

## **Use of Transcatheter Flow Reducer in Complex Fontan Circulation Based on Computation Fluid Dynamics Simulation**

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**Background:** Patients with single ventricle (SV) and heterotaxy syndrome are at increased risk for pulmonary arteriovenous malformations (PAVM) after Fontan completion. We report a complex case in whom Computation Fluid Dynamics (CFD) simulation was initially employed to evaluate the potential use of a new transcatheter flow reducer (TFR) to improve flow distribution to the AVM-affected lung and preliminary results from an animal study aimed to test the efficacy of this device and its percutaneous retrieval several weeks after device implantation.

**Methods and Results:** A 13-year old patient with functionally SV and absent hepatic segment of the IVC with hemyzygos continuation to the left SVC, with previous Kawashima followed by surgical incorporation of the hepatic veins to the central PA, was referred to our institution due to significant desaturation. Cardiac catheterization revealed normal pressures, diffuse AVM in the right lung and hypoplastic central PA. CMR showed no hepatic flow to the lung with AVM. Based on CFD simulation, most optimal hepatic flow distribution to the lungs was achieved with enlargement of central PA combined with reduction of IVC flow. A prototype flow reducer (Occlutech GmbH, Germany; 20x30mm with 10mm fenestration) made of nitinol mesh with polyurethane covering, was then implanted percutaneously via a 12 Fr Occlutech delivery sheath in the intrahepatic segment of the IVC in 3 domestic swine followed by re-catheterization 2 weeks later. During this period, all animals received warfarin o.d. The device implantation and the follow-up were uneventful. Two weeks after implantation, the device was patent in 2 animals and found embolized in the 3rd animal most likely due to significantly larger IVC in this animal. Although there was no significant gradient across the device, collaterals were noted on angiography with approximately 10 % increase in SVC/IVC flow on CMR. In 1 animal, the device was easily retrieved percutaneously.

**Conclusion:** Transcatheter reduction of systemic venous flow in complex univentricular circulation with PAVM might be useful in optimizing hepatic flow distribution. Additional studies at our institution are under way to further assess the utility of CFD simulation in interventional and surgical treatment of patients with Fontan circulation.