Early Experience with Reverse Double Switch Operation for the Borderline Left Heart

Objective:
Patients with borderline left hearts may have poor outcomes with traditional biventricular repair. An alternative to single ventricle palliation or transplantation utilizes the hypoplastic morphologic left ventricle (mLV) as the subpulmonary ventricle by performing an arterial and atrial switch ("reverse" double switch operation (R-DSO)). Bidirectional Glenn (BDG) can further unload the subpulmonary LV. This study reviews our early experience with the R-DSO for borderline left hearts.

Methods:
A retrospective review of children with borderline left hearts who underwent R-DSO between 2017-2021 was conducted. Patient characteristics and early hemodynamic and clinical outcomes were collected.

Results:
R-DSO was performed in 7 patients; 5 underwent decompressing BDG. Underlying diagnoses, indications, and associated procedures are outlined in Figure 1. Non-compliance of the LV was the dominant pathophysiology, with median preoperative LV end diastolic pressure (LVEDP) of 18 mm Hg (range 10-32). Median indexed LV end diastolic volume was 45 ml/m² (35-140). Four patients had undergone LV recruitment but were not candidates for traditional biventricular circulation due to LV hypoplasia and/or dysfunction. Six of 7 patients had risk factors for Fontan circulation: pulmonary vein stenosis (3), pulmonary HTN (2), pulmonary artery stenosis (1). Median age at R-DSO was 4.3 years (19mo-12yrs). In 2 patients, some LV outflow tract obstruction was maintained to avoid ventricular septal shift and preserve tricuspid valve function. Postoperatively, 1 patient required ECMO for 4 days after a cardiac arrest. Arrhythmias occurred in 4 (junctional rhythm in 3, atrial flutter in 1); all returned to sinus rhythm before discharge. At median follow up of 12 months (18d-4.1yrs) no mortalities, reoperations or heart transplants had occurred. Systemic RV function was normal (4) or mildly depressed (3). Tricuspid regurgitation was trivial (3), mild (3), or moderate (1). All patients had normal mLV systolic function. In one patient, pre-existing pulmonary HTN resolved after R-DSO. Reinterventions included transcatheter mitral valve replacement for residual mitral stenosis and neo-pulmonary balloon valvuloplasty. One patient was readmitted (volume overload). In 4 patients follow-up cardiac catheterization done at a median of 400 days (320d-4y) demonstrated median cardiac index of 3.2 L/min/m² (2.2-4); median sub-pulmonary LVEDP was 9 mm Hg (7-15); median IVC/baffle pressure was 9 mm Hg (7-16).

Conclusions:
The reverse double switch operation is an alternative to traditional biventricular repair or single ventricle palliation in patients with borderline left hearts and can result in low IVC pressures. This approach can also relieve pulmonary HTN and allow future transplant candidacy. Early results are favorable. Further studies are necessary to assess long-term outcomes.

Brandi Scully (1), Eric Feins (1), Wayne Tworetzky (1), Sunil Ghelani (1), Rebecca Beroukhim (1), Pedro del Nido (1), Sitaram Emani (1), (1) Boston Children’s Hospital, Boston, MA