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Eight Years of Neuroendoscopy Practice at the University Hospital Center of Yaounde: Indications, Procedures and Results

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Abstract

Objective
The author is reporting on an eight year experience of neuroendoscopy practice in Cameroon.

Methods
Indications, clinical manifestations, procedures and outcome data of patients who underwent neuroendoscopy were retrospectively reviewed.

Results
Thirty four patients (21 men and 13 women) were enrolled. Their ages ranged from 03 months to 50 years. The main clinical manifestations were related to raise intracranial pressure. Preoperative computed tomography was done in all patients and magnetic resonance imaging in nine. Indications for neuroendoscopy were obstructive hydrocephalus in 30 cases and pituitary macro adenomas in four. The causes of hydrocephalus were; aqueductal stenosis in 17 cases, posterior fossa tumors in 8, stenosis of fourth ventricle outlets in two, two communicant hydrocephalus, and one shunt dysfunction. Procedures were endoscopic third ventriculostomy in 30 cases and endoscopic transsphenoidal pituitary surgery in 4 cases. Four intraoperative bleedings lead to abortion of procedure in two cases. Except for these 2 cases, endoscopic third ventriculostomy was efficient in 85.71 % (24/28) of cases. For the pituitary adenomas, total removal was done in 3 cases and partial in one. But in all cases, we observed disappearance of symptoms and normalization of

visual and hormonal parameters. There was no death related to these procedures. Five patients (14.70%) had postoperative transitory complications including 4 cerebrospinal fluid leaks and 1 meningitis. Endoscopic third ventriculostomy reduced the cost of treating obstructive hydrocephalus by 600 $.

Conclusions
Even in poor areas, neuroendoscopy can be practiced regularly with clinical and financial benefits.

Keywords: Cameroon; Indication; Neuroendoscopy; Procedure; Result; Sub-Saharan Africa.

Abbreviations:CSF: Cerebrospinal Fluid; CT: Computed Tomography; ETV: Endoscopic Third Ventriculostomy; EVD: External Ventricular Drain; ICP: Intracranial Pressure; MRI: Magnetic Resonance Imaging; UHC: University Teaching Hospital Center of Yaoundé; USD / $: United States Dollar.

1. Introduction

The purpose of this work is to report on eight years of neuroendoscopy practice at the University Teaching Hospital Center (UHC) of Yaoundé. Neuroendoscopy is a mini-invasive or less-invasive neurosurgical procedure [1-18], with endoscopic third ventriculostomy (ETV) being the most frequent operation for the treatment of obstructive hydrocephalus [19-22]. Endoscopic endonasal transsphenoidal surgery had also revolutionized the treatment of pituitary adenomas [23-27]. Nevertheless, indications of neuroendoscopy are not limited to those two entities but they are being more and more diversified [1-13,15-16,28-35].In spite of its numerous advantages, neuroendoscopy is still less used in Africa, particularly in the Sub-Saharan part and most publications are related to the treatment of hydrocephalus. Besides the works from Benjamin C. Warf in Uganda, reports on neuroendoscopy in Africa are rare [36-41]. In Cameroon, the UHC of Yaoundé was the only hospital where neuroendoscopy was regularly practiced between June 2006 and December 2014. Indications, procedures and results of this experience were retrospectively reviewed.

2. Materialand Methods

2.1 Materials

2.1.1 Equipmentfor Neuroendoscopy

Comprised: 0° and 30° rigid endoscopes with 2.7 millimeters outer diameter; a ventriculoscope with 6 mm outer diameter with 3 channels (working, irrigation, suction), micro biopsy forceps; micro scissors; micro holding forceps;monopolar and bipolar coagulation probes (Aesculap, Tuttlingen, Germany). An analogic screen (Sony, Tokyo, Japan).

Equipment for Transsphenoidal Pituitary Surgery (Aesculap, Tuttlingen, Germany).

2.2 Methods

2.2.1 Patients' selection

All patients who benefited from a neuroendoscopic procedure as total or partial treatment in their management were recruited consecutively. Patients who did not have a neuroendoscopic procedure were excluded.

3. Procedures

All patients were operated under general anesthesia with oral endotracheal intubation.

Endoscopic Third Ventriculostomy(ETV):ETV has been thoroughly described in the medical literature [9, 22]. It was the procedure used to treat hydrocephalus. To fenestrate the 3rd ventricle floor, we used the micro biopsy forceps. Its teeth were open to enlarge the stoma. We used to pass the ventriculoscope through the stoma to look for Liliequist's and other arachnoid membranes which might cause failure of the procedure. Most often, the 0° endoscope was used, but sometimes we used the 30° endoscope to look in the posterior 3rd ventricle (Figure 1).

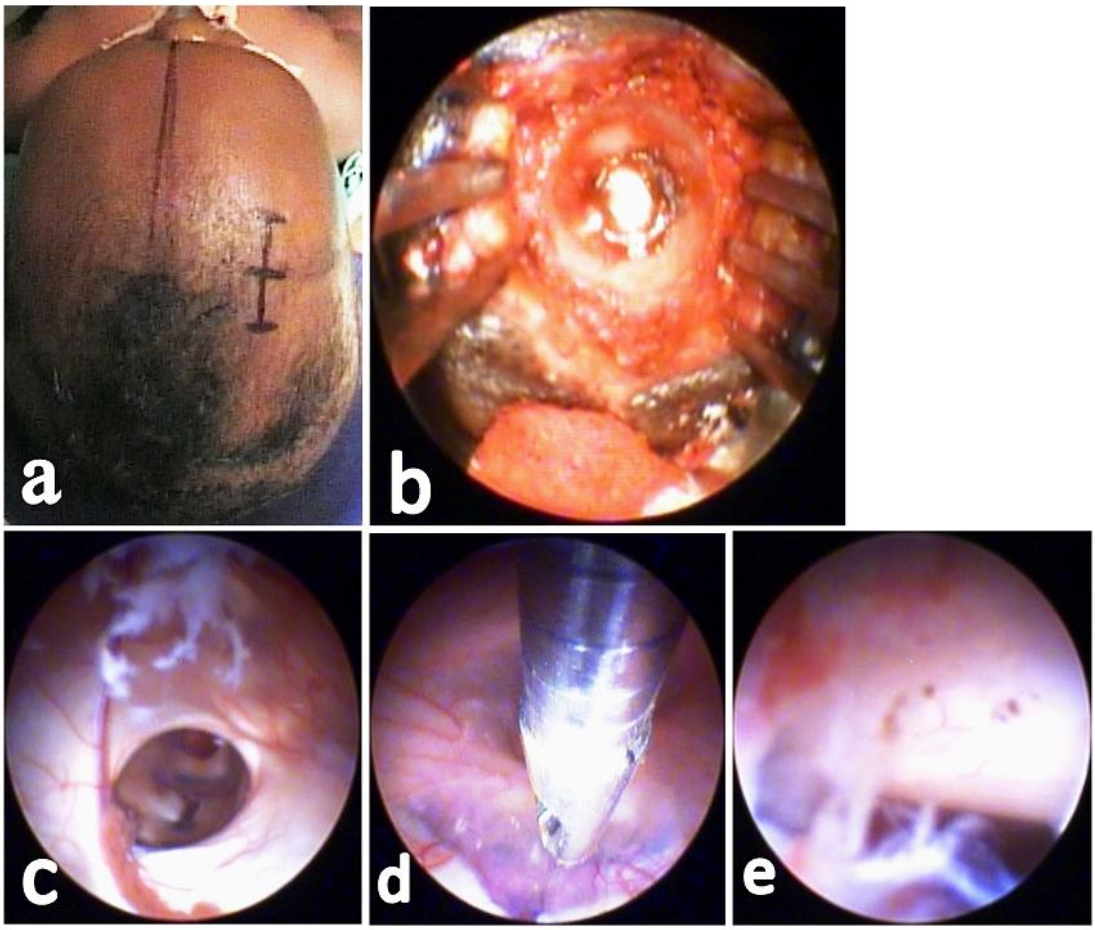

Figure 1: Endoscopic third ventriculostomy.**a:** precoronal skin incision, **b:** precoronal burrhole, **c:** localization of the interventricular foramen by identifying the choroid plexus, septal and thalamostriate veins, **d:** stoma made on the midline just before the mammillary bodies, **e:** visualization of the clivus dura matter.

Endoscopic endonasal transsphenoidal removal of pituitary adenomas [1, 16]

It was done via the rhinoseptal approach in 3 cases and the sub labial approach in one case under fluoroscopy. For this operation, we used the 30° endoscope in most cases.

3.1 Patients follow up

After surgery, patients were hospitalized for 2 to 3 days after ETV and at least one week after resection of pituitary adenomas. Removal of nasal padding was done between 3rd and 5th postoperative days. Local and systemic complications were systematically checked. For pituitary adenomas, patients were screened for diabetes insipidus, diuresis was evaluated every 3 hours, urinary density and blood electrolytes once a day. Clinical and neurological status of all patients was evaluated at least 3 times a day every day until discharge. Patients were then seen on consultation once a month during 3 months and then once every six months. Thereafter, patients were seen once a year. The follow up was considered until the last visit. Patients who underwent ETV were aware that in some cases, late closure of the stoma may occur with possible rapid deterioration. Postoperative computed tomography (CT) scan was systematically prescribed to all patients at one month after surgery or earlier in absence of clinical improvement and when complications were suspected.Magnetic resonance imaging (MRI) was prescribed postoperatively to all patients with pituitary adenomas.

4. Results

4.1 Clinical and Radiological Data

Thirty four patients had a neuroendoscopic procedure during the study period. They were 21 males and 13 females and their ages ranged from 03 months to 50 years.Most clinical findings were due to raised intracranial pressure (ICP)(as detailed on Tables 1 and 2). Preoperative radiological tools used were CT scanning which was done in all patients and MRI practiced in nine.

Table 1 : Clinical manifestations of hydrocephalies.

Clinical manifestations	N(30)	Percentage
Headache	17	56.66
Visual disturbances*	13	43.33
Macrocrania	10	33.33
Sunset gaze	09	30.00
Suture diastasis	07	23.33
Vomiting	06	20.00
Scalp veins bulging	05	16.66
Disequilibrium	05	16.66
Cerebellar syndrome	05	16.66
Difficulty to concentrate	04	13.33
Memory disturbance	03	10.00
Vertigo	03	10.00
Upward gaze paralysis	02	06.66
Psychomotor delay	02	06.66
Sphincter disturbances	01	03.33
Seizures	01	03.33
Insomnia	01	03.33
Consciousness disturbance	01	03.33
Cervicalgia	01	03.33

N= number of cases.

*: diplopia, blurred vision, decreased visual acuity, papilledema.

Table 2: Clinical manifestations of pituitary adenomas.

Clinical manifestations	N (4)	Percentage (%)
Headache	4	100
Bitemporal hemianopia	4	100
Decreased visual acuity	3	75
Blurred vision	2	50
Vertigo	1	25

N = number of cases.

4.2 Indications for Neuroendoscopy

The indication for neuroendoscopy was hydrocephalus in 30 cases and pituitary adenomas in four. The causes of hydrocephalus were idiopathic (congenital) aqueductal stenosis in 17 cases, posterior fossa tumor in 8 cases, stenosis of foramina of Luschka and Magendie in 2, two cases of communicating hydrocephalus and one shunt dysfunction (Table 3).

Table 3 : Hydrocephalus etiology.

Etiology	N (30)	Percentage (%)
Idiopathic (congenital) aqueductalstenosis	17	56.66
Posteriorfossatumor*	8	26.66
Stenosis of fourth ventricle outlets	2	06.66
Communicating†	2	06.66
Shunt failure	1	03.33

N = number of cases

*: fourth ventricle ependymoma (5), cerebellar medulloblastoma (2), pinealoblastoma (1).

†: undetermined origin.

4.3 Neuroendoscopy Procedures

The neuroendoscopic procedures practiced were ETV in 30 cases and endoscopic endonasal transsphenoidal removal of pituitary adenomas in 4. Operation duration varied from 22 minutes for ETV to 125 for adenomas surgery. We had 4 intraoperative bleedings that lead to abortion of the procedure in 2 cases. Excepting these two abandonments, ETV was efficient in 85.71% (24/28) of cases and inefficient in 4 cases (2 communicating hydrocephalus, 3 months old infant and pinealoblastoma case). Concerning the 4 pituitary adenomas, all were macro prolactinomas and removal was total in 3 cases and subtotal in one. But in all 4 patients, disappearance of symptoms and normalization of visual and hormonal parameters were observed.

4.4 Follow up

Mean and median follow up duration were 4.22 and 4.19 years respectively (range: 5.5 months-7.94 years). Mean and median hospital stay were 6.17 and 11.5 days respectively (range: 2-21 days). There was no death related to neuroendoscopy but, two cerebellar medulloblastomas and pinealoblastoma patients died few months after neuroendoscopy from progression of their cancers. Five patients (14.70%) had postoperative complications including 4 cerebrospinal fluid (CSF) leaks and 1 meningitis. We calculated that ETV diminished the treatment cost of obstructive hydrocephalus by $600.

5. Discussion

5.1 Rarity of Publications on Neuroendoscopy from Africa

Publications in English or in French reporting neuroendoscopy practice are rare from Africa especially from the Sub-Saharan region. Most reports concern those from Benjamin C. Warf in Uganda and are limited to the treatment of hydrocephalus [36-41]. In all, we found two reports from Nigeria [36, 40], one from Malawi [38], one from Piquer et al. in Kenya and Zanzibar [37], one from Egypt [39] and one from South Africa [41].Of the two articles from Nigeria, one compared ETV versus shunting in terms of efficacy, complications and cost and concluded that ETV was efficient as shunting for obstructive hydrocephalus with less long term morbidity and significantly cheaper. It is important to emphasize that the comparison was made with the low cost Chhabra shunt [40]. The other report studied efficiency of ETV in children aged 2 years or less [36]. The article from Piquer et al. reported training in neurosurgery and neuroendoscopy in Kenya and Zanzibar [37]. To the best of our knowledge, our study is the first to report on endonasal endoscopic surgery of pituitary adenomas. Nevertheless, it is possible that we missed articles published in languages other than English or French or not cited in data bases.

5.2 Neuroendoscopy Indications

Neuroendoscopy practice in this series was essentially limited to the treatment of obstructive (non-communicating) hydrocephalus and accessorily to transsphenoidal removal of pituitary adenomas. We also successfully treated a case of shunt failure. Neuroendoscopy indications have been diversified in the last decades but the two most common remain obstructive hydrocephalus [1-3,9,13,17-22,33] and pituitary adenomas [1,23,24].But indications for neuroendoscopy also extend to: lesions of anterior skull base and petroclival area [25,27], removal or biopsy of tumors within or close to ventricles [4,5,12,34], frameless biopsy of brain tumors, arachnoid cysts [8,11, 29,30], encephaloceles and osteodural fistula [43], aspiration of capsulothalamic or intraventricular hematomas [4,5,12,34], syringomyelia and intraspinal adhesions [7,35]. In one study, neuroendoscopy allowed identification of meningeal seeding of carcinomatous cells well before it could be evidenced by MRI [10]. Although communicating hydrocephalus was considered a contraindication for ETV, many works have reported its efficiency in 17-40% in this indication [9,19]. ETV failed in 2 cases of communicating hydrocephalus of this series. But, these failures may be explained by the fact that we did not cauterize the choroid plexuses as preconized. Shunt failure was also considered a contraindication for ETV. But, reports from Chhun et al.in 2015, Brichtova et al. in 2013 and Lee et al. in 2011 yielded ETV success rates for shunt failure around 70% [28,31,32]. And efficiency of ETV was not correlated with patient age, cause of hydrocephalus or the number of previous shunt revisions before ETV. Therefore, these authors drew the following conclusions: “ETV should be the method of choice for treating shunt failure in obstructive hydrocephalus”. We successfully treated a case of shunt dysfunction in this series. ETV has made obsolete the paradigm “once a shunt, always a shunt”.

5.3 Some Advantages of Neuroendoscopy

Neuroendoscopy has many advantages compared to other microsurgical techniques: it is less invasive, has less mid and long terms complications and is costless [2,6,8,10-12,15]. In our setting, ETV reduced treatment cost of obstructive hydrocephalies by 600USD.This cost reduction is due to avoidance of purchasing the shunt hardware (shunt hardware prices in Cameroon range between 300 to 1000 USD). In Brazil, De Lima BO and PatresiR. showed that ETV is not more expensive than shunting regarding public insurance funding [44].

5.4 Mortality and Morbidity of Neuroendoscopy

Neuroendoscopy mortality remains very low. Most deaths related to ETV reported occurred after late closure of the stoma. Therefore, it is important to inform patients and families of this late threat [31]. Some authors' preconize implantation of an Omaya reservoir or a ventricular catheter to some patients treated with ETV to palliate the risk from late failure [31]. We did not have death related to neuroendoscopic procedures or late failure in this series.

Many complications had been attributed to ETV [14,43,45-47,50]. They can be intraoperative like intraventricular bleeding or hemodynamic disturbances [14, 50]. Other can occur during the early postoperative period as CSF leaks, meningitis, ventriculitis, and injuries to fornix, thalami, hypothalamus or cranial nerves [14, 44, 45, 50]. Generally speaking, long term complications are not frequent and permanent disability is rare. In this series, two intraoperative ventricular bleeding imposed abortion of the procedure. But, even in this situation, it is possible to insert an external ventricular drain (EVD) and perform a successful ETV later. We had five postoperative transitory complications giving a morbidity of 14.70% which is low giving our limited equipment and is similar to ETV morbidity rates reported from literature. These complications included four CSF leaks and aseptic meningitis. CSF leaks were successfully managed by repeated lumbar punctures with compressive head dressings. Meningitis was cured with probabilistic antibiotics. We did not have a permanent disability in this series.

5.5 ETV Success

For obstructive hydrocephalus, ETV was efficient in 85.71% (24/28) of cases and inefficient in 4 cases (2 communicating hydrocephalus, 3 months old infant and pinealoblastoma case). Depending on etiology of obstructivehydrocephalus, reported success rates of ETV range from50-100% [14, 30, 36, 40, 42, 44, 50]. The best indication for ETV is idiopathic aqueductal stenosis. In this series, ETV was efficient in 16 out of 17 aqueductal stenosis cases (94.11%). The only failure occurred on a 3 months old infant. Many studies have shown that psychomotor development of children treated with ETV is similar to that of those treated with shunting [36, 38, 40, 46, 47]. The report from Wisniewska et al. revealed a statistically significant difference in favor of ETV for intellectual quotient and motor impairment in children [47].

5.6 Endoscopic Removal of Pituitary Adenomas

For the 4 macro adenomas of this series, all subjects were women. All adenomas were prolactinomas. Removal was total in 3 cases and partial in one. But, in all cases we had disappearance of symptoms and normalization of visual and hormonal parameters. The lady in whom removal was partial had normalization of vision and pituitary hormones after six months of treatment with Cabergoline (Dostinex*) with no progression of residual tumor since six years. These 4 patients are the only for whom we had postoperative MRI. Microsurgical or endoscopic transsphenoidal approach is actually considered the gold standard for pituitary surgery. It has many advantages upon the trans cranialapproach. The transsphenoidal approach was developed by pioneers like Halstead, Cushing or Hirsch. It was popularized by the Canadian neurosurgeon Jules Hardy with the use of the operating microscope at the end of sixties. The introduction of endoscopy by Jho, Carrau and Cappabianca [1,24] has extended transsphenoidal surgery to parasellar (planumsphenoidale, clivus) and skull base lesions [1,24-27]. We used the endoscopic rhinoseptal approach in 3 cases and sub labial approach in one case. Endonasal endoscopy has undeniable advantages upon transsphenoidal microsurgery: avoids sub labial incision, dissection of septal mucosa and fracture of nasal septum, thus decreasing postoperative morbidity. There is no need for the nasal speculum which narrows surgical field and limits visibility and manipulation of instruments. Endoscopes give a wider angle of view with better visualization of anatomic landmarks rendering intraoperative fluoroscopy unnecessary. Endoscopy gives better illumination and better control of nasal cavity than the microscope. At last, endoscopy allows looking around the corners of cavernous sinus and behind the carotid artery [1,24]. Controversy remains concerning superiority of endoscopy over microsurgery for pituitary adenoma surgery.But, benefits of neuroendoscopy need no further demonstrations [1,24].

5.7 Neuronavigation for Neuroendoscopy

It could be necessary to associate neuronavigation to neuroendoscopy in some circumstances to increase patient's safety for example when anatomical landmarks are disorganized by the pathology [9, 15]. Our equipment did not have neuronavigation.

6. Conclusions

In spite of its numerous advantages recognized worldwide, neuroendoscopy still appear as a luxurious technique in Africa, especially in the Sub-Saharan part where its practice is rarely reported in scientific publications. Reports on neuroendoscopy from that area are limited exclusively to the treatment of hydrocephalus. In this region where management of shunt related problems (cost, complications) are much more difficult to face compared to developed countries, neuroendoscopy appears as an option to promote and vulgarize. Our work and those done in other Sub-Saharan African countries demonstrated without doubt, the benefits, either therapeutically and financially of neuroendoscopy, mainly in managing obstructive hydrocephalus. To the best of our knowledge, this series is the first reporting on endoscopic pituitary surgery from Sub-Saharan Africa where most neurosurgeons do not have operating microscopes.

References

1. Grunert P (2013) From the idea to its realization: the evolution of minimally invasive techniques in neurosurgery. Minimally Invasive Surgery: 1-18.http://dx.doi.org/10.1155/2013/171369.
2. Teegala R, Rajesh KG, Raviprasad VY, Chennappa Y. Emergency neuroendoscopic management of third ventricular neurocysticercosis cyst presented with Bruns syndrome: report of two cases and review of literature. J Korean NeurosurgSoc 2014; 55 (3): 173-177.http://dx.doi.org/10.3340/jkns.2014.55.3.173.
3. Yildrim AE, Karaoglu D, Divanlioglu D, Belen AD. A difficult endoscopic third ventriculostomy procedure: perforation of a thick Liliequist membrane with high basilar artery location. Turk Neurosurg 2014; 24 (6): 946-947.DOI: 10.5137/1019-5149.JTn.12847-14.1.
4. Zhang HZ, Li YP, Yan ZC, Wang XD, She L, Wang XD, Dong L. Endoscopic evacuation of basal ganglia hemorrhage via keyhole approach using an adjustable cannula in comparison with craniotomy. BioMed Research International 2014: 1-6.http://dx.doi.org/10.1155/2014/898762.
5. Li Y, Zhang H, Wang X, She L, Yan Z, Zhang N, et al. Neuroendoscopic surgery versus external ventricular drainage alone or with intraventricular fibrinolysis for intraventricular hemorrhage secondary to spontaneous supratentorial hemorrhage: a systematic review and meta-analysis. Plos One. November 2013; 8 (11): 1-14.doi:10.1371/journal.pone.0080599.
6. Shahinian H, Ra Y. Fully endoscopic resection of pineal region tumors. Journal of Neurological Surgery-Part B 2013; 83 (74): 114-117.DOI http://dx.doi.org/ 10.1055/s-0033-1338165.
7. Kashcheev AA, Arestov SO, Gushcha AO. Flexible endoscopy in surgical treatment of spinal adhesive arachnoiditis and arachnoid cysts. N.N. Burdenko Journal of Neurosurgery 2013; 5: 41-50.
8. Lee EJ, Ra YS. Clinical and neuroimaging outcomes of surgically treated intracranial cysts in 110 children. J Korean NeurosurgSoc 2012; 52: 325-333.http://dx.doi.org/10.3340/jkns.2012.52.4.325.
9. Sokal P, Birski M, Rusinek M, Paczkowski D, Zielinski P, Harat A. Endoscopic thir ventriculostomy in the treatment of hydrocephalus. VideosurgeryMiniinv 2012; 7 (4): 280-285.DOI: 10.5114/wiitm.2011.30810.
10. Iacoangeli M, Di Rienzo A, Colasanti R, Zizzi A, Gladi M, Alvaro L, et al. Endoscopy-verified occult subependymal dissemination of glioblastoma and brain metastasis undetected by MRI: prognostic significance. Onco Targets and Therapy 2012; 5: 449-456.http://dx.doi.org/10.2147/OTT.S39429.
11. Sengul G, Tuzun Y, Cakir M, Duman S, Colak A, Kadioglu HH, Aydin IS. Neuroendoscopic approach to quadrigeminal cistern arachnoid cysts. EAJM 2012; 44: 18-21.doi:10.5152/eajm.2012.04.
12. Zhu H, Wang Z, Shi W. Keyhole endoscopic hematoma evacuation in patients. Turkish Neurosurgery 2012; 22 (3): 294-299.DOI: 10.5137/1019-5149.JTN.5136-11.1.
13. Chen CC, Kasper E, Warnke P. Palliative sterotactic endoscopic third ventriculostomy for the treatment of obstructive hydrocephalus from cerebral metastasis. SurgNeurolInt 2011; 2 (76).DOI: 10.4103/2152-7806.82083.
14. Ganjoo P, Sethi S, Tandon MS, Singh D, Pandey BC. Perioperative complications of intraventricular neuroendoscopy. A 7-year experience. Turkish Neurosurgery 2010; 20 (1): 33-38.
15. JiHye Song, Doo-Sik Kong, Ho Jun Seol, Hyung Jin Shin. Transventricular biopsy of brain tumor without hydrocephalus using neuroendoscopy with navigation. J Korean NeurosurgSoc 2010; 47: 415-419.doi: 10.3340/jkns.2010.47.6.415.
16. Yadav YR, Sachdev S, Namdev H, Bhatele PR. Endoscopic endonasal trans-sphenoid surgery of pituitary adenoma. J Neurosci Rural Pract. Sep-Dec 2012; 3 (3): 328-337.
17. Rezaee O, Sharifi G, Samadian M, Haddadian K, Ali-Asgari A, Yazdani M. Endoscopic third ventriculostomy for treatment of obstructive hydrocephalus. Arch Iranian Med 2007; 10 (4): 498-503.
18. Burtscher J, Bartha L, Twerdy K, Eisner W, Benke T. effect of endoscopic third ventriculostomy on neuropsychological outcome in late onset idiopathic aqueduct stenosis: a prospective study. J NeurolNeurosurg Psychiatry 2003; 74: 222-225.
19. Zhenhua He, CaixaAn, Xinding Zhang, Xiaodong He, Qiang Li. The efficacy analysis of endoscopic third ventriculostomy in infantile hydrocephalus. J Korean NeurosurgSoc 2015; 57 (2): 119-122.http://dx.doi.org/10.3340/jkns.2015.57.2.119.
20. Stachura K, Grzywna E, Kwinta BM, Moskata MM. endoscopic third ventriculostomy – effectiveness of the procedure for obstructive hydrocephalus with different etiology in adults. VideosurgeryMiniinv 2014; 9 (4): 586-595.DOI: 10.5114/wiitm.2014.46076.
21. Locatelli M, Draghi R, Di Cristofori A, Carrabba G, Zavanone M, Pluderi M, et al. Third ventriculostomy in late-onset idiopathic aqueductal stenosis treatment: a focus on clinical presentation and radiological diagnosis. Neurol Med Chir (Tokyo). December 2014; 54: 1014-1021.doi: 10.2176/nmc.oa.2013-0367.
22. Venkataramana NK, Rao SAV, Naik AL. endoscopic third ventriculostomy. J PediatrNeurosci. Jul-Dec 2009; 4: 108-112. DOI10.4103/1817-1745.57329.:
23. Yadav YR, Mukerji G, Shenoy R, Basoor A, Jain G, Nelson A. Endoscopic management of hypertensive intraventricular haemorrhage with obstructive hydrocephalus. BMC Neurology 2007; 7 (1).http://www.biomedcentral.com/1471-2377/7/1.

24. Leite dos Santos AM, Fonseca Neto RM, EstevesVeiga JC, VianaJr J, Scaliassi NM, PenteadoLancellotti CM, Lazarini PR. Enoscopicendonasal transsphenoidal approach for pituitary adenomas. Technical aspects and report of casuistic. ArqNeuropsiquiatr 2010; 68 (4): 608-612.
25. De Monaco BA, Ramos HF, Telles Gomes MQ, do Espirito Santo MP, Foroni F, Ubirajara Sennes L, Teixeira MJ. Expanded endonasal approach to skull base meningiomas. ArqNeuropsichiatr 2013; 71 (5): 330-335. DOI: 10.1590/0004-282X20130030.
26. Kim YH, Kim JE, Kim MJ, Cho JH. New landmark for the endoscopic endonasal transsphenoidal approach of pituitary surgery. J Korean NeurosurgSoc 2013; 53: 218-222.http://dx.doi.org/10.3340/jkns.2013.53.4.218.
27. Arai T, Horiguchi K, Saeki N, Oka H, Saito T, Takahashi-Fugigasaki J, et al. Surgical treatment of a calcified Rathke's cleft cyst with endoscopic extended transsphenoidal surgery. Neurol Med Chir (Tokyo) 2011; 51: 535-538.
28. Chhun V, Sacko O, Boetto S, Roux FE. Third ventriculostomy for shunt failure. World Neurosurg. March 2015; S1878-8750 (15): 211-219.doi: 10.1016/j.wneu.2015.01.058
29. Goyal N, Sharma BS, Mahapatra AK. Third ventricular colloid cysts in children. A series of eight cases and review of the literature. Turkish Neurosurgery 2014; 24 (1): 1-7.DOI: 10.5137/1019-5149.JTN.7945-13.1.
30. Furlanetti LL, Santos MV, Santos de Oliveira R. Neuroendoscopic surgery in children: an analysis of 200 consecutive procedures. ArqNeuropsichiatr 2013; 71 (3): 165-170.
31. Brichtova E, Chlachula M, Hrbac T, Lipina R. Endoscopic third ventriculostomy in previously shunted children. Minimally Invasive Surgery 2013: 1-4.http://dx.doi.org/10.1155/2013/584567.
32. SeungHoon Lee, Doo Sik Kong, Ho JoonSeol, Hyung Jin Shin. Endoscopic third ventriculostomy in patients with shunt malfunction. J Korean NeurosurgSoc 2011; 49: 217-221.http://dx.doi.org/10.3340/jkns.2011.49.4.217.
33. Vaz-GuimaraesFilho FA, Ramalho CO, Suriano IC, Zymberg ST, Cavalheiro S. Neuroendoscopic surgery for unilateral hydrocephalus due to inflammatory obstruction of the Monro foramen. ArqNeuropsiquiatr 2011; 69 (2-A): 227-231.
34. Yadav YR, Mukerji G, Parihar V, Sinha M, Pandey S. Complex hydrocephalus (combination of communicating and obstructive type): an important cause of failed endoscopic third ventriculostomy. BMC Research Notes 2009; 2: 137.http://www.biomedcentral.com/1756-0500/2/137.
35. Hayek SM, Helm S, Benyamin RM, Singh V, Bryce DA, Smith HS. Effectiveness of spinal endoscopic adhesiolysis in post lumbar surgery syndrome: a systematic review. Pain Physician. March / April 2009; 12: 419-435.
36. Ojo OA, Bankole OB, Kanu OO, Okubadejo NU. Efficacy of endoscopic third ventriculostomy in the management of hydrocephalus in children under 2 years of age: experience from a tertiary institution in Nigeria. Niger J ClinPract. May-Jun 2015; 18(3): 318-22.
37. Piquer J, Qureshi MM, Young PH, Dempsey RJ. Neurosurgery education and development program to treat hydrocephalus and to develop neurosurgery in Africa using mobile neuroendoscopic training. J NeurosurgPediatr. Mar 2015; 6: 1-8.
38. Kamalo P. Point of view: exit ventriculoperitoneal shunt; enter endoscopic third ventriculostomy (ETV): contemporary views on hydrocephalus and their implications on management. Malawi Medical Journal. September 2013; 25 (3): 78-82.
39. Zohdi AZM, El Damaty AM, Aly KB, El Refaee EA. Success rate of endoscopic third ventriculostomy in infants below six months of age with congenital obstructive hydrocephalus (a preliminary study of eight cases). Asian Journal of Neurosurgery 2013; 8 (3): 147-152.DOI: 10.4103/1793-5482.121686.
40. Idowu OE, Falope LO, Idowu AT. Outcome of endoscopic third ventriculostomy and Chhabra shunt system in non-communicating non-tumor childhood hydrocephalus. J PediatrNeurosci. Jul-Dec 2009; 4: 66-69.DOI: 10.4103/1817-1745.57323.
41. Figaji AA, Fieggen AG, Peter JC. Endoscopic third ventriculostomy in tuberculous meningitis. Childs NervSyst 2003; 19: 217-225.
42. Joong-Uhn Choi, Dong-Seok Kim, Se-Hyuk Kim. Endoscopic surgery for obstructive hydrocephalus. Yonsei Med J 1999; 40 (6): 600-607.
43. Sharifi G, Alavi E, Jalessi M, Haddadian K, Faramarzi F. Transethmoidalencephalocele after reduction of high intracranial pressure in aqueductal stenosis. Turkish Neurosurgery 2014; 24 (1): 75-77.DOI: 10.5137/1019-5149.JTN.3268-10.2.
44. Oton de Lima B, Pratesi R. Endoscopic third ventriculostomy has no higher costs than ventriculoperitoneal shunt. ArqNeuropsiquiatr 2014; 72 (7): 524-527.DOI: 10.1590/0004-282X20140070.
45. Kariyattil R, PanikarD.Fungal granuloma following endoscopic third ventriculostomy for infantile hydrocephalus. SQU Medical Journal 2013; 13 (1): 162-164.
46. Tafuri KS, Wilson TA. Growth hormone deficiency and diabetes insipidus as a complication of endoscopic third ventriculostomy. J Clin Res PediatrEndocrinol 2012; 4 (4): 216-219.DOI : 10.4274/Jcrpe.801.
47. Sung HJ, Sohn JT, Kim JG, Shin IW, Ok SH, Lee HK, Chung YK. Acute respiratory alkalosis occurring after endoscopic third ventriculostomy. Korean J Anesthesiol. December 2010; 59 (Suppl): 194-196.DOI: 10.4097/kjae.2010.59.S.S194.
48. Larysz P, Larysz D, Mandera M. Radiological findings in relation to the neurodevelopmental outcome in hydrocephalic children treated with shunt insertion or endoscopic third ventriculostomy. Childs NervSyst 2014; 30: 99-104.DOI 10.1007/s00381-013-2200-y.

49. Wisniewska B, Mikolajczyk-Wieczorek W, Polis B, Polis L, Zakrzewski K, Nowoslawska E. The long-term psychological effects of surgical treatment using neuroendoscopic techniques and orbis sigma shunt implantation in children suffering from hydrocephalus. AdvClinExp Med 2012; 21 (3): 373-384.
50. Jones HC, Klinge PM. Hydrocephalus 2008, 17-20th September, Hannover Germany: a conference report. Cerebrospinal Fluid Research 2008; 5 (19): 1-18.http://www.cerebrospinalfluidresearch.com/content/5/1/19.