CASE REPORT

Recurrent aseptic meningitis as a rare but important presentation of congenital petrous apex cholesteatoma: the value of appropriate imaging

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SUMMARY

We describe the presentation, investigation and challenging management of a young adult with recurrent aseptic meningitis. The presence of cholesterol and triglycerides in the cerebrospinal fluid sample was recognised as a potential sign of an underlying dermoid or epidermoid cyst. We demonstrate how appropriate imaging of the skull base with diffusion-weighted imaging (DWI) MRI can help differentiate between lesions of the petrous apex, facilitating the diagnosis of a petrous apex congenital cholesteatoma/epidermoid cyst. Awareness of this unusual mode of presentation of a rare disease, as well as knowledge of key diagnostic investigations, may allow for earlier identification, treatment and reduced morbidity/mortality.

BACKGROUND

In cases of aseptic meningitis, where cerebrospinal fluid (CSF) Gram stain and culture are negative, causes of chemical meningitis should be considered. Elevated CSF levels of lipids/cholesterol should prompt a more thorough investigation for intracranial structural abnormalities such as congenital cholesteatoma/epidermoid cyst and dermoid cysts.

Petrous apex congenital cholesteatomas are rare congenital epidermoid cysts which usually present with gradual onset of compressive symptoms of hearing loss (conductive and sensorineural), facial weakness, headache and other cranial neuropathies. This case illustrates an unusual presentation of this condition, demonstrates the need for appropriate imaging and highlights the value of measuring CSF lipid levels in recurrent aseptic meningitis.

CASE PRESENTATION

An 18-year-old woman presented with pulsatile headache, photophobia, phonophobia and fever. She had no relevant medical history other than otitis media in her childhood. A CT of the head was reported as normal and a lumbar puncture (LP), performed prior to initiation of antibiotics, revealed cloudy CSF with raised protein, polymorphonuclear leucocytes, reduced glucose and negative Gram stain and culture (table 1). A diagnosis of possible bacterial meningitis was made and she recovered completely following a course of intravenous antibiotics.

One month later she re-presented with identical symptoms. A repeat CT of the head was reported as normal and the CSF analysis showed a polymorphonuclearcytosis with negative Gram stain and

culture. Once again, her symptoms resolved while on a course of ceftriaxone. Clinical history, examination and CT did not identify an underlying cause. Specifically, the middle ear and mastoid air cells and sinuses all appeared aerated and healthy.

The patient's third presentation with meningitis within the 3-month period prompted a more thorough investigative process. On this occasion, the possibility of an aseptic/chemical meningitis was raised and the CSF was tested and identified as having raised triglyceride and cholesterol levels. In addition, an ENT (ear, nose and throat) opinion was sought. Part of this assessment included a pure tone audiogram which demonstrated an unexplained mixed (conductive/sensorineural) hearing loss of 65 dB average in the left ear. Examination showed a dry perforation of the left tympanic membrane with no evidence of infection or discharge. In view of the hearing loss, she underwent CT with fine cuts and bony windows to assess the temporal bone (figures 1 and 2) and MRI of the skull base and cerebellopontine angle (figure 3). These identified a large erosive, expansile lesion within the left petrous apex of the temporal bone (medial to the cochlear) which on MRI was hypointense on T1 and non-enhancing with gadolinium but hyperintense on T2. In order to differentiate between other potential differential diagnoses of a cystic lesion in the petrous apex, a non-echo planar imaging (EPI) diffusion-weighted imaging (DWI) MRI was suggested. Although with this technique the cross-sectional imaging becomes degraded, the lesion identified clearly appears bright, confirming the diagnosis of petrous apex cholesteatoma (figure 4 and table 2).

TREATMENT

Once recovered from the meningitis, definitive management options were discussed with the patient. In view of the medial and inferior location of the lesion within the temporal bone and pre-existing hearing loss, she was counselled for a transotic surgical excision. This allowed for medial dissection of the temporal bone to the petrous apex with removal of the cholesteatoma sacrificing the cochlea and vestibular structures while preserving the facial nerve. At the time of surgery, the middle ear and mastoid were completely free of disease and there was no direct communication from the middle ear to the more medially located cholesteatoma. Histological examination of an intraoperative specimen sample was consistent with cholesteatoma.

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Table 1 Lumber puncture CSF analysis results from all 3 episodes of meningitis

CSF examination with normal reference values	First episode of meningitis	Second episode of meningitis	Third episode of meningitis
Colour (clear)	Turbid	Turbid	Turbid
White cell count (<5/mm ³)	1000	650	3300
Percentage of PMN	50%	70%	80%
Glucose (40–85 mg/dL)	20 mg/dL	42 mg/dL	40 mg/dL
Protein (15–45 mg/dL)	50 mg/dL	22 mg/dL	110 mg/dL
Cholesterol	Not tested	Not tested	1 mg/dL
Triglycerides	Not tested	Not tested	3 mg/dL
Microscopy and culture	Negative	Negative	Negative

CSF, cerebrospinal fluid; PMN, polymorphonucleocytes.

Figures 5–7 show the postoperative images following removal of the majority of the temporal bone other than the bone covering the anatomical limits of dissection (figure 5). The operative cavity was obliterated with abdominal fat, as seen in the T1 MRI in figure 6. Although the postoperative non-EPI DWI MRI showed no evidence of residual cholesteatoma (figure 7), this technique is not sufficiently sensitive to identify microscopic disease.

OUTCOME AND FOLLOW-UP

The patient had an uncomplicated recovery with normal facial nerve function and was discharged home the following day with a short course of vestibular sedatives to treat the vertigo related to the iatrogenic vestibulopathy associated with this surgical route. She was followed up with non-EPI DWI MRI scans annually. Five years following her surgery, despite being asymptomatic, a follow-up non-EPI DWI MRI identified a probable recurrence of cholesteatoma.

To prevent any further complications, she underwent revision surgery via a similar route with extended drilling of the temporal bone around the carotid canal and horizontal portion of the internal carotid artery to improve access to the recidivistic disease. This was uncomplicated and she remains well under outpatient review with annual MRI.

Figure 1 Axial CT through left temporal bone (bony windows) at the level of the cochlea. (1) Erosive, expansile lesion at apex of temporal bone medial to cochlea; (2) basal turn of cochlea; (3) internal acoustic canal and (4) heads of malleus and incus in healthy middle cavity.

Figure 2 Axial CT at level below figure 1 demonstrating the horizontal portion of the internal carotid artery (ICA) in contact with petrous apex lesion (1). The lesion is also seen as a dumbbell shape with the more lateral portion in the infralabyrinthine area and the more medial portion also eroded through the posterior wall of the pyramid to be in contact with the posterior cranial fossa. Also labelled, sigmoid sinus, middle cranial fossa and external auditory canal (EAC).

DISCUSSION

Central nervous system epidermoid and dermoid cysts are developmental tumours caused by the inclusion of epidermal or dermal components within the neuroaxis during embryogenesis. They account for ~1% of intracranial and intraspinal tumours. The lining of an epidermoid cyst produces epidermal debris consisting of keratin, cholesterol and fat, which causes gradual expansion of the cyst resulting in compression of local structures. Epidermoid cysts located within the temporal bone are also called congenital cholesteatomas and are usually differentiated from acquired cholesteatoma by the lack of involvement in the tympanic membrane. Within the petrous temporal bone, these lesions most commonly present with gradual onset hearing loss and facial nerve paralysis.^{1 2}

Recurrent meningitis can be defined as two or more episodes of meningitis with complete resolution of symptoms and signs (and laboratory findings) between episodes. The most common reason for this is a persisting source for infection or inflammation such as from a CSF leak following a traumatic skull base fracture, following a neurosurgical procedure such as a shunt, or a persisting ENT infection (sinonasal or middle ear). Most of these can be identified on history and examination.³

Figure 3 Axial T2 MRI showing hyperintense well-delineated dumbbell-shaped lesion in the region of left petrous apex.

Figure 4 Axial non-echo planar imaging diffusion-weighted imaging (DWI) MRI demonstrating diffusion restriction within the lesion (bright) supporting a diagnosis of cholesteatoma.

Aseptic meningitis denotes the failure to identify bacteria on microscopy or culture from the LP CSF sample. There are multiple potential causes of recurrent aseptic meningitis, too many to cover in this brief review, but, in general, they may fall under the headings of drugs, chronic inflammatory disease, infection (non-pyogenic, eg, herpes simplex virus), and structural lesions (such as epidermoid cyst as in our case).⁴

The mechanism of action for how the epidermoid cyst causes aseptic meningitis is thought to be rupture of the cyst into the subarachnoid space with release of keratin, cholesterol and lipoids causing a chemical irritation to the meninges.^{3 5}

At presentation, trying to differentiate between bacterial and chemical meningitis can be difficult due to similar presentations and similar CSF findings. However, a white cell count above 7500/ μ L and a glucose level <10 mg/dL are rarely seen in chemical meningitis.^{6 7} In addition, patients with chemical meningitis do not usually present with coma, focal neurological findings, new onset seizures or temperatures above 39.4°C.⁶ It should be noted that, in our case, we cannot exclude the possibility that meningitis was bacterial. However, given a negative CSF culture on three occasions, the medial location and absence of external communication or tract, and the presence of lipoids in the CSF, we feel that the evidence available supports the diagnosis of an aseptic/chemical meningitis.

Although it is recognised that intracranial epidermoid cysts are a rare cause of recurrent aseptic meningitis, we could find only two other cases in the literature reporting a congenital cholesteatoma of the petrous apex presenting in this way.^{8 9} Our case adds to this number, and, in addition, highlights some

Figure 5 Postoperative axial CT showing almost complete removal of the left temporal bone and key anatomical limits of dissection; internal carotid artery (ICA), temporomandibular joint (TMJ), sigmoid sinus (SS) and facial nerve (F). The facial nerve can be seen in the preserved bony canal of the internal auditory canal and first genu. The operative cavity has been obliterated with fat.

Figure 6 Postoperative axial T1 MRI showing complete obliteration of the cavity with fat up to the petrous apex with exception of the preserved facial nerve/internal carotid artery bony canal.

Table 2 MRI findings of the key differential diagnoses for cystic lesion of the petrous apex

Type of MRI sequence	Cholesterol granuloma	Epidermoid cyst (congenital cholesteatoma)	Arachnoid cyst	Mucocoele
T1	Hyperintense	Hypointense	Hypointense	Hypointense
T1 with gadolinium	Non-enhancing	Non-enhancing	Non-enhancing	Rim enhancing
T2	Hyperintense	Hyperintense	Hyperintense	Hyperintense
DWI	No diffusion restriction	Diffusion restriction (bright)	No diffusion restriction	No diffusion restriction

DWI, diffusion-weighted imaging.

Figure 7 Postoperative follow-up axial non-echo planar imaging (EPI) diffusion-weighted imaging (DWI) MRI displaying no evidence of persisting diffusion restriction or residual cholesteatoma.

important learning points regarding developments in diagnostic imaging when investigating lesions of this type.

Accurate and prompt diagnosis of an epidermoid cyst presenting with meningitis can be difficult and relies on appropriate imaging and interpretation of images. Failure or delay is associated with mortality.¹⁰ The development and increased use of DWI MRI over the past decade allows us to more accurately identify cholesteatomas/epidermoid cysts and differentiate this from other similar lesions found at the petrous apex.

Treatment of congenital petrous apex cholesteatoma is surgical removal to prevent complications. Due to the difficult surgical access, given the medial/central location of the petrous apex and often disease-related significant hearing loss, most authors advocate a non-hearing preservation approach (translabrynthine

or transcochlear) with emphasis placed on facial nerve preservation.^{1 2 11} Despite macroscopic removal, microscopic recidivism is a potential problem and is recognised as one of the fundamental challenges in managing these lesions. With this in mind, serial scanning with non-EPI DWI MRI has a key role in the long-term follow-up of these patients.

Contributors All authors have been involved in the clinical management of the patient, manuscript preparation and review.

Competing interests None.

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Learning points

- ▶ A thorough ear, nose and throat assessment is key when investigating a patient with recurrent meningitis.
- ▶ In aseptic meningitis, elevated levels of triglyceride and cholesterol in the cerebrospinal fluid should raise the possibility of an intracranial or intraspinal dermoid or epidermoid cyst (congenital cholesteatoma).
- ▶ Diffusion-weighted imaging MRI helps differentiate congenital cholesteatoma from other diagnoses within the petrous apex.
- ▶ Petrous apex cholesteatoma is difficult to manage due to the complexity of surgery and high rates of recidivism. It should, therefore, be managed by a specialist neuro-otologist, preferably from within the setting of a skull base multidisciplinary team.

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