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External ventricular drainage for intraventricular hemorrhage

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Abstract: *Background:* Intervention to reduce intracranial pressure using External Ventricular Drain (EVD) is a common life saving measure in a neurosurgery intensive care unit(ICU). *Objective:* The present study was undertaken to assess the outcome of patients who underwent external ventricular drainage for intraventricular hemorrhage(IVH). *Methods:* The available data of the patients who underwent placement of external ventricular drain from February 2012 to May 2016 for intraventricular hemorrhage (IVH) at Narayana Medical College and Hospital, Nellore, was retrieved from the hospital case records and analyzed. *Results:* Total of 69 patients were included in this study. Mean age was 53.7 ±11.6 years. Clinical presentation included altered sensorium in 66 patients (96%), hemiparesis in 62 patients (90%) , vomiting in 40 patients (58%) and seizures in 9 patients (13%). Fifty two patients (75%) were known hypertensives and 10 patients (15%) were diabetic. Past history of smoking was recorded in 16(23%) patients and alcohol intake in 17 patients (25%). GCS at the time of admission was 3-8 (low) in 39 patients (57%), 9-12 in 23 patients(33%) and 13-15 in 7 patients (10%). At the time of admission, 60 patients (87%) had diastolic blood pressure more than 90 mmHg, 63 patients (91%) had systolic blood pressure more than 140 mmHg. Major site of hemorrhage was basal ganglia in 24

(35%), thalamus in 13 (19%), cerebellum in 5 (7%), brain stem in 3, frontal/temporal in 2 patients. SAH with IVH was noted in 12 patients (17%) and only IVH was noted in 10 patients (14%). Mean duration of external ventricular drainage was 4.6+1.7 days (Range 1-9 days). Mean hospital stay was 11.3±7.5 days and mean ICU stay was 8+5.4 days. Thirty eight patients (55%) died during hospital stay. At the time of discharge, poor out come (Glagow out come score 1-3) was noted in 52 patients (75%) and good out come (Glagow out come score-4,5) was noted in 17 patients. Among various parameters analyzed , poor GCS (3-8) at admission, history of smoking and alcohol intake were found to correlate significantly with poor outcome. None of the other factors like old age, site of bleed, pupillary asymmetry at admission, high blood pressure at admission, past history of hypertension and diabetes were found to correlate with poor outcome. *Conclusions:* Majority of the patients with intracranial hematomas with intraventricular extension presented in poor neurological condition (GCS= 3-8). Poor neurological condition at the time of admission, past history of smoking and alcohol intake were associated with poor outcome.

Key words: basal ganglia bleed, thalamic bleed, external ventricular drainage, hydrocephalus, intraventricular hemorrhage, intracerebral hemorrhage, subarachnoid hemorrhage

Introduction

The external ventricular drain (EVD), also called as ventriculostomy or extraventricular drain, is often used as an emergency procedure in neurosurgery to manage hydrocephalus and reduce raised intracranial pressure (ICP) when there is acute obstruction to the normal flow of cerebrospinal fluid (CSF). Insertion of an EVD help in reduction of ICP by draining CSF/intraventricular blood, permits introduction of various medications and allow intracranial pressure monitoring. Well trained nursing staff are required for managing these cases to ensure appropriate zeroing, maximum sterility, and flawless integrity of the EVD collecting system. ICP waveform analysis and close monitoring of CSF drainage are extremely important and can affect clinical outcomes. 1 EVD is required in various conditions like intracranial (basal ganglia/ thalamus/ brainstem) hemorrhage (ICH) with intraventricular extension, subarachnoid hemorrhage (SAH) with intraventricular hemorrhage, traumatic brain injury (TBI), cerebellar infarct with hydrocephalus, bacterial/tubercular meningitis etc. Many of these conditions are associated with intracranial hypertension with intracranial pressure (ICP) above 20 mmHg due to obstruction of cerebrospinal fluid (CSF) outflow. 2 External ventricular drain (EVD) provides temporary cerebrospinal fluid (CSF) diversion in these patients. The present study was undertaken to assess the outcome in patients with intraventricular hemorrhage who underwent EVD placement.

Methods

The present retrospective observational study was carried out at Narayana Medical College and Hospital, Nellore. After Institutional Ethical Committee (IEC) approval, the data of the patients who underwent placement of external ventricular drainage for intraventricular hemorrhage (IVH) from February 2012 to May 2016 was retrieved from the hospital case records and analyzed. The demographic, clinical, radiological, management and outcome details of the patients were recorded in a pre-designed proforma.

External ventricular catheter placement was performed in the operation theatre and a standard approach was followed to perform the procedure i.e. Kocher's point to insert the ventricular catheter, tunneling of the catheter to reduce infection, fixation of the catheter to the scalp, secure attachment for CSF collection and keeping the CSF collection bag at appropriate height. The side of the insertion was decided based on the ventricular enlargement and amount of the blood in the lateral ventricles. EVD catheter was subcutaneously tunneled for an approximate distance of 5 cm from the ventriculostomy site incision and externalized. All the patients received prophylactic pre-operative antibiotics.

After EVD insertion, patients were managed in intensive care unit and CSF output was closely monitored. CSF was regularly monitored for any evidence of infection (cell count, gram staining and culture). Once the CSF became clear and ventricles were cleared reasonably of blood (particularly disappearance of the blood from the fourth ventricle), the EVD catheter was removed. Before removing the EVD, the drain was raised approximately 20 cm above the external auditory meatus to make sure that the patient is not drain dependent.

Statistical Analysis

The study data were collected in a predesigned data collection tool and later entered into the Microsoft EXCEL sheet. SPSS version 24 was used to analyze data and calculate frequency distribution, percentages and descriptive statistics. Chi-square / Fisher Exact test was used to find the significance of study parameters on categorical scale and independent samples T test for parameters on continuous scale. Significance is assessed at 5 % level of significance.

A probability (P) value of <0.05 was considered significant.

Results

Sixty nine patients were included in this study. There were 45 male (65.2%) and 24 female (34.8%) with a male to female ratio of 1.87: 1. Mean age was 53.7 ±11.6 years and majority (30) were in the age group of 51-60 yrs [Table 1]. Fifty two patients (75%) were known hypertensives and 10 patients (15%) were diabetic. Past history of smoking was recorded in 16(23%) patients and alcohol intake in 17 patients (25%). Clinical presentation included altered sensorium in 66 patients (96%), hemiparesis in 62 patients (90%) , vomiting in 40 patients (58%) and seizures in 9 patients (13%). At the time of

admission, 60 patients (87%) had diastolic blood pressure more than 90 mmHg, 63 patients (91%) had systolic blood pressure more than 140 mmHg. Pupillary asymmetry was noted in 5 patients. Pupillary light reaction was absent in 3 patients. GCS at the time of admission was 3-8 (low) in 39 patients (57%), 9-12 in 23 patients (33%) and 13-15 in 7 patients (10%). Mean GCS at admission was 8 ±3. Major site of hemorrhage was basal ganglia in 24 (35%), thalamus in 13 (19%) , cerebellum in 5 (7%), brain stem in 3, frontal/temporal in 2 patients. SAH with IVH was noted in 12 patients (17%) and only IVH was noted in 10 patients (14%). Mean duration of external ventricular drainage was 4.6+1.7 days (Range 1-9 days). Mean hospital stay was 11.3±7.5 days and mean ICU stay was 8+5.38 days.

Thirty eight patients died during hospital stay. At the time of discharge, poor out come (Glagow out come score 1-Dead, 2- Persistent vegetative state, 3- Severe disability) was noted in 52 patients (75%) and good out come (Glagow out come score 4-Moderate disability, independent and 5- Good Recovery, Normal life despite minor deficits) was noted in 17 patients (25%). Poor GCS (3-8) at admission was found to significantly correlate with poor outcome (P value 0.025) [Table 1]. Mean GCS at the time of admission in patients with poor out come was 7.4+3 as compared to 9.7+1.8 in patients with good out come (P value 0.001). Statistically significant poor outcome was also noted in patients with past history of smoking and alcohol intake [Table 3]. Poor outcome was noted in 94% (16/17) of patients with past history of alcohol intake as compared to 69% (36/52) in patients without history of alcohol intake (P value- 0.05). Poor outcome was also noted in all the patients (16/16) with past history of smoking as compared to 68% (36/53) in patients without history of smoking (P value- 0.007). None of the other factors like age, gender, site of bleed, pupillary asymmetry/ reaction to light at the time of admission, systolic blood pressure/diastolic blood pressure at the time of admission, past history of hypertension / diabetes mellitus were found to correlate with poor outcome [Tables 1,2,3].

Table 1 - The outcome correlation with age, gender, GCS at admission, pupil size/reaction to light and blood pressure at the time of admission (n=69)

		Poor outcome (GOS 1-3)	**Good outcome (GOS 4,5)**	**P value**
Age group[a] (yrs)	21-30	4 (100%)	0 (0%)	0.71
	31-40	2(100%)	0	
	41-50	12(80%)	3(20%)	
	51-60	22(73%)	8(27%)	
	61-70	8(67%)	4(33%)	
	71-80	4(67%)	2(33%)	

Mean age		52.6±12.1 yrs	57.4±9.5 yrs	0.141
Gender[a]	Male	35 (78%)	10(22%)	0.15
	Female	17 (71%)	7(29%)	
GCS[a,b]	3-8	34(87%)	5(13%)	**0.025**
	9-12	13(56%)	10 (44%)	
	13-15	5(71%)	2 (29%)	
Mean GCS		7.4±3.1	9.7±1.8	**0.001**
Pupil size[a,b]	Equal	48 (75%)	16(25%)	0.64
	Asymmetry	4 (80%)	1 (20%)	
Pupillary light reaction[a,b]	Present	49 (74%)	17 (26%)	0.57
	Absent	3 (100%)	0	
Systolic blood pressure[a,b]	>140 mm Hg	49 (78%)	14 (22%)	0.15
	≤140 mm Hg	3(50%)	3 (50%)	
Mean systolic blood pressure[a,b] (mm Hg)		176±30.9	162±41.8	0.172
Diastolic blood pressure[a,b]	>90 mm Hg	47(78%)	13 (22%)	0.2
	≤90 mm Hg	5 (55%)	4 (45%)	
Mean diastolic blood pressure[a,b] (mm Hg)		100.6±14.5	94.47±18	0.159

[a] Data for poor and good outcome is given as number of patients (%)

[b] Examination findings at the time of admission

Table 2 - Location of bleed and patient outcome

Location of bleed	Poor outcome (GOS 1-3)	Good outcome (GOS 4,5)	P value
Basal ganglia	20 (83%)	4(17%)	0.371
Thalamus	10(77%)	3(23%)	
Cerebellum	2(40%)	3(60%)	
SAH	8(67%)	4(33%)	
Only intraventricular hemorrhage	8(80%)	2(20%)	
Frontal/temporal lobe	1(50%)	1(50%)	
Brain stem	3(100%)	0	

Data for poor and good outcome is given as number of patients (%)

Table 3 - Risk factors and patient outcome

Risk Factors		Poor outcome (GOS 1-3)	Good outcome (GOS 4,5)	P value
Hypertension	Yes	40 (77%)	12 (23%)	0.747
	No	12 (71%)	5(29%)	
Diabetes Mellitus	Yes	8 (80%)	2 (20%)	0.53
	No	44(75%)	15 (25%)	
Alcohol intake	Yes	16 (94%)	1(6%)	**0.05**
	No	36 (69%)	16 (31%)	
Smoking	Yes	16 (100%)	0	**0.007**
	No	36(68%)	17(32%)	

Data for poor and good outcome is given as number of patients (%)

Discussion

Numerous forms of acute brain injury benefit from continuous ICP monitoring and cerebrospinal fluid (CSF) diversion provided by an EVD. After insertion, EVD monitoring and maintenance essentially become responsibility of nursing staff and well trained nursing staff are required to prevent EVD associated meningitis and for early detection of complications like blockage of EVD. [1-9] It has been reported that the occurrence of intraventricular hemorrhage (IVH) ranges from 30% to 50% in cases of spontaneous intracerebral hemorrhage and it frequently results in acute obstructive hydrocephalus. [9-11] External ventricular drainage is a life saving procedure in these patients. [6,12] EVD does help to drain CSF, remove ventricular and subarachnoid blood and blood products. EVD not only reduce intracranial pressure but also potentially reduce the inflammatory response from blood products which might help in reducing chances of persistent hydrocephalus following IVH. [13] It is difficult to specify the timeline when to remove the EVD as it may vary from cases to case. Once the purpose of EVD is served (either discontinuations of the ICP monitoring or resolution of the clot and hydrocephalus) a decision to remove EVD can be made. [14,15]

EVD placement can be associated with many complications like infection (e.g. ventriculitis and meningitis), hemorrhage, disconnection, misplacement, dislodgement or blockage of the catheter. [16-19] Reported incidence of EVD associated meningitis/ ventriculitis is 0-22%. [2,20] This risk can be reduced by judicious use of prophylactic antibiotics while taking precautions to avoid the risk of the development of resistant organisms. [2,20] In literature EVD catheters which are covered with antibiotic-impregnated and coated with ionized silver particle have shown to be beneficial, however we did not use these catheters in our series because of the cost involved. [2,20] We followed the standard strategies to reduce the infection rate i.e. proper tunneling of the EVD catheter, careful monitoring of the EVD dressing site, any evidence of CSF leak, keeping the CSF collection system in an upright position, less frequent change in the drain tubing and minimizing the duration of the EVD. [2,20,21] EVD related infections can be prevented by careful surgical technique, tunneling of the ventricular catheter 22 and early removal of the EVD (preferably within 5 days). [23,24]

In patients with intracranial hematomas, presence of IVH and associated hydrocephalus are associated with poor outcome and mortality independently. [9-11,25] Hypertension, diabetes mellitus, smoking and alcohol intake are reported to be high risk factors for intracranial hematomas. [26-27] The reported mortality from ICH (with hypertensive intracerebral hemorrhages) ranges from 60 to 86% similar to 55% noted in our series. [28-32] However in a series it was shown that EVD was lifesaving with a survival rate of 67.9% . [15]

Conclusions

Majority of the patients with intracranial hematomas with intraventricular extension presented in poor neurological condition (GCS= 3-8). Poor neurological condition at the time of admission, past history of smoking and alcohol intake were associated with poor outcome.

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