Cerebrospinal Fluid Shunting After Pediatric Fellowship Training: Failure Rates and Economic Considerations

Jonathan Jay Stone MD; Corey Walker BS; Minal Jain MD; Maxwell Jacobson; Valerie Phillips; Howard J. Silberstein MD, FACS

University of Rochester Medical Center, Department of Neurosurgery

Introduction

Simiar to our recent report on ventriculoperitoneal shunt failure rate [2], a study from The National Hospital in Norway demonstrated that 81% of patients needed at least 1 revision and required a mean of 4.2 revisions.[1]

Fellowship training was shown to improve outcomes in other pediatric specialties. Smith et al. compared the management of pediatric femoral shaft fractures between children's and community hospitals. They found that patients at community hospitals were more likely to undergo surgery versus immediate casting, stayed longer (2.8 vs 8.9 days) and spent more than double the hospital charges.[3] Another study by Snow et al. compared ureteral reimplantation by pediatric versus general urologist and demonstrated that the trained surgeons spent both less time and charges in the operating room.[4]

We reviewed 20 years of cerebrospinal fluid shunting procedures to elucidate risk factors for failure and differences in care delivered between a pediatric neurosurgeon and faculty without fellowship accreditation.

Methods

- Retrospective review from 1990-2011 using billing codes for shunting
- Study author HJS began in 2001 as sole pediatric neurosurgeon
- Comparisions between HJS and other faculty performed using Chi Squared, Fishers' Exact, ANOVA, Kaplan-Meier Log Rank

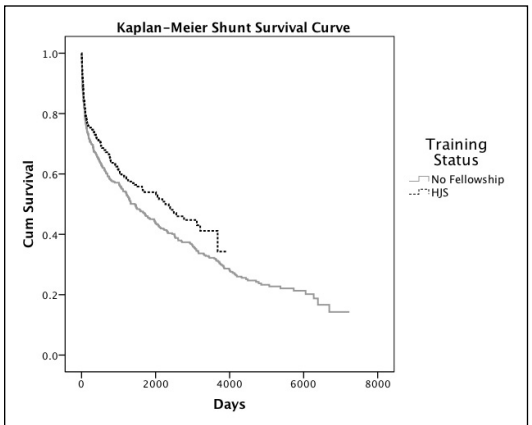
Results

We reviewed 343 patients who underwent a total of 849 procedures. Including HJS who performed 352 procedures (41.5%), there were 23 total surgeons. Overall, there was a 57% shunt failure rate with a mean follow up of 9.3 years. While HJS experienced 150 (42.6%) failures, other faculty members collectively performed 326 revisions (65.6%, p <0.001). A Kaplan-Meier Curve showed a corresponding beneficial difference in survival (Figure 1, p = 0.037). There was also a trend for shorter length of stay associated with procedures by HJS (median 4 days versus 6, p = 0.096). Several factors may have contributed to these differences including a more diverse patient population from referrals, the predilection for frontal catheter placement, and the use of medium pressure valves.

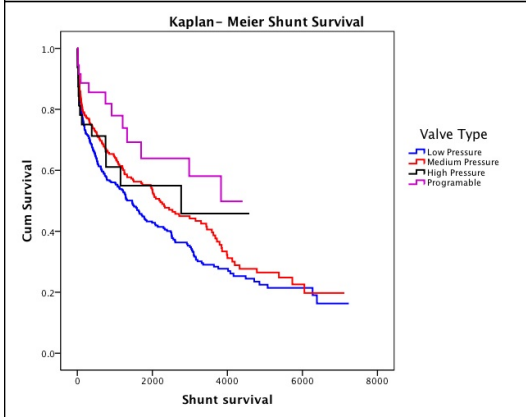
Reason for Revision	Overall (%)	HJS	Others	p value
Catheter Obstruction	219 (25.8)	90 (25.6)	129 (26)	0.937
- Proximal	174	78	96	**0.028**
- Distal	45	12	33	
Equipment Failure	89 (10.5)	20 (5.7)	69 (13.9)	**<0.001**
Failed Independence Attempt	44 (5.2)	23 (6.5)	21 (4.2)	0.157
Valve Selection	30 (3.5)	13 (3.7)	17 (3.4)	0.852
Infection	46 (5.4)	22 (6.3)	24 (4.8)	0.227
Shunt Tie-off/Removal	7 (0.8)	2 (0.6)	5 (1.0)	0.706
Perioperative Complication	4 (0.5)	3 (0.9)	1 (0.2)	0.313
Unknown	23 (2.7)	5 (1.4)	18 (3.6)	0.056

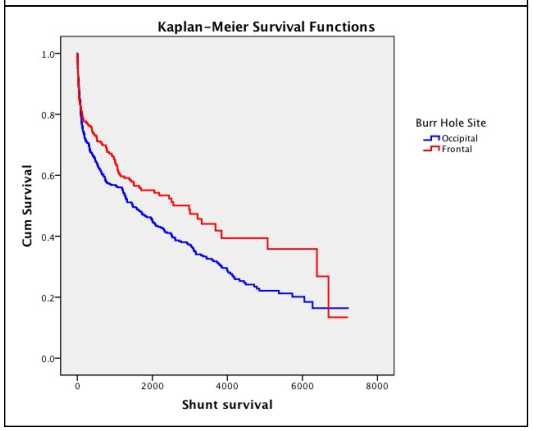
Catheter Obstruction	Proximal or Distal, Non absorbing peritoneum
Equipment Failure	Tube Migration, Disconnection, or Break, Valve Failure
Failed Independence	EVD, SDH, Subgaleal or ETV to Shunt, Reimplant After Removal
Valve Selection	Overdrainage or Underdrainage
Infection	Staph, Strep, P.Acnes, Citrobacter, Pseudomonas, E.Coli, Hemophilus, Kelbsiella
Shunt Removal	Shunt Removal or Tie
PostOp Complication	Hematoma, New Neurological Deficit, Trapped 4th
Unknown	

	HJS	Others	p value
Age at Shunt	2.24 yr	2.32 yr	0.769
Public Insurance	41.7%	31.7%	0.052
Premature	38.3%	15.8%	<0.001
Failure from OSH	4.8%	5.0%	1.000
Follow-up Time	5.18 yr	12.8 yr	<0.001
Average number revisions	0.77	1.69	<0.001
No Revision	52.4%	37.1%	0.003
EBL	15 cc	49 cc	0.014
Median Stay	4 days	6 days	0.096
Non-VPS (VA,VPl, ETV, Subgaleal)	15.7%	9.8%	0.014
Bactiseal Use after 2005	78%	37.1%	<0.001
Frontal Catheter Placement	61%	18.1%	<0.001



Valve Pressure Selection	HJS %	Others %	p value
Low	30.8	53.6	<0.001
Medium	51.1	37.9	<0.001
High	9.2	0.9	<0.001
Programable	5.6	4.4	0.490





Conclusions

Pediatric subspecialization appeared to positively impact shunt survival. While the explanation is likely multifactorial, we demonstrated that our single pediatric trained faculty member had a lower revision rate and trended towards shorter length of stay. This equates to decreased patient morbidity and tremendous cost savings.

Factors related to training we would like to highlight include:

- Use of VPS alternatives (ETV, Subgaleal shunt, etc.)
- Lower distal failure rate and equiptment failure
- Up-to-date knowledge of literature (ie: Bactiseal use)
- Catheter placement and valve selection preference
- Ability to treat younger/complex patients

References

1.Paulsen AH, Lundar T, Lindegaard KF. Twenty-year outcome in young adults with childhood hydrocephalus: assessment of surgical outcome, work participation, and health-related quality of life. J Neurosurg Pediatr 2010;6:527-35.
2.Stone JJ, Walker CT, Jacobson M, Phillips V, Silberstein HJ. Revision rate of pediatric ventriculoperitoneal shunts after 15 years. J Neurosurg Pediatr 2013;11:15-9.
3.Smith JT, Price C, Stevens PM, Masters KS, Young M. Does pediatric orthopedic subspecialization affect hospital utilization and charges? J Pediatr Orthop 1999;19:553-5.
4.Snow BW, Catwright PC, Young MD. Does surgical subspecialization in pediatrics provide high-quality, cost-effective patient care? Pediatrics 1996;97:14-7.