JOURNAL OF NEUROSURGERY:
Case Lessons

J Neurosurg Case Lessons 4(16): CASE22307, 2022
DOI: 10.3171/CASE22307

Endoscope-assisted far lateral craniotomy for resection of posterior fossa neurocysticercosis: illustrative case

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BACKGROUND Neurocysticercosis is a parasitic infection that commonly affects the ventricles, subarachnoid spaces, and spinal cord of the central nervous system. The authors report an unusual manifestation of purely posterior fossa neurocysticercosis treated with endoscope-assisted open craniotomy for resection.

OBSERVATIONS A 67-year-old male presented with 2 months of progressive dizziness, gait ataxia, headaches, decreased hearing, and memory impairment. Imaging revealed an extra-axial cystic lesion occupying the foramen magnum and left cerebellopontine angle with significant mass effect and evidence of early hydrocephalus. Gross-total resection was accomplished via a left far lateral craniotomy with open endoscopic assistance, and pathological findings were consistent with neurocysticercosis. Postoperatively, he was noted to have a sixth nerve palsy, and adjuvant therapy included albendazole. By 9 months postoperatively, he exhibited complete resolution of an immediate postoperative sixth nerve palsy in addition to all preoperative symptoms. His hydrocephalus resolved and did not require permanent cerebrospinal fluid (CSF) diversion.

LESSONS When combined with traditional skull base approaches, open endoscopic techniques allow for enhanced visualization and resection of complex lesions otherwise inaccessible under the microscope alone. Recognition and obliteration of central nervous system neurocysticercosis can facilitate excellent neurological recovery without the need for CSF diversion.

https://thejns.org/doi/abs/10.3171/CASE22307

KEYWORDS neurocysticercosis; endoscopic; far lateral; posterior fossa

Neurocysticercosis is a parasitic infection resulting from ingestion of contaminated pork or contact with feces of infected humans carrying the tapeworm *Taenia solium,* with spread occurring through ingestion of eggs or gravid proglottids via the fecal-oral route.[1] The parasite is endemic in developing countries and is the most common cause of acquired epilepsy worldwide but rare in the United States.[2,3] However, there is increasing prevalence in the United States because of increased globalization and travel. Thus, it is important to illustrate appropriate treatment options to eradicate the disease.[4] The varied presentation of the disease invites a wide differential that may be difficult to diagnose. Cysts usually present in the ventricles, subarachnoid spaces, or spinal cord. Common clinical presentations are usually due to mass effect or inflammation resulting in seizures, increased intracranial pressure, focal neurological deficits, and cognitive deficits depending on the location of infection and stage of disease.[1,3]

Minimally invasive procedures are increasing in use across many surgical fields, including neurosurgery, due to the benefits of sparing healthy structures during the procedure.[5] Despite its challenges involving small anatomical space in the skull, neuroendoscopic procedures are becoming more popular in the treatment of neurocysticercosis particularly in the treatment of intraventricular cysts.[6,7] However, guidelines remain unclear on the role of neuroendoscopic surgical approaches for extraventricular cysts.[7] We present a case of neurocysticercosis in the unusual location of the posterior fossa treated by endoscope-assisted open surgery resulting in complete resection and resolution of neurological symptoms.

ABBREVIATIONS CN = cranial nerve; CSF = cerebrospinal fluid; CT = computed tomography; MRI = magnetic resonance imaging.
INCLUDE WHEN CITING Published October 17, 2022; DOI: 10.3171/CASE22307.
SUBMITTED July 20, 2022. **ACCEPTED** August 25, 2022.

Illustrative Case

A 67-year-old male presented with 1 month of progressive dizziness, gait ataxia, headaches, severe nausea and vomiting, decreased hearing on the left, and memory impairment. Mental status was normal. Cranial nerve examination was pertinent for a rightward beating nystagmus with greater velocity on rightward gaze, as well as decreased left-sided hearing. Motor strength was 5/5 bilaterally, sensation was intact in all extremities, and deep tendon reflexes were 2+. Romberg test was negative. Computed tomography (CT) imaging of the head showed a hypoattenuating lesion involving the left cerebellopontine angle/left cerebellar medullary cistern with mass effect on the pons and enlargement of the ventricular system concerning for communicating hydrocephalus (Fig. 1A). Magnetic resonance imaging (MRI) revealed a large, cystic, multiseptated, nonenhancing, T1-hypointense (Fig. 1B) and T2-hyperintense lesion without contrast enhancement or diffusion restriction (Fig. 1C and D). The lesion extended transaxially measuring 2.3 $\times$ 5.9 cm across the lower brainstem and rostro-caudally measuring 9 cm from Meckel's cave to the level of C2. There was displacement of the lower cranial nerves (CNs) including the CN VII/VIII complex with severe mass effect on the left brainstem and posterior fossa. There was no sign of a focal enhancing nodule or tumor. At this time, a diagnosis remained elusive, and the decision was made to resect the lesions as both a therapeutic and diagnostic procedure.

The lesions were resected via a left far lateral craniotomy with C1 hemilaminectomy, with endoscopic assistance. Intraoperatively, the microscope was originally used to help visualize the removal of multiple discrete cysts that looked consistent with parasitic infection within the posterior fossa. Once all visualized cysts were removed, a 45-degree endoscope was introduced to further inspect the jugular foramen and left acoustic meatus in all directions revealing two additional cysts that extended across the midline toward the patient's right that were removed (Fig. 2). Final pathology report confirmed neurocysticercosis (Fig. 3). No anesthesia or surgery complications were noted.

On postoperative day 1, MRI revealed gross total resection with good decompression of brainstem cysts with expected postsurgical changes. Postoperative examination was notable for a left sixth, seventh, and eighth nerve palsies, and gait instability with dizziness. He wore an eyepatch on his left eye to address his postoperative diplopia, which improved with regression of postsurgical edema. The patient was started on a course of albendazole 600 mg twice a day for 14 days and was discharged on postoperative day 6. He returned to clinic 2 weeks later for mild wound dehiscence with cerebrospinal fluid (CSF) drainage, treated by oversewing the wound. A week later, the patient presented to the emergency department for severe headache with vomiting. CT head revealed a pseudomeningocele without evidence of hydrocephalus. He had no signs of infection with no neck stiffness or leukocytosis, thus lumbar puncture was deferred at this time. By 2-month follow-up, the pseudomeningocele completely resolved.

By the 9-month follow-up, the patient experienced complete resolution of his abducens nerve palsy, facial nerve palsy, preoperative gait ataxia, memory impairment, dizziness, and headaches. One-year postoperative MRI showed no recurrence of the cysts (Fig. 4).

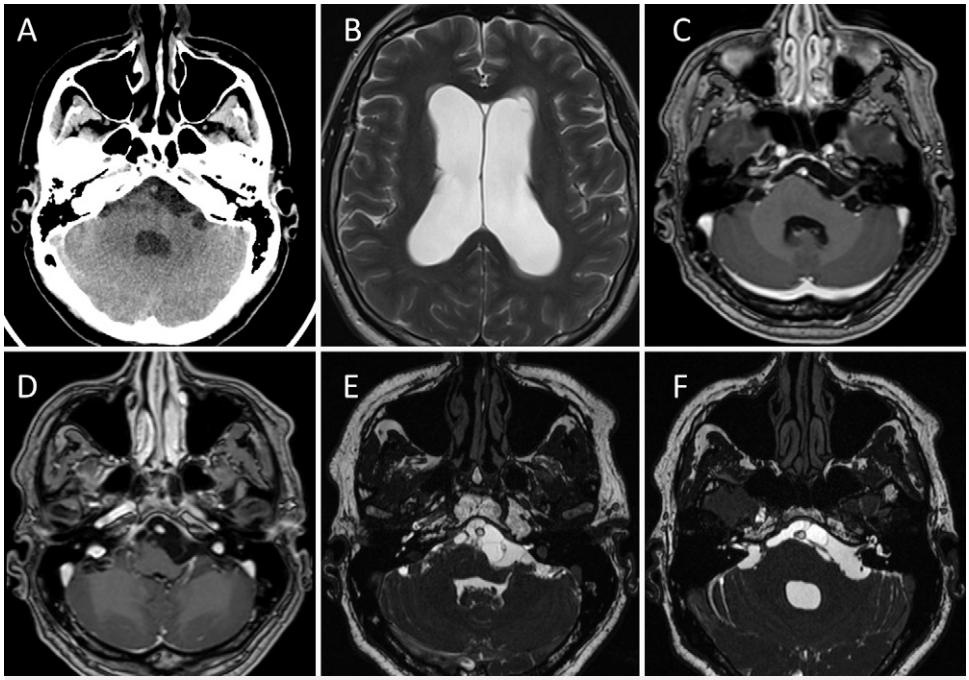

FIG. 1. Preoperative noncontrast CT (**A**) and T2-weighted magnetic resonance (**B**) images show evidence of an extra-axial cystic lesion with associated hydrocephalus. Postcontrast axial T2-weighted MRI (**C and D**) and axial fast imaging employing steady-state acquisition (FIESTA) MRI (**E and F**) show evidence of extensive lesions primarily at the left cerebellopontine angle causing mass effect onto the pons. Displacement of the left cranial nerves can be appreciated.

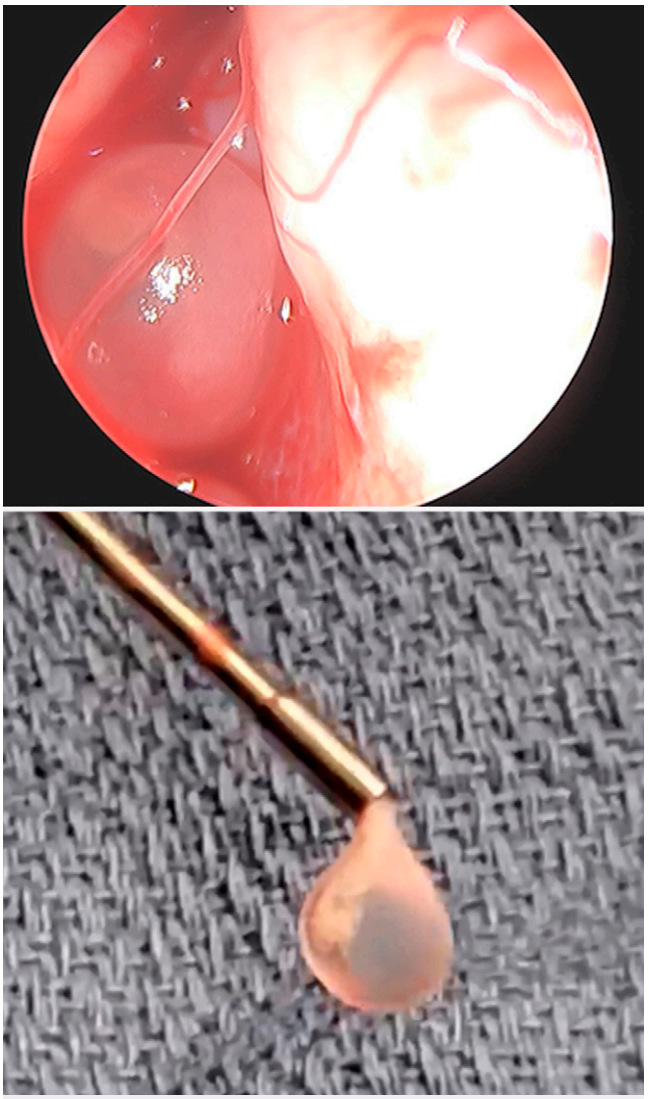

FIG. 2. Intraoperative pictures of intact cysts in the posterior fossa visualized by the endoscope (**upper**). With adequate visualization, full resection of intact cysts was possible (**lower**).

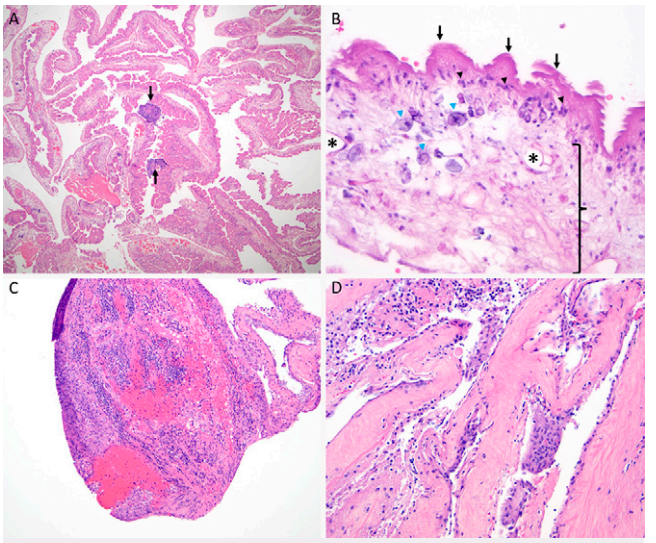

FIG. 3. Microscopic examination of the pathological tissue. A low-power view (hematoxylin and eosin [H&E], original magnification ×40) of the parasitic cyst wall (**A**) shows primarily strips of parasite cyst wall with focal host giant cell reaction and lymphocytes (*arrows*). A higher power view (H&E, original magnification ×400) of the parasitic cyst (**B**) showing three main layers: an outer cuticular layer (*arrows*) shows convoluted contour with rounded protrusions/knobs and microtriches on the surface; a cellular layer (*black arrowheads*) comprised of cell bodies with small nuclei; and an inner reticular layer (*brace*) shows loose connective tissue, calcifications (*blue arrowheads*) and excretory canaliculi (*asterisks*). An intact larva with scolex and hooklets was not identified; thus, the findings were most compatible with the cysticercus racemous form of *Taenia solium*. **C and D:** Surrounding host tissues, which are comprised of a fibrous pseudocapsule and associated inflammation, comprised of primarily histiocytes and lymphocytes. H&E, original magnification ×100 (C) and original magnification ×200 (D)

Discussion

Observations

This case presents a novel approach of utilizing endoscopic assistance in the surgical treatment of an uncommon presentation of neurocysticercosis. Neurocysticercosis is most commonly intraparenchymal in locations such as the gray-white matter junctions and the subarachnoid sulci, or it can also commonly be found intraventricularly in the third or fourth ventricles. However, it is also rarely found in locations such as the sylvian fissure, medullar space, or spinal cord.[8–10] Our patient presented with cysts in a rare location with extensive racemose cystic lesions in the posterior cranial fossa, compressing medullary and pontine structures. This unusual location presented a challenging approach for the full resection of lesions.

Endoscope-assisted neurosurgery is a continuously evolving field with the advancement of technology and development of advanced techniques. Since its inception, it has gained popularity in an increasing number of operations but remains limited by current instruments and surgeon skills. A study conducted by Proaño et al.[11] described the role of minimally invasive flexible endoscopy neurosurgery in the management of subarachnoid basilar cistern neurocysticercosis showing improved patient outcomes due to full exploration of the basilar cistern space and complete cyst extraction when compared to ventriculoperitoneal shunt placement with pharmacological treatment. Similarly, as seen with this case, endoscope-assisted neurosurgery can help minimize postoperative complications and result in complete resolution of clinical symptoms of neurocysticercosis. Despite the extensive lesions, this minimally invasive approach allowed for the complete resection of all cysts without extensive postoperative complications. This favorable outcome illustrates the benefits of endoscopy within neurosurgery and emphasizes the importance of further developing the technology and skills in the field to a wider range of operations.

Lessons

Open endoscope-assisted neurosurgical techniques can facilitate the resection of complex lesions by providing endoscopic navigation of small corridors within the skull base. This can maximize therapeutic potential by providing substantial visualization of anatomy while avoiding retraction or subsequent mass effect on surrounding

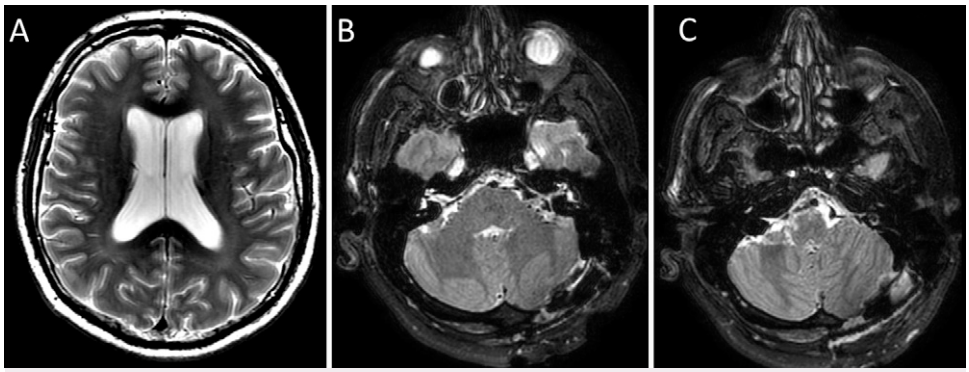

FIG. 4. One-year postoperative T2-weighted MRI showed no recurring lesions and decompression of the ventricular system.

healthy neural tissue, thereby avoiding many postoperative complications associated with traditional open approaches.

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Disclosures

The authors report no conflict of interest concerning the materials or methods used in this study or the findings specified in this paper.

Author Contributions

Conception and design: Rutkowski. Acquisition of data: Rutkowski, Fang, Banerjee. Analysis and interpretation of data: Rutkowski, Barrett. Drafting the article: Rutkowski, Fang, Banerjee, Gilbert. Critically revising the article: Rutkowski, Fang, Banerjee, Barrett. Reviewed submitted version of manuscript: Fang, Barrett, Gilbert. Approved the final version of the manuscript on behalf of all authors: Rutkowski. Administrative/technical/material support: Fang, Banerjee. Study supervision: Rutkowski. Selected imaging: Gilbert.

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