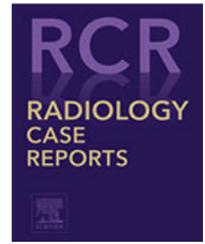


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Case Report

Intracranial neurenteric cyst with post-operative chemical meningitis and vagal nerve palsy[☆]

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ABSTRACT

Intracranial neurenteric cysts are rare congenital lesions that, though benign, are difficult to diagnose radiologically given their similar imaging appearance to other intracranial cystic lesions. We present a case of a 21-year-old female with a pathologically proven, symptomatic neurenteric cyst in the premedullary cistern. Superimposed on this uncommon diagnosis were also rare post-operative complications of chemical meningitis and vagal nerve injury. We review the current literature surrounding intracranial neurenteric cysts, their imaging characteristics, differential diagnosis, therapeutic options, and potential complications related to their resection.

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Introduction

Neurenteric cysts are rare, benign, congenital central nervous system lesions derived from the embryonic endoderm. Although they primarily occur in the spine, intracranial neurenteric cysts are exceedingly rare, and difficult to diagnose pre-operatively given their significant imaging similarities with other intracranial cystic lesions. We present a case of a pathologically proven intracranial neurenteric cyst, review the current literature surrounding this uncommon entity and highlight chemical meningitis and brainstem and cranial nerve injuries as rare but important potential post-operative complications.

Case report

A 21-year-old female with a reported history of migraines, viral meningitis, and known intracranial mass presented with occipital headaches increasing in frequency and duration, bilateral tinnitus, and confusion.

She had initially presented to an outside facility at age 12 with a severe headache, at which time a non-contrast head CT showed premedullary hyperdensity interpreted as possible subarachnoid hemorrhage. Subsequent MRI demonstrated a 0.7 × 1.4 × 1.2 cm lobulated lesion along the ventral pontomedullary junction with hyperintense T1 signal, hypointense T2 signal, and no significant enhancement,

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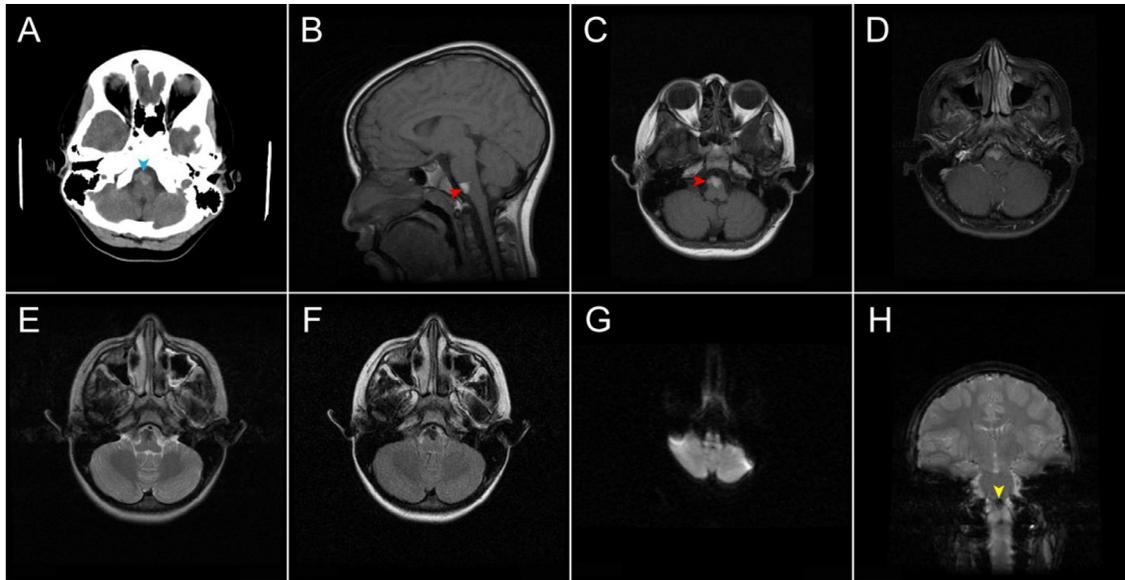


Fig. 1 – Imaging at initial presentation. Axial non-contrast head CT image at the level of the medulla (A) shows a hyperintense, lobulated lesion in the premedullary cistern (blue arrowhead). sagittal (B) and axial (C) T1-weighted MRI demonstrate a corresponding hyperintense mass (red arrowheads) that does not significantly enhance or suppress on the post-contrast T1-weighted, fat-suppressed sequence (D). The mass is hypointense on T2-weighted (E) and T2/FLAIR (F) images, and there is no appreciable diffusion abnormality (G). The coronal T2*-weighted sequence (H) does, however, reveal associated susceptibility artifact (yellow arrowhead) (Color version of the figure is available online.).

diffusion restriction, or fat suppression (Fig. 1). MR spectroscopy was reportedly also performed and notable only for a large lipid peak. A differential diagnosis of hemorrhagic dermoid cyst or slow-flow vascular malformation was provided, and surveillance imaging was recommended. Over the next 5 years, MR imaging showed gradual enlargement of the mass by up to 5 mm without change in signal characteristics, and the differential diagnosis was broadened to include a white epidermoid cyst or neurenteric cyst.

She was then lost to follow up for the next 4 years, which ended with her current presentation to our facility with increasing symptoms as described. Repeat MRI showed further enlargement of the premedullary mass, which nevertheless remained unchanged in MR signal characteristics (Fig. 2). Given the increasing size of the lesion and its symptomatic nature, a decision was made to proceed with surgical intervention, and a right retrosigmoid approach resection was performed.

Intraoperatively, the tumor capsule was cut and the majority of the debulking was performed by suctioning and curetting. The portion of the tumor adjacent to the brainstem, however, was firm and needed to be dissected free with microscissors; left-sided motor evoked potentials were lost during removal of this portion of the mass and remained absent at the conclusion of the case. Surgical pathology demonstrated histologic patterns consistent with neurenteric endodermal cyst with xanthogranulomatous change based on the presence of pseudostratified columnar epithelium, goblet cells, diffuse foamy macrophages, and scattered cholesterol clefts.

Following the surgery, the patient experienced left upper and lower extremity weakness and decreased sensation as

well as dysphagia and dysphonia. Post-operative MRI showed edema in the right medullary pyramid at the site of the corticospinal tract (Fig. 3) and diffuse leptomeningeal enhancement and sulcal FLAIR signal abnormality concerning for chemical and/or aseptic meningitis (Fig. 4). The patient was treated with a 7-day tapered course of dexamethasone. In addition, during her recovery, she was found laryngoscopically to have right true vocal fold paralysis, suspected secondary to high vagal nerve injury, for which she was treated with injection laryngoplasty. She was discharged in stable condition for inpatient rehabilitation with speech and language therapy.

Discussion

Neurenteric cysts are benign, congenital central nervous system lesions derived from the embryonic endoderm. They are estimated to account for only 0.03% of intracranial lesions [1], with up to 140 cases of histologically-confirmed intracranial neurenteric cysts reported in the literature as of 2011 [2]. While their etiology is not completely understood, it is generally agreed that these cysts form due to incomplete resorption of the neurenteric canal, leading to persistent endodermal-ectodermal adhesions from failure of separation of the notochord, and foregut. Alimentary cells that migrated and assimilated may eventually form the cyst [3]. As a result, these cysts tend to demonstrate characteristic pseudostratified columnar epithelium with varying amounts of mucin-producing cells, with the cyst itself containing clear mucoid or xanthochromic proteinaceous contents [4,5]. Although these

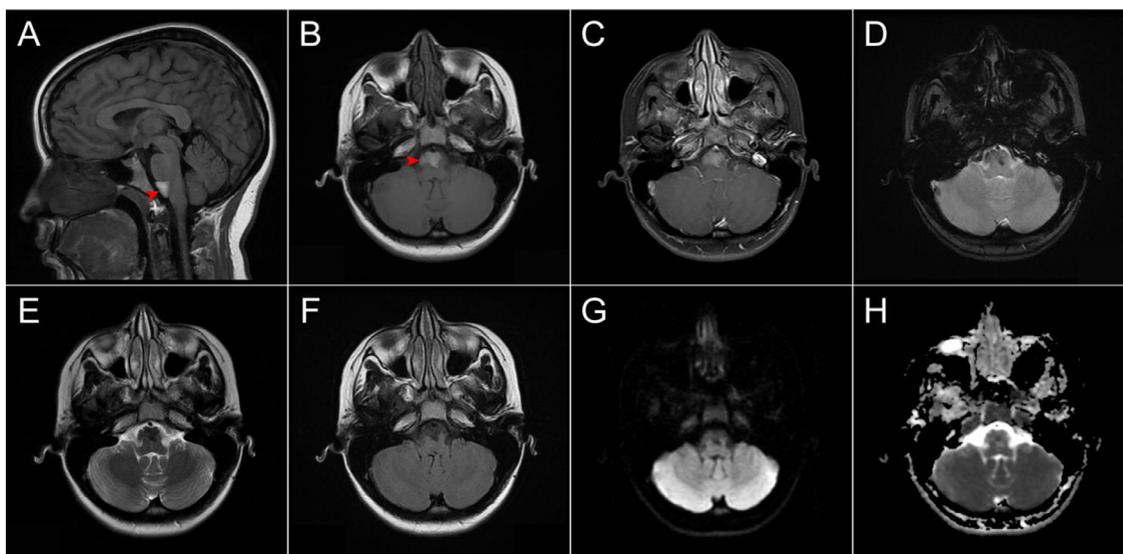


Fig. 2 – Pre-operative MR imaging including sagittal T1-weighted (A) and axial T1-weighted (B), post-contrast T1-weighted fat-suppressed (C), T2*-weighted (D), T2-weighted (E), T2/FLAIR (F), diffusion trace (G), and ADC (H) images. A T1-hyperintense, T2-hypointense, non-enhancing extra-axial mass is seen in the premedullary cistern at the pontomedullary junction (red arrowheads) (Color version of the figure is available online.)

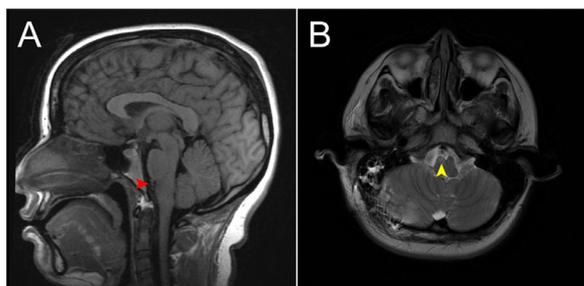


Fig. 3 – Post-operative sagittal T1-weighted (A) and axial T2-weighted (B) images show changes of a right retrosigmoid approach resection with a trace amount of T1-isointense debris in the premedullary cistern (red arrowhead) and edema within the right medullary pyramid (yellow arrowhead) (Color version of the figure is available online.)

cysts may be asymptomatic and discovered incidentally, patients can present with chronic headaches characterized as migraine or tension-type in addition to cranial nerve deficits, as in this case. Less commonly, they can present with motor and sensory deficits, seizures, or chemical and/or aseptic meningitis due to leakage from the cyst [4,6,7].

The spectrum of imaging characteristics for neurenteric cysts can be broad with a differential diagnosis including epidermoid cysts, arachnoid cysts, Rathke cleft cysts, and colloid cysts [3,4]. Intracranial neurenteric cysts are usually located in the posterior fossa, midline, and anterior to the medulla. Up to 3 times more often, neurenteric cysts arise along the ventral aspect of the spinal cord [3,8]. However, very rarely, they can occur in the supratentorial region. Regardless of location, they

usually measure less than 2 cm. Depending on the cyst protein contents, findings with both CT, and MRI imaging vary significantly. On CT, they usually appear hypodense with no contrast enhancement but can occasionally appear hyperdense (as in our case) and may have cyst wall enhancement [2]. MRI is the preferred modality in evaluating intracranial cystic masses [9]. Neurenteric cyst signal characteristics may vary depending on the proteinaceous content within the cyst, but they tend to be isointense or hyperintense on T1-weighted imaging and nonenhancing. On T2-weighted imaging and FLAIR, they are typically hyperintense (though highly viscous or proteinaceous contents may induce T2 shortening as in our case), and they may show mild restriction on diffusion-weighted imaging. Biochemical analysis usually demonstrates protein and cholesterol content within the cyst, which may explain the initial MR spectroscopy findings in this patient.

Neurenteric cysts can be most easily differentiated from other endodermal cysts based on location, as colloid cysts usually arise in the foramen of Monro and Rathke cleft cysts occur in their intrasellar and/or suprasellar eponymous region [3]. Arachnoid cysts can also be easily distinguished by their off-midline location and characteristic CSF signal on all sequences. It can be more difficult to differentiate neurenteric cysts from the rare white epidermoid cysts, which have hyperintense T1 signal compared to classic epidermoid cysts due in part to their high protein content. Like neurenteric cysts, white epidermoids also appear hyperintense on T1-weighted images, show variable T2 signal intensity, and may be located along the midline.

Management of neurenteric cysts depends on their location, which determines resectability. The standard treatment for symptomatic intracranial neurenteric cysts is total excision, often through a retrosigmoid craniotomy approach [8,10,11]. However, this may not always be possible, for exam-

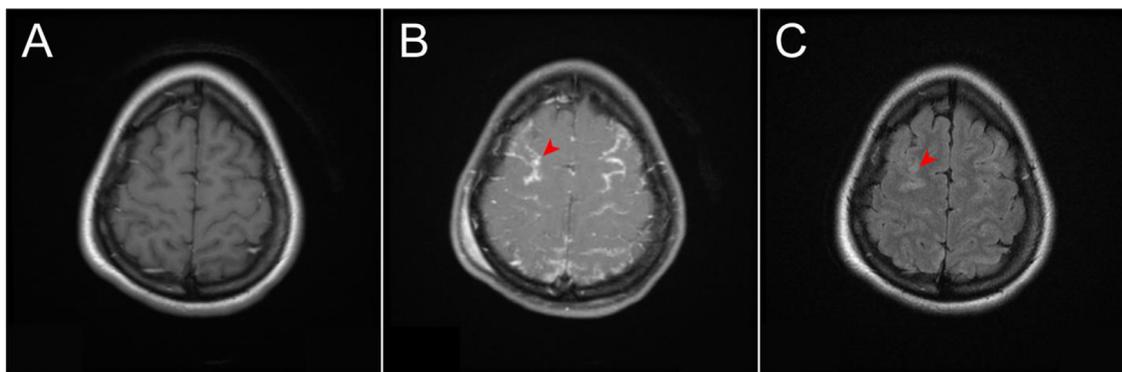


Fig. 4 – Post-operative axial T1-weighted (A), post-contrast T1-weighted (B) and T2/FLAIR (C) images reveal features of chemical meningitis including diffuse leptomeningeal enhancement and sulcal FLAIR hyperintensity (red arrowheads) without corresponding intrinsic T1 signal abnormality (Color version of the figure is available online.)

ple, when the cyst is adherent to brain or spine parenchyma or adjacent vascular structures. Conservative management with anti-inflammatory agents and close clinical and radiologic follow-up may also be preferred for patients who are clinically stable and carry significant risk of surgical complications. Cyst fenestration is also being explored as an alternative form of management; recently, Ogulnick et al described a case of intracranial neurenteric cyst fenestration using a retrosigmoid approach to access the cerebellopontine angle lesion. Post-operative neuroimaging demonstrated no residual mass after the fenestration, no post-operative complications were reported, and the patient remained symptom-free. However, incompletely excised neurenteric cysts are linked to a recurrence risk ranging from 12%-37% over a span of 4 months to 14 years [10], with associated morbidity.

While intracranial neurenteric cysts are uncommon congenital lesions, chemical meningitis as a post-operative complication is considered even more rare. Chemical or aseptic meningitis is defined as meningitis with sterile cerebrospinal fluid Gram stain and culture, and resolution of symptoms without antibiotic therapy [12]. The mechanism of action is believed to be secondary to the leakage of cyst contents into the subarachnoid space [2]. To date, several cases of chemical meningitis as a result of leakage of intracranial cystic contents have been described in the literature, including a recurrent case of chemical meningitis caused by a leaking craniopharyngioma [13] and a few cases related to ruptured epidermoid cysts [14,15] and ruptured dermoid cyst [16]. Since the occurrence of neurenteric cysts is exceedingly rare in comparison to the other intracranial lesions, cases of chemical meningitis in association with neurenteric cysts are quite uncommon. Chemical meningitis may be present pre-operatively, as illustrated by a case of intracranial neurenteric cyst that was diagnosed as a result of the chemical meningitis producing the presenting symptoms [7]. More commonly, though, chemical meningitis is seen in the post-operative setting. In a retrospective review of 7 patients undergoing surgical treatment of intracranial neurenteric cysts in an 8 year institutional review, 4 patients developed chemical meningitis post-operatively with symptom resolutions in 24 hours after dexamethasone treatment initiation [9]. In another 14-year in-

stitutional review, 1 of 6 patients with intracranial neurenteric cysts developed chemical meningitis post-operatively [1]. We note that in both of these reviews, definitive pre-operative diagnosis of the lesions was difficult given the highly variable imaging features, and the differential considerations included epidermoid cysts, arachnoid cysts, and schwannomas [1,9].

Additionally, post-operative vagal palsy is a rare complication of cerebellopontine angle surgery. Unilateral vocal cord paralysis is usually caused by lower laryngeal nerve damage and rarely high vagal lesions. In a 7-year institutional review of patients undergoing laryngoplasty due to swallowing or voice disturbances, only 17 of 186 patients were diagnosed with unilateral high vagal damage. Of these 17 patients, 11 developed vagal palsy suddenly rather than gradual loss of vagal function, with 6 after skull base surgery, 4 after skull base fractures with associated hemorrhage, and 1 after a cerebrovascular accident [17]. Consistent with these findings, another 3 year institutional review found that of 181 patients undergoing resections of cerebellopontine angle masses, only 19 (10%) developed unilateral vagal palsy post-operatively. Reviewing the different risk factors, including tumor pathology, surgical approach (suboccipital craniotomy vs translabirithine approach), and prior treatment (stereotactic radiation or prior surgery), only tumor size was cited as the statistically significant risk factor. Interestingly, each millimeter increase in tumor size was associated with an 8% increased risk of post-operative vagal nerve palsy [18].

Conclusion

Neurenteric cysts are benign, congenital central nervous system lesions that rarely occur intracranially. These lesions are difficult to diagnose pre-operatively given the variable imaging features and overlap with other cystic intracranial masses. Our case report highlights the challenges in pre-operative diagnosis of these rare lesions and further illustrates rare post-operative complications associated with their resection, including chemical meningitis, and vagal nerve injury.

Patient consent

This patient signed an agreement to undergo procedures and treatments at our institution including imaging examinations, an agreement to have trainees participate in patient care, and an agreement to have photographs, video, and other images used for training and education purposes. We have suppressed all personally-identifiable information from this report, including all 18 HIPAA identifiers.

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