

Original Research Article

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Obstruction at the level of foramen of monro causing obstructive hydrocephalus

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ABSTRACT

Background: The foramen of monro is also known by the name of interventricular foramen. The study was conducted to determine the etiology, clinical picture, radiological features, and different modalities of management and related complications.

Methods: A prospective study of 30 cases with diagnosis of hydrocephalus due to obstruction at the interventricular foramen. Lesions at the foramen of monro were addressed either by open craniotomy approach or neuroendoscopy approach. For open craniotomy transcortical or interhemispheric approach was preferred and Karl Storz's Lotta system was used for all the neuroendoscopic procedures.

Results: Craniopharyngioma and colloid cysts were the most common pathology in children and adults respectively. Endoscopic approach was particularly helpful in decreasing the convalescence period and postoperative complications. Wound site CSF leak is the most commonly faced complications. In our study, out of 30 patients, males accounted for 23 (77%) cases and females for 7 (23%) cases. Majority were in the age group of 20-40 years. The most common presenting complaints of patients having foramen of monro obstruction with hydrocephalus were headache and vomiting. Gadolinium enhanced contrast MRI of brain was the investigation of choice for diagnosing these lesions.

Conclusions: Endoscopic approach can be offered as a first line of treatment as a part of standard treatment in all patients having foramen of monro obstruction. It obviates the need for multiple shunt procedures. Although small solid lesions less than 3 cm in size can be addressed by endoscopic approach, the learning curve required for endoscopic approach to deal with solid lesions is very steep.

Keywords: Interventricular foramen, Brain, Ventricular system, Pathology

INTRODUCTION

The foramen of monro has also been referred to by the name of interventricular foramen. The first description of this foramen was given by Alexander Monro in the year 1783 and 1797. The authors of that era were of the opinion that the use of nomenclature 'foramen of monro' was incorrect; instead 'interventricular foramen' would be more apt. Their reason was that monro had interpreted the connection between lateral and the third ventricle in

an incorrect way. The structures comprising this foramen are the anterior part of the thalamus, the fornix and the choroid plexus. The foramen of monro is a short conduit between the paired lateral ventricles and the third ventricle of the brain. This deep structure becomes clinically significant when obstructed and leads to obstructive (non-communicating) hydrocephalus. Etiologies of obstruction at the foramen of monro include infections, congenital atresia, vascular malformations, and neoplastic processes.¹ The dimension of this foramen

is not even one centimeter and thus the area present for any operative intervention is very small. The operative approach depends on the location of the tumor which can be either in the lateral or the third ventricle. The lesions commonly obstructing this region are subependymal giant cell astrocytoma, craniopharyngioma, colloid cysts, neurocytoma.²

We aimed to assess the management and associated complications of lesions at foramen of monro causing obstructive hydrocephalus based on their type, clinical picture and their appearance on imaging.

METHODS

Study design and sample population

This observational cross-sectional study was carried from November 2018 to October 2020 in the Department of Neurosurgery, DY Patil Medical College and Hospital, Pune. All patients with hydrocephalus due to obstruction at the level of interventricular foramen were included and patients having asymmetrical ventricles due to volume loss, cerebral atrophy, asymmetrical dilated ventricles due to midline shift and patients having intraventricular extension of hemorrhage from other sites were excluded from the study. Institutional Ethical committee clearance was acquired prior to the start of the study. Informed written consent was obtained from the patients before enrolment in the study.

Surgical techniques

Lesions at the foramen of monro were addressed either by open craniotomy approach or neuroendoscopy approach. All surgeries were done by the same surgical team. For open craniotomy either transcortical or interhemispheric approach was used. All cases were operated under general anesthesia in supine position. The prophylactic antibiotic chosen was ceftriaxone and was given as per the weight of the patient at the time of induction.³

Interhemispheric approach

With adequate positioning a bicoronal incision was placed, commonly from the border of one zygoma to the other zygoma. Two burr holes were done adjacent to the sagittal sinus on the contralateral side for the purpose of craniotomy. A craniotomy of 4 x 4 cm was usually adequate. The interhemispheric fissure was entered by bluntly dissecting it with cottonoids. After reaching the corpus callosum a further dissection of one to one and a half centimeter was usually adequate for excision of pathology located proximally in the lateral ventricles.

Anterior transcortical approach

After a frontal craniotomy the lateral ventricle was approached through a middle frontal gyrus corticectomy.

Open surgical technique

Interhemispheric subfrontal trans-lamina terminalis approach was commonly used. The incision taken was bicoronal, and a midline frontobasal craniotomy was performed. Arachnoid dissection was carried out interhemispherically and subfrontally (on the side where the lesion was lateralized) and the lamina terminalis was exposed. The lamina terminalis was opened strictly in the midline. The anterior transcortical incision is more adequate for cases who had big size ventricles. Corticectomy was done commonly by the frontal gyrus middle part. The benefit of this incision is that bridging veins are safeguarded. The disadvantage of this incision in comparison to the interhemispheric transcallosal approach is that there is damage to both the commissural and the projection fibers along with the short and the long fiber. Many authors are of the opinion that the frequency of seizures occurring in the postoperative period is higher when the transcortical route is used. In the recent studies it has been said that this may not be true.⁴

Endoscopic techniques

Standard endoscopic positioning was followed. Karl Storz's LOTTA system was used for all the neuroendoscopic procedures. After registration of the neuro navigation system, the lateral ventricle was reached. Subsequently, the interventricular foramen pathology was addressed.

Data collection and data analysis

Data was collected using a common proforma which included bio-data, symptoms, radiological investigations, intra-operative findings, management and post-operative outcome and complications. After radiological confirmation of the diagnosis the treatment plan was individualized for each patient and they were offered definitive tumor excision, neuroendoscopic monoprostomy and septostomy or VP shunt surgery (uni-ventricular/bi-ventricular).

The data were compiled in microsoft excel and was checked for completeness. The analysis was performed in EpiInfo software (CDC, Atlanta). Descriptive analysis was performed and results were described in tabulated format.

RESULTS

Males accounted for 23 (77%) cases and females for 7 (23%) cases. Majority were in the age group of 20-40 years. The most common presenting complaint was headache followed by vomiting, visual complaints, altered sensorium, seizures and gait ataxia (Table 1). The most common clinical signs were papilledema followed by neurocutaneous markers, hormonal changes and enlarged head circumference. In our study 18 (60%) patients presented with features of acute rise in

intracranial pressure. The most common pathology observed was colloid cyst (23%) and craniopharyngioma (23%). Next most common pathology was subependymal giant cell astrocytoma (SEGA), which was observed in 20% of the patients. Other pathologies observed have been described in Table 2. In our study the most common surgical intervention chosen was endoscopic approach for the lesions. The definitive treatment of the lesion was always supplemented with septostomy and monroplasty. Nineteen patients were offered endoscopic surgery and

11 patients were managed by open surgery (Table 3). In all cases operated by endoscopic approach septostomy was done (Figure 1). It facilitates a communication between the two lateral ventricles and this allows both the ventricles to be drained by one shunt. We dilated the foramen of monro endoscopically by excision of the offending lesion, clearance of the exudates, adhesions or blood products, perforation of septations or membranes and enlargement with balloon catheter or dilating forceps (Figure 1).

Table 1: Baseline characteristics of the patients.

Variables	Number	%
Age groups (years)		
0 to 10	8	27
11 to 20	2	7
21 to 30	11	37
31 to 40	7	23
41 to 50	2	7
Gender		
Female	7	23
Male	23	77
Clinical presentation		
Headache	30	100
Vomiting	21	70
Visual symptoms	10	33
Seizures	7	23
Gait ataxia	6	20
Altered sensorium	7	23
Enlarged head	1	3
Hormonal symptoms	3	10
Papilledema	18	60
Neurocutaneous markers	5	17

Table 2. Distribution of patients according to their diagnosis.

Condition	Number	%
Colloid cyst	7	23
Craniopharyngioma	7	23
SEGA	6	20
Neurocysticercosis	2	7
Ventriculitis	2	7
TB Meningitis	1	3
Pituitary macroadenoma	1	3
Neurocytoma	1	3
Multiseptate hydrocephalus	1	4
Intraventricular hemorrhage	1	4
Functional hydrocephalus	1	3
Total	30	100

Table 3. Operative and post-operative details of the patients.

Variables	Number	%
Type of treatment		
Endoscopic	19	63
Open surgery	11	37

Continued.

Variables	Number	%
Post-operative complications		
CSF leak	4	13
Residual tumor	4	13
Intraventricular haemorrhage	2	7
Post-operative seizures	2	7
Wound gaping	1	3
Neurodeficit	1	3
Transient aphasia	1	3
Death	1	3

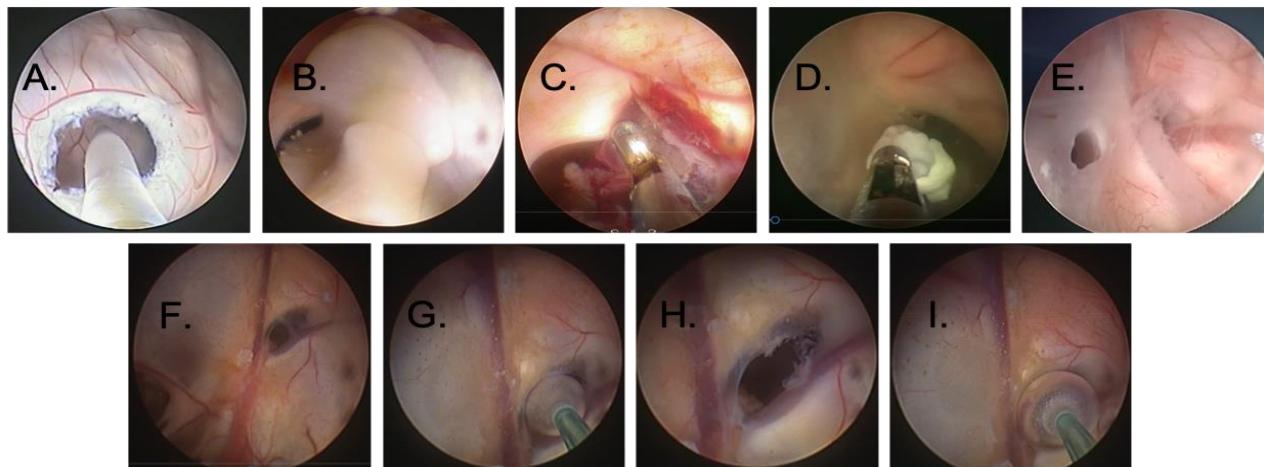


Figure 1: Various steps in the operative procedure. (A) Performing endoscopic septostomy. (B) Excision of the offending lesion (colloid cyst). (C-E) Clearance of the blood products, exudates, adhesions. (F-H) Perforation of septations or membranes. (I) Enlargement with balloon catheter or dilating forceps.

DISCUSSION

The foramen of Monro becomes clinically significant when it is obstructed causing obstructive (non-communicating) hydrocephalus.⁵ We observed that 77% of the cases were males. In a study done by Shunji Nishio et al, there were 8 (40%) male and 12 (60%) female patients.⁶ Furthermore, we observed that the most common clinical signs were papilledema followed by neurocutaneous markers, hormonal changes and enlarged head circumference. The same pattern of symptoms was observed in a study done by Qiang Cai, and others the most common clinical symptom was headache followed by vomiting, visual impairment, memory decline, sensory dysfunction and seizures.² In a study done by Shunji Nishio et al on twenty cases, (75%) presented with neurological complaints. Twelve patients (60%) presented with clinical features of raised intracranial pressure (ICP), two (10%) cases had mental deterioration and one case presented with seizures.

In the present study, the most common pathology observed was colloid cyst (23%) and craniopharyngioma (23%). Next most common pathology was subependymal giant cell astrocytoma (SEGA), which was observed in 20% of the patients. Literature suggests that colloid cysts are the most common masses of foramen of monro. They have an incidence of 0.2–2% of all intra-cranial tumors.⁷

This well-defined round cyst occurs in adult patients and may be from several millimeters to 3 cm in size and also attached to the anterosuperior aspect of the third ventricle.⁸ Subependymoma (WHO grade I) is a rare slow-growing tumor most commonly occurring in the fourth ventricle of middle-aged to elderly patients. Shunji Nishio et al observed that among tumors around the foramen of monro, there were eight (25%) cases of neurocytomas, three of them had sub ependymomas, four of them had SEGAs (20%), 2 (10%) cases were of fibrillary astrocytoma, and one each of pilocytic astrocytoma, malignant astrocytoma and malignant teratoma.⁶

In our study the most common surgical intervention chosen was endoscopic approach for the lesions. Nineteen patients were offered endoscopic surgery and 11 patients were managed by open surgery. In a study by Oertel et al, lesion causing occlusion of the foramen of monro was documented to be the commonest reason for septostomy.⁹ Neuroendoscopy has changed the treatment options for complex multiloculated hydrocephalus with using fenestration in one or several stages to combine multiple cavities into the least number cavities.¹⁰ In their study, septostomy was performed five to ten mm posterior to the interventricular foramen, in the middle of the corpus callosum (CC) and the fornix. In a study by Hamada et al perforation of the septum was done

between the anterior and posterior septal veins.¹¹ The transcallosal microsurgery and endoscopic approach were compared for the first time by Lewis et al. in 1994.¹² The findings of their comparison were shorter stay in the hospital and early recovery in the endoscopic approach group. At our center for cases in whom we anticipated a septostomy a linear incision was generally taken 5-6 cm lateral to the midline which is more lateral than the incision taken for endoscopic third ventriculostomy. The use of navigation also helps in deciding the site of the incision. A semicircular incision may be opted if we are planning to insert an Ommaya reservoir. The site of septostomy on the septum pellucidum is generally posterosuperior to the foramen of monro, posterior to the anterior septal vein, at the point where the septum appears to be thinned out. The probing of the septum also gives the surgeon an idea of the thickness of septum pellucidum.

The procedure of dilatation of foramen of monro carries the risk of injury to the septal vein or thalamostriate vein and there can also be injury to the fornix leading to memory problems. However, in none of our cases there was injury to any of the above structures. Intraventricular haemorrhage has been documented in multiple cases and the possible reason is injury to the contralateral septal vein during the septostomy being performed. However, in our study there was no evidence of any gross haemorrhage in the opposite side ventricle. Delayed failure of the septostomy can occur due to severe inflammation and thickening of the septum pellucidum requiring a second septostomy.³

There are a few limitations of this study. First, the results of the present study might not be applicable to other geographical areas as the clinical outcomes of the patients would depend in part on the surgical expertise of the operating team. Second, we did not assess the long term functional and clinical outcome of the patients.

CONCLUSION

Lesions causing foramen of monro obstruction resulting in hydrocephalus are a fairly uncommon entity with craniopharyngioma and colloid cysts being the most common pathology in children and adults respectively. Endoscopic approach is particularly helpful in decreasing the convalescence period and postoperative complications and thus, should be offered as a first line of treatment whenever suited.

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