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*Original Article*

# *Comparison between Ventriculoatrial Shunt and Ventriculoperitoneal Shunt: Revision Rate and Complications*


**Korrapakc Wangtanaphat, MD**
**Porn Narischart, MD**

*Prasat Neurological Institute, Department of Medical Services, Ministry of Pubic Health, Bangkok, Thailand*



*Abstract*

*Background and Objective:* **Hydrocephalus is a common problem in neurosurgical field. In current clinical practice guidelines, ventriculoatrial shunt and ventriculoperitoneal shunt are recommended treatment options. No previous study reported differences between two procedures in term of complications and revision rates.**

*Methods:* **Chart review of all patients who underwent ventriculoatrial (VA) or ventriculoperitoneal (VP) shunts at the Prasat Neurological Institute, Bangkok, Thailand during 1 May 2012 and 31 October 2013 was carried out. Patients with previous VA or VP shunt operation were excluded. Complications and revision rate were recorded at the postoperative interval of one week, one month, and three months.**

*Results:* **Thirty eight patients were divided by surgeon preferences. Twelve underwent VA shunt surgery and 26 underwent VP shunt surgery. The rates of complications were 16.7% and 38.5% in the VA shunt and VP shunt respectively. Only 2 patients (7.7%) from VP shunt group required revision.**

*Conclusion:* **In this study, no difference in complications and revisions between VA and VP shunts was found. Patients with VP shunt placement were more likely to experience complications and revisions than patients with VA shunt placement.**



*Keywords:* **Ventriculoatrial shunt, ventriculoperitoneal shunt, revision rates, complications**


## INTRODUCTION

Hydrocephalus is a common problem in neurosurgical field which could be caused by congenital disorders, post infectious disorders, neurological disorders, vascular disorders and tumors.

In the past, there are many locations of the shunt available: right atrium of the heart (ventriculo-atrial), the peritoneal cavity (ventriculo-peritoneal), pleural cavity (ventriculo-pleural) and gallbladder. In current clinical practice guidelines, shunting to the right atrium


**Correspondence address:** *Korrapakc Wangtanaphat, MD, Prasat Neurological Institute, 312 Ratchawithi Road, Kwang Thung Phyathai, Khet Ratcha Thewi, Bangkok 10400, Thailand; Telephone: +66 2306 9899; E-mail: win0000000@gmail.com*

and the peritoneal cavity is recommended. However, both locations require revision surgery due to blockage of the shunt and other complications such as infection, seizures, circulation system complication, internal organ complication and death.

There are many researches about the comparison of ventriculoatrial (VA) and ventriculoperitoneal (VP) shunts but the researches do not provide statistically significant differences for the rate of revision and complications.

## Methods

There were 38 patients enrolled in the study. These patients either have ventriculoatrial (VA) or ventriculoperitoneal (VP) cerebrospinal fluid shunts for hydrocephalus or related conditions. The study was conducted at Prasat Neurological Institute, Bangkok, Thailand during 1 May 2012 and 31 October 2013.

Patients who underwent previous VA or VP shunt operations were excluded.

Patients were divided by surgeon preferences and the placement of either VA or VP shunts. The results were compared between the two groups (VA or VP shunts) using age, gender, diagnosis, underlying disease, the past surgical history, and the operative data.

Patients were followed postoperatively at one week, one month, and three months complication and revision.

### *Measurements*

Complications and revision rates between the two groups were compared.

### *Statistic analysis*

Statistical analysis was done with SPSS 15.0 for Windows. Continuous and categorical variables were expressed as median and interquartile range. Regarding categorical data, Fisher's exact was used. The significant level was set at 0.05.

**Table 1** Demographic data

| | VA | VP | *P* value |
|---|---|---|---|
| Population | 12 | 26 | |
| Sex | | | |
| Male | 8 (66.7%) | 9 (34.6%) | |
| Female | 4 (33.3%) | 17 (65.4%) | |
| Age | 59.0 | 58.5 | 0.540 |
| (Median, IQR) (47.25-61.50) | (51.50-71.75) | | |
| ASA | | | |
| 1 | 2 (16.7%) | 1 (3.8%) | |
| 2 | 8 (66.7%) | 14 (53.8%) | |
| 3 | 2 (16.7%) | 11 (42.3%) | |
| DM | 3 (25.0% | 7 (26.9%) | 1.000 |
| HbA1c | 5.4 | 5.4 | 0.468 |
| (Median, IQR) (90.75-145.00) | (102.25-145.50) | | |
| HT | 8 (66.7%) | 13 (50%) | 0.337 |
| Alcohol | 4 (33.3%) | 2 (7.70%) | 0.066 |
| Smoking | 3 (25.0%) | 3 (11.5%) | 0.357 |
| ESR | 26.5 | 30.0 | 0.950 |
| (Median, IQR) (11.50-58.75) | (17.75-55.20) | | |
| ANC | 4948 | 4969 | 0.660 |
| (Median, IQR) (4673-6457) | (3122-7253) | | |
| BMI | 23.95 | 22.70 | 0.066 |
| (Median, IQR) (23.00-29.97) | (18.90-24.70) | | |
| KPS | 65 | 50 | 0.179 |
| (Median, IQR) (35.0-87.5) | (30.0-62.5) | | |
| EVAN | 0.37 | 0.34 | 0.186 |
| (Median, IQR) (0.33-0.44) | (0.31-0.38) | | |

**Table 2** Preoperative data

| | | VA | VP | *P* value |
|---|---|---|---|---|
| Diagnosis | | | | |
| | Tumor | 2 (16.7) | 9 (34.6%) | |
| | Trauma | 1 (8.3%) | 1 (3.8%) | |
| | Vascular | 5 (41.7%) | 7 (26.9%) | |
| | NPH | 1 (8.3%) | 5 (19.2%) | |
| | Infection | 2 (16.7%) | 4 (15.4%) | |
| | Congenital | 1 (8.3%) | 0 (0%) | |
| Duration (Months) | 1.5 | 1.0 | 0.344 | |
| (Median, IQR) | (0.35-200) | (0.30-1.00) | | |
| Previous | | | | 0.180 |
| Operation | | | | |
| | Craniotomy | 7 (58.3%) | 15 (57.6%) | |
| | Cranioplasty | 3 (25%) | 0 (0%) | |
| | Other | 0 (0%) | 6 (23%) | |
| Prior Ventriculostomy | | 2 (16.7%) | 4 (15.4%) | 1.000 |

**Table 3** Operative data

| | | VA | VP | *P* value |
|---|---|---|---|---|
| Position | | | | |
| | RF | 7 (58.3%) | 13 (50.0%) | |
| | LF | 3 (25.0%) | 8 (30.8%) | |
| | RP | 2 (16.7%) | 5 (19.2%) | |
| Shunt | | | | 0.504 |
| | Adjustable | 4 (33.3%) | 12 (46.2%) | |
| | Low | 0 (0%) | 1 (3.8%) | |
| | Medium | 8 (67.7%) | 13 (50.0%) | |
| Duration time | 90 | 70 | 0.039 | |
| (Minutes) | (75.00-116.25) | (60.00-91.25) | | |
| (Median, IQR) | | | | |
| Blood loss (ml) | 35 | 20 | 0.098 | |
| (Median, IQR) | (22.5-87.5) | (17.5-50.0) | | |
| Type of Wound | | | | 1.000 |
| | Clean | 9 (75.0%) | 19 (73.1%) | |
| | Clean-Contaminated | 3 (25.0%) | 7 (26.9%) | |
| CSF profile | | | | |
| | WBC | 5.0 | 0.0 | 0.118 |
| | (Median, IQR) | (0.00-7.00) | (0.00-5.25) | |
| | PMN | 0.5 | 0.0 | 0.550 |
| | (Median, IQR) | (0.00-72.25) | (0.00-0.00) | |
| | RBC | 92.5 | 75.0 | |
| | (Median, IQR) | (0.00-912.00) | (0.00-1525.00) | |
| | Protein | 63.5 | 37.5 | 0.540 |
| | (Median, IQR) | (13.00-17500) | (12.20-123.50) | |
| | Sugar | 62.,0 | 67.5 | 0.838 |
| | (Median, IQR) | (43.00-90.25) | (57.00-7475) | |

## Results

From the study, the total of 38 patients received the treatment for hydrocepholus, 12 patients underwent VA shunt surgery and 26 patients underwent VP shunt surgery.

Table 1 represents basic characteristic of 38 patients demographically. The majority of patients who underwent VA shunt surgery are in ASA class 2, which accounts for 66.7%. The patients who underwent VP shunt were in ASA class 2 for 53.8% and class 3 for 42.3%. For Evans ratio in VA group 0.37 (0.33-0.44) and in VP group 0.34 (0.31-0.38).

In Table 2 the main cause of the disease in VA shunt populations was the vascular, which accounted to 41.7% of the overall enrolled patients. In the VP shunt group, the diseases were caused by tumor and vascular, which accounted for 34.6% and 26.9% respectively from the total enrolled patients.

The average progress period of the disease was 1.5 month and 1 month respectively.

Table 3 shows the operation durations of the two procedures. For VA shunt placement, the mean duration of the operation was 90 minutes (range 75 - 116.25 minutes). For VP shunt placement, the mean duration of the operation was 70 minutes (range 60 - 91.25 minutes) ($p = 0.039$).

**Table 4** Complications

| | VA (n=12) | VP (n=26) | *P* value |
|---|---|---|---|
| Complication | 2 (16.7%) | 10 (3.85%) | 0.268 |
| Infection | 0 (0%) | 4 (15.3) | 0.287 |
| Revision | 0 (0%) | 2 (7.7%) | 0.287 |

In the VA shunt group the mean operative blood loss was 35 ml (range 22.5-87.5 ml) and in the VP shunt group, the mean operative blood loss was 20 ml (range 17.5-50.0 ml) ($p = 0.098$).

The rate of complications in the VA shunt group was 16.7% (2 out of 12 patients) and in the VP shunt group 38.5% (10 out of 26 patients) ($p = 0.268$). Out of 26 patients from the VP shunt group, only 4 patients (15.3%) had procedure-related infections ($p = 0.287$). Only 2 patients from VP shunt group (7.7%) required revision as shown in Table 4.

The detailed explanations of complications in these patients were stated in Table 5.

**Table 5** Complications cases

| Case No. | Sex | Age | VA/VP | Diagnosis (Days) | Duration | Complication | Treatment |
|---|---|---|---|---|---|---|---|
| 4 | Male | 58 | VA | Right Basal Ganglion Hemorrhage | 153 | Seizure | AED |
| 7 | Female | 35 | VA | Sparganosis | 325 | Slit Ventricle | Supportive treatment |
| 14 | Male | 58 | VP | Brain Stem Glioma | 35 | Distal end Malposition | Revision |
| 15 | Male | 64 | VP | Left Frontal OG | 3 | Meningitis (MRSA) | Systemic ATB |
| 17 | Female | 65 | VP | Left ICA Aneurysm | 225 | Wound dehisence Meningitis | Externalization Revision |
| 19 | Male | 17 | VP | Encephalitis | 32 | SDH | Supportive treatment |
| 26 | Female | 57 | VP | Meningitis | 41 | Isolated Hydrocephalus | Second VP shunt |
| 29 | Female | 58 | VP | Tuberculum Meningioma | 34 | Wound dehisence | Dressing |
| 32 | Male | 74 | VP | NPH | 40 | Skin infection | Dressing |
| 33 | Male | 71 | VP | NPH | 10 | Meningitis | systemic ATB |
| 37 | female | 86 | VP | Left Thalamic Hemorrhage | 31 | (Meninitis Sustemic ATB | |

## Discussion

In comparison between ventriculoatrial and ventriculoperineal shunts, the study showed no significant difference in related complications and the rate of revisions. However, the findings of this study appear to contradict previous studies mentioned below.

In 1975, RJ.Iynelzi found that VA developed more serious complications than VP shunt[4]. Olsen L. conducted research on 172 children and found that VP shunt had more complications but lesser degree of severity, and the procedure was easier and faster to perform[6]. Fernell found that VP had higher risk of infection but complications from VA were more severe[7]. In 1997, CH. CAM conducted retrospective research and found that two groups had similar complications

but VP case of placement had lesser severity of potential complication[10].

Complications associated with VA shunt from the previous studies include endocarditis[13], pulmonary hypertension[14], nephritis and overdrainage of CSF[12]. This study only found Slit Ventricle Syndrome condition in patients and the patients were asymptomatic. There were no additional complications observed in this study.

Even though the study could not be obviously concluded in term of the difference in complications and revisions between VA and VP shunts, patients with VP shunt placement were more likely to experience complications and revisions than patients with VA shunt placement. This finding may be due to cautiousness of staff when performing vascular surgery and the longer surgery time spent during VA shunting than in VP shunting. Additionally, patient selection might contribute to the result of this study as well.

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