Despite many advances in the management of hydrocephalus since valve-regulated shunts were introduced longer than half a century ago, treatment of hydrocephalus without the need for implantable shunt devices remains a reasonable goal. The level of enthusiasm for the management of hydrocephalus by performing endoscopic third ventriculostomy (ETV) as the initial treatment or at the time of shunt failure is increasing. Except in the very young, most patients with acute hydrocephalus can now be safely treated using this technique.

To date, a consensus on which patients are appropriate candidates for this procedure is lacking. Some patients with hydrocephalus related to an obstructive process at the level of the sylvian aqueduct are not ideal candidates for ETV because of clinical or anatomical factors. For these patients, cannulation of the sylvian aqueduct is an effective alternative and may eliminate the need for extracranial shunt treatment. In the November issues of the *Journal of Neurosurgery* and *Journal of Neurosurgery: Pediatrics*, two separate groups relate their experience with a new approach to treating such patients. The technique involves inserting an endoscope through the foramen of Magendie, traversing the fourth ventricle, and opening the aqueduct from below. Cannulation of the aqueduct through the fourth ventricle is not an entirely new concept. Lapras, who developed the catheter that bears his name and wrote about his experiences with its use, inserted the device into the aqueduct from the fourth ventricle. The expansive tip at each end of the catheter anchored it in the aqueduct. What is new about the techniques reported in the November issues is the use of minimally invasive techniques to open the aqueduct or to place a stent within it.

The methods described in both articles are similar. In one technique a significant amount of bone is removed so that a rigid endoscope can be inserted to perform the procedure. In the other technique the procedure is attempted using a smaller, steerable endoscope, which eliminates the need for bone removal in most cases. Both articles demonstrate that the procedure is feasible and can be performed with a relatively low complication rate.

Nevertheless, a number of questions remain. What patients should be selected to undergo this procedure? What surgeon should attempt to perform such a procedure and after what training? How is this procedure tailored to the needs of individual patients? After a large number of these procedures have been performed at a great number of centers, what will the rates of mortality and permanent morbidity be? What will the patients’ outcomes be? Is the risk of harm associated with this procedure equivalent to that associated with an ETV? Except for the last issue, these groups present some evidence to help answer these questions. The literature offers further clues.

Relative to patient selection, Gawish and colleagues have defined poor candidates for ETV as patients in whom there is a narrow space between the mammillary bodies and the dorsum sellae, those in whom the basilar artery (BA) lies near the floor of the third ventricle, and those in whom the floor of the third ventricle has herniated into the sella turcica. If a short-segment closure of the sylvian aqueduct was found in such patients, they were selected for treatment with this innovative technique.

Both groups of authors describe the risks associated with performing a third ventriculostomy, focusing particular attention on arterial injury and late sudden death. Unfortunately, neither article offers a denominator relating the percentage of patients treated with ETV or with shunt placement. This information would be quite helpful in analyzing selection criteria in these patients. Will a busy practice specializing in hydrocephalus be likely to include a large number of these patients?

Fortunately, some information is available about the usefulness of aqueductoplasty relative to ETV, albeit from a surgeon who performs the procedure from above. In an article on indications for aqueductoplasty, Miki and colleagues found six patients in whom magnetic resonance (MR) imaging studies revealed excessive risks for ETV. Of 110 patients treated endoscopically, only those six patients (5.5%) underwent aqueductoplasty.

Clearly patients with a Chiari malformation Type II (spina bifida) are not candidates for the trans–fourth ventricular
approach. In these patients the foramen of Magendie lies well below the foramen magnum in the cervical canal. The choroid plexus is everted from within the fourth ventricle, which is elongated, narrow, and often encased in an arachnoidal scar.

Authors of neither report comment on the degree of hydrocephalus upstream from the point of occlusion. The illustrations accompanying the articles indicate that the membrane will be thin, easily found, and easily perforated. Is this always the case?

Even more compelling questions raised by these articles include who should perform these procedures and what training and preparation are needed to do so. In courses on neuroendoscopy, the preparation needed to perform an ETV is a common topic of discussion. I recommend that a course be taken to familiarize the endoscopist with the instrumentation and its handling. The new neuroendoscopic neurosurgeon should begin by using the endoscope to place ventricular catheters into very large ventricles so that he or she may become accustomed to looking around within the ventricular system and gaining familiarity with the intraventricular anatomy. Only when the surgeon has become comfortable with the necessary motor skills should an ETV be attempted. Initial attempts should be limited to patients with new-onset hydrocephalus and very large ventricles. In such cases the floor of the third ventricle is thin and the BA can be seen below. With experience, more difficult procedures can be performed.

In the case of an ETV, the anatomy is commonly seen in neuroendoscopic procedures. When the fourth ventricle is transversed, however, it is the first time that the neurosurgeon has seen this anatomy. When an ETV is performed, the area of the brain susceptible to injury is located directly in front of the endoscope. Proximal to the end of the scope, the barrel is within the lateral ventricle and passes through cerebral tissue in an area that is quite forgiving. In the case of a trans–fourth ventricular procedure, the structure in front of the endoscope is not the only structure in danger: the floor of the fourth ventricle, which lies below and behind the view of the operating surgeon, is also at significant risk. The anatomy involved is no less dangerous than that of the floor of the third ventricle.

During decompression of a Chiari malformation Type I, the caudal loops of the posterior inferior cerebellar arteries often touch in the midline at the foramen of Magendie, which is often scarred shut. In my opinion, this procedure should be performed only by extremely dedicated and experienced neuroendoscopists. Before such a procedure is performed in a patient, the neurosurgeon must first practice by using one or more cadaveric heads.

Although the risk of late sudden death in patients undergoing ETV is now well established, it was not recognized for at least a decade after general acceptance of the procedure. Perforation of the BA, also a very rare event, was probably first seen when the procedure was applied in patients in whom the third ventricular floor was opaque. According to these two reports, the procedure was performed safely in 14 patients; however, the risk of serious complications cannot be ascertained until a larger number of patients have undergone the procedure.

Personally, I am skeptical that this procedure is likely to be more effective or safer than ETV as a treatment for aqueductal stenosis, even in the most ideal patients in whom the highest level of difficulty is seen on MR images. This technique is most likely to be justified for the treatment of one of the most difficult conditions confronting pediatric neurosurgeons: the case of the isolated fourth ventricle. In this situation, the trajectory is significantly larger and therefore potentially more forgiving. Furthermore, the available forms of treatment are less successful and associated with higher risks. Performing the procedure first in cases of isolated fourth ventricular hydrocephalus will allow the neurosurgeon to become familiar with the unique anatomy viewed with the endoscope. It may then be possible to perform the procedure safely in a normal-sized fourth ventricle. The procedure described here is likely to confer a major benefit in the management of the isolated fourth ventricle, but it will be challenging to justify the use of this procedure in patients with isolated obstruction of the aqueduct.

**References**


**RESPONSE:** I would like to thank Prof. Rekate for his objective editorial, in which he confronts us with a very important question related to the technique that we describe in this issue.

Prof. Rekate’s comments focus on the selection of patients and the choice of a neurosurgeon capable of performing this uncommon approach. We performed surgery in these patients between 1997 and 2002. During the same period we performed ETV in nearly 75 patients and cranial endoscopic aqueductoplasty in 11 patients. Nevertheless, this is a rough estimation, because I believe that a meticulous preoperative evaluation of the anatomical situation might have changed our selection of the approach in one or two patients.

After we have gained familiarity with various endoscopic approaches, I believe that we should no longer condemn every patient with triventricular hydrocephalus to a particular technique or approach. Instead, a careful evaluation should be made before an ETV or a cranial or caudal aqueductoplasty is selected. Part of this evaluation is based on preoperative imaging; recent developments in this field have proven its high accuracy, providing the neurosurgeon