

# Post-hemispherectomy Hydrocephalus in Children: Results of a Comprehensive, Multi-institutional Review

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Hemispherectomy Hydrocephalus  
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# Introduction

- Hemispherectomy surgery for medically intractable epilepsy causes hydrocephalus in a subset of patients.
  - What is the incidence?
  - What are the risk factors?
  - What is the timing of onset?
  - Why the variability in timing?
- Data has been limited by small number of cases at any given center

Year	N	Surg details	HCP Incidence	Reference
1993 Davies et al	<b>N=17</b>	All AH	3/17 ( <b>18%</b> )	J Neurosurg 78: 733-740
1996 Carson et al	<b>N=52</b>	2AH, 50 HD, 3 periop deaths	16/49 ( <b>33%</b> )	J Neurosurg 84: 903-911
1996 Peacock et al	<b>N=54</b>	27 AH, 27 FH	AH 22/27 ( <b>81%</b> ) FH 3/27 ( <b>11%</b> )	Child's Nervous System 12:376-384
2000 DiRocco et al	<b>N=15</b> (All hemimeg)	11 AH, 2 FH, 2HD	AH 3/11 ( <b>27%</b> ) FH & HD ( <b>each 50%</b> )	Pediatric Neurosurg 33:198-207
2004 Cook et al	<b>N=115</b>	37AH ,32 FH, 46 PIH	29/37 AH ( <b>78%</b> ), 3/32 FH ( <b>9%</b> ), 10/46 ( <b>22%</b> )	J Neurosurg (Pediatrics 2) 100:125-146
2005 Gonzalez-Martinez et al	<b>N=18</b>	4 AH, 13 FH, 3 Mod AH	2/18 ( <b>11%</b> )	Epilepsia 46(9): 1518-1525
2007 Basheer et al	<b>N=22</b>	HD, PIH	2/22 ( <b>9%</b> )	Epilepsia 48(I): 133-140
2010 Kwan et al	<b>N=24</b>	5 HD, 19 PIH	2/23 ( <b>9%</b> )	Neurosurgery 67:429-436

AH=Anatomic hemispherectomy, HD=Hemidecortication, FH=Functional hemispherectomy, PIH=Periinsular hemispherotomy

# Methods

- Fifteen pediatric epilepsy centers participated in this study
- A retrospective chart review was performed on all available patients who had hemispherectomy surgery
- Two-tiered de-identified data collection system

## Center

Children's Hospital-Denver

Children's Hospital of WI-Milwaukee

Cook Children's Hospital-Fort Worth

Duke University Med Center-Durham

Johns Hopkins Hospital-Baltimore

Medical College of Georgia-Augusta

National Center for Neurology and Psychiatry-Tokyo

Nationwide Children's Hospital-Columbus

NYU-NYC

Phoenix Children's Hospital

Sanbo Brain Institute-Beijing


Seattle Children's Hospital

UCLA

University of Alabama-Birmingham

Wayne State-Detroit

# Methods

- First tier data collected on all Hemi patients
  - Basic demographics
  - Etiology of epilepsy
  - Surgical technique
    - Anatomic, functional, hemicortectomy
    - Any resection of basal ganglia or thalamus tissue?
    - Use of hemostatic adjuncts, EVD
  - Post-operative infection
  - Prior resective brain surgery?
  - Pre-existing CSF shunt?  Excluded from analysis

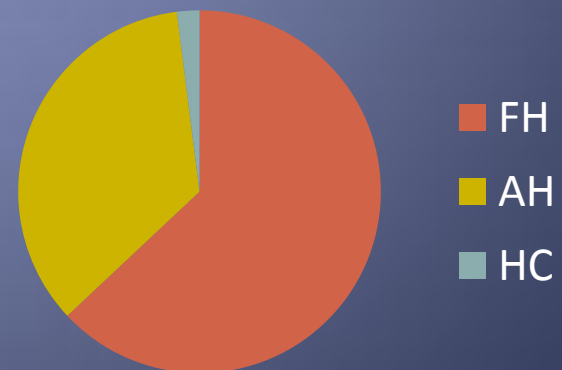
# Methods

- Second tier data collected on subset of patients who developed HCP requiring shunt placement or ETV (n=1)
  - Time to shunt placement
  - Presenting symptoms and signs
    - Headache, emesis, diminished LOC, cognitive decline, behavioral issue, wound issues
  - Presenting imaging changes?
  - Confirmatory studies
    - ICP monitoring, diagnostic LP, temporary CSF drainage, other invasive diagnostics
- Multivariate logistic regression analysis with a fixed effect controlling for center was performed

# Results

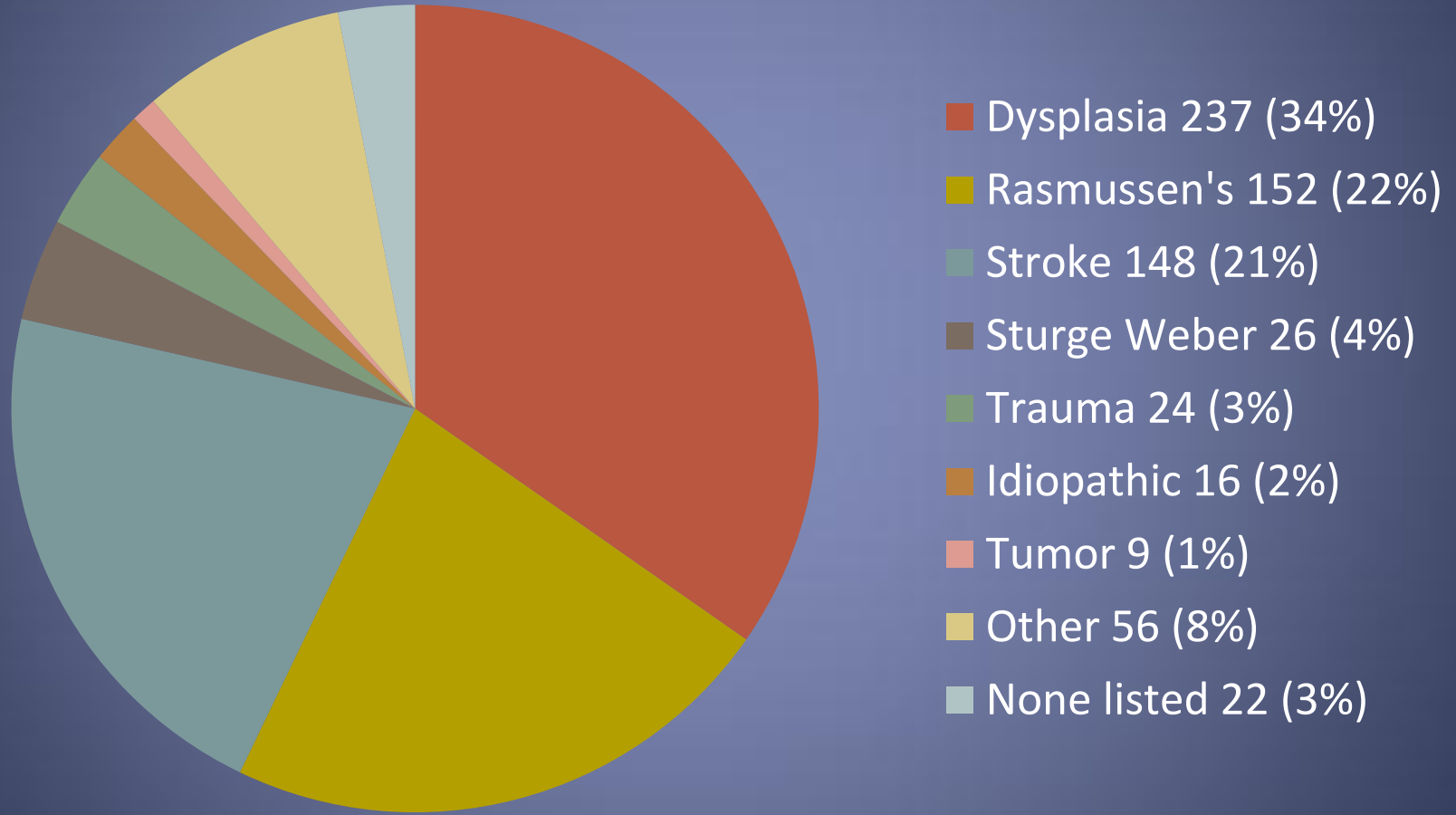
- Data were collected on 736 patients who had hemispherectomy surgery between 1986 and 2011.
- Male: Female 367:369
- Age range 0.1 year to 42 years
- Follow-up ranged from 21.5 mos to 302 mos, but F/U data was incomplete on 45 patients
- 46 patients had pre-existing shunts-EXCLUDED
- **n=690**

Functional	435 (63%)
Anatomic	244 (35%)
Hemicorticectomy	11 (2%)

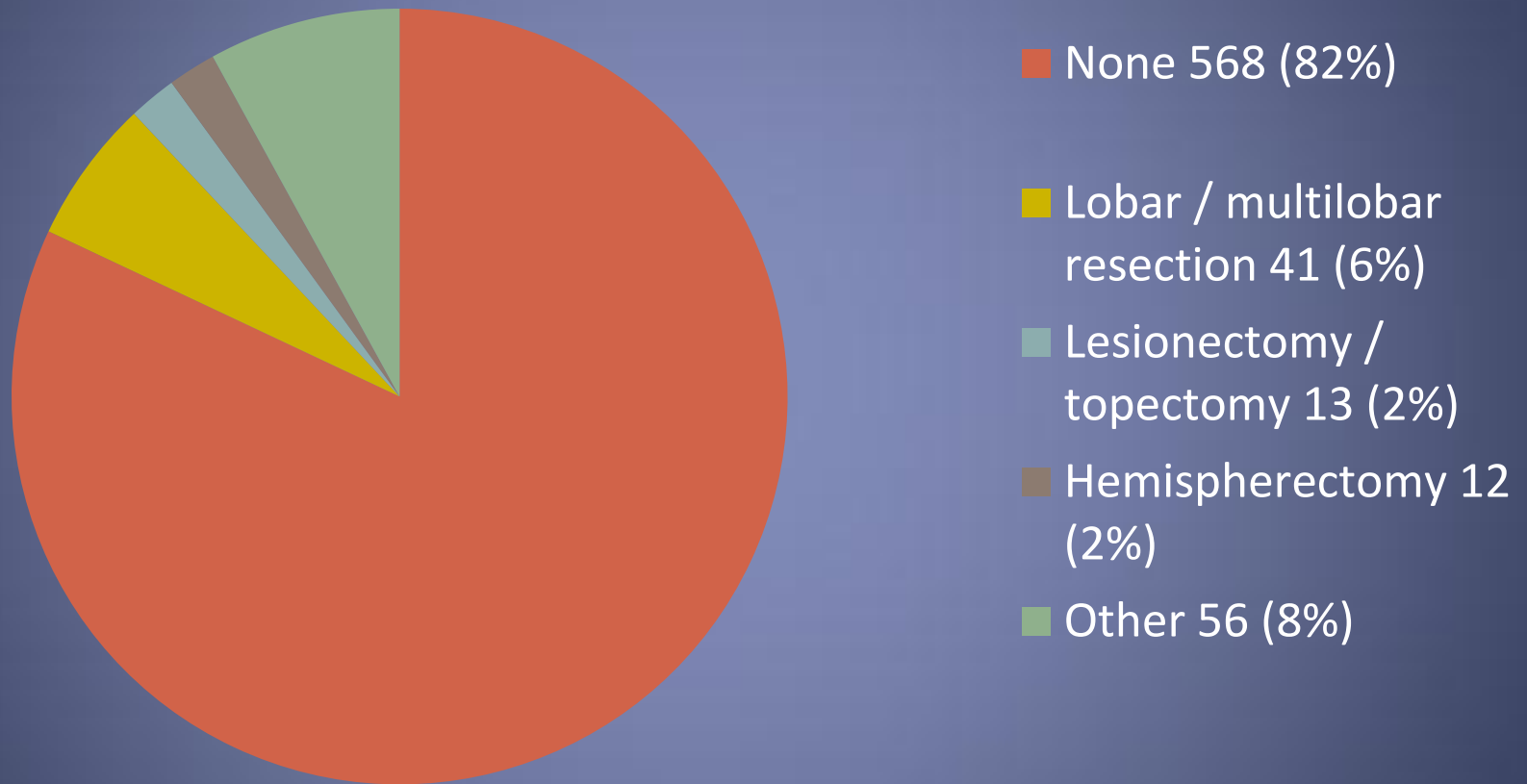




# Etiology of epilepsy



# Prior resective surgery



(12 patients had two prior surgeries and 6 patients had three prior surgeries)

# Basal ganglia and/or thalamus included in resection

No	461/690 (67%)
Yes	219/690 (32%)
Unknown	10/690 (1%)

# Perioperative EVD use

Yes	485/690 (70.3%)
No	196/690 (28.4%)
Unknown	9/690 (1.3%)

# Post-operative infection

No	640/690 (93%)
Yes	50/690 (7%)

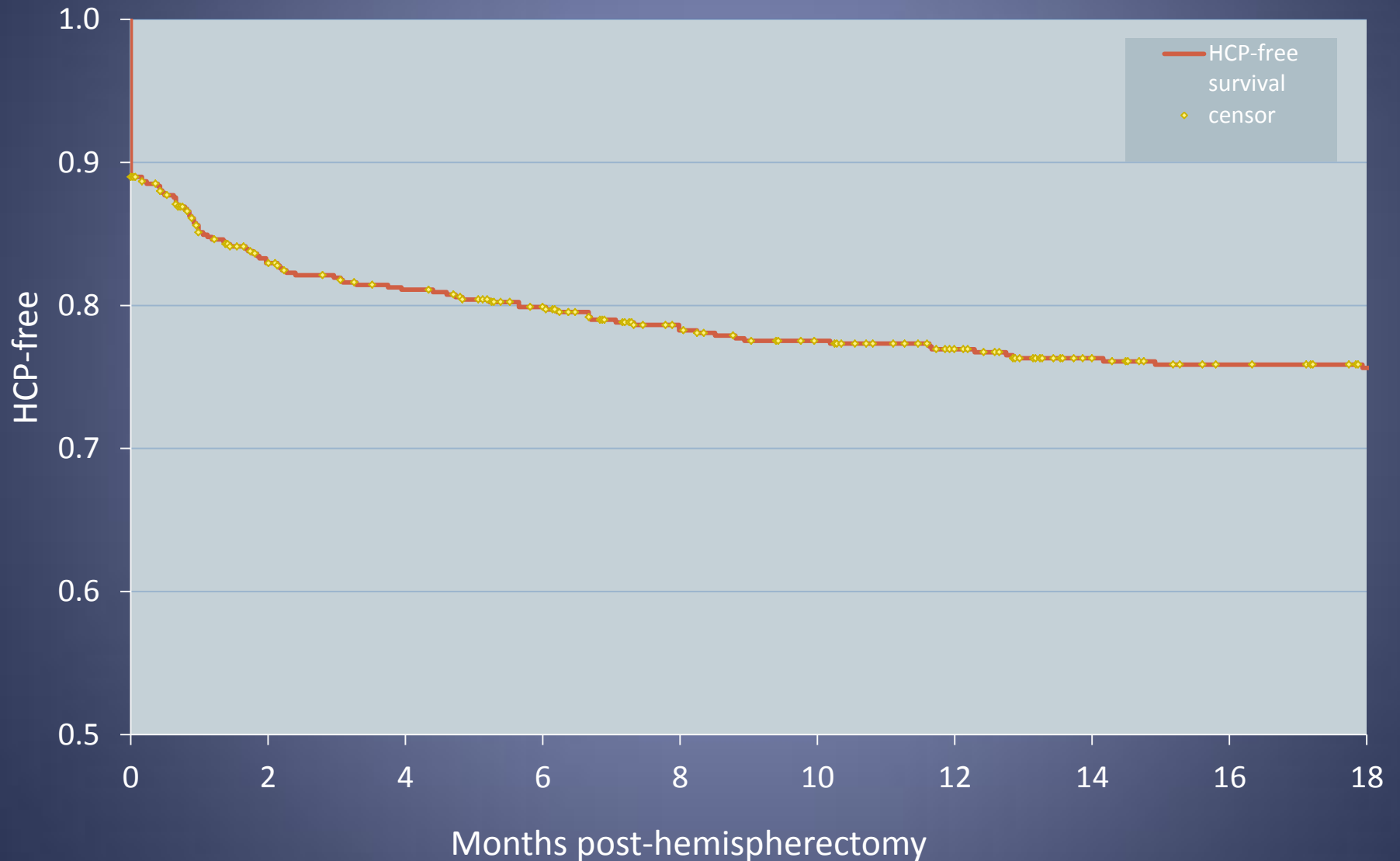
# Results-HCP incidence

- 162/690 (23%) patients required HCP treatment (shunt or ETV)
- 1/11 (9%) Hemicortectomy patients developed HCP. Due to low power, these patients were excluded from the multivariate regression analysis.
- 161/679 (24%) FH and AH patients developed HCP and further multivariate regression analysis was performed
- Of these 24%, 118/161 (73%) were treated “early” (within 90 days) and 43/161 (27%) were treated “late”

# Time to develop hydrocephalus



# Time to develop hydrocephalus



# Predictive variables – Univariate

Variable	Early			Ever		
	N(%)	OR (CI)	p	N(%)	OR (CI)	p
Anatomic vs Functional	53/244 (22%) vs 65/435 (15%)	6.1 (3.1,12)	<.0001	74/244 (30%) vs 87/435 (20%)	4.2 (2.3,7.6)	<.0001
BGT resection Yes vs No	73/219 (33%) vs 45/471 (10%)	4.1 (1.6, 10)	.0035	75/129 (34%) vs 87/471 (18%)	2.8 (1.2,6.6)	0.0161
Prior resection Yes vs No	21/122 (17%) vs 97/568 (17%)	2.1 (1.1,3.8)	0.0163	32/122 (26%) vs 130/568 (23%)	1.7 (1.1,2.9)	0.0281

# Predictive variables - Multivariate

Variable	Early			Ever		
	N(%)	OR	p	N(%)	OR	p
Anatomic vs Functional	53/244 (22%) vs 65/435 (15%)	5.4 (2.8,11)	<.0001	74/244 (30%) vs 87/435 (20%)	3.8 (2.1,6.9)	<.0001
BGT resection Yes vs No	73/219 (33%) vs 45/471 (10%)	3.0 (1.1,8.1)	0.0344	75/129 (34%) vs 87/471 (18%)	2.2 (0.9,5.2)	0.0801
Prior resection Yes vs No	21/122 (17%) vs 97/568 (17%)	2.0 (1.1,3.8)	0.0215	32/122 (26%) vs 130/568 (23%)	1.7 (1.0,2.8)	0.0377



# Results - Non-predictive variables

Variable	Early		Ever	
	OR	P-value	OR	P-value
Etiology	---	0.3268	---	0.5012
Hemostatic adjunct	---	0.9537	---	0.3535
Post-op EVD	0.72	0.6417	0.84	0.7513
Post-op infection	1.61	0.3303	1.54	0.2526

# Results-HCP presentation and work-up

Presenting signs or sx	Incidence
Failure to wean drain	48%
Change in imaging findings	41%
Headache	23%
Emesis	23%
Diminished LOC	22%
Other neurologic symptoms	12%
Cognitive decline	8%
Behavioral changes	8%
Wound issues	8%

Evaluation	Incidence
Temporary CSF drainage	14%
Diagnostic LP	10%
ICP monitoring	4%
Other invasive test	1%

No significant differences between  
“early” and “late” patients

# Conclusions

- Hydrocephalus is a common sequela of hemispherectomy surgery
- Surgical technique and prior brain surgery influence the occurrence of post-hemispherectomy hydrocephalus
- A significant portion of patients develop hydrocephalus on a delayed basis, indicating the need for long-term surveillance.

# Acknowledgements

Data analysis provided by Daniel Eastwood, Biostatistician with the Medical College of Wisconsin, supported IN PART by grant 1UL1RR031973 from the Clinical and Translational Science Award (CTSA) Program of the National Center for Research Resources, National Institutes of Health.

