

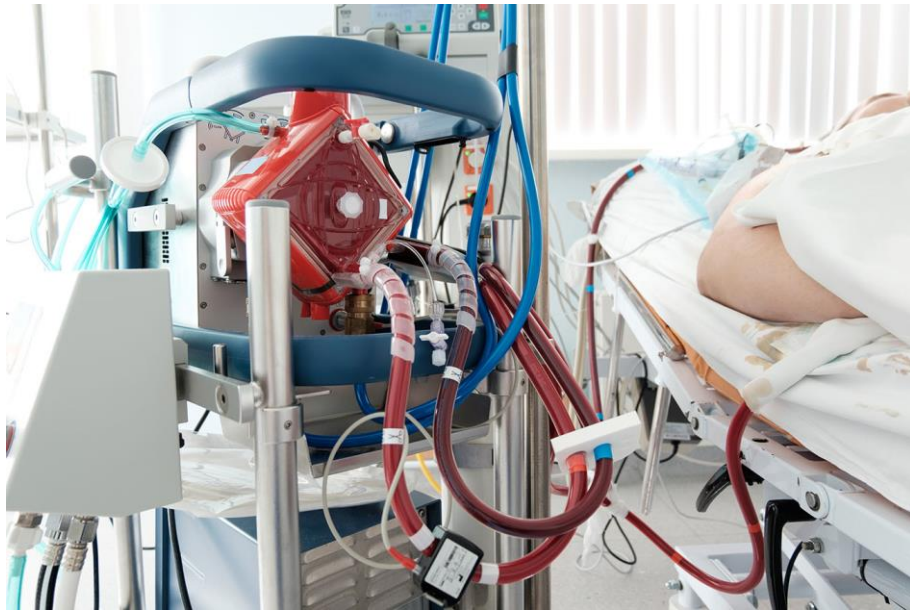
Risk of Cardiac Ischemia in respiratory failure patients using upper body venoarterial extracorporeal membrane oxygenation: A computational study

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Evolving field of organ support and replacement therapy

Extracorporeal Membrane Oxygenation (ECMO)

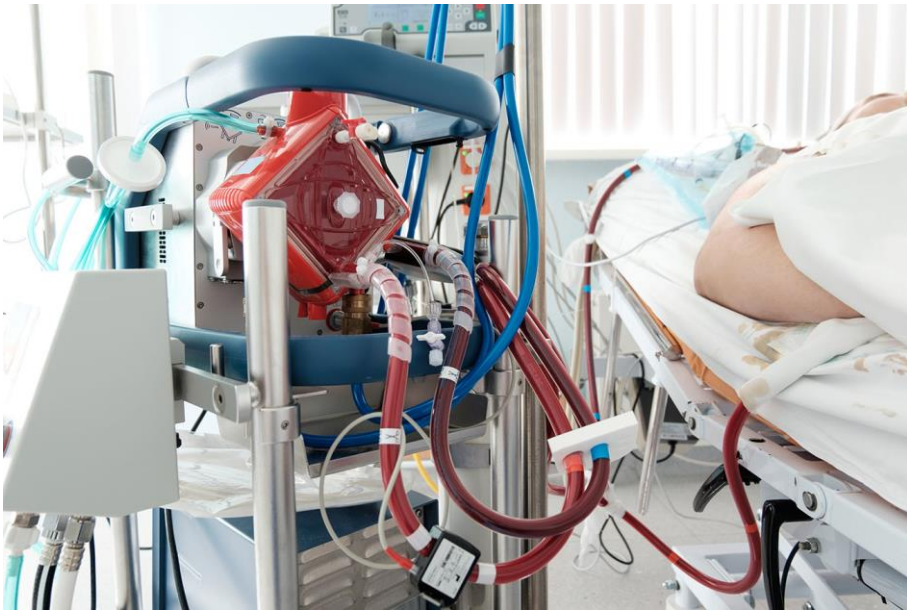
- Temporary heart and lung support outside of the OR



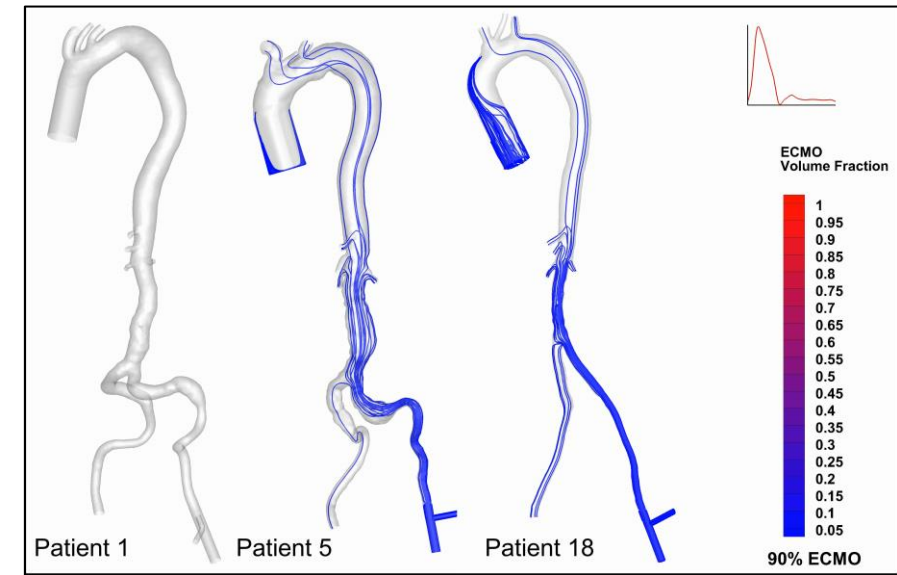
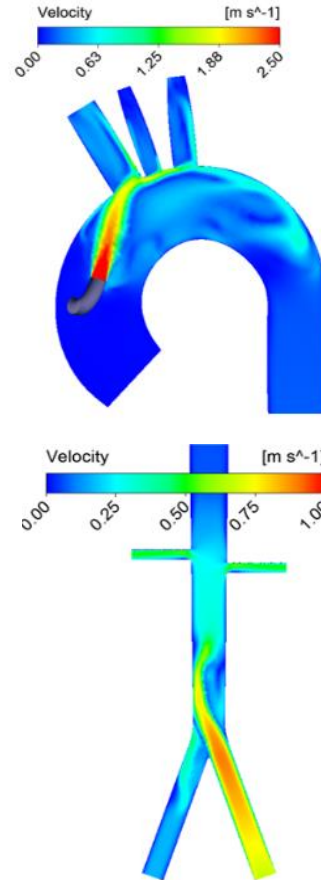
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Computational simulation

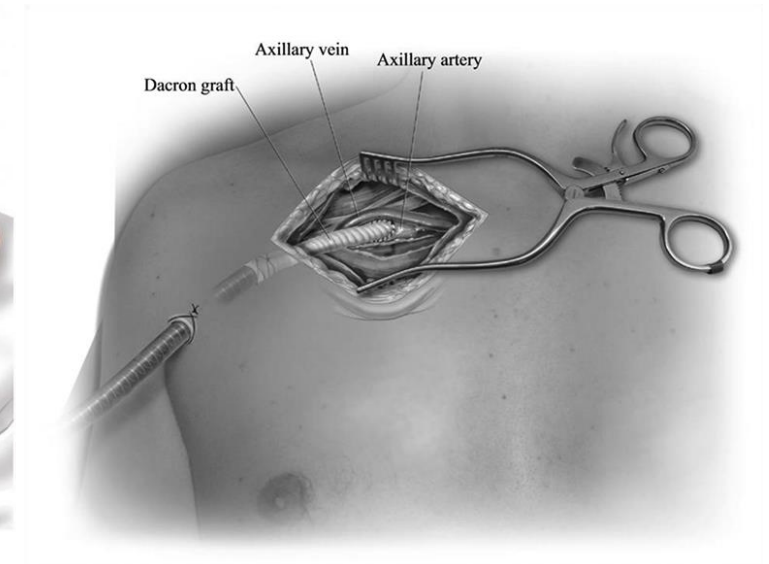
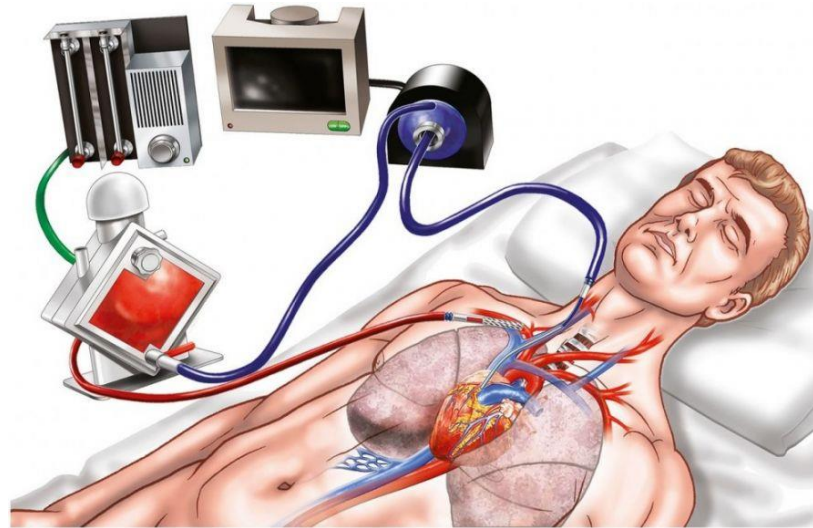


VPH 2018, ASAIO 2021, Computers in Biology and Medicine 2021, Journal of Cardiovascular Translational Research 2021

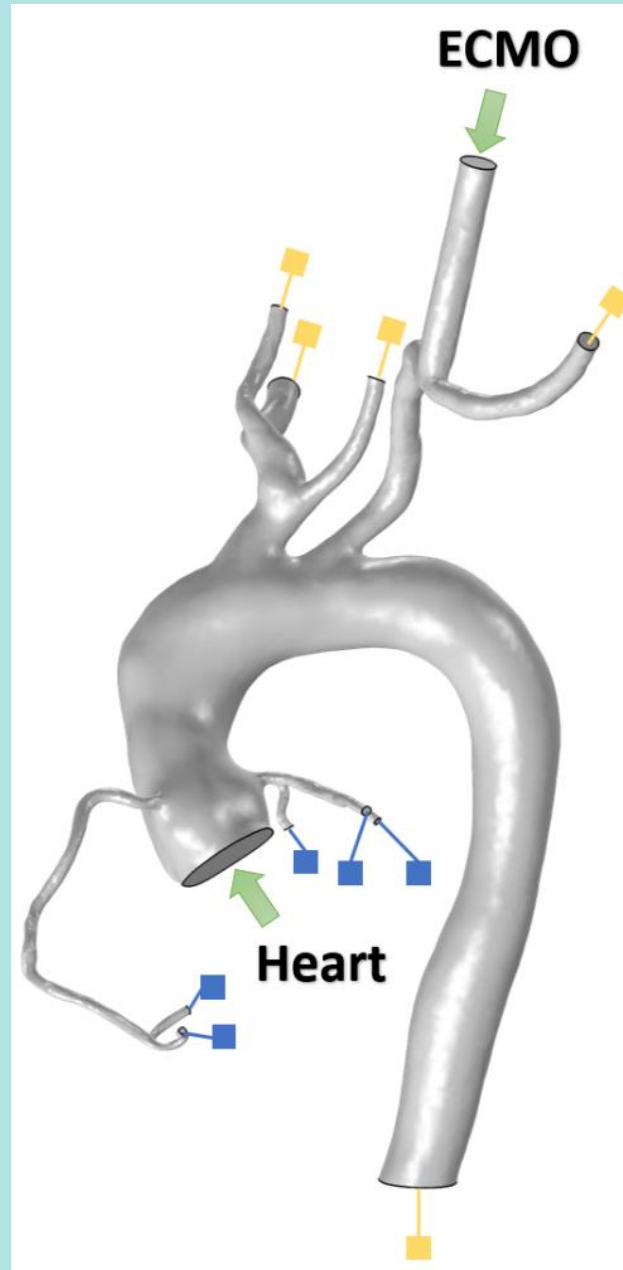
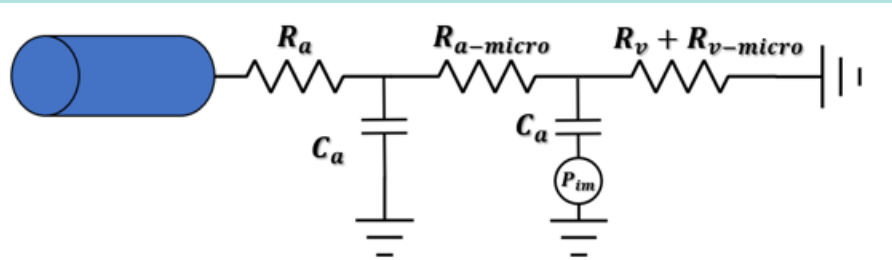
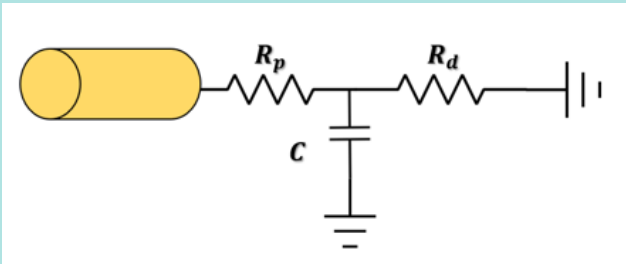


ECMO to Bridge Upper Body Venoarterial Approach

- Transplant centers motivated to **maintain** transplant candidates
- Bridge patients with end-stage lung disease complicated by **pulmonary hypertension/RV failure**
 - profoundly challenging as they have **both lung failure and circulatory failure** -> the optimal approach is **unknown**
- Shunt blood around the cardiopulmonary circulation and **off load the RV** while simultaneously providing for **gas exchange**

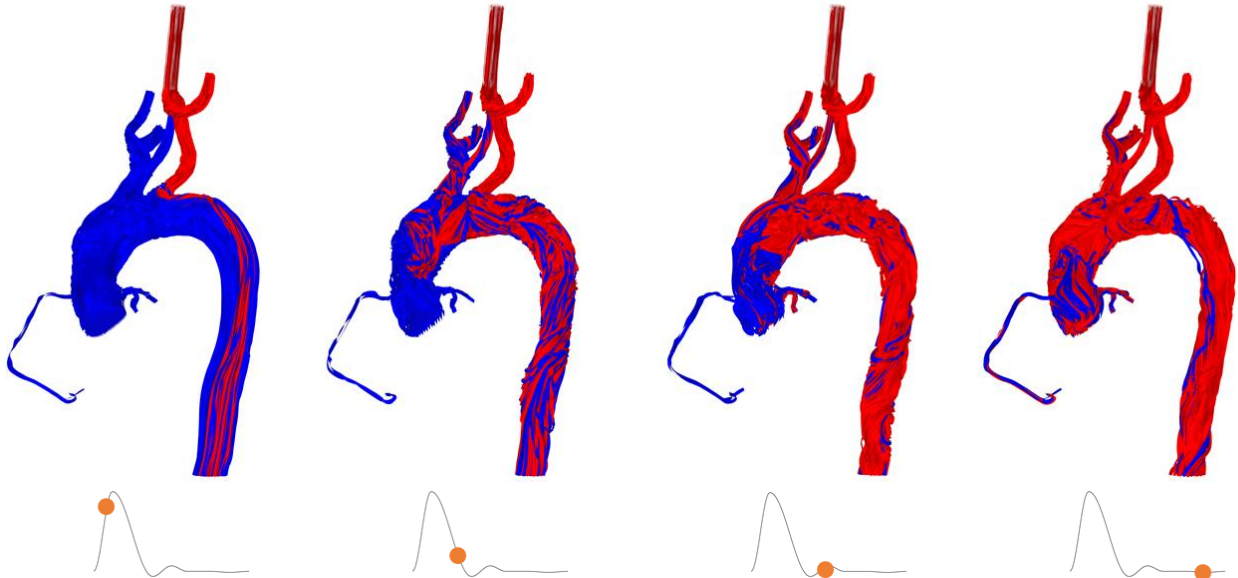


Results

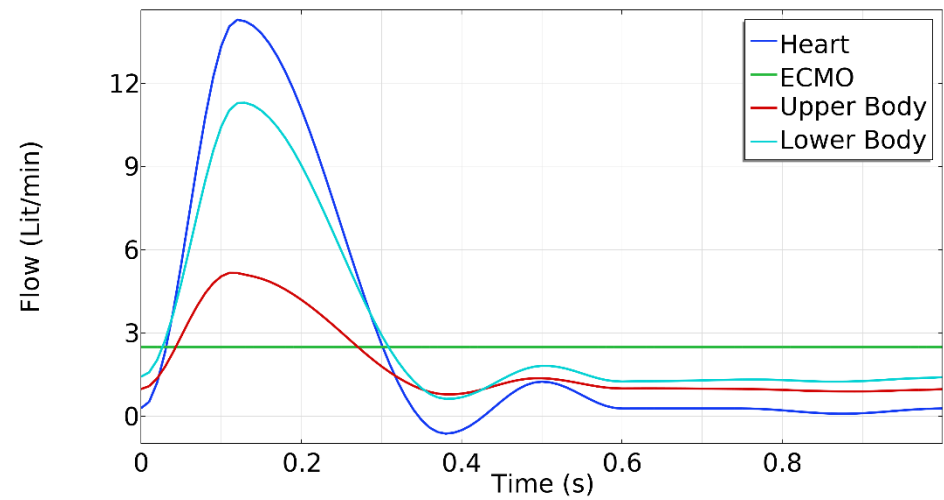


Results

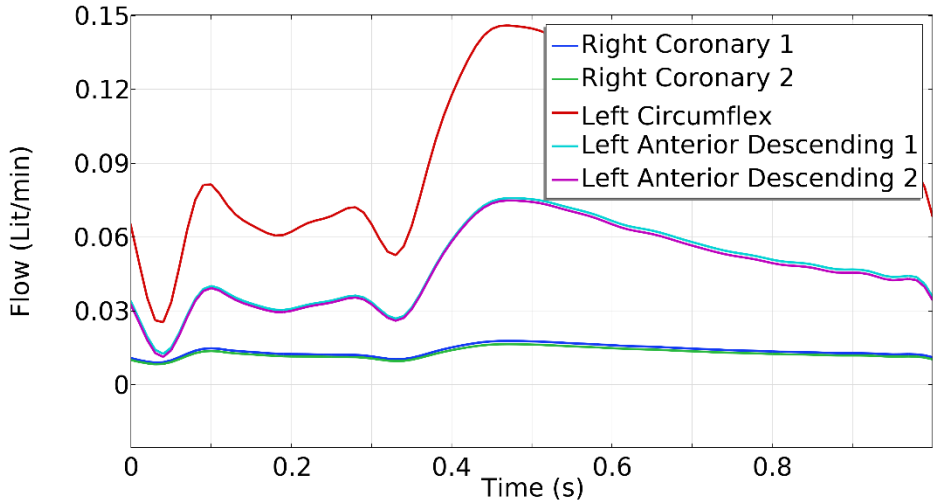
Hemodynamics



Blood Flow rate



Coronary perfusion

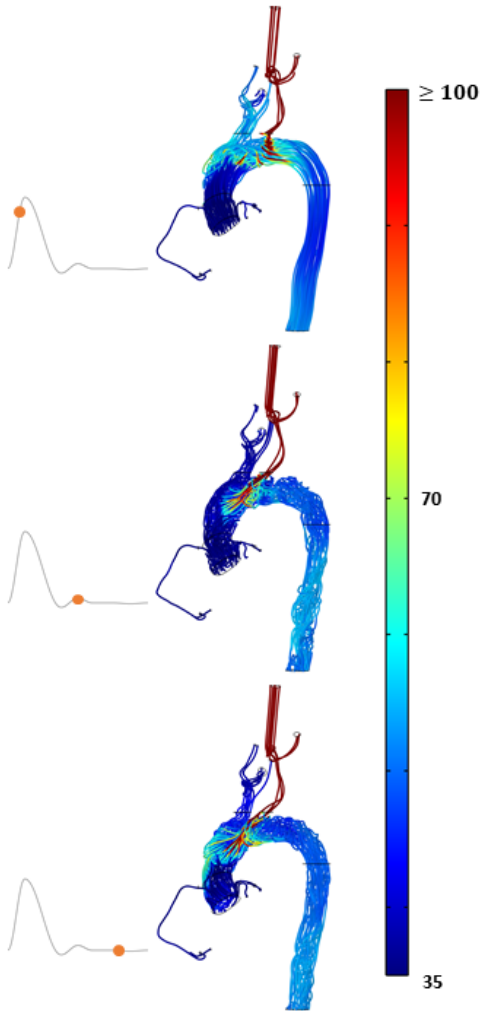


Results

Oxygen Transport

Perfusion with
low-oxygen blood!!

	Artery	Area-time average of oxygen pp (mmHg)
Lower Body	Descending Thoracic Aorta	51.575
Upper Body	Left subclavian	400
	Left carotid	41.565
	Right carotid	41.741
	Right subclavian	43.179
Coronary Arteries	Right coronary 1	35.595
	Right coronary 2	35.568
	Left Circumflex	36.726
	Left Anterior Descending 1	36.515
	Left Anterior Descending 2	36.407



In Closing

- Complex interaction of VA ECMO and host
- Computational modeling as an effective tool
- Numerous questions to answer:
 - Efficacy to oxygenate the aorta?
 - Risk of cardiac ischemia?
 - How does titration of support alter blood flow distribution and end organ oxygen delivery?
 - Effect on perfusion of and flow to the arm?



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Acknowledgment

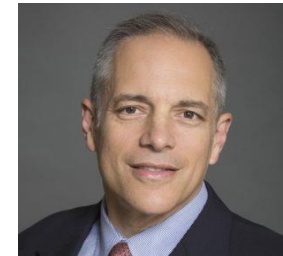
- Hamed Moradi (PhD student, TU Eindhoven)
- Prof. Elazer Edelman (MIT, HMS, BWH)
- Prof. Steven Keller (Johns Hopkins)



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