Image-Guided Percutaneous Aspiration and Gelfoam Treatment of Petrous Apex Cholesterol Granuloma: A New Theory and Method for Diagnosis and Treatment

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Abstract

Although diagnosis of cholesterol granulomas of the skull base can be straightforward with computed tomography (CT) and magnetic resonance imaging (MRI) appearance, treatment is controversial with various skull base approaches described in the literature. This report describes a 35-year-old man who presented with a symptomatic, enlarging cystic lesion in the left petrous apex and clivus that had imaging features of a cholesterol granuloma (cholesterol cyst). Due to a prior history of treated mediastinal germ cell tumor, pathologic confirmation of the lesion was requested. A CT-guided percutaneous aspiration revealed dark used motor oil-like fluid. Continued aspiration yielded a change in the character of the fluid to marrow red. Injection of contrast revealed no communication with cerebrospinal fluid. Gelfoam (Pfizer, New York, New York, USA) was subsequently injected percutaneously into the residual cavity. Histopathology showed no evidence of malignancy and follow-up MRI at 1 month, 3 months, 6 months, and 1 year demonstrated continued decrease in size and signal of the lesion.

Keywords

- cholesterol granuloma
- petrous apex
- Gelfoam
- image guided

Introduction

Cholesterol granuloma of the petrous apex has been described as having characteristic imaging features but can result in complex surgical management.¹ This report describes diagnostic imaging and image-guided percutaneous histopathology consistent with a petrous apex cholesterol granuloma with percutaneous Gelfoam (Pfizer, New York, New York, USA) treatment. The patient is a 35-year-old man with prior medical history remarkable for treated mediastinal germ cell tumor who presented with several weeks of gradually increasing pain along the left head and trapezius as well as intermittent difficulty with speech and swallowing.

Pertinent physical exam findings included leftward tongue deviation as well as inability to curl the tongue, causing mild aphasia.

Noncontrast head computed tomography (CT) demonstrated a cystic lesion in the left petrous apex and clivus that was increased in size compared with a remote prior CT study from an outside institution. There was interval involvement of the left hypoglossal canal (►Fig. 1). Subsequent magnetic resonance imaging (MRI) demonstrated intrinsic T1 high signal, a fluid-fluid level, and no evidence of internal enhancement (►Fig. 2). A positron emission tomography (PET)-CT study did not demonstrate any corresponding fluorodeoxyglucose (FDG) avidity in the left petrous apex. The

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Fig. 1 (A) Noncontrast axial head computed tomography (CT) revealing a hypodense ovoid expansile lesion in the left petrous apex. (B) Remote axial CT image from an outside institution May 2, 2006, before the onset of hypoglossal palsy, shows that the lesion was smaller and further away from the hypoglossal canal.

imaging findings were most compatible with a cholesterol granuloma. However, due to the patient's prior history of treated mediastinal germ cell tumor, an image-guided percutaneous aspiration was requested for histopathological confirmation.

Technique

Informed written consent was obtained from the patient. Preoperative laboratory work-up included a coagulation profile with normal values. The patient was placed in supine position on the CT table. A metallic grid marker was placed over the left cheek and an initial planning CT was performed 45 seconds after administration of 80 mL of nonionic contrast dye intravenously without adverse reaction. A needle trajectory was planned on an axial slice on which the petrous internal carotid artery (ICA) was protected by bone and was slightly over 1 cm away from the planned needle trajectory. Intravenous midazolam and fentanyl were administered for conscious sedation, and subcutaneous 2% lidocaine buffered with sodium bicarbonate was used for local anesthetic after standard sterile prep. Under CT guidance, a 17-gauge 10-cm introducer sheath was inserted into the left petrous apex lesion via a left lateral maxillary approach. A 22-gauge 20-cm aspiration needle was then inserted into the lesion via the introducer sheath, and percutaneous aspiration yielded a dark motor oil-like fluid (►Figs. 3 and 4). Continued aspiration led to a

gradual change in character of the fluid to a lighter, reddish color. After aspiration, there were small amounts of solid debris layering dependently within the cavity on CT imaging (►Fig. 3). Injection of 0.3 mL of Omnipaque (GE Healthcare, Princeton, New Jersey, USA) contrast showed stasis within the cavity with no gross communication with cerebrospinal fluid within the cisterns or vessel enhancement.

A decision was made to inject a Gelfoam (Pfizer, New York, New York, USA) slurry. Half a pack of Gelfoam was cut into thin strips and placed into a 10-mL syringe and attached via a three-way stopcock to a 10-mL syringe with normal saline with subsequent mixture back and forth through the stopcock to create a Gelfoam slurry. Initiation of injection of the Gelfoam slurry resulted in patient noting pressure in the left ear, which was alleviated by intermittent 1:1 suctioning of air and injection of Gelfoam slurry. A total of ~4 mL of Gelfoam slurry was injected and 4 mL of air suctioned. The patient tolerated the procedure well, was asymptomatic by the time he was transferred to the recovery room, and was discharged home 1 hour later. The aspirated fluid was histopathologically consistent with chronic blood products with no neoplastic cells, which supported the initial imaging diagnosis of cholesterol granuloma.

Follow-up

MRI scans from preoperatively, 2 weeks postprocedure, 3 months postprocedure, 6 months postprocedure, and 1 year postprocedure (►Fig. 5) showed decreasing size of the expansile bony lesion away from the hypoglossal canal, resolution of fluid/fluid level, and continued decrease in T1 signal. Axial T1 MRI 1 year posttreatment without and with contrast (►Fig. 6) showed interval resolution of abnormal T1 signal and decrease in size. At 1 year follow-up, patient's presenting symptom remained resolved.

Discussion

Cholesterol granulomas (cholesterol cysts) of the petrous apex are postulated to arise from a repeating cycle of hemorrhage into a petrous apex air cell with cystic expansion.^{1,2} There is debate whether the hemorrhage arises from the thin mucosa lining the cavity to the more recently proposed exposed petrous apex bone marrow.¹

These lesions in the petrous apex are differentiated from cholesterol granulomas of the middle ear, which can yield cholesterol crystals and granulation tissue.³ Although imaging characteristics can be straightforward, treatment approach is controversial. If the patient is asymptomatic and the lesion is stable, only observation is necessary. However, if the lesion grows in size or there is onset of symptoms, such as cranial neuropathies, treatment is required, often involving complex skull base surgery.⁴

Surgical management primarily involves drainage and aeration, sometimes with marsupialization. Complete resection is rarely performed given the difficult location and

Fig. 2 (A) Axial T2-weighted magnetic resonance imaging (MRI) showing a T2 bright fluid/fluid level within the lesion. (B) Diffusion-weighted MRI (DWI) showing no restricted diffusion in the lesion. (C and D) Axial precontrast and postcontrast T1-weighted imaging shows intrinsic high T1 signal with no enhancement .

Fig. 3 Computed tomography–guided coaxial needle aspiration and Omnipaque injection of cholesterol granuloma. Subsequently, the cavity was injected with Gelfoam with intermittent aspiration of an equivalent amount of air.

Fig. 4 Syringe from lesion aspiration showing dark, used motor oil–like fluid.

Fig. 5 (A) Preprocedure sagittal T1-weighted magnetic resonance imaging (MRI) of the left petrous apex and clivus demonstrating the cholesterol granuloma with hyperintense T1 signal fluid/fluid level. (B) A 2-week postprocedure sagittal T1-weighted MRI shows interval decrease in size and hyperintense T1 signal of the cholesterol granuloma. (C, D, and E) Sagittal T1-weighted imaging from additional follow-up imaging at 3 months, 6 months, and 1 year shows continued decrease in size of the cholesterol granuloma with improvement of the high T1 signal and fluid/fluid level.

because these lesions lack a true epithelial lining. Multiple surgical approaches including, but not limited to, translabyrinthine, infracochlear, transphenoidal, retrosigmoid, trans-temporal, and middle cranial fossa approaches, have been described.⁵

These operations are not without risk and can be technically challenging. A significant percentage of patients may develop hearing loss, and hearing status is a crucial factor in determining surgical approach.⁶ The middle cranial fossa approach requires a craniotomy and carries a risk of retraction injury to the brain parenchyma.⁶ The rate of recurrence of cholesterol granulomas after surgery has been reported to be 14.7% in one series of 34 patients by Brackmann and Toh.¹² In another series of 17 patients by Hoa and colleagues,² 41% of patients had to undergo revision surgery. Endonasal endoscopic surgical treatment has gained popularity over the past 10 to 15 years and has been associated with reduced risk as well as a lower rate of recurrence than traditional surgical approaches.^{4,7–11}

This report describes CT-guided aspiration and Gelfoam injection as a treatment method in the management of petrous apex cholesterol granuloma. Aspiration of the lesion revealed dark used motor oil-like fluid. The absence of cholesterol crystals in our pathologic specimen may have been related to the somewhat different nature of cholesterol granulomas presenting as petrous apex expansile cystic lesions as opposed to cholesterol granulomas of the middle ear cavity. Alternatively, this discrepancy may be related to the technical nature of performing a needle aspiration as opposed to open surgery, in which both fluid and nonfluid components of cholesterol granulomas can be resected. In our procedure, we percutaneously injected a Gelfoam slurry, comprising pieces of Gelfoam in sterile saline, into the cavity. The use of Gelfoam has been previously documented in the surgical treatment of petrous apex cholesterol granulomas for packing of an open surgical cavity.¹² In our patient, rather than attempting the creation of a persistent drainage pathway, we used Gelfoam to create hemostasis and solidify the fluid in the cavity.

The inferior aspect of the lesion in this article protruded into soft tissue and a bone access needle was not required. At our institution, petrous lesions entirely surrounded by bone have been successfully accessed with either a Bonopt manual drill needle (AprioMed AB, Uppsala, Sweden) or an OnControl® power driver needle (Vidacare, Shavano Park, Texas, USA); future cases of petrous apex cholesterol granulomas with a complete rim of bone may be accessed similarly.

This report describes a technically successful CT-guided percutaneous aspiration and Gelfoam injection of a petrous apex cholesterol granuloma/cyst in a single patient. No complications occurred, and imaging decrease in the size and abnormal high T1 signal of the lesion over 1 year follow-up was observed. Additionally, the patient experienced complete resolution of presenting symptoms. Larger studies are warranted to evaluate the safety and efficacy of this procedure as it may represent a minimally invasive treatment alternative.

Fig. 6 (A) One-year follow-up axial T1 precontrast image and (B) axial T1 postcontrast image with fat saturated showing decreased size and T1 signal with minimal posterior rim enhancement.

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