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Original Article

Lamina Terminalis Fenestration in Ruptured Anterior Circulation Aneurysm for Hydrocephalus - The Limitations

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Abstract

Aim: The aim of the study is to analyze the usefulness of lamina terminalis fenestration (LTF) in hydrocephalus secondary to subarachnoid hemorrhage while performing surgical interventions for anterior circulation aneurysm and to know the limitations of this procedure in patients who undergo clipping of these aneurysms.

Materials and Methods: A total of 81 aneurysms in 78 patients were included in this study from the year 2001 to 2018. Patients in the age range of 12–80 years were included. Male-female ratio was 1:1.1. Until February 2011, LTF was done for 9 patients who had any degree of hydrocephalus as an adjuvant to clipping of the anterior circulation aneurysms. After March 2011, instead of LTF, intraoperative ventricular tapping was done in patients with hydrocephalus.

Results: Among the 9 cases who had undergone LTF, two patients developed frontoparietal subdural hygromas with mass effect. From March 2011 till date after stopping LTF, only 2 of 47 patients required ventriculoperitoneal shunt who ultimately developed chronic hydrocephalus.

Conclusion: LTF can lead to potential complications such as subdural hygromas due to poor absorption in blood clogged subarachnoid spaces. This procedure must be adopted with caution as it has its own limitations.

Key words: Lamina terminalis fenestration, Hydrocephalus, Anterior circulation aneurysms

INTRODUCTION

Subarachnoid hemorrhage (SAH) is a common brain insult among all age groups, especially young people. SAH can lead to hydrocephalus and vasospasm and subsequent neurological morbidity and mortality. Approximately 20% of patients who survived are inactive and remain dependent.[1]

The incidence of hydrocephalus after SAH has been reported to range from 6 to 67% in various studies, and the incidence time is varied from several days to years.[2] Cerebral vasospasm occurs following SAH with a morbidity and mortality rate of 10–30%, and there are 70% of cases.[3,4] Vasospasm in patients with SAH is one of the major causes of mortality and morbidity among patients. Therefore, prevention and treatment of cerebral vasospasm are critical in the management of SAH patients.[1,5]

Following SAH, ventricular dilatation results in ischemic brain damage. Placing the shunt for chronic hydrocephalus following SAH is associated with a mortality rate of 7–9%, and the failure rate is high (43% per year and 85% at 10 years).[2] In addition, shunt procedures are associated with complications such as revision, subdural hemorrhage or intracranial hemorrhage, infections, seizure, cerebrospinal fluid (CSF) leakage, and injuries to the lungs or abdomen.[4,6] Lamina terminalis fenestration (LTF) is a surgical creation of a defect in between the upper edge of chiasm and the lower edge of anterior commissure with average size of 8.25 mm and a minimum size of 2 mm. LTF causes the CSF release from the third ventricular and it facilitates the brain relaxation.[5]

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Recently, there are conflicting few reports of the effect of LTF on the incidence of the vasospasm and shunt-dependent hydrocephalus in SAH.[2,6] The complex interactions between LTF, vasospasm and shunt-dependent hydrocephalus in SAH is insufficiently investigated. Due to the uncertainty of the efficacy of LTF and the lack of comprehensive studies in this area, the aim of this study was to assess the effect of LTF on the incidence of shunt-dependent hydrocephalus in anterior circulation aneurysms in patients with SAH, in Hannah Joseph Hospital, Madurai, Tamil Nadu, India, during the year 2001–2018.

MATERIALS AND METHODS

A total of 81 aneurysms in 78 patients were included in this study from the year 2001 to 2018. Patients in the age range of 12–80 years were included. Male:female ratio was 1:1.1. Until February 2011, LTF was done for 9 patients who had any degree of hydrocephalus as an adjuvant to clipping of the anterior circulation aneurysms. After March 2011, instead of LTF, intraoperative ventricular tapping was done in patients with hydrocephalus.

All the patients underwent routine pterional craniotomy and sphenoid drilling. Dura was opened with base toward the sphenoid wing. After Sylvian fissure dissection, vessels of anterior circulation were delineated. Microsurgical dissection and clipping were done according to the site of aneurysm. Among 31 cases until February 2011, nine cases with significant ventricular enlargement underwent LTF. After that period, LTF was not done until December 2018 in 47 patients.

All the patients were analyzed with post-operative computed tomography (CT) brain as a routine on the 1st post-operative day. The CT brain was repeated only when the patient developed any neurological deterioration.

RESULTS AND ANALYSIS

Among the nine patients who had undergone LTF, two patients developed frontoparietal subdural hygroma and hydrocephalus with mass effect. The morbidity associated with these complications was high, and both the patients were discharged with the GOS of 2. From March 2011 till date after stopping LTF, only 2 of 47 patients required ventriculoperitoneal shunt who ultimately developed chronic hydrocephalus.

Statistical analysis was performed using Chi-Square test [Tables 1 and 2].

Table 1: LTF vs No LTF

LTF	SDH/Hydrocephalus		Total
	+	–	
+	2	7	9
–	2	45	47
Total	4	52	56

LTF: Lamina terminalis fenestration, SDH: Subdural hygroma

Table 2: Statistical analysis

Test	Value	*P* value (1 tail)*	*P* value (2 tail)
Uncorrected Chi-square	3.676	0.02760*	0.05519

*$P<0.05$

DISCUSSION

Despite the increasing awareness and knowledge of surgery, over the past decade, there has been no change in mortality and morbidity of SAH. Spontaneous SAH is usually due to rupture of an intracranial aneurysm that can cause morbidity and mortality or leads to complications such as vasospasm and hydrocephalus.[7-11] In this study, there were significant differences between the LTF and without LTF group on the incidences of hydrocephalus in aneurysmal ruptures.

Dehdashti *et al.*,[6] in a study of shunt-dependent hydrocephalus after rupture of intracranial aneurysms, found that there was no significant difference in the rate of shunt-dependent hydrocephalus in both therapy groups. Komotar *et al.*[12] found LTF associated with a decreased incidence of shunt-dependent hydrocephalus of >80% after aneurysmal SAH. In another study, Komotar *et al.*[13] stated that in LTF done by single-surgeon in contrast to multisurgeons does not reduce the incidence of shunt-dependent hydrocephalus after aneurysmal SAH. Kim *et al.*,[3] in relation to the influence of LTF on the occurrence of the shunt-dependent hydrocephalus in anterior circulation aneurysmal ruptures, found no significant correlation between the microsurgical fenestration and the rate of incidences of shunt-dependent hydrocephalus. In a systematic review by Komotar *et al.*,[14] they revealed no significant association between the reduced incidence of shunt-dependent hydrocephalus and LTF. Tomasello stated the favorable effect of LTF on CSF dynamics.

Hydrocephalus following SAH can be classified into three forms: The acute (0–3 days after hemorrhage), subacute (4–13 days after hemorrhage), and chronic (over the 14 days after hemorrhage). In chronic hydrocephalus, fibrosis and occlusion of the subarachnoid granules are effective in accelerating malabsorption and the communicating hydrocephalus. The LTF was carried out as a safe procedure

by many surgeons, but some complications such as decreased level of consciousness, hypothalamic injuries, transient confusion, and memory loss were reported. LTF has been used for the treatment of non-communicating hydrocephalus-associated high intracranial pressure due to the obstructive pathologies in the midbrain and/or posterior cranial cavity. The mechanisms include CSF flow through the LT opening to an absorptive subarachnoid space and rapid transmission of the pulse pressure through a free communicating CSF space.[2]

Fox and Sengupta[15] applied LTF for the treatment of acute hydrocephalus and to avoid progress of chronic hydrocephalus. Another study reported that LTF decreased the incidence of shunt-dependent hydrocephalus by >80% and reduced the morbidity and mortality associated with the shunt operation.[2]

According to studies, older age, poor clinical grade on admission (Hunt-Hess and Fisher grade), the amount of the SAH and the presence of intraventricular hemorrhage, hyponatremia, hypertension, and the use of antifibrinolytic were all significant predictors of chronic hydrocephalus. Factors associated with the development of shunt-dependent hydrocephalus included age, female, location of aneurysm, poor neurological status, and presence of initial intraventricular hemorrhage.

All patients enrolled in this study underwent surgery by a single surgeon that was the strengths of this study. Due to the limited study population, the time of the study was prolonged. Data collected from a single center is the only limitation of this study.

CONCLUSION

Despite LTF can be a safe method, there were observed significant differences between groups in relation to the effect of LTF on the incidence of shunt-dependent hydrocephalus. LTF can lead to potential complications such as subdural hygroma due to poor absorption in blood clogged subarachnoid spaces. This procedure must be adopted with caution as it has its own limitations.

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