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Role of External Ventricular Drainage (EVD) in Treating Spontaneous Intraventricular Haemorrhage

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Abstract

Background: There is no consensus in the literature on the effects of the development of hydrocephalus on survival and disability after intracerebral haemorrhage (ICH) and the benefits of external ventricular drainage (EVD). This study is planned to describe the role of external ventricular drainage in treating patients of spontaneous, either primary or secondary, intraventricular haemorrhage with hydrocephalus. **Material & Methods:** A hospital based prospective interventional study was conducted in the Department of Neurosurgery of Dhaka Medical College Hospital, which is a tertiary level hospital, from April 2016 to September 2017.Total 42 patients of spontaneous intraventricular haemorrhage, either primary or secondary, with hydrocephalus were selected for this study. All the collected data were entered into IBM SPSS software, Version 24. For statistical analysis, paired t-test to compare the preoperative GCS with postoperative GCS at 24 hours was done. **Results:** Among 42 patients, age range was 26-75 years with the mean age 65.2 ± 10.87 years. Male were 26 (61.9%) and female were 16 (38.1%). Male-Female ratio was 1.625:1. No patient needed conversion of EVD into VP shunt. EVD drain became blocked in 5 cases which were managed accordingly. 5 patients developed ventriculitis among which 2 patients died and rest 3 improved with antibiotics. **Conclusions:** The results of present study shows that EVD has a good role in the treatment of spontaneous IVH with hydrocephalus when ICH volume is low (<30ml) and modified Graeb Score is low (≤10 found in this in this study. Preoperative higher GCS or initial improvement in GCS or initial improvement in GCS at 24 hours positively correlates with Glasgow outcome scale which is an indication of good function outcome.

Keywords:- External Ventricular Drainage (EVD), Intraventricular Haemorrhage (IVH), hydrocephalus, intracerebral haemorrhage (ICH), subarachnoid haemorrhage (SAH).

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INTRODUCTION

Intraventricular hemorrhage (IVH) complicates subarachnoid hemorrhage (SAH) and intracerebral hemorrhage (ICH) in 15% and 40% of patients, respectively. When IVH is large enough to impede normal cerebrospinal fluid (CSF) circulation, acute obstructive hydrocephalus can occur. In the subacute and chronic stages of IVH, communicating hydrocephalus may develop if fibrosis of the basal leptomeninges occurs or if reabsorption of CSF becomes impaired from fibrosis of the arachnoid villus.[1] Approximately 30 and 70% of IVHs are primary and secondary, respectively. The main etiologies for primary IVH include head trauma, manipulation of an intraventricular catheter, aneurysms, tumors, hypertension, coagulopathies, or spontaneous formation. Since secondary IVH is a direct result of ICH or SAH extension, it's most common causes are dependent on ICH and SAH etiologies (hypertension, aneurysm, amyloid angiopathy, arteriovenous malformation, drug effect, vasculitis, coagulopathies, tumors, and hemorrhagic transformation of ischemic infarction).[2] The primary goal of intraventricular hemorrhage (IVH) treatment is to limit hemorrhagic mass effect, edema, increased intracranial pressure (ICP), and obstructive hydrocephalus by the rapid removal of blood and blood products from the ventricular system. Complete surgical evacuation of ventricular blood may be impossible if all ventricles are involved, and this inherently increases the risk of edema, bleeding, and infection in an already precarious clinical situation. ICH can occur in various cerebral locations, which in turn relate to the type of neurological deficits and disabilities, but no clear relationship exists between hemispheric ICH location and mortality. Mortality is associated with ICH volume. For ICH volumes 30 mL, there exists an incremental, direct relationship to mortality. Currently, all available data support the concept that the IVH extension of an even relatively small ICH (30 mL) increases mortality to 50 to 75%, largely due to the IVH. Most recent research supports the view that IVH is a significant and independent contributor to morbidity and mortality in both ICH and aneurysmal SAH. Four prognostic studies have demonstrated a strong independent effect of IVH on mortality. A prospective evaluation of ICH patients demonstrated a direct, continuous, dose– effect relationship between the initial volume of IVH and mortality. This effect was independent of concurrent ICH size. Mortality estimates for this condition range from 50 to 75%. [2] Hydrocephalus resulting from ICH is generally treated with external ventricular drainage (EVD). However, although appropriate treatment is offered, mortality rates are higher in this group. On the other hand, 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.[3] The aim of this study was to investigate the efficacy and the results of EVD in hydrocephalus developing after ICH or primary intraventricular haemorrhage.

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MATERIAL AND METHODS

A hospital based prospective interventional study was conducted in the Department of Neurosurgery of Dhaka Medical College Hospital, which is a tertiary level hospital, from April 2016 to September 2017. Total 42 patients of spontaneous intraventricular haemorrhage, either primary or secondary, with hydrocephalus were selected for this study. Glasgow Coma Scale score for level of consciousness and Modified GRAEB score for severity of ventricular haemorrhage were recorded preoperatively. Collected CSF volume at 24 hours was recorded to see the functional status of EVD and GCS was also measured at the same time. Glasgow Outcome Scale scores were noted at 30 days to see short term outcome. All the collected data were entered into IBM SPSS software, Version 24. For statistical analysis, paired t-test to compare the preoperative GCS with postoperative GCS at 24 hours was done. Correlations were determined by linear regression analysis. A p-value threshold for significance of 0.05 was used for correlation. Data are presented as means ± SD.

RESULTS

Among 42 patients, age range was 26-75 years with the mean age 65.2 ± 10.87 years. Male were 26 (61.9%) and female were 16 (38.1%). Male-Female ratio was 1.625:1. Table shows Modified Graeb score of the patients. Minimum score was found 4 who had 4th ventricular haemorrhage only. Maximum was found 19. Mean score was 8.86± SD 3.8 .Total 19 (45.2%) patients had modified Graeb score 6-10, 16 (38.1%) patients had 11-15, 5 (11.9%) patients had 16-20 and 2 (4.8%) patients had the score 0-5. Total 09 (21.42%) patients had primary intraventricular haemorrhage and rest of 33 (78.58%) patients had intraventricular haemorrhage secondary to intracerebral haemorrhage or subarachnoid haemorrhage. Preoperative GCS ranged from 4 to13 with mean value 7.14 ± SD 1.995. Modified GRAEB score were ranged from 5 to 19 with the mean 8.85 ± SD 0.7693.Difference of GCS at 24 hours were ranged from minimum -3 to maximum +10 with the mean increase of +1.67 ± SD 2.09. Collected CSF volume at 24 hours were ranged from minimum 50 to maximum 480 ml with the mean 338.33 ml ±SD 113.329. Glasgow Outcome Scale score were ranged from minimum 1 (Death) to maximum 5 (mild or no disability) with the mean 3.905 ±SD 1.3031. Total 5 patients died within 30 days. Mortality was 11.9%. 17 patients recovered well with mild or no disability. 7 patients had severe disability and 12 patients had moderate disability. No patient needed conversion of EVD into VP shunt. EVD drain became blocked in 5 cases which were managed accordingly. 5 patients developed ventriculitis among which 2 patients died and rest 3 improved with antibiotics.

Table 1: Age distribution of the study population.

Age	n=42	%
21-30	01	2.4
31-40	00	00
41-50	05	11.9
51-60	14	33.3

61-70	14	33.3
71-80	08	19.0

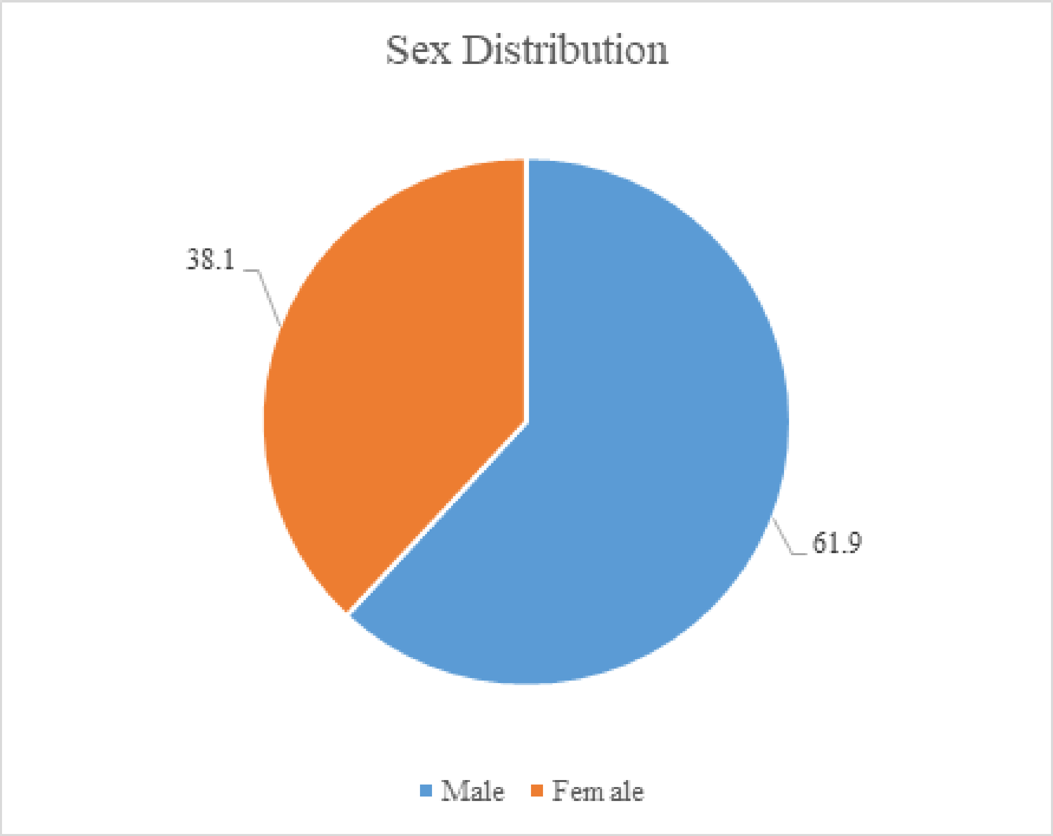

Figure 1: Sex distribution of the study patients

Table 2: Presenting symptoms of patients undergoing external ventricular drainage of the study population.

Presenting symptoms	n	%
History of loss of consciousness	38	90.47
Vomiting	34	80.95
Weakness of one side of the body	25	59.52
History of severe headache	05	11.90

Table 3: Modified Graeb score of the patients.

Modified Graeb score	n	%
0-5	2	4.8
6-10	19	45.2
11-15	16	38.1
16-20	5	119

21-25	0	0
26-32	0	0

Table 4: Glasgow Outcome Scale (GOS) score at 30 days of the patients

Glasgow Outcome Scale (GOS) score at 30 days	**Interpretation**	**(n=42)**	**(%)**
1	Death	5	11.9
2	Persistent vegetative state	0	0
3	Severe disability	8	19
4	Moderate disability	12	28.6
5	Mild or no disability	17	40.5
Total		42	100

Table 5: Correlation in between Modified GRAEB score and Glasgow Outcome Scale score at 30 days

Modified GRAEB score	**Frequency**	**GOS score at 30 days**	**Frequency**	**"P" value**
0-5	02	1	5	P < 0.001
6-10	19	2	0	
11-15	16	3	8	
16-20	05	4	12	
21-25	0	5	17	
26-32	0			
Total	42	Total	42	

Table 6: Comparison in between preoperative and postoperative GCS at 24 hours

Preoperative GCS	**n**	**Postoperative GCS at 24 hours**	**n**	**P-value**
4	1	3	2	P<0.001
5	8	4	1	
6	4	5	3	
7	16	6	1	
8	6	7	3	
9	3	8	8	
10	1	9	8	
11	1	10	7	
12	0	11	2	
13	2	12	3	
		13	3	
		14	1	

Table 7: Correlation in between preoperative GCS and Glasgow Outcome Scale score at 30 days

Preoperative GCS	**n**	**GOS score at 30 days**	**n**	**P-value**
4	1	1	5	P=0.007
5	8	2	0	

6	4	3	8	
7	16	4	12	
8	6	5	17	
9	3			
10	1			
11	1			
13	2			

Table 8: Comparison of outcome in between modified Graeb score ≤10 and >10

Outcome	**Modified Graeb Score**		**Total**	**P-value**
	≤10	**>10**		P=0.003
Favourable	20	08	28	
(GOS4-5) Poor (GOS 1-3)	3	11	14	
Total	20	22	42	

DISCUSSION

Intraventricular haemorrhage (IVH) is a significant and independent contributor to mortality and morbidity in both intracerebral haemorrhage (ICH) and aneurysmal subarachnoid haemorrhage (SAH). Four prognostic studies have demonstrated a strong independent effect of IVH on mortality. Most recently, a prospective evaluation of ICH patients demonstrated a direct, continuous, dose– effect relationship between the initial volume of IVH and mortality. This effect was independent of concurrent ICH size. Mortality estimates for this condition range from 50 to 75%.[2] Intraventricular haemorrhage (IVH) frequently complicates intracerebral haemorrhage (ICH) and subarachnoid haemorrhage (SAH) in 40% and 15% of patients respectively.[4] Hydrocephalus resulting from ICH is generally treated with external ventricular drainage (EVD) However, although appropriate treatment is offered, mortality rates are higher in this group. On the other hand, 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. Result of a prospective study suggested that EVD is a life-saving and effective procedure that should be performed in patients who develop hydrocephalus following spontaneous intracerebral haemorrhage.[5]

In the present study mean age ± SD was found 65.2 ± 10.87 years .Minimum age was 26 and maximum age was 80 years. This result correlates with other international studies such as Herrik Daniel B. et al (2014), Neal J. Naff et al, (2000) and M. Murat Sumer et al (2002) observed a mean age ± SD were 62 ± 15.6 years, 57±13.1 (range 35 to 80) years and 61.7 ± 10.2 (range 40 to 82) years respectively. Regarding the sex distribution in this study, male were 61.9% and female were 38.1%. Male-female ratio was 1.625: 1. This correlates with the study [4] where male: female ratio was 1.5:1. In this study, the mean ± SD of preoperative Glasgow Coma Scale (GCS) score was found as

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7.19 ± SD 1.96.[4] This preoperative GCS is similar to the study where preoperative GCS was observed as 8.7±3.89 (range 3 to 15) in the patients of intraventricular haemorrhage.[4]

Regarding the modified Graeb score, in this study the median was found as 9. A study carried out by Timothy C. Morgan et al (2013) on "The Modified Graeb Score- An Enhanced Tool for Intraventricular Hemorrhage Measurement and Prediction of Functional Outcome" where the median was found as the median of the present study was found close to but higher than the study.[6,7] The main reason behind it may be the difference in inclusion criteria of these two studies. In this study, only patients of intraventricular haemorrhage with hydrocephalus were included which usually requires large volume of intraventricular blood to develop hydrocephalus. Included all patients with intraventricular haemorrhage irrespective of hydrocephalus where a number of small IVH patients were included.[4,6] Regarding the improvement of GCS at 24 hours, it was found that there was an overall increase in the mean of GCS at 24 hours by +1.67 ± SD 2.09. The preoperative GCS was compared with the post-operative GCS by student paired "t" test which was found statistically significant. (p<0.001) This findings is similar to the study carried out on "Hypertensive Caudate Hemorrhage: Prognostic Predictor, Outcome, and Role of External Ventricular Drainage'' where preoperative GCS score for the surgical patients was 7.162.3 (mean ±SD), whereas postoperative 48-hour GCS score was 9.264.0 (mean±SD).[8] Postoperative 48-hour GCS score was better than preoperative score (P<0.001).

Another observational review study done by a study showed that among 22 patients of spontaneous intracerebral haemorrhage with hydrocephalus admitted in ICU and treated with external ventricular drainage, only 3 patients survived at 3 months with good outcome and 85% patients died at 3 months [9-]. The predicted 30 day mortality rates using models of some study were 51% and 55% in this case but actual mortality was found much higher than this.[8] Again 12 patients of that study had care withdrawn, based on their prior expressed wishes, in the face of poor unchanged condition. Only 3 patients succumbed to brain death. This result is not inconsistent with the finding of the current study. Because, the three patients who survived with good outcome found in that study had small ICH volume (3, 1 and 1 ml), stable or improved GCS at admission and decreased ventricular volume. In this study, patients of intraventricular haemorrhage with small ICH volume only were selected. As we excluded the large ICH patients, the overall mortality was found better than that study.[9,10,11]

Correlation in between the collected CSF volume at 24 hours and improvement in GCS was analyzed by linear regression analysis and found statistically significant. (p=0.002) It indicates that, if EVD is functioning, the volume of collected CSF increases which decreases the ICP and leads to improvement in GCS in most of the patients. But in case of massive intraventricular haemorrhage, EVD can be blocked frequently and may become ineffective. On the other hand, in 6 cases, despite having adequate CSF drainages (≥ 300 ml/24 hours), GCS did not improve or rather decreased. The possible explanation for this can be that, the cause of poor consciousness level was not only due to the raised ICP. Rather the toxic effect of blood causes periventricular irritation which leads to decreased level of consciousness or irreversible damage in the neural tissues occurred before the time when EVD was given. There are some studies regarding the use of urokinase and rTPA in the treatment of intraventricular haemorrhage. One study done where patients of intraventricular haemorrhage were treated with intraventricular Urokinase through the external ventricular drain.[4] They found a 30 days mortality rate of 20% among 20 patients. The outcome of the present study was better than this study in comparison to 30 days mortality or outcome. The strength of the present study is that it is a prospective study. In this study, all the confounding variables were avoided which could give a false interpretation regarding the effectiveness of external ventricular drainage such as presence of large ICH or patients of GCS 3. Again patients of good neurological status such as GCS 15 were excluded in this study who are likely to improve without surgery.[12,13,14]

Therefore, this study shows that external ventricular drainage has a good role in the treatment of intraventricular haemorrhage with hydrocephalus which can improve the outcome of the patients when other bad prognostic factors such as high grade of SAH or high ICH score is not present.[15]

Limitation of this study

Sample size is not large enough. There was no control group of conservative patients (This could not be done due to ethical issue as pre-existing knowledge of the effectiveness of EVD in case of a patient with hydrocephalus due to intraventricular haemorrhage did not allow us to deprive a patient from the benefit from EVD only for study purpose.)

Short period of follow up.

Single centre study.

Recommendations

As external ventricular drainage showed good outcome in the treatment of intraventricular haemorrhage with hydrocephalus, all patients with spontaneous intraventricular haemorrhage with hydrocephalus with altered consciousness level should be treated with external ventricular drainage. But to avoid ventriculostomy related infection, strict standard methods of sterility must be followed at every steps and EVD should be removed as soon as the ICP decrease to normal level. The method of long tunneling during the insertion of EVD was found also beneficial to reduce the infection rate. Use of medications for clot lysis may be done in case of massive intraventricular haemorrhage.

CONCLUSIONS

The results of present study shows that EVD has a good role in the treatment of spontaneous IVH with hydrocephalus when ICH volume is low (<30ml) and modified Graeb Score is low (≤10 found in this in this study. Preoperative higher GCS or initial improvement in GCS or initial improvement in GCS at 24 hours positively correlates with Glasgow outcome scale which is an indicator of good functional outcome.

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