

Outcomes of Treated Aneurysms in the Pediatric Population: Analysis of Time to Treat and Identification of Prognostic Indicators

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Introduction

Aneurysmal subarachnoid hemorrhage is a much rarer entity in the pediatric population relative to adults. Few studies have examined their treatment outcomes. Recent studies suggest that early treatment of ruptured aneurysms in adults yield improved perioperative outcomes, but this has not been thoroughly examined in the pediatric population. In this study, we retrospectively evaluate the relationship between patient- and treatment-related factors and perioperative outcomes for subarachnoid hemorrhage in the pediatric population and identify predictors of outcome.

			Complication			Mortality			Routine Discharge		ve.
	n	%	n n	%	р	n	%	p	n	%	g
Total	168		62	36.7		4	2.4		131	77.5	
Time to treat											
(hrs)					0.188			0.209			0.716
≤48	115	77.1	16	45.7		3	2.0		28	80.0	
	35	22.9									
>48			42	35.6		0	0		91	77.1	
Age (yrs)					0.052			0.354			0.087
0-9	33	19.6	17	51.5		0	0.0		30	90.0	
10-14	51	30.4	21	41.2		1	0.6		37	72.6	
15-18	84	50.0	24	28.6		3	1.8		64	76.2	
Sex					0.710			0.836			0.325
Male	92	55.1	33	35.9		2	2.2		69	75.0	
Female	75	44.9	29	38.7		2	2.7		61	81.3	
Race					0.887			0.735			0.875
White	61	50.4	22	36.1		2	1.7		47	77.1	
Black	21	17.4	8	38.1		0	0.0		15	71.4	
Hispanic	22	18.2	11	50.0		0	0.0		18	81.8	
Asian	3	2.5	1	33.3		0	0.0		2	66.7	
Nat.Amer.	4	3.3	1	25.0		0	0.0		3	75.0	
Other	10	8.26	4	40.0		0	0.0		9	90.0	
Adm. Source					0.014			0.948			0.040
ED	51	31.1	27	52.9		1	2.0		37	72.6	
Transfer	40	24.4	15	37.5		1	2.5		29	72.5	
Health Fac.	6	3.7	2	33.3		0	0.0		2	50.0	
Routine	67	40.9	16	23.9		1	1.5		59	88.1	
					< 0.000						
EVD		0.0			1			0.909			0.006
Yes	38	22.6	38	100		1	2.63		23	60.6	
No	130	77.4	24	18.3		3	2.31		108	82.4	
Intervention					0.011			0.497			0.063
Clip	95	59.0	43	45.3		3	3.16		69	72.6	
Coil	66	41.0	17	25.8		1	1.52		56	84.9	
Severity score'					< 0.001			0.079			0.009
1	15	12.1	0	0.0		0	0.0		14	93.3	
2	46	37.1	7	15.2		0	0.0		41	89.1	
3	41	33.1	17	41.5		3	7.3		29	70.7	
4	22	17.7	18	81.8		0	0.0		13	59.1	
			Unit			Unit			Unit		
Comorb. score			O.R.	O.R.		O.R.	O.R.		O.R.	O.R.	
					< 0.000			< 0.000			< 0.000
>0			2.3	27.8.	1	2.0	15.9	1	2.2	25	1

Methods

We identified a cohort of pediatric patients (less than 19 years) that underwent treatment (clipping and/or coiling) for aneurysm from the Nationwide Inpatient Sample (1998 to 2009). We used multivariate logistic regression and analysis of covariance to evaluate whether intrinsic and extrinsic patient factors were associated with outcomes and to identify independent predictors of outcome. The primary outcomes included mortality, complication, routine discharge, and length of stay. These were analyzed with covariates of interest including demographic and baseline clinical variables and time to treatment.

eurysmal subara		Complication		N	fortali	tv		Routine dischar	re.
	OR	CI	p	OR	CI	D.	OR	CI	p
Fime to treat (hrs)									
							0.5		
≤48	0.40	0.19 - 0.81	0.011	2.5e-8		0.072	1	0.26 - 0.95	0.035
>48	ref	ref	ref	ref			ref	ref	ref
Age (yrs)									
							0.2		
0-9	1.04	0.47 - 2.30	0.928				.7	0.11 - 0.60	0.001
							1.1		
10-14	0.85	0.40 - 1.83	0.668				3	0.66 - 1.92	0.656
15-18	Ref	Ref	Ref				ref	ref	ref
Sex									
Male	1.05	0.58 - 1.89	0.874						
Female	ref								
Comorbidity									
score*				*****			0.0	0.0022	
>0	6.25	1.63 - 25.6	0.007	6095.		0.076	0.3	0.0033 -	0.048
Admission source	6.23	1.63 - 25.6	0.007	4		0.076	2	0.62	0.048
Admission source		5.05 -	< 0.000				0.4		
ED	10.66	23.57	1	6e7		0.032	4	0.29 - 1.03	0.017
ED	10.00	23.37	1	007		0.032	0.3	0.29 - 1.03	0.017
Transfer	2.86	1.33 - 6.22	0.007	8e7		0.029	8	0.25 - 0.86	0.004
Transici	2.00	1.33 - 0.22	0.007	867		0.029	0.0	0.23 - 0.80	< 0.000
Health facility	n/a	n/a	n/a	22e7		0.171	6	0.02 - 0.27	1
riculai facility	W.	th a	th a	2201	Re	0.171		0.02 - 0.27	1
Routine	Ref	Ref	ref	Ref	f	Ref	ref	ref	ref
EVD	101	1001	650	100	•	1001	COL	660	680
							0.2		
Yes	n/a	n/a	n/a				9	0.15 - 0.55	0.0001
No	ref	ref	ref				ref	ref	ref
Severity score*	****	•	****					•	****
6	2.65e-		>0.000			0.999	3.5		
1	9	0-0.026	1	0.06		7	3	1.10 - 12.75	0.033
		0.021 -	>0.000			0.999	3.5		
2	0.056	0.13	1	0.19		8	6	1.61 - 7.91	0.002
		0.043 -							
100		0.28	>0.000	1000			3.7		0.0001
3	0.113		1	6e7		0.059	5	1.89 - 7.64	
					Re				
4	ref	ref	ref	Ref	f	Ref	ref	ref	ref

Results

A total of 168 patients had aneurysms that were treated with surgical clipping and/or endovascular coiling. Perioperative mortality was 2.4% and the overall

complication rate was 36.7%. Compared to delayed treatment, early treatment did not confer a significant difference in complication (, p=0.188) or mortality (p=0.209). Of the 168 patients, 131 (77.5%) had a routine hospital discharge and mean length of stay was 14.2 days. While there was no difference in odds of routine discharge (OR 0.33, CI 0.04-2.18, p=0.253), early treatment independently was associated with significantly shorter mean length of hospital stay (12.1 vs. 22.9 days, p=0.0007) and less hospital charges (\$155,431 vs. \$204,409, p=0.035). Patients with multiple comorbidities had longer length of stay (p<0.048). Age of 0-9 years was an independent predictor of higher odds of routine discharge (OR .027, CI .026-0.95, p=0.035). The need for an external ventricular drain was associated with higher risk of complications (p<0.0001) and less odds of routine discharge (OR 0.29, CI 0.15-0.55, p=0.0001).

m) in Francisc F.	monto who u		cht ireathich	t for aneurysmal subarachnoid hemorrha	ge
	mean (days)	SE	Univariate p	Multivariate p	
l'otal	14.2	1.2			
Time to treat (hrs)			0.0005	0.0007	
≤48	12.1	1.5			
>48	22.9	2.7			
Age (yrs)			0.393	0.180	
0-9	17.5	2.8			
10-14	14.1	2.2			
15-18	13.1	1.7			
Sex			0.482	0.655	
Male	13.5	1.7			
Female	15.2	1.8			
Race			0.843	0.626	
White	13.1	2.1			
Black	12.5	3.7			
Hispanic	17.0	3.6			
Asian	15.0	10.2			
Native American	10.2	8.2			
Other/unknown	18.6	5.2			
Comorbidity score*			>0.0001	0.046	
Admission source			>0.0001	0.003	
ED	17.8	2.1			
Transfer	17.4	2.4			
Health facility	33.1	6.2			
Routine	8.5	1.8			
EVD			>0.0001	0.0008	
Yes	27.9	2.3			
No	10.3	1.2			
intervention			0.442	0.738	
Clipping	15.8	1.7			
Endovascular	12.6	1.8			
Severity score*			>0.0001	0.169	
1	2.8	3.4			
2	7.2	1.9			
3	16.2	2.0			
4	30.1	2.8			

Conclusions

There is a paucity of outcomes studies of aneurysmal subarachnoid hemorrhage in the pediatric population due to their relatively rarity. Although time to treat impacts morbidity and mortality, partition analysis for each outcome demonstrated that time to treatment was less important than intrinsic patient factors, and that timelines for effective treatment extend beyond 48 hours.. It needs to be kept in mind that patients who received early treatment most likely had worse clinical presentation and disease; hence, the effect of early treatment may be confounded by unidentifiable factors.

	mean (days)	SE	Univariate p	Multivariate p
Total				
Time to treat (hrs)			0.003	0.052
≤48	115,979	113,045		
>48	180,521	120,556		
ige (yrs)			0.286	0.996
0-9	148,250	115,723		
10-14	145,679	109,857		
15-18	147,823	115,716		
ex			0.445	0.472
Male	156,457	114,782		
Female	140,043	117,754		
Race			0.558	0.610
White	138,578	111,152		
Black	135,715	116,524		
Hispanic	155,704	119,426		
Asian	250,927	141,740		
Native American	70,313	128,979		
Other/unknown	138,262	117,083		
Comorbidity score*			>0.0001	0.268
Admission source			>0.0001	0.0002
ED	65,974	111,116		
Transfer	214,628	118,518		
Health facility	201,386	131,202		
Routine	111,011	115,588		
EVD			>0.0001	0.0002
Yes	213,168	117,568		
No	83,332	117,568		
Intervention			0.779	0.666
Clipping	217,083	51,940		
Endovascular	202,165	50,370		
Both	148,250	115,723		
Severity score*			>0.0001	0.053
1	148,250	115,723		
2	136,668	111,972		
3	163,062	107,668		
4	236.96	114,621		

Learning Objectives

By the end of the session, participants should be albe to understand prognostic and treatment-related factors impacting outcomes in pediatric aneurysm treatment.