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Assessment of the Neurological Outcome after External Ventricular Drainage: A Comparative Study in a Tertiary Care Hospital, Chittagong, Bangladesh

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Abstract

Background: IVH is classified as either primary, involving the ventricular system and adjacent ependymal lining, or secondary to intracerebral hemorrhage or subarachnoid hemorrhage with extension into the ventricular system. When IVH is large enough to impede normal cerebrospinal fluid (CSF) circulation, acute obstructive or non-communicating hydrocephalus can occur. Many neurosurgical procedures have been enhanced by the application of computer-assisted navigation, using a combination of imaging and patient anatomy. The history of EVD is a great example of technical innovation and evolution in the field of neurosurgery. Aim of the study: To assess the neurological improvement of the patient after external ventricular drainage by assessing the Glasgow coma scale (GCS) score, Glasgow outcome scale (GOS) score, and modified Rankin (mRS) score pre and postoperatively. **Methods:** This is a Quasi-experimental study conducted in the Department of Neurosurgery, Chittagong Medical College Hospital, Chittagong, Bangladesh during the period from 24th July 2018 to 23rd July 2019. After a detailed history and clinical examination, 150 Patients were selected for this study. The study participants were divided into two major groups- EVD and Conservative; both groups consisted of 44 patients. Based on inclusion and exclusion criteria, 43 patients were excluded, among them 18 patients had GCS 3 with non-reacting pupil, 8 patients needed surgical evacuation of haematoma and 7 patients legal guardian did not want to continue with the study procedure, 10 patients were dropped out due to not attend to follow up schedule.**Results:** This prospective quasi-experimental study was conducted to compare the outcome of patients with a spontaneous IVH managed with or without EVD. This study also observes demographic and hemorrhagic characteristics among participants. Table I depicts that, both the groups were similar in terms of age and sex distribution. Overall mean age was around 60 years with an age range from 15-85 years. More than three fourth of the patients in both groups were from the age group of >50 years (73.83%). The male to female ratio was almost equal in both groups (p = 0.374). The mean GCS score level was significantly lower in the patients with EVD than their counterparts from 1st post-operative day to 8th post-operative day. However, within-group comparison shows that the GCS score was significantly increased from 1st day to 8th day in both groups of patients. To compare the outcome of EVD and conservative treatment following spontaneous IVH GOS score were assessed at discharge and after 3 months. Among the patients who underwent EVD at discharge, most of the patients (93.3%) were either severely disable or moderately disable. On the contrary, after 3 months majority of the patients (81.5%) were either moderately disable or had a mild disability. After 3 months there was no significant difference in the GOS score category between the patients who underwent EVD or were treated conservatively after spontaneous IVH. During discharge, there was no significant difference in the mRS score category between the patients who underwent EVD or were treated conservatively after spontaneous IVH. **Conclusion:** EVD is an effective interventional modality in the armamentarium of the neurosurgeon to rapidly reduce life-threatening mass effects. This data can be used to develop evidence-based protocols for EVD use.

Keywords: IVH, Ventricular System, Neurological Improvement, Glasgow Coma Scale, Glasgow Outcome Scale, Modified Rankin.

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INTRODUCTION

IVH is classified as either primary, involving the ventricular system and adjacent ependymal lining, or secondary to intracerebral hemorrhage or subarachnoid hemorrhage with extension into the ventricular system. When IVH is large enough to impede normal cerebrospinal fluid (CSF) circulation, acute obstructive or non-communicating hydrocephalus can occur. There are four mechanisms that explain the pathophysiology of IVH: (1) acute obstructive hydrocephalus; (2) the mass effect exerted by the blood clot; (3) the toxicity of blood breaking products on the adjacent brain parenchyma and (4) the development of chronic hydrocephalus. Based on this, it is evident that clearance of blood from the ventricles should be a therapeutic goal.[1]Many neurosurgical procedures have been enhanced by the application of computer-assisted navigation, using a combination of imaging and patient anatomy. The history of EVD is a great example of technical innovation and evolution in the field of neurosurgery. Srinivasan et al. (2014) study investigated the history of EVD and they mentioned four eras of EVD among which we are in the era of accuracy, training, and infection control stage. This technology has been applied to the placement of EVD, especially for those with variant anatomy or ventricular shift. The use of prophylactic antibiotics has been debated and well-reviewed. The infection rate in the prophylaxis group was 9%, compared with 27% without. The primary objective of IVH treatment is to reduce increased intracranial pressure (ICP), limit the hemorrhagic mass effect and associated edema thereby halt the development of obstructive hydrocephalus by the prompt removal of irritant blood and blood products from the ventricular system. Complete surgical evacuation of ventricular blood may not always possible if all ventricular system is involved resulting increase risk of edema, bleeding, and infection in an already devastating condition. Associated ICH can occur in various cerebral locations resulting in neurological deficits and disability, but no clear correlation exists between hemispheric ICH location and mortality.[2] Hydrocephalus resulting from ICH is generally treated with external ventricular drainage (EVD) and it is one of the treatment options despite fatal compliance.[3,4] The clinical response to EVD and its effects on hydrocephalus are not known in detail. The efficacy of ventricular drainage can be evaluated by knowing the patients who will benefit from the treatment by clinical improvement and reversal of the hydrocephalus. Management of Intraventricular hemorrhage started with conventional therapy which includes emergency care and resuscitation of the patient. The patient should be treated in neurointensive care if possible, with endotracheal intubation, mechanical ventilation where necessary. Sedatives, neuromuscular blocking agents that do not elevate ICP should be selected. For those who do not require ICU, care should be assured for control of ICP including resuscitation with

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intravenous fluids, placement of the head of the bed at 30°, correction of fever with antipyretics, control of blood pressure, hyperglycemia, and deep venous thrombosis prophylaxis, seizure prophylaxis.[5]

MATERIALS AND METHODS

This is a Quasi-experimental study conducted in the Department of Neurosurgery, Chittagong Medical College Hospital, Chittagong, Bangladesh during the period from 24th July 2018 to 23rd July 2019. After a detailed history and clinical examination, 150 Patients were selected for this study. The study participants were divided into two major groups- EVD and Conservative; both groups consisted of 44 patients. Based on inclusion and exclusion criteria, 43 patients were excluded, among them 18 patients had GCS 3 with non-reacting pupil, 8 patients needed surgical evacuation of haematoma and 7 patients legal guardian did not want to continue with the study procedure, 10 patients were dropped out due to not attend to follow up schedule. So, 107 patients with spontaneous intraventricular hemorrhage were enrolled in this study. Among them, 47 patients' relatives agreed to surgery who were accepted as part of the EVD group and had EVD. The remaining 60 patient's relatives declined authorization for surgery and were accepted as a conservative group and underwent conservative management. Modified graeb score was calculated from the CT scan and documented. On admission, the GCS score was recorded. In the EVD group, all patients were treated with external ventricular drainage after resuscitation and proper counseling to the legal guardian. In the Conservative group, patients were managed conservatively with standard medical management of intraventricular hemorrhage. Study subjects were selected by the Consecutive sampling technique.

Inclusion Criteria

- Patients with intraventricular haemorrhage, either primary or secondary.
- Presence of obstructive hydrocephalus.

Exclusion Criteria

- Traumatic intraventricular haemorrhage.
- Intraventricular haemorrhage with ICH that requires surgical evacuation of the haematoma.
- Patients with GCS score 3 with the non-reacting pupil.
- The patient's legal guardian does not intend to include in the study.

RESULTS

This prospective quasi-experimental study was conducted to compare the outcome of patients with a spontaneous IVH managed with or without EVD. This study also observes demographic and hemorrhagic characteristics among participants. [Table 1] depicts that, both the groups were similar in terms of age and sex distribution. Overall mean age was around 60 years with an age range from 15-85 years. More than three fourth of the patients in both groups were from the age group of >50 years

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(73.83%). The male to female ratio was almost equal in both groups (p = 0.374). There were no differences between EVD and conservative groups regarding medical comorbidities. Most prevalent comorbidity among the patients of both groups' hypertension, followed by diabetes and previous ischemic stroke. The distribution of other predisposing factors and risk factors were also similar in both groups [Table 2]. Overall the most frequent symptoms in the studied patients were vomiting, followed by loss of consciousness, headache and convulsion. There were no significant differences between the two groups regarding presenting symptoms [Table 3]. On the contrary, preoperative GCS score was significantly lower (p<0.001) and=- 0mGS was significantly higher (P=0.001) among the patients who had EVD compare to the patients treated conservatively. The overall correlation between baseline GCS and mGS score is presented in [Figure 1] and it depicts that, as the mGS score increases the GCS score decreases. Moreover, there was an increased likelihood of EVD requirement with decreasing GCS score and increasing mGS score. [Table 4] shows that the mean GCS score level was significantly lower in the patients with EVD than their counterparts from 1st post-operative day to 8th post-operative day. However, within-group comparison shows that the GCS score was significantly increased from 1st day to 8th day in both groups of patients. To compare the outcome of EVD and conservative treatment following spontaneous IVH GOS score were assessed at discharge and after 3 months. [Table 5] shows that among the patients who underwent EVD at discharge most of the patients (93.3%) were either severely disable or moderately disable. On the contrary, after 3 months majority of the patients (81.5%) were either moderately disable or had a mild disability. These changes were statistically significant. [Table 6] shows that among the patients treated conservatively at discharge most of the patients (90.5%) were either severely disable or moderately disable. On the contrary, after 3 months majority of the patients (87.5%) were either moderately disable or had a mild disability. These changes were statistically significant. Besides the GOS score, the Modified Rankin Scale score (mRS) was also used to evaluate the functional outcome after 3 months among the study patients. [Table 7] indicates that severe disability was significantly reduced (from 50.0% to 3.7%) after 3 months among the patients who underwent EVD. [Table 8] indicates that severe disability was significantly reduced (from 30% to 0%) after 3 months among the patients who were treated conservatively. Most of the patients with severe disabilities were improved to a status of moderate or slight disability. [Figure 2] shows that during discharge there was no significant difference in the GOS score category between the patients who underwent EVD or were treated conservatively after spontaneous IVH. [Figure 3] shows that after 3 months there was no significant difference in the GOS score category between the patients who underwent EVD or were treated conservatively after spontaneous IVH. Figure IV shows that

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during discharge there was no significant difference in the mRSscore category between the patients who underwent EVD or were treated conservatively after spontaneous IVH.

Table 1: Demographic data of the study participant (n = 107) with spontaneous IVH

Variables	EVD (n=47)	Conservative (n=60)	P-value
Age (years)			
Mean ±SD	59±14	60±14	0.645† ns
Range	15-85	16-85	
Sex			
Male	21 (44.7%)	32 (53.3%)	0.374*ns
Female	26 (55.3%)	28 (46.7%)	

Table 2: Co-morbidities of the study participant (n = 107) with spontaneous IVH with EVD or conservative management

Variables	EVD (n=47)	Conservative (n=60)	P-value*
No comorbidity	6 (12.8%)	3 (5.0%)	0.177ns
(Previous History of)			
Hypertension	41 (87.2%)	57 (95.0%)	0.151 ns
Ischemic heart disease	9 (19.1%)	8 (13.4%)	0.437 ns
Diabetes mellitus	11 (23.4%)	15 (25.0%)	1.0 ns
Chronic kidney disease	1 (2.1%)	1 (1.7%)	1.0 ns
Ischemic stroke	7 (14.9%)	10 (16.7%)	0.892 ns
Hemorrhagic stroke	1 (2.1%)	0 (0%)	0.439 ns
Intra cranial space occupying lesion	1 (2.1%)	0 (0%)	0.439 ns
Used Anti-coagulant	8 (17.0%)	13 (21.7%)	0.548 ns
Used Anti-platelet	13 (27.7%)	14 (23.3%)	0.609 ns
No habit of tobacco	5 (10.6%)	15 (25.0%)	0.080 ns
Smoker	16 (34.0%)	16 (26.7%)	0.524 ns
Use betel nut	28 (56.6%)	28 (46.7%)	0.242 ns
Drink alcohol	0 (0%)	1 (1.7%)	0.458 ns

Table 3: Baseline clinical characteristics of the study participant (n = 107) with spontaneous IVH with EVD or conservative management

Variables	EVD (n=47)	Conservative (n=60)	P-value
Vomiting	45 (95.7%)	52 (86.7%)	0.109* ns
Loss of consciousness	41 (87.2%)	45 (75.0%)	0.114* ns
Headache	16 (34.0%)	16 (26.7%)	0.408*ns
Convulsion	17 (36.2%)	13 (21.7%)	0.097*ns
Systolic blood pressure(mmHg)	171±26	174±28	0.642†ns
Diastolic blood pressure(mmHg)	101±13	102±17	0.811†ns
Pulse, min	72±17	79±12	0.015†s
Respiratory rate, min	24±4	25±4	0.322†ns
Glasgow coma scale	5±2	7±2	
13-15 (Grade 1)	0 (0.0%)	2 (3.3%)	<0.001†s
9-12 (Grade 2)	4 (8.5%)	14 (23.3%)	
≤8 (Grade 3)	43 (91.5%)	44 (73.4%)	
Modified Graeb score	16±6	12±6	0.001†s

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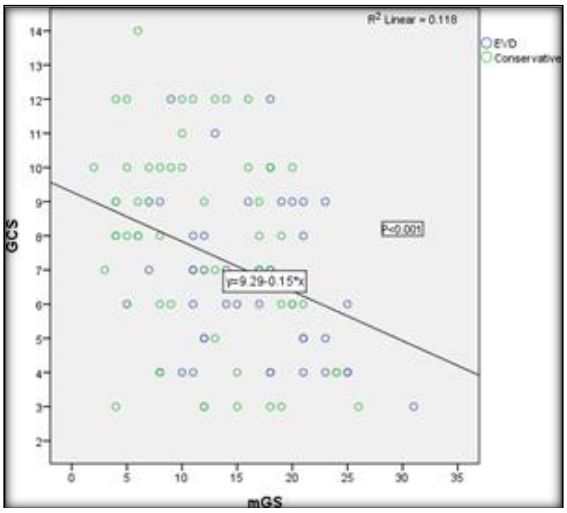

Figure 1: A plot comparing baseline modified Graeb score (mGS) and Glasgow coma scale (GCS) score.

Table 4: Changes in GCS score levels at 1st Post-EVD day /1st conservative day, 3rd Post EVD day/3rd conservative day, and 8th Post EVD day/ 8th conservative day of the study participant (n=107) with spontaneous IVH with EVD or conservative management

Mean (±SD) value of GCS			
Glasgow coma scale	**EVD**	**Conservative**	**P-value a**
At 1st post EVD day/1st conservative day	6.63±2.25	7.8±2.94	0.032 s
At 3rd post EVD day/3rd conservative day	8.57±2.97	10.15±2.66	0.012 s
At 8th post EVD day/ 8th conservative day	11.77±2.98	12.76±2.14	0.013 s
P value b	<0.001	0.001 s	

Table 5: Change in GOS score from discharge to after 3 months of the patients with spontaneous IVH with EVD

Glasgow outcome scale score	At discharge (n=30)	At 3 months (n=27)	P-value*
(Death)	1 (3.3%)	1 (3.7%)	1.0ns
(Persistent vegetative state) 3 (Severe disability)	0 (0%)	0 (0%)	--
(Moderate disability)	15 (50.0%)	4 (14.8%)	0.006s
(Mild or no disability)	13 (43.3%)	16 (59.3%)	0.292ns
	1 (3.3%)	9 (22.2%)	0.004s

Table 6: Change in GOS score from discharge to after 3 months of the patients with spontaneous IVH with conservative management

Glasgow outcome scale score	At discharge (n=42)	At 3 months (n=40)	P value*
(Death)	3 (7.1%)	6 (15.0%)	0.307ns
(Persistent vegetative state) 3 (Severe disability)	0 (0%)	0 (0%)	--
(Moderate disability)	20 (47.6%)	3 (7.5%)	<0.001s
(Mild or no disability)	18 (42.9%)	18 (45.0%)	1.0ns
	1 (2.4%)	13 (32.5%)	<0.001s

Table 7: Change in mRS score from discharge to after month 3 of the patients with spontaneous IVH with EVD

Modified Rankin scale score	At discharge (n=30)	At 3 months (n=27)	P-value*
(No symptoms)	0 (0%)	2 (7.4%)	0.219ns
(No significant disability) 2	1 (3.3%)	2 (7.4%)	0.598 ns
(Slight disability)	1 (3.3%)	2 (7.4%)	0.598 ns
(Moderate	2 (6.7%)	7	0.070

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disability) (Moderately severe disability) 5 (Severe disability) 6 (Dead)		(25.9%)	ns
	10 (33.3%)	12 (44.4%)	0.426 ns
	15 (50.0%)	1 (3.7%)	<0.001 s
	1 (3.3%)	1 (3.7%)	1.0 ns

Table 8: Change in mRS score from discharge to after month 3 of the patients with spontaneous IVH with conservative management

Modified Rankin scale score	At discharge (n=42)	At 3 month (n=40)	P-value*
(No symptoms) (No significant disability) 2 (Slight disability) (Moderate disability) (Moderately severe disability) 5 (Severe disability) 6 (Dead)	0 (0%)	3 (7.5%)	0.011s
	1 (2.4%)	7 (17.5%)	0.027 s
	0 (0%)	3 (7.5%)	0.011 s
	8 (19.0%)	7 (17.5%)	0.785 ns
	14 (33.3%)	14 (35.0%)	0.872 ns
	16 (38.3%)	0 (0%)	<0.001s
	3 (7.1%)	6 (15.0%)	0.307 ns

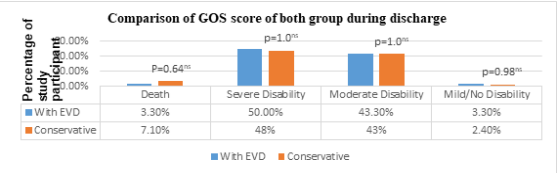

Figure 2: Comparison of GOS score during discharge in study participant with IVH with EVD (n=30) or without EVD (n=42).

ns = not significant

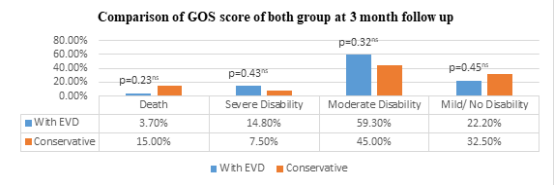

Figure 3: Comparison of GOS score after 3 months in study participant with IVH with EVD (n=27) or without EVD (n=40).

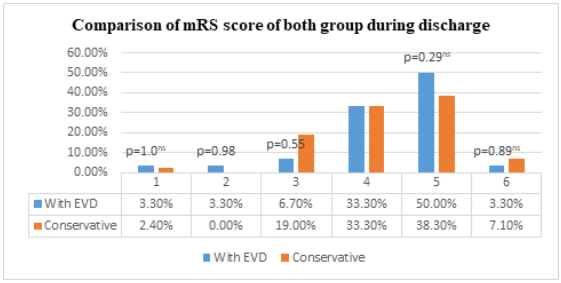

Figure 4: Comparison of mRS score during discharge in 72 patients with IVH with EVD (n=30) or without EVD (n=42).

ns = not significant

DISCUSSION

This quasi-experimental study was conducted to compare the outcome of patients with a spontaneous IVH managed with or without EVD. This study evaluated a large cohort of patients in our setting perspective (107) with spontaneous IVH treated at a government level tertiary care academic centers representing diverse patient populations and demographic characteristics. Approximately 43.92% of patients received an EVD, and the impact of this intervention on patient mortality and clinical outcome by GOS and mRS was determined from discharge till 3 months. We hypothesized that EVD improves the outcome in a patient of spontaneous IVH significantly more than the outcome achieved by conservative treatment. The study revealed that after adjustment for known predictors of IVH outcomes EVD had significantly

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reduced 90 days mortality compared to conservative treatment but had a similar effect in terms of favorable outcome (GOS>3) after 90 days. Our finding was in accordance with the findings of a recent RCT 6 where mortality following medical management for IVH was 100% compared to 75% in a surgically managed group (p=0.02). A standard treatment plan for spontaneous IVH has not yet been established. Although various treatment protocols including supportive medical treatments, steroids, antihypertensive agents, and EVD methods are in use, there is still controversy surrounding the effects of these methods.[1] Considering that EVD was conducted primarily in those who had poor consciousness levels with significant hydrocephalus, which might be associated with a poor prognosis, it is difficult to judge Among the survivors at 3 months majority of them (56.7%) had a moderate disability and 36.7% had a mild disability. Similarly, Lee et al., 7reported that, majority of survivors (80%) had no deficits or mild deficits (GOS ≥4). The reported rate of poor outcome following a large series of intracerebral hemorrhages ranges from 49% to 78% (Maslehaty et al.,[8]Mendelow et al.,[9] Therefore, the neurological prognosis of PIVH is likely superior to that of intracerebral hemorrhage. This relatively favorable neurological course for PIVH might be associated with comparatively little brain parenchymal damage. Nieuwkamp et al.,[10]in their meta-analysis reported that, in cases of SAH with IVH, the prognosis seems even more dismal, with risks of death and severe handicap of 84% and 93%, respectively, in patients treated without EVD and risks of 67% and 87 %, respectively, in patients treated with EVD. In the present study this trend is supported but probably due to the small representation of such cases might prevent us to get a significant association. The majority of our patient, 79 (73.83%) were from > 50 years age group and 28 (26.16%) patient from ≤ 50 years age group whereas study was done by Lee et al.,[7] found among 112 patient, 55 (49%) were from >50 years age group and 57 (51%) were from ≤ 50 years age group. The male to female ratio was almost equal in our study (49.53% male and 50.46% female) which is consistent with Nieuwkamp et al.,[10] studies wherein eight reported study, they found 51% were male. But Lee et al.,[7] found 57% male and 43% female. But these demographic characteristics are not statistically significant in our study (p= 0.374). The CT scan findings reveal the type of IVH. In 13 (12.14%) patients, IVH was confined only to the ventricular system with no bleeding into other compartments that is _primary IVH whereas 94 (87.85%) patients, it was associated with other hemorrhagic lesions that are, _secondary IVH. It is almost similar to the findings of El-Saadany et al.,[11] where they stated primary IVH 18.5% and secondary IVH 81.5%. In the present study majority of the patients had HTN. Both the groups were similar regarding the distribution of risk factors and comorbidity. A wide variety of underlying risk factors have been associated with IVH in adults. These include hypertension, AVM,

aneurysm, tumor, coagulopathy, trauma, carotid occlusion, arteritis, and choroid plexus cyst.[11-13] The mode of presentation of IVH is relatively common. Sudden onsets of headache, nausea, vomiting together with alteration of the mental state and or level of consciousness are the cardinal features of IVH.[11-13] Our cohort supports these findings. The majority of our patients (n = 91, 85%) had IVH secondary to spontaneous ICH and it is similar to the findings of Hughes et al.,[14] who reported that the majority of their patients (n = 90, 85.7%) had IVH secondary to spontaneous ICH, with deep hematomas predominating over lobar hematomas. The overall incidence of hydrocephalus was 51.4% in the present study without any significant difference between the two groups (57.4% versus 46.7%, p=0.268). El-Saadany et al.,[11] reported that hydrocephalus developed significantly in a linear correlation with the number of ventricles filled with blood and with the severity of the IVH. Among their 54 patients with IVH, good outcomes correlated significantly with young age, female patient, and absence of hydrocephalus. Our observation was in line with these findings as the presence of hydrocephalus was revealed as an independent factor for mortality, poor outcome, and functional dependency. Similar to our findings Hughes and Diringer et al.[14] examined the effect of hydrocephalus in the outcomes of patients with IVH and ICH and reported that hydrocephalus was an independent predictor of mortality on multivariate analysis. Granting the prognosis of IVH was poor, compared with conservative treatment, EVD treatment significantly improved the outcome of these patients. To our knowledge and based on our review of the literature, no previous reports have been published that compare the outcome of EVD with conservative treatment following IVH in our country. The strength of our study is that with our limited resources and time we were able to enroll a reasonable number of patients and to observe their outcome for a reasonable time frame. We hope that our findings will be helpful for the neurosurgeon of this country in their decision-making during the management of IVH cases.

Limitations of the Study

It was a single-center study. The number of patients enrolled in this study was relatively small, which may not reflect the scenario of the whole community. For all critical patients, we could not provide ICU support. Follow-up after discharge was short, a longer follow-up might bring a better result.

CONCLUSION

EVD is an effective interventional modality in the armamentarium of the neurosurgeon to rapidly reduce the life-threatening mass effect. This data can be used to develop evidence-based protocols for EVD use. However, a randomized study recruiting a large number of patients is required to Clarify our findings and to establish a protocol and a recommendation, which can assist in the formulation of universally accepted guidelines.

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