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Assessing the Impact of Ommaya Reservoirs in Combination with External Ventricular Drainage Therapy on Intraventricular Haemorrhage:A Retrospective Analysis

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ABSTRACT

Introduction

Intraventricular hemorrhage (IVH) is a serious complication of various neurological conditions that can lead to increased intracranial pressure, hydrocephalus, and poor neurological outcomes. External ventricular drainage (EVD) systems are commonly used for managing IVH by draining cerebrospinal fluid (CSF) and blood from the ventricles of the brain. However, the optimal EVD system for managing IVH is still debated. This study aims to evaluate the influence of combining Ommaya reservoirs with external ventricular drainage (EVD) therapy in patients diagnosed with intraventricular hemorrhage (IVH).

Methods

A total of 20 patients with IVH were included in this retrospective study, with 10 patients receiving dual catheters (EVD with Ommaya) and 10 patients receiving single catheter EVD. The patient characteristics, IVH volume, mean arterial pressure (MAP), amount of CSF drainage, modified Graeb score (mGS), Glasgow Outcome Scale (GOS) score, duration of drainage, ICU length of stay, and mortality rate were compared between the two groups. Data Analysis was performed to compare outcomes, clinical markers, and imaging findings between the Ommaya-utilized and Ommaya-unused groups. Anticipated findings will shed light on the significance of Ommaya reservoir utilization in conjunction with EVD therapy for IVH patients. Additionally, the study aims to identify specific clinical markers that can aid in the decision-making process regarding Ommaya reservoir implantation.

Results

Both groups had similar demographic and clinical features in this trial comparing dual catheters (EVD with Ommaya) against single catheter drainage for intraventricular hemorrhage. The IVH volume was larger in the dual catheter group (EVD with Ommaya), while the MAP was lower. The dual catheter group had a considerably lower mean mGS score at the follow-up scan than the single catheter group. The dual catheter group required no repositioning and had a shorter period of drainage. The dual catheter group had a decreased mortality rate and a higher GOS score after 30 days. The reduction in mGS score was considerable in the dual catheter group, particularly in individuals with mGS scores ranging from 15 to 25. Considering the fact that the sample size was small and no statistical analysis was provided.

Conclusion

Dual catheter EVD systems may be more effective than single catheter systems for managing IVH, as they were associated with a greater reduction in mGS score, higher GOS score, shorter duration of drainage, and lower mortality rate. and less repositioning/recatherization However, greater sample size studies and statistical analysis are required to corroborate these findings.

Keywords: : Ommaya reservoir, External ventricular drainage, Intraventricular haemorrhage, Glasgow Outcome Scale

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INTRODUCTION

Spontaneous intracerebral hemorrhage (ICH) is a serious condition that has a high fatality rate and leaves survivors permanently disabled. Over 50% of ICH patients experience intraventricular hemorrhage (IVH), a potentially fatal consequence of the disease caused by bleeding into the ventricular system, and the volume of IVH is a key indicator of a bad prognosis.[1] IVH can lead to increased intracranial pressure, hydrocephalus, and poor neurological outcomes. Therefore, prompt and effective management of IVH is crucial for improving patient outcomes. External ventricular drainage (EVD) systems are commonly used for managing IVH by draining cerebrospinal fluid (CSF) and blood from the ventricles of the brain.[2] EVDs can help to reduce intracranial pressure, which is a key factor in IVH management. However, the optimal EVD system for managing IVH is still debated. Some studies suggest that dual catheter EVD systems may be more effective than single catheter systems, but more research is needed to confirm this hypothesis.[1,2] We aim to study the role of Ommaya reservoir when used along with EVD in management of intraventricular haemorrhage.

Methods:

This study is a retrospective analysis comparing the outcomes of two groups: one comprising 10 patients who received dual catheters (EVD and Ommaya Reservoir) and the other comprising 10 patients who received single catheter EVDs for managing intraventricular haemorrhage (IVH). The study included patients from a tertiary care center in India, with data collected between January 2023 and May 2023.

Inclusion Criteria: Age ≥18 years, Diagnosis of IVH with or without subarachnoid hemorrhage or intracerebral hemorrhage with a modified Graeb Score (mGS) >10, No contraindications for EVD placement, Availability of clinical and radiological data.

Exclusion Criteria: Coagulopathy, Uncontrolled hypertension, Active infection, Prior EVD placement, Pregnancy, Secondary causes of ventricular hemorrhage (e.g., aneurysm rupture, arteriovenous malformation rupture, neoplasm, or traumatic haemorrhages).

Procedures:

Group Receiving Ommaya Reservoir with EVD:

Patients in this group underwent a procedure that involved the placement of an Ommaya reservoir (Surgiware, CEREBRAL CATHETER RESERVOIR LARGE SH012, OD 2.5 mm ID 1.3 mm) under sterile conditions. The Ommaya reservoir was typically positioned in the frontal region of the patient's skull by a neurosurgeon. Following the placement of the Ommaya reservoir, a drainage bag was meticulously connected to it through a vertical puncture, facilitated by the use of an 8-gauge butterfly scalp vein set (Hongyu, China). This connection served the purpose of collecting cerebrospinal fluid (CSF) for monitoring and management. To ensure efficient fluid drainage and measurement, the drainage bag attached to the Ommaya reservoir was positioned at the same level as the external ventricular drainage (EVD) bag. This setup allowed for the continuous collection of CSF and monitoring of its volume. Trained nursing staff took on the responsibility of closely observing and recording the quantity of CSF drained into the bag connected to the Ommaya reservoir. This frequent monitoring was typically conducted on an hourly basis and played a crucial role in the comprehensive management of intraventricular hemorrhage (IVH) in these patients.

Group Receiving Single Catheter EVD:

Patients in this group underwent a procedure involving the placement of a single catheter EVD (Surgiwear Ventricular External CSF Drainage System SH024, OD 2.5 mm ID 1.3 mm) under sterile conditions. The placement procedure was carried out by a neurosurgeon, following a Freehand technique. In this group, a single catheter was inserted into the frontal horns of the lateral ventricle for the purpose of draining cerebrospinal fluid (CSF) from the brain. The EVD system was connected to a drainage bag, which was positioned at the patient's head level. Similar to the group receiving the Ommaya reservoir, trained nursing staff in this group were responsible for monitoring and recording the volume of CSF drained into the bag connected to the single catheter EVD. This monitoring process was conducted regularly, typically on an hourly basis. The procedures performed in both groups aimed to achieve efficient

CSF drainage while allowing for continuous monitoring of intracranial pressure and CSF characteristics, which played a significant role in the management of intraventricular hemorrhage (IVH) in these patients.

Data Collection:

The volume of IVH was calculated using the IVHS score system for each scan and recorded. Mean arterial pressure (MAP) was recorded hourly using an arterial line. The Glasgow Coma Scale (GCS) and mGraeb score were assessed at admission, stability scan (scan at the time of admission), and follow-up scans (day 3 and day 6). The duration of drainage, based on the clearance of blood clots in the third and fourth ventricles, was recorded. Additional data included ICU length of stay, mortality rate, and Glasgow Outcome Scale (GOS) scores were recorded.

Ethics approval:

The study was conducted in accord with the ethical standards of the Helsinki Declaration of 1975. This work was approved by the institutional Ethics Committee -Andhra medical college. All methods were carried out in accordance with relevant guidelines and regulations.

Results:

Case Series Description: We conducted a retrospective analysis involving two groups of patients diagnosed with intraventricular hemorrhage (IVH): one group receiving Ommaya reservoirs in conjunction with external ventricular drainage (EVD) therapy (n=10) and another group receiving EVD therapy without Ommaya reservoirs (n=10). The purpose of this case series is to compare the clinical outcomes and management strategies of these two patient cohorts. Demographic and Clinical Characteristics: Patients in both groups shared similarities in demographic and clinical characteristics, as detailed in Table 1.

Table 1 Demographic characteristics of single and dual catheter treated patients

Dual catheter Single catheter	*Dual catheter*	*Single catheter*
Mean age		
(±SD)	57 (±13)	61 (±14)
Gender (*n*)		
MALE	6	7
FEMALE		3
	4	
Etiologies (*n*)	9	9
Hypertension	1	3
Diabetes		
Alcohol Use	2	5
Tobacco	1	5
Ckd	2	3
Collegen		
Vascular Disease	1	

Notably, the Ommaya-receiving group displayed a slightly larger mean IVH volume compared to the non-Ommaya-receiving group (76.2 ml vs. 64.4 ml, respectively). Additionally, the Ommaya-receiving group exhibited a lower mean arterial pressure (MAP) in comparison to the non-Ommaya-receiving group (127 mmHg vs. 135 mmHg, respectively). Both groups demonstrated comparable average Glasgow Coma Scale (GCS) scores, with scores of 6.4 and 6.1 for the Ommaya-receiving and non-Ommaya-receiving groups, respectively. Modified Graeb Score (mGS): The mean mGS score at the stability scan showed no significant difference between the two groups (20.5 vs. 20.4 in the Ommaya-receiving and non-Ommaya-receiving groups, respectively). However, at the follow-up scan, an intriguing disparity emerged. The Ommaya-receiving group displayed a lower mean mGS score compared to the non-Ommaya-receiving group (12.3 vs. 14.5, respectively).

Duration of Drainage and ICU Stay: The Ommaya-receiving group experienced a notably shorter duration of drainage compared to the non-Ommaya-receiving group. Specifically, the former group required drainage for 5-7 days, while the latter group necessitated drainage for 10-12 days. Remarkably, the length of stay in the intensive care unit (ICU) remained consistent for both groups, with 15 days for the Ommaya-receiving group and 14 days for the non-Ommaya-receiving group. Interventions and Mortality: An intriguing finding was that the Ommaya-receiving group did not require any repositioning or second external ventricular drainage (EVD) placements due to blockages or hydrocephalus. In contrast, the non-Ommaya-receiving group necessitated three such interventions. Furthermore, the mortality rate was notably lower in the Ommaya-receiving group (30%) compared to the non-Ommaya-receiving group (40%). Glasgow Outcome Scale (GOS): Importantly, the Ommaya-receiving group achieved a higher mean Glasgow Outcome Scale (GOS) score after 30 days compared to the non-Ommaya-receiving group. The scores were 3.1 and 2.7 for the Ommaya-receiving and non-Ommaya-receiving groups, respectively. It's essential to note that specific p-values for comparing these variables between the two groups were not provided in the study due to the limited sample size.

Table 2 (Clinical parameters taken for the study)

Clinical Characteristics	Dual Catheter (n=10)	Single Catheter (n=10)	P-value
IVH volume	76.2 ml	64.4 ml	
MAP	127 (110-194)	135 (119-185)	
GCS	6.4 (3-14)	6.1 (3-13)	
mGraeb score at stability scan	20.5 (19-28)	20.4 (16-25)	
mGraeb score at follow-up scan	12.3 (3-25)	14.5 (3-25)	
Duration of drainage	5-7 days	10- 12 days	
ICU length of stay	15days	14days	
Reposition/Second EVD due to block or Hydrocephalus	NILL	3	
Mortality	3	4	
GOS for 30days	3.1(1-4)	2.7(1-4)	

Note: P-value column is left empty as that the sample size in this study was relatively small, with only 20 patients in total (10 in each group), which could limit the statistical power and generalizability of the findings.

DISCUSSION

The mechanism by which dual catheter EVD systems lead to better outcomes in IVH management is not fully understood.[4,5] It has been suggested that dual catheter systems provide better drainage of CSF and blood from the ventricles, leading to a more rapid reduction in IVH volume and improvement in neurological status.[5] The lower MAP in the dual catheter group in this trial may have also contributed to the better results, since high blood pressure has been linked to an increased risk of bleeding and poor outcomes in IVH.[6] This study's findings further emphasize the significance of thorough monitoring and control of CSF outflow in IVH patients.[4] The duration of CSF draining was shorter in the dual catheter group in this trial, which may have contributed to the superior results.[4] However, the appropriate length of CSF draining in IVH therapy is still debatable, and further research is needed to discover the best duration and amount of CSF drainage in these patients. The use of the mGraeb score as a measure of IVH severity and response to treatment is supported by previous studies.[7] The significant reduction in mGraeb score in both groups in this study suggests that EVD placement and CSF drainage can effectively reduce IVH volume and improve neurological status in these patients. However, the lack of a significant difference in Graeb score reduction between the two groups may be due to the small sample size and the retrospective design of the study. The scatter plots for the dual catheter and single catheter drainage groups with mGraeb scores divided into three categories suggest that dual catheter drainage may provide a benefit to patients with mGraeb scores in the range of 15-25. (FIGURE 2A and 2B).

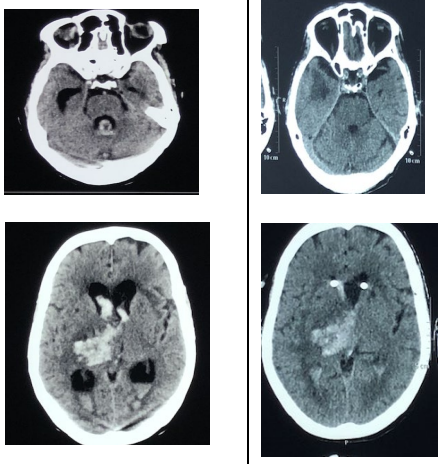
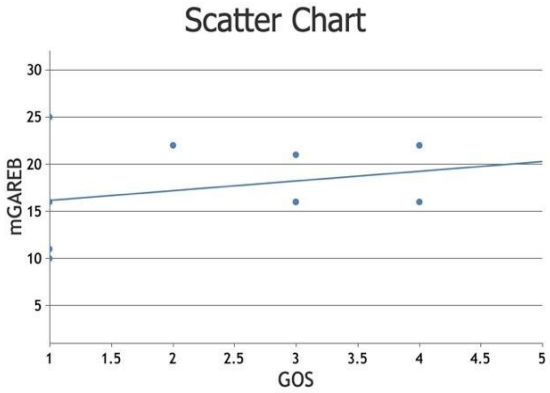
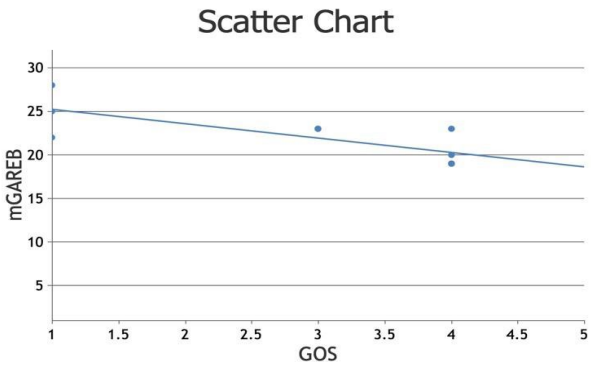
Modified Gareb score	Ommaya with EVD group		EVD alone Group	
	POD 1	POD 6	POD 1	POD 6
15-25				

Figure 1: CT brain of PREOP and POSTOP patients where 4th ventricle clearance is better in group receiving Both EVD and Ommaya Reservoir.

FIGURE 2A AND 2B: Scatter plot Explaining GOS against mGAREB score suggesting patients with mGAREB score between 15-25 has better GOS in patients with OMMAYA and EVD group



EVD GROUP



EVD WITH OMMAYA GROUP

These patients had higher GOS scores compared to patients with mGraeb scores in the ranges of 1-15 or 25-30. However, this study is limited by its small sample size, and further analysis may be required to draw any definitive conclusions. Previous studies have suggested that dual catheter drainage may be more effective than single catheter drainage in improving outcomes for patients with intracerebral hemorrhage (ICH).[8,9] One study found that dual catheter drainage was associated with a lower mortality rate and better functional outcomes compared to single catheter drainage.[8] Another study reported that dual catheter drainage was associated with a greater reduction in hematoma volume and mass effect, leading to better outcomes.[9] However, these studies did not specifically investigate the effect of dual catheter drainage(EVD WITH OMMAYA) on patients with mGraeb scores in the 15-25 range. Therefore, further studies are needed to confirm the potential benefits of dual catheter drainage for this specific patient population. he mortality rate in this study was high, which is consistent with previous studies reporting high mortality rates in patients with IVH.[10,11] Factors that have been associated with poor outcomes in IVH include older age, higher initial IVH volume, hydrocephalus, and comorbidities such as hypertension and diabetes.[10,11] Early identification and management of these factors may help improve outcomes in patients with IVH. The combined treatment of EVD with an Ommaya reservoir in IVH management offers advantages such as simplified CSF sampling, drainage and avoidance of EVD exchanges. In summary, our retrospective analysis demonstrates that dual catheter EVD systems may be more successful in treating IVH and improving neurological outcomes than single catheter systems. However, bigger sample numbers and prospective designs are required in future research to validate these findings and investigate the best EVD approach for IVH treatment. The study's findings emphasize the significance of careful monitoring and management of CSF draining in patients with IVH, as well as the need for more research to discover the best duration and amount of CSF drainage in these individuals. The study's limitations include its limited sample size and retrospective nature. Because the study was done at a single centre, it may not be generalizable to other environments. Furthermore, the decision to utilize a single or dual catheter was not randomized, but rather dependent on the neurosurgeon's preference. Conclusion: Our case series highlights the potential benefits of Ommaya reservoirs in combination with external ventricular drainage (EVD) therapy for managing intraventricular hemorrhage (IVH) by higher decrease in IVH volume and superior neurological outcome. Further research with larger sample sizes is warranted to confirm these findings and elucidate optimal management strategies for IVH patients.

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