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Endoscopy

Success and complication rates of endoscopic third ventriculostomy for adult hydrocephalus: a series of 108 patients

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Abstract

Background: The clinical response to ETV of adult patients with noncommunicating hydrocephalus may differ from that of children because of such factors as chronicity of hydrocephalus, physiologic differences in CSF dynamics, and changes in brain viscoelastic properties. We sought to determine which factors might predict clinical success and failure.

Methods: A retrospective single-surgeon case series analysis was performed. This was a consecutive case series for which the goal of the ETV procedures was shunt independence. One hundred ten ETV procedures were performed in 108 adult patients (mean, 48 years; range, 17-88 years). There were 52 cases of idiopathic aqueductal stenosis, 47 cases of mass lesions causing noncommunicating hydrocephalus, plus 9 other miscellaneous obstructive etiologies.

Results: Long-term shunt independence was achieved in 77% of patients. Two additional patients, who initially failed, later achieved success after reoperation and remained shunt free for the duration of their follow-up. Therefore, after reoperation, shunt independence was achieved in 79% of patients. Of the patients who ultimately failed, 11 failed within 1 month. Therefore, 52% who ultimately failed had more than 1 month of shunt-free existence (mean, 10 months). There were 6 surgical complications, including 2 deaths related to intracranial hemorrhage from brain tumors (not directly related to ETV per se), and 10 medical complications. The median hospital length-of-stay was 3 days. The median follow-up was 8 months (range, 0-95 months).

Conclusions: Endoscopic third ventriculostomy is an effective treatment option for adult patients with noncommunicating hydrocephalus. Although most procedures resulted in long-term shunt independence, more than half of the eventual failures were delayed, and therefore, appropriate follow-up is required.

Keywords: Adult hydrocephalus; Endoscopic third ventriculostomy; Neuroendoscopy; Intraventricular; Endoscope

1. Introduction

The procedure of ETV has gained popularity over the last 2 decades in large part because of improved endoscope optics, high intensity lighting systems, and miniaturized CCD cameras. In addition, more cases of noncommunicating hydrocephalus are being diagnosed because of the improved ability to visualize ventricular anatomy with high-resolution MRI. The increased clinical interest in ETV procedures has been driven mainly by pediatric neurosurgeons, and consequently, most of the larger published studies have focused primarily on pediatric populations [7,8,11,15,32,51]. In some reports, the authors did not distinguish adult vs pediatric cases in their analysis [14,21,23,47,53,60].

The management of hydrocephalus in adult patients, however, differs from that of children. For example, CSF production and absorption changes over time. At one end of

Abbreviations: CCD, charged-coupled device; CISS, constructive interference in steady state; CSF, cerebrospinal fluid; ETV, endoscopic third ventriculostomy; FIESTA, fast imaging employing steady state acquisition; ICP, intracranial pressure; MRI, magnetic resonance imaging; NPH, normal pressure hydrocephalus; UCLA, University of California at Los Angeles; VP, ventriculoperitoneal.

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the spectrum, infants with presumed immature CSF absorption mechanisms have generally been considered to have a higher ETV failure rate compared with children older than 6 to 12 months [5,7,12,15,20,22,26,31,37,38,48,64,66]. Inadequate CSF absorption may play a role with advancing age, especially among elderly patients, in whom an increase in CSF absorption resistance [2,17,39,62,63] might likewise lead to a lower ETV response rate.

Chronic "compensated hydrocephalus," in which both structural and physiologic hydrocephalic brain changes have been present for decades, may be less likely to respond favorably to an abrupt change in CSF circulation. Alternatively, adult patients with long-term shunted congenital hydrocephalus may have developed increased resistance to CSF outflow, thereby predisposing to ETV failure secondary to inadequate CSF absorption [2,17,39].

From a methodological standpoint, judging the success or failure of an ETV operation may be more problematic in adults. For example, patients with subtle symptoms and chronic ventriculomegaly may not experience dramatic clinical improvements, or improvements may be delayed. Here, we present a decade experience of consecutive ETV operations as the treatment of adult hydrocephalus.

2. Materials and methods

2.1. Patient population

We retrospectively identified all consecutive patients who underwent ETV procedures, with a primary goal of shunt avoidance, performed by the senior author (MB) at UCLA and Harbor-UCLA Medical Centers, Torrance, Calif, from 1995 to 2006. Patients younger than 16 years were excluded. Nineteen patients who underwent a combined CSF shunt placement and an ETV procedure in the same setting during this period were not included in the analysis because the intent of the ETV procedure in these cases was not shunt avoidance. The resultant analysis consisted of 110 ETV procedures performed in 108 patients.

The mean age was 48 years (range, 17-88 years), and there were 48% males. Median hospital length of stay was 3 days (range, 1-59 days). Median postoperative follow-up was 8 months (range, <1 to 101 months). This study was approved by our institutional review board.

Diagnoses included 47 cases (43.5%) of mass lesions causing noncommunicating hydrocephalus, 52 cases (48%) of idiopathic aqueductal stenosis, 4 cases (3.7%) of triventricular hydrocephalus with a narrowed but patent aqueduct, and 5 other cases (4.6%) of hydrocephalus due to various pathologies (one-third ventricular obstruction due to large massa intermedia and 4 fourth ventricular outlet obstructions due to Chiari's malformation or webs/adhesions of unknown etiology, Table 1). The cases of fourth ventricular outlet obstruction demonstrated a dilated aqueduct and proximal fourth ventricle with an obliterated and adhered distal segment including the area of the outlet foramina. Most of these patients had a suspected, but unconfirmable, history of neurocysticercosis. In 2 of these cases, the fourth ventricle was explored at the time of surgery, confirming the abnormal anatomy with complete fourth ventricular outlet obstruction. None of the cases demonstrated a definitive mass or cystic lesion that could be safely resected or undergo a biopsy.

Table 1
Patient characteristics and pathologies

Pathology	No. of patients (success rate)
Mass lesions	47 (76.6%)
Pineal region	14 (71.4%)
Pineocytoma	5
Glioma	3
Germinoma	2
Benign pineal cyst	1
Mature teratoma	1
Cavernous malformation	1
Pineal tumor not otherwise specified	1
Midbrain and/or diencephalon (glioma or cyst)	13 (76.9%)
Arachnoid cysts (prepontine, third ventricle, post fossa, or suprasellar)	7 (85.7%)
Neurocysticercosis (intraventricular, aqueductal, and tectal), nonresectable	4 (100%)
Cerebellar metastases	3 (66.7%)
Fourth ventricle (medulloblastoma, choroid plexus papilloma, and glioma)	3 (66.7%)
Optic glioma	1 (100%)
Petroclival meningioma	1 (100%)
Colloid cyst	1 (0%)
Idiopathic aqueductal stenosis	52 (86.5%) *
Triventricular hydrocephalus without imaging evidence of obstruction	4 (50%)
Other	5 (40%)
Fourth ventricle outlet obstruction by webs/adhesions	3
Fourth ventricle outlet obstruction by Chiari's malformation	1
Third ventricle obstruction by large massa intermedia	1

* Including 2 patients with successful ETV after reoperation.

In 25 cases, one or more additional endoscopic procedures were also performed at the same time as the ETV procedure. These included tumor biopsy or resection (12 cases), cyst excision or fenestration (13 cases), septum pellucidotomy (5 cases), and foramen of Monro-plasty (3 cases).

2.2. Indications for surgery and reoperation

The clinical indications for treatment varied, but in general, all patients had symptoms and/or clinical signs referable to hydrocephalus. The most common symptoms included headache, nausea and vomiting, visual dysfunction, memory or cognitive decline, ataxia, urinary symptoms, shunt infection, and decline in mental status. Twenty-six patients presented with clinical symptoms suggestive of normal pressure hydrocephalus (disturbance of gait, urinary bladder control, and/or cognition); however, most of these had MRI evidence of noncommunicating hydrocephalus and,