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A Case of Petrous Apex Cholesterol Granuloma Successfully Treated with Endoscopic Endonasal Surgery

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ABSTRACT

A transcranial approach in combination with a transpetrosal setting has been the mainstream of surgical treatment of cholesterol granulomas in the petrous apex. However, endoscopic endonasal surgery has become a choice of treatment for these lesions with recent advancements in surgical techniques and instruments. We report a successful case of cholesterol granuloma managed with endoscopic endonasal surgery.

A 45-year-old woman, who had a long-standing history of otitis media, presented with left abducens nerve palsy and discomfort around the left eye. Magnetic resonance (MR) imaging showed a large cystic lesion, suggesting cholesterol granuloma, in the left middle fossa abutting the cavernous sinus and lateral wall of the sphenoid sinus. We chose an endoscopic endonasal approach to drain the contents of the cyst because the lesion protruded into the left sphenoid sinus. The sphenoid sinus was widely opened and the cyst wall was fenestrated with the assistance of an image guidance navigation system. Postoperative MR images confirmed the complete collapse of the cyst. She has been free from symptoms since the operation.

Key words: *Cholesterol granuloma, Endonasal approach, Internal carotid artery*

Cholesterol granulomas (CGs) of the petrous apex may present with various symptoms such as headache and cranial nerve dysfunction[5]. The incidence of CG is estimated to be ~0.6 per million[4]. Hyperplastic mucosa and bone marrow exposed to the air cells in the petrous apex easily bleeds. The trapped blood can cause an inflammatory granulomatous reaction and interposed infection may aggravate the inflammatory process[3]. Suitable approaches should be selected depending on the location of the cyst[8]. However, the surgical goal is drainage of the cyst and aeration, irrespective of the surgical approach selected[5]. The endoscopic endonasal approach has recently become a choice of treatment for selected cases of petrous apex CG[5]. In this report, we describe a case of CG in the petrous apex successfully treated by endoscopic endonasal surgery. Appropriate case selection and limitations of this approach are discussed.

CASE REPORT

A 45-year-old woman presented with double vision and discomfort around the left eye. She had a long-standing history of otitis media on the left side. Diplopia had appeared just after the recurrence of otitis media. An otolaryngologist diagnosed the problem as left abducens nerve palsy. She was referred to our hospital for the mass lesion detected by magnetic resonance (MR) imaging. The left abducens nerve palsy was temporary and it had already improved at the first visit. MR images showed a large cystic lesion in the middle cranial fossa abutting the cavernous sinus and lateral wall of the sphenoid sinus. The signal of the lesion was high intensity on T1- and T2-weighted images. Fat-suppression T2-weighted images also revealed the lesion as high intensity (Fig. 1A-C). The lesion showed no enhancement on T1-weighted image after Gd-DTPA. Three-dimensional fast imaging employing steady-state acquisition MR imaging (D) showed ICA located

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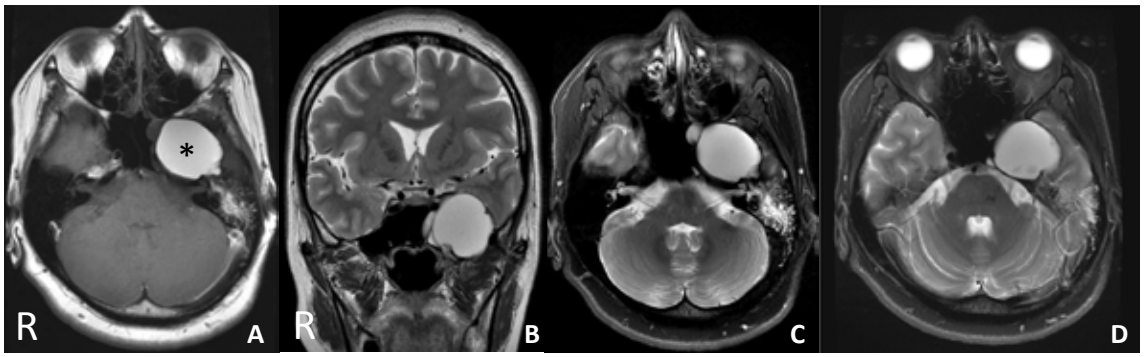

Fig. 1. Magnetic resonance images showed a large cystic lesion (*) in the left petrous apex with high signal intensity on T1 (A)- and T2 (B)-weighted images and also on fat suppression T2 (C)-weighted images. Three-dimensional fast imaging employing steady-state acquisition MR imaging (D) showed ICA located medial to the lesion and trigeminal nerve was not identified along the medial wall of the cyst.

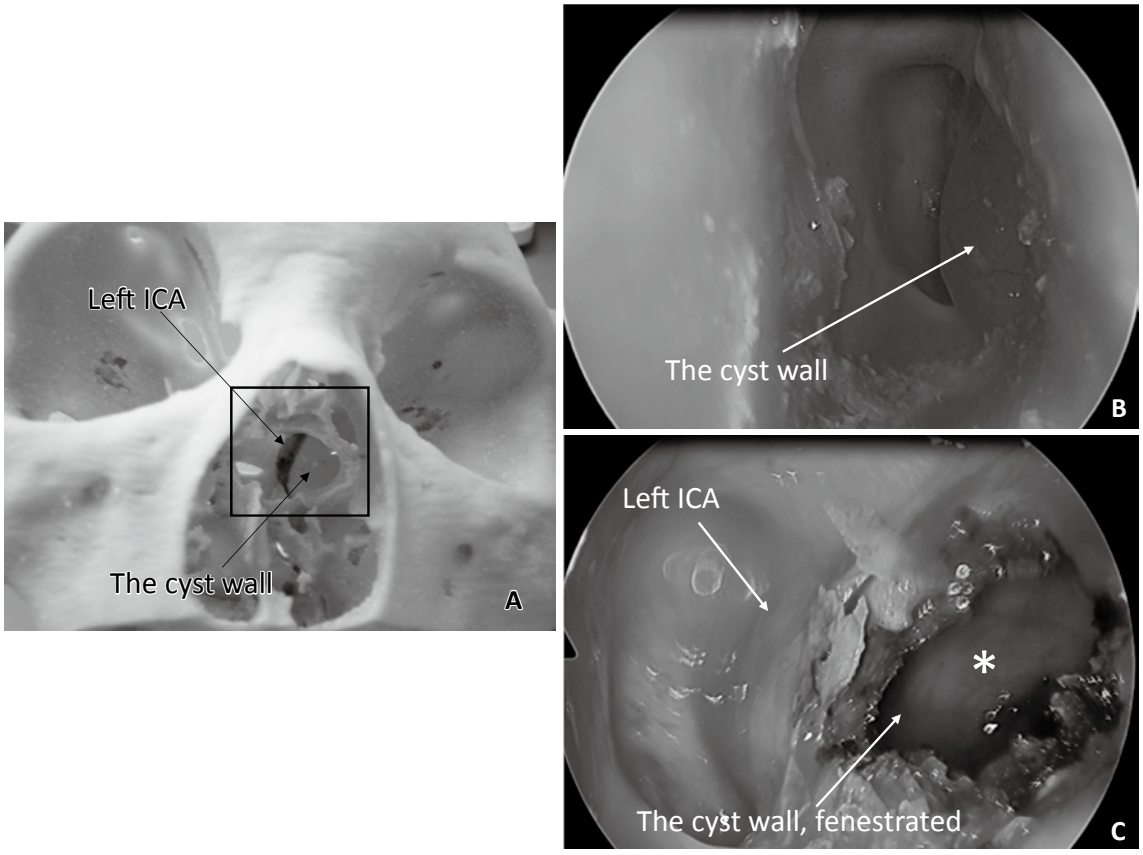

Fig. 2

A: A skull model of the present case showing cyst wall of cholesterol granuloma (CG) extending into sphenoid sinus and deviated ICA.

B & C: Intraoperative pictures showing surgical steps in an endoscopic approach for a petrous apex CG.

B: The cyst wall (arrows) protruded into the sphenoid sinus.

C: The cyst was widely fenestrated (*) in front of the internal carotid artery of cavernous portion.

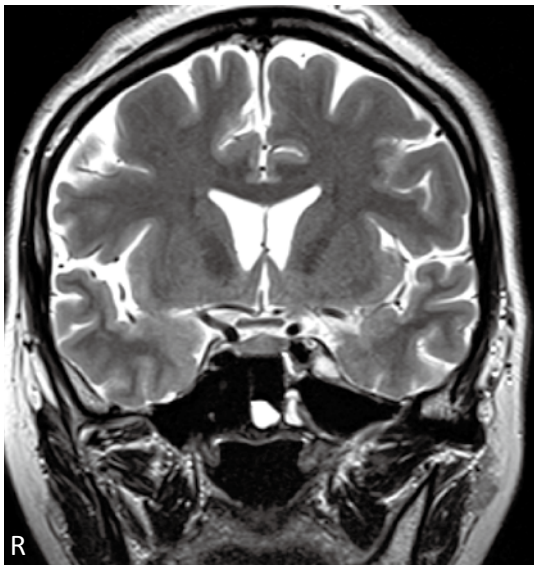

Fig. 3. A coronal T2-weighted magnetic resonance image obtained a month after the operation confirmed the considerable size reduction of the cyst.

medial to the lesion and the trigeminal nerve was not identified along the medial wall of the cyst (Fig. 1D). The lesion showed low density on computed tomography (CT) images and was causing osteolysis of the left petrous apex and middle cranial fossa. We chose an endoscopic endonasal approach to drain the contents of the cyst because the lesion protruded into the left sphenoid sinus. The sphenoid sinus was opened widely and the cyst wall was fenestrated with the assistance of an image guidance navigation system. Additionally, we enlarged the natural orifice of the sphenoid sinus to ensure the drainage route from the cyst (Fig. 2). Postoperative MR images confirmed the complete collapse of the cyst (Fig. 3). The patient has been free from symptoms since the operation.

DISCUSSION

The petrous apex as an anatomical transitional zone

The petrous apex is an anatomical transitional zone where both neurosurgeons and otolaryngologists operate. Cholesterol granuloma (CG) is a representative lesion arising in such transitional zones and it has been treated by both kinds of surgeons with various approaches[7]. Whatever approach one may choose, the goal of treatment is not to remove the cyst itself but to assure the drainage route and aeration. Neurosurgeons have traditionally chosen the middle cranial fossa approach because of their familiarity with craniotomy[9]. Otolaryngologists usually perform neuro-otologic procedures such as transmastoid-translabyrinthine and transcanal infracochlear approaches. An endoscopic endonasal approach to the petrous apex was first described in 1977 by Montgomery, and was adapted to the petrous apex CG in 1994 by Fucci[5]. With the recent advancement of surgical techniques and instruments, the endoscopic transsphenoidal approach has become a choice of treatment for petrous apex CGs. The application of endoscopic surgery on CGs has mainly been reported in the otolaryngologic literature, and articles from the neurosurgical field are very scant[7].

The advantage of the endoscopic endonasal approach

The distinct advantage of the endoscopic endonasal approach is the capability of aeration because the corridor of the endoscope in the sphenoid sinus can be directly utilized as an aeration and drainage route from the cyst[7]. Another advantage is a lower recurrence rate after the endoscopic procedure: the recurrence rates of the open and endoscopic approaches have been reported to be as high as 60% and 12%, respectively[2,5]. In the case of recurrence after endoscopic surgery, the patency of the drainage route can easily be appreciated by the endoscope in the outpatient ward because the sphenoid sinus has already been opened widely at the first operation. Revision of an endoscopic endonasal procedure may potentially be less morbid than that of transcranial and transpetrosal procedures[7].

Limiting factors of endoscopic endonasal approach

Limiting factors of the endoscopic endonasal approach are the internal carotid artery (ICA) and the trigeminal nerve. The location of the ICA in the endoscopic view is most important because ICA injury may result in a fatal outcome. In the present case, three-dimensional fast imaging employing steady-state acquisition MR imaging (3D-FIESTA) was useful to understand the positional relation among the lesion, ICA, and trigeminal nerve.

Open approaches such as middle cranial fossa- and transmastoid surgeries carry the risk of hearing loss, facial nerve deficit, and injury to the petrous ICA. While the endoscopic endonasal approach totally avoids hearing and facial nerve disturbance, ICA injury is a possible complication of this approach[5]. In a large series, ICA injury by the endoscopic endonasal approach to the petrous apex CGs has not been reported so far[5,7,10]. In the case of endoscopic transsphenoidal surgery to pituitary tumors, perforation or laceration of the internal carotid artery (ICA) in the carotid canal or in the cavernous sinus has been reported to

occur in 0 to 3.8%[1]. To avoid ICA injury, some authors advocate the use of an image guidance system to identify anatomical landmarks such as optic-carotid recesses, especially in poorly pneumatized sphenoid sinuses[8,10]. The anatomical relation between the CG and ICA is a limiting factor for the endoscopic endonasal approach[8]. When CGs develop parallel to the petrous horizontal ICA and invade the wall of the carotid canal, the cyst is hidden behind the petrous horizontal ICA in the endoscopic approach and we should consider the open approach[5]. A case with CG extending medially into the sphenoid sinus is feasible for endoscopic endonasal surgery. In this situation, ICA will not disturb the operative field.

Options of endoscopic endonasal approach to petrous apex lesions

Zanation et al have described 3 options of the endosopic endonasal approach to reach petrous apex lesions: 1) medial transsphenoidal approach, 2) medial approach with ICA lateralization, and 3) transpterygoid infrapetrous approach[7,10]. The first is suitable when the CGs extend medially enough and the ICA deviates postero-medially, as in the present case. The other two approaches are technically demanding because they require additional drilling of the petro-clival bone and mobilization of the ICA. They also require manipulation of anatomical structures such as the Eustachian tube and the vidian artery. Zanation's medial transsphenoidal approach was performed in the present case. This simple and technically less demanding approach may become the mainstream for endoscopic surgery of petrous CGs. The application of the endoscopic endonasal approach on petrous CGs, however, requires careful selection of the cases, because of the complicated three-dimensional anatomical relation between the CG and surrounding structures.

CONCLUSION

The authors report a case of CG successfully treated by endoscopic endonasal surgery. The endoscopic endonasal approach should be considered in CGs with medial extension and posterior deviation of the ICA because this approach enables less invasive surgery and shorter hospitalization.

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REFERENCES

1. **Dusick, J.R., Esposito, F., Malkasian, D. and Kelly, D.F.** 2007. Avoidance of carotid artery injuries in transsphenoidal surgery with the Doppler probe and micro-hook blades. Neurosurgery **60**: 322-328.
2. **Eisenberg, M.B., Haddad, G. and Al-Mefty, O.** 1997. Petrous apex cholesterol granulomas: evolution and management. J. Neurosurg. **86**: 822-829.
3. **Hoa, M., House, J.W., Linthicum, F.H., Jr. and Go, J.L.** 2013. Petrous apex cholesterol granuloma: pictorial review of radiological considerations in diagnosis and surgical histopathology. J. Laryngol. Otol. **127**: 339-348.
4. **Jaberoo, M.C., Hassan, M.C., Pulido, M.A. and Saleh, H.A.** 2010 Endoscopic endonasal approach to management of cholesterol granuloma of the petrous apex. **20**: 375-379.
5. **Paluzzi, A., Gardner, P., Fernandez-Miranda, J.C., Pinheiro-Neto, C.D., Scopel, T.F., Koutourousiou, M., et al.** 2012. Endoscopic endonasal approach to cholesterol granulomas of the petrous apex: a series of 17 patients. J. Neurosurg. **116**: 792-798.
6. **Royer, M.C. and Pensak, M.L.** 2007. Cholesterol granulomas. Curr. Opin. Otolaryngol. Head Neck Surg. **15**: 319-322.
7. **Sade, B., Batra, P.S., Scharpf, J., Citardi, M.J. and Lee, J.H.** 2012. Minimally invasive endoscopic endonasal management of skull base cholesterol granulomas. World Neurosurg. **78**: 683-688.
8. **Scopel, T.F., Fernandez-Miranda, J.C., Pinheiro-Neto, C.D., Peris-Celda, M., Paluzzi, A., Gardner, P.A., et al.** 2012. Petrous Apex Cholesterol Granulomas: Endonasal Versus Infracochlear approach. Laryngoscope **122**: 751-761.
9. **Terao, T., Onoue, H., Hashimoto, T., Ishibashi, T., Kogure, T. and Abe, T.** 2001. Cholesterol Glanuloma in the Petrous Apex: Case Report and Review. Acta Neurochir. **143**: 947-952.
10. **Zanation, A.M., Snyderman, C.H., Carrau, R.L., Gardner, P.A., Prevedello, D.M. and Kassam, A.B.** 2009. Endoscopic endonasal surgery for petrous apex lesions. Laryngoscope **119**: 19-25.