Original Article

Surgical outcome of intraventricular hemorrhage using an intraventricular catheter, and its complications at Civil Hospital, Karachi, Pakistan

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Objective: To determine the surgical outcome of intraventricular hemorrhage extraction using a drainage system, its complications and management.

Methodology: This prospective clinical trial was conducted for a period of 3 years at Civil Hospital Karachi, Pakistan. The study population consisted of 150 patients who underwent the closed system external drainage procedure for the drainage of ventricular hemorrhage. Various parameters were noted and data were analyzed using SPSS version 23.

Results: A total of 150 patients underwent 175 ventriculostomies. Ventriculostomy infection developed in 38 (25.33%) patients. Overall mortality rate was 30% (n=45). Age, gender, prophylactic antibiotics, steroid use and surgical diagnosis did not show any association with infection. Among all those who were infected, the culture was positive in 85.71% patients. The infection was of polymicrobial in 19 patients and unimicrobial in 11. Co-existing sepsis was present in 65 patients, while 31 patients had an open source of infection like tracheostomy, pressure sore, or wound infection. In 105 (70%) patients, the ventriculostomy catheter was not changed. In 30 patients, the catheter was changed only one time, in 8 patients it was changed twice and in 7 it was changed three times. Fifteen patients belonging to the non infected group had a catheter change, while 22 catheters were changed in the infection group.

Conclusion: There was an exponential increase in the rate of infection after 5 days of putting in the external catheter. Therefore, it is necessary that extraventricular drainage by closed system only to be placed when it is very necessary and the ventriculostomy should only be kept for the duration that is required. Monitoring should be done on a daily basis to prevent the complications. (Rawal Med J 201;42:90-94)

Keywords: Ventricular hemorrhage, ventriculostomy, external ventricular drainage, neurosurgical procedure, intracranial infection.

INTRODUCTION

Recently, the management of acute hydrocephalus is done by placing a ventricular catheter. It can be used both for monitoring of intracranial pressure and also for management of conditions that result in increased intracranial pressure.[1] The monitoring of intracranial pressure with the use of a ventricular catheter is regarded as gold standard[2] but it has its own drawbacks, such as blockage or displacement of the catheter from the site.[1] The most critical complication is infection resulting in meningitis and ventriculitis and thes increase the lenght of stay in the hospital and are difficult to manage.[3-7] The rates of infection have been reported between 0 and 40% and several studies have shown that infection is independent of the time duration of catheter placement, thus suggesting that the catheter be placed and remain in place regardless of infection till the purpose of putting in the catheter is resolved.[8,9] This is still controversial as a number of studies also suggest that increasing the duration of catheter placement is directly related to the rates of infection and that the catheter be replaced after every five days.[4,10,11]

METHODOLOGY

This prospective trial was conducted for a period of 3 years, from January 2013 to December 2015, at the Department of Neurosurgery, Civil Hospital, Karachi, Pakistan. The study population consisted of 150 patients who underwent the external drainage procedure for the drainage of ventricular

hemorrhage using closed system. All the patients who had intraventricular hemorrhage and enlarged ventricles with a decreasing level of consciousness, low GCS score, unstable vitals, patients requiring either bedside or surgical EVD and patients having intraventricular or paraventricular tumors (prophylaxis for post operative hydrocephalus and ICP monitoring) were included in the study. All those patients who had to undergo exteriorization of a previously formed shunt, those having signs of infection in the first stem cell factor sample, and those having meningitis for greater than 7 days after removal of an EVD were excluded from the study. All patients signed an informed consent.

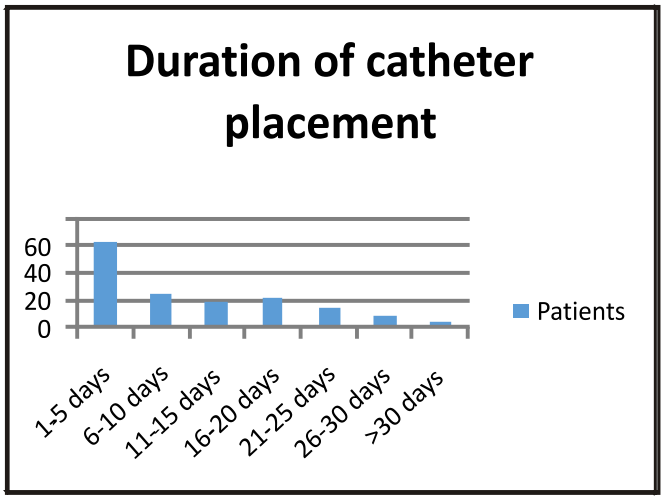
The surgical procedure was done under strict aseptic conditions, prophylactic antibiotics (such as ceftriaxone) were administered in all cases. Intraventricular antibiotics according to culture and sensitivity and empirically vancomycin were administered in cases of intraventricular infection, for post operative ventriculitis either removal of catheter or changing of catheter along with systemic administration of antibiotics was done. The type of drainage system used was closed system EVD. The surgical procedures were performed by residents level year IV and V of the neurosurgical department under the supervision of assistant professors. Age, gender, diagnosis, co morbidities, complications, co existing infections, use of drugs, past surgical history were recorded. CSF analysis was done at least once in 48 hours, for cytology, culture and biochemical analysis, various variables were noted such as, number of catheter changes, total duration of catheter placement, time of onset of infection and resolution.

Catheter was changed at an interval of 5 to 8 days of insertion and whenever the need arose, as in case of a blocked catheter. A positive CSF culture and/or a decreased CSF sugar that is less than 15mg/dL and 50 leucocytes with at least 50% neutrophils was considered to be an infection. A large RBC to WBC ratio 500:1 was also considered as infection. Radiographic and bed side analysis (blood in tubing) was noted to demonstrate intraventricular hemorrhage. CT scans were done both pre and post operatively for all patients. Data were analyzed using SPSS version 23.

RESULTS

The study population consisted of 150 patients for a total of 175 ventriculostomies done over a period of three years by 8 surgeons. The majority of patients had subarachnoid hemorrhage with concomitant intraventricular hemorrhage in (n=60; 40%). All the patients with increased intracerebral pressures with acute dilatation of ventricles had external ventricular drainage done, and those who had intracerebral hematomas were subjected to craniotomy with evacuation of the hematoma and EVD to drain the intraventricular component of the bleed. The EVD catheter was kept in place till the CSF was clear and neurological condition of the patient improved. The time for short term use of EVD was kept between 4 to 7 days.

Figure 1. Catheter placement.



A total of 38 (25.33%) patients had ventriculostomy infection, and among all those who were infection culture was positive in 30 (85.71%) patients. The infection was of polymicrobial variety in 19 patients and unimicrobial in 11 patients. The infective organisms were Staphylococcus spp in 15, Klebsiella spp in 02, Enterobacter in 02, Acenitobacter spp in 15, Cornybacterium xerosis in 04 and Pseudomonas spp in 03 patients. Co existing sepsis was present in 65 patients, while 31 patients had an open source of infection, as tracheostomy, pressure sore, or wound infection. The common infections were urinary tract infections in 24 patients, wound infection in 18 patients, respiratory

tract infection in 28 patients, septicemia in 14 patients, tracheostomy related infections in 8 patients, and bed sores in 10 patients. In 105 (70%) patients, the ventriculostomy catheter was not changed, and in the remaining patients the catheter was changed sequentially. In 30 patients, the catheter was changed only one time, in 8 patients it was changed twice and in 7 patients it was changed three times. In the patients who developed EVD infection, the first catheter placed was infected in 19 patients, second in 16 patients and third in the remaining 3 patients.

Table 1. Risk factors and mean values of CSF analysis.

Risk Factors	Non Infected Group		Infected group		P
	Present	Absent	Present	Absent	
Age (<10 or >50)	30	74	12	34	0.084
Male Gender	73	31	30	16	0.09
Use of steroids	75	29	35	11	0.77
Antibiotics (intraventricular)	29	75	15	31	0.99
Coexisting sepsis	30	74	35	11	0.008
Infection source (open)*	11	93	20	26	0.002
Neurosurgical procedures	38	66	32	14	0.003
Duration of catheter greater than 5days	50	54	37	9	0.003
Changes in Catheter	18	86	25	21	0.005
Intraventricular hemorrhage	48	56	34	12	0.038
CSF ANALYSIS (Mean values)					
Total leucocyte count	125		1125		0.001
Sugar	66		26		0.04
Protein	210		155		0.12

*bedsore, tracheostomy, wound infection

Table 2. Diagnosis, surgical intervention and mortality rate.

Diagnosis	No of patients	Age range	Hydrocephalus at presentation	Surgical intervention	No of deaths
SAH (spontaneous)	60	30 to 45	10	EVD	24
SAH (traumatic)	26	20 t o35	12	EVD	06
Primary IVH	07	40	-	EVD	
Intracerebral hemorrhage with IVH	26	48 to 65	8	Craniotomy with evacuation	08
Hydrocephalus	18	Birth to 8	18	EVD	3
Hydrocephalus with paraventricular tumors	13	Birth to 30	13	EVD	4

Fewer patients underwent catheter change in non infected group. Fifteen patients belonging to the non infected group had a catheter change, while 22 catheters were changed in the infection group. The mean duration of catheter placement was 11 days (range 1 to 32 days) (Figure 1). The mean for the day of onset of infection was 9.6 days (range 5 to 26 days). Intraventricular hemorrhage was observed radiographically in 90(60%) patients. Various risk factors for ventriculitis are listed in Table 1. There was a significant association between catheter changes and infection rate, as 25 patients had

undergone a change in catheter in infected group, 20 patients undergone change of catheter once, while 5 patients undergone change of catheter twice. The mean duration of ventriculostomy was 20.4 days in the infected group, compared to 4.5 days in the non infected group. The factors which failed to show a significant association with EVD infection were age (<10 or >50 years), gender, systemic steroids, prophylactic antibiotics and neurosurgical diagnosis. For analysis of CSF parameters refer to Table 1. Catheter blockage was seen in 30(20%) patients. It was minor block in 18 patients and required manipulation to clear the block and in 12 patients. It required a change of catheter because of severe block. The overall mortality was 30% (n=45) (Table 2).

DISCUSSION

For the treatment of acute hydrocephalus and increased intracranial pressure, the treatment of choice is extraventricular drainage, especially for cases of subarachnoid hemorrhage and Intracerebral hemorrhage with hydrocephalus. Acute onset hydrocephalus is diagnosed when there is clinical and radiographic evidence of enlargement of the ventricles that usually develops within two weeks following subarachnoid hemorrhage. However, an abrupt decrease of the intra cerebral pressure might result in rebleeding due to the decreased trans mural pressure and the removal of clot that had sealed the site of bleeding, factors affect this phenomenon are timing of the procedure, the duration of drainage, the size of the aneurysm, and the severity of the initial bleed.[12]

In our study, the rate of infection was 25.33%, which is similar to the rates of 0 to 40% reported in other such studies.[4,8,10,13-15] CSF pleocytosis might be due to the ventricular drain placed, elicited as a foreign body reaction, the definition of ventriculitis has to include this phenomenon, despite the criticism,[4,9,11,16,17] but according to Mayhall et al, EVD associated ventriculitis is defined in terms of culture positivity.[4] Subarachnoid hemorrhage is also knows to be associated with pleocytosis of the cerebrospinal fluid, with reduced sugar and increased protein levels, which we also found in our study, but a significant CSF pleocytosis with low sugar can only be due to an infectious process.[18] In our study, the mean cell count and sugar values of the cerebrospinal fluid were different between the infected and non infected group.

The patients with infection required the ventricular drainage to be maintained for longer duration compared to other studies.[15] The mean duration being 7.5 days before infection, some authors have claimed that flushing the catheter with antibiotics is a risk factor for ventriculitis,[18-20] while one study reports the flushing with antibiotics solution to be a safe procedure.[1] This routine injection of intraventricular antibiotics does not show a role in prophylaxis for ventriculitis, but it has a role once the ventriculitis has developed.[3]

The skin commensal organisms were in the highest proportion and revealed the importance of colonization of the catheter assembly as also observed by other studies.[6,8,15,21-24] We did not find any association of age and systemic steroids with the rate of infection, which could be due to the small number of study subjects, we did found an association of intraventricular hemorrhage and infection and which is also reported in other studies,[4,8] which is also independent of the effect of intraventricular hemorrhage on the duration of catheter.[4] According to some studies [4,16] having neurosurgical procedure performed and immunosuppression (after trauma or surgery) is a predisposing factor for infection, which we also observed in our study. Sundbarg et al also made similar observation where patients with high rates of infection had another procedure done.[9] Sepsis also correlates with the development of ventriculitis, as was also observed in other studies.[48,16] In our study, we found a significant relationship exists between duration of catheter and ventriculitis, which was evident from the mean duration of catheter in the infected and the non infected group. This was also found in other prospective studies.[4, 14, 22]

CONCLUSION

There was an exponential increase in the rate of infection after 5 days of putting in the external catheter. Therefore, it is necessary that extraventricular drainage only to be placed when it is very necessary and the ventriculostomy should

only be kept for the duration that is required. Monitoring should be done on a daily basis to prevent the complications.

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