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Original Research Article

The relationship between modified Graeb score and intraventricular hematoma volume with Glasgow outcome scale and modified Rankin scale in intraventricular hemorrhage of brain: a comparative study

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ABSTRACT

Background: Intraventricular hemorrhage (IVH) is an acute neurosurgical condition. The aim of this study was to identify the relationship between modified Graeb score (mGS) and intraventricular hematoma volume with Glasgow outcome scale (GOS) and modified Rankin scale (mRS).
Methods: This is a Quasi-experimental study conducted in the department of neurosurgery, Chittagong Medical College Hospital, Chittagong, Bangladesh during the period from 24 July 2018 to 23 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- external ventricular drainage (EVD) and conservative; both groups consisted of 44 patients. Written informed consent were taken from the participants. Data were analyzed using statistical package for the social sciences (SPSS) software.
Results: 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%). 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. 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. The mean Glasgow coma scale (GCS) score level was significantly lower in the patients with EVD than their counterpart 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.
Conclusions: These findings can be used to identify patients in whom an EVD may provide measurable outcomes benefit with respect to patient mortality and help guide neurosurgical decision-making in particular patient subgroups with acute IVH.

Keywords: Intraventricular hemorrhage, Relationship, Modified Graeb score, Intraventricular hematoma volume, GOS

INTRODUCTION

Intraventricular hemorrhage (IVH) is an acute neurosurgical condition. The incidence of IVH is increasing nationwide, correlating with an aging and vasculopathy population coupled with the widespread use of anticoagulant and antiplatelet medications among which primary IVH occurs in 30% and secondary IVH occurs in 70% patients.[1,2] IVH, hydrocephalus, and herniation syndromes are of particular importance in intracerebral haemorrhage (ICH) as they may be lethal to patients with a mortality rate ranging from 45% to 80%. 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. IVH is a devastating situation predicting worsened morbidity and mortality. At present, external ventricular drainage is one of the commonly used surgical techniques in the management of IVH with hydrocephalus. Previous studies show good outcomes for EVD in decreasing mortality in the case of an acute phase of hydrocephalus.[5] In other studies, conservative treatment for IVH with the aim of control and reduction of ICP with certain medications shows no correlation between ICP and outcome. In some studies, the use of fibrinolytic medications such as urokinase or r-tPA along with EVD was shown to speed the resolution of IVH compared with EVD alone. But these fibrinolytic medications are not easily available in Bangladesh. Craniotomy and surgical evacuation of IVH, minimally invasive drainage of IVH has limited experience in literature and not commonly used measure in our country. In our institution, EVD is practiced for the management of IVH. There are huge numbers of patients with IVHand in various literature, there is a debate between conservative management and operative procedure.[6] So, it is rational to evaluate the functional outcome after EVD placement in patients with spontaneous IVH by a prospective controlled trial. If an evidence-based indication of external ventricular drainage can be established, it will be easier for the neurosurgeons to deal with the patients of ventricular haemorrhage in respect of deciding to go for EVD when a good outcome is likely, counseling of the patient ‘s family members and above all to reduce morbidity and mortality. There is an association between intraventricular blood volume and poor outcomes. Patients with a ventricular blood volume of more than 20 ml, in general, had a poor outcome.[7] But it is not always possible to measure intraventricular blood volume radiologically. A computed tomography scan with software is required to calculate intraventricular blood volume which is not always available. A simple and rapid measure of IVH volume is lacking. But Timothy et al developed the modified Graeb score (mGS).[3] In their study, they found mGS and IVH volume were highly correlated. Baseline mGS was predictive of poor outcomes.

METHODS

This is a Quasi-experimental study conducted in the department of neurosurgery, Chittagong Medical College Hospital, Chittagong, Bangladesh during the period from 24 July 2018 to 23 July 2019. After 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 Glasgow coma scale (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 IVH 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. mGS was calculated from the computed tomographic (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. Data were analyzed using statistical package for the social sciences (SPSS) software.

Inclusion criteria

Patients with intraventricular haemorrhage, either primary or secondary and presence of obstructive hydrocephalus were included.

Exclusion criteria

Traumatic IVH or IVH with ICH that requires surgical evacuation of the haematoma including patients with GCS score 3 with a non-reacting pupil and patient’s legal guardian does not intend to include were excluded from 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. Study depicted that, both groups were similar in terms of age and sex distribution. According to Table 1, the overall mean age was around 60 years in both groups 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) (Table 1). To

compare the outcome of EVD and conservative treatment following spontaneous IVH, GOS score were assessed at discharge and after 3 months. Study showed that among the patients who underwent EVD at discharge most of the patients (93.3%) were either severely disable or moderately disable (Table 2). 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 2). Table 3 showed 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 (Table 3). Besides the GOS score, the mRS was also used to evaluate the functional outcome after 3 months among the study patients. Study indicated that severe disability was significantly reduced (from 50.0% to 3.7%) after 3 months among the patients who underwent EVD (Table 4). Table 5 indicates that severe disability was significantly reduced (from 38.3%% 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 (Table 5). Figure 1 showed 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 2 showed 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 3 showed that 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. However, table 6 showed that patients who died within 90 days of their IVH were significantly older, had lower GCS scores and higher mGS scores than the patients who survived. Patients with hydrocephalus died significantly more than the patients without hydrocephalus (Table 6). Study showed that treatment modality had no effect on functional dependency among survivors at 3 months after the event (p=0.211). However, patients who had functional dependency had significantly lower GCS (GCS≤8: n=34, 82.9%) than the patients who were functionally independent among the survivor (p<0.001) (Table 7). Binary logistic regression analysis was done to determine the independent predictor of functional dependency at 90 days following spontaneous IVH among the survivors (Table 8). It depicts that, after adjustment patient's treatment modalities either EVD or conservative did not reveal as an independent predictor. Only GCS score at admission was the independent predictor of 90 days functional dependency.Binary logistic regression analysis was done to determine the independent predictor of functional dependency at 90 days following spontaneous IVH among the survivors (Table 8). It depicted that, after adjustment patient's treatment modalities either EVD or conservative did not reveal as an independent predictor. Only GCS score at admission was the independent predictor of 90 days functional dependency.

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)	

*P values were derived from Chi-square test; †p values were derived from the independent sample t-test; ns=not significant

Table 2: 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)	1.0 ns
Persistent vegetative state	0 (0)	0 (0)	--
Severe disability	15 (50.0)	4 (14.8)	0.006 s
Moderate disability	13 (43.3)	16 (59.3)	0.292 ns
Mild or no disability	1 (3.3)	9 (22.2)	0.004 s

*P values were derived from Chi-square test; †p values were derived from the independent sample t-test; ns=not significant

Table 3: 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)	0.307 ns
Persistent vegetative state	0 (0)	0 (0)	-
Severe disability	20 (47.6)	3 (7.5)	<0.001 s
Moderate disability	18 (42.9)	18 (45.0)	1.0 ns
Mild or no disability	1 (2.4)	13 (32.5)	<0.001 s

*P values were derived from Chi-square test; †p values were derived from the independent sample t-test; ns=not significant

Table 4: 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) N (%)	At 3 months (n=27) N (%)	P value*
No symptoms	0 (0)	2 (7.4)	0.219 ns
No significant disability	1 (3.3)	2 (7.4)	0.598 ns
Slight disability	1 (3.3)	2 (7.4)	0.598 ns
Moderate disability	2 (6.7)	7 (25.9)	0.070 ns
Moderately severe disability	10 (33.3)	12 (44.4)	0.426 ns
Severe disability	15 (50.0)	1 (3.7)	<0.001 s
Dead	1 (3.3)	1 (3.7)	1.0 ns

*P values were derived from Chi-square test; †p values were derived from the independent sample t-test; ns=not significant

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

*P values were derived from Chi-square test; †p values were derived from the independent sample t-test; ns=not significant

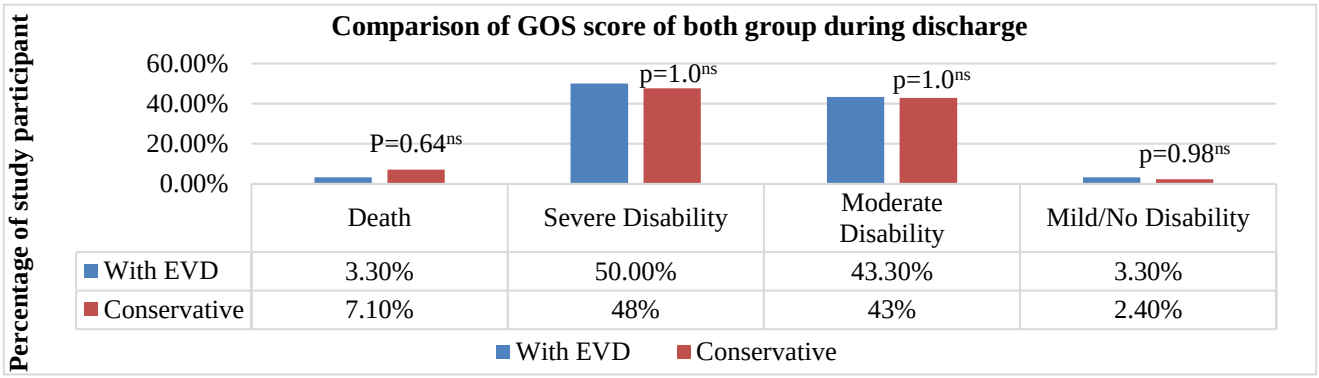

Figure 1: Comparison of GOS score during discharge in study participant with IVH with EVD (n=30) or without EVD (n=42).

ns=not significant.

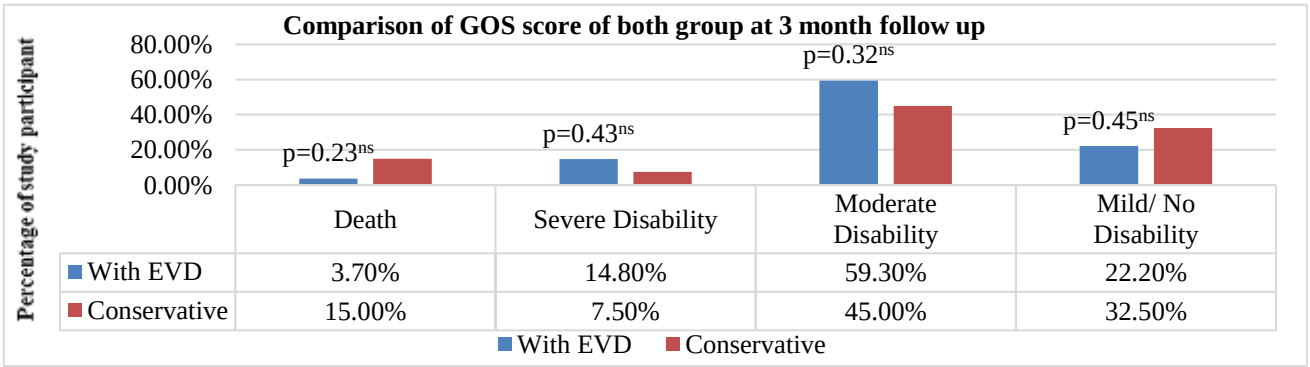

Figure 2: Comparison of GOS score after 3 months in study participant with IVH with EVD (n=27) or without EVD (n=40).

ns=not significant.

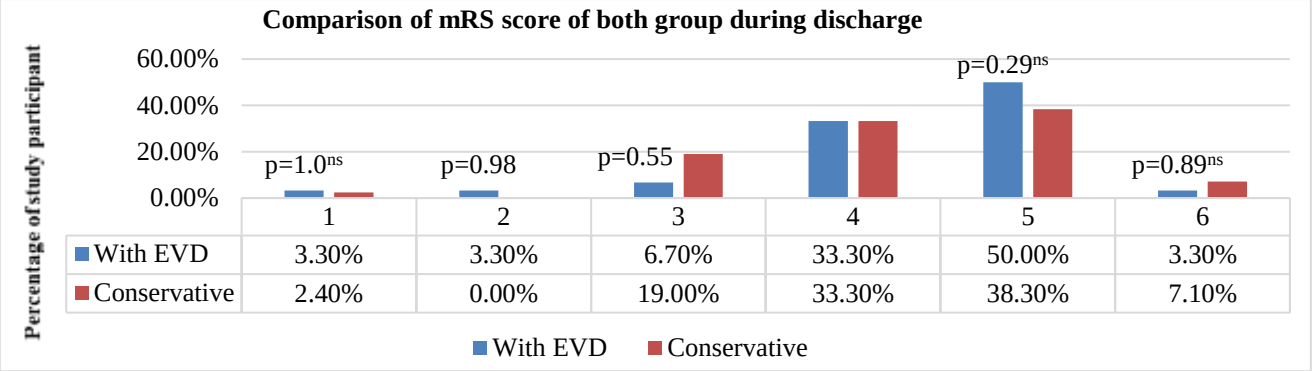

Figure 3: Comparison of mRS score during discharge in 72 patients with IVH with EVD (n=30) or without EVD (n=42).

ns=not significant.

Table 6: Association of different predictive variables with favorable GOS scores outcome after 3 months of the study participants (n=107) with IVH.

Variables	Poor outcome GOS:1-3 (n=61)	Favorable outcome GOS: 4-5 (n=46)	P value
Age (years)			
Mean±SD	64.19±12.39	55.4±14.89	0.001†s
Sex (%)			
Male	27 (50.0)	26 (49.1)	0.922*ns
Admission Glasgow coma scale score (%)			
Mean±SD	5±1	7±2	
13-15 (grade 1)	0 (0.0)	2 (3.8)	<0.001†s
9-12 (grade 2)	2 (3.7)	16 (30.2)	
≤8 (grade 3)	52 (96.3)	35 (66.0)	
Admission modified Graeb score			
Mean±SD	14±7	12±6	0.102†ns
Hydrocephalus (%)			
Present	40 (74.1)	15 (28.3)	<0.001*s
Group (%)			
EVD	25 (46.3)	22 (41.5)	0.922*ns
Conservative	29 (53.7)	31 (58.3)	

*P values were derived from Chi-square test; †p values were derived from independent sample t-test; ns=not significant, s=significant

Table 7: Association of different predictive variables with functional dependence (mRS>2) of the 60 survivors with IVH after 3 months.

Variables	Dependent mRS>2 (n=41)	Independent mRS≤2 (n=19)	P value
Age			
Mean±SD	56.56±16.37	53.74±13.27	0.513†ns
Sex (%)			
Male	18 (43.9)	11 (57.9)	0.313*ns
Admission Glasgow coma scale score (%)			
Mean±SD	7±2	9±2	
13-15 (grade 1)	0 (0)	2 (10.5)	<0.001†s
9-12 (grade 2)	7 (17.1)	10 (52.7)	
≤8 (grade 3)	34 (82.9)	7 (36.8)	
Admission modified Graeb score			
Mean±SD	12±6	13±5	0.662†ns

Continued.

Variables	Dependent mRS>2 (n=41)	Independent mRS≤2 (n=19)	P value
Hydrocephalus (%)			
Present	11 (26.8)	6 (31.6)	0.704*ns
Group (%)			
EVD	20 (48.6)	6 (31.6)	0.211*ns
Conservative	21 (51.2)	13 (68.4)	

*P values were derived from Chi-square test; †p values were derived from independent sample t-test; ns=not significant, s=significant

Table 8: Independent predictor of functional dependence (mRS>2) of the 60 survivors with IVH after 3 months.

Variables	Odds ratio (OR)	95% C.I. for OR		P value
		Lower	Upper	
Treated conservatively	1.427	0.271	7.501	0.675 ns
Age in years	1.043	0.995	1.093	0.075 ns
Glasgow coma scale score on admission	0.598	0.428	0.836	<0.001 s
Hydrocephalus	0.910	0.204	4.056	0.901 ns

ns=not significant, s=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. 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.[8] 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 the effects of the treatment modality by itself. In the present study, the patients underwent EVD had significantly poor consciousness level (GCS≤8: grade 3 observed in 43 or 91.5%) and more hydrocephalus compared to patients treated conservatively. To assess the independent impact of treatment modalities in our binary logistic regression analysis it was revealed that, after adjusting the other predictive variables (age, GCS, and hydrocephalus) patients who were treated conservatively were 3.98 times more likely to die within 90 days than the patients who had EVD. On the contrary, EVD had a similar effect in terms of favorable outcomes (GOS>3). Recently Lee et al reported that many of their patients received EVD, of whom the majority (78%) displayed unfavorable outcomes (GOS<4).[9] Interestingly, Liu et al retrospectively investigated the discharge outcome of EVD in severe IVH with a control group matched by IVH volume and age who received conservative treatment.[10] Their findings demonstrated that the mortality rate of the treatment group was 13.3% (10/75), much lower than that of the control group 41.1% (31/75, p<0.001). Considering the result of the present study and the above-mentioned studies it could be stated that, compared with conservative treatment, EVD treatment significantly improved the outcome of patients with IVH. Among the survivors at 3 months, the majority of them (56.7%) had a moderate disability and 36.7% had a mild disability. Similarly, Lee et al reported that the majority of survivors (80%) had no deficits or mild deficits (GOS≥4).[9] The reported rate of poor outcome following a large series of intracerebral hemorrhages ranges from 49% to 78%.[7,11] 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. Within the IVH literature, indications for EVD use are compelling: Nieuwkamp et al demonstrate a 26% decrease in IVH mortality associated with EVD utilization (78% versus 58%) through a meta-analysis, but no difference in functional outcomes (poor outcomes 90% versus 89%).[12] Nieuwkamp et al's findings are consistent with the results of the present analysis, demonstrating trends toward positive mortality benefit without overall positive functional outcomes benefit.[12] Logistic regression analysis was done to determine the independent predictor of functional dependency after 3 months following spontaneous IVH among the survivors. It revealed that after adjustment patient's treatment modalities either EVD or conservative did not reveal as an independent predictor. Only GCS score at admission was the independent predictor of 90 days functional dependency (mRS>2). This discrepancy between mortality and functional outcome and morbidity may suggest that other concomitant physio-pathological mechanisms that influence the final outcome other than initial age, GCS, and hydrocephalus. 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 a study was done by Lee et al found among 112 patients, 55 (49%) were from >50 years age group and 57 (51%) were from ≤50 years age group.[9] 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's studies wherein eight reported study, they found 51% were male.[12] But Lee et al found 57% male and 43% female.[9] But these demographic characteristics are not statistically significant in our study (p=0.374). 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

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

In multivariate-adjusted analyses, EVD use showed a trend towards lower overall mortality, with significantly lower mortality in patients with hydrocephalus and a lower initial GCS score of 9-12 (grade 2). These findings can be used to identify patients in whom an EVD may provide measurable outcomes benefit with respect to patient mortality and help guide neurosurgical decision-making in particular patient subgroups with acute IVH.

Recommendations

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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