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## How I Do It

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# A Novel Endoscopic Technique for Long-Term Patency of Cholesterol Granulomas of the Petrous Apex

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## INTRODUCTION

Cholesterol granulomas (CGs) are rare benign cystic lesions containing cholesterol crystals in a glue-like fluid and are frequently found in the petrous apex (PA) and in the nearby anatomical area. The gold standard treatment of PA CG counts on its surgical drainage and ventilation to prevent recurrence. Different surgical approaches have been described in the past to achieve drainage of these lesions, either through lateral, or more recently through an endoscopic endonasal corridor.<sup>1</sup> In this report, we describe an innovative technique used to keep open the site of drainage, using a vascular pedicled nasoseptal flap (Hadad-Bassagasteguy flap)<sup>2</sup> after an endoscopic trans-ethmoid-pterygoid-sphenoidal approach to a petrous apex PACG.

## TECHNICAL NOTE

A 68-year-old woman presented with a lengthy history of recurrent blackouts associated with tonic-clonic twitches. Neurological examination and electroencephalography did not reveal any significant alterations. A computed tomography (CT) scan of the brain showed a large well-defined erosive lesion in the right PA with bone remodeling of the clivus, sphenoid body, and carotid canal in the intrapetrous tract (Fig. 1). Magnetic resonance imaging (MRI) confirmed the presence of a large cystic lesion that appeared to be hyperintense on both T1- and T2-weighted images. Small signal voids related to hemosiderin-ferritin deposits, suggestive of a chronic long-lasting process, were also present (Fig. 2).

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After careful evaluation of the extension of the mass and its relationships with the petrous and cavernous segments of the internal carotid artery (ICA), optic nerve, and surrounding brain limits, we decided to drain the granuloma through an endoscopic trans-ethmoid-pterygoid-sphenoidal approach.<sup>3</sup> A “two nostrils–four hands technique”<sup>4</sup> was adopted during the procedure to enlarge the surgical field and allow the second operator to actively aid the main surgeon by inserting instruments through the contralateral nasal fossa. An antero-posterior ethmoidectomy and a large antrostomy were initially performed. A nasoseptal mucosal flap pedicled on the septal branch of the sphenopalatine artery was raised (Fig. 3A). The posterior portion of the vomer was then resected, and the anterior wall of the sphenoidal sinus was opened bilaterally. The intrasphenoidal septum was drilled out, gaining complete exposure of the sphenoid sinus and of the anterior wall of the lesion. Once the basisphenoid and the right pterygoid were drilled out, the vidian nerve was identified and followed until the anterior genu of the ICA. The displaced vertical portion of the ICA was identified, and the sphenoidal wall of the CG was opened, marsupializing the granuloma itself. The pedicled nasoseptal flap previously achieved was then positioned on the floor and lateral walls of cystic cavity, also covering the sphenoidal drainage pathway to avoid its obstruction (Fig. 3B). In this manner, we were able to achieve our purpose of preventing the closure of the cyst now draining into the sphenoid. A bilateral parasseptal Silastic sheet and nasal packing were placed in each nasal fossa. A CT scan was performed within 24 hours and showed no evidence of any intracranial complications. Histopathological examination confirmed the diagnosis of CG.

At 3 years of follow-up, there are no clinical signs of recurrence, and the patient remains symptom free. Post-operative follow-up by means of endoscopic examination (Fig. 4) and MRI revealed a complete re-epithelization of the sphenoidal mucosa, complete integration of the septal mucosal flap with wide opening of the sphenoidal drainage pathway, and no evidence of recurrence of the disease (Fig. 5).

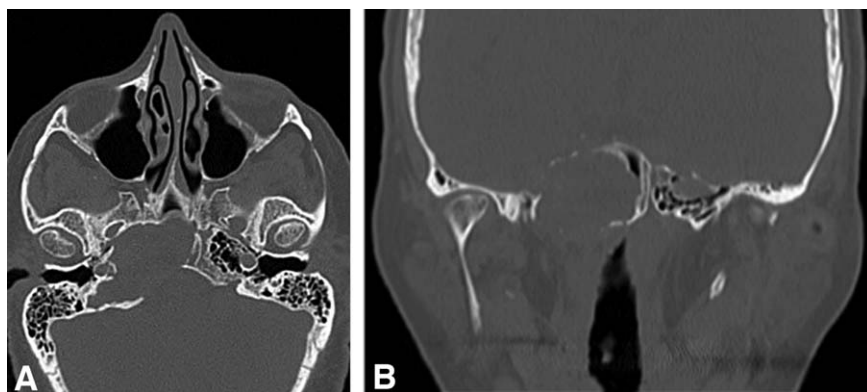


Fig. 1. Preoperative computed tomography (CT) scan without contrast in the axial (A) and coronal (B) planes showing the right petrous apex filled with isodense material that has also determined the bony reabsorption.

## DISCUSSION

The surgical goal in the management of a PA CG is the drainage of the lesion. Open surgical approaches, such as the middle cranial fossa and the transtemporal approaches (infra-labyrinthine, infra-cochlear), have unavoidable disadvantages such as high postoperative morbidity caused by brain retraction, lengthy duration in terms of anesthesia and postoperative hospitalization, facial nerve palsy (temporary or permanent), as well as hearing loss and balance dysfunction, especially in the case of transtemporal approaches.<sup>5</sup>

The endonasal endoscopic technique, first used in association with external approaches and nowadays also used as an exclusive procedure, may represent a useful alternative. In selected cases when the mass is expanded from the PA medially toward the clivus, it is possible to use the endoscopic endonasal technique to marsupialize the cystic lesion.<sup>6</sup> The most important landmark that must be accurately identified to avoid injuries of the petrous ICA is the vidian canal.<sup>7</sup> The surgeon should always approach the area of the PA by drilling the pterygoid below and medially to the vidian canal to safely reach the anterior genu of the ICA.<sup>8</sup> When in expert hands and following this rule, the endoscopic technique is safe and less traumatic than external approaches, leaving no aesthetic disfigurements, permitting shorter hospitalization time, and preserving the hearing of the

patient. Moreover, the endoscopic approach offers a wide field of vision thanks to the angled endoscopes, the “two nostrils–four hands technique”<sup>4</sup> permits the employment of more instruments through the nasal cavities, and new technological advancements such as neuronavigation and intranasal Doppler are precision tools for approaching the PA safely. However, some of the patients who undergo an endoscopic procedure may subsequently experience symptomatic recurrence of the cyst that will require a new surgical drainage.<sup>9</sup> The new technique we describe, through the sphenoidal sinus corridor and using a vascular pedicled nasoseptal flap<sup>2</sup> placed on the floor and walls of the empty cavity of the cyst, prevents the scarring and the subsequent obstruction of the surgical drainage.

The philosophy of the present technique is based on two facts; first, CG are locally expansive cysts without a natural ostium and this is the reason why there is a high percentage of re-stenosis.<sup>1</sup> Second, the experience gained with functional endoscopic sinus surgery and marsupialization of sinonasal mucocoeles taught the endoscopic community that these lesions are caused by the obstruction of the natural ostium of the sinus and are characterized by the absence of cystic wall boundaries. In fact, they are bordered by the bony walls and Schneiderian mucosa of the paranasal sinus that they are occupying. The gold standard treatment consists in surgical

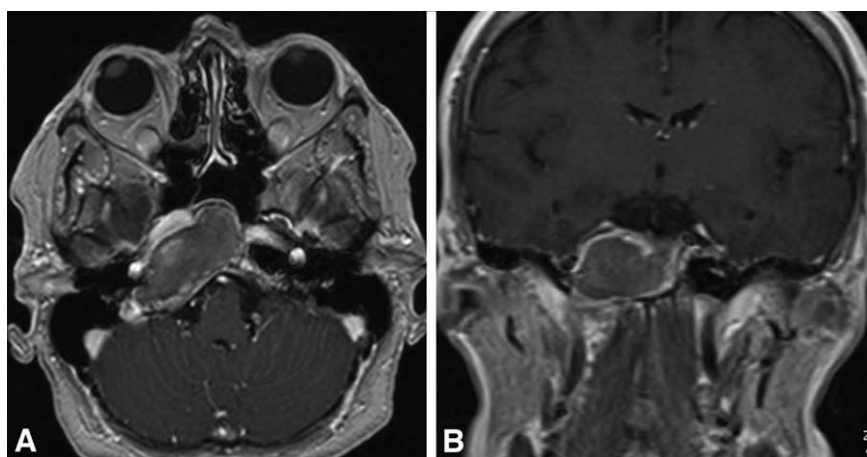


Fig. 2. Preoperative magnetic resonance imaging (MRI) in the axial plane showing the right petrous apex lesion. (A) T1 with gadolinium: the lesion appears to be characteristically hyperintense with some areas of hypointensity within its content. (B) T1 with gadolinium: the lesion has the typical inflammatory MR pattern, as the enhancement appears to involve only the peripheral area of the lesion. This image shows also the close relationship between the mass and the internal carotid artery.

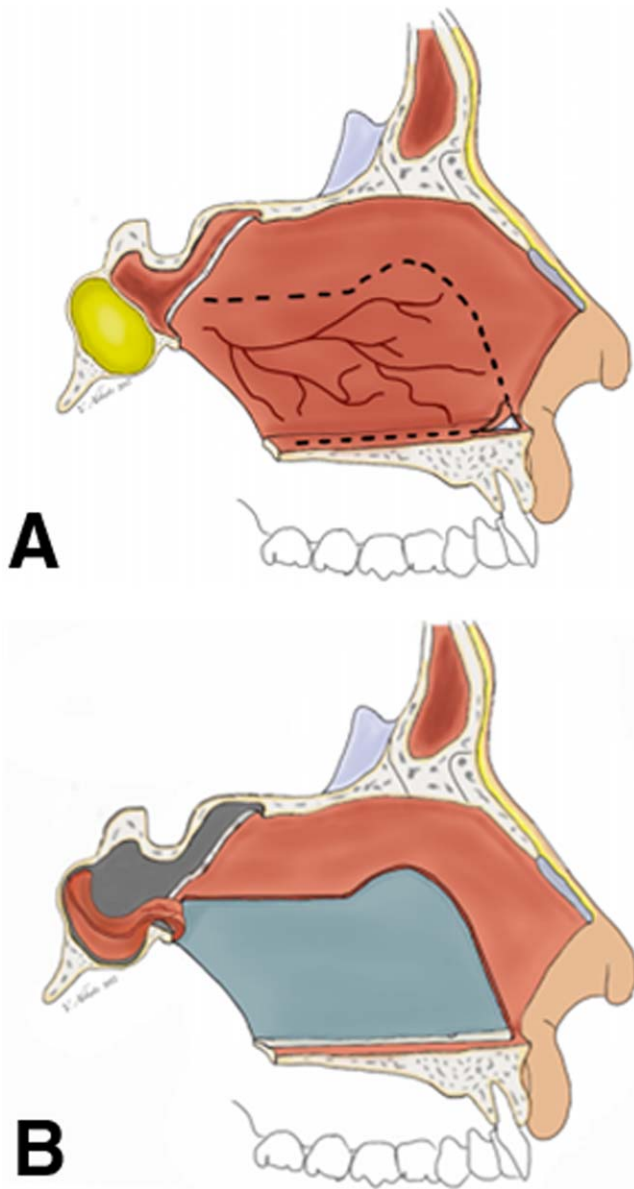


Fig. 3. Schematic illustration of the pedicled nasoseptal flap (Hadad-Bassagasteguy flap). (A) The dotted line indicates the size and the site of the flap. The cholesterol granuloma (yellow) of the petrous apex is protruding in the sphenoid sinus. (B) The pedicled nasoseptal flap is positioned on the floor and lateral walls of the cystic cavity, also covering the sphenoidal drainage pathway to avoid its obstruction.

marsupialization of the mucocele content, reestablishing an adequate drainage of the sinus into the nasal cavity through the opening of the mass, at the level of the natural ostium of the sinus.<sup>10</sup> This will prevent recurrence of the mucocele, which might occur if the natural ostium remains intact and not opened. Keeping in mind these considerations, it is our opinion that if an artificial ostium is created at the cystic walls of the CG, this should be kept open somehow to prevent an unavoidable stenosis and occlusion of the artificial drainage. According to our point of view, the endoscopic endonasal

corridor associated with the nasoseptal flap may reduce the recurrence rate and provide a permanent drainage pathway of the cyst into the sphenoidal sinus, with no need for stents, and reducing both the duration of surgery and postoperative morbidity.

In the present case, the lesion had expanded into the infrapetrous region and protruded medially into the sphenoid sinus, a condition that allowed a large endoscopic marsupialization and facilitated the flap to cover all of the surface of the CG's cavity. In a recent study<sup>11</sup> comparing the endoscopic endonasal and the infracochlear approaches, Scopel et al. proposed the endonasal approach as the preferred surgical option for CGs that extended into the sphenoid sinus and those in the superior and antero-inferior petrous apex, which requires exposure and lateralization of the ICA. Moreover the endoscopic route can provide a large drainage window, allowing placement of a Silastic stent three times larger than the infracochlear approach.<sup>11</sup> This last finding may permit the application of the nasoseptal flap instead of the Silastic stent. Pinheiro-Neto et al.<sup>12</sup> assessed that the potential length and width of the nasoseptal flap is adequate to cover all defects resulting from all anterior skull base, sphenoid, and clivus approaches, independently. It is important to drill and remove the basisphenoid as it may limit the length of the flap; this expediency allows the flap to be longer and adhere at the lateral wall of the sphenoid. In our view, is important that the flap covers the edge of the marsupialized CG and not the whole cavity to protect the medial genu of the ICA and interrupt the circular re-epithelization of the cavity. However more studies dealing with these topics are needed.

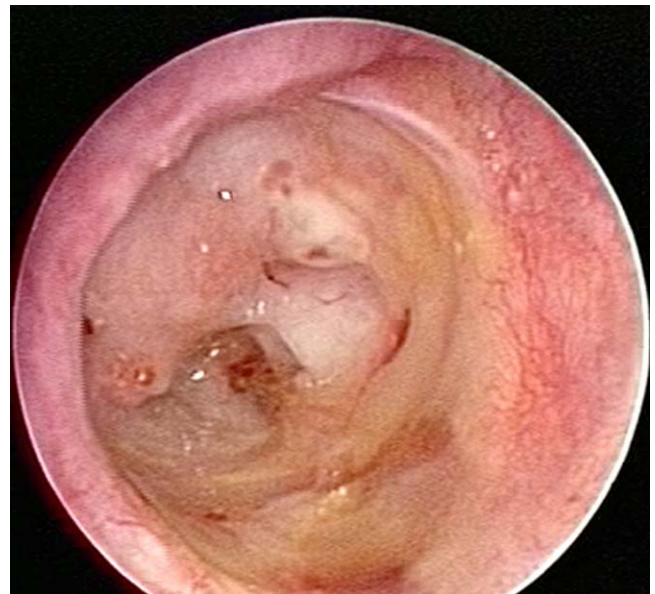


Fig. 4. Endoscopic endonasal control performed 3 years after surgery with a 0° endoscope. The nasal mucosal flap seems to be definitely integrated and has prevented stenosis and recurrence.



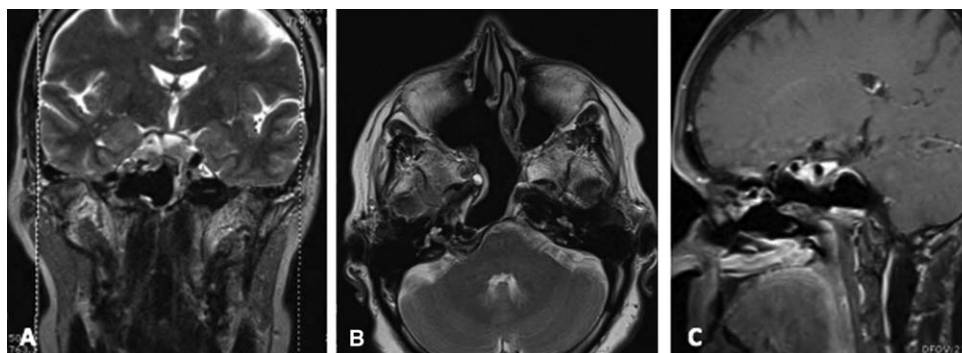


Fig. 5. Postoperative MRI performed 3 years after surgery showing a well-healed and aerated surgical cavity in the coronal T2-weighted (A), axial T2-weighted (B) and sagittal T1-with gadolinium (C) planes.

## CONCLUSION

Until recent years, surgical approaches for CG of the PA were only external, and although these were valuable techniques, they were burdened by high complication rates such as relapses, vestibule or acoustic system lesions, VII cranial nerve lesion, and a high rate in morbidity.<sup>1</sup> Nowadays, in selected cases when the lesion lies in a favorable position, particularly when it extends medially toward the sphenoid sinus, the endoscopic endonasal approach, if performed by expert hands, represents a safe surgical procedure that is minimally invasive and provides excellent surgical outcomes. The use of the pedicled nasoseptal flap<sup>2</sup> could be the solution to the postoperative scarring that causes restenosis of the cystic cavity, because the presence of the flap avoids the concentric growth of the granulomatous cyst epithelium, assuring ventilation and drainage of the cystic cavity.

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