

Effect of Fixed-setting Versus Programmable Valve on Incidence of Shunt Revision after Ventricular Shunting for Normal Pressure Hydrocephalus

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Introduction

Shunt revision surgery is often necessary for patients with normal pressure hydrocephalus (NPH). We compared shunt revision rates between patients receiving a fixed-setting (FSV) versus programmable valve (PV).

Methods

Patients with NPH treated with ventricular shunting between 2001 and 2017 were included for analysis. The incidence of shunt revision was determined from the electronic medical record, and the indication for revision was categorized as follows: proximal obstruction, distal obstruction, infection, overdrainage, or no obstruction with persistent symptoms. Risk factors for revision subtypes were identified using a Cox proportional hazards model.

Table 1

Table 1. Outcomes of initial ventriculoperitoneal shunt placement	
Patients, n	348
Age, years	73.2
Female (%)	124 (35.6)
Valve-Type (%)	
Fixed-Setting	250 (71.8)
Programmable	98 (28.2)
Patients Requiring Revision surgery, n (%)	73 (21.0)*
Distal Malfunction	18 (5.2)
Infection	13 (3.7)
Overdrainage	14 (4.0)
Persistent Symptoms without Obstruction	24 (6.9)
Ventricular Catheter Obstruction	6 (1.7)
Multiple Revisions	12 (16.4)

Table 2

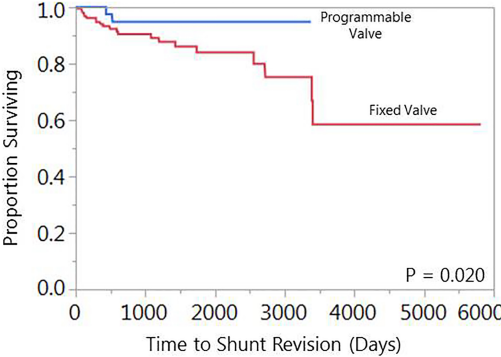
Table 1. Multivariate cox proportional hazards model determining predictors of revision surgery due to persistent symptoms		
Variable	OR (95% CI)	P-Value
Age	1.02 (0.97-1.08)*	0.331
Programmable Valve	0.25 (0.04-0.87)	0.027

* Unit Risk ratio denotes the increase in risk per one unit increase in variable

Results

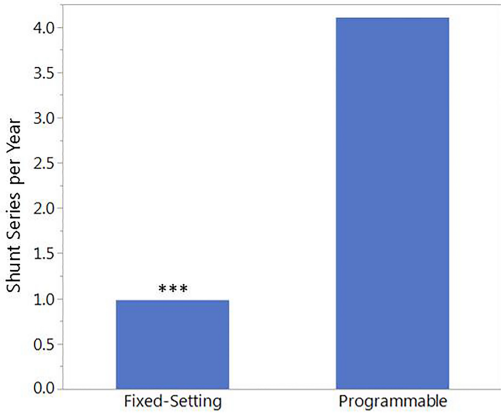
There were 348 patients included for analysis, with 98 patients (28.1%) receiving a PV. Shunt revision occurred in 73 patients (21.0%), with 12 patients (3.4%) undergoing multiple revisions. Overall revision rates were lower in patients receiving a PV (13.3% vs 24.0%; p = 0.027), and all patients undergoing multiple revisions initially received a FSV. Patients with a PV were less likely to undergo revision due to distal obstruction (1.0% vs 6.8%; p = 0.030) and persistent symptoms without obstruction (2.0% vs 8.8%; p = 0.032). On multivariate analysis, increasing age (Unit RR 0.93, 95% CI 0.90-0.96; p = 0.001) and PVs (RR 0.18, 95% CI 0.01-0.90; p = 0.035) were associated with reduced risk of distal obstruction, and PVs were associated with reduced risk of revision due to persistent symptoms without obstruction (RR 0.26, 95% CI 0.04-0.91; p = 0.032). PVs were associated with more frequent shunt series during follow-up (4.1 vs 1.0 x-rays/follow-up year; p < 0.001), but not more frequent head CT scans (4.8 vs 3.9 CTs/follow-up year; p = 0.26).

Figure 1. Kaplan-Meier Curve



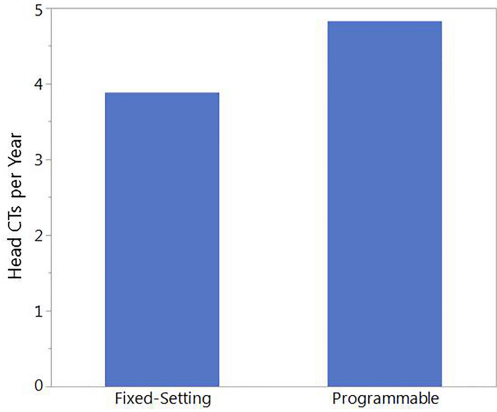
Time to revision surgery due to persistent symptoms for patients with programmable versus fixed-setting valves.

Figure 2. Shunt Series per Year



Comparison of number of shunt series for fixed-setting versus programmable valves

Figure 3. Head CTs per year



Comparison of number of head CTs of fixed-setting versus programmable valves

Conclusions

Our results suggest that programmable valves lead to reduced rates of shunt revision in patients with NPH. Despite the increased cost of PVs, they may be cost-effective.

Learning Objectives

By the conclusion of this session, participants should be able to: 1) identify shunt revision subtypes that are more common in patients with normal pressure hydrocephalus treated with a fixed setting valve.