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Intraventricular neuroendoscopic surgery in adult patients with obstructive hydrocephalus. A short case series

Enrique Marcos Sierra-Beníte[1,*], Lenier Laud-Rodríguez[1], Alberto Lázaro Carrillo-Coma[1], Mario Javier Garces-Ginarte[2]

1. University Clinical Surgical Hospital Comandante Faustino Pérez Hernández, Matanzas, Cuba 2. University of Medical Sciences of Matanzas, Matanzas, Cuba
*Corresponding Author
Email address: enriquemarcossierra@gmail.com

Abstract: Introduction: hydrocephalus is a neurosurgical pathology that presents several treatment alternatives. Despite this, the rate of dysfunctions and re-interventions of the patients is considered high.

Objective: to describe the results of intraventricular neuro-endoscopic surgery in patients operated on for obstructive hydrocephalus.

Materials and methods: This is an observational, descriptive, cross-sectional, case series study describing clinical, imaging, and surgical variables in patients operated on using intraventricular neuroendoscopy. After applying inclusion and exclusion criteria, the sample consisted of five patients.

Results: The Glasgow Coma Scale score at the time of surgery was greater than 12 in all cases. Sixty percent of cases presented with a grade 4 on the Frisen scale for assessing papilledema severity. The mean Evans index, measured by CT scan, was 0.39; the mean diameter of the third ventricle was 14.75 mm, while the mean diameter of the temporal horns was 4.1 mm. Three cases presented with dilated anatomical variations of the foramina of Monro, while two presented with medium diameters. The mean surgical time was 45 minutes. Postoperative complications included surgical stoma dysfunction in one patient with a third ventriculostomy.

Conclusions: Intraventricular neuroendoscopic surgery is an effective method for treating patients with obstructive hydrocephalus in selected patients.

Key words: obstructive hydrocephalus; intraventricular neuroendoscopy

1 Introduction

Hydrocephalus is a disease characterized by the abnormal accumulation of cerebrospinal fluid (CSF) within the ventricular system [1,2]. Several production mechanisms are defined that respond to the hyperproduction of CSF, obstruction of its circulation and disorders in its absorption, which are due to multiple etiological causes [2,3].

The two most commonly used treatment methods are the insertion of a ventriculoperitoneal shunt catheter and endoscopic third ventriculostomy (ETV). Over the last three decades, the development of neuroendoscopic techniques has allowed their inclusion in the therapeutic arsenal for hydrocephalus [3,4]. A lower rate of dysfunction is reported with ETV,

although it has limitations in hydrocephalus of non-obstructive etiology [4].

The present work aims to describe the results of intraventricular neuroendoscopic surgery in patients operated on for obstructive hydrocephalus.

2 Materials and methods

An observational, descriptive, cross-sectional, case series study was conducted at the Comandante Faustino Pérez Hernández University Clinical Surgical Hospital in Matanzas Province, during the period from January to September 2022. The study population consisted of 18 patients who underwent surgery for hydrocephalus. After applying inclusion and exclusion criteria, a study sample of five patients was obtained.

The inclusion criteria were as follows:

- Age over 18 years.
- Patients who have undergone intraventricular neuroendoscopy for obstructive hydrocephalus.
- Informed consent to participate in the study.

The variables used were: age, sex, diagnosis, degree of papilledema according to the Frisen scale, Glasgow Coma Scale score at the time of surgery, diameter of the third ventricle (mm), diameter of the temporal horns (mm), and Evans index measured by cranial computed tomography (CT) scans, type of foramen of Monro according to its morphology(2), surgical time (minutes), and postoperative complications. All information was collected by reviewing the medical records and CT scans of each patient. The results are expressed as absolute numbers and relative frequency.

The ethical principles established in the *Declaration of Helsinki* were applied to the conduct of the research.

Overview of the surgical technique applied

The patient was positioned in the supine position, under general endotracheal anesthesia; the head was centered in the midline with 25 degrees of flexion, fixed with a Sugita headrest. After performing asepsis and antisepsis of the region, a frontal incision and trephine were made at the Kocher craniometric point, with cruciform opening of the dura mater and bipolar electrocoagulation of the pia mater of the region, with introduction of a rigid endoscope 18 cm long and 3 mm in diameter, and a zero-degree lens (Karl Storz, Germany).

Lateral ventricle structures are visualized to ensure proper anatomical orientation (anterior septal vein, thalamostriate vein, choroid plexus, foramen of Monro, septum pellucidum). In the case of an endoscopic septostomy, the septum prelucidum was fenestrated with a size 2 Fogarty balloon, which was then inflated with 0.6 ml of saline solution. In the case of ETV, the third ventricle was accessed through the foramen of Monro, where the mammillary bodies, cerebral aqueduct (aqueduct of Sylvius), and premammillary region were visualized. Subsequently, a stoma was created using a Fogarty balloon similar to the one previously described, and cerebrospinal fluid (CSF) flow through the stoma was verified. Intraventricular irrigation with Ringer's lactate solution was performed, the endoscope was withdrawn, and careful hemostasis and closure of the surgical wound were achieved.

In all cases, a postoperative cranial CT scan was performed 24 hours later to rule out any procedure-related complications, and a cranial magnetic resonance imaging (MRI) scan was performed seven days after surgery. Patients were followed up as outpatients.

3 Results

Five patients with obstructive hydrocephalus underwent neuroendoscopic intervention; three (60%) were female and two (40%) were male. The average age was 53.4 years.

The Glasgow Coma Scale score at the time of surgery was greater than 12 points in all cases: 60% scored 15 points

and 40% scored 13 points. Sixty percent of cases presented with grade 4 on the Frisen scale for assessing papilledema severity. The mean Evans index, measured by CT scan, was 0.39; the mean third ventricle diameter was 14.75 mm, while the mean temporal horn diameter was 4.1 mm.

In three cases, dilated anatomical variations of the foramina of Monro were present, while two presented with medium diameters. The average surgical time was 45 minutes. Among the postoperative complications, stoma dysfunction occurred in one patient with ETV (Table 1).

Table 1. Clinical-imaging-intraoperative characteristics of patients operated on for obstructive hydrocephalus

Age/Sex	Diagnosis	Evans Index	Diameter of the third ventricle (mm)	Frisen scale (degrees)	Type of foramen of Monro
61/F	Triventricular hydrocephalus secondary to left cerebellar hemisphere hyperinsulinism	0,36	13	4	Dilated
68/M	Triventricular hydrocephalus secondary to cerebellar vermis HIP	0,40	15	4	Dilated
20/F	Univentricular hydrocephalus after shunting contralateral ventriculoperitoneal	-	9	1	Medium
47/F	Triventricular hydrocephalus secondary to metastatic tumor of posterior fossa	0,38	16	5	Dilated
71/M	Secondary triventricular hydrocephalus due to aqueductal stenosis	0,41	15	4	Medium

The following are images of three surgical cases included in this study.

Case 1 (Figure 1)

This is a 61-year-old female patient, with a history of controlled hypertension, who suffers from an intraparenchymal cerebellar hemorrhage of the left cerebellar hemisphere with vermian extension.

Image description:

1A: Presents with a Glasgow Coma Scale (GCS) score of 15 points at all times, so it is decided to treat her conservatively. After seven days of evolution, she begins with progressive dilation of the ventricular system (Evans I: 0.36).

1B: decreased level of consciousness appears (GCS: 13 points), therefore an EVT is performed.

1C: Kocher point (PK).

1D: Endoscopic view of the third ventricle. CMi: Left mammillary body; CMd: Right mammillary body; MPM: Premamillary membrane; Bf: Fogarty balloon.

1E: The procedure was uneventful; surgical time 40 minutes. Postoperative recovery was favorable, with a hospital stay of 12 days. Imaging studies were performed seven days after surgery. CMi: left mammary body; CMd: right mammary body; Es: stoma.

1F and 1H: path of the endoscope where the fenestration of the premammillary membrane is visualized on the MRI; sagittal slice T1 weighting.

1I: Post-surgical MRI, showing regression of hydrocephalus (I . Evans: 0.25).

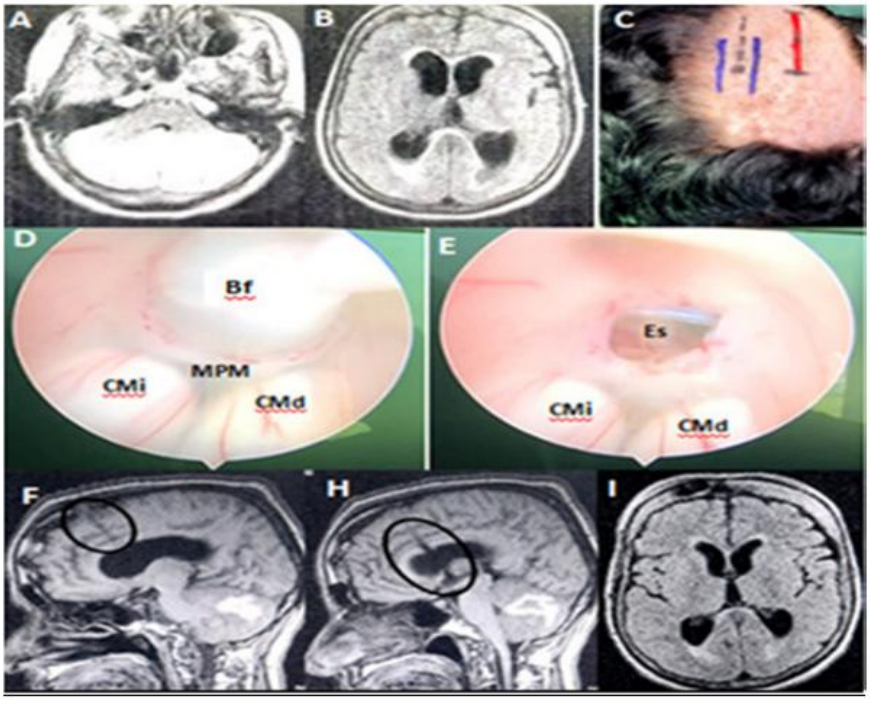

Figure1. Surgical procedure for case 1

Case 2 (Figure 2)

A 68-year-old male patient, with a history of compensated hypertension, was admitted due to a hemorrhage of the cerebellar vermis.

Image description:

2A and 2B: He underwent an endoscopic third ventriculostomy with decompression of the posterior cranial fossa.

2C: patient with 48 hours of evolution with associated triventricular obstructive hydrocephalus (I . Evans: 0.40; third ventricle: 15 mm).

2D: planning of the right Kocher point.

2E: Endoscopic view of the right lateral ventricle. During the procedure, the basilar artery is observed indented against the premammillary membrane in the endoscopic view of the third ventricle. This anatomical variant contraindicates fenestration due to the high risk of vascular injury. FMd: Right foramen of Monro; Vsa: Right anterior septal vein;

PC: Choroid plexus; Vte: Right thalamostriate vein.

2F: It was decided to perform an endoscopically guided external ventricular bypass. AB: visualization of the basilar artery; Mpm: premammillary membrane; CMi: left mammillary body; CMd: right mammillary body.

2H: CVE: external ventricular catheter; FMd: right foramen of Monro.

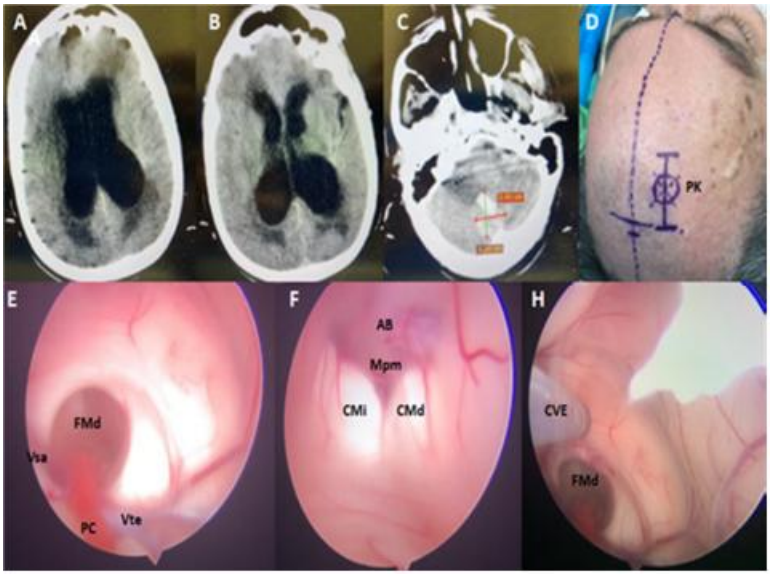

Figure 2. Surgical procedure for case 2

Case 3 (figure 3)

A 20-year-old patient is shown, with a history of surgery (7 months prior), who underwent a ventriculoperitoneal shunt due to triventricular hydrocephalus secondary to aqueductal stenosis with an Arnold-Chiari type 1 malformation. She returns with sustained holocranial headache, so a cranial MRI is performed, where a post-shunt left univentricular hydrocephalus is observed.

Image description:

3A and 3B: dilation of the left lateral ventricle. An endoscopic septostomy is decided upon.

3C: Trephine at Kocher's point.

3D: Endoscopic view of the left lateral ventricle.

3E: The medial wall of the frontal horn of the left lateral ventricle is visualized. Spr: septum prellucidum; Bf: Fogarty balloon.

Figure 3F: shows a performed septostomy; the contralateral ventriculoperitoneal shunt catheter from the previous surgery is visible. The procedure was uneventful and lasted 50 minutes; a cranial MRI was performed seven days later. Vsa: Anterior septal vein; Es: prellucidum septum stoma; FOR: fornix; FMi: left foramen of Monro; CdC: contralateral ventriculoperitoneal shunt catheter; PC: choroid plexus.

3H: Post-surgical MRI; normal parameters were observed in the left ventricular system, indicating the effectiveness of the septostomy performed. The patient had a 10-day hospital stay. The evolution was favorable, with regression of the symptoms presented.

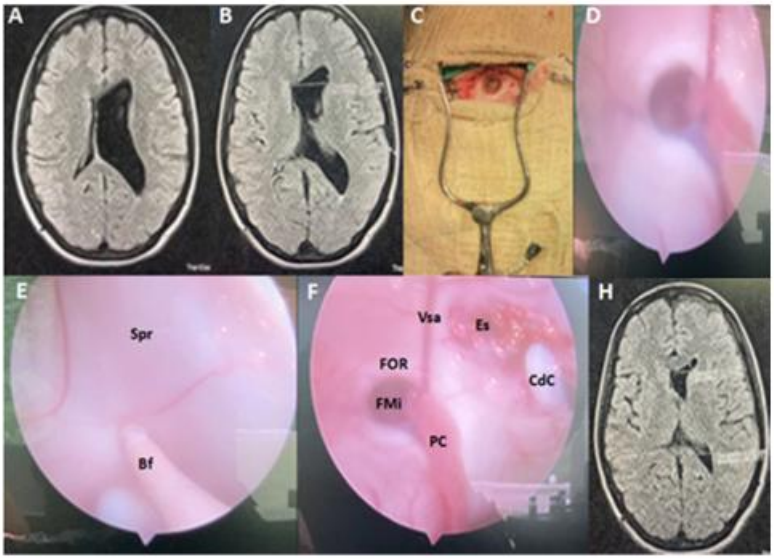

Figure 3. Surgical procedure for case 3

4 Discussion

Obstructive hydrocephalus is a condition in which there is an obstruction to the flow of cerebrospinal fluid (CSF). The most frequent causes include posterior fossa tumors, cerebellar intraparenchymal hematomas, aqueductal stenosis and its variants, Arnold-Chiari malformation, among others. All share the unique pathophysiological feature of compression of the fourth ventricle and/or cerebral aqueduct, resulting in dilation of the lateral ventricles and the third ventricle (triventricular hydrocephalus) [5].

The search for an alternative route for CSF circulation has been previously studied using microsurgical methods, such as the Torkildsen procedure (communication of the lateral ventricles with the cisterna magna), the Stookey-Scarff technique (perforation of the third ventricle in its floor and the lamina terminalis, resulting in a communication of the lateral ventricles and the third ventricle with the chiasmatic and interpeduncular cisterns) —proposed in 1936—, the Anton-Bramman method (ventriculostomy through the corpus callosum to establish a communication between the lateral ventricles and the subarachnoid and subdural space), the Contreras method (ventricular drainage of the lateral ventricles towards the ambient cistern) and the Hitman method (communication of the third ventricle with the interpeduncular cistern by microsurgery). These procedures were used to restore circulation through alternative cisternal routes [6]. With the development of endoscopic methods, these procedures have been systematized with greater safety and effectiveness [7].

Endoscopic third ventriculostomy is an effective method for treating triventricular hydrocephalus. A 10-year study by Rocque et al [8]., with an analysis of 203 patients, demonstrated that even in patients with a previous ventriculoperitoneal shunt, third ventriculostomy was a successful procedure, with a complication rate of 22%.

In the case of posterior fossa tumors, the use of other shunt procedures is not recommended if endoscopic third ventriculostomy is a viable option [9], due to the inherent risks of these techniques. External ventricular drainage increases the risk of overdrainage, cerebellar culmen herniation, and intratumoral hemorrhage [10]. However, some series have highlighted the need for temporary shunt systems due to the risk of stoma closure by debris or blood clots, which is associated with an increased incidence of ventriculitis—impairment of CSF homeostasis after resection—and cerebellar infarction [11].

Another neuroendoscopic technique employed is septostomy with or without foraminoplasty of the foramen of Monro, which is useful in univentricular hydrocephalus. The causes of univentricular hydrocephalus are usually neoplastic lesions,

infectious inflammatory pathologies, vascular malformations, congenital occlusions of the foramen of Monro, or, functionally, in patients undergoing CSF shunts [12].

The literature shows evidence of the effectiveness and safety of endoscopic third ventriculostomy and endoscopic septostomy in patients with triventricular and univentricular obstructive hydrocephalus, respectively. These procedures are considered the treatment of choice in these cases [10,13-15].

Intraventricular neuroendoscopic surgery is an effective method for treating patients with obstructive hydrocephalus in selected patients, with good post-surgical results and a low incidence of complications.

Conflicts of interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Nishiyama K. Theory and Practice of Endoscopic Third Ventriculostomy. Neurological Surgery [Internet]. 2022 [citado 11/10/2022];50(2):366-75. Disponible en: https://europepmc.org/article/med/35400654

[2] Olazábal Armas I. Variantes anatómicas endoscópicas del agujero de Monro en la tercer ventriculostomía. Rev Cubana Neurol Neurocir [Internet]. 2013 [citado 11/10/2022];3(2):122–5. Disponible en:

http://www.revneuro.sld.cu/index.php/neu/article/view/78

[3] Tefre S, Lilja-Cyron A, Arvidsson L, et al. Endoscopic third ventriculostomy for adults with hydrocephalus: creating a prognostic model for success: protocol for a retrospective multicentre study (Nordic ETV). BMJ Open [Internet]. 2022 [citado 11/10/2022];12(1):e055570. Disponible en: https://bmjopen.bmj.com/content/12/1/e055570.abstract

[4] Salah M, Elhuseny AY, Youssef EM. Endoscopic third ventriculostomy for the management of hydrocephalus secondary to posterior fossa tumors: A retrospective study. Surg Neurol Int [Internet]. 2022 [citado 11/10/2022];13:65. Disponible en: https://www.ncbi.nlm.nih.gov/pmc/articles/PMC8888306/

[5] Picart T, Dumot C, Meyronet D, et al. Characteristics and management of hydrocephalus in adult patients with cerebellar glioblastoma: lessonsfrom a French nationwide series of 118 cases. Neurosurg Rev [Internet]. 2022 [citado12/10/2022];45(1):683-99. Disponible en: doi.org/10.1007/s10143-021-01578-2

[6] Karagiosov L. Técnica neuroquirúrgica. La Habana: Editorial Científico-Técnica; 1977.

[7] Lu L, Chen H, Weng S, et al. Endoscopic Third Ventriculostomy versus Ventriculoperitoneal Shunt in Patients with Obstructive Hydrocephalus: Meta-Analysis of Randomized Controlled Trials. World Neurosurg [Internet]. 2019 [citado11/10/2022];129:334-40. Disponible en: https://linkinghub.elsevier.com/retrieve/pii/S187887501931263X

[8] Rocque BG, Jensen H, Reeder RW, et al. Endoscopic third ventriculostomy in previously shunt-treated patients. J Neurosurg Pediatr [Internet]. 2022 [citado 11/10/2022];30(4):428-36.

Disponible en: https://thejns.org/pediatrics/view/journals/j-neurosurg-pediatr/30/4/article-p428.xml

[9] Dewan MC, Lim J, Shannon CN, et al. The durability of endoscopic third ventriculostomy and ventriculoperitoneal shunts in children with hydrocephalus following posterior fossa tumor resection: a systematic review and time-to-failure analysis. J Neurosurg Pediatr [Internet]. 2017 [citado 12/10/2022];19(5):578-84.

Disponible en: https://thejns.org/view/journals/j-neurosurg-pediatr/19/5/article- p578.xml

[10] Horta-Tamayo EE, Acosta-González LC, Ortega-Raez DR, et al. Tercer ventriculostomía endoscópica en hidrocefalia secundaria a tumores de fosa posterior en adultos. Rev cienc méd Pinar Río [Internet]. 2021 [citado 12/10/2022]; 25(6). Disponible en: http://revcmpinar.sld.cu/index.php/publicaciones/article/view/5273

[11] Anania P, Battaglini D, Balestrino A, et al. The role of externalventricular drainage for the management of posterior cranial fossa tumours: a systematic review. Neurosurg Rev [Internet]. 2021 [citado 12/10/2022];44:1243-53.

Disponible en: doi.org/10.1007/s10143-020-01325-z

[12] Taguchi A, Kinoshita Y, Amatya VJ, et al. Intratumoral Hemorrhage After Endoscopic Third Ventriculostomy for Obstructive Hydrocephalus Caused by Brain Tumors. World Neurosurg [Internet]. 2022 [citado 12/10/2022];158:e256-e64.

Disponible en: https://www.sciencedirect.com/science/article/abs/pii/S1878875021016739

[13] Giammattei L, Aureli V, Daniel RT, et al. Neuroendoscopic septostomy: Indications and surgical technique. Neurochi rurgie [Internet]. 2018 [citado 11/10/2022];64(3):190-3.

Disponible en: https://www.sciencedirect.com/science/article/abs/pii/S0028377018300389

[14] Atchley TJ, Sowers B, Arynchyna AA, et al. Complications of neuroendoscopic septostomy. J Neurosurg Pediatr [Internet]. 2021 [citado 12/10/2022];29(2):185-91. Disponible en: https://thejns.org/pediatrics/view/journals/j-neurosurg-pediatr/29/2/article-p185.xml

[15] Sherrod BA, Iyer RR, Kestle JR. Endoscopic third ventriculostomy for pediatric tumor-associated hydrocephalus. Neurosurg Focus [Internet]. 2020 [citado 06/09/2021];48(1):e5.

Disponible en: https://thejns.org/focus/view/journals/neurosurg-focus/48/1/article-pE5.xml

Contribution of authorship

Enrique Marcos Sierra-Benítez: conceptualization, formal analysis, research, methodology, supervision, visualization, drafting of the original document, feedback, revision, and editing.

Lenier Laud-Rodríguez: conceptualization, formal analysis, methodology, supervision, visualization, drafting, revision, and editing.

Alberto Lázaro Carrillo-Comas: conceptualization, formal analysis, methodology, visualization, drafting of the original document, drafting, revision, and editing.

Mario Javier Garces-Ginarte: conceptualization, formal analysis, methodology, visualization, drafting of the original document, drafting, revision, and editing.