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Chronic Subdural Hematoma after Endoscopic Third Ventriculostomy for Chronic Obstructive Hydrocephalus: A Case Report

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Abstract

Endoscopic third ventriculostomy (ETV) is a safe treatment option for chronic obstructive hydrocephalus. However, we encountered a case of chronic subdural hematoma (CSDH) with bilateral large hematoma volumes after ETV for chronic obstructive hydrocephalus. We herein report a rare complication of ETV. The patient was a 53-year-old woman who had been diagnosed with asymptomatic ventricular enlargement with aqueductal stenosis 5 years previously. However, over the course of 5 years, her gait and cognitive function gradually declined. ETV was administered to relieve symptoms. Head Magnetic resonance imaging performed 1 week after ETV indicated bilateral subdural hygroma. Three weeks after ETV, she presented with headache and left incomplete paralysis, and head Computed tomography (CT) demonstrated bilateral CSDH with a large volume hematoma. Burr-hole evacuation and drainage of the bilateral CSDH were performed, after which the symptoms resolved. However, 7 weeks after ETV, she again presented with headache and incomplete right paralysis, and CT revealed bilateral CSDH re-enlargement. After the second burr-hole evacuation and drainage of bilateral CSDH, her symptoms resolved. The bilateral CSDH continued to shrink following the second hematoma evacuation surgery and completely disappeared on CT scan performed 3 months after ETV. Ventricular enlargement due to chronic obstructive hydrocephalus stretches the brain mantle for several years. This long-term stretching may have diminished the brain compliance and led to the development, growth, and recurrence of CSDH. In ETV for chronic obstructive hydrocephalus, surgeons should consider the risk of postoperative CSDH with a high hematoma volume and tendency to recur.

Keywords: endoscopic third ventriculostomy, chronic subdural hematoma, hydrocephalus

Introduction

Endoscopic third ventriculostomy (ETV) is an established therapy for symptoms associated with increased intracranial pressure (ICP) in obstructive hydrocephalus.[1-3] In recent years, the efficacy of ETV for chronic symptoms associated with chronic obstructive hydrocephalus has been reported, and indications for ETV are expanding to chronic obstructive hydrocephalus.[3-7]

ETV has been reported to be a safe technique,[1,3-5,8] and ETV for chronic obstructive hydrocephalus has also been reported to be a safe therapy.[4] However, we encountered an adult patient with chronic bilateral large volume subdural hematoma (CSDHs) after ETV for chronic obstructive hydrocephalus. In this study, we describe a rare complication of ETV for chronic obstructive hydrocephalus.[3-5]

Case Report

A 53-year-old woman presented with dizziness 5 years before ETV. Computed tomography (CT) revealed ventricular enlargement, and she was referred to our hospital for treatment. Magnetic resonance imaging (MRI) of the head revealed ventricular enlargement (Fig. 1A), aqueductal

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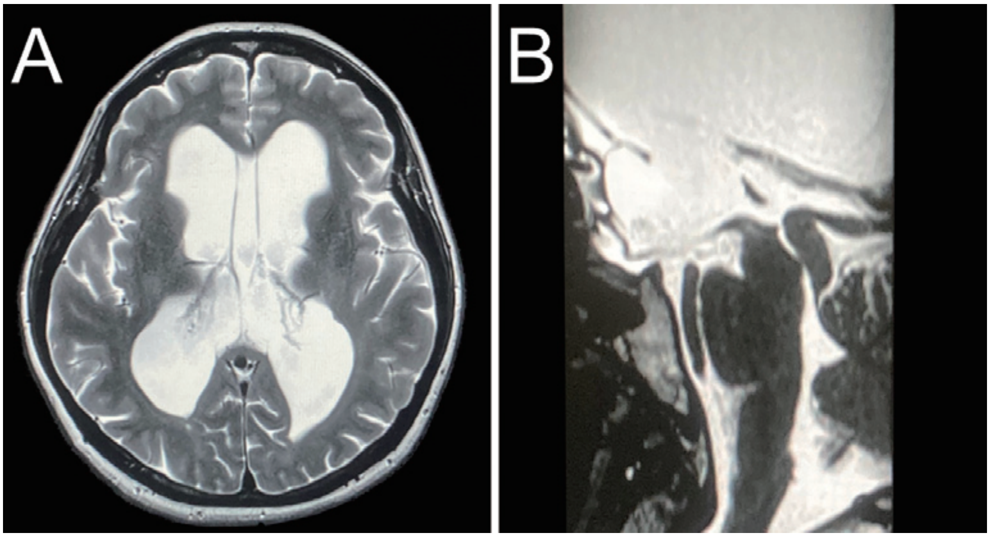

Fig. 1 Magnetic resonance imaging before endoscopic third ventriculostomy. T2-weighted images of the axial section demonstrate enlarged ventricles (A), and T2-weighted images of the sagittal section demonstrate aqueductal stenosis and downward bulging floor of the third ventricle (B).

stenosis, and downward bulging floor of the third ventricle (Fig. 1B). However, her dizziness resolved and she presented with no other neurological symptoms. She was diagnosed with asymptomatic ventricular enlargement and followed up for 5 years. However, over the course of 5 years, her gait and cognitive function gradually declined. Before ETV, she took 17 s to perform the Timed Up and Go test,[9] and her Mini-Mental State Examination (MMSE) score was 23 points. These symptoms were diagnosed to be a result of a chronic hydrocephalus caused by aqueductal stenosis. ETV was administered to relieve the symptoms. A burr hole was made at the right Kocher's point and an endoscopic sheath (Neuro sheath; Medikit, Tokyo, Japan) was made in the anterior horn of the right lateral ventricle. The intraventricular pressure at the time of sheath insertion was 40 mmH_2O. We observed the aqueduct using a flexible neuroendoscope (VEF-TYPE V; Olympus, Tokyo, Japan) and confirmed the stenosis (Fig. 2A). We then identified the bottom of the third ventricle using a flexible neuroendoscope and created a stoma using an 8 mm balloon (Expander Balloon Catheter SI; Fuji System, Tokyo, Japan; Fig. 2B). To confirm the patency of the stoma, we observed cerebrospinal fluid (CSF) movements of the margins of the stoma site during surgery (Fig. 2C) and the CSF flow void at the stoma site on postoperative MRI (Fig. 2D). Head MRI performed 1 week after ETV indicated bilateral subdural hygroma (Fig. 3A and B). Three weeks after ETV, she presented with headache and left incomplete paralysis. Head CT revealed bilateral CSDH (Fig. 3C). The CSDH had a large volume, with a right and left hematoma width of 31 and 21 mm, respectively. We performed a burr-hole evacuation of the bilateral CSDH. We evacuated 160 mL hematoma and left a subdural drain in place for 24 h. After hematoma evacuation surgery, her symptoms resolved, and the CSDH shrank (Fig. 3D). However, 7 weeks after ETV, she again presented with headache and incomplete right paralysis, and CT revealed bilateral CSDH re-enlargement (Fig. 3E). We reperformed burr-hole evacuation of the bilateral CSDH using a burr hole made during the first hematoma evacuation surgery. Then, 10 mL was evacuated from the right side, 150 mL was evacuated from the left side, and a subdural drain was left in place for 24 h. Thereafter, her symptoms resolved. The bilateral CSDH continued to shrink following the second hematoma evacuation surgery and was observed to have completely disappeared on a CT scan performed 3 months after ETV (Fig. 3F). The third ventricular floor stoma remained patent 6 months after ETV. Her MMSE score was 24 points, which was not significantly different from the preoperative level; however, her Up and Go test result was slightly shorter at 14 s, and her gait improved.

Discussion

We herein report a case of CSDH after ETV for chronic obstructive hydrocephalus. Approximately 70% of obstructive hydrocephalus in adults is associated with aqueductal stenosis,[3] and surgical intervention for aqueductal stenosis is recommended only in symptomatic cases.[10] There are two patterns of obstructive hydrocephalus symptomatization in adults.[6,11] The first is associated with increased ICP,[1-4] and the second is associated with more gradual and chronic hydrocephalus symptoms.[3-5,7,12] The efficacy and safety of ETV for symptoms associated with increased ICP are well established.[1-4] However, it remains unclear whether ETV or a ventriculoperitoneal (VP) shunt is superior in relieving chronic hydrocephalus symptoms, such as gait disturbance, cognitive dysfunction, and urinary dys-

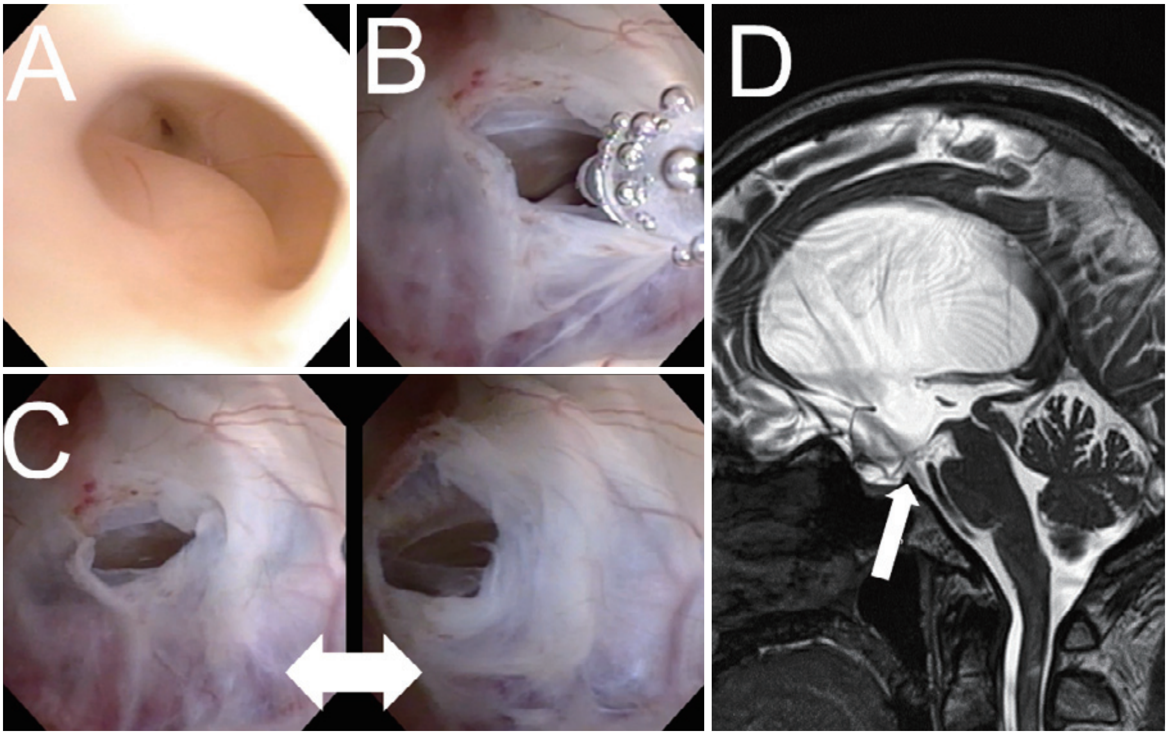

Fig. 2 Endoscopic images during endoscopic third ventriculostomy. Aqueductal stenosis was observed (A), and a stoma was created at the base of the third ventricle (B). We then observed to and fro cerebrospinal fluid (CSF) movements of the margins of the stoma site (C). Postoperative T2-weighted MRI of sagittal sections revealed the CSF flow void at the stoma site (D: white arrow).

function.[10] Several reports have suggested that chronic obstructive hydrocephalus is sometimes accompanied by CSF reabsorption disorders, and these reports indicate that a VP shunt is more effective than ETV in relieving chronic symptoms.[5,12,13] In fact, the patient also showed poor improvement in her cognitive function and ventricular size with ETV. It is possible that CSF reabsorption disorders and aqueductal stenosis were involved in the symptoms observed in our case. However, it has been reported that ETV can relieve symptoms of chronic obstructive hydrocephalus as effectively as VP shunt.[1,3-5,14]

Although no complete conclusions have been reached in terms of efficacy, ETV is superior to VP shunts in terms of safety.[5,10,15] VP shunts for patients with chronic obstructive hydrocephalus have a high risk of CSDH and device-associated complications.[5,6,11,13,15,16] In a study by Oi et al., nine of eighteen patients with chronic obstructive hydrocephalus were safely treated with ETV, but all seven treated with differential pressure valve (DPV) shunts developed CSDH.[15] Although gravitational shunts, including pressure programmable valve shunts, are considered safer than DPV shunts,[15] Keifer et al. reported the development of symptomatic subdural hematomas in 2 of 26 patients with chronic obstructive hydrocephalus treated with gravitational shunts.[13] However, several reports have shown that ETV for chronic obstructive hydrocephalus is a safe procedure with few complications, including CSDH,[3-5,10,15] and have recommended it for safety reasons.[4,5,7,15]

Despite these reports emphasizing the safety of ETV for chronic obstructive hydrocephalus,[4] the patient developed CSDH after ETV. Furthermore, the CSDH in our case involved bilateral large volume hematomas and two surgeries were required for treatment. Referring to previous case reports, most cases of CSDH after ETV are unilateral or treated with a single surgery.[17-21] To date, seven adult cases of subdural hematoma after ETV have been reported (Table 1),[17-23] five of which had unilateral subdural hematomas[17-21] and six of which were curatively treated in a single surgery.[17-21,23] In contrast, there have been two reports of CSDH cases with bilateral large volume hematomas. The CSDH of a 61-year-old patient reported by Gondar et al. was bilateral, had a large hematoma volume, and required three surgeries for treat.[22] Although his CSDH was curatively treated with a single surgery, the CSDH in the 51-year-old patient reported by Kim et al. was bilateral and had a large hematoma volume.[23] The cases of Gondar et al. and Kim et al. and our own had two common characteristics: the patients were all middle-aged[22,23] and had chronic obstructive hydrocephalus due to aqueductal stenosis.[22,23] These two characteristics suggest that the patient had a long-term history of hydrocephalus.

Long-term history of hydrocephalus may be associated with the development, growth, and recurrence of CSDH. There are two main hypotheses regarding the etiology of

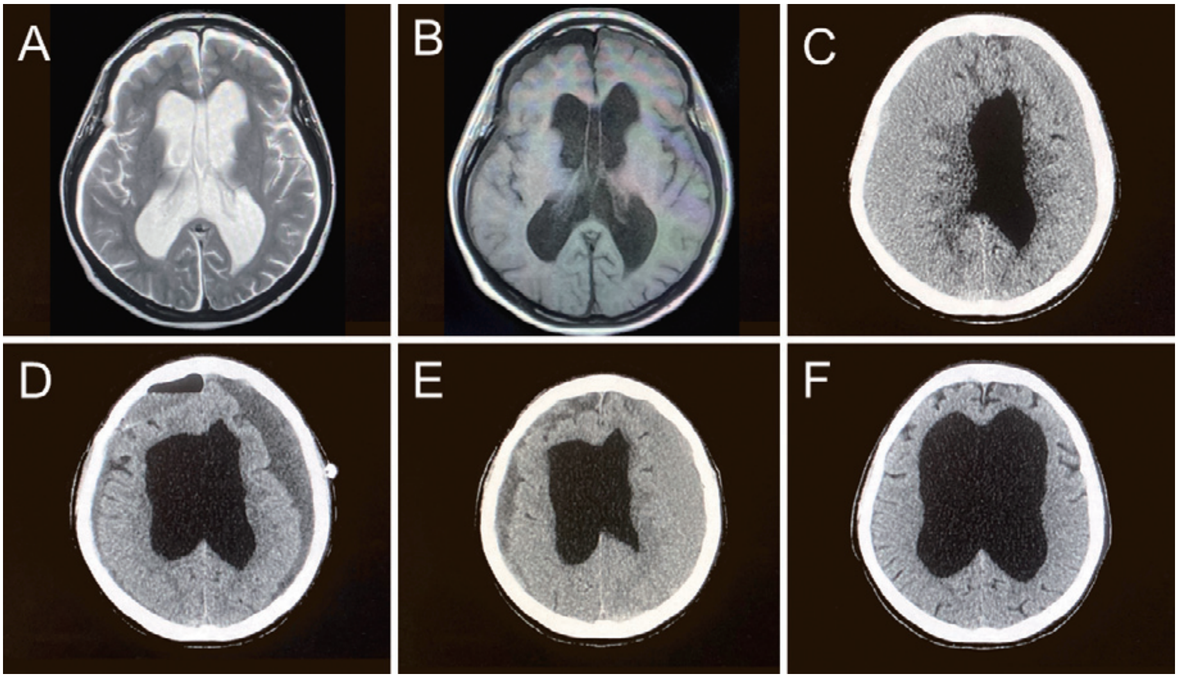

Fig. 3 Magnetic resonance imaging 1 week after endoscopic third ventriculostomy (ETV). Axial sections of T2-weighted (A) and T1-weighted (B) images indicate shrinkage of the ventricle and enlargement of the subdural space. Three weeks after ETV, computed tomography (CT) revealed bilateral chronic subdural hematomas (C). Burr-hole evacuation and drainage of the bilateral chronic subdural hematomas were performed (D). However, 7 weeks after ETV, CT indicated re-enlargement of the bilateral chronic subdural hematoma (CSDH) (E). Burr-hole evacuation and drainage of the bilateral chronic subdural hematomas were reperformed. After the second hematoma evacuation surgery, the bilateral chronic subdural hematomas shrank, and 3 months after ETV, CT revealed no evidence of CSDH (F).

Table 1 Adult cases of CSDH after endoscopic third ventriculostomy

Authors (year)	Age (years), sex	Diagnosis	Cause of hydrocephalus	Laterality of CSDH	Therapy	Recurrence of CSDH	Outcomes
Beni-Adani et al. (1999)	20, male	Obstructive hydrocephalus	Aqueductal stenosis	Right	One burr-hole evacuation	None	Recovery
Sgaramella et al. (2003)	69, male	Obstructive hydrocephalus	Aqueductal stenosis	Left	One burr-hole evacuation	None	Recovery
Kim et al. (2004)	51, male	Obstructive hydrocephalus	Aqueductal stenosis	Bilateral	One burr-hole evacuation	None	Recovery
Kamel et al. (2006)	16, male	Obstructive hydrocephalus	Aqueductal stenosis	Right	One minicraniotomy evacuation	None	Recovery
Civelek et al. (2007)	42, female	Obstructive hydrocephalus	Aqueductal stenosis	Right	One burr-hole evacuation	None	Recovery
Tekin et al. (2010)	21, male	Obstructive hydrocephalus	Aqueductal stenosis	Right	One burr-hole evacuation	None	Recovery
Gondar et al. (2015)	61, male	Obstructive hydrocephalus	Aqueductal stenosis	Bilateral	Two burr-hole evacuation One subduroperitoneal shunt	Two times	Recovery

CSDH, chronic subdural hematoma

CSDH after ETV. The first is associated with technical aspects of ETV.[17] Bleeding from the scalp vessels, cortical vessels, or bridging veins during ETV accumulates in the subdural space and may lead to CSDH.[17,21,22] Moreover, sudden CSF drainage during ETV enlarges the subdural space, tears the bridging vein, and may lead to CSDH development of CSDH.[17,21,22] The second is associated with loss of brain compliance.[22] Ventricular enlargement due to chronic hydrocephalus stretches the brain mantle for many years, and this long-term stretching deprives the brain of thickening after ETV.[17] As a result, the subdural space is enlarged following ETV and CSDH may develop.[17,22,24] The second mechanism may explain the development of CSDH in our case and in the cases reported by Gondar and Kim. All patients had a long-term history of hydrocephalus, which may have stretched their brain mantle for a long time and reduced brain compliance, leading to the development of CSDH. However, several clinical studies have shown that many ETV surgeries are safe in patients with long-term hydrocephalus.[3-5,10,15] Loss of brain compliance due to a long-term history of hydrocephalus may not be a strong risk factor for the development of CSDH after ETV.

Loss of brain compliance may promote the process of increasing the subdural hematoma volume rather than the development of CSDH.[22] The most striking feature of our case was that the enlargement of a thin subdural space grew into a CSDH with a large hematoma volume in just 2 weeks. Gondar et al. speculated that the brain mantle that lost compliance was less stiff than the normal brain mantle, and if the subdural space was enlarged for any reason, the brain was easily compressed.[22] A brain mantle that is easily compressed further enlarges the subdural space.[22] The enlarged subdural space tears the bridging vein and creates a large volume subdural hematoma.[22] This etiology may have contributed to the increased volume of the subdural hematoma in our case.

Moreover, loss of brain compliance may contribute to the recurrence of CSDH. It has been reported that advanced age, brain atrophy, and large hematomas are risk factors for recurrence of traumatic CSDH.[25,26] Several investigators have noted that these factors suggest loss of brain compliance, an important risk factor for the recurrence of traumatic CSDH.[26-28] Loss of brain elasticity may be a risk factor for CSDH recurrence after ETV and traumatic CSDH.

The favorable clinical outcomes of ETV for symptoms associated with chronic obstructive hydrocephalus in recent studies indicate that ETV may be performed more frequently for chronic hydrocephalus in the near future.[3-5] However, cases of chronic hydrocephalus may include patients who lose brain compliance due to their long-term history of hydrocephalus. Loss of brain compliance may be associated with development, growth, and recurrence of CSDH after ETV. Unfortunately, there is no effective method to prevent CSDH after ETV. VP shunts have a higher risk of CSDH than ETV.[5,10] Although reducing the size of the stoma may reduce the risk of CSDH, it increases the risk of stoma occlusion. However, all adult cases of CSDH after ETV, including the present case, recovered with appropriate surgical intervention (Table 1). Surgeons should carefully consider the risk of postoperative CSDH with large volume hematoma when performing ETV for chronic obstructive hydrocephalus. CSDH after ETV for chronic obstructive hydrocephalus also tends to recur, but recovery can be expected with appropriate surgical intervention.

Informed Consent

Informed consent was obtained from the patient.

Conflicts of Interest Disclosure

All authors declare no conflicts of interest.

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