DEATH AFTER LATE FAILURE OF ENDOSCOPIC THIRD VENTRICULOSTOMY: A POTENTIAL SOLUTION

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Received, January 10, 2003.
Accepted, March 27, 2003.

OBJECTIVE: Late failure after successful third ventriculostomy is rare, and death caused by failure of a previously successful third ventriculostomy has been reported on four occasions. We describe a simple innovation that adds little morbidity and has the potential to reduce the advent of death after late failure of endoscopic third ventriculostomy.

METHODS: After endoscopic fenestration of the floor of the third ventricle, a ventricular catheter and subcutaneous reservoir are placed via the endoscope path. With acute blockage and neurological deterioration, cerebrospinal fluid can be removed via needle puncture of the reservoir until consultation with a neurosurgeon.

RESULTS: From 1979 to 2003, more than 240 endoscopic third ventriculostomies have been performed at our institution, with one death after late failure. The revised technique was devised after this death and has been performed on 21 patients to date.

CONCLUSION: The addition of a reservoir adds little time and morbidity to the procedure and offers the potential to sample cerebrospinal fluid, measure intracranial pressure, and reduce mortality associated with late failure of endoscopic third ventriculostomy.

KEY WORDS: Endoscopic third ventriculostomy, Failure, Solution, Ventriculostomy

Neurosurgery 53:384-386, 2003 DOI: 10.1227/01.NEU.0000073534.04767.B1 www.neurosurgery-online.com

Endoscopic third ventriculostomy (ETV) has evolved to be considered a safe and effective treatment for hydrocephalus (7, 9). Complications associated with the treatment of obstructive hydrocephalus with third ventriculostomy are uncommon and rarely fatal (6, 8). A large number of studies have established the relatively high success rate and low complication rate of ETV; however, many reports are descriptive, with highly variable periods of follow-up (10, 11).

The most devastating late complication after ETV is closure of the fenestration, resulting in rapid neurological deterioration and death. A recent report of three late deaths after ETV (6) strengthens the argument that we need to consider alternative strategies to combat the problem. Our unit experienced one late failure of ETV resulting in death (8). Because ETV is a relatively recent procedure in many neurosurgeons' repertoire, it is predicted that this complication will increase in prominence over time. The issue is especially topical in countries, such as Australia, that have few neurosurgical units and in which patients may have to travel large distances to reach neurosurgical care.

DESCRIPTION OF TECHNIQUE

Since 1979, the Department of Neurosurgery at the Prince of Wales Hospital, Sydney, Australia, has performed more than 240 ETV procedures. There has been one death during this time period, related to late failure of the ETV in a young boy. The boy had congenital hydrocephalus that was shunted when he was a neonate. An ETV was performed when he was 4 years old, and he was clinically well for more than 7 years. While camping, he developed a headache and within 24 hours became drowsy, then rapidly unresponsive, before presentation to a peripheral hospital, where resuscitation failed. An autopsy was performed and verified that death was caused by acute hydrocephalus and failure of the ventriculostomy. This catastrophic case instigated a new approach to ETV for patients who are not in close proximity to neurosurgical care or who may present late after ETV failure for whatever reason.

The authors perform ETV through a coronal burr hole with stereotactic advancement of the endoscope through the frontal cortex into the lateral ventricle. The endoscope is passed through the foramen of Monro into the third ventricle under visual control. Perforation of the floor of the third ventricle is placed into the tuber cinereum at the anterior border of the mamillary bodies to enter the prepontine cistern. Perforation is performed with a blunt technique with subsequent dilation of the fenestration with a balloon catheter. After endoscopic fenestration of the floor of the third ventricle, a ventricular catheter and subcutaneous reservoir (Rickham or Ommaya) is

placed through the path made by the endoscope insertion. Cerebrospinal fluid (CSF) is withdrawn from the reservoir to verify placement of the catheter in the lateral ventricle. The skin incision is closed in a standard fashion over the subcutaneous reservoir. A generous-sized reservoir is placed so that a novice health practitioner can access the reservoir in emergent situations for intracranial pressure control. The two senior authors (MV, MAD) have used the technique in 21 patients during a 24-month period, with no additional morbidity associated with the reservoir insertion.

With acute blockage and neurological deterioration, a neurosurgeon can instruct an operator over the telephone or Internet to remove CSF via needle puncture. Intracranial pressure stability can be maintained until the patient reaches a neurosurgical unit.

DISCUSSION

The pathophysiology of failure remains speculative. Proposed mechanisms for failure include inadequate size of the initial fenestrations (2), unnoticed second membranes (3), reduced flow through the stoma (7), subsequent closure of the fenestration (4), bleeding around the ventriculostomy site, increased concentration of protein and fibrinogen (3), infection causing obliteration of CSF pathways (5), patients having undetected deficiency in CSF absorption at the arachnoid villi level (1), and, finally, progression of tumor to block the ETV. Explanations for the timing of failure are also conjectural. Early failures are thought to be associated with a patent stoma and failure of reabsorption of CSF, and delayed failures are thought to be related to obstruction of the third ventriculostomy stoma by gliotic tissue or arachnoid membrane (12).

Irrespective of the pathology that results in late failure, a surgeon must consider the event. Because of the relatively small population base per unit area, Australia has the dilemma that many patients have to travel large distances, sometimes for several days, to reach a neurosurgical service. Many other countries, such as Canada, India, and China, experience a similar problem. In the event of acute blockage of an ETV fenestration, the technique that we propose would offer the patient the best chance of survival until a neurosurgical unit can be reached. The authors accept the potential disadvantages of the technique, which include an increased risk of infection, entrapment of the ventricular catheter by the choroid plexus, and the fact that no studies have examined the long-term patency rates of a ventricular reservoir. To date, we have not experienced the complication of infection; however, our technique has not been subjected to the rigors of time.

CONCLUSIONS

Late failure after successful third ventriculostomy is a rare cause of death. The addition of a ventricular catheter and subcutaneous reservoir after ETV in selected patients adds little time and morbidity to the procedure, with the potential to sample CSF, measure intracranial pressure, and reduce mortality.

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COMMENTS

This article reports a series of 21 patients who had subcutaneous reservoirs placed along the endoscope path into the lateral ventricle at the time of endoscopic third ventriculostomy (ETV). The authors envision this location as an access site for cerebrospinal fluid (CSF) sampling, intracranial pressure measurement, and emergency access at the time of sudden deterioration caused by the rare but increasingly recognized complication of late ETV failure (2). They report no complications but apparently have not yet accessed the devices. Other authors have proposed using this technique in patients with hydrocephalus (3) and to monitor and salvage patients in whom ETV has failed (1). Potential complications that the authors' patients have not experienced include CSF leak, subdural collection, and infection. Lifesaving emergency access, if possible, may well balance these other risks. As more experience with this access device is gained, the associated risks and benefits will be clarified.

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Most ETV failures occur early. Late ETV failures are uncommon, and death as a result of late ETV failure is particularly rare. A total of four cases of death after late failure of ETV have been reported to date, and the suspected cause of death is increased intracranial pressure secondary to delayed obstruction of the stoma. It is not clear why some patients develop sudden deterioration, but shunt-induced noncompliance may play a role, because two of the four patients who died, including one in the authors' own unit, previously had undergone ventricular shunting procedures.

In an attempt to reduce mortality as a result of late ETV failure, the authors propose inserting a ventricular catheter and a subcutaneous reservoir at the end of the procedure. Whether this technique refinement will make a difference in patient outcomes remains to be shown. If the patient dies suddenly at home, the presence of an indwelling reservoir and catheter is of no help. Likewise, if the patient deteriorates suddenly in a tertiary medical center, the ventricle can be accessed immediately through an existing burr hole. This was exactly the case in two of the four reported late deaths after ETV: one child was found dead at home, and another underwent emergent external ventricular drain placement at the time of his deterioration in the hospital. In these two cases, it seems that an indwelling reservoir would not have made a significant difference.

The other two late deaths after ETV occurred in patients who presented to peripheral hospitals. It is unclear whether an indwelling reservoir would have made a difference in these cases. In fact, it is unclear whether an indwelling reservoir will even remain patent. In an extreme circumstance, however, a reservoir could be tapped at a peripheral hospital in an attempt to stabilize a patient who is acutely deteriorating. In my practice, I do not routinely leave a ventricular catheter and reservoir after performing ETV. In selected cases, when patients do not have ready access to a neurosurgeon postoperatively, it may be reasonable to leave a ventricular catheter and subcutaneous reservoir in place.

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After one late ETV failure resulting in death (in a total of 240 procedures performed during the course of more than 20 years), the authors provide a simple solution to this problem. It consists of the placement of a ventricular catheter and subcutaneous reservoir after performing endoscopic fenestration of the third ventricle. The risk of complications is low, and the advantage of using this technique is the possibility of removing CSF through a needle puncture of the reservoir in an emergency when the patient is too far away from a neurosurgical unit. The idea is not completely new—a similar technique is occasionally used, for instance, in patients with cystic gliomas—but may be considered innovative in this particular context. Considering that this complication is expected to increase over time, we support the authors' clear message that lives may indeed be saved in the future.

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The authors identify the long-term complication of death after ETV. This problem has been underscored in recent publications. The authors suggest that a potential means of preventing such a disaster might be the insertion of a ventricular access device at the time of ETV. Their rationale for this technique is that it may make it easier for emergency room physicians to tap the ventricle and treat acute decompensated hydrocephalus. The authors identify two concerns with regard to their solution. First, the patient needs to be in close proximity to the emergency room. If the patient is in a secluded area, such as in the case they describe in this article, then time will not allow use of the reservoir. Second, they concede that insertion of such a device increases the cost and risk of the procedure. Both concerns are reasonable. Furthermore, ventricular catheters that are not constantly flushed with CSF can become obstructed. The advantage of a reservoir over a burr hole through which the surgeon can tap the enlarged ventricle is questionable. Although this well-written article underscores the low but significant incidence of late death after ETV, I am somewhat skeptical that this technique will have a significant impact in treating patients with this complication. The solution is to ensure that neurosurgeons who offer this operation to patients educate the patients and their relatives that ETV is not a cure and that recurrence of symptoms may indicate treatment failure. Regular follow-up is mandatory and may detect early, subtle evidence of stomal closure.

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A goal in performing ETV is to avoid the need for permanent CSF diversion and all that is associated with the need for a shunt. Avoidance of shunt occlusion, shunt infection, and the morbidity that results from acute and/or unrecognized occlusion are obvious goals. Although a reservoir is permanent, it allows the most deleterious complications to be avoided. Thus, it is a reasonable therapeutic avenue to pursue.

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