Car Seat Screening in Infants with Critical Congenital Heart Disease

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BACKGROUND

- The AAP recommends pre-discharge car seat tolerance screening (CSTS) in all premature and low birthweight infants.
- In their most recent clinical report, the AAP acknowledged varied hospital practices for inclusion of other "at risk" infants, including those with congenital heart disease (CHD)[1]; though, no formal recommendations for testing exist.
- Research on CSTS in infants with CHD is limited[2-4].

METHODS

- Study Design: Observational, retrospective chart review
- Data Source: University of Maryland Medical Center EMR
- Time frame: January 1, 2016 – December 31, 2020
- Inclusion Criteria: Neonates with cyanotic CHD admitted to University of Maryland NICU, PICU, or NBN
- Exclusion Criteria: Died prior to discharge, not initial (newborn admission), discharged in a car bed due to medical necessity
- Outcome Measures: Incidence and predictors of CSTS failure
- Statistical Analysis: Bivariate analysis using SAS 9.4
- Ethics Review: Granted exemption by University of Maryland Baltimore IRB

CONCLUSIONS

- 9.4% CSTS failure rate in the CCHD population
- Incidence of CSTS failure was highest among infants with diagnoses of aortic stenosis, TAPVR, pulmonary valve stenosis, and HLHS
- Those with neurologic abnormalities including seizures, hypotonia, and PVL were also more likely to fail a CSTS
- Future directions: additional data collection, multivariable modelling, post-discharge outcomes including readmissions and BRUE

REFERENCES

Cyanotic CHD underwent CSTS (N=53)	Passed CSTS N=48 (90.6%)	Failed CSTS N=5 (9.4%)	p-value
Race: Non-Hispanic White	20 (42%)	1 (20%)	0.3264
Race: Non-Hispanic Black	22 (46%)	4 (80%)	
Female Sex	22 (46%)	2 (40%)	0.8031
Singleton	45 (94%)	4 (80%)	0.2679
Delivery resuscitation required	11 (23%)	3 (60%)	0.0735
Admit location: Newborn Nursery	0 (0%)	1 (20%)	**0.0072**
Admit location: Neonatal ICU	47 (98%)	4 (80%)	
Admit location: Pediatric ICU	1 (2%)	0 (0%)	
Birth Gestational Age, weeks	38.1 (1.5)	37.3 (2.8)	0.6006
Premature	5 (10%)	2 (40%)	0.0630
Birthweight, grams	2940 (539)	2447 (475)	0.0552
Birth Length, centimeters	47.9 (2.9)	45.8 (2.8)	0.1300
Birth Head Circumference, centimeters	32.8 (1.7)	31.1 (1.9)	**0.0452**
Small for Gestational Age	11 (23%)	2 (40%)	0.3982
Intrapartum pain medication: Stadol	1 (2%)	1 (20%)	**0.0454**
No antenatal steroids	38 (79%)	3 (60%)	0.3246
Cardiac surgery during admission	35 (73%)	4 (80%)	0.7324
Cardiac bypass during surgery	19 (54%)	3 (75%)	0.4287
Balloon atrial septostomy	10 (21%)	2 (40%)	0.3298
Required CPR	3 (6%)	1 (20%)	0.2680
ECMO	4 (8%)	0 (0%)	0.5020
Micrognathia	5 (10%)	0 (0%)	0.4482
Laryngomalacia	2 (4%)	1 (20%)	0.1448
Vocal cord paresis/paralysis	3 (6%)	0 (0%)	0.5649
Hemidiaphragm paresis/paralysis	4 (8%)	1 (20%)	0.3957
PAH [a]	17 (35%)	2 (40%)	0.8388
Diuretics at the time of CSTS	25 (52%)	2 (40%)	0.1002
Antacid at the time of CSTS	18 (37%)	3 (60%)	0.5898
Propranolol at the time of CSTS	7 (15%)	1 (20%)	0.1198
Clonidine at the time of CSTS	5 (10%)	1 (20%)	0.5198
Caffeine off before CSTS	5 (10%)	3 (60%)	**0.0127**
Caffeine on at time of CSTS	2 (4%)	0 (0%)	
Steroids: Any (all reasons)	25 (52%)	2 (60%)	0.7358
Steroids: Peri-extubation	22 (46%)	3 (60%)	0.5459
Steroids: Hypotension	13 (27%)	2 (40%)	0.5417
Steroids: Adrenal insufficiency	7 (15%)	1 (20%)	0.747
Trisomy 21	1 (2%)	0 (0%)	0.7445
NAS [b]	7 (15%)	1 (20%)	0.7475
Seizures	0 (0%)	1 (20%)	**0.0018**
Hypotonia	1 (2%)	1 (20%)	**0.0454**
PVL	1 (2%)	1 (20%)	**0.0454**
IVH Grade 3 or 4	1 (2%)	0 (0%)	0.7445
Infant toxicology positive (opiates)	5 (12%)	0 (0%)	0.4205
Age (days) at time of CSTS	23 (6-44.5)	58 (3-71)	0.5322
Weight at CSTS, grams	3406 (858)	3753 (1586)	0.6537
Length of stay, days	23.5 (7-45.5)	58 (17-73)	0.2536
Readmitted within 1 month of discharge	11 (23%)	2 (40%)	0.3982

Table 1. Characteristics of Study Population

[a] Subjects were defined as having PAH if any of the following were true: (1) listed on patient's problem list, (2) ECHO report indicating any of the following: pulmonary hypertension, pulmonary pressure > ½ systemic pressure, right ventricular dilation, right ventricular hypertrophy, or right ventricular dysfunction, or (3) ECHO report with septal flattening in systole, PLUS any of the following: BNP > 117 pg/mL, hypoxic events, or FiO2 requirement > 25%.

[b] Includes iatrogenic NAS

Diagnosis	Total "n" with diagnosis	"n" failed CSTS	Incidence of failure	p-value
AVSD	1	0	0%	0.7445
Aortic stenosis	2	1 [a]	50%	**0.0454**
Pulmonary valve stenosis	4	1 [b]	25%	0.2680
Coarctation of the aorta	3	0	0%	0.5649
Interrupted aortic arch	0	0	0%	--
TOF PA	5	0	0%	0.4482
TOF PS	9	1	11%	0.8502
TGA	16	2 [b]	12.5%	0.6156
Truncus arteriosus	2	0	0%	0.6417
TAPVR	3	1	33%	0.1448
HLHS	6	1 [a]	17%	0.5198
Tricuspid atresia	6	0	0%	0.4012
Pulmonary atresia	7	0	0%	0.3594
DORV	8	1 [b]	12.5%	0.7475

Table 2. CSTS Failure by Cyanotic Heart Lesion

[a] One subject with failed CSTS had both aortic stenosis and HLHS

[b] One subject with failed CSTS had DORV, TGA, and pulmonary valve stenosis

Abbreviations:

AVSD, Atrioventricular Septal Defect; CHD, Congenital Heart Disease; CPR, cardiopulmonary resuscitation; CSTS, Car Seat Tolerance Screening; DORV, Double outlet right ventricle; ECMO, extra-corporeal membrane oxygenation; HLHS, Hypoplastic Left Heart Syndrome; ICU, intensive care unit; IVH, intraventricular hemorrhage; NAS, neonatal abstinence syndrome; PAH, pulmonary arterial hypertension; PVL, periventricular leukomalacia; TAPVR, Total anomalous pulmonary venous return; TGA, Transposition of the great arteries; TOF PA, Tetralogy of Fallot with pulmonary atresia; TOF PS, Tetralogy of Fallot with pulmonary stenosis