ORIGINAL ARTICLE

Analysis of Factors associated with Revision of Ventriculoperitoneal shunt at National Institute of Neurological and Allied Science, Nepal

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ABSTRACT

Introduction: Ventriculoperitoneal (VP) shunt is the commonest procedure for hydrocephalus. The cases requiring shunt revision is a major obstacle in its management. Various factors have been implicated for failure or revision of shunt like patient's age, sex, cause of hydrocephalus, duration of surgery. This study aims to analyze the rate of VP shunt revision and various factors associated with it.

Methods: In this study, we analyzed 237 cases aged three months to 75 years, of VP shunt from January 2010-December 2014 with at least one year follow up at National Institute of Neurological and Allied Sciences. We evaluated the rate of VP shunt revision and various factors associated with it. The categorical variables were evaluated by chi-square test. Odds ratio was calculated for each factors at 95% CI.

Results: There were 54 (22.78%) cases having at least one revision within one year of shunt insertion. The odds of revision of shunt was 6.58 times higher when inserted through frontal approach than occipital approach. The external ventricular drain placement prior to shunt surgery had statistically significant association with shunt revision (p=0.02). There was no difference in patients requiring/not requiring shunt revision when compared in terms of age group, gender, various etiologies and side of shunt insertions.

Conclusions: The rate of shunt revision in our study was 22.78% which is comparable to other studies. Frontal approach in VP shunt insertion was associated with increased rate of shunt failure thus requiring revision. Likewise, external ventricular drain placement prior to shunt surgery was associated with increased incidence of revision surgery.

Key words: *hydrocephalus; revision; ventriculoperitoneal shunt.*

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INTRODUCTION

Ventriculoperitoneal shunt (VP shunt) is the commonest and most widely accepted procedure for hydrocephalus. Infections and complications resulting in revision of shunts are still a major obstacle in its management.[1] Common causes of shunt malfunction include shunt blockage (valve, proximal catheter, and distal catheter), infection, migration, disconnection, overdrainage.[2,3]

Many studies have been performed to study the complication rates, revision rates and causes of shunt revision in both adult and children. Various factors have been implicated with failure or revision of VP shunts in the literature including patient's age, sex, cause of hydrocephalus, use of antibiotics, duration of surgery and experience of a surgeon.[1,4-7] There are hardly any studies performed to study revision of VP shunt and its causative factors in Nepal.

This study was carried out with an objective to assess the revision rate of VP shunt and various factors associated with revision.

METHODS

This retrospective study was carried out in National Institute of Neurological and Allied Sciences, a tertiary care neurosurgical center in Nepal. A total of 237 patients, aged three months to 82 years, with a diagnosis of hydrocephalus of varied etiologies who underwent VP shunt surgery from January 2010 to December 2014 were included in the study after obtaining approval from the institutional R

review board. All these patients had at least one year of follow up. Patients with follow up of less than a year or those who died in less than a year, patient who had lumbo-peritoneal shunt, ventriculo-atrial shunt, subduro-peritoneal shunt and those who had primary surgery elsewhere and revision surgery as their first surgery in our center were excluded from the study.

Etiology of shunt insertion was divided into congenital, infarction, intracerebral hematoma, infections, trauma, tumors and cysts, normal pressure hydrocephalus. The age of the patient was divided into two groups; pediatric (<14 years) and adult (>14 years). The site and side of shunt insertion were noted from surgical note. Insertion of external ventricular drain (EVD) prior to definite shunt surgery was also noted. In cases where revision of shunt were done, the cause of revision and the time interval between last shunt surgery and revision was also noted. The cause of shunt revision was also evaluated.

Statistical analysis was performed using IBM SPSS 20.0 software. The categorical variables were evaluated by chi-square test. Odds ratio at 95% confidence interval were calculated for each variable. P-value ≤0.05 was considered statistically significant.

RESULTS

A total of 268 patients underwent ventriculo-peritoneal (VP) shunt surgery during the study period in our center, out of which seven patients died, 12 patients had incomplete follow up and 12 patients had VP shunt elsewhere and underwent revision surgery in our hospital as their first procedure. Thus 237 cases were included in our study.

There were 54 (22.78%) cases having at least one revision within one year of initial VP shunt insertion. The mean age of patients who had shunt revisions was 31.41± 17.61 years, ranging from three months to 75 years. While evaluating the variables associated with revision of VP shunt; the frontal approach of shunt insertion and EVD placement prior to surgery were found to be clinically significant (Table 1).

Table 1. Various Factors associated with shunt revision

S. N	Variables	Revisions (%)	No Revisions (%)	P value	OR	95%CI
1	Age Group			0.07	0.49	0.22-1.07
	Pediatric	9 (14.50%)	53(85.50%)			
	Adults	45 (25.70%)	130 (74.30%)			
2	Sex			0.58	0.83	0.43-1.59
	Female	17 (20.70%)	65 (79.30%)			
	Male	37 (23.90%)	118 (76.10%)			
3	Insertion Site			0.00*	6.58	2.83-15.31
	Frontal	16 (59.30%)	11 (40.70%)			
	Occipital	38 (18.10%)	172 (81.90%)			
4	Side			0.81	0.89	0.36-2.20
	Left	7 (21.20%)	26 (78.80%)			
	Right	47 (23%)	157 (77%)			
5	EVD			0.02*	2.13	1.11-4.07
	Yes	21 (33.30%)	42 (66.70%)			
	No	33 (19%)	141 (81%)			

6	Etiology of Shunt					
	Congenital	6(15%)	34 (85%)	0.19	0.54	0.21-1.38
	Infarction	1 (20%)	4 (80%)	1.00	0.84	0.09-7.71
	Infection	16 (30.20%)	37 (69.80%)	0.14	1.66	0.83-3.30
	Trauma	6 (28.60%)	15 (71.40%)	0.58	1.40	0.51-3.80
	Tumors & Cysts	15 (19.70%)	61 (80.30%)	0.44	0.76	0.39-1.50
	NPH	2 (28.60%)	5 (71.40%)	0.66	1.36	0.25-7.26
	ICH	8 (22.90%)	27 (77.10%)	0.99	1.00	0.42-2.36

EVD: External Ventricular Drain; NPH: Normal Pressure Hydrocephalus; ICH: Intracerebral Hemorrhage; OR: Odds Ratio; CI: Confidence Interval

The causes of shunt revisions are presented in (Table 2).

Table 2. Causes of Revision.

S.N	Causes	No.	Percentage
1	Blockage	18	33.30
	Proximal end	9	50
	Shunt chamber	3	16.67
	Distal end	6	33.33
2	Infected/SSI	19	35.20
3	Shunt Extrusion	6	11.10
4	Malposition	7	13
5	Migrated	3	5.60
6	Overdrainage	1	1.90

SSI: Surgical site infection.

The time interval from initial VP shunt insertion to first revision is presented in (Table 3).

Table 3. Time interval from insertion of shunt to first revision

S.N	Time since insertion of VP shunt	No. of cases requiring Revision of shunt	Percentage
1	Less than 3 Months	23	42.60
2	3-6 Months	11	20.40
3	6-12 months	20	37
	Total	54	100

Out of the revised shunts, 75% had one revision, 13% cases had two revisions, 6.30% had three revisions and 1.90% had four revisions within one year of the study period.
There were 155 (65.4%) males and 82 (34.6%) females. The mean age of the patients was 32.10 years (SD 21.84), ranging from three months to 82 years. The cause of hydrocephalus requiring VP shunt are presented in (Table 4)

Table 4. Causes of Hydrocephalus

Causes of Hydrocephalus requiring VP Shunt	Frequency	Percentage
Congenital	40	16.88
Aqueductal Stenosis	16	
Arachnoid Cyst	7	
Dandy Walker Syndrome	7	
Meningomyelocele	6	
Chiari Malformation	4	

Infarction	5	2.11
Infection	53	22.36
Tubercular Meningitis	25	
Bacterial meningitis	23	
Abscess	5	
Trauma	21	8.86
Tumors & Cysts	76	32.07
Ventricular Tumors	11	
Cerebello-Pontine Angle Lesions (CPA)	11	
Cerebellar Astrocytoma	10	
Ventricular Cysts	10	
Thalamic Glioma	9	
Sellar/Suprasellar Tumors	7	
Medulloblastoma	7	
Brainstem Glioma	5	
Pilocytic Astrocytoma	5	
Tectal Plate Glioma	1	
Normal Pressure Hydrocephalus (NPH)	7	2.95

Intracerebral Hemorrhage (ICH)	35	14.76
Supratentorial	16	
Subarachnoid Hemorrhage (SAH)	12	
Posterior Fossa	4	
Intraventricular Hemorrhage (IVH)	3	

DISCUSSION

Though ventriculoperitoneal (VP) shunt is one of the commonest neurosurgical procedures performed worldwide, complications are equally high and cumbersome to manage. The failure rates due to various complications of VP shunt requiring shunt revision have been reported as high as 11 to 25% in literature within the first year of shunt insertion. [1,8-10] In our institute we had 22.78% cases of VP shunt requiring at least one revision within one year of placement of VP shunt which is in accordance with various other published data.

The commonest cause of shunt failure are shunt blockage and shunt infection. In our study, out of all shunt revisions we had 19 cases of shunt infection (35.2%) and 18 cases of shunt blockage (33.3%). Risk factors for shunt infections predominantly includes young age, previous shunt infections, etiology of intraventricular hemorrhage, glove holes during shunt handling and post-operative CSF leakage. Shunt infections mostly occur due to inoculation of microbes during VP shunt placement however they might also occur due to hematogenous spread, peritonitis and abdominal pseudocyst.[11,12] In our institute we follow strict non touch technique while handling the shunt hardware, allow limited people in operating theatre during shunt surgery and use meticulous pre-cleaning of the surgical site with a solution of Chlorhexidine Gluconate(7.5%), Cetrimide (16%) and Isopropyl Alcohol (6.8%) followed by three coats of Povidine-Iodine.

Obstruction of shunt is another most common cause of shunt revision. In our study there were 18 cases (33.3%) of shunt obstruction out of all shunt revisions. Amongst blockage of shunt, nine cases (50%) had proximal catheter blockage, six cases (33.33%) had distal catheter blockage and three cases (16.67%) had blockage at chamber. The commonest site of shunt obstruction reported in literature is the proximal catheter.[2,13,14] Growth of choroid plexus within the shunt pores, collapsed ventricle after drainage of CSF which might compress the catheter, blood clots, tissue debris are the main factors responsible for blockage of proximal catheter.[14] The distal catheter obstruction is not as common as the proximal catheter and the most common cause of distal

obstructions are peritoneal debris, kinking of the tube and abdominal pseudocyst.[15]

Many studies have reported pediatric age group and male sex to be strong risk factors for VP shunt failure, however our study does not show any statistical significant difference in between age, gender or etiology of hydrocephalus and revision of VP shunt. [1,10]

In our study there was statistically significant difference between revisions of shunt when there was history of external ventricle drain (EVD) insertion prior to insertion of shunt. This may be due to introduction of infection, inflammation and resultant tissue reaction while placement of EVD. [16,17] Khan FR et al also have reported early shunt failure in patients who had EVD placement before VP shunt.[9]

In our study we also found that the odds of revision of shunt was 6.58 times higher when inserted through frontal approach than occipital. There are studies which suggest that complications related to obstructions are similar with both frontal and occipital approaches but others also report that obstruction of shunt is seen less commonly with frontal approach because the catheter is placed far anterior to foramen of Monroe and the choroid plexus. The occipital approach on the other hand has higher chances of placement of catheter nearer to the foramen of Monroe and the choroid plexus. Similarly, the placement of burr hole and trajectory of placement of catheter can also be highly inaccurate with occipital approach. [18-20] The higher rates of obstruction in our study may be due to the fact that frontal approaches were mostly done only in cases where EVD were placed before VP shunt insertion, otherwise we usually prefer occipital approach for VP shunt in our center.

The retrospective nature is one of the limitations of our study. Only those patients whose records were complete and retrievable were included in the study which could have introduced a selection bias. Results of this study could also be affected by technical factors like different surgeons and their expertise, preference of surgical approach and methods.

CONCLUSION

The rate of shunt revision in our study was 22.78% which is comparable to other studies. Frontal approach in VP shunt insertion was associated with increased rate of shunt failure thus requiring revision. Likewise, external ventricular drain placement prior to shunt surgery was associated with increased incidence of revision surgery. VP shunt infection and shunt blockage were the most common reason for shunt failure requiring revision.

CONFLICT OF INTEREST

None

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None

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