Hydrocephalus secondary to stenosis of the foramen of Monro is rare. Foraminal stenosis has been attributed to infectious origins (particularly TORCH infections) causing inflammation and subsequent scarring in the region, congenital atresia, vascular malformations, and neoplastic processes, particularly thalamic or intraventricular tumors. Unilateral hydrocephalus from foraminal stenosis may be treated using shunting or endoscopic procedures. We report a case of idiopathic bilateral stenosis of the foramina of Monro causing obstructive hydrocephalus and describe an endoscopic technique used to treat this rare condition.

Case Report

History and Presentation. This patient was a 28-year-old woman with a 3-year history of headaches who presented with episodic near syncope and progressive lethargy. She had no history of meningitis or other inflammatory conditions. There were no focal neurological deficits on examination. The patient was normocephalic. Her fundoscopic examination was notable for papilledema. An MR image revealed enlargement of both lateral ventricles and a very small third and fourth ventricle consistent with stenosis of both foramina of Monro and patency of the cerebral aqueduct and fourth ventricular outlet (Fig. 1A and B). The patient began to receive acetazolamide, which provided some headache relief, but her symptoms returned shortly. She was referred to our center for further evaluation and treatment. After discussing the risks and benefits of various treatment options with the patient, including shunt placement and continued medical management, we recommended a Monro foraminoplasty and septostomy.

Operation. The patient was positioned supine on the operating table and placed in a Mayfield head holder. Using frameless stereotactic guidance, an incision and bur hole were made on the left coronal suture approximately 2 cm off midline, and a trajectory was planned toward the ipsilateral foramen of Monro. The left side was used in this instance because the right ventricle was slightly larger than the left, enabling a safer penetration into the contralateral frontal horn during septostomy.

After the dura was coagulated and incised, a 0° Aesculap MINOP endoscope with a Xenon light source was passed through a 14 Fr introducer sheath into the left frontal horn (Video 1).

**Video 1.** Clip showing the Monro foraminoplasty. Click here to view with Windows Media Player. Click here to view with Quicktime.

We confirmed our location by identifying the septum on the right side of our field. We visualized the left foramen on Monro, which was occluded by a thin, translucent membrane (Fig. 2). The choroid plexus appeared normal and there was no evidence of tumor.
Using bipolar and monopolar electrocautery, we made a large fenestration in the septum pellucidum and entered the right frontal horn through this septostomy (Fig. 3). We inspected the right foramen of Monro and found that it was not patent.

We removed the endoscope and switched to a 30° angled scope. We maneuvered into the left frontal horn again, tracing the choroid plexus to the occluded left foramen of Monro. The 5 Fr Fogarty catheter was advanced into this foramen and balloon-dilated the opening (Fig. 4). After the foramenoplasty, the orifice was patent, the third ventricle was visualized, and a brisk flow of CSF was noted. The endoscope was slowly removed and no bleeding was noted. A third ventriculostomy was not performed, as the cerebral aqueduct and fourth ventricular outflow were patent.

**Postoperative Course.** The patient was observed in the neurosurgical intensive care unit overnight and discharged on postoperative Day 2 without any complications. At the 1-month follow-up visit, the patient’s headaches and papilledema had resolved. She underwent MR imaging (Fig. 1C and D), which showed smaller ventricular caliber and expansion of the cortical subarachnoid spaces. She reported no headaches 1 year after surgery.

**Discussion**

Stenosis of the foramen of Monro, either unilateral or bilateral, is a rare occurrence. Infectious, neoplastic, vascular, and developmental causes have been implicated in this type of stenosis. Our patient had no history of an infectious condition, and there was no evidence of a neoplastic or vascular process on MR imaging or intraoperatively.

Endoscopic techniques have proven safe and effective in treating hydrocephalus caused by foraminal stenosis, and spare the patient the high lifelong cumulative risk of shunt failure. Fenestration of the foramen of Monro or septum pellucidum have been used for unilateral foraminal stenosis. In a series of 32 patients who underwent septostomy for isolated lateral ventricular hydrocephalus, the initial success rate was 53%, which increased to 81% with repeat procedures. Procedural risks include the inability to fenestrate the septum and intraventricular hemorrhage; these risks appear to be increased in the presence of distorted anatomy or a thickened septum. Compared with septostomy, there are no large series describing outcomes of foramenoplasty. However, 10 of 13 patients combined from recent series had acceptable outcome without the
Monro foraminoplasty

Foraminoplasty may be performed safely in the presence of a thin avascular membrane covering the foramen. However, if the foramen is atretic or obscured, there is increased risk of injury to the fornix. In this instance, shunting or septostomy may be performed.

By performing a septostomy and unilateral foraminoplasty, we were able to restore CSF flow in a patient with bilateral obstructions at the foramina of Monro. We did not believe an endoscopic third ventriculostomy was indicated because the third ventricle was small and there was no evidence of outflow obstruction. Postoperatively, the patient’s symptoms resolved, her fundoscopic examination results returned to normal, and her MR imaging results showed improvement in ventricular size with redistribution of the CSF along the cortical subarachnoid spaces. Potential complications of this endoscopic approach include injury to the nearby fornix, deep veins, or internal capsule, but are rare in our experience. In the presence of favorable anatomy, hydrocephalus caused by bilateral stenosis of the foramina of Monro may be effectively treated with endoscopic septostomy and unilateral foraminoplasty.

TABLE 1: Studies reporting the outcome of endoscopic fenestration of the foramen of Monro

<table>
<thead>
<tr>
<th>Authors &amp; Year</th>
<th>Age</th>
<th>Postop Ventricular Size</th>
<th>Follow-Up Period (no shunt required)</th>
<th>Postfenestration Day (shunt required)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mohanty et al., 1996</td>
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<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Oi et al., 1999</td>
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<td>unchanged</td>
<td>5 yrs</td>
<td>NR</td>
</tr>
<tr>
<td>Kumar, 1999</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
<td>NR</td>
</tr>
<tr>
<td>Wong &amp; Lee, 2000</td>
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<td>5</td>
</tr>
<tr>
<td></td>
<td>9 yrs</td>
<td>NR</td>
<td>14 mos</td>
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<td>12 mos</td>
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<td></td>
<td>8 yrs</td>
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* NR = not reported.

Disclosure

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 to the study and manuscript preparation include the following. Conception and design: all authors. Acquisition of data: all authors. Analysis and interpretation of data: all authors. Drafting the article: all authors. Critically revising the article: all authors. Reviewed final version of the manuscript and approved it for submission: all authors. Administrative/technical/material support: all authors. Study supervision: Harter.

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