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Preoperative Endovascular Embolization in an Easily Bleeding Respiratory Epithelial Adenomatoid Hamartoma of the Olfactory Cleft: A Case Report

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Respiratory epithelial adenomatoid hamartomas (REAHs) are rare tumors occurring in the nasal cavity and sinuses, and their etiology is unknown. REAH is a relatively recently established lesion and is often misdiagnosed as nasal polyposis or other tumors. Preoperative endovascular embolization for sinonasal tumors is now widely accepted as an effective method to reduce blood loss, soften the tumor, and facilitate surgical procedures. However, to the best of our knowledge, there are no reports of the requirement for preoperative embolization in the management of REAH. Here, we present a 70-year-old man with an easily bleeding REAH of the olfactory cleft, vascularized by branches of the bilateral internal and external carotid arteries. We removed the tumor endoscopically after preoperative embolization of the bilateral sphenopalatine arteries. Histological investigation revealed an intratumoral hemorrhage accompanying the REAH, with no evidence of a residual or recurrent tumor during the last follow-up at 3 months. In conclusion, accurate preoperative diagnosis and proper preoperative interventions such as embolization are needed for safe and adequate treatment of REAHs that have an abundant blood flow.

Keywords: endoscopic endonasal surgery; nasal cavity; olfactory cleft; preoperative embolization; respiratory epithelial adenomatoid hamartoma (REAH)
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Introduction

Respiratory epithelial adenomatoid hamartomas (REAHs) were first described in 1995 by Wenig and Heffner and is a relatively recently established disease (Wenig and Heffner 1995). REAH is a rare tumor that occurs in the nasal cavity and sinuses, especially in the olfactory cleft. Hamartoma is defined as a non-neoplastic overgrowth of normal and mature cells and tissues native to the constituent organ in a disorganized manner. Histologically, REAH is a benign glandular proliferation lined by ciliated respiratory epithelium that originates from the surface epithelium to form a polypoid mass lesion (Wenig and Heffner 1995; Safi et al. 2019).

Although the etiology of REAHs is still unknown, chronic rhinosinusitis and a prolonged pro-inflammatory environment are presumed to be the contributing factors (Al Hawat et al. 2015). The gross appearance of an REAH is described as a fleshy to firm, pinkish or sometimes yellowish mass, and endoscopic diagnosis is difficult because of the frequent coexistence of common inflammatory polyps (Nguyen et al. 2014). REAHs are often misdiagnosed as nasal polyposis (NP) and hence warrants a careful selection of surgical approaches that include complete resection and debulking surgery.

A general understanding is that REAH is not an easily hemorrhaging tumor, and bleeding control in REAH surgery is not as crucial as that in juvenile angiofibroma surgery. Preoperative endovascular embolization of sinonasal tumors helps reduce blood loss, soften the tumor, and facili-

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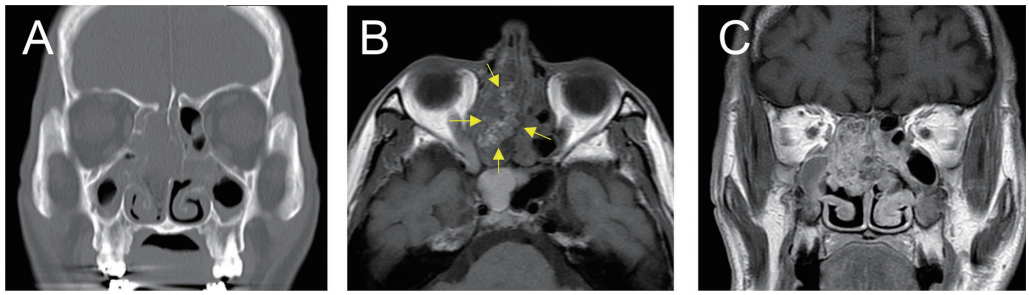

Fig. 1. Preoperative radiological images.
A: Plain coronal computed tomography scan showing widening of the right olfactory cleft and a mass with expansive growth without bone invasion and intracranial extension. B: T1-weighted magnetic resonance image showing multiple dot-like high-signal intensities (yellow arrows). C: Post-contrast T1-weighted magnetic resonance image showing a mass with heterogeneous enhancement, with a partial honeycomb-like contrast effect.

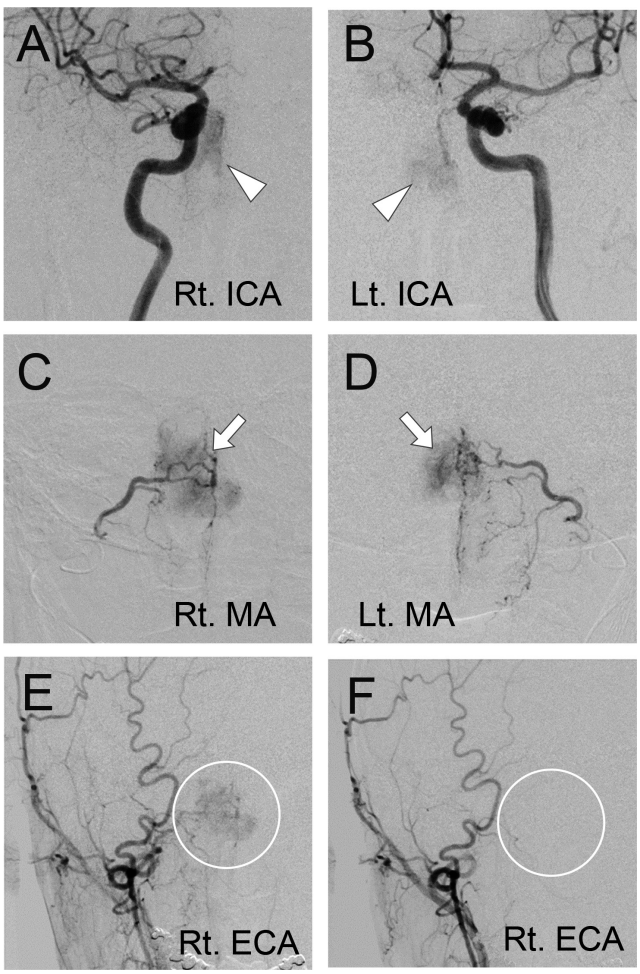

Fig. 2. Anterior-posterior digital subtraction angiography images.
A and B: Right (A) and left (B) internal carotid angiograms showing vascularization of the tumor fed by the ethmoidal arteries (arrowheads). C and D: Right (C) and left (D) maxillary angiograms showing vascularization of the tumor fed by the sphenopalatine arteries (arrows). E and F: Pre-embolization (E) and post-embolization (F) right external carotid angiograms showing marked devascularization of the tumor (dotted circle).
Rt, right; Lt, left; ICA, internal carotid artery; MA, maxillary artery; ECA, external carotid artery.

tate the surgical procedures (Tamaki et al. 2017). However, there are no reports of preoperative embolization for endoscopic endonasal surgery to treat REAH. To the best of our knowledge, we report, for the first time, a case of an easily bleeding REAH of the olfactory cleft treated with preoperative embolization, followed by endoscopic endonasal resection.

Case Presentation

A 70-year-old man presented with a complaint of right nasal bleeding for 5 days. His medical history, including chronic sinusitis and allergic diseases, and laboratory studies were unremarkable. Endoscopy revealed a reddish and irregular surface mass that filled the right olfactory cleft and caused a lateral deviation of the middle turbinate. Computed tomography (CT) without a contrast medium showed a unilateral right olfactory cleft mass with expansive growth without bone invasion and intracranial extension, and mucosal inflammation within the right pan-paranasal sinuses, especially within the sphenoid sinus (Fig. 1A). Magnetic resonance imaging (MRI) revealed a tumor occupying the olfactory cleft. T1-weighted images showed multiple dot-like high-signal intensities in the lesion (Fig. 1B), T2-weighted images revealed a hyperintense mass with heterogeneous features, and T1-weighted MRI contrast-enhanced images following gadolinium injection showed heterogeneous enhancement with partial honeycomb-like contrast effects (Fig. 1C). The initial radiological diagnosis was adenocarcinoma or olfactory neuroblastoma (ONB).

Nasal biopsy was performed under local anesthesia, but massive bleeding hindered sufficient specimen collection. Inflammatory granulation was diagnosed using the histological specimen. Additional biopsy under general anesthesia was performed, and the total bleeding eventually reached 175 mL. Although the pathological diagnosis during surgery was an inflammatory variation, the final histological diagnosis was REAH.

Owing to the propensity of the tumor to bleed, preoperative transarterial embolization was performed via the femoral approach under local anesthesia. Digital subtrac-

tion angiography (DSA) was performed with 4 French catheters by selective catheterization of the bilateral external (ECA) and internal (ICA) carotid arteries. DSA showed a large tumor blush supplied predominantly by the sphenopalatine branches of the bilateral ECA and small feeders from bilateral ethmoidal artery branches of the bilateral ICA (Fig. 2A-E). Bilateral maxillary arteries were selectively catheterized using a 2.2/2.9 French catheter (EstreamROSA; TORAY, Tokyo, Japan) over 0.016 guidewires (Meister GW; MEDIKIT, Tokyo, Japan), and a gelatin sponge slurry in saline was injected. Post-embolization DSA demonstrated marked devascularization of the tumor blush and retarded flow in the bilateral maxillary artery (Fig. 2F), with a residual blush supplied by the ethmoidal arteries of the bilateral ICA.

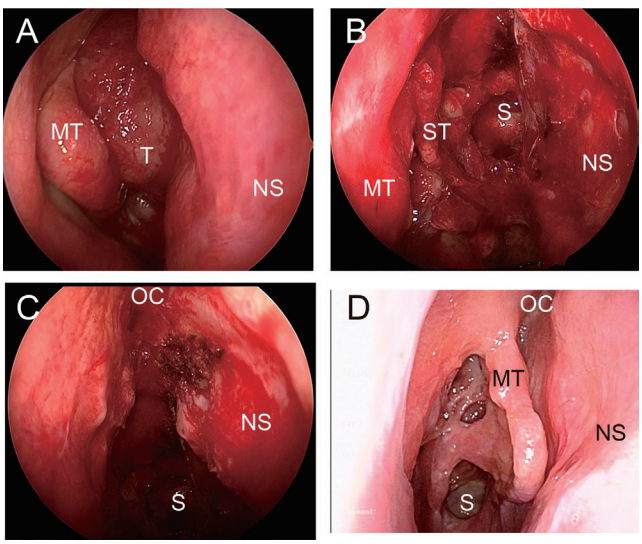

Fig. 3. Preoperative and postoperative images.
A: An easily bleeding reddish mass occupying the right olfactory cleft. B and C: Complete resection of the tumor with remodeling of the surrounding nasal structures. D: Intranasal image at 3 months after the surgery.
T, tumor; NS, nasal septum; MT, middle turbinate; ST, superior turbinate; S, sphenoid sinus; OC, olfactory cleft.

Endoscopic endonasal surgery was performed a day after the tumor embolization. The tumor originated from the right nasal septum in the olfactory cleft area and had a broad base. It was pressing on the middle and superior turbinates and extended to the common nasal meatus and the posterior nostril. We resected the tumor completely, including surrounding normal mucosa using a microdebrider without subperiosteal dissection and drilling of the underlying bone, and completed the pan-sinus surgery (Fig. 3A-C). Although we encountered significant bleeding during the tumor resection, some of which was arterial, it was controlled by frequent electrocoagulation. The final blood loss was 850 mL, including the suction-resected tumor volume. The postoperative course was uneventful, and the final pathological results showed REAH with intratumoral hemorrhage (Fig. 4). The patient had no evidence of residual or recurrent tumor during the last follow-up at 3 months (Fig. 3D). Written informed consent was obtained from the patient.

Discussion

Hamartoma is a benign, non-neoplastic malformation that consists of an overgrowth of one or more tissue components of an organ (Wenig and Heffner 1995; Bignami et al. 2014). Hamartomas usually develop in the lungs, kidneys, and small intestine, and rarely occur in the sinonasal region (Al Hawat et al. 2015; Nomura et al. 2014). The number of REAH cases reported has increased in recent years (Safi et al. 2019), suggesting that what was previously misdiagnosed as chronic sinusitis and inflammatory polyps may now be widely recognized clinically and correctly diagnosed.

An expansively growing tender, soft tissue mass is an imaging hallmark of REAH (Fitzhugh and Mirani 2008). The typical radiological feature is an increase in the width

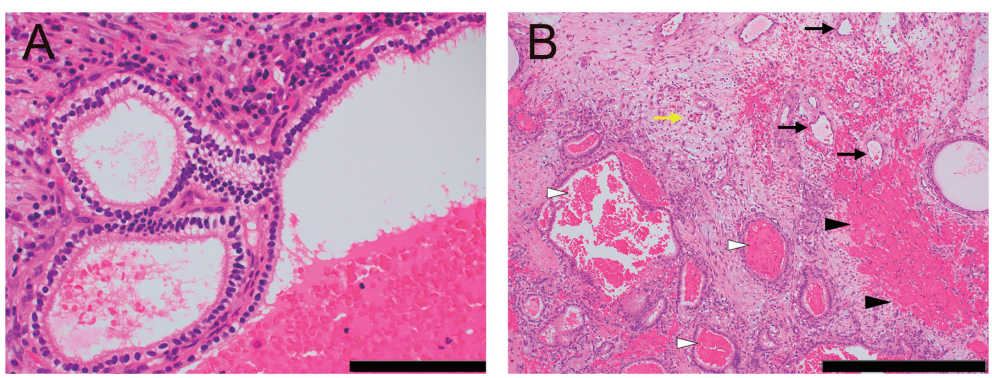

Fig. 4. Microscopic appearance of the respiratory epithelial adenomatoid hamartoma (hematoxylin and eosin).
A: A high-powered photomicrograph (×400) showing a typical adenomatoid proliferation, composed of ciliated respiratory epithelium with the lumen filled with mucus, erythrocytes, or debris. B: A low-powered photomicrograph (×100) showing glandular proliferation separated by edematous stroma with massive interstitial hemorrhage and infiltration of inflammatory cells. Arrows indicate capillary proliferation, arrowheads indicate interstitial hemorrhage, white arrowheads indicate intraglandular hemorrhage and a yellow arrow indicates hemosiderin deposition. Scale bars, 100 μm in A and 500 μm in B.

of the olfactory cleft (> 10 mm) on CT images (Safi et al. 2019), and this finding was also confirmed in this case. However, an accurate diagnosis is difficult with imaging alone (Hawley et al. 2013), and this case was also hard to diagnose because of the tumor's tendency to bleed easily.

Typically, easily bleeding masses in the nasal cavity are vascular tumors such as juvenile angiofibromas and hemangiomas (Tamaki et al. 2017). The typical MRI finding of REAH is a homogeneous hyperintensity on contrast-enhanced T1-weighted images (Braun et al. 2013; Safi et al. 2019). In this case, multiple dot-like high-signal intensities on T1-weighted images and honeycombed lesions surrounded by enhanced signals on T1-weighted MRI contrast-enhanced images were observed, suggesting a hemorrhage within the tumor. This finding might be useful to differentiate the easily bleeding type of REAH. This is the first reported case of preoperative embolization for a REAH lesion, indicating that REAH should be considered in the differential diagnosis of easily hemorrhaging masses in the nasal cavity.

In this case, DSA showed bilateral blood flow from the sphenopalatine artery of the ECA system and the ethmoidal artery of the ICA system. Although preoperative embolization is useful in surgeries for sinonasal tumors such as juvenile angiofibroma and hemangioma (Tamaki et al. 2017), endovascular embolization of the ethmoidal artery for sinonasal tumors is not popular possibly because of potentially severe vascular complications to the brain or the ophthalmic artery (Tamaki et al. 2017). For this reason, we only performed endovascular embolization of the bilateral sphenopalatine arteries. Although we experienced moderate intraoperative bleeding with a total blood loss of 850 mL, we could complete the endoscopic resection of the tumor without any complications, and the patient did not require a blood transfusion. It should be noted that even when an olfactory cleft tumor has feeding vessels from both the ICA and the ECA systems, preoperative endovascular embolization of only the ECA system is useful for reducing blood loss. In such cases, preparation for substantial intraoperative bleeding must be done.

REAH is a benign lesion and curable by complete resection including the tumor pedicle. Therefore, excessive resection is not required for REAH cases (Bignami et al. 2014). In this case, we initially suspected a malignant lesion based on the imaging findings. However, on an endonasal biopsy under general anesthesia, we arrived at a pathological diagnosis of REAH. Hence, we could perform proper surgical intervention without excessive resection. Thorough efforts to obtain the preoperative pathological diagnosis of olfactory cleft tumors should be made, especially in atypical cases similar to ours. We did not perform a pathological examination during surgery in this case. However, considering the possibility of the coexistence of malignancies with REAH, we now think that it should have been performed in this atypical case.

In conclusion, some REAHs may receive an abundant blood flow, and olfactory cleft tumors may receive blood from both the ECA system and the ICA system, limiting the effectiveness of embolization of the branches of the ECA system alone. Preoperative arterial embolization could aid in safe surgery for cases of REAH with an abundant blood flow.

Conflict of Interest

The authors declare no conflict of interest.

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