EFFECTS OF REVERSE BLALOCK-TAUSSIG SHUNT DIAMETER IN THE SETTING OF THE HYBRID NORWOOD PALLIATIVE TREATMENT: A MULTI-SCALE CFD ANALYSIS OF SYNTHETIC AND PATIENT SPECIFIC ANATOMIES

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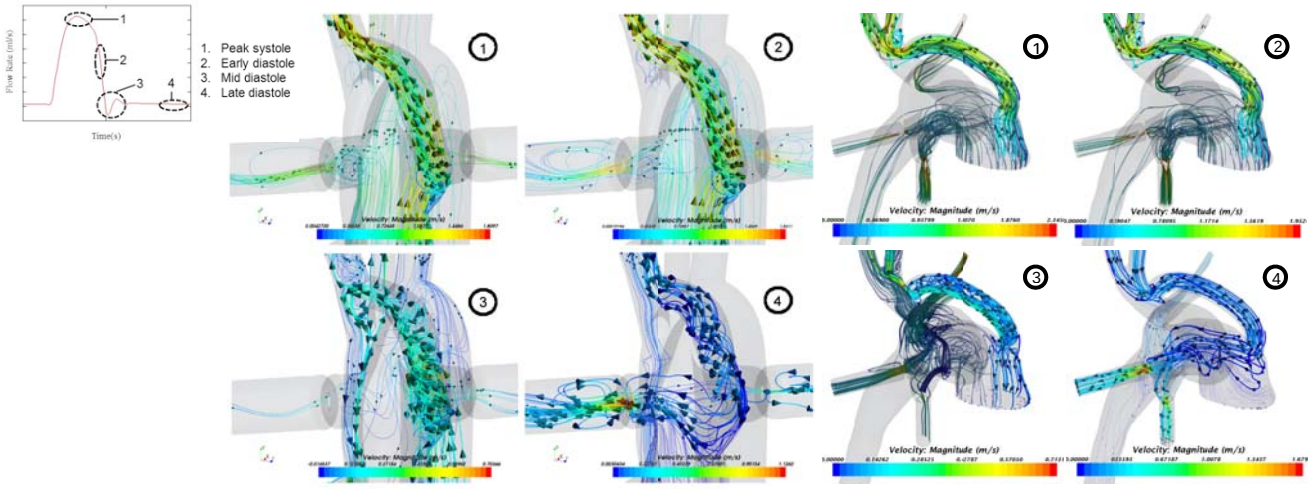
The hybrid Norwood (HN) approach for the management of Hypoplastic Left Heart Syndrome (HLHS) has emerged as a promising palliative strategy that avoids cardiopulmonary bypass, cardioplegic arrest, and circulatory arrest. We utilized a multiscale model of the circulation following the HN procedure examine the effects of various levels of possible post-operative obstruction of the mid-aortic arch and the effect of implementing a main pulmonary-to-innominate artery shunt (RBTS), which may prevent myocardial and cerebral ischemia due to such obstruction. We utilized synthetic and patient-specific anatomic models that elucidate the substantial disorganized, swirling, and low velocity hemodynamics that occur throughout the main pulmonary, aortic, branching arteries, and RBTS. Several RBTS diameters were studied: the 3.0mm and 3.5mm shunts maintain carotid flow-rates and oxygen delivery similar to those of the 4.0mm shunt but without the deleterious hemodynamic patterns experienced with the large shunt. In the setting of the hybrid Norwood circulation, our results suggest: (1) the 4.0mm RBTS may be more thrombogenic when implemented in the absence of severe arch stenosis and (2) the 3.0mm and 3.5mm RBTS may be a more suitable alternative, with preference to the latter since it provides similar hemodynamics at lower levels of wall shear stress.



(a) Synthetic Anatomy (b) Patient Specific Anatomy

Figure: Shunt flow at selected time-points from peak systole to late diastole for the 4.0mm diameter RBTS used in the absence of stenosis.