INTRODUCTION

Organized hematoma (OH) of the maxillary sinus is a rare benign mass that exhibits locally invasive features (1). Despite the histologically benign nature of this lesion, accurate preoperative diagnosis is important for therapeutic strategies because a simple complete resection via endoscopic sinus surgery or a Caldwell-Luc operation is sufficient to cure OH, instead of extensive surgical approaches (2-4).

There have been several reports regarding the OH in the maxillary sinus observed by computed tomography (CT) and magnetic resonance (MR) imaging. However, it is occasionally still difficult to diagnose this mass precisely based only on CT and MR imaging, owing to its variable shapes and enhancement patterns (2, 5-7). In this study, we present CT, MR imaging, and \(^{18}\)F-fluorodeoxyglucose (FDG) positron emission tomography-computed tomography (PET-CT) data for two cases of maxillary sinus OH mimicking inverted papilloma. We then correlated these findings with clinical and pathologic findings.

CASE REPORT

Case 1

A 34-year-old man presented with a three-day history of pain, mild numbness, and a sensation of heat in the left zygomatic area. On anterior rhinoscopic examination, fungal sinusitis or inverted papilloma was suspected. On contrast-enhanced CT of the osteomeatal unit, a heterogeneous enhancing soft tissue mass measuring approximately 3.7 × 4.0 cm in size...
Positron Emission Tomography—CT, CT, and MR Imaging Findings of Tumor-Mimicking Organized Hematoma in the Maxillary Sinus

with only erosion of the medial and superior walls of the maxillary sinus was noted in the left maxillary sinus. On MR imaging, a lobulated mass with isointense signal intensity was detected on T1-weighted images, and heterogeneous high signal intensity with a hypointense peripheral rim was noted on the T2-weighted images (Fig. 1A, B). This lesion pressed against the medial wall of the left maxillary sinus with extension into the nasal cavity and orbital floor with bony remodeling. The mass was strongly enhanced on contrast-enhanced T1 weighted images (Fig. 1C). Moreover, these imaging findings led us to suspect the presence of maxillary sinus cancer accompanied by mucocele. On PET-CT, slightly uneven FDG uptake [maximum standard uptake value (SUV) = 2.7] occurred at the anterior portion of the mass only. Based on these CT, MR imaging, and PET-CT, we suspected inverted papilloma rather than maxillary sinus cancer (Fig. 1D). A biopsy was conducted during an anterior rhinoscopic examination. The pathologic evaluation of this specimen demonstrated that the inflammatory polyp evidenced hemorrhage with hemosiderin pigmentation and mild chronic inflammation. The sur-

**Fig. 1.** MR, PET imaging, and histopathologic findings for case 1.

A. Coronal T2-weighted fast spin-echo image depicts a heterogeneous high-signal intensity mass (arrow) with a hypointense peripheral rim in the left maxillary sinus.

B, C. Coronal T1-weighted spin-echo image and contrast-enhanced T1-weighted spin-echo coronal images show a highly heterogeneously enhancing mass (arrow) in the left maxillary sinus.

D. PET-CT axial image shows subtle uneven FDG uptake (maximum SUV = 2.7) in the mass (arrow).

E. Hematoxylin-eosin staining (x 100) shows endothelialization of the organized hematoma from case 1.

Note—FDG = fluorodeoxyglucose, PET = positron emission tomography, SUV = standard uptake value
A left maxillary sinus mass with relatively increased FDG uptake (maximum SUV = 4.3) at the peripheral portion of the mass (Fig. 2B). Based on the clinical and radiologic findings, inverted papilloma was strongly suspected. However, the biopsy was conducted during an anterior rhinoscopic examination, and the final pathologic diagnosis was OH. The patient request no further operative procedures, and only conservative treatment was administered.

**DISCUSSION**

In both of our cases, heterogeneously enhancing, expansile soft tissue masses with bony erosion were noted on CT and MR imaging, and were found by PET-CT to exhibit a mild degree of uneven FDG uptake. The masses were diagnosed as cases of OH that had been clinically and radiologically regarded as inverted papilloma, on the basis of those findings.

The most plausible theory regarding the etiology and pathophysiology of OH is: chronic hematomas resulting from various causes, such as trauma, surgery, or underlying bleeding tendency, can develop into OH (8). During this process, chronic hematomas undergo several pathophysiologic events...
including angiogenesis, neovascularization, and surface fibrosis. Growth and poor ventilation of the mass coupled with drainage into the large maxillary sinus are also important factors in the formation of OH (2, 3, 9). This complex process results in progressive expansion and local bony erosion associated with OH.

OH is associated with a number of typical clinical symptoms, including recurrent epistaxis, nasal obstruction, cheek swelling, and headache (3). One patient in our study also presented with recurrent epistaxis. However, clinical findings have been proven to be insufficient in distinguishing OH from other tumors that may occur in the maxillary sinus. Therefore, imaging findings are important for the diagnosis of OH. In a previous study of 13 subjects with pathologically proven OH, the most common CT findings indicating the presence of OH in maxillary sinus were an expansile mass in one maxillary sinus, occasional extension into the ipsilateral ethmoid sinus, bony erosion of medial sinus wall, mucoperiosteal thickening with heterogeneous high density on preenhanced CT scan, and patchy heterogeneous enhancement on enhanced CT resulting from neovascularization (2). Other studies demonstrated that MR imaging is a better option for delineating the internal characteristics of the lesion. Heterogeneous signal intensity seen on T2-weighted MR images suggests the presence of various stages of hematoma development, vascular proliferation, and fibrosis (7). Additionally, the hypointense peripheral rim of the mass on T2-weighted images corresponds to a fibrous pseudocapsule (7). Overall, these reports clearly demonstrate that OH is associated with characteristic enhancement patterns that enable the exclusion of other neoplasms growing in the maxillary sinus such as mucocele, fungus ball, inflammatory polyp, and cholesterol granuloma, in part because it is unusual for these lesions to exhibit enhancement (7). On the other hand, inverted papilloma or any malignant neoplasm cannot be completely excluded, as these types of lesions can also be enhanced. Even though inverted papilloma primarily involves the nasal cavity and evidences a convoluted cerebriform pattern on T2 and contrast-enhanced T1 weighted images without exhibiting the hypointense peripheral rim of a fibrous pseudocapsule, there are still limitations inherent to the diagnosis of OH or the exclusion of other enhancing neoplasms (7).

The PET-CT findings for the two cases in our study demonstrated uneven FDG uptake (maximum SUV = 2.7 and 4.3) in the peripheral portion of the OH only. This is contrary to previous reports of high SUVs associated with inverted papillomas or malignancies on PET-CT (10). It remains to be determined whether the cause of mild FDG uptake on PET-CT is associated with inflammation or neangiogenesis; however, these findings may provide information valuable for diagnosis of cases of suspected OH, since it remains difficult to distinguish inverted papilloma from OH based solely on CT, MR imaging, and PEC/CT findings.

In conclusion, this study describes two cases of locally aggressive and expansile soft tissue masses in the maxillary sinus evidencing possible malignancy on CT and MR imaging. These lesions were also found to exhibit mild uneven FDG uptake on PET-CT. The findings of this study demonstrate that both OH, and inverted papilloma, should be considered when attempting to render a differential diagnosis.

REFERENCES

종양처럼 보이는 상악동 기질화 혈종의 Positron Emission Tomography–CT, CT, MRI의 영상소견: 2예 보고

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기질화 혈종과 반전성 유두종은 모두 상악동에 발생하는 종괴로, 영상의학적 소견이 유사하여 주의 깊은 감별을 요한다. 저자는 컴퓨터단층촬영 및 자기공명영상에서 팽창성 종괴로 이질적 조영증강을 보이며, 양전자방출단층촬영술에서 약간의 비균질 대상향긴소견을 보이는 바, 반전성 유두종과 감별이 어려운 기질화 혈종의 두 증례를 경험하였기에 이를 보고하고자 한다.

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