Vocal Fold Movement and Silent Aspiration After Congenital Heart Surgery

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BACKGROUND

Infants who undergo congenital heart surgery are at risk of developing vocal fold motion impairment (VFMI) and swallowing difficulties.

PURPOSE

The purpose of this study is to: 1) describe dysphagia and airway protection using videofluoroscopic swallow study (VFSS) data in infants who underwent congenital heart surgery; 2) determine whether the complexity of surgery, as defined by the STAT categories, can predict swallowing abnormalities; 3) quantify the impact of VFMI on swallowing abnormalities, in particular silent aspiration. To our knowledge, there has not been a study of this size describing swallowing deficits in this patient population using instrumental swallow evaluation

METHODS

A retrospective chart review was performed of all infants (age <12 months) who underwent cardiac surgery and also received a VFSS within 3 months of surgery from June 1, 2008, to January 1, 2018.

Patients were classified into a STAT category based on the highest category of all surgeries performed (Table I).

Vocal fold mobility was screened on all postoperative infants with either flexible nasolaryngoscopy (FNL) performed by a pediatric otolaryngologist or laryngeal ultrasound (LUS) performed by a pediatric radiologist.

Statistical analysis was performed using chi-square tests to compare STAT categories and VFMI to multiple dysphagia outcomes. In addition, multivariate logistic regression was performed for the outcome of silent aspiration, using multiple risk factors: STAT category, VFMI, prematurity, and genetic syndrome. A P value less than .05 determined significance.

Example Cardiac Surgeries Within Each STAT Category.

Category 1	Category 2	Category 3	Category 4	Category 5
VSD repair	PDA ligation	Atrioventricular canal defect (AVCD) repair	Aortic arch repair	Norwood procedure
ASD repair	TOF repair	Arterial switch	Pulmonary artery banding	Truncus arteriosus
Vascular ring repair	Coarctation repair		Orthotopic heart transplant	
Patent foramen ovale (PFO) closure			TAPVR repair	
			Blalock–Taussig (BT) shunt	

ASD = atrial septal defect; PDA, patent ductus arteriosus; STAT = Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery; TOF, tetralogy of Fallot; TAPVR, total anomalous pulmonary venous return; VSD = ventricular septal defect.

Patient Demographic Characteristics.

Category	Number of Patients
Total patient sample	374 (100%)
Female	172 (46%)
Average age at the time of VFSS	59 days
Premature	90 (24%)
Genetic syndrome	128 (34%)
Gastrostomy tube (lifetime)	105 (28%)
Gastrostomy tube (prior to VFSS)	6 (2%)
Gastrostomy tube (after VFSS)	99 (26%)
Vocal fold motor impairment (VFMI)	145 (39%)
STAT category	
Category 1	27 (7%)
Category 2	74 (20%)
Category 3	32 (9%)
Category 4	175 (47%)
Category 5	65 (17%)

STAT = Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery; VFSS = videofluoroscopic swallow study.

Multivariate Logistic Regression for Silent Aspiration With Various Risk Factors.

Risk Factor	Odds Ratio Estimate (95% CI)	*P* Value
VFMI	1.94 (1.22–3.06)	0.0049*
STAT category (2 vs. 1)	1.33 (0.41–4.31)	0.64
STAT category (3 vs. 1)	0.52 (0.15–1.84)	0.31
STAT category (4 vs. 1)	0.90 (0.28–2.94)	0.86
STAT category (5 vs. 1)	1.26 (0.37–4.37)	0.71
Genetic syndrome	1.04 (0.64–1.70)	0.88
Prematurity	1.02 (0.60–1.74)	0.94

STAT = Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery; VFMI = vocal fold motion impairment.

Statistical Comparisons of Dysphagia Outcomes with VFMI and STAT Categories.

		Oral Dysphagia	Pharyngeal Dysphagia	Laryngeal Penetration	Tracheal Aspiration	Silent Aspiration
VFMI	VFMI present	53%	61%	56%	53%	42%
	VFMI absent	65%	67%	62%	42%	28%
	P value	0.023*	0.21	0.25	0.035*	0.0039*
STAT category	Category 1	70%	59%	70%	56%	33%
	Category 2	71%	66%	59%	51%	38%
	Category 3	53%	53%	69%	47%	22%
	Category 4	56%	63%	55%	40%	31%
	Category 5	58%	74%	64%	52%	38%
	P value	0.12	0.31	0.42	0.29	0.49

*significant, defined as $p < 0.05$.
STAT = Society of Thoracic Surgeons-European Association for Cardio-Thoracic Surgery; VFMI = vocal fold motion impairment.

RESULTS

- 60% (225/374) oral dysphagia
- 64% (241/374) pharyngeal dysphagia
- 51% (190/374) laryngeal penetration
- 45% (170/374) tracheal aspiration
- 33% (124/374) silent aspiration
- 26% (99/374) gastrostomy tube

CONCLUSION

Dysphagia and subsequent aspiration are significant adverse effects of congenital heart surgery. Although our study did not reveal a relationship to the complexity of the surgery as determined by its STAT category, we did validate the increased risk of silent aspiration with presence of VFMI. However, patients without VFMI still showed significant swallowing deficits, and nearly one-third of the entire cohort exhibited silent aspiration on VFSS. Therefore, both identification of VFMI by either FNL or LUS and SLP involvement with instrumental evaluation are important to identify patients at greater risk for feeding difficulties and aspiration. This collaborative approach can lead to prompt intervention to improve feeding outcomes and decrease postoperative hospital length of stay.

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