

# Neuro-Endoscopic Management of Multiloculated Hydrocephalus

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## Abstract

**OBJECTIVE:** The aim of this study is to evaluate the role of endoscopy in management of multiloculated hydrocephalus.

**PATIENTS AND METHODS:** We reviewed 30 consecutive patients during the period from January 2012 to December 2015 with multiloculated hydrocephalus who underwent neuroendoscopic approach for treatment, in Sohag university Hospital. The patients' clinical outcomes, and complications were reported.

**RESULTS:** There were 30 patients (12 male 18 female). Endoscopic septum pellucidum fenestration was done in 9 cases and endoscopic ventricular septal fenestration was done in 21 cases; The success rate was achieved in 25 cases (83.3%). The remaining 5 cases (16.7%) needed a re-do the procedure due to the presence of residual compartments not opened and not drained by the existing shunts, no immediate or late postoperative complications and there was no mortality.

**CONCLUSION:** Neuroendoscopic management for multiloculated hydrocephalus can restore communication between isolated intraventricular compartments transforming them into single cavity and one intraventricular catheter can be used, reduce the number of surgical procedures, and improving the quality of life of the patient.

**KEY WORDS:** Endoscopy, multiloculated hydrocephalus, fenestrations, outcome, complications.

## Introduction

Hydrocephalus is an important and serious disease accounting for one of the most challenging issues in neurosurgical field (1). There are many types of hydrocephalus, each of which has different prognostic and therapeutic issues. The so called "septated hydrocephalus" is the most difficult subtype of hydrocephalus to manage, and is still a major health problem (1). Septated hydrocephalus can be further subdivided into two subtypes: uniloculated or multiloculated. The definition of multiloculated hydrocephalus means "multiple and separated cystic cavities or spaces located in or in close relation to the ventricular system and filled with CSF; either fresh or altered". This definition describes the shape and morphology of the distorted ventricular system (2). The term "multiloculated hydrocephalus"

means that there is an isolated CSF compartment or multiple CSF compartments within the ventricular system despite a patent shunt system (3). The term "multiloculated hydrocephalus" generally replaced many other terms including: polycystic hydrocephalus, polycystic brain disease, multiseptate hydrocephalus, multilocular hydrocephalus, ventricular compartmentalization, intraventricular septations and multicompartamental hydrocephalus (4). The usual macroscopic picture of multiloculated hydrocephalus is ventricular dilatation divided into compartments by membranes. These membranes are usually translucent but vary in their thickness (5). Microscopically, these septations are formed of fibroglial elements with

polymorphonuclearleukocytic infiltration and some round cells (6).

The pathophysiology of multiloculated hydrocephalus is not clear but it may be due to the formation of fibrous adhesion within the ventricles following intraventricular hemorrhage or infection. The infection may vary from pyogenic infection (bacterial meningitis) or chronic granulomatous infection, e.g. tuberculousventriculitis. Also, it may be congenital interventricular ependymal multiple (arachnoid) cysts. Histologically, ventricular septa are formed by glial protrusion into the ventricles (2). Low birth weight, premature labor, pre or perinatal complications and the presence of some CNS congenital malformations may constitute some of the important predisposing factors for the development of multiloculated hydrocephalus (7).

Diagnosis can be made using computerized tomography (CT) and/or magnetic resonance imaging (MRI). However, early multiloculated hydrocephalus may be difficult to diagnose by non-contrast CT because the cysts have a density similar to CSF and their walls may be transparent (8). With time, the septations may increase in number and thickness, thus makes the ventricular architecture more distorted and become more readily diagnosable by conventional CT. Sometimes the diagnosis may require intrathecal injection of water soluble contrast (9).

The goal of treatment is to restore the normal or near normal communication between isolated intraventricular compartments aiming to create a single ventricular cavity and to implant a single shunt with only one intraventricular catheter (4). However, the actual treatment techniques are usually done surgically by more than one shunt

insertion. Patients with multiloculated hydrocephalus have often multiple or complex shunts and may need numerous shunt revisions consequentially, with very high morbidity (9). To reduce the morbidity and complications, neuroendoscopic intervention may play an important role in the management of multiloculated hydrocephalus aiming at creating multiple fenestrations between the different cysts with the least number of draining device (8, 9).

#### **Patients and Methods:**

The study was carried out on 30 patients suffering from multiloculated hydrocephalus (12 males, 18 females); in Sohag University Hospital; in the period from Januray 2012 to December 2015. The patients' age ranged from 1-18 months. The demographic data are summarized in table 1.

From the total of 30 patients, 19 passed through the well-known popular scenario of shunts and their problems of infection, obstruction, revision hemorrhage and/or shunt removal. The remaining 11 cases were de novo (figure 1).

#### **Surgical techniques:**

The intervention was endoscopic septum pellucidum fenestration in 9 cases and endoscopic ventricular septal fenestration in 21 cases; transformmultiple cystic cavities into single cyst harbouring the fenestrated end of the shunt.

#### **Statistical analysis:**

Data were analyzed using the Microsoft Excel 2016 software (Microsoft corporation, Chicago, USA, 2016), and the IBM-SPSS software, version 24 (IBM corporation, Chicago, USA, 2016). Qualitative data were expressed as frequencies and percentages, while quantitative date were expressed as means, medians and standard deviations.

## Results

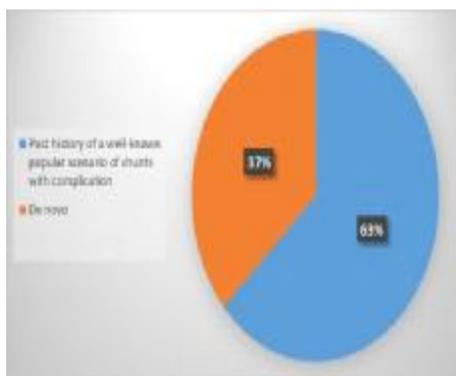
The operation was done as planned in all of the cases, with no immediate or early postoperative complications. Two weeks postoperatively a follow up CT scan was done in all patients. The follow up CT scan showed that the primary success was achieved in 25 cases (83.3%). The remaining 5 cases (16.7%) needed a re-do the procedure due to the presence of residual compartments not opened and not drained by the existing shunts. Among these 5 cases, the second operation succeeded in 3 cases while only 2 patients (6.7%) needed new shunt application because the endoscopic trials failed to unify all compartments. There was no mortality cases during the one-month follow up of all of our cases. Table 2 summarizes the operative and postoperative data of our study patients.

**Table 1. Demographic data of the study group**

Item	Value
Age (in months)	Mean±SD 6.97±4.32
	Median(range) 6.00(1-18)
Sex	Male 12(40%)
	Female 18(60%)

**Table 2. Operative and postoperative data of the study population**

Item	Number of cases
<b>Past history of surgical operation for hydrocephalus</b>	19(63.3%)
<b>Type of operation</b>	Endoscopic septum pellucidum fenestration 9(30%)
	Endoscopic ventricular septal fenestration 21(70%)
<b>Immediate postoperative complications</b>	0(0%)
<b>Primary operation</b>	Succeeded 25(83.3%)
	Failed (needed second operation) 5(16.7%)
<b>Second operation</b>	Succeeded 3(10%)
	Failed (needed new shunt application) 2(6.7%)
<b>Mortality</b>	0(0%)



**Figure 1. Past history of surgical trials for repair of hydrocephalus**

## Discussion

In the past three decades, neuroendoscopic management of hydrocephalus, especially those with septation or multiloculation; have gained a wide acceptance worldwide (10). It was found that simple shunting alone gives non satisfactory results. Because scaring and collapse of the cyst around

the catheter tip can cause shunt malfunction. In order to correct this issue; multiple or complex shunts are put to achieve balance between the CSF production and absorption between the cyst and the remaining ventricular system. However, the embedded ventricular catheters may serve as a

focus for infection and contribute to cyst infection. In most cases, these embedded catheters can never be removed without the risk of intraventricular hemorrhage (11). Craniotomy with transcallosal fenestration of the intraventricular septations has reduced the rates of shunt malfunction, but the risk of the repeated surgery is high and shunt revision may still be required. The high morbidity associated with the open craniotomies has raised the interests in endoscopy as a minimally invasive alternative for treatment of loculated hydrocephalus (11).

Any change of the local intracystic CSF secretion and absorption leads to a change in the intracystic pressure. The resulting non similarities of local intracranial pressure (ICP) in different compartments may lead to different growths in the size of intraventricular cysts. As a result, a decrease in brain compliance occurs. This mechanism might explain the discrepancy in growth growth or shrinking of some postmeningitic cysts. The thickness, vascularity, absorptive capacity and lastly the secretory activity of entrapped parts of the choroid plexus may also have an effect on the differential growth or collapse of intraventricular cysts (12). Our study aimed to evaluate the early postoperative results and success rate of multiloculated hydrocephalus neuro-endoscopic treatment in Sohag University Hospital. Our study revealed a primary success rate of over 80% of cases, with minimal or no postoperative complications. Also, the overall success rate of our technique either from a single or a double endoscopic trials exceeded 93%. Only 2 cases out of 30 cases needed to be shifted to open surgery due to failure of twice neuro-endoscopic correction.

Our results confirms the previous published data about the efficacy and safety of neuro-endoscopic surgical treatment of multiloculated hydrocephalus. The study done by Nowoslawska et al compared data obtained in two groups of patients with multiloculated hydrocephalus: one treated by neuro-endoscopic technique while the other treated with conventional multiple shunt implantations. This study revealed that endoscopy not reduced the shunt revision rate as a result of reduced total shunt system volume. Moreover, patients treated endoscopically were in a better clinical state than those in the open surgery group, this is due to less complications, especially CNS infection (13, 14).

This was also agreed with the study done by Spennato et al who mentioned that the complications of the neuro-endoscopic treatment of hydrocephalus in 18 cases included only three cases of CSF infection, one case of a CSF leak through the wound, and another case of thalamic hematoma with a resulting kinetic mutism, which was mild and transient (3). Post endoscopic subdural collections are of little; if any; clinical importance, with complete radiologically demonstrated resolution in most of patients without clinical significances (15).

### Conclusion

- To restore communication between isolated intraventricular compartments of one intraventricular catheter, reduce the number of surgical procedures, and improving the quality of life of the patient, neuro-endoscopy should be highly addressed.
- Due to the complexity of multinucleated hydrocephalus, each patient must be carefully studied

with no clear procedure by the literature should be ruled out.

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