

Associations between Pre-Fontan CMR and CC data with Fontan Failure at Moderate Altitude



University of Colorado
Anschutz Medical Campus

Caleb Wipf, Carson Platnick BA, Kaitlin Olson MS, Hannah R. Spears MPH, Samuel Schofield, Nicolas D. Drysdale MD, Benjamin Frank MD, Matthew Stone MD, Michael DiMaria MD, Jennifer Romanowicz MD, Jenny Zablah MD, Gareth Morgan MD, Alex Verhoeven MD, Christopher Mascio MD, Dhaval Chauhan MD, Jai Udassi MD, Nita R. Chaudhuri MD, Joseph Kay MD, Vitaly O. Kheyfets PhD, Brian Fonseca MD, Lorna P. Browne MD, and Mehdi H. Moghari PhD

Background

- The Fontan procedure is a palliative surgical intervention for single-ventricle congenital heart disease
- Long-term survival rates range from 61-83% at 20 years, with limited data on pre-Fontan hemodynamic factors at moderate altitude
- Data obtained was between the Glenn and Fontan operation
- The aims of this study was to establish a 20-year Fontan operation survival rate at altitude and identify associations between pre-Fontan hemodynamics and post-operative Fontan failure

Methods

- Retrospective cohort study of 240 Fontan patients from a single moderate-altitude center.
- Included patients underwent cardiac catheterization (CC) and cardiovascular magnetic resonance (CMR) between 1999-2021.
- CC and CMR data was obtained and analyzed
- Univariate logistic regression modeling was used to assess association with post-Fontan death or heart transplantation

Results

240 Unique Patients Included

- 55% Systemic Right Ventricle
- 45% Systemic Left Ventricle
- 89% External Conduit
- 94% Fenestrated Fontan
- Mean Home Elevation: **5109 feet**

220 pre-Fontan CATHs
56 pre-Fontan CMRs

Mean Post-Fontan
Follow-up Time:
9.7 years

29 Instances of Fontan Failure (6 Death, 23 Transplant)

Variable	N	OR	95% CI	p-value
Mean Pressure (mmHg)				
AAO	130	1.06	(1, 1.13)	0.051
IVC	9	1.72	(0.91, 6.83)	0.202
SVC	201	1.03	(0.88, 1.16)	0.598
LPA	208	1.08	(0.85, 1.37)	0.523
LA	192	1.23	(0.98, 1.54)	0.065
RPA	207	1.29	(1.05, 1.62)	0.021
Peak Systolic Pressure (mmHg)				
Systemic Ventricle	203	1.05	(1.01, 1.08)	0.009
AAO	131	1.04	(0.99, 1.09)	0.072
DAO	211	1.02	(0.99, 1.06)	0.205
End-Diastolic Pressure (mmHg)				
Systemic Ventricle	200	1.00	(0.88, 1.07)	0.986
AAO	131	1.06	(1, 1.12)	0.038
DAO	211	1.00	(0.93, 1.05)	0.912
Indexed PVR	167	0.76	(0.35, 1.44)	0.459
SVR	198	1.16	(1.04, 1.3)	0.007
Qp (L/min/m ²)	173	0.55	(0.2, 1.01)	0.220
Qs (L/min/m ²)	199	0.86	(0.56, 1.22)	0.461

OR: odds ratio; CI: confidence interval; AAO: ascending aorta; DAO: descending aorta; SVC: superior vena cava; LA: left atrium; LPA: left pulmonary artery; RPA: right pulmonary artery; PVR: pulmonary vascular resistance; SVR: systemic vascular resistance; Qs: systemic flow; Qp: pulmonary flow.

Variable	N	OR	95% CI	p-value
Indexed Vessel Area (cm²/m²)				
AAO	46	0.68	(0.2, 1.6)	0.442
LPA	45	2.47	(0.12, 23.22)	0.450
RPA	43	0.19	(0, 6.24)	0.356
Indexed Vessel Flow (ml/beat/m²)				
Aorta net flow	52	0.88	(0.75, 1.01)	0.089
LPA net flow	49	1.30	(0.71, 2.42)	0.361
RPA net flow	48	0.63	(0.24, 1.29)	0.266
IVC flow	41	1.00	(0.74, 1.16)	0.998
SVC flow	47	0.67	(0.25, 1.17)	0.215
Systemic Ventricle Indexed ESV (ml/m ²)	55	1.03	(0.98, 1.08)	0.246
Systemic Ventricle Indexed EDV(ml/m ²)	55	1.02	(0.99, 1.05)	0.125
Ejection Fraction of Systemic Ventricle (%)	55	0.98	(0.85, 1.12)	0.759
Cardiac Index	49	1.40	(0.78, 2.56)	0.233

No CMR Parameters were Significantly Associated with Fontan Failure.

Conclusions

- Pre-Fontan hemodynamic parameters are significant predictors of post-Fontan death or heart transplantation.
- Elevated systemic vascular resistance, elevated right pulmonary artery mean pressure, elevated peak systolic pressure of the systemic ventricle and elevated end diastolic pressure of the ascending aorta were associated with the primary outcome.
- Improved screening and monitoring protocols could be established at altitude to identify high-risk patients

Implications

- Improved screening and monitoring protocols could be established at altitude to identify high-risk patients

Disclosures

- None