Turk Neurosurg 36(4):581-586, 2026
DOI: 10.5137/1019-5149.JTN.49075-25.4

Original Investigation

General Neurosurgery and Miscellaneous-Others

Received: 17.06.2025
Accepted: 10.10.2025
Published Online: 24.07.2026

Results of a Long-Term Follow-Up on the Dry-Field Maneuver Application in Hemorrhage Control During Neuroendoscopic Procedures

Elif BOLAT, Elif Ezgi CENBERLITAS, Tuncer TURHAN

Ege University, School of Medicine, Department of Neurosurgery, Izmir, Türkiye

This study has been presented as an oral presentation at the 18th WFNS Congress between 4-8 December 2023, Cape Town, South Africa.

Corresponding author: Elif Ezgi CENBERLITAS ✉ ecenberlitas@gmail.com

ABSTRACT

AIM: To present the long-term follow-up results of dry-field maneuver in neuroendoscopy.

MATERIAL and METHODS: The dry-field maneuver has been used in our clinic since 2012, leading to a retrospective review of patients undergoing neuroendoscopic procedures from 2012 to 2024.

RESULTS: The dry-field maneuver was successfully implemented in 13 patients in our clinic, achieving effective control of bleeding without any postoperative complications. No neurological or vascular issues or deaths associated with this method were reported in any patient throughout the long-term follow-up period.

CONCLUSION: The dry-field maneuver is a successful and reliable technique for controlling bleeding in neuroendoscopic procedures. It may also be used in certain cases during elective procedures.

KEYWORDS: Cerebral intraventricular hemorrhage, Dry field, Neuroendoscopy, Surgical hemostasis

ABBREVIATIONS: CSF: Cerebrospinal fluid, **CP:** choroid plexus, **ETV:** endoscopic third ventriculostomy, **IR:** infundibular recess, **MB:** mammillary bodies, **SV:** septal vein, **TC:** tuber cinereum, **TSV:** thalamostriate vein

INTRODUCTION

Neuroendoscopic surgery is increasingly applied in treating hydrocephalus, ventricular system disorders, and selected skull base lesions. Also, the complications related to these procedures are reported more frequently. Among these, hemorrhage is one of the most significant challenges for neurosurgeons (1,10). The narrow endoscopic working space and limited options for intraoperative hemostasis make bleeding control difficult. Even a minor hemorrhage can obscure the field of view, prolong the surgery, and increase postoperative risks. Therefore, careful intraoperative management of bleeding is essential for both patient safety and operative success. In cases where severe bleeding cannot be controlled, morbidity and mortality may occur, underscoring the need for improved strategies for complication management.

The risk and severity of bleeding during neuroendoscopic procedures depend on several factors. These factors include the type of procedure performed, the patient's medical history or comorbidities influencing coagulation, the size and location of the lesion, the surgeon's level of experience, and the instruments employed.

Endoscopic third ventriculostomy (ETV) is generally associated with a low risk of bleeding, whereas procedures such as tumor biopsy or resection carry a higher risk. Though rare, massive hemorrhages can occur during ETVs. A meta-anal-

Elif BOLAT : 0000-0003-1420-762X Elif Ezgi CENBERLITAS : 0009-0004-2363-6885 Tuncer TURHAN : 0000-0002-3559-1918

ysis of 2,984 ETVs performed on 2,884 patients detected an intraoperative bleeding rate of 3.7%, with massive bleeding occurring in 0.6% of cases (2). The mortality rate was 0.21% (6 patients), with four deaths attributed to bleeding-related complications. Thus, two-thirds of mortalities during ETV are due to bleeding. A more recent meta-analysis of 3,749 patients from 46 case series reported bleeding rates during ETVs performed with flexible and rigid endoscopes at 4% and 6%, respectively (1). In a case series of 60 patients undergoing endoscopic tumor biopsy, bleeding occurred in 21 (35%) patients, with severe hemorrhage in 2 cases (4). A systematic review evaluating the use of ultrasonic aspirators in endoscopic tumor resections reported a bleeding incidence of 7.5%, identifying hemorrhage as the most frequent complication (10). Overall, available studies indicate that bleeding occurs more often in biopsy and resection procedures than in ETV alone.

Conventional methods to address bleeding in neuroendoscopic procedures typically involve irrigation and electrocauterization. However, these techniques may be insufficient, especially in cases of massive bleeding where the source is unclear.

Dry-Field Maneuver

In neuroendoscopy, the dry-field maneuver is employed when conventional methods of controlling hemorrhage, such as irrigation and cauterization, fail to work within a 3-minute period. The effectiveness of this maneuver in controlling bleeding depends on the principle of allowing dispersed platelets in the fluid to come together at the site of vascular injury because of gravity in a dry environment. Another important goal of this maneuver is to improve the clarity of the surgical field by eliminating the blurriness caused by bleeding in the fluid environment, thereby allowing the continuation of the surgical procedure.

The dry-field maneuver was first successfully used during an animal study in 2012 (14). This method was employed on seven patients in our clinic between 2012 and 2017, and the results were published in 2017 (13). Following our study, Oertel and colleagues published outcomes using the same technique in a series of six patients in 2018 (9). In 2022, Spennato and colleagues reported successfully using the dry-field maneuver to control bleeding in a case where irrigation and cauterization had failed (12).

The steps involved in this maneuver were detailed in a previously published study (13), and are shown in Figure 1. They are summarized as follows:

1. Irrigation is stopped if it fails to stop the bleeding after being performed effectively for 3 minutes. The cerebrospinal fluid (CSF) is slowly and carefully drained from the ventricle using a suction catheter.

2. During this process, the irrigation line is removed from the endoscope and left open to allow air to flow easily into the ventricular system in place of the withdrawn CSF. At least one

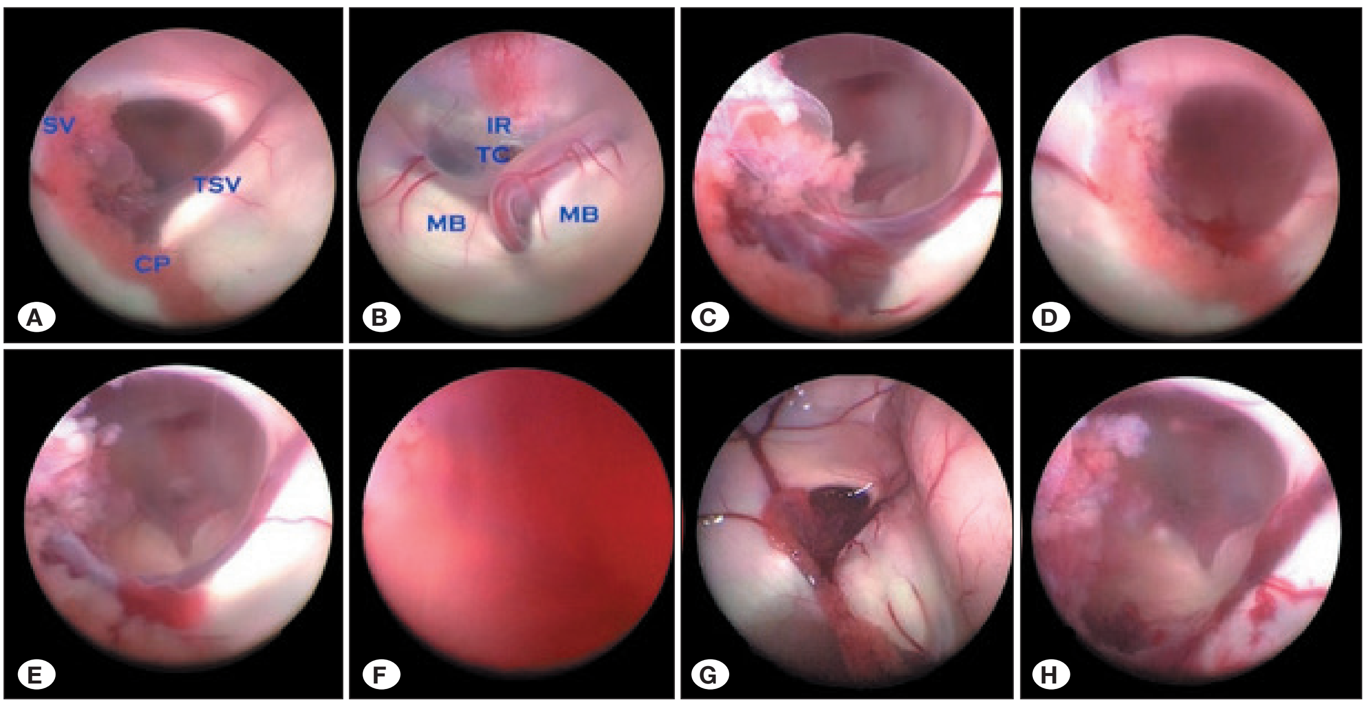

Figure 1: Dry-field maneuver demonstrated through a sample case. **A)** Choroid plexus (CP), septal vein (SV), and thalamostriate vein (TSV) were observed at the level of the foramen of Monro. **B)** Upon entering the third ventricle, the mammillary bodies (MB), tuber cinereum (TC), and infundibular recess (IR) were visualized. **C)** As the view became blurred while working within the third ventricle, the camera was withdrawn to investigate the etiology. **D)** A venous source of bleeding was identified. **E)** Progression of the bleeding was observed. **F)** Image clarity was lost due to bleeding, and irrigation could not control it. **G)** Entire cerebrospinal fluid in the ventricular system was drained. Active bleeding ceased, and clot formation was observed. **H)** Ventricular system was refilled with Ringer's lactate solution, and the bleeding was noted to have stopped.

channel of the telescope remains open to prevent ventricular collapse. If there is any suspicion of ventricular collapse, CSF drainage is stopped and air is introduced into the ventricle if necessary.

3. Once all the CSF has been drained, a waiting period of approximately 2–3 min is observed over the bleeding site to allow platelet aggregation and control the hemorrhage.

4. After the bleeding has stopped, the ventricles are slowly filled with Ringer's lactate solution while allowing air to escape through the previously opened channel.

This study examined the effectiveness and long-term outcomes of using the dry-field maneuver to manage hemorrhagic complications during neuroendoscopic surgeries.

MATERIAL and METHODS

The dry-field maneuver has been used in our clinic since 2012 (13,14). Therefore, the operating-room records of all patients treated using neuroendoscopy between 2012 and 2024, including patient files and video recordings from our clinic, were retrospectively reviewed. The study included patients identified from these records, in whom the dry-field maneuver was used. Storz–Lotta telescopes and a Xenon-Nova 175-W light source (Karl Storz GmbH & Co KG, Tuttlingen) were used in all surgeries.

RESULTS

The dry-field maneuver was used for hemorrhage control on 13 patients undergoing neuroendoscopic procedures. Before deciding on the dry-field maneuver, at least 3 min of Ringer's lactate irrigation was attempted. The maneuver was applied in cases where this was unsuccessful.

The age of the patients varied from 6 months to 51 years, with a mean age of 17 years. The group had a male predominance, with a male-to-female ratio of 9:4. In pediatric cases, the average age was 8 years.

Biopsies were taken in two patients diagnosed with craniopharyngioma, and an Ommaya reservoir was placed into the cyst. Two patients underwent colloid cyst excision. Biopsies were taken from patients with pineal (*n* = 2), tectal (*n* = 1), thalamic (*n* = 1), and ependymal (*n* = 1) masses. One patient underwent arachnoid cyst fenestration, and one patient had an intraventricular hematoma evacuated endoscopically. Hemorrhage occurred during ETV procedures in two patients diagnosed with aqueductal stenosis.

Bleeding was completely controlled with the dry-field maneuver in all patients. No neurological or vascular complications were observed in any patient during the early postoperative period. Although routine biochemical tests showed no significant changes, radiological examinations revealed varying levels of pneumocephalus and minor intraventricular hemorrhage, particularly in the atrial horns, as expected in all patients. These radiological changes resolved completely during follow-up, and no long-term complications related to them were observed.

Patients were followed up for an average duration of 5 years. No acute or chronic vascular or neurological complications associated with the dry-field maneuver were reported in these patients. Two patients required the placement of a ventriculoperitoneal shunt in the acute period. Morbidities related to the natural progression of the tumor were recorded in two cases. Also, no procedure-related mortality was noted. The results are shown in Table I.

Table I: Information on Patients Undergoing the Dry Field Maneuver

	Location	Procedure	Bleeding origin	Age (years)	Gender	Follow-up (years)
Craniopharangioma	Suprasellar	TR	Arterial	8	Male	10
Cyst	Colloid	TR	Venous	13	Male	5
Cyst	Colloid	TR	Venous	31	Male	1
Aquaduct stenosis	Aquaduct	E3V	Venous	36	Male	1
SEGA	Ependymal	TR	Venous	13	Female	10
Aquaduct stenosis	Aquaduct	E3V	Venous	9	Female	10
Hemorrhage	Intraventricular	Hematom evacuation	Arterial	9	Male	4
Tumor	Thalamic	TR + E3V	Venous	11	Female	6
Tumor	Pineal gland	TR	Venous	51	Male	9
Arachnoid cyst	Temporal	Cystostomy	Arterial	2	Male	1
Craniopha-rangioma	Suprasellar	Cystostomy	Venous	11	Male	1
Glioma	Tectal	TR + E3V	Venous	26	Female	2
Tumor	Pineal gland	E3V + TB	Venous	0.5	Male	1
				Mean: 17		Mean: 5

E3V: *Endoscopic third ventriculostomy;* ***SEGA:*** *Subependymal giant cell astrocytoma;* ***TB:*** *Tumor biopsy;* ***TR:*** *Tumor resection.*

DISCUSSION

Bleeding in neuroendoscopic procedures is one of the most serious complications. Controlling bleeding is challenging due to the narrow surgical field and the fact that the surgery is performed in a fluid environment. Therefore, measures to prevent bleeding have been the initial focus of investigation.

As an example of a preventive strategy for avoiding vascular injury during ETV, Yadav et al. introduced the “water jet dissection” technique in patients with a thick and opaque third ventricular floor (15). This method is not intended to control bleeding once it occurs; however, it represents an important effort to prevent hemorrhagic complications during endoscopic procedures. The “water jet dissection” technique was used during the ETV procedure, when the ventricular floor appeared thick and opaque enough to obscure the basilar artery, to prevent potential basilar artery injury while creating the stoma. In the first step of this technique, a starting point was created on the floor of the third ventricle, located just behind the dorsum sellae, using bipolar forceps. A water jet was then created by injecting Ringer’s lactate solution through a 2-mm catheter. During this process, aspiration was performed to clear soft tissues and prevent an increase in potential pressure. The water jet dissection to create the stoma typically took 2–5 min. When water jet techniques were insufficient for stoma creation, bipolar forceps were used to expand the opening. This method was applied to 36 patients and was sufficient to create the stoma in 31 of them; however, it was inadequate in 5 patients. No vascular injury or bleeding was reported in the patients who underwent the procedure.

Nishihara et al. noted that using a transparent endoscopic sheath during the endoscopic evacuation of intracerebral hematomas allowed for a clearer visualization of the boundary between the hematoma and the surrounding brain tissue, thus enabling easier and quicker identification of bleeding points (8).

The primary methods used for surgical hemostasis are irrigation and, where the source of bleeding can be identified, electrocauterization. The most significant limitation of neuroendoscopic procedures is the difficulty in controlling bleeding, which has led to the search for various techniques and equipment to assist surgeons in surgical hemostasis. The “small-chamber irrigation technique,” described by Manwaring et al. (6), is one approach used to control bleeding during endoscopic procedures. The method aims to reduce visual obstruction caused by blood, which can rapidly cloud the irrigation fluid and obscure the surgical field. In this technique, a small chamber is created between the endoscope sheath and the camera, allowing the surgeon to better visualize the bleeding source. Once identified, bleeding can be managed with irrigation and cauterization. However, the limitations of this technique include situations where the source of bleeding remains outside the camera’s field of view or when bleeding stems from free-floating vessels.

Cappabianca et al. developed a method to stop bleeding that could not be controlled with irrigation (3). In this method, direct pressure is applied to the bleed using a cotton pad placed inside the endoscope cannula. The endoscope is first removed from the cannula, followed by placing the pad into the cannula and then positioning the pad in a way that stops the bleeding using the imaging tip of the endoscope. Applying short-term pressure effectively controls the bleeding. However, this technique seems limited to situations where the source of bleeding is visible.

Nagasaka et al. introduced the “balanced irrigation–suction technique” (7). This method uses a multifunctional aspiration cannula that enables simultaneous and balanced irrigation and suction to maintain a clear view for controlling bleeding during intracerebral hematoma evacuation surgeries. This technique aims to preserve the surgeon’s field of vision during the procedure, thereby creating more favorable conditions for addressing the bleeding area.

In a case report, a 5-year-old child experienced bleeding during an endoscopic cyst fenestration. Despite a 2-min attempt at effective irrigation, the bleeding could not be controlled, leading to the endoscopic application of Floseal. After applying Floseal and waiting for 2 minutes, irrigation was performed, and a clear fluid flow was observed, indicating that the bleeding had been successfully stopped (11).

Endoscopic irrigation techniques have also been described for removing intraventricular blood. Etus et al. reported in a multicenter study that early endoscopic ventricular irrigation could be applied safely and was associated with reduced complication rates (5). These findings highlight the diversity of endoscopic strategies aimed at managing intraventricular bleeding and hematoma.

The dry-field maneuver is a technique used to control severe bleeding that can occur during intraventricular neuroendoscopic procedures. This maneuver aids in hemostasis by creating a dry surgical field, which allows platelets to aggregate at the site of the injured vessel. Additionally, it provides a better surgical view during bleeding events. The dry-field maneuver has been used in our clinic for more than a decade, and the cases have been followed up to the present day. No serious neurological complications have been observed during an average follow-up period of 5 years.

Since its introduction, the maneuver has been implemented in 13 patients in our clinic and 7 patients in other clinics, with published results (9,12). In these outcomes, no vascular or neurological complications associated with the technique have been reported, consistent with our clinic’s experience.

Theoretically, significant expected complications of the dry-field maneuver include ventricular collapse and the development of a subdural hematoma during the procedure. However, neither our clinical practice nor previous related studies reported these expected complications. Postoperative radiological imaging in patients often revealed pneumocephalus and intraventricular hematomas, but these spontaneously regressed during follow-up.

Reviewing the literature on hemorrhagic control in neuroendoscopic procedures reveals that all studies focus on developing techniques to create a clearer surgical field during bleeding. In terms of achieving hemostasis, no other effective method exists besides the dry-field maneuver. Although Floseal can be used in all surgical procedures, it is not specific to neuroendoscopic procedures. Considering the mechanism of action of Floseal, its combined use with the dry-field maneuver may also be more effective.

The dry-field maneuver has been effectively used for intraventricular hemorrhages. Previous findings support the hemostatic efficacy and safety of the dry-field maneuver. Given these characteristics, it raises the question of whether the dry-field maneuver can be used in elective surgeries when necessary. The use of the dry-field maneuver as a prophylactic measure can be considered, particularly in surgeries with an anticipated high likelihood of bleeding. This can offer a new perspective in developing surgery-specific hemostatic strategies, thereby enhancing the safety and efficacy of surgeries. Existing studies demonstrate the successful application of this method in major bleeding cases, but data regarding its use in elective surgeries are lacking.

CONCLUSION

The dry-field maneuver has been effective in managing intraventricular hemorrhages, with studies demonstrating its hemostatic efficacy and safety. Future studies should focus on conducting more clinical experimentation related to the dry-field maneuver and consider its broader integration into surgical practice.

Declarations

Funding: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Availability of data and materials: The datasets generated and/or analyzed during the current study are available from the corresponding author by reasonable request.

Disclosure: The authors declare no competing interests.

Ethics approval and consent to participate: This study was approved by the Ege University Medical Research Ethics Committee (Decision No: 2024-208024-1.1T/15). Written informed consent was obtained from all patients or their legal guardians.

AUTHORSHIP CONTRIBUTION

Study conception and design: EB, TT
Data collection: EB, EEC
Analysis and interpretation of results: EEC
Draft manuscript preparation: EB, EEC, TT
Critical revision of the article: TT
Other (study supervision, fundings, materials, etc...): TT
All authors (EB, EEC, TT) reviewed the results and approved the final version of the manuscript.

REFERENCES

1. Boaro A, Mahadik B, Petrillo A, Siddi F, Devi S, Chawla S, Abunimer AM, Feletti A, Fiorindi A, Longatti P, Sala F, Smith TR, Mekary RA: Efficacy and safety of flexible versus rigid endoscopic third ventriculostomy in pediatric and adult populations: a systematic review and meta-analysis. Neurosurg Rev 45:199-216, 2022. https://doi.org/10.1007/s10143-021-01590-6
2. Bouras T, Sgouros S: Complications of endoscopic third ventriculostomy. J Neurosurg Pediatr 7:643-649, 2011. https://doi.org/10.3171/2011.4.PEDS10503
3. Cappabianca P, Cinalli G, Gangemi M, Brunori A, Cavallo LM, de Divitiis E, Decq P, Delitala A, Di Rocco F, Frazee J, Godano U, Grotenhuis A, Longatti P, Mascari C, Nishihara T, Oi S, Rekate H, Schroeder HW, Souweidane MM, Spennato P, Tamburrini G, Teo C, Warf B, Zymberg ST: Application of neuroendoscopy to intraventricular lesions. Neurosurgery 62:575-597, 2008. https://doi.org/10.1227/01.neu.0000316262.74843.dd
4. Ebel F, Greuter L, Guzman R, Soleman J: Resection of brain lesions with a neuroendoscopic ultrasonic aspirator – a systematic literature review. Neurosurg Rev 45:3109-3118, 2022. https://doi.org/10.1007/s10143-022-01837-w
5. Etus V, Kahilogullari G, Karabagli H, Unlu A: Early endoscopic ventricular irrigation for the treatment of neonatal posthemorrhagic hydrocephalus: a feasible treatment option or not? A multicenter study. Turk Neurosurg 28:137-141, 2018. https://doi.org/10.5137/1019-5149.JTN.18677-16.0
6. Manwaring JC, El Damaty A, Baldauf J, Schroeder HW: The small-chamber irrigation technique (SCIT): a simple maneuver for managing intraoperative hemorrhage during endoscopic intraventricular surgery. Neurosurgery 10:375-379, 2014. https://doi.org/10.1227/NEU.0000000000000406
7. Nagasaka T, Tsugeno M, Ikeda H, Okamoto T, Takagawa Y, Inao S, Wakabayashi T: Balanced irrigation-suction technique with a multifunctional suction cannula and its application for intraoperative hemorrhage in endoscopic evacuation of intracerebral hematomas: technical note. Neurosurgery 65:E826-E827, 2009. https://doi.org/10.1227/01.NEU.0000350985.58062.3F
8. Nishihara T, Teraoka A, Morita A, Ueki K, Takai K, Kirino T: A transparent sheath for endoscopic surgery and its application in surgical evacuation of spontaneous intracerebral hematomas. Technical note. J Neurosurg 92:1053-1055, 2000. https://doi.org/10.3171/jns.2000.92.6.1053
9. Oertel J, Linsler S, Strohm L, Senger S: Management of severe intraoperative hemorrhage during intraventricular neuroendoscopic procedures: the dry field technique. Acta Neurochir (Wien) 164:2551-2557, 2022. https://doi.org/10.1007/s00701-022-05207-9
10. Oppido PA, Fiorindi A, Benvenuti L, Cattani F, Cipri S, Gangemi M, Godano U, Longatti P, Mascari C, Morace E, Tosatto L: Neuroendoscopic biopsy of ventricular tumors: a multicentric experience. Neurosurg Focus 30:E2, 2011. https://doi.org/10.3171/2011.1.FOCUS10326
11. Reeves A, Muhonen M, Loudon W: FloSeal hemostatic matrix use for intraventricular hemorrhage during a neuroendoscopic procedure. Minim Invasive Neurosurg 54:132-134, 2011. https://doi.org/10.1055/s-0031-1279717
12. Spennato P, De Rosa A, Meccariello G, Quaglietta L, Imperato A, Scala MR, Russo C, Cinalli G: Endoscopic ultrasonic aspiration as alternative to more invasive surgery in initial management of optic pathway gliomas in children. Childs Nerv Syst 38:1281-1287, 2022. https://doi.org/10.1007/s00381-022-05515-6
13. Turhan T: Dry-field maneuver for controlling the massive intraventricular bleeding during neuroendoscopic procedures. Childs Nerv Syst 34:541-545, 2018. https://doi.org/10.1007/s00381-017-3652-2

14. Turhan T, Aydin O, Ersahin Y: Neuroendoscopic surgery in empty ventricular system under continuous gas infusion: experimental study of pressure changes and complications. Childs Nerv Syst 28:73-77, 2012. https://doi.org/10.1007/s00381-011-1586-7
15. Yadav YR, Shenoy R, Mukerji G, Parihar V: Water jet dissection technique for endoscopic third ventriculostomy minimises the risk of bleeding and neurological complications in obstructive hydrocephalus with a thick and opaque third ventricle floor. Minim Invasive Neurosurg 53:155-158, 2010. https://doi.org/10.1055/s-0030-1263107