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Title: Spontaneous healing in maxillary fungus ball: beware of asymptomatic patients

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Key Clinical Message: Incidentally diagnosed, asymptomatic, paranasal fungus ball might occasionally undergo spontaneous healing. Accurate preoperative workup may avoid unnecessary surgical or anesthesiological procedures.

## Introduction

Paranasal sinuses fungus balls (PSFB) are a noninvasive mycosis [1] which most commonly affects women in the 5th and 6th decade of life[2]. While their most frequent presentation is in the maxillary sinus, they can affect as well the other paranasal sinuses[2], sometimes even bilaterally[3].

PSFB are a common sinonasal condition and they underwent an unexplained incidence increase in the last decade[4]. Some authors linked such an increase to the more widespread use of head imaging techniques (computed tomography and magnetic resonance) which allowed discovering a significant number of asymptomatic PSFB[5]. While most fungus ball present with rhinosinusitis-like symptoms[6], most probably due to the frequent bacterial superinfection that characterizes these hyphal concretions[6,7], fungus ball might also be completely asymptomatic[8]. Furthermore, PSFB have an unclear relationship with odontogenic sources of infection[9], and many papers associate endodontic material dispersion in the maxillary sinus as a possible facilitator of PSFB development [5,10].

We present the case of a 78-year old woman who was incidentally diagnosed with an odontogenic right maxillary sinus fungus ball who completely and spontaneously healed over the course of 1 year.

## Case Presentation

In October 2019, a 79-year-old female came to our otolaryngology outpatient service at the Santi Paolo e Carlo Hospital (Milan, Italy) reporting an incidental finding of a right maxillary, frontal and ethmoidal sinus opacity at a recent head CT scan. The CT scan was prescribed by the patient's neurologist as a first-line evaluation for a holocranial headache. The CT scan images confirmed the right fronto-ethmoid-maxillary opacification and also showed a partial dental implant penetration in the maxillary sinus (see Figure 1), and hyperdense floccular bodies floating amidst the isodense

opacity (see Figure 2). The patient did not report any sinonasal symptoms (nasal breathing difficulties, hyposmia, sinus pressure, or rhinorrhea). Her history included only hypertension and type 2 diabetes mellitus, both correctly under treatment. The physical examination and routine blood tests were non-contributory. During ENT evaluation, nasal endoscopy showed a congested middle osteomeatal complex, with a significant uncinate process medialization. Based on clinical and radiological data, a diagnosis of PSFB was made, with an indication of surgical treatment. A functional endoscopic sinus surgery (FESS) procedure was planned, to be followed by dental evaluation for the protruding dental implant removal. To complete the clinical staging, a head MRI without contrast was programmed prior to the surgical procedure. Due to the internal reorganization of our ward and hospital following the Italian outbreak of SARS-CoV-2[11], the patient could not perform the MRI until late September 2020, and surgery was postponed accordingly. No therapy was indicated meanwhile, being the patient completely free from symptoms. The MRI showed a complete resolution of the inflammatory process, without any sign of sinonasal opacification. Moreover, a wide opening of the right maxillary ostium was clearly visible (see Figures 3 and 4). A new flexible fiberoptic nasal endoscopy was performed immediately after the MRI. The endoscopy (see video 1) confirmed the presence of a wide communication between the right nasal fossa and the ipsilateral maxillary sinus (see Figure 5), which appeared free from disease. The wide opening allowed a complete sinus exploration, which showed only some granulomatous tissue on the maxillary sinus floor, in adherence with the protruding dental implant (see Figure 6). On the left side, no sign of pathology was to be found. In the wake of these findings, we retracted the indication to FESS and the patient was sent for dental evaluation as had already been programmed. The dentist suggested the removal of the implant to avoid potential sinusitis recurrences. Nevertheless, the patient decided to leave the implant untouched and opted for a simple otolaryngologic follow up. At present, the patient remains asymptomatic and no signs of recurring sinusitis or fungus ball have been reported.

## Discussion

While uncommon, spontaneous healing of odontogenic sinonasal pathology has been documented over several publications, mostly related to small-sized oro-antral communications[12,13].

Furthermore, if we focus again on odontogenic sinusitis, a number of authors propose treating the underlying dental condition as a possible means of achieving complete sinonasal healing[14], albeit current consensus recommends such conservative approaches only for the treatment of asymptomatic or paucisymptomatic patients[15].

Spontaneous healing of PSFB has not been described to date in the scientific literature, though the findings that characterize our case appear consistent with the patient history. The pathophysiologic mechanisms underlying this case might lie in the role of the uncinate process. As already described by Dal Pozzo et al [16], the uncinate process shows a significant medialization in odontogenic sinusitis patients, as in this specific case. Our hypothesis is that in this case the uncinate process, after extreme medialization under the push of the endosinusal content, might have acted as a fail-safe valve. This mechanism, together with the mucociliary clearance of the sinus, might have allowed the hyphal and purulent content pressing on the maxillary sinus to leak from the sinus, preventing empyema, similarly to what happens in cystic fibrosis patients. [17] In fact, mucociliary clearance as the primary innate defense mechanism might be the reason for the complete resolution of the disease after the opening of the medial wall of the sinus itself. Interestingly, the MCC is dependent on a multitude of external and internal factors such as pH changes, cigarette smoke, etc. and the wave generated by the ciliated cells travels across the epithelium propelling the overlying mucus in a cephalad direction or towards the rhinopharynx[18]. The ensuing sinus ventilation, altering the microenvironment and therefore the pH, might have also allowed healing for a more efficient MCC and elimination of the PSFB. Of course, these hypotheses would require further validation but pose an intriguing clinical and scientific question.

Furthermore, the clinical course of this patient introduces two relevant data in the PSFB scenario. First and foremost, spontaneous healing following ventilation of the sinus seems to validate that PSFB, due to their non-invasive nature, can colonize the sinuses only given that specific

microenvironment requirements are met (tendency to anaerobiosis in immune-privileged sites)[7]. Secondly, it might appear as if the relationship between PSFB and dental pathology lies simply in the facilitation of the fungal infection, whereas the simple dental focus persistence is not able to sustain the whole fungal infection. Conversely, it would be interesting to explore the relationship between fungal ball and prosthetics material infections, a relationship that has been thoroughly explored for bacterial biofilms[19]. This specific case seems to suggest that fungus balls are not able to colonize implants, which remain free from infection after the fungus ball has been evacuated. Besides these interesting pathophysiological speculations, this case report highlights without any doubt or inference of sorts how a complete preoperative workup of the patient is mandatory to avoid unnecessary treatments or surgeries[20]. In the setting of an asymptomatic patient, nasal endoscopy and a careful evaluation of its findings represent an unsurpassed, non-invasive, and informative tool in the hands of otolaryngologists

## CONFLICT OF INTERESTS

The authors have no potential conflicts of interests to disclose pertaining to this article

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## Figure Legends

Figure 1 - Coronal head CT scan image showing a right fronto-ethmoid-maxillary sinus opacification, with a dental implant protruding into the right maxillary sinus.

Figure 2 - Coronal head CT scan image showing hyperdense floccular bodies floating amidst the isodense opacity, suggesting the diagnosis of a paranasal sinus fungus ball.

Figure 3 - T1-weighted coronal head MR image showing complete healing of the right maxillary sinus, with a wide antrostomy-like aperture allowing for ventilation of the sinus.

Figure 4 - T2-weighted coronal head MR image showing complete healing of the right maxillary sinus, with a wide antrostomy-like aperture allowing for ventilation of the sinus.

Figure 5 - Flexible nasal endoscopy image of the right middle meatus showing a complete opening of the right maxillary sinus, without any residual sign of paranasal sinus fungus ball.

Figure 6 - Flexible nasal endoscopy image of the right maxillary sinus floor, showing a small amount of granulomatous tissue in adherence with the protruding dental implant.

Video 1 - Flexible nasal endoscopy showing a complete opening of the right maxillary sinus, without any residual sign of paranasal sinus fungus ball. Only a small amount of granulomatous tissue can be seen on the maxillary floor, in adherence with the protruding dental implant.

Authorship list:

AM Bulfamante & U D'Agostino Fiorenza wrote and finalized the article

Arnone F and Pipolo C evaluated the patient and collected her data

Lozza P and Felisati G critically revised the paper

Saibene AM performed the endoscopic evaluation, prepared the images, and drafted the manuscript