ISSN: 2755-015X

Journal of Surgery & Anesthesia Research

SCIENTIFIC Research and Community

Review Article

Open Access

Endoscopic Treatment of Neurosurgical Pathologies: Experience and Future Prospects in the Neurosurgery Department at Mohammed 6 University Hospital, Marrakech

Drai Badr, Ait M'barek Yassine, Benantar Lamia and Aniba Khalid

Neurosurgery department, Mohammed 6 University Hospital, Marrakech, Morocco

ABSTRACT

Endoscopy is a new procedure in neurosurgery that uses optical magnification and video-assisted endoscopes to guide the hand to hard-to-reach locations. Despite extensive trials and meta-analyses, no definitive results have been published on its benefits. Neuroendoscopy has expanded beyond ventricular operations to treat various neurosurgical conditions, including cyst fenestration, tumor biopsy, tumor excision, and metastatic disease evaluation. It is beneficial for patients with hydrocephalus, intraventricular cysts, and concurrent hydrocephalus. Intracranial cysts are ideal for neuro-endoscopic therapy, and it can treat cystic craniopharyngiomas, dysontogenic tumors, gliomas, and metastases. Endoscopic tumor biopsy is a reliable technique for ventricle brain tumors. our study treated 480 hydrocephalus patients using endoscopic third ventriculostomy, accounting for 50.5% of cases. The most common cause was Sylvius aqueduct stenosis. Endoscopy was beneficial for treating colloidal cysts, arachnoid cysts, pituitary adenoma, and craniopharyngioma. It also served as a complement to microsurgery in 55 cases. Neuroendoscopy improved sciatic pain in 15 patients who underwent lumbar discectomy, with only minor issues due to the surgical scar. Neuroendoscopic surgery is expected to advance significantly in the future, with advancements in camera and optical technology, surgical instrument design, navigation systems, multiport surgery, and improved microsurgery.

***Corresponding author**
Drai Badr, Neurosurgery Department, Mohammed 6 University Hospital, Marrakech, Morocco.

Received: May 09, 2024; **Accepted:** May 16, 2024; **Published:** October 14, 2024

Keywords: Neuroendoscopy, Hydrocephalus, Colloid Cysts, Cystic Brain Lesions, Endoscopic Pituitary Surgery, Spinal Endoscopy

Introduction

In neurosurgery, endoscopy is a relatively new procedure that has not yet been thoroughly evaluated by scientific research. Although extensive randomized controlled trials and meta-analyses are underway, no definitive results about the possible benefits, for different indications, of this novel technique over other well-established ones have been published as of yet.

This surgical method makes use of an optical magnification system, instruments, and direct light introduction into the surgical field of work through the use of a rigid or flexible video-assisted endoscope. Its operation necessitates an aerial or liquid cavity. Therefore, the primary contribution of endoscopy is to provide a method through which the hand can be guided to locations that are hard to reach and seen through exceedingly tiny approaches.

In the light of our experiment in the neurosurgery department at Mohammed 6 University Hospital and recent literature, this article will outline and discuss neuro-endoscopic procedures, as well as their indications and outcomes.

"Neuroendoscopy," "hydrocephalus," "colloid cysts" "cystic brain lesions," "endoscopic pituitary surgery," and "spinal endoscopy" were the search phrases used in the literature.

History of Neuroendoscopy

L'Espinasse carried out the first neurosurgery endoscopic treatment in 1910, fulgurating the choroid plexus in two newborns suffering from hydrocephalus [1,2]. Afterwards, a 9-month-old child with obstructive hydrocephalus underwent the first successful endoscopic third ventriculostomy (ETV) procedure performed by Walter and Mixter [3].

Scarff first announced his findings in 1935 with a new type of endoscope. The period of ventricular cerebrospinal fluid shunting was initiated by Nulsen in 1952. With advancements in endoscope imaging capabilities, there has been a renewed interest in using ETV to treat obstructive hydrocephalus. The development of endoscopic tools and miniature endoscopes in the later part of the 1980s brought about a change in the situation. Endoscopic methods are now part of the conventional repertoire of neurosurgical operational techniques for specific, well-defined indications [4,5].

The neurosurgery department of the IBN TOFAIL Hospital in Marrakech has been equipped with endoscopy equipment since 2016, which has improved our post-operative results.

Operative Instruments

Although there was no standard set of instruments for neuroendoscopy at first, it is now known which instruments are absolutely necessary for these procedures

The Neuro-Endoscope
There are currently many varieties of neuro-endoscopes with good optical qualities on the market (FIGURE 1;2), and it doesn't appear like much more work is needed in this field [6]. In addition to a channel for irrigation and suction, a neuro-endoscope should feature two working channels so the surgeon can perform endoscopic microsurgery with both hands. A compromise must be reached in order to reduce parenchymal stress caused by the device's implantation while keeping the endoscope maximally manipulable for surgical purposes. The usual diameter of neuro-endoscopes today ranges from 3 to 6 mm. Diameters bigger than 8 mm are not allowed because using such instruments provides no advantage over traditional microsurgery. Intraoperatively interchangeable endoscopes with varied viewing angles must be employed to inspect the operative field from a range of perspectives.

Figure 1: 3D Endoscopy Column

Figure 2: Arrangement of the Neuro-Endoscope with Setting Up of the Arm of Endoscopy

Micro-Instruments
The use of incredibly small and flexible tools securely, as well as the achievement of repeatable micro-cuts and micro-coagulations, are made possible by recently designed, automatically controlled ESUs. These characteristics qualify them for use in neuro-endoscopic procedures. Bipolar cutting and coagulating micro-instruments, micro-scissors, grasping and biopsy forceps are now recognized as instruments that are definitely required for these procedures.

Current Status of Neuroendoscopy
The scope of neuroendoscopy has expanded beyond ventricular operations. The endoscope is used to treat several neurosurgical conditions, including intracranial cysts, intraventricular tumors, hypothalamic hamartoma (HH), skull base tumors, craniosynostosis, degenerative spine disease, and rare subtypes of hydrocephalus.

In recent years, neuro-endoscopic procedures have grown more standardized, with the goal of treating preexisting or pathologically formed cavities within the central nervous system.

Cyst fenestration, tumor biopsy, tumor excision, and evaluation of metastatic disease are among the endoscopic operations. When hydrocephalus is present, suprasellar or quadrigeminal arachnoid cysts make suitable candidates for endoscopic fenestration. The majority of patients who have tumors or intraventricular cysts also have concurrent hydrocephalus. Because CSF diversion and tumor therapy can be done simultaneously, endoscopic surgery is very beneficial in this regard [7].

Intracranial cysts are ideal for neuro-endoscopic therapy. Colloid, arachnoid, and pineal cysts can be endoscopically aspirated, fenestrated, or excised. Neuroendoscopy, along with microsurgical resection, radiation, and adjuvant chemotherapy, can effectively treat cystic craniopharyngiomas, dysontogenic tumors, gliomas, and metastases.

For brain tumors located inside the ventricles, endoscopic tumor biopsy is a reliable technique. It has a minimal risk (<3.5%) and a high diagnostic yield (>90%). Endoscopic biopsy can be used to treat germ cell tumors, infiltrative hypothalamic/optic pathway gliomas, and Langerhans cell histiocytosis [8].

Treatment of Hydrocephalus
According to recent research, neuroendoscopy can effectively cure individuals with hydrocephalus who have received shunt treatment and who have experienced repeated shunt malfunction events, enabling them to live without a shunt. Endoscopic procedures should be performed on patients who are at high risk of complications from surgical shunt revision, such as post-hemorrhagic and post-meningitic hydrocephalus. "Once a shunt, always a shunt" is no longer a valid clinical guideline [9].

With a success rate of more than 60%, endoscopic third ventriculostomy, or ETV (Figure 3), is a commonly used therapy for obstructive hydrocephalus. It influences the hydrocephalus etiology and patient age and is useful in treating hydrocephalus caused by tectal plate lesions [10].

Preoperative ETV is a viable option to shunt implantation for postoperative hydrocephalus and is taken into consideration for severe hydrocephalus that needs immediate care. Other complex kinds of hydrocephalus, like septostomy, septum pellucidotomy, fenestration of loculated ventricles, aqueductoplasty, and endoscopic fourth ventriculostomy, have also been treated by endoscopy [11].

When a solid intraventricular tumor causes an occlusive hydrocephalus, a third ventriculostomy can be performed simultaneously or a stent can be inserted between lateral or third ventricles, depending on the tumor's location. Solid intraventricular tumors can be treated using neuroendoscopy, with the advantage of direct vision biopsies in the foramen of Monro and pineal tumors in the posterior third ventricle. This approach allows for a visual check of ventricular vessels and functionally important structures. The likelihood of complete tumor resection depends on tumor size, and neuroendoscopy can be time-consuming for tumors over 2 cm in diameter.

In our series of cases, we had to treat 480 hydrocephalus patients by endoscopic third ventriculostomy, accounting for 50.5% of all cases treated with endoscopy. 211 cases of hydrocephalus were caused by tumors (44%), 264 by malformations (55%), and 5 by infection (1%). The most common cause of malformative hydrocephalus was Sylvius aqueduct stenosis (54%).

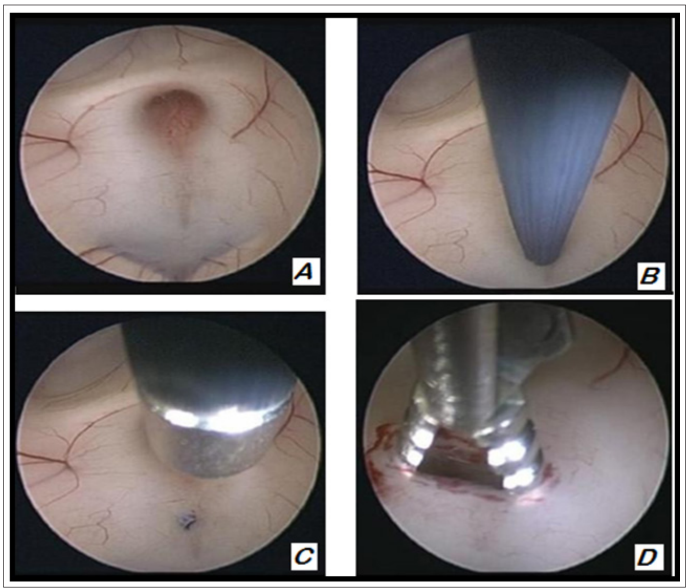

Figure 3: ETV: (A) Third Ventricle floor Visualization (B) (C) Coagulation (D) Ventriculostomy Enlargement

Treatment of Intracranial Cysts

Colloid Cysts

Colloid cysts, due to their intraventricular position, are a common reason for neuroendoscopy. Patients with occlusive hydrocephalus symptoms require surgical intervention. Asymptomatic patients should have surgery if the cyst is large enough to threaten an acute occlusion of the Monro foramen, which would result in acute occlusive hydrocephalus. A prophylactic procedure is recommended in light of instances of sudden death in previously asymptomatic patients with colloid cysts [12].

Neuroendoscopic surgery for colloid cysts has at least as favorable postoperative outcomes as microsurgery in terms of morbidity, mortality, and recurrence rate. The study analyzed 32 patients with colloid cysts treated by neuro-endoscopic surgery, with most undergoing subtotal removal. Only one patient experienced recurrent cysts after 12 years. However, only a few patients have been followed for over 10 years, suggesting that endoscopic cyst evacuation and partial resection may lead to higher recurrence rates [12].

The use of endoscopy was beneficial in our series, for the treatment of colloidal cysts of the third ventricle. We used this technique in 31 cases, with no significant operational or post-operative complications.

Arachnoid Cysts

Arachnoid cysts, located in the ventricular system or intracranial cisterns, are large cavities that are well-suited for neuro-endoscopic surgery. These cysts can cause headaches or neurological symptoms when they elevate intracranial pressure. Neuroendoscopy can be used alone or in combination with conventional microsurgery. Postoperative results are comparable to conventional microsurgery, and approximately 75% of patients benefit from the operation (Figure 4). The most important factor is the cyst's linkage to draining CSF pathways, allowing normalization of intracranial pressure [13].

Among the 952 cases in our series, an endoscopic marsupialization of arachnoid cyst was performed for 11 patients.

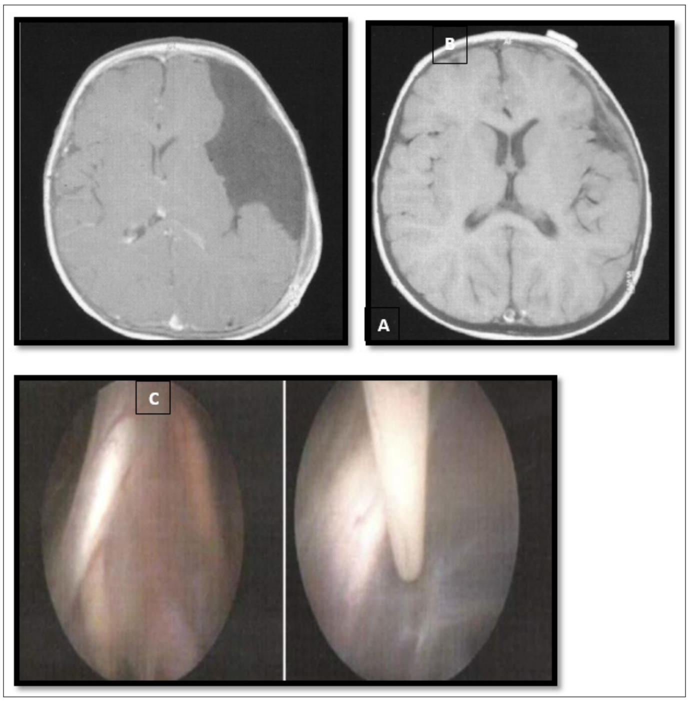

Figure 4: Treatment of Arachnoid Cysts: Initial(A) and Post-Operative(B) MRI Control, and the Per-Operative Endoscopic View (C)

Treatment for Skull Base Lesions

Neuroendoscopy has evolved from Carrau and colleagues initial experience of endonasal transsphenoidal hypophysectomy to include other lesions of the sellar and parasellar regions [14,15]. The bilateral endonasal endoscopic approach now allows visualization of tumors at the anterior skull base up to the crista galli and down to the level of C2. This technique has been applied for surgical excision of pituitary adenoma and craniopharyngioma with encouraging results and low morbidity. The route of the endoscopic approach for sellar or suprasellar tumors should be based on the extent of the lesion. Endoscopic treatment has been applied for CSF rhinorrhea, which is often caused by trauma and iatrogenic disruption of the skull base [8].

In 1962, Guiot became the first surgeon to operate on pituitaries using an endoscope [16]. Though not yet common, endoscopy has become more frequently used in adenoma removal procedures since that time. The surgical method is easy to use, quick, and involves few problems. In order to switch techniques in the event of technical difficulties, neurosurgeons doing endoscopic pituitary surgery should be proficient in traditional transsphenoidal microsurgery. Long-term outcomes are not available in the literature, but preliminary findings point to faster recovery times after surgery, less trauma, less problems, and shorter recovery times [17].

260 individuals with pituitary adenoma had trans-nasal trans-sphenoid excision, accounting for 27% of all cases treated by endoscopy. Furthermore, 67 cases of craniopharyngioma have profited from this technological advancement, with a post-operative morbidity-death rate of less than one percent.

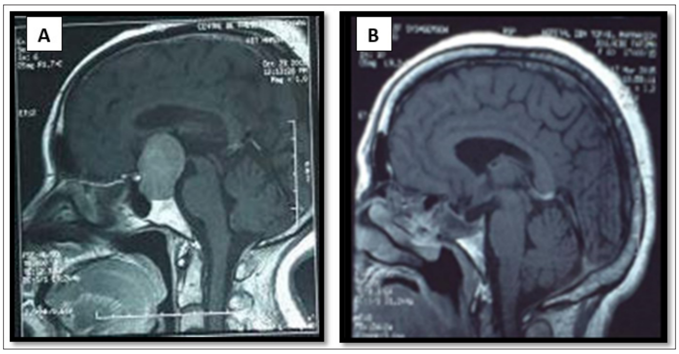

Figure 5: MRI of a Pituitary Macro-Adenoma (A) and its Post-Operative Control (B)

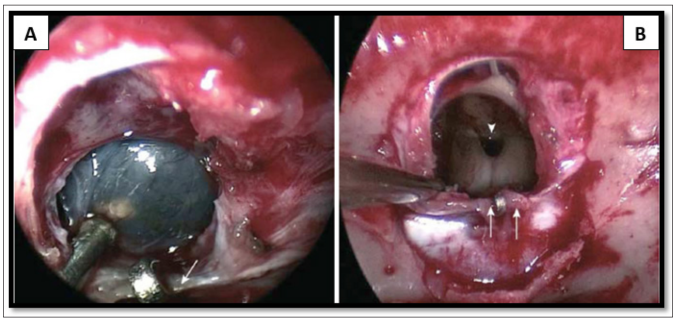

Figure 6: Endoscopic view before (A) and after(B) a Complete Resection of a Craniopharyngioma

Neuroendoscopy-Assisted Microsurgery

Endoscopes are used as supplementary instruments in microsurgery, especially in procedures for lesions of the cerebellopontine angle, microvascular decompression, and cerebral vascular aneurysms. There are various designs of endoscopes available for a variety of applications. They offer the crucial capacity to see around corners or behind the alleged lesion. For instance, during aneurysm surgery, the ideal clip placement can be verified, and during microvascular decompression, the vascular loop impinging on the trigeminal nerve can be examined from all angles.

Neurosurgeons are increasingly adopting neuro-endoscopes to supplement traditional skull base microsurgery. This technology, which employs a microscopic approach to make dissected structures visible in a straight line, provides great resolution, superior color fidelity, and stereoscopic vision. To minimize retraction and prolonged drilling, the endoscope is used to inspect bony or dural corners as well as neurovascular systems [8,15]. The approach has been useful in skull base surgery for tumor removal, aneurysm clipping, and trigeminal microvascular decompression. The endoscope-assisted approach is frequently employed freehand for inspection or with a self-retaining gripping device for bimanual dissections [14].

In addition, in our series, endoscopy was a complement to microsurgery in 55 cases, including 9 base meningiomas, 12 endoscopic decompressions of a facial neuralgia, 8 pontocerebellar angle epidermoid cysts, and 11 cases of vestibular schwannoma.

Spinal Endoscopic Surgery

The neuro-endoscope has become increasingly used in surgical management of spinal diseases, including fenestration of intradural arachnoid cysts and dissecting multiloculated syringomyelia cavities. It is an essential part of minimally invasive spine surgery, with endoscopic approaches expanding to thoracoscopic sympathectomy, discectomies, lumbar laminotomies, anterior approaches for spinal reconstruction, and resection of tumors and cysts. Endoscopic discectomy is increasingly performed in both thoracic and lumbar regions. Epiduroscopy is used for patients with peripheral fibrosis following spinal procedures.

Treatment for many spinal diseases has been revolutionized by recent developments in minimally invasive endoscopic spinal surgery. Subligamentous, freely sequestrated, intraforaminal, mediolateral, and medial disc fragments, as well as those that have become cranially or caudally displaced within the spinal canal, can now all be removed thanks to neuroendoscopy [18]. After the prolapse is removed, the intervertebral area may not always need to be totally free of disc material. Merely extracting the fragment is seen as sufficient therapy and has had similar outcomes. Microendoscopic discectomy (MED), another endoscopic technique for treating disc prolapses and spinal canal stenosis, using a posterior or posteromedial approach via the interlaminar window. It's unclear, meanwhile, if endoscopic spinal procedures produce superior long-term outcomes than traditional microsurgery [19].

In our department, 15 patients underwent lumbar discectomy via neuroendoscopy, and all of them experienced a clinical improvement in their sciatic pain. The only problems were a meningeal rupture in two instances and postoperative pain that the EVA deemed to be minimal given due to the surgical scar.

Conclusion

Neuroendoscopic surgery is predicted to advance significantly in the future, including camera and optical technology miniaturization, surgical instruments design breakthroughs, new navigation systems, multiport endoscopic surgery, and improved endoscope-assisted microsurgery. These developments will allow endoscopic surgery to treat intraparenchymal brain lesions as well as intraventricular and skull base lesions. Telemanipulated neurosurgery using supervisory-controlled robotic systems, shared control systems, and completely robotic telesurgery are also anticipated. Nanotechnology advancements are required for minimum or ultra micro-access neurosurgery. Neuroendoscopy is predicted to become more common in current neurosurgical practice, necessitating training programs for young neurosurgeons.

References

1. Shim KW, Park EK, Kim DS, Choi JU (2017) Neuroendoscopy: Current and Future Perspectives. Journal of Korean Neurosurgical Society 60: 322-326.
2. Li KW, Nelson C, Suk I, Jallo GI (2005) Neuroendoscopy: past, present, and future. Neurosurg Focus 19: E1.
3. Mixter WJ (1923) Ventriculoscopy and puncture of the floor of the third ventricle: preliminary report of a case. Boston Med Surg J 188: 277-278.
4. Hellwig D, Bauer BL (1998) Minimally invasive techniques for Neurosurgery. Berlin, Heidelberg, New York: Springer 7-35.

5. Duffner F, Freudenstein D, Wacker A (1998) 75 years after Dandy, Fay and Mixter – a look back at the history of neuroendoscopy. Zentralblatt Neurochir 59: 121-128.
6. Hellwig D, Riegel T, Bertalanffy H (1998) Neuroendoscopic techniques in treatment of intracranial lesions. Minimally Invasive Therapy & Allied Technologies 7: 123-135.
7. Fukushima T, Ishijima B, Hirakawa K, Nakamura N, Sano K (1973) Ventriculofiberscope: a new technique for endoscopic diagnosis and operation. Technical note. J Neurosurg 38: 251-256.
8. Sgouros S (2013) Neuroendoscopy: current status and future trends, ed 1. Heidelberg: Springer Science & Business Media.
9. Boschert J, Hellwig D, Krauss JK (2003) Endoscopic third ventriculostomy for shunt dysfunction in occlusive hydrocephalus: long-term follow-up and review. J Neurosurg 98: 1032-1039.
10. Wellons JC, Tubbs RS, Banks JT, Grabb B, Blount JP, et al. (2002) Long-term control of hydrocephalus via endoscopic third ventriculostomy in children with tectal plate gliomas. Neurosurgery 51: 63-67.
11. Oi S, Abbott R (2004) Loculated ventricles and isolated compartments in hydrocephalus: their pathophysiology and the efficacy of neuroendoscopic surgery. Neurosurg Clin N Am 15: 77-87.
12. Kavalar MS, Kavalar R, Strojnik T (2005) A colloid cyst of the third ventricle – the cause of episodic headache and sudden unexpected death in an adolescent girl. Wiener Klin Wochenschr 117: 837-840.
13. Tirakotai W, Schulte DM, Bauer BL, Hellwig D (2004) Neuroendoscopic surgery of intracranial cysts in adults. Childs Nerv Syst 20: 842-851.
14. Carrau RL, Jho HD, Ko Y (1996) Transnasal-transsphenoidal endoscopic surgery of the pituitary gland. Laryngoscope 106: 914-918.
15. De Divitiis E, Cappabianca P, Cavallo LM (2002) Endoscopic transsphenoidal approach: adaptability of the procedure to different sellar lesions. Neurosurgery 51: 699-705.
16. Guiot G, Rougerie J, Fourester M, Fournier A (1963) Une nouvelle technique endoscopique : Explorations endoscopiques intracrâniennes. Presse Med 1225-1258.
17. Cappabianca P, Cavallo LM, de Divitiis E (2004) Endoscopic endonasal transsphenoidal surgery. Neurosurgery 55: 933-940.
18. Krämer J (2002) Treatment of lumbar spine problems. Dsch Arztebl 99: 1510-1516.
19. Yeung AT, Yeung CA (2003) Advances in endoscopic disc and spine surgery: foraminal approach 11: 255-223.