ENDOSCOPIC THIRD VENTRICULOSTOMY IN THE TREATMENT OF HYDROCEPHALUS SECONDARY TO POSTERIOR FOSSA TUMOURS IN CHILDREN

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ABSTRACT

Objective: The purpose of the present study is to describe our experience with endoscopic third ventriculostomy in children with obstructive hydrocephalus secondary to posterior fossa tumours.

Methods: Between January 2000 and January 2006, 42 children with posterior fossa tumour were treated. Thirty patients had symptomatic hydrocephalus. Third ventriculostomy was performed to relieve intracranial pressure in all cases as an urgent procedure after admission. The other 12 cases had no hydrocephalus or non symptomatic mild dilatation of ventricles. They were excluded from the study.

Results: Pre craniectomy endoscopic third ventriculostomy procedures were technically successful. One case was complicated with infection. The procedure resolved the increased intracranial pressure before posterior fossa surgery in all cases. One case developed post operative hydrocephalus and was treated by ventriculo-peritoneal shunt insertion.

Conclusions: Endoscopic third ventriculostomy is a plausible choice for the emergency control of severe hydrocephalus caused by posterior fossa tumours. It can quickly eliminate symptoms. In addition, it eliminates the risks of cerebrospinal fluid infection related to external drainage, minimizes the risk of over drainage because it provides more physiological cerebrospinal fluid drainage than the other procedures and avoids the complications of shunting procedures.

Key words: Cerebrospinal fluid shunt, Endoscopic third ventriculostomy, Hydrocephalus, Neuroendoscopy, Posterior fossa tumor.

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Introduction

Tumours of the central nervous system are the most common solid neoplasms in infancy and most of them are located in the posterior fossa.[1,2]

The proximity of these lesions to the fourth ventricle explains the common presentation of these patients with obstructive hydrocephalus as described in about 80% of the cases.[3-6]

Neurosurgeons still differ in their opinions concerning the best way to manage obstructive hydrocephalus secondary to posterior fossa tumours.

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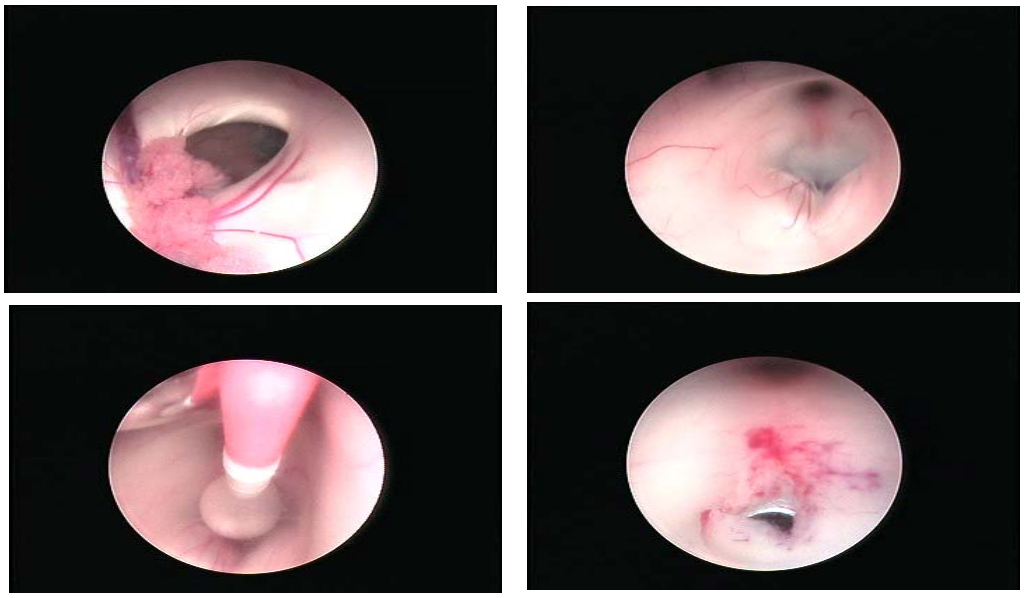

Fig.1.
Neuroendoscopic view of dilated foramen of Monro
Floor of the third ventricle
Fenestration of floor of third ventricle using Fogarty catheter
Fenestrated floor of third ventricle

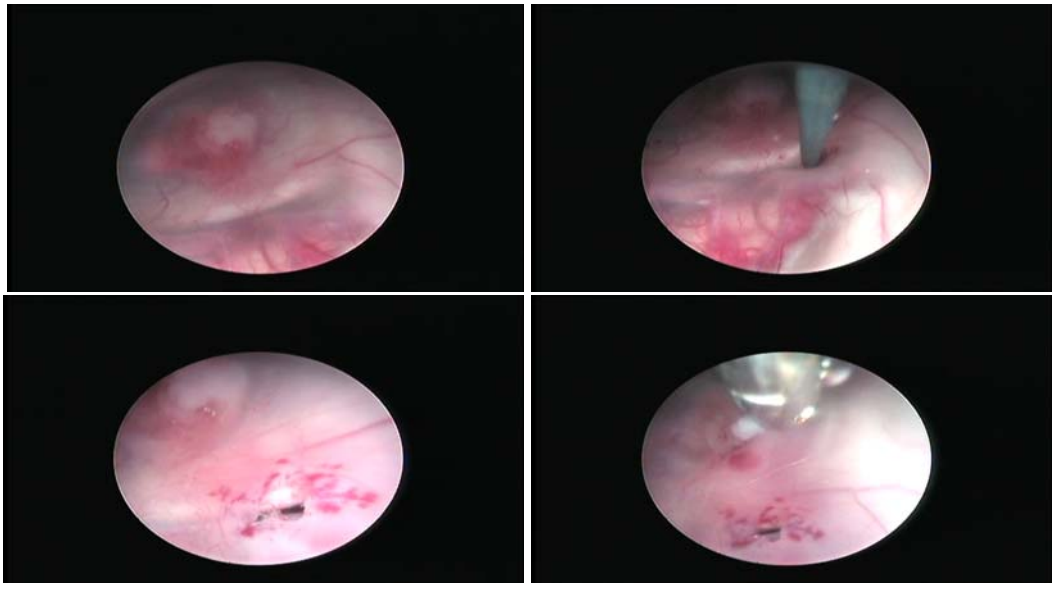

Fig. 2.
Neuroendoscopic view of a suprasellar intraventricular seedling in a case of posterior fossa medulloblastoma
Fenestration of floor of third ventricle using blunt probe
Fenestrated floor of third ventricle
Biopsy of suprasellar seedling

Some authors proposed a preoperative indwelling cerebrospinal fluid shunt as most advantageous for the subsequent surgical approach to the tumour.[3,5,7-10] Others proposed pre-treatment with corticosteroids and direct approach to the posterior fossa pathology, when possible, and/or external ventricular drainage, when necessary.[2,6,11-16] Based on recent reports,[8,9,13,17,18] we adopted the policy of performing a preoperative endoscopic third ventriculostomy (ETV) in cases of symptomatic hydrocephalus. Our experience over the past six years in 30 patients is discussed.

Methods

Between January 2000 and January 2006, 42 patients with posterior fossa tumour were admitted to the neurosurgery department at King Hussein Medical Centre. All 42 patients had a CT scan upon admission. Patients with no hydrocephalus, mild non symptomatic dilatation of ventricles, and shunted patients were excluded from this study.

Thirty patients with CT scan showing severe hydrocephalus, and had symptoms and signs of intracranial hypertension constituted the study group.

Patients' age ranged from three to 13 years (mean age six years), 17 females and 13 males. All thirty patients were started on corticosteroid agents on admission, brain and whole spine MRI were obtained and ETV performed on urgent basis (seven cases as emergency procedure). Follow up CT scan was performed after ETV for all patients.

Endoscopic third ventriculostomy was performed using a rigid neuroendoscope. A blunt probe was used to fenestrate the floor of third ventricle followed by fogarty catheter number four dilatation, Lilliquest membrane was always sought and fenestrated. (Fig. 1) Biopsy was performed in one case where seedling of tumour was detected. (Fig. 2)

Tumour resection was scheduled under non-emergency conditions on the next available surgical slot.

Results

Endoscopic third ventriculostomy was performed in the thirty patients. There were no technical difficulties in the procedure even in the cases associated with anatomical distortion of the floor of the third ventricle due to the tumour. Ventricular drainage device (reservoir) was inserted in 5 cases for the suspicion of inadequate ventriculostomy.

The signs and symptoms of increased intracranial pressure improved after ETV in all patients. Follow up brain CT scan showed no complications related to third ventriculostomy except for insignificant asymptomatic airocele in four cases. The size of ventricles showed reduction in 25 cases (83%). One patient developed fever and meningeal irritation signs after three days from ETV, external ventricular drain was inserted and antibiotics started. Patient improved and surgery was performed with no sequels.

Twenty cases underwent definitive surgery on the next available operating slot that was 2-4 days from performing ETV. Surgery in six patients was deferred till their general and clinical conditions improved. Those patients presented with altered level of consciousness and poor general condition related to vomiting and increased intracranial pressure. Three patients' operation was delayed due to theatre time availability.

The definitive surgery showed satisfactory posterior fossa condition in relation to the CSF pressure. Even with cases which showed some tightness in the posterior fossa the routine measures were adequate to control the pressure, especially after the cisterna magna was opened and more CSF released.

Total resection was achieved in all cases except for one where the tumour was adherent to the floor of the fourth ventricle. The anatomical pathway of the CSF was opened in all cases with satisfactory flow. The histopathology of tumours is shown in Table I.

Table I. Histopathological type of tumors

Type of Tumor	Number of cases	%
Medulloblastoma	15	50
Pilocytic Astrocytoma	10	33
Ependymoma	5	17

The post operative period showed no complications related to CSF pressure; there was no hydrocephalus, no CSF leak, or any CSF collection in the wound area in all cases.

None of the thirty patients needed any further drainage procedures during the early post operative period or later on follow up visits including the shunted case.

Discussion

The association of posterior fossa tumors with hydrocephalus, both potentially lethal conditions, necessitates urgent surgical treatment. The routine placement of preoperative shunts significantly reduces the overall morbidity and mortality rates. The advantages of preliminary shunting are rapid normalization of raised intracranial pressure (ICP), lowering of the risk of infection due to continuous extraventricular drainage (EVD), improvement of the patient's general condition, prevention of postoperative ICP elevation, and the possibility of

implementing further diagnostic and therapeutic procedures through a reservoir.[3,4,7,11,12,19]

Nevertheless, several arguments have been raised against systematic preshunting. There is considerable morbidity when compared with EVD for less than 5 days with a very low complication rate (2.2%),[2,7,20-22] where a 10% rate of upward herniation in cases of posterior fossa tumors subjected to preliminary shunting,[20] and spreading of medulloblastomas through ventriculo-peritoneal shunts was reported.[23-25]

These arguments and the improvements in the availability and type of neuroimaging systems that permit earlier diagnosis have caused neurosurgeons to question the need for routine shunt placement. Therefore, a more expectant policy (Corticosteroid therapy, early surgery, and external ventricular drainage when needed.) was proposed and adopted. Steroids reduce posterior fossa swelling. Preoperative drainage is required where, despite steroids, there are serious problems, such as decreasing consciousness or visual impairment due to papilledema.

Although theoretically appealing, this protocol is not without concern. External ventricular drainage used in these situations is not without the attendant risk of infection (10% reported by Rappaport and Shalit and 4.9% by Schmid and Seiler)[12,14] and upward herniation or hemorrhage. Seventeen to 40% of patients treated with this protocol have uncontrolled hydrocephalus after tumor removal and required placement of a definitive CSF shunt.[5,9,19-26]

This kind of hydrocephalus occurs predominantly within the first month of surgery. These patients, placed at risk of suffering intracranial hypertension, have an increased rate of CSF leakage and pseudomeningocel formation, a prolonged hospitalization, and a high risk of pseudobulbar palsy.

Endoscopic third ventriculostomy in the management of hydrocephalus secondary to posterior fossa tumours was proposed, for the first time, by Chumas *et al.* in 1995[8] and its efficacy was reviewed by Sainte-Rose *et al.* [13] in 2001. The rational basis of ETV is provided by the obstructive nature of hydrocephalus that is due to the presence of blockage of the CSF pathway at the level of fourth ventricle outlets or at the aqueduct. ETV creates a communication between the ventricular system and subarachnoid spaces at the level of the floor of the third ventricle.

Sainte-Rose *et al.* reviewed 67 ETVs performed before tumour removal in patients with severe hydrocephalus. In this series there were no deaths and no permanent morbidity related to the procedure, a 98.5% rate of immediate symptomatic resolution, and a 94% rate of shunt-free patients after tumour removal.[13]

Comparing these results with patients with hydrocephalus who underwent a "conventional treatment" (steroid medications, early surgery, and ventricular drainage) and with patients with no evidence of ventricular enlargement, they concluded that ETV had a curative effect on intracranial hypertension and a prophylactic effect by preventing the development of hydrocephalus after tumour removal.

Preoperative normalization of CSF hydrodynamics seems to decrease the risk of permanent postoperative impairment of CSF circulation. Hopf *et al.*[17] and Valenzuela and Trellez[18] have also reported a significant experience in 17 and 21 cases respectively, both with a 76% success rate in controlling hydrocephalus.

In our unit we adopted the policy of treating severe hydrocephalus in patients with posterior fossa tumour with ETV. The patients were also started on steroids on admission. The procedure seems to provide a valid alternative to placement of a permanent shunt in cases in which hydrocephalus develops following posterior fossa surgery

ETV is a procedure that can be performed on emergency basis, allows rapid relief of clinical signs and symptoms, avoids the risks and complications of other approaches to treat hydrocephalus like shunt infection and failure, upward herniation and possible peritoneal seedling. It allows restoration of normal mechanism of CSF flow.

The burr hole used for ETV can provide a rapid access to the ventricles post operatively if need arises. CSF is obtained for cytology during procedure.

ETV proved successful in immediate and long-term control of hydrocephalus both clinically and radiological with minimal risk and complications. Pre operative ETV allowed time to schedule the patients for definitive surgery on more convenient basis and resuscitating patients. ETV resulted in satisfactory posterior fossa surgical conditions. The post operative period had no complications related to hydrocephalus, no CSF leak from posterior fossa or ETV wounds, and no pseudomeningeocele.

Conclusion

Our work supports the trend of adopting the preoperative ETV for the management of hydrocephalus secondary to posterior fossa tumours and is in accordance with the conclusions reached by other authors who adopted the same policy.

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