Computational Fluid Dynamics In Tetralogy Of Fallot Repair: Sensitivity Of Energy Efficiency Calculations To Boundary Conditions

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Background

- Surgical repair of Tetralogy of Fallot (TOF) can produce a variety of potential postoperative geometries, some of which may be hemodynamically superior to, or more energy efficient than, others
- Energy efficiency can be estimated using computational fluid dynamics (CFD) simulations of the postoperative geometries
- However, the accuracy of these simulations is dependent on the boundary conditions imposed on the geometry's inlet(s) and outlet(s)

Aim

- Investigate the sensitivity of the calculated energy efficiency to changes in the boundary conditions.

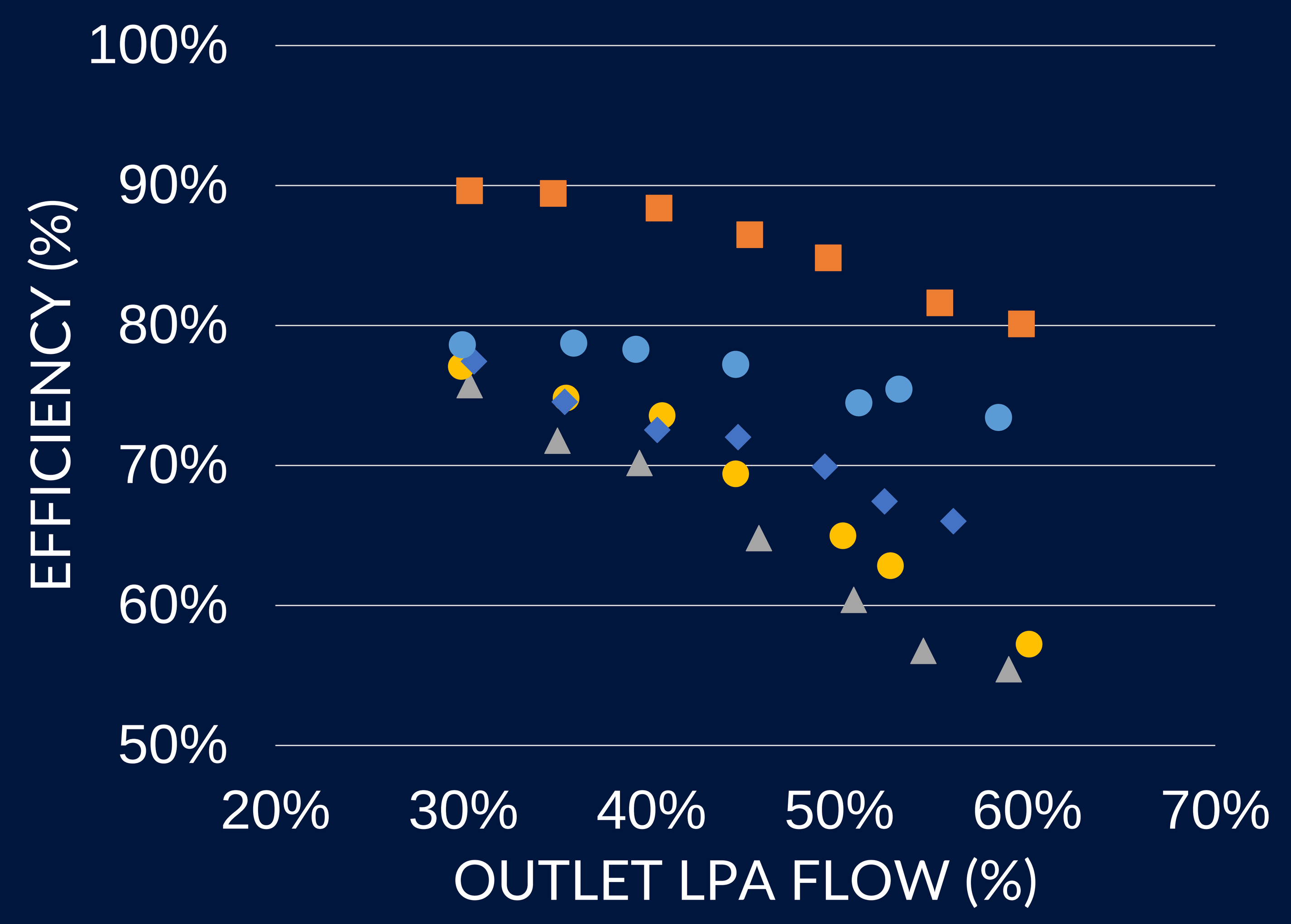
Methods

- 16 postoperative TOF patient geometries were segmented from cardiac magnetic resonance angiography imaging
- CFD simulations were completed in SimVascular with a range of inlet flow rates and outlet resistances
- Energy efficiency was calculated for each case

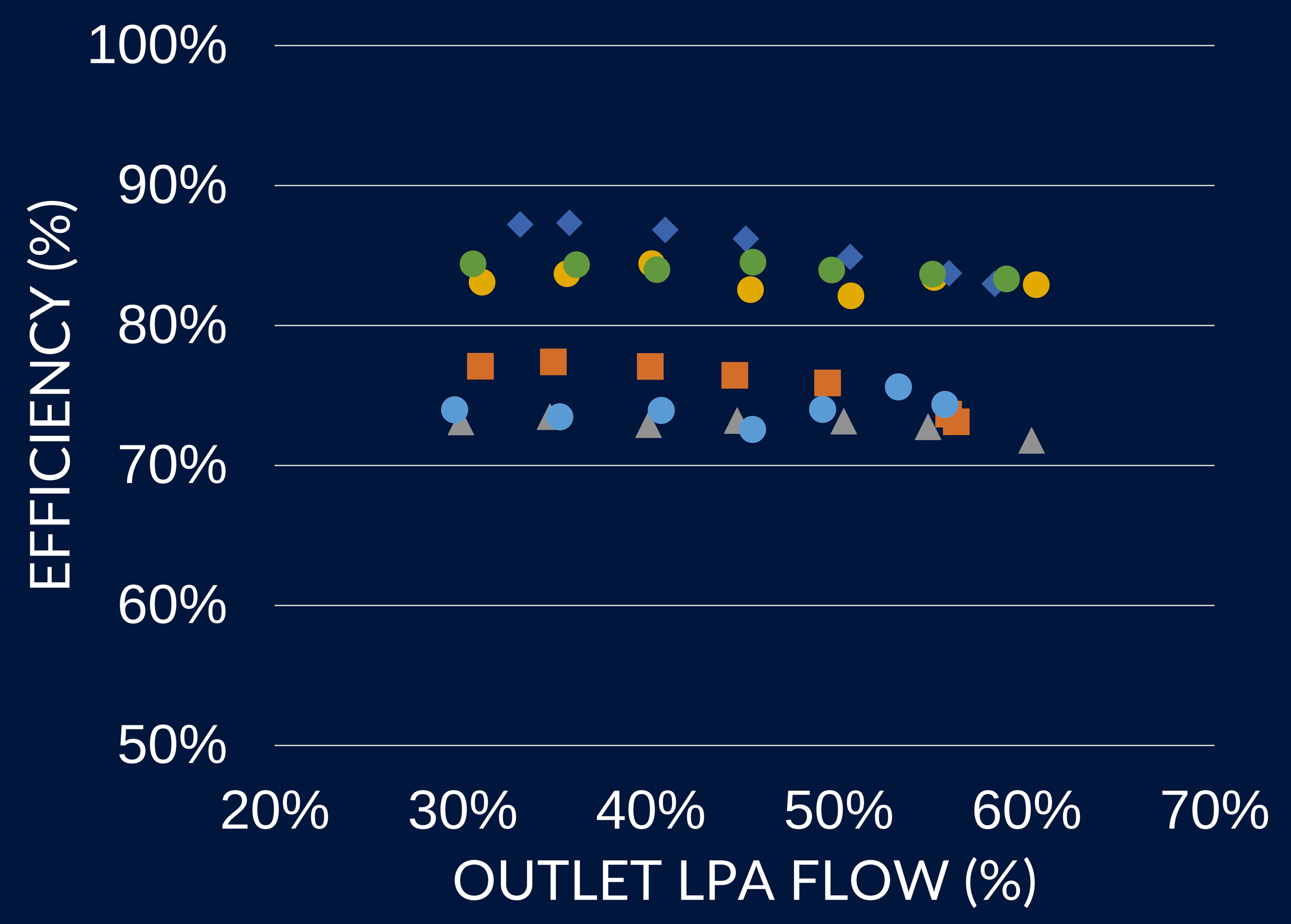
Pulmonary artery geometries exhibit a **drop in efficiency** with an **increased cardiac output** (inlet flow rate).

Some geometries are more **sensitive to** changes in **downstream resistance** (outlet flow percentage) than others.

Group A (More Sensitive)



Group B (Less Sensitive)



Extra Tables & Figures

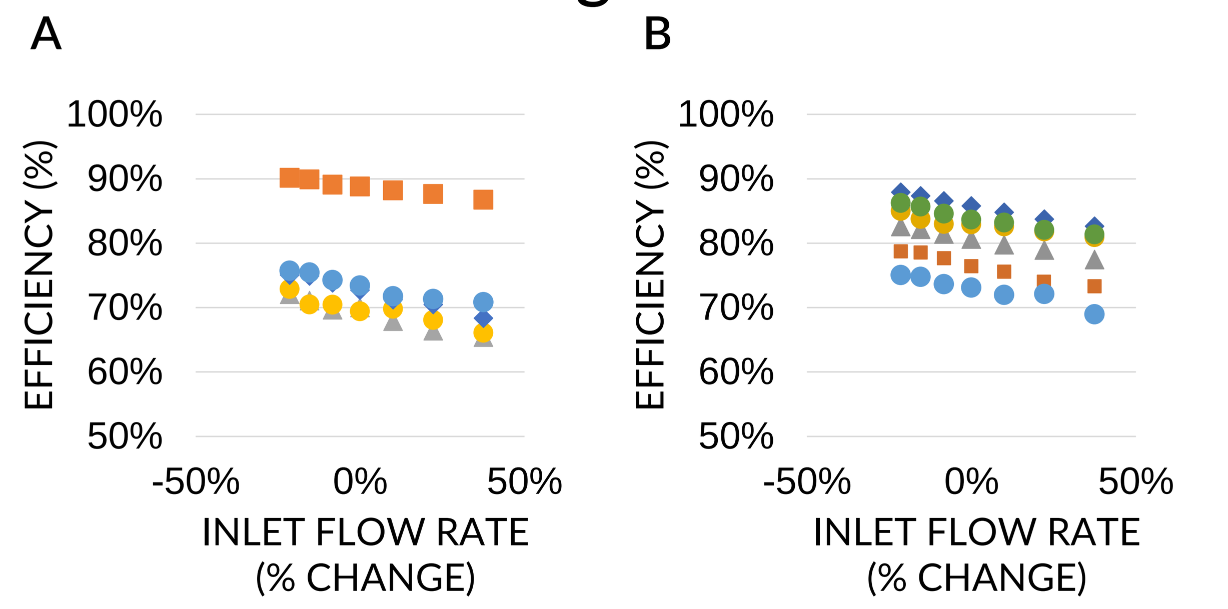


Figure 1: Changes in efficiency with inlet flow rate (cardiac output). (A) Geometries sensitive to flow split changes. (B) Geometries less sensitive to flow split changes.

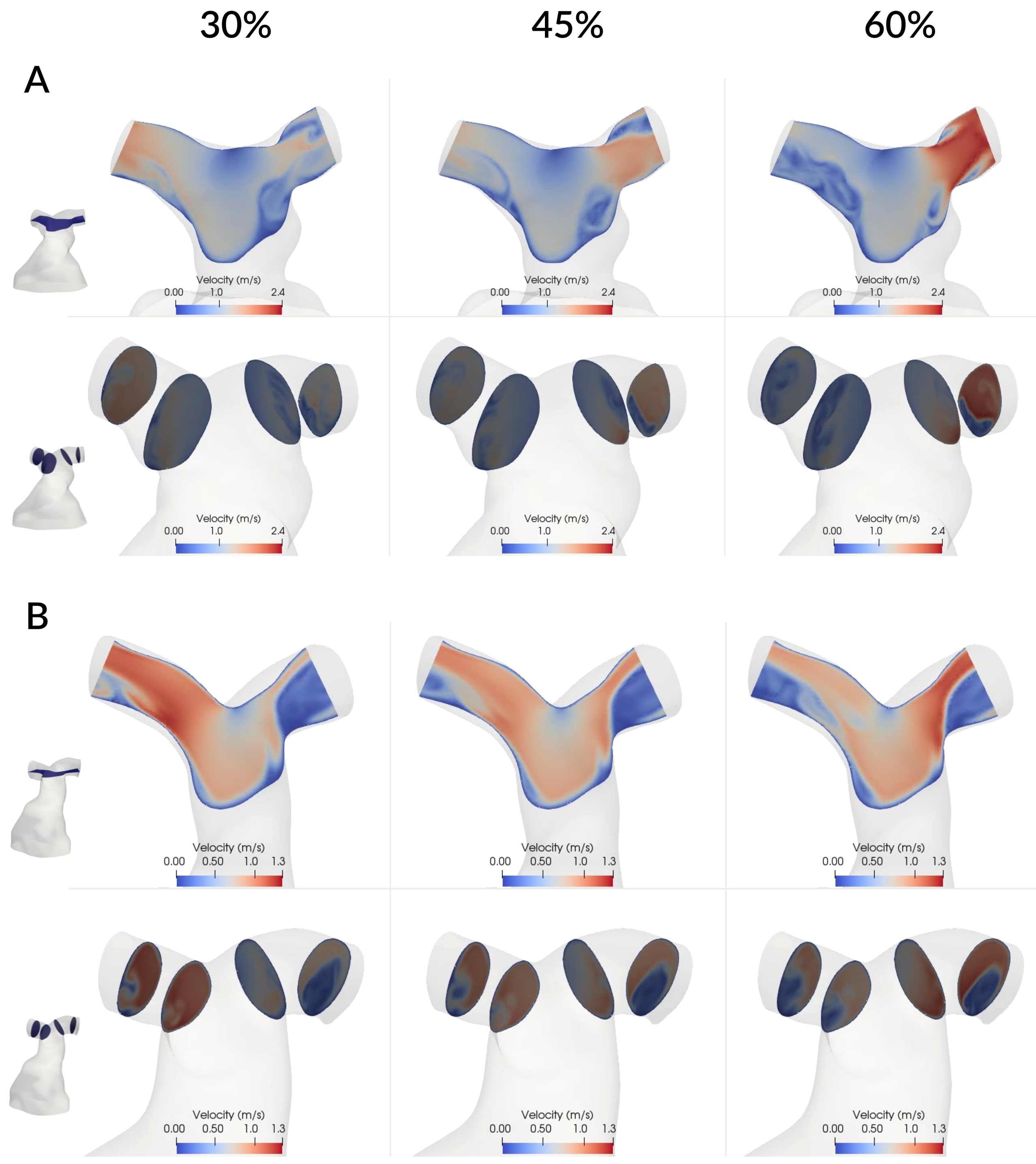


Figure 2: Velocity contours for (A) a geometry more sensitive to changes in downstream resistance and (B) a geometry less sensitive to changes in downstream resistance. Columns show changes to LPA flow percentage (30%, 45%, 60%).

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