Correlation between fungus ball of maxillary sinus and previous root canal therapy. Case report and narrative literature review

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Abstract

Fungus ball (FB) is a non-invasive mycosis typically found in the paranasal sinuses, predominantly the maxillary sinus. This case report describes the diagnosis and treatment of a recurrent maxillary FB in a 58-year-old patient, managed through Functional Endoscopic Sinus Surgery (FESS) combined with an intraoral approach. The patient presented with chronic unilateral nasal obstruction and recurrent sinusitis, with imaging studies revealing a heterogeneous mass in the left maxillary sinus. Histopathological examination confirmed the presence of a fungal ball. FESS was utilized to ensure minimal invasiveness and precision in removing the fungal mass while preserving normal sinus anatomy. The intraoral approach facilitated the direct access to the maxillary sinus, to complete the debridement required after recurrence from the first line FESS treatment. Postoperative follow-up showed significant symptomatic relief and no recurrence of the fungal ball. This case highlights the efficacy of combining FESS with an intraoral approach in treating maxillary fungal balls recurrence, emphasizing the importance of a tailored surgical strategy to achieve optimal Results. The combined approach not only ensures complete removal of the fungal mass but also minimises complications and enhances patient recovery.

Keywords: Fungal rhinosinusitis, Fungus ball, Endodontic treatment, Odontogenic sinusitis, Endoscopic sinus surgery

Introduction

Fungal infection is a rare pathology that can affect paranasal sinuses in both immunocompromised and healthy people. The uncommon occurrence of this condition and the difficulty in recognition, often lead to a diagnostic delay preceded by non-resolving approaches such as prolonged antimicrobial therapies. Furthermore, with the widespread use of drugs such as corticosteroids, antibiotics and anticancer drugs, the incidence of this type of infection appears to increase over the years in immunocompetent patients (1). The improper drug intake promotes a microbiological shift, consisting of a fungal proliferation which starts from microorganisms commonly present in the sinus cavity as commensal species. The increase in the incidence of fungal infections is another aspect related to the overuse of antibiotics (2,3). On the other hand, antimicrobial resistance also affects these types of infections with raising and development of antifungal-resistant species (4).
Although there is a lack of consensus on the classification of fungal sinusitis, new

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classifications are often proposed and they are usually divided into invasive and non-invasive forms (5,6).
Fungus balls (FB) represent a non-invasive form that occurs in healthy subjects with no medical history of allergies. In the literature, other terms have often been used to define this condition, such as mycetoma and aspergilloma but nowadays, fungus ball or fungal ball are more accepted (5).
Higher prevalence was found in patients in the fifth decade with a predilection for female (7). Liu et al. found that the three main symptoms of these patients were nasal obstruction (53.6%), purulent rhinorrhea (43.6%), and headache (34.1%). Nasal obstruction (63.8%), purulent rhinorrhea (48.9%), and facial pain or discomfort (54.2%) emerged as the predominant symptoms for maxillary sinus FB. Only (6%) were asymptomatic, and these cases were primarily associated with maxillary sinus FB (8).
Aspergillus fumigates and Aspergillus flavus, are more associated with FB, although fungal cultures show low positive rate of 32.1-34% (9,10).
The maxillary and the sphenoid sinus are the most affected sites, unilaterally, with rare localizations in other paranasal structures or in multiple sites. According to Nicolai et al., the involvement of the maxillary sinus reached 84.4%, followed by the sphenoid sinus (14.4%) (7). Similar Results were also found in the retrospective study of 175 patients, where maxillary sinus involvement was 85.7%. Rare localizations of the frontal sinus cannot be excluded, when present they can mimic mucoceles or tumors (11).
Anatomical variations are more frequent in patients with FB compared to the control group, such as the concha bullosa on the affected side (37% vs 23% in control group), the presence of Haller cells (10% vs 22%) and the width of the maxillary ostium (7.07 + 1.8 vs 5.48 + 1.3 mm) (12).
Conglomerates of extramucosal fungal hyphae, without affecting sinus mucosa, are intraoperatively found. The CT scans show peculiar images with opacification of the sinus and the presence of radiopaque spots inside. These rx-images are typical of this pathology (13).
Early identification of FB leads to appropriate therapy and therefore to better outcomes (14,15).

Case Presentation - Materials and methods

A 57-year-old patient, who came under our observation, has been experiencing episodic extra-oral facial pain associated with localized headache in the right temporal area for more than 8 months. In addition, there was pain at the level of the dental elements of the right postero-superior arch. Treated with anti-inflammatory drugs and prolonged antibiotic therapy, the symptoms have not resolved. Consequently, the dentist requested a second-level exam by CBCT.
The patient, smoker (about 20 cigarettes per day), has a history of no relevant chronic or previous diseases. The family history is negative for hereditary diseases or major medical conditions. No relevant medical records were acquired, the patient does not take any medications regularly and reports no drug or food allergies.
Panoramic dental X-ray shows a radiopaque image in the right maxillary sinus (Figure 1), a computed tomography (CT) was therefore prescribed. It revealed a foreign body with strongly radiopaque imaging of about 6mm at the level of the right maxillary sinus, a chronic inflammatory tissue and hyperplasia of the lining mucosa (Figure 2).
In December 2022, Functional Endoscopic Sinus Surgery (FESS) with antrostomy was performed and samples sent for histological analysis.
A second operation was performed in June 2023, which included a nasal endoscopy with 0° optics. During this operation, the ostium of the right maxillary sinus was enlarged and a portion of inflammatory-like tissue was removed with aspiration of purulent material. Due to the difficulty of removing the amount of material in the sinus, an intraoral approach was also performed (Figure 3a). A significant amount of purulent material mixed with brownish fungal-like tissue from the right maxillary sinus was analyzed (Figure 3b). The sample was subsequently sent for histological examination

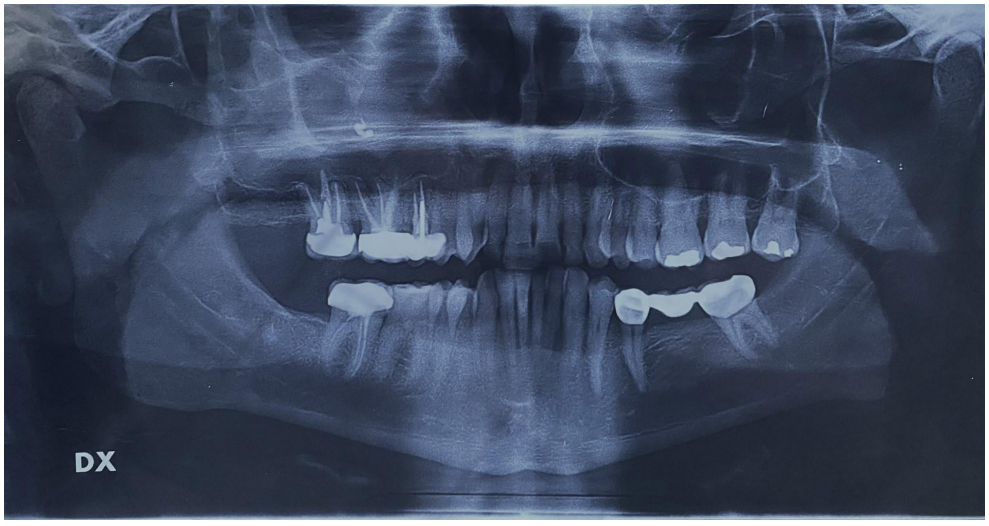

Figure 1. Panoramic dental x-ray shows a radiopaque material in the right maxillary sinus

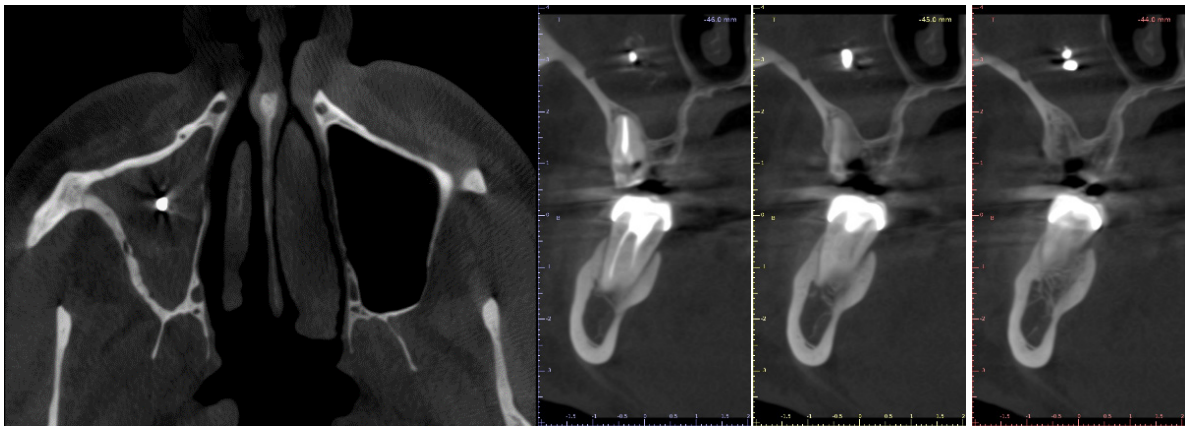

Figure 2. Computed tomography (CT) imaging a) axial image; b) cross-section images.

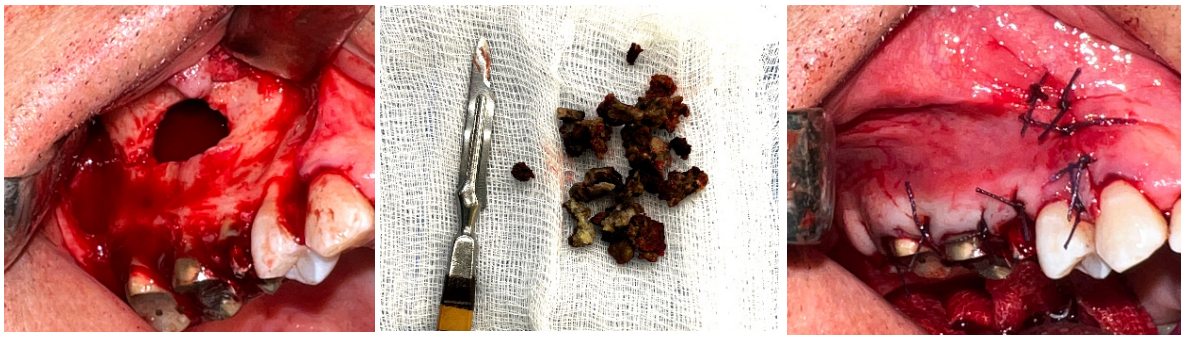

Figure 3. intraoperative images a) intraoral access to the maxillary sinus; b) material collected from the maxillary sinus; c) flap sutured

and the oral access sutured with resorbable 3/0 suture (Figure 3c).

Histologically (Figure 4), the excised sample showed features consistent with fungus ball. The associated fragments of respiratory mucosa were free of fungal invasion and granulomatous reaction.

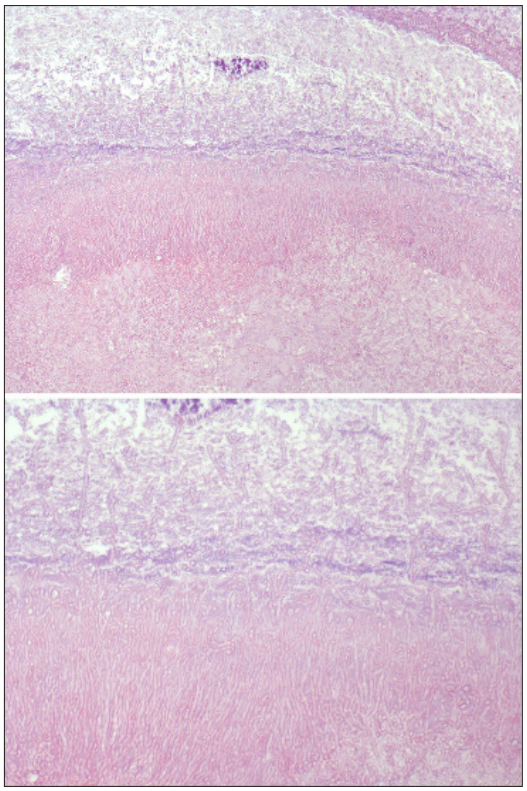

Figure 4. Histological representative low (top panel) and high (bottom panel) power magnification images of the FB. The fungal organisms, which show a lamellated distribution, are evident with haematoxylin-eosin stain.

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Discussions

According to recent classifications, FB represents a non-invasive form of fungal rhinosinusitis, although there is no agreement on which is the most appropriate classification to use (Table 1) (5).

Various factors have been considered regarding the etiology of the FB, such as the presence of mold in the environment, prolonged antibiotic or corticosteroid therapies and the presence of previous dental treatments. These factors can cause, separately or together, a microbiological shift in favor of fungal species. To diagnose FB there are various criteria used which allow us to distinguish between the various forms of fungal rhinusinusitis and other forms of conditions that affect the paranasal sinuses (Table *2*) (6).

Various studies have highlighted that endodontic treatments were present in teeth of the upper arch in many cases of FB. The etiological hypothesis is that the presence of zinc in root canal cements may favor the development and growth of aspergillus in case of overfilling or displacement in the maxillary sinus and, at the same time, reduce the ciliary movements (16). Although during surgical procedures it is not common to find evidence of dental material inside the maxillary sinus.

Dufour et al analyzed 173 cases revealing the presence of endodontic treatments in 131/173 (75.7%) of cases, of which overfilling was detectable in only 18/173 (10.4%) and in 7 (4%) cases of bilateral involvement there was no previous endodontic treatment (9).

Other studies analyzing this correlation showed similar Results: the association with endodontic treatments ipsilateral to the FB was found in high percentages such as 81% by Pagella et al. and 86.7% by Nicolai et al. (7,10) .

A retrospective study of 85 cases found radiopaque images inside maxillary sinus in almost all cases, which supposed to be related with endodontically treated teeth, despite this, intraoperative proof of dental paste was detected in only 12% of cases. The study also demonstrated in vitro that the presence of zinc oxide and eugenol promotes the growth of *Aspergillus fumigatus* at low concentrations while it is inhibited when concentration increases. However, the authors concluded that the dental origin cannot be confirmed in any of the cases analyzed and that the radiopaque spots may be due to calcifications of the fungal species (17).

Mensi et al. analyzed in vitro samples taken from FB of maxillary sinus and tested the growth with exposure to three different endodontic sealers. The growth of *Aspegillus fumigatus* increases in the presence of zinc oxide. Instead, the eugenol inhibits it, although its effects decrease in the long term (18).

In the study of Park, the endodontic treatments were compared between the FB group and the paranasal rhinosinusitis (PNS) group. Contrary to previous studies, Park et al. found endodontic treatments of maxillary teeth in 36.3% of the FB group. The difference is statistically significant when compared with 16.1% of the PNS group, highlighting a 2.147 times greater frequency of endodontic treatments in the FB group. Other factors analysed such as previous tooth

Table 1. Fungal Rhinosinusitis (FRS) classification

Invasive	Noninvasive
Acute Invasive (fulminant) FRS Granulomatous invasive FRS Chronic invasive FRS	Saprophytic Fungal Infestation Fungal Ball Fungus-related Eosinophilic that includes allergic fungal rhinosinusitis (AFRS),

Table 2. deShazo's et al. clinicopathological criteria for diagnosis of fungus ball (6).

Diagnostic criteria for fungus ball
Radiological evidence of sinus opacification with or without associated flocculent calcifications
Mucopurulent, cheesy or clay-like material within a sinus
A matted, dense conglomeration of hyphae separate from but adjacent to sinus respiratory mucosa
A chronic inflammatory response of variable intensity in the mucosa adjacent to fungal elements. This response includes lymphocytes,plasma cells, mat cells and eosinophils without an eosinophil predominance or a granuloma response. Allergic mucine is absent on haematoxylin–eosin stained material
No histological evidence of fungal invasion of mucosa, associated blood vessels, or underlying bone visualised microscopically on Gomori methenamine silver or other special stains for fungus

extractions, asthma, and allergic rhinitis, did not show statistically significant associations (19)

Conclusions

The etiology of FB is still not clear, many studies have suggested that endodontic therapies may be an important risk factor for this pathology. Although this theory is difficult to prove in certain circumstances like absence of root canal therapies in the maxillary teeth, involvement of sphenoid sinus or other paranasal sinus. FESS is the standard therapy and the treatment of the suspected dental elements with extractions, endodontic retreatments etc. is not necessary as demonstrated in the present clinical case.

In rare cases of relapse after treatment with FESS, a combined intraoral and nasal approach is indicated (9,20,21).

Despite the possible role in the development of the pathology, overfilling of zinc oxide in the maxillary sinus can, over time, cause the growth of fungal microorganisms. Even removing the suspected causal factor, the infection does not resolve as happens with odontogenic sinusitis whereby treating the dental condition represents the first approach.

Further studies are necessary to fully understand the etiology of this pathology and to achieve early interception which leads to a better outcome, avoiding incongruous and unnecessary therapies such as dental extractions, prolonged antibiotic therapies etc.

Although there are no studies evaluating the association, the recent bioceramic cements used in endodontics could play a protective role against the development of FB given their different characteristics, composition and the absence of zinc.

Author Contributions

F.R. Federici Stanganelli and G.Pingitore Writing - Preparation of the original draft

A.Corsi, M.Riminucci - Histological diagnosis and images

G.D'Erme, A.Riccardi and V.Vannini G. D'angeli - Conceptualization, Methodology, Validation, Data Curation.

All authors read and approved the final manuscript.

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