The Hybrid Norwood procedure has emerged as a promising alternative palliative first stage treatment for infants with Hypoplastic Left Heart Syndrome (HLHS). The procedure is done to provide necessary blood flow to the pulmonary and systemic regions of the body. The procedure can affect hemodynamic conditions to be pro-thrombotic, and thrombus particles can form and release from the vessel walls and enter the flow. Assuming these particles are formed and released from the shunt surface, a Computational Fluid Dynamics (CFD) model can be used to mimic the patient’s vasculature geometry and predict the occurrence of embolization to the carotid or coronary arteries, as well as the other major arteries surrounding the heart. This study used a time dependent, multi-scale CFD analysis on patient’s specific geometry to determine the statistical probability of thrombus particles exiting each major artery. The geometries explored were of a nominal and patient specific nature. Cases of 90% and 0% stenosis at the aortic arch were analyzed, including shunt diameters of 3mm, 3.5mm, and 4mm. Three different placements of the shunt were explored as well. The intent of this study was to suggest best methods of surgical planning in the Hybrid Norwood procedure by providing supporting data for optimal stroke and myocardial infarction prevention.