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Technical Note

Single-port endoscopic removal of intraventricular central neurocytoma

Cheng-Hsin Cheng, Chun-Lin Liu, Chun-Chung Chen *, Shinn-Zong Lin, Der-Yang Cho

Department of Neurosurgery, Stroke Center, Center for Neuropsychiatry, China Medical University Hospital, No. 2, Yu-Der Road, Taichung 404, Taiwan

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ABSTRACT

Central neurocytoma is a rare benign intraventricular tumor which occurs in young adults. Craniotomy with tumor removal is associated with relatively high rates of morbidity and mortality. To improve the efficiency of endoscopic surgery for removal of this tumor, we used a polypropylene tube combined with a working channel endoscope. From January 2006 to October 2008, three patients with intraventricular central neurocytoma with acute hydrocephalus were treated by endoscopic surgery in our hospital. The tumor was almost totally removed. At 6-month follow-up no recurrence was found. One patient required a permanent ventriculoperitoneal shunt due to hydrocephalus during follow-up. We report that a working channel endoscope combined with a polypropylene endoscopic sheath facilitates the removal of intraventricular central neurocytoma. Endoscopic neurosurgery is a safe method for removing a central neurocytoma with low risk of permanent neurological deficits.

1. Introduction

Management of intraventricular tumors is controversial. Direct traditional approaches, such as the transfrontal, transcortical, and transcallosal routes to the ventricular system, may expose the patient to a high risk of morbidity.[1] Endoscopic neurosurgery is effective and commonly used in the management of non-communicating hydrocephalus and intracranial cysts, and in tumor biopsy procedures. The use of endoscopes for removal of intraventricular brain tumors has typically been reserved for cystic tumors such as colloid cysts and inclusion cysts.[2] Endoscopic removal of solid brain tumors has less commonly been reported.[3] Although minimally invasive endoscopy reduces operative trauma compared with conventional neurosurgical techniques,[4] some authors report it to be relatively inefficient for removal of intraventricular lesions.[5,6] In our opinion, because conventional neuroendoscopy uses rigid endoscopes with one or two working channels and a dual-port technique, the instruments are limited for removal of the lesion. To attain a wider corridor for more feasible maneuverability of surgical instruments, we designed an endoscopic sheath to guide the endoscope and surgical instruments to remove intraventricular tumors. Here we present three patients who underwent endoscopic resection of a central neurocytoma.

2. Materials and methods

2.1. Endoscopic sheath and endoscopy

A 10-cm long, rigid endoscopic sheath made of polypropylene was used in combination with a 14F Foley catheter as a stylet. The endoscopic sheath had a 7-mm outside diameter and 6-mm working channel (Fig. 1). A 2.7-mm 0° rod-lens working channel endoscope (Karl-Storz, Tuttlingen, Germany) was used for illumination. A 2.5-mm diameter suction tube was manually inserted and passed through the remaining space within the sheath.

2.2. Patient population

From January 2006 to October 2008, three patients with an intraventricular central neurocytoma were treated by endoscopic surgery in our hospital. The surgical indication was intraventricular tumor with acute hydrocephalus.

2.3. Surgical procedure

The patient was placed in the supine position while under general anesthesia. The patient's head was fixed in a 3-pin head holder. A 3-cm skin flap was made in the frontal scalp. The tumor was approached from a single burr hole (1-cm diameter) on the ipsilateral side approximately 3 cm from the midline and 2 cm anterior to the coronal suture (Fig. 2). A transcortical transventricular puncture was performed with the 7-mm rigid polypropylene endoscopic sheath. When the ventricle was emtered, the Foley

* Corresponding author. Tel.: +886 4 2205 2121x5034; fax: +886 4 22344055.
E-mail address: cck36701@ms21.hinet.net (C.-C. Chen).

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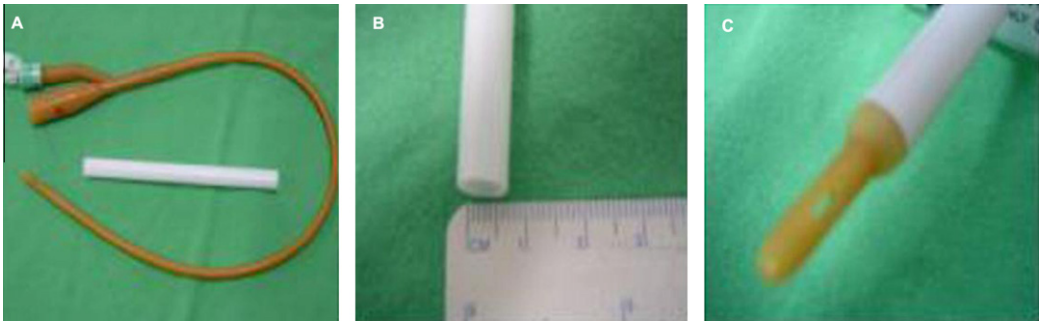

Fig. 1. Photographs showing: (A) the rigid polypropylene endoscopic sheath and a 14F Foley tube used as endoscopic stylet; (B) the inner diameter of sheath is 6 mm; and (C) the 14F Foley tube balloon set up as the endoscopic sheath stylet. This figure is available in colour at www.sciencedirect.com.

stylet was removed and a 2.7-mm 0° endoscope and a suction tube were inserted through this tube. Following entry into the ventricular compartment, normal anatomical landmarks including the choroid plexus, venous tributaries, and the septum pellucidum were identified to establish orientation. A central neurocytoma is usually grayish and friable, with cystic degeneration and hemorrhagic areas (Fig. 3A, B). We used the suction tube to aspirate the tumor after the tube was completely embedded within the tumor tissue (Fig. 3C). When tissue such as choroid plexus is being suctioned, the suction pressure can be controlled by an assistant. The degree of suction can be regulated to remove friable tumor tissue rather than the more solid parenchymal interface. As part of the tumor is removed, active bleeding from the choroidal vessels will be encountered. The suction tube can be replaced with a 3-mm unipolar suction-coagulation tube to cauterize bleeding (Fig. 3D). If persistent bleeding is a problem, placing a small piece of cotton for compression is helpful. Continuous irrigation can help to maintain clear image transmission and reduce bleeding. The tumor can be removed completely if the bleeding is carefully monitored and the tumor excised piece-by-piece.

After the suction tube has been used for gross total resection of the tumor, to avoid delayed hydrocephalus related to intraventricular hemorrhage, cerebrospinal fluid (CSF) should be drained via an external ventricular drain until the fluid is clear.

Fig. 2. Photograph showing the head fixed in a 3-pin head holder with a 3-cm skin flap in the frontal scalp (3 cm from the midline and 2 cm anterior to the coronal suture). This figure is available in colour at www.sciencedirect.com.

2.4. Illustrative case

A 23-year-old female complained of progressive headache for 3 months, accompanied by dizziness and double vision. The pain could last from hours to days and the frequency had increased during the 2 weeks prior to presentation. She had experienced headaches since junior high school. Neurologic examination showed horizontal diplopia, right abducens palsy, and bilateral papillary edema of the fundus. Her brain MRI revealed a lobulated mass 52 mm by 52 mm by 45 mm in the left lateral ventricle extending into the third ventricle (Fig. 4A, B). Magnetic resonance spectroscopy showed elevated *N*-acetyl aspartate. A burr hole was drilled to approach the left frontal horn because the major mass was located in the left lateral ventricle. The endoscope was inserted and gross total removal of the mass was performed. Minimal bleeding was cauterized with unipolar suction. The external ventricular drain was left for CSF drainage and for monitoring the intracranial pressure. The patient tolerated the procedure well. Pathological examination demonstrated a central neurocytoma. The immunohistochemistry stained positive for neuron-specific enolase and negative for glial fibrillary acidic protein. The MRI at 1 month postsurgery showed gross total resection. Postoperative radiation or radiosurgery was not suggested. There was no evidence of recurrence at the follow-up examination 6 months after surgery.

3. Results

The intraventricular central neurocytomas were nearly totally removed. At 6-month follow- up, no recurrent tumors were found. One patient required a permanent ventriculoperitoneal shunt due to hydrocephalus during follow-up.

4. Discussion

Central neurocytoma corresponding to World Health Organization grade II was first described by Hassoun et al. in 1982.[7] They coined the term to describe a neuronal tumor occurring in young adults located in the supratentorial ventricles.[7] This is a benign lesion with favorable prognosis after adequate surgical intervention. Since most central neurocytomas are centered on the septum pellucidum, the transcallosal or transcortical approach is typically the surgical choice. However, subtotal resection may result due to limited visualization and rich vascular supply.[8] Classic open surgery to remove intraventricular tumors has relatively high morbidity and mortality rates.[9] Endoscopic surgery to remove intraventricular tumors has a lower morbidity rate. Luther et al.[10] reported a low rate (3.5%) of hemorrhagic sequelae from neuroendoscopic procedures

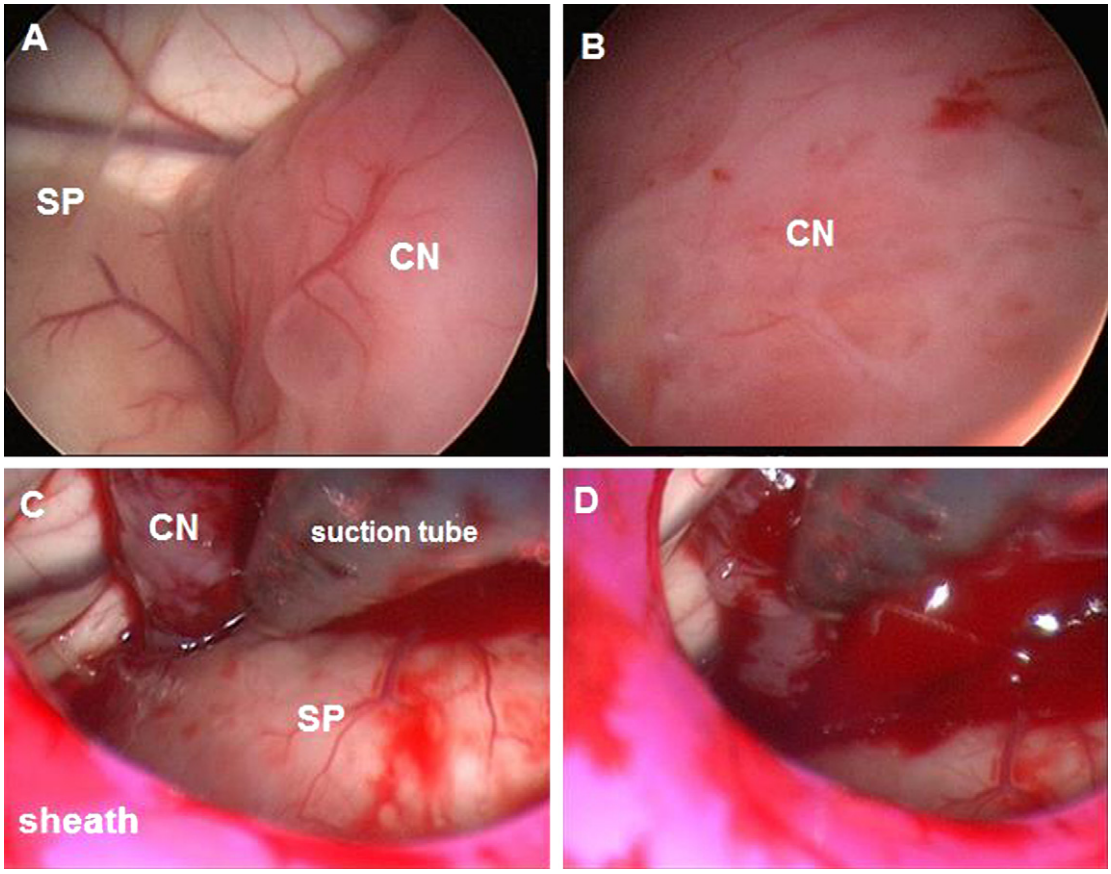

Fig. 3. Intra-operative photographs showing: (A, B) vascular, soft and friable central neurocytoma (CN) which attaches attaches to the septum pellucidum (SP); (C) suction to aspirate the tumor, after a specimen was removed for pathology; (D) active bleeding cauterized using the unipolar suction tube.

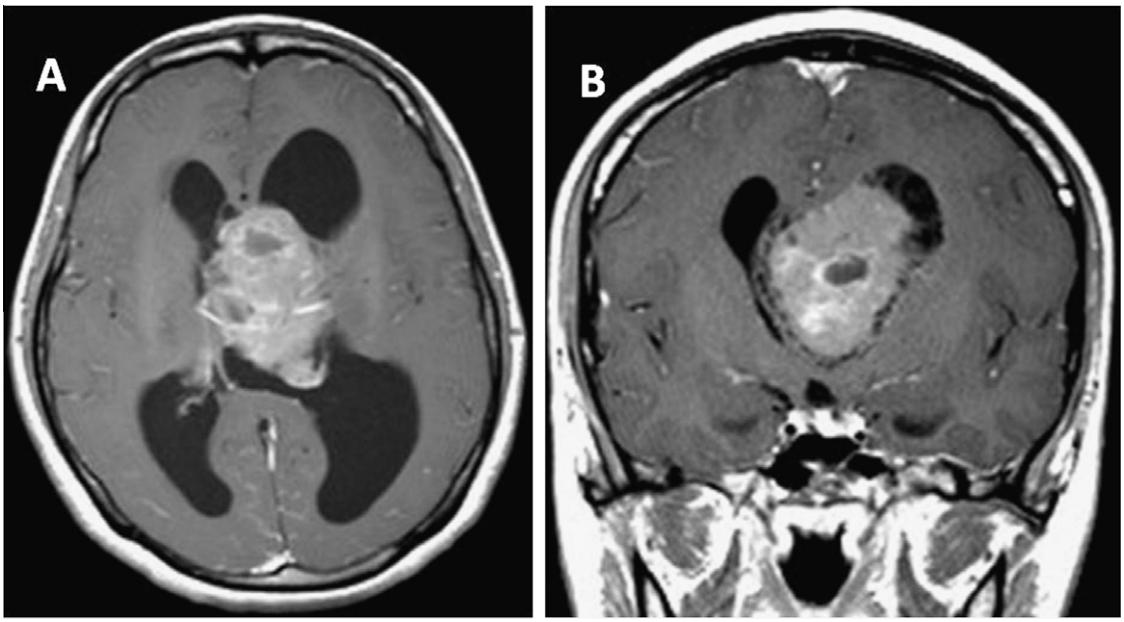

Fig. 4. Contrast-enhanced (A) axial and (B) coronal T1-weighted brain MRI showing a lobulated mass 52 by 52 by 45 mm attached to the septum pellucidum with obstructive hydrocephalus.

for intraventricular tumors. In our series, complete tumor removal with radiographic confirmation was accomplished by endoscopic tumor resection in three patients. No patient experienced significant complications from surgery.

In conventional neuroendoscopy, rigid endoscopes with one or two working channels and a dual-port technique are used,[2–5] which limits the number of endoscopic instruments that can be employed for lesion removal. In conventional endoscopy, bipolar

and monopolar diathermy probes, as well as a laser in a fluid environment are used because CSF is not removed from the ventricles. Excessive electrocoagulation or the laser may induce thermal injuries. We report a novel combination of neuroendoscopy and microsurgery, with a single-port technique to remove intraventricular tumors. Endoscopic access to the ventricle was achieved with an endoscopic sheath. In our technique, a rigid endoscope was used as a visualization tool, and microsurgical instruments were used for lesion removal via a 7-mm diameter endoscopic sheath conduit. The endoscopic sheath conduit provided an adequate but small corridor to accommodate both the endoscope and the microsurgical instruments.

Our method has several advantages for surgical treatment of a central neurocytoma. First, the approach only requires a single burr hole, the skin flap is small, and it reduces superficial brain retraction with less iatrogenic trauma to the neighboring structures when compared to microsurgery. This allows faster recovery and shortens the hospitalization stay. Second, the technique allows for simultaneous tumor removal and hemostasis. Third, it provides excellent visualization; inspection of hidden corners reveals anatomical details that are not precisely visible in the zoomed, and thus light-reduced, beam of the microscope.[11]

Patient selection is the key to successful endoscopic neurosurgery. The ideal tumor for endoscopic resection should have the following characteristics: moderate vascularity, soft consistency, small diameter, associated hydrocephalus, low histological grade, and location inside the lateral ventricle. A central neurocytoma is grayish, soft and friable, with cystic degeneration and hemorrhagic areas. It can easily be removed through a suction tube. A unipolar suction tube can be used to cauterize active bleeding. Moreover, central neurocytomas are often discrete, solitary masses near the foramen of Monro, most of which are attached to the septum pellucidum and expand into one or both lateral ventricles.[12] They are easily found by entering the frontal horn of the ventricle without disorientation. Hence, endoscopic surgery may be a good choice for treatment of a central neurocytoma.

5. Conclusion

A working channel endoscope combined with a polypropylene endoscopic sheath facilitates the removal of intraventricular central neurocytomas. Endoscopic neurosurgery is a safe method of removing central neurocytomas with a low risk of permanent neurological deficits.

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