Open Journal of Modern Neurosurgery, 2015, 5, 137-143
Published Online October 2015 in SciRes. http://www.scirp.org/journal/ojmn
http://dx.doi.org/10.4236/ojmn.2015.54022

Non-Tumor Obstructive Hydrocephalus Treated with Endoscopic Third Ventriculostomy in Cameroon

Aurélien Ndoumbe[1,2*], Chantal Simeu[3], Mathieu Motah[2,4]

[1]Service of Surgery, University Hospital Center of Yaoundé, Yaoundé, Cameroon
[2]Faculty of Medicine & Pharmaceutical Sciences, University of Douala, Douala, Cameroon
[3]Service of Anesthesiology & Intensive Care, University Hospital Center of Yaoundé, Yaoundé, Cameroon
[4]Service of Surgery, General Hospital of Douala, Douala, Cameroon
Email: *aurelien.ndoumbe@gmail.com, *aurelen@yahoo.fr

Received 24 August 2015; accepted 26 October 2015; published 29 October 2015

Abstract

Objective: In Sub-Saharan Africa, shunt dependence is a real threat for patients. For this reason, any method allowing shunt independence such as endoscopic third ventriculostomy should be promoted. The goal of this study was to show the advantages of neuroendoscopy in treating non-tumor obstructive hydrocephalus in Cameroon. Methods: We retrospectively reviewed the cases of non-tumor obstructive hydrocephalus treated with endoscopic third ventriculostomy in our hospital. Results: Twenty patients (15 males, 5 females) underwent endoscopic third ventriculostomy as first choice treatment for non-tumor obstructive hydrocephalus. Their ages ranged from six months to 41 years (mean 11.96 years, median 20.75 years). Fourteen patients (70%) were children (≤18 years old), 6 were adults, 7 were under age of two years and 3 were below one. Computed tomography scan was the radiological tool used in all cases. None did a magnetic resonance imaging scan. Etiology of hydrocephalus was aqueductal stenosis in 18 cases and stenosis of the foramina of Luschka & Magendie in two. Aqueductal stenosis was associated with myelomeningocele in one case and shunt failure in another one. Endoscopic third ventriculostomy was successful in alleviating clinical symptoms with shunt independence in 19 cases (95%), but failed in one case. ETV success was not related to patient age. Cerebrospinal fluid leak occurred in two patients as post-operative complication (10%). Overall, ETV diminished treatment cost by 600 USD. Conclusion: Even in areas with limited medical equipment like in Sub-Saharan Africa where shunt dependence is a real danger, ETV can be routinely used to successfully treat non-tumor obstructive hydrocephalus.

*Corresponding author.

How to cite this paper: Ndoumbe, A., Simeu, C. and Motah, M. (2015) Non-Tumor Obstructive Hydrocephalus Treated with Endoscopic Third Ventriculostomy in Cameroon. *Open Journal of Modern Neurosurgery*, **5**, 137-143.
http://dx.doi.org/10.4236/ojmn.2015.54022

Keywords

Non-Tumor Obstructive Hydrocephalus, Endoscopic Third Ventriculostomy, Sub-Saharan Africa, Cameroon

1. Introduction

In Sub-Saharan Africa, because of many restrictive factors such as lack of neurosurgeons, poor transportation, and financial difficulties faced by patients' families, shunt dependence is a real danger which threatens patients' survival at any time. For this reason, methods allowing shunt independence like endoscopic third ventriculostomy (ETV) should be promoted and become the first choice treatment for (obstructive) hydrocephalus in these areas [1]-[8].

2. Material and Methods

2.1. Material

Our neuroendoscopy equipments comprised of a ventricular trocar with a 6 mm outer diameter and a working, irrigation and aspiration channels, 0˚ and 30˚ rigid fiber scopes, grasping and biopsy forceps, micro scissors, bipolar and monopolar coagulation probes, xenon cold light source, one chip standard definition digital camera (Aesculap, Tuttlingen, Germany), and an analogic screen (Sony, Tokyo, Japan).

2.2. Methods

2.2.1. Study Design and Data Collection

It was a retrospective observational study on 20 cases of non-tumor obstructive hydrocephalus treated with ETV in our hospital between June 2007 and December 2014. Data was collected from patients' files and included age, gender, clinical manifestations, imaging data, type, duration and eventual complications of surgery, post-operative clinical and radiological investigations.

Inclusion criteria: patients of any age with non-tumor obstructive hydrocephalus treated with endoscopic third ventriculostomy.

Exclusion criteria: patients with tumor obstructive hydrocephalus; non-obstructive (communicant) hydrocephalus; obstructive hydrocephalus treated with shunt or external ventricular drainage.

Criteria for successful ETV: ETV was considered successful if it achieved clinical improvement, shunt independence and normal psychomotor development (for children).

2.2.2. Surgical Procedure [9]

All patients underwent ETV under general anesthesia with orotracheal intubation. Patients were positioned supine with the head resting on a horse shoe head holder, slightly flexed with no rotation. After sterile draping, a 2 - 3 cm linear skin incision, 2 - 3 cm from midline, was made across the coronal suture. A pre-coronal bore hole was then drilled on the right side and dura opened in cruciate fashion. The cerebral cortex was cauterized to avoid bleeding while inserting the ventricular trocar into the right frontal horn. The entry of ventricular trocar into the ventricle was evidenced by the reflux of cerebrospinal fluid (CSF). At this point, a 0˚ fiberscope was introduced into the trocar and operation was then conducted under direct visualization. After entering the right frontal horn, it was mandatory to localize the foramen of Monro by identifying the choroid plexus, septal and thalamostriate veins before ventricular navigation was continued. Upon localizing the interventricular foramen of Monro, the endoscope was then gently passed through that foramen taking care not to injure the fornix or tear the thalamostriate or septal veins. Once into the third ventricle, tuber cinereum, dorsum sellae, mammillary bodies, and in case of thin third ventricle floor, basilar artery complex were identified. A stoma was then made on the midline just anterior to mammillary bodies using the grasping forceps. The aperture was widened by opening the forceps. The forceps was slightly withdrawn to watch for pulsations of third ventricle floor due to CSF flow through the stoma. Subsequently, the endoscope was passed through the stoma in order to fenestrate any arachnoid or Liliequist membranes. Dorsum sellae dura and basilar artery complex were visualized. Sometimes, the

0˚ fiberscope was withdrawn and 30˚ scope introduced in order to visualize the posterior part of the third ventricle to see whether the cerebral aqueduct was opened or obstructed. We used ventricular irrigation only in cases of poor vision due to bleeding and not routinely. The ventriculoscope was then withdrawn and the cortical opening obstructed with gel foam. The dura was tightly sutured and the skin closed in two layers. All operations were done free hand as we did not have an endoscopic holder.

2.2.3. Follow-Up

Patients were hospitalized for 2 to 3 days. The wound was inspected and dressed daily. Vital signs, neurological status, head circumference, anterior fontanel when not closed or any symptoms were monitored until discharged. Patients in whom CSF leak was noticed had repeated lumbar punctures or drainage for 2 to 3 days along with compressive dressing of the head. After discharge from the hospital, patients were seen on outpatient consultation at one week, one month, 3, 6, 12 months and then annually. Clinical symptoms, neurological status, psychomotor development were evaluated. Postoperative CT scan was prescribed to all patients at 3 months after surgery. Patients and parents were informed of possible late closure of stoma with the risk of sudden clinical deterioration.

2.2.4. Statistical Analysis

Because of the small sample size and discrepancy in age distribution of this series, we found it not worthy to perform statistical analysis to search for statistically significant differences among age groups.

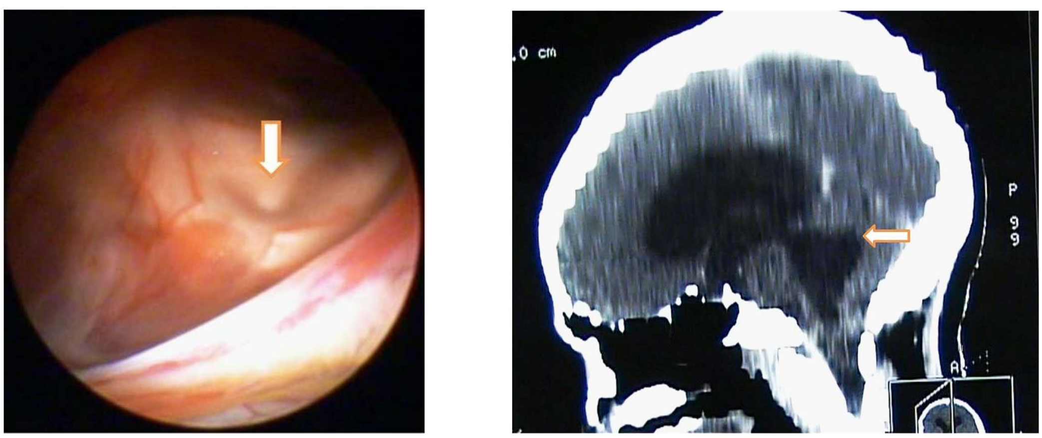
3. Results

3.1. Clinical Data

We enrolled 20 patients (15 males, 5 females) with a mean age of 11.96 years (median age, 20.75 years; range, 6 months to 41 years). At the time of ETV, 14 patients (70%) were children, 2 were 18 years old while only 4 were adults. Seven patients were under 2 years of age and 3 were less than 1 year old.

3.2. Radiological Data

The radiological diagnosis was made by computed tomography (CT) scan in all patients. None of them did magnetic resonance imaging (MRI) because it was not available or unaffordable. CT scans showed triventricular hydrocephalus in consonance with primary aqueduct stenosis (in 18 cases). In two cases, CT-scans showed quadriventricular obstructive hydrocephalus with round shaped outlets of fourth ventricle suggesting stenosis of the foramina of Luschka and Magendie (**Figure 1**). In one case, aqueduct stenosis was associated with lumbosacral myelomeningocele and shunt dysfunction in another one. Although it was prescribed to all, only 3 out of 20



(a) (b)

Figure 1. Etiologies of hydrocephalus. (a) Endoscopic view of an aqueductal stenosis. The rostral aperture of the aqueduct is replaced by a fold (arrow). (b) Head CT scan of stenosis of foramina of Luschka and Magendie, sagittal reconstruction. Note the round shape apex of fourth ventricle instead of sharp angle (arrow).

patients did post-operative CT scans. Therefore, we could not analyze preoperative and postoperative ventricular indices.

3.3. ETV and Clinical Outcomes

The procedure done was ETV alone in 19 cases and ETV combined with shunt removal in one case. The mean operation time was 34 minutes (median, 43 minutes; range, 22 - 64 minutes). During ETV procedure, we observed two minor intraventricular haemorrhages easily managed with intraventricular infusion of isotonic saline. ETV was successful in 19 cases (95%) but failed in one case (10 months old boy). ETV was successful in the shunt failure case and myelomeningocele case. Concerning post-operative complications, two patients had cerebrospinal fluid leak successfully treated with repeated lumbar puncture or drainage for three days. There was neither no death nor permanent morbidity related to this technique.

3.4. Follow-Up

The mean hospital stay was 2.9 days (median, 4.5 days, range, and 2 - 7 days). The mean follow up duration was 4.37 years (median, 4.20 years, range, 5 months 15 days - 7 years 11 months 9 days). By the time of the last follow up visit we did not have to repeat ETV for late closure.

4. Discussion

4.1. Sub-Saharan Africa Context

In Sub-Saharan Africa, financial and logistical constraints render hydrocephalus management with shunts very hazardous and shunt dependence really dangerous for patients [1]-[8]. Urgent neurosurgical care is rarely available, appropriate management of shunt complications is not ensured, limited transportation facilities and patients' financial difficulties restrict hydrocephalus patients with shunts to be adequately managed compared to those from developed countries. For these reasons, any methods allowing patients with hydrocephalus to be shunt-free should be promoted. In Cameroon, a country with 20 million inhabitants, we are only 10 certified practicing neurosurgeons all embedded in the two big cities of Douala and Yaounde. So, patients from remote areas seeking neurosurgical care have to travel long distances in very bad conditions.

In spite of its numerous advantages in treating obstructive hydrocephalus, ETV is still not widely or routinely used in Sub-Saharan African countries like Cameroon. Besides the works of Benjamin C Warf in Uganda [5]-[7] [10], we found only five reports addressing this procedure in Africa: two in Nigeria [1] [3], one in Malawi by Kamalo P [2], one in Kenya and Tanzania by Piquer *et al*. [4], one in South Africa [11], and one in Egypt [12]. This is really surprising because ETV is much more crucially advantageous in Africa where shunt related problems are very difficult to manage appropriately compared to developed countries.

4.2. Indications for ETV

Endoscopic third ventriculostomy has become the preferred treatment for obstructive or non-communicating hydrocephalus from various etiologies [2] [9] [13]-[20]. The best indication of ETV is primary or idiopathic aqueduct stenosis as it was the case in 18 out of 20 cases (90%) of our series. We also treated two cases of primary stenosis of foramina of Luschka and Magendie with ETV. Theoretically, any kind of obstructive hydrocephalus is an indication for ETV [1] [3] [13]-[18] [21]-[25]. Some authors had reported the use of ETV associated or not with choroid plexus cauterization in treating communicating hydrocephalus [2] [16]. In Sub-Saharan Africa where management of hydrocephalus with shunts is very difficult, maybe it is better to reserve shunting only for patients in whom ETV with or without choroid plexus cauterization had failed [3] [5] [6].

4.3. Success Rates of ETV

The overall success rates of ETV reported from medical literature range from 17% to 100% [1] [3] [13]-[18] [21]-[25]. Success rate is related to type and etiology of hydrocephalus, patient's age, primary versus repeated ETV and operative technique. The discrepancy in success rates reported is in part explained by the criteria used in defining ETV as successful. The best end-point for considering ETV as successful seems to be shunt independence and it was one of the criteria we used in our study. The best success rates are reported for primary aqueductal stenosis and range from 50% - 100%. The success rate of 95% (19/20 patients) from this series is similar to those from other authors [1] [3] [14]-[16] [18] [24] [25] and may rely on the fact that in 18 (90%) patients, hydrocephalus was caused by primary aqueduct stenosis even though it was associated with myelomeningocele and shunt failure in one case each. In Zanzibar and Kenya, Piquer *et al*. [4] achieved a 73% success rate in patients with aqueduct stenosis and 1 year old or above. Ojo *et al*. [3] in Nigeria achieved the same success rate in children under 2 years of age irrespective of etiology. In Uganda in 2005, Warf BC [8] had reported success rates of 81% and 90% in children older than 1 year depending on etiology.

4.4. Factors Influencing ETV Success Rate

There are controversies concerning age, etiology of hydrocephalus, primary and repeated ETV as predictors of success or failure of ETV [3] [8] [15] [20] [21] [23] [26]. There is some evidence that type and etiology of hydrocephalus do influence outcome of ETV [21] [23]. In the first series, age under 2 years was considered a contra-indication for ETV. But, recent series had shown that age should not be a limitation when ETV is indicated. In their study in Nigeria, Ojo *et al*. [3] did not find age or etiology as predictors for success or failure of ETV. In our series, the only failure occurred on a 10 months old boy, but ETV was successful in 6 and 7 months old patients. For Piquer *et al*., Warf BC and Zohdi *et al*., age and etiology of hydrocephalus had influenced ETV success rates in their respective series [4] [6] [8] [12]. Post-infectious, post-haemorrhagic and previously shunted hydrocephalies were also considered contra-indications for ETV. The success rates reported by Warf BC [8] for post-infectious hydrocephalus are 59% and 81% for patients younger or older than 1 year respectively. Chhun *et al*. [22] treated 53 previously shunted patients with ETV and had 73% success rate not related to age, cause of hydrocephalus or number of previous shunt failures. Similar results were obtained by Brichtova *et al*. [21] (69%) and Lee SH *et al*. [23] (68.4%) in previously shunted patients. Moreover, ETV success rates in previously shunted patients are significantly higher in patients with post-hemorrhagic and post-infectious hydrocephalus than when it is performed as the initial treatment [23]. Therefore, ETV should be the first choice treatment for patients with shunt failure and obstructive hydrocephalus [21] [22]. ETV was successful in the only case of shunt failure of this series. ETV was also successful in the myelomeningocele case of our series. For Warf BC [5] ETV with choroid plexus cauterization provides a more durable primary treatment of hydrocephalus for infants with spina bifida than does shunt placement and is therefore a better treatment for these children in developing countries. We had two cases of fourth ventricle outlets stenosis successfully treated with ETV. Idiopathic stenosis of foramina of Luschka and Magendie is a rare cause of obstructive hydrocephalus. In their series, Choi JU *et al*. [14] had also two cases of fourth ventricle outlets stenosis successfully treated with ETV.

4.5. ETV Complications

Although ETV is a simple and a safe procedure, many complications had been reported. Some are intraoperative like hemodynamic disturbances, intraventricular bleeding, and injury to fornix, thalamus, hypothalamus or basilar artery complex. Others are post-operative as CSF leak, meningitis or ventriculitis, diabetes insipidus, memory disturbance, epidural or subdural hematoma, delayed intraventricular hemorrhage, seizures [14] [24] [27]. Late complications are mainly due to secondary closure of the stoma. Factors which promote complications are poor vision due to bleeding or xanthocromic CSF, distorted or abnormal anatomy, thick third ventricle floor, small interpedoncular cistern, high basilar artery bifurcation, repeated ETV, high volumes of intraventricular irrigation and surgical technique [20] [26]. To overcome such difficulties, ETV can be combined with neuronavigation [19]. Overall, morbidity and mortality related to ETV are low. Reported morbidity rates are 5% - 15% and permanent morbidity is 0% - 2.1% [25]. In our series we had 2 (10%) transient post-operative complications in the form of CSF leak. We had neither permanent morbidity nor death related to ETV in our series. This was the case for other series reported from Sub-Saharan Africa [1] [3]. From the series of Warf BC [5] [6] [8] in Uganda, operative mortality of ETV ranged between 1.1 and 1.8%.Worldwide reported perioperative mortality is 0% - 1.5% [25].

4.6. Psychomotor Development of Infants after ETV

Many reports had shown that psychomotor or neurocognitive outcome of infants treated with ETV alone or associated with choroid plexus cauterization is not significantly different to that of infants treated with VP shunts [2] [10] [14] [28] [29]. Moreover, in the series from Warf *et al*. [10] ETV combined with choroid plexus cauterization was significantly superior to shunting for receptive communication outcome in children with myelomeningocele treated for hydrocephalus. In the study from Wisniewska *et al*. [29], intellectual disability occurred significantly more frequently in patients treated with shunt than in those who had ETV, incidence of gait disturbances was also significantly higher in shunted patients than in those who had ETV (P = 0.006). In adult patients suffering from late onset idiopathic aqueduct stenosis, ETV achieved neurocognitive improvement in most patients and was recommended as the treatment of choice [13] [17].

4.7. Cost of ETV

Few studies had addressed the cost of ETV in comparison to that of shunting. In Sub-Saharan Africa where income is low and most patients do not have any health insurance, cost of treatment is always a concern for patient's management. In Brazil, Oton de Lima *et al*. [30] reported that ETV has no higher costs than VP shunt. In our study, ETV reduced treatment cost of obstructive hydrocephalus by almost 600 $. Idowu *et al*. [1] in Nigeria has drawn the same conclusion concerning the financial benefit of ETV over shunt insertion.

5. Conclusion

Even in our clinical practice with limited equipments, we were able to perform ETV in non-tumor obstructive hydrocephalus with a very good success rate, significant cost reduction and low transient morbidity. Other authors sharing the same difficulties like us have reported similar results from other Sub-Saharan African countries. Therefore, we conclude that ETV is safe and efficient in treating obstructive hydrocephalus even in the difficult context of Sub-Saharan Africa and should be the treatment of choice.

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