Reviewer’s report

Title: An In-vitro evaluation of the flow haemodynamic performance of Gore-Tex extracardiac conduits for univentricular circulation

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Reviewer: Yasemin Karaca-Altintas

Reviewer's report:

This is a very interesting article, well-written and with detailed explanations even for readers unused to this specific field.

The aim of this article was to model a pediatric scenario of TCPC, trying to stick to the reality more than a usual rigid circuit, and understand energy dynamics. The main quality of this article comes from the information brought by the use of compliant models versus the rigid ones, traditionally used by researchers evaluating hemodynamic performances of circuits, but actually poorly reflecting true flows, with lower levels of turbulence. The authors show that the use of a rigid model of TCPC underestimates energy losses by 21 to 30%, and show with Doppler visualisation that the nature of the flows are really different between rigid and compliant models. The second advantage is the use, in a compliant model, of a Gore-tex conduit, which is nowadays highly used by surgeons for TCPC connections, mimicking a "true" TCPC patient flow hemodynamics. They show that the use of a Gore-tex conduit lowers energy losses. Their models have high qualities because they include a fluid with density similar to blood, and also used a circuit that includes the variations linked to flow pulsatility.

My major remark adresses the choice of the models and to correctly understand the choices of the authors, I have to ask the following questions :

1. If the goal was to offer a current TCPC model for future geometry and graft studies, the model should look like a true TCPC patient nowadays, who has, most of the time, an extra-atrial connection. The width of the gore-tex conduit used in the model seems too large compared to a real connection between IVC and PAs. We can think that this large conduit does not give the same flow hemodynamics than a TCPC patient with a classic extracardiac conduit. Can the authors compare their connection with their conduit in the model to a classic extracardiac connection, with, I think, a conduit with a width close to the width of IVC?

2. Can the authors explain why do they chose this patient for the modeling? Do this patient has Fontan-related complications?

Minors questions are the following :

Concerning the model:
3. I don't understand why authors modeled the LIV without giving a flow within this part of the circuit. They say that no flow rate was described in the literature for LIV but wasn't it possible to give a classic "venous" flow of an intermediate size?
4. The authors give the numbers for the wall compliance of the compliant models. Was it possible to measure also the compliance of the rigid model?

Concerning the flow analysis:
5. With ultrasound analysis, The authors show that compliant models have more turbulence and mixing, with the gore-tex model performing better due to less mixing in the IVC and RPA. Can the authors explain why less mixing occur specifically in these vessels, specially RPA? Was it the same in the 60:40 scenario versus 50:50 pulmonary split?

6. The authors explain that pulmonary flow split variations induce an increase in energy loss when passing from 60:40 to 50:50. In this model, they use a patient with PA size in the normal range. But as they explain, some patients who need TCPC have small PAs. Was it possible to find the best pulmonary split inducing the least energy loss for this patient included in the model?

Finally minor remarks concerning syntax and spelling:
line 154. after "Markl et al." should come the number of the reference
line 162. the flow rates were split and not where split

Very good and interesting article, but the model should be more practical and close to the "real" patient.

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