurred after three to six weeks. Nasal lavage with a saline solution was recommended during the same period from three to six times per day according to the presence of secretions and crusts. Clinical follow-up ranged from 1 to 132 months with a mean of 7 years, and the endoscopic follow-up ranged from 1 to 24 months with a mean of 10 months. The mucous membrane was normal, inflammatory, and swollen in 151, 22, and 2 cases, respectively. As depicted in Table 3, only 7 patients were not cured after the first procedure (maxillary sinus,  $n = 5$ ; frontal sinus,  $n = 2$ ). For 4 patients with maxillary localization, problems consisted in persisting concretions due to an incomplete removal of the fungus ball. Treatment was reduced to a post-operative cleaning of the cavity, through the middle anastomy, the week

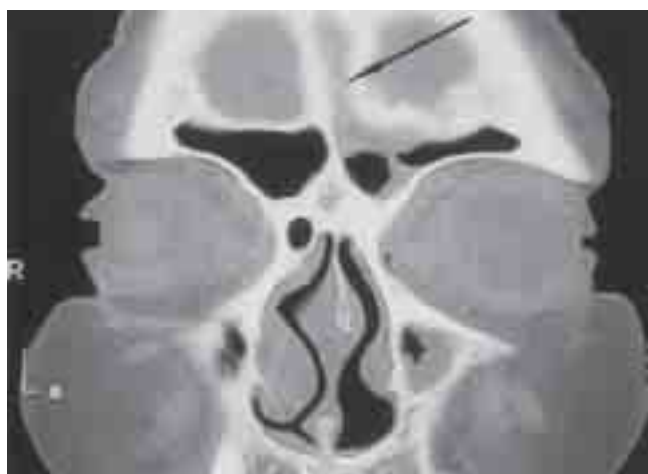


Figure 5. Patient C: Pre-operative coronal CT scan view of persisting concretion in the left frontal sinus (black arrow).

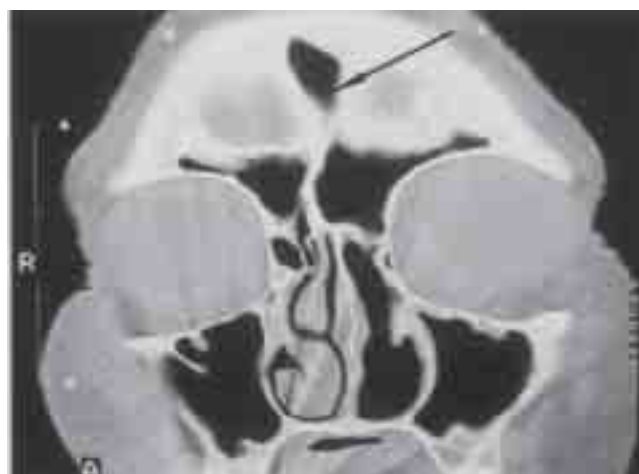


Figure 6. Patient C: Post-operative coronal CT scan view after removal of persisting concretion in the left frontal sinus (black arrow).

Table 3. The different surgical procedures according to fungus ball localizations, local recurrences, and persisting of fungus ball.

Localizations	Surgical procedure	Recurrence	Persisting of fungus ball
Maxillary sinus n = 150	Middle antrostomy, n = 53 Combined antrostomy, n = 97	n = 1	n = 4
Sphenoid sinus n = 20	Sphenoidotomy, n = 20	n = 0	n = 0
Ethmoidal sinus n = 4	Partial or complete ethmoidectomy, n = 4	n = 0	n = 0
Frontal n = 4	Unfundibulotomy associated with frontal irrigation, n = 4	n = 0	n = 2
Pansinusitis n = 3	Complete sphenoidotomy with middle antrostomy and frontal irrigation, n = 3	n = 0	n = 0
Concha bullosa n = 2	Opening of the concha, n = 2	n = 0	n = 0

after the surgery under local anesthesia. For the last patient, (maxillary sinus, n = 1), a recurrence has been diagnosed three years after the first procedure and treated with an endoscopic endonasal surgery under general anesthesia.

For 2 patients with frontal localization, a revision under general anesthesia had been performed with frontal irrigations for one, and an endoscopic endonasal surgery for the other one. A third revision with a combined approach was decided for the last one due to a persisting concretion of fungus ball in the frontal sinus (Figures 5 and 6).

## DISCUSSION

Fungus balls of the paranasal sinuses are defined as a noninvasive fungal rhinosinusitis occurring in the immunocompetent host<sup>[5,6,8,11]</sup>. The diagnosis is based chiefly on histopathology as fungal cultures are frequently negative<sup>[5,8]</sup>. To our knowledge, Mackenzie<sup>[12]</sup> was the first to publish in the English literature a case of non invasive fungal sinusitis although in France, the

first published case is attributed to Plaignaud in 1791<sup>[13]</sup>.

In our study, as in previous series, the maxillary and sphenoid sinuses were the most frequent localizations encountered. Since 1980, endoscopic endonasal surgery has become popular to treat most surgical cases of sinus pathologies [14]. With expert surgeons, it has been demonstrated its low morbidity and rate of complications compared to classical external approaches [5]. To reinforce this opinion, we present one of the largest series of fungus balls treated through an endonasal approach to analyze its reliability and safety for each location.

Maxillary sinus: all maxillary sinus cases were treated at least by a middle antrostomy, associated in cases of a well pneumatized sinus cavity completely filled by fungal concretions with an inferior antrostomy. After opening the sinus cavity more or less widely and removal of the fungus ball, the maxillary sinus is explored with a 30° and eventually 70° endoscope to detect any remaining fungal material. Whatever the degree of inflam-

mation of the mucous membrane surrounding the fungus ball, no additional removal has been carried out. The duration of hospital stay was from one to two days including the operative day. Only few minor complaints have been recorded such as tooth pain or postnasal discharge; these disappeared in all cases in the first postoperative year. Among the 150 maxillary sinus cases, only 5 local recurrences were observed. Four of them were secondary to incomplete removal of the fungal concretions due to a major inflammatory reaction surrounding a massive fungus ball. Only one may be considered as a real recurrence as it reappeared under the form of a small fungus ball 3 years after the previous procedure. Furthermore, the recurrence was observed in the first cases of the series.

Sphenoid localizations were all managed by endonasal sphenoidotomy whatever the degree of pneumatization<sup>[15]</sup>. The duration of the hospital stay was mainly limited to 48 hours. No closure of the sphenoidotomy or recurrence was noted in our 20 cases. These results confirm the low morbidity of such an approach even when a major inflammation with bone lysis is present.

Ethmoid involvement was managed according to the extension with partial or complete opening of the ethmoid cells filled by fungal concretions.

Frontal involvement has been the most problematic localization to manage. If endonasal access to the frontal cavity has always been successful, complete removal of the fungus ball was not possible for two patients even when associated with frontal irrigation. The two failures were observed 4 and 8 months after surgery due to either complex pneumatization of the sinus cavity or insufficient visualization of the entire cavity due to a narrowed frontal recess. These residual fungus balls were successfully treated after a combined (external / endonasal) approach. Finally, this localization represents one of the limitations of an exclusive endonasal approach, even if some authors suggest that the adjunction of complete removal of the bottom of the frontal sinus cavity may be helpful<sup>[16, 17]</sup>. The degree of hydration of the fungus ball may also play a role as well as the thickness of the sinus concretions. In such cases, complete removal of the fungus ball is sometimes problematic.

When all sinuses are involved, a combination of the previously described techniques is required. In our 3 cases of pansinusitis including frontal involvement, all patients have been cured.

Finally, whatever the localization, the single removal of the fungus ball without any local or systemic antifungal treatment has to be considered enough to cure the patients. Only specific cases as AIDS or severe diabetes have to be closely controlled (histopathology) to eliminate the rare invasive chronic fungal rhinosinusitis. We had no such patients in this study since all were immunocompetent.

#### *Follow-up*

Recovery of sinus mucosa has been observed between three to six weeks after surgery. A spray form of topical steroids was given bid for three weeks associated with nasal lavage (saline

solution). Broad-spectrum antibiotics were given for 10 days in cases of super infection observed after surgery. Postoperative control was reduced to one visit at day 8 to clean the nasal cavity and remove secretions and eventually remaining crusts closing the sinus cavity. The final step of the healing process was controlled three months after the surgery whatever the initial surgical procedure.

Finally, sinuses presented a clean cavity with regular epithelial lining, with recovery of mucociliary transport when controlled by colored solution (indigo). A post-operative CT scan was performed when bone lysis was seen pre-operatively to control complete restoration of bony walls consistent with the architecture met in the contralateral sinuses.

Although no recommendations or randomized studies are available, topical steroids were given bid during the post-operative period to control the inflammation frequently observed after endonasal surgery. No superinfection or complication was correlated with this prescription. In return, systemic antibiotics or corticosteroids were not given routinely except when a silent bacterial infection was associated with the fungus ball during surgery. Finally, as previously published [3, 5, 7, 8, 14], there was no need for local or systemic antifungal drugs whatever the clinical or radiological presentation in our large series. Long-term follow-up including CT scan control led us to observe recovery of bone modifications (thickening, lysis) which were present pre-operatively [9].

#### CONCLUSION

Fungus balls are becoming one of the most frequent noninvasive fungal sinusitis in the immunocompetent adult. Diagnosis is frequently made after an ongoing symptomatic period as no specific clinical finding discloses the diagnosis. Whatever the clinical presentation and localization, FESS may be considered as the first step of surgical management for this pathology. Only rare cases, especially frontal sinus involvement, need in our experience a complementary external approach. The low complication rate and morbidity rate lead us to consider the endoscopic endonasal approach as a reliable and safe technique whether performed under general or local anesthesia.

#### REFERENCES

1. Hora JF (1965) Primary Aspergillosis of the Paranasal Sinuses and Associated Areas. *Laryngoscope* 75: 768-773.
2. Milosev B, el-Mahgoub S, Aal OA, el-Hassan AM (1969) Primary aspergilloma of paranasal sinuses in the Sudan. A review of seventeen cases. *Br J Surg* 56: 132-137.
3. deShazo RD, O'Brien M, Chapin K, Soto-Aguilar M, Gardner L, Swain R (1997) A new classification and diagnostic criteria for invasive fungal sinusitis. *Arch Otolaryngol Head Neck Surg* 123: 1181-1188.
4. Washburn RG (1998) Fungal sinusitis. *Curr Clin Top Infect Dis* 18: 60-74.
5. Ferguson BJ (2000) Fungus balls of the paranasal sinuses. *Otolaryngol Clin North Am* 33: 389-398.
6. Stammberger H, Jakse R, Beaufort F (1984) Aspergillosis of the paranasal sinuses x-ray diagnosis, histopathology, and clinical aspects. *Ann Otol Rhinol Laryngol* 93: 251-256.

7. Ferreiro JA, Carlson BA, Cody DT (1997) Paranasal sinus fungus balls. *Head Neck* 19: 481-486.
8. Klossek JM, Serrano E, Peloquin L, Percodani J, Fontanel JP, Pessey JJ (1997) Functional endoscopic sinus surgery and 109 mycetomas of paranasal sinuses. *Laryngoscope* 107: 112-117.
9. Dhong HJ, Jung JY, Park JH (2000) Diagnostic accuracy in sinus fungus balls: CT scan and operative findings. *Am J Rhinol* 14: 227-231.
10. Willinger B, Obradovic A, Selitsch B, Beck-Mannagetta J, Buzina W, Braun H, Apfalter P, Hirschl AM, Makristathis A, Rotter M (2003) Detection and identification of fungi from fungus balls of the maxillary sinus by molecular techniques. *J Clin Microbiol* 41: 581-585
11. Castelnovo P, Gera R, Di Giulio G, Canevari FR, Benazzo M, Emanuelli E, Galli J, Di Girolamo S, Staffieri A (2000) Paranasal sinus mycoses. *Acta Otorhinolaryngol Ital* 20:6-15.
12. Mackenzie J (1893) Preliminary report on aspergillus mycosis of the antrum maxillare. *Johns Hopkins Hospital Bulletin* 4: 9-10.
13. Plaignaud M (1791) One case of maxillary sinus fungus ball. *J Chir* 1: 111-116.
14. Stammberger H (1985) Endoscopic surgery for mycotic and chronic recurring sinusitis. *Ann Otol Rhinol Laryngol Suppl* 119: 1-11.
15. Klossek JM, Peloquin L, Fourcroy PJ, Ferrie JC, Fontanel JP (1996) Aspergillomas of the sphenoid sinus: a series of 10 cases treated by endoscopic sinus surgery. *Rhinology* 34: 179-183.
16. Draf W (1991) Endonasal microscopic frontal sinus surgery. The fulda concept. *Op Tech Otolaryngol Head Neck Surg* 2: 234-240.
17. Weber R, Draf W (1994) Osteoplastic macroscopic and microscopic frontal sinus surgery. *Am J Rhinol* 8: 247-251.

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