ScientificScholar®
Knowledge is power
Publisher of Scientific Journals

www.surgicalneurologyint.com

Surgical Neurology International

Editor-in-Chief: Nancy E. Epstein, MD, Clinical Professor of Neurological Surgery, School of Medicine, State U. of NY at Stony Brook.

SNI: Neuroendoscopy

Editor
J. André Grotenhuis, MD
Radboud University Medical Center; Nijmegen, The Netherlands

SNI
Open Access

Case Report

Upward transtentorial herniation: A new role for endoscopic third ventriculostomy

Júlia Moscardini-Martelli[1], Juan Antonio Ponce-Gomez[2,3,4], Victor Alcocer-Barradas[3,4], Samuel Romano-Feinholz[2], Pilar Padilla-Quiroz[5], Marcela Osuna Zazueta[2,3], Luis Alberto Ortega-Porcayo[1,2,3]

[1]Department of Medicine, Faculty of Health Sciences, Universidad Anáhuac, [2]Neurological Center, Centro Médico ABC, [3]Department of Neurological Surgery, Hospital Ángeles Pedregal, [4]Department of Neurological Surgery, Instituto Nacional de Neurología y Neurocirugía "Manuel Velasco Suárez", [5]Department of Internal Medicine, Fundación Clínica Médica Sur.

E-mail: Júlia Moscardini-Martelli - juliamoscardini@outlook.com; Juan Antonio Ponce-Gomez - japg_20@yahoo.com.mx; Victor Alcocer-Barradas - barradas67@hotmail.com; Samuel Romano-Feinholz - drsamuelromanof@gmail.com; Pilar Padilla-Quiroz - pilar.padilla83@gmail.com; Marcela Osuna Zazueta - maosza_10@yahoo.com.mx; *Luis Alberto Ortega-Porcayo - opalberto@gmail.com

***Corresponding author:**
Luis Alberto Ortega-Porcayo, Department of Neurological Surgery, Hospital Ángeles Pedregal, Mexico City, Mexico.

opalberto@gmail.com

Received : 10 February 2021
Accepted : 27 April 2021
Published : 06 July 2021

DOI
10.25259/SNI_140_2021

Quick Response Code:

ABSTRACT

Background: The placement of external ventricular drainage (EVD) to treat hydrocephalus secondary to a cerebellar stroke is controversial because it has been associated to upward transtentorial herniation (UTH). This case illustrates the effectiveness of endoscopic third ventriculostomy (ETV) after the ascending herniation has occurred.

Case Description: A 50-year-old man had a cerebellar stroke with hemorrhagic transformation, tonsillar herniation, and non-communicating obstructive hydrocephalus. Considering that the patient was anticoagulated and thrombocytopenic, an EVD was placed initially, followed by clinical deterioration and UTH. We performed a suboccipital craniectomy immediately after clinical worsening, but the patient did not show clinical or radiological improvement. On the 5th day, we did an ETV, which reverses the upward herniation and hydrocephalus. The patient improved progressively with good neurological recovery.

Conclusion: ETV is an effective and safe procedure for obstructive hydrocephalus. The successful resolution of the patient's upward herniation after the ETV offers a potential option to treat UTH and advocates further research in this area.

Keywords: Cerebellar stroke, Endoscopic third ventriculostomy, Obstructive hydrocephalus, Upward transtentorial herniation

INTRODUCTION

The gold-standard treatment of a cerebellar stroke with acute neurological deterioration is a decompressive suboccipital craniectomy with dural expansion; it prevents brain herniation and is the preferred treatment even in the setting of associated hydrocephalus. External ventricular drainage (EVD) is recommended in obstructive hydrocephalus but should be followed or accompanied by decompressive craniectomy.[24] Historically, EVD in the setting of acute hydrocephalus secondary to a cerebellar infarction had been associated to higher mortality attributed to upward transtentorial herniation (UTH).[2]

UTH is clinically characterized by impaired consciousness and brainstem dysfunction.[2,6] UTH occurs when the pressure exerted from the posterior fossa promotes a dorsal displacement of the brainstem toward the tentorial notch secondary to an acute supratentorial intracranial pressure (ICP) decrease after draining CSF from the EVD.[6] Hydrocephalus management in this setting is controversial. The following case study illustrates the utility of endoscopic third ventriculostomy (ETV) for UTH.

CASE REPORT

A 50-year-old male was admitted for a diagnostic evaluation of chest precordial pain, shortness of breath, nausea, diaphoresis, and abdominal pain. He had a past medical history of hypothyroidism treated with levothyroxine and atrial fibrillation treated with apixaban. Myocardial infarction was ruled out, and the EKG confirmed paroxysmal atrial fibrillation. On the 2nd day, the patient developed acute suboccipital headache, nausea, vomiting, dizziness, and dysmetria. Subsequently, he developed acute neurological deterioration. On examination, he was in coma, pupils were miotic, corneal, and nausea reflexes were present and symmetrical. Abnormal flexion was observed under pain stimuli. He had hyperreflexia and bilateral Babinski. Laboratory findings revealed thrombocytopenia and brain MRI showed a bilateral cerebellar ischemic stroke in PICA territory with hemorrhagic transformation, tonsillar herniation, and non-communicating obstructive hydrocephalus [Figures 1a-f].

We initially placed an EVD considering that the patient was anticoagulated and thrombocytopenic. The EVD was connected to ICP monitoring, which measured 35 mmHg. After draining 10 cc of CSF, the patient developed bradycardia, hypertension, and bilateral mydriasis, he was transferred back to the OR, and we performed a middle suboccipital craniectomy; the cerebellum was 5 mm deep from the dura and it did not swell immediately through the dural defect [Figure 2a]. After the surgery, we sedated the patient using propofol and fentanyl; cerebellar edema and brainstem upward herniation were treated using hypertonic solutions and amines to maintain an adequate cerebral perfusion pressure. The EVD was closed most of the time and only opened when the ICP reached above 20 mmHg. After 5 days of close neurological monitoring and intracranial hypertension management, we did two clinical serial examinations without sedation and the patient persisted in coma with bilateral fixed 5 mm pupils without response, corneal reflexes persisted, but other brainstem reflexes were absent. MRI revealed cerebellar infarction with hemorrhage transformation, cerebellar edema, UTH, and the aqueduct of Sylvius persisted occluded. On the 5th day, we took out the EVD, and an ETV was performed. During the endoscopy, microhemorrhages were observed on the midbrain, the third ventricle was dorsally displaced and after the premamillary fenestration, an active pulsatile flow from the interpeduncular cistern was visualized [Figures 2b and c]. State of consciousness and brainstem reflexes improved significantly the 1st day after the surgery. MRI 1 week after the ETV showed upward herniation resolution, less cerebellar edema, and no hydrocephalus. The patient needed a tracheostomy and gastrostomy, and he started with neurological rehabilitation. Three months after the surgery, the patient made a good recovery with mild cerebellar disabilities (GOS 5); however, the MRI revealed mild enlargement of the lateral ventricles and a suboccipital CSF internal leak. A Hakim programmable ventricle-peritoneal shunt was placed. One year after surgery, the patient improved progressively until he recovered his previous functional status and only persisted with mild intention tremor of his left hand.

DISCUSSION

There have been reported several UTH cases secondary to posterior fossa lesions. In 1920, Meyer gave the earliest descriptions of UTH,[17] when he reported an unusual supratentorial distention of the splenium. In 1938, LeBeau[8,15] reported an UTH in a case of a cerebellar tumor in which, during exploration along the falx, he described severe displacement and elongation of the vein of Galen. In 1964, Dinsdale[7] reported 9 cases of UTH secondary to cerebellar and pontine hemorrhage. Historically, a cerebellar lesion had been the most frequent etiology of UTH (65%), followed by the cerebellopontine angle, pons, and 4th ventricle lesions.[6] In 1960, McKissok[16] reported 9 cases of cerebellar hemorrhage that died after ventricular tapping or drainage.[11] Cuneo *et al*.[6] reported that 25% of patients developed UTH after ventricular drainage. Recently, Braksick *et al*.[5] reported only 2/25 cases (8%), who had clinical worsening after EVD placement, even when they observed preoperative UTH. Using an EVD in the setting of cerebellar lesions has been controversial; however, the reported series are insufficient for proper statistical analysis to determine the actual risk for UTH after EVD.[1,2,4-8,10,12,13,23]

In our case, the patient was initially treated with an EVD to reduce ICP while the anticoagulant activity was reversed; however, the ventricular CSF drainage triggered an UTH because of a pressure gradient difference in the supratentorial and infratentorial compartments that resulted from a sudden pressure resistance decrease of the supratentorial space.[2,3,6] Afterward, a suboccipital craniectomy was performed without clinical benefit. Therefore, an ETV was proposed hypothesizing that pressure gradient would be balanced and the ICP would be equalized in both compartments. Although ETV in patients with obstructive

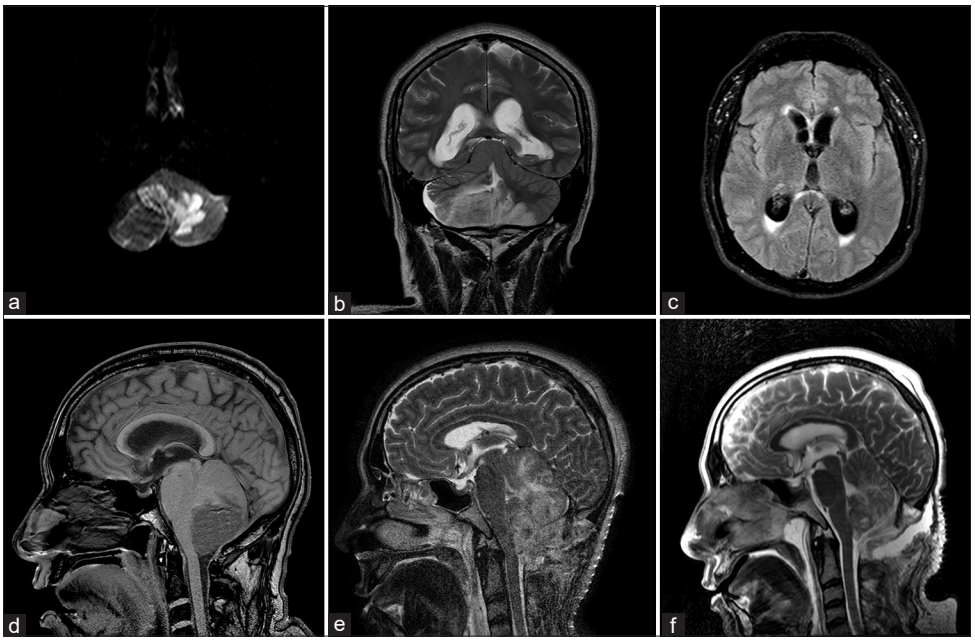

Figure 1: PICA infarct with hemorrhagic transformation involving the posterior lobe of both cerebellar hemispheres seen on DWI (a), T2 (b) and the associated obstructive non-communicating hydrocephalus (c, d). After the EVD and the suboccipital craniectomy, the patient persisted with upward transtentorial herniation (e); notice the flattening of the quadrigeminal cistern, the "spinning top" appearance of the midbrain and the cerebral aqueduct occlusion. After the ETV, the upward transtentorial herniation was reversed (f) and the patient improved clinically.

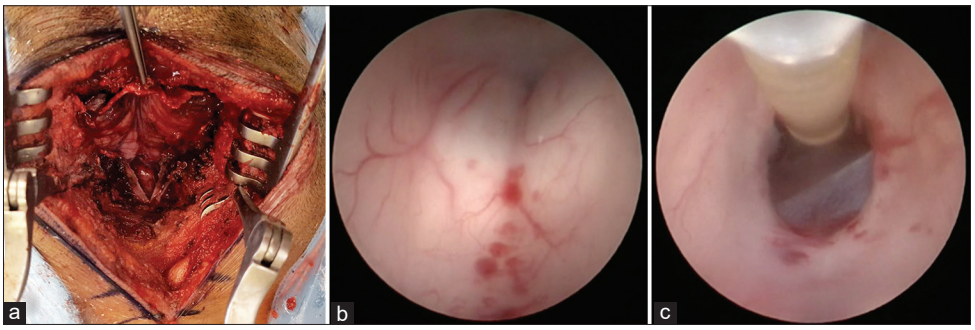

Figure 2: Middle suboccipital craniectomy (a). Even though the MRI showed severe edema, the cerebellum was displaced dorsally away from the dural edge (a). During the endoscopic third ventriculostomy, we observed midbrain microhemorrhages and an active flow through the tuber cinereum fenestration (b and c).

hydrocephalus from a posterior fossa lesion has been successful,[22] this is the first case to our knowledge, in which an UTH is reversed using an ETV. The fenestration of the tuber cinereum reversed the pressure gradient difference, which facilitated the resolution of UTH and the acute obstructive hydrocephalus, improving the neurological deficits after the surgery.

The treatment of UTH has been proposed in the literature since 1947 when Ecker recommended a tentorial section and cerebellar aspiration to release the CSF and vein obstruction.[8] Severe neurological deficits and poor outcome after UTH are associated to cranial nerve traction and diencephalic stroke associated to severe vein compression.[6] At present, UTH treatment includes decompression surgery of the posterior fossa,[19,23] hyperventilation,[13] hyperosmotic therapy,[13,20] head elevation,[19] and diuretics. If an EVD is placed, it should have close monitoring, and the drainage must be not <15–20 mmHg above the level of the third ventricle.[13]

The clinical diagnosis of UTH is characterized by intracranial hypertension syndrome, altered state of consciousness, loss of brainstem reflexes, and abnormal posturing.[6,10,12,25] On imaging, the vermis covers the tentorial notch, clears the cisterns, showing compression and flattening of the quadrigeminal plate, and the posterior third ventricle;

it can compress the aqueduct of Sylvius, resulting in hydrocephalus.[9,14,18,21] UTH has a poor outcome;[10] therefore, we must make a prompt clinical diagnosis in patients with acute neurological deterioration after an EVD.

CONCLUSION

ETV is an effective and safe procedure for obstructive hydrocephalus. The successful resolution of the patient's upward herniation after the ETV offers a potential option of treatment and advocates further research in this area.

Acknowledgments

Thanks to Karla Ortega for proofreading this manuscript.

Declaration of patient consent

Patient's consent not required as patients identity is not disclosed or compromised.

Financial support and sponsorship

Nil.

Conflicts of interest

There are no conflicts of interest.

REFERENCES

1. Adamson DC, Dimitrov DF, Bronec PR. Upward transtentorial herniation, hydrocephalus, and cerebellar edema in hypertensive encephalopathy. Neurologist 2005;11:171-5.
2. Amar AP. Controversies in the neurosurgical management of cerebellar hemorrhage and infarction. Neurosurg Focus 2012;32:E1.
3. Arriada N, Sotelo J. Continuous-flow shunt for treatment of hydrocephalus due to lesions of the posterior fossa. J Neurosurg 2004;101:762-6.
4. Auer LM, Auer T, Sayama I. Indications for surgical treatment of cerebellar haemorrhage and infarction. Acta Neurochir (Wien) 1986;79:74-9.
5. Braksick SA, Himes BT, Snyder K, van Gompel JJ, Fugate JE, Rabinstein AA. Ventriculostomy and risk of upward herniation in patients with obstructive hydrocephalus from posterior fossa mass lesions. Neurocrit Care 2018;28:338-43.
6. Cuneo RA, Caronna JJ, Pitts L, Townsend J, Winestock DP. Upward transtentorial herniation: Seven cases and a literature review. Arch Neurol 1979;36:618-23.
7. Dinsdale HB. Spontaneous hemorrhage in the posterior fossa. A study of primary cerebellar and pontine hemorrhages with observations on their pathogenesis. Arch Neurol 1964;10:200-17.
8. Ecker A. Upward transtentorial herniation of the brain stem and cerebellum due to tumor of the posterior fossa with special note on tumors of the acoustic nerve. J Neurosurg 1948;5:51-61.
9. El-Gaidi MA, El-Nasr AH, Eissa EM. Infratentorial complications following preresection CSF diversion in children with posterior fossa tumors. J Neurosurg Pediatr 2015;15:4-11.
10. Gurajala I, Brahmaprasad V, Rajesh A, Ramachandran G, Purohit AK. Reverse brain herniation following ventriculoperitoneal shunt. Indian J Anaesth 2012;56:585-7.
11. Heros RC. Cerebellar hemorrhage and infarction. Stroke 1982;13:106-9.
12. Knupling R, Fuchs EC, Stoltenburg G, Gerull G, Giesen M, Mrowinski D. Chronic and acute transtentorial herniation with tumours of the posterior cranial fossa. Neurochirurgia (Stuttg) 1979;22:9-17.
13. Koenig MA. Cerebral edema and elevated intracranial pressure. Continuum (Minneap Minn) 2018;24:1588-602.
14. Laine FJ, Shedden AI, Dunn MM, Ghatak NR. Acquired intracranial herniations: MR imaging findings. AJR Am J Roentgenol 1995;165:967-73.
15. LeBeau J. L'oedème du Cerveau. Son Rôle Dans L'évolution de Tumeurs et des Abcès Intracrâniens, Thesis. Paris: J. Recht; 1938. p. 233.
16. McKissock W, Richardson A, Walsh L. Spontaneous cerebellar hemorrhage: A study of 34 consecutive cases treated surgically. Brain 1960;83:1-9.
17. Meyer A. Herniation of the brain. Arch Neuropsych 1920;4:387-400.
18. Osborn AG, Heaston DK, Wing SD. Diagnosis of ascending transtentorial herniation by cranial computed tomography. AJR Am J Roentgenol 1978;130:755-60.
19. Rai R, Iwanaga J, Shokouhi G, Oskouian RJ, Tubbs RS. The tentorium cerebelli: A comprehensive review including its anatomy, embryology, and surgical techniques. Cureus 2018;10:e3079.
20. Stevens RD, Shoykhet M, Cadena R. Emergency neurological life support: Intracranial hypertension and herniation. Neurocrit Care 2015;23 Suppl 2:S76-82.
21. Stone JL, Bailes JE, Hassan AN, Sindelar B, Patel V, Fino J. Brainstem monitoring in the neurocritical care unit: A rationale for real-time, automated neurophysiological monitoring. Neurocrit Care 2017;26:143-56.
22. Vindigni M, Tuniz F, Ius T, Cramaro A, Skrap M. Endoscopic third ventriculostomy in patients with secondary triventricular hydrocephalus from a haemorrhage or ischaemia in the posterior cranial fossa. Minim Invasive Neurosurg 2010;53:106-11.
23. Waidhauser E, Hamburger C, Marguth F. Neurosurgical management of cerebellar hemorrhage. Neurosurg Rev 1990;13:211-7.
24. Wijdicks EF, Sheth KN, Carter BS, Greer DM, Kasner SE, Kimberly WT, *et al*. Recommendations for the management of cerebral and cerebellar infarction with swelling: A statement for healthcare professionals from the American heart association/ American stroke association. Stroke 2014;45:1222-38.
25. Yadav G, Sisodia R, Khuba S, Mishra L. Anesthetic management of a case of transtentorial upward herniation: An uncommon emergency situation. J Anaesthesiol Clin Pharmacol 2012;28:413-5.

How to cite this article: Moscardini-Martelli J, Ponce-Gomez JA, Alcocer-Barradas V, Romano-Feinholz S, Padilla-Quiroz P, Zazueta MO, *et al*. Upward transtentorial herniation: A new role for endoscopic third ventriculostomy. Surg Neurol Int 2021;12:334.