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Background

Children with congenital and acquired heart disease are at high risk for stroke. One-quarter of acute ischemic strokes in children with cardiac disease occur in the perioperative period¹. There were 31 post-catheterization strokes between 2010 and 2014 at Boston Children's Hospital (BCH)². This represented 37% of the strokes in children with cardiac disease; however, little is known about these strokes. We describe post-catheterization strokes occurring over the past decade at BCH as a foundation for quality improvement interventions aimed at decreasing the time to detection of peri-procedural strokes in children.

Methods

- Retrospective review of the medical records of children with post-catheterization strokes at BCH between 2006 and 2016.
- Included children with acute or subacute stroke identified on neuroimaging within 20 days of cardiac catheterization.
- Excluded children with cardiac arrest, cardiac surgery, extracorporeal membrane oxygenation, a ventricular assist device, or an arrhythmia
- Approved by the Institutional Review Board of BCH. Consent not required.

Results

Patient demographics and medical history	
Median age	8.5 years (2 days—16 years)
Congenital heart disease	22/23 (96%)
Acquired heart disease	1/23 (4%)
Cardiac surgery	18/23 (78%)
Ischemic stroke	2/23 (9%)
Hemorrhagic stroke	1/23 (4%)
Epilepsy	5/23 (22%)

Left heart catheterization	Number of patients
Retrograde	10 (43%)
Trans-septal needle puncture	7 (30%)
Atrial septal defect	3 (13%)
Trans-baffle puncture	1 (4%)

Catheterization Procedure	# patients
Pulmonary vein dilation	7 (30%)
Coil/systemic pulmonary collateral closure	6 (26%)
Balloon dilation of aorta	2 (9%)
Mitral valvotomy	2 (9%)
Atrial pacing	1 (4%)
Electrophysiology with ablation	1 (4%)
Hemodynamic	1 (4%)
Pulmonary valvotomy	1 (4%)
Stenting of atrial septum	1 (4%)
Stenting of left ventricular outflow tract	1 (4%)
Presenting symptoms	# patients
Arm weakness	10 (43%)
with leg weakness	7 (30%)
with facial weakness	5 (22%)
Seizure	8 (35%)
Depressed level of consciousness	3 (13%)
Aphasia	3 (13%)
Bradycardia	2 (9%)
Silent	2 (9%)
Clot embolization during catheterization	1 (4%)

Location of stroke	# patients
MCA	20 (87%)
PCA	4 (17%)
Vertebrobasilar	4 (17%)
ACA	1 (4%)
Treatment	# patients
Continued baseline antithrombotic regimen	7 (30%)
New antithrombotic agent	9 (39%)
Intravenous thrombolysis	1 (4%)
Mechanical thrombectomy	2 (9%)
Outcome	
Median PSOM at discharge	0.5 (0-4)
# with PSOM >=1 at discharge	6 (26%)
Median PSOM at 3 months follow-up	1 (0-3)
# with PSOM >=1 at 3 months follow-up	6 (26%)

PSOM – Pediatric Stroke Outcome Measure

Conclusions

- Stroke after cardiac catheterization is rare but is accompanied by a high degree of morbidity
- Pulmonary vein dilation, coil/systemic pulmonary collateral closure, and catheterizations of the left heart appear to be especially risky procedures
- The diagnosis of stroke after cardiac catheterization is often delayed
- The majority of strokes occur within the first four days after catheterization
- Treatment of children with post-catheterization strokes with tPA and/or mechanical thrombectomy was not associated with complications

Future Directions

Development and implementation of a standardized screening neurologic assessment to be performed serially on all children after cardiac catheterization with the goal of decreasing the time to detection of post-catheterization strokes.

Selected References

1. Dowling MM, Hyman LS, Lo W, et al. International Pediatric Stroke Study: stroke associated with cardiac disorders. Int J Stroke 2012; 8: 39-44.
2. Cheng HH, Rajagopal S, McDavitt E, Wigmore D, Williams K, Thiagarajan R, Grant PE, Danehy A, Rivkin MJ. Stroke in acquired and congenital heart disease patients and its relationship to hospital mortality and lasting neurologic deficits. Pediatr Crit Care Med 2016; XX: 00-00.