

# EP09.14. Computational model of fetal oxygen distribution in hypoplastic left heart syndrome

I. Villanueva-Baxarias, G. Pennati, F. Berti, L. Nogu  , O. G  mez, F. Crispi, P. Garcia-Canadilla, O. Camara, B. Bijnens, G. Bernardino

## Introduction

We created a **computational model of fetal circulation** (Figure A) to study O<sub>2</sub> distribution of healthy and hypoplastic left heart syndrome (HLHS) fetuses, as O<sub>2</sub> is crucial for growth.

## Methodology

In **HLHS**, we minimized the left ventricle, mitral and aortic valves, and dilated the right ventricle, ductus arteriosus, and pulmonary artery.

We computed **O<sub>2</sub> distribution** using our simulated blood flows, placental diffusion (lower for HLHS, as it is more inefficient), and fixed organ O<sub>2</sub> consumption.

**Validation** was done by comparing blood flows and O<sub>2</sub> saturations with the MRI data reported by Sun *et al.* UOG 2021.

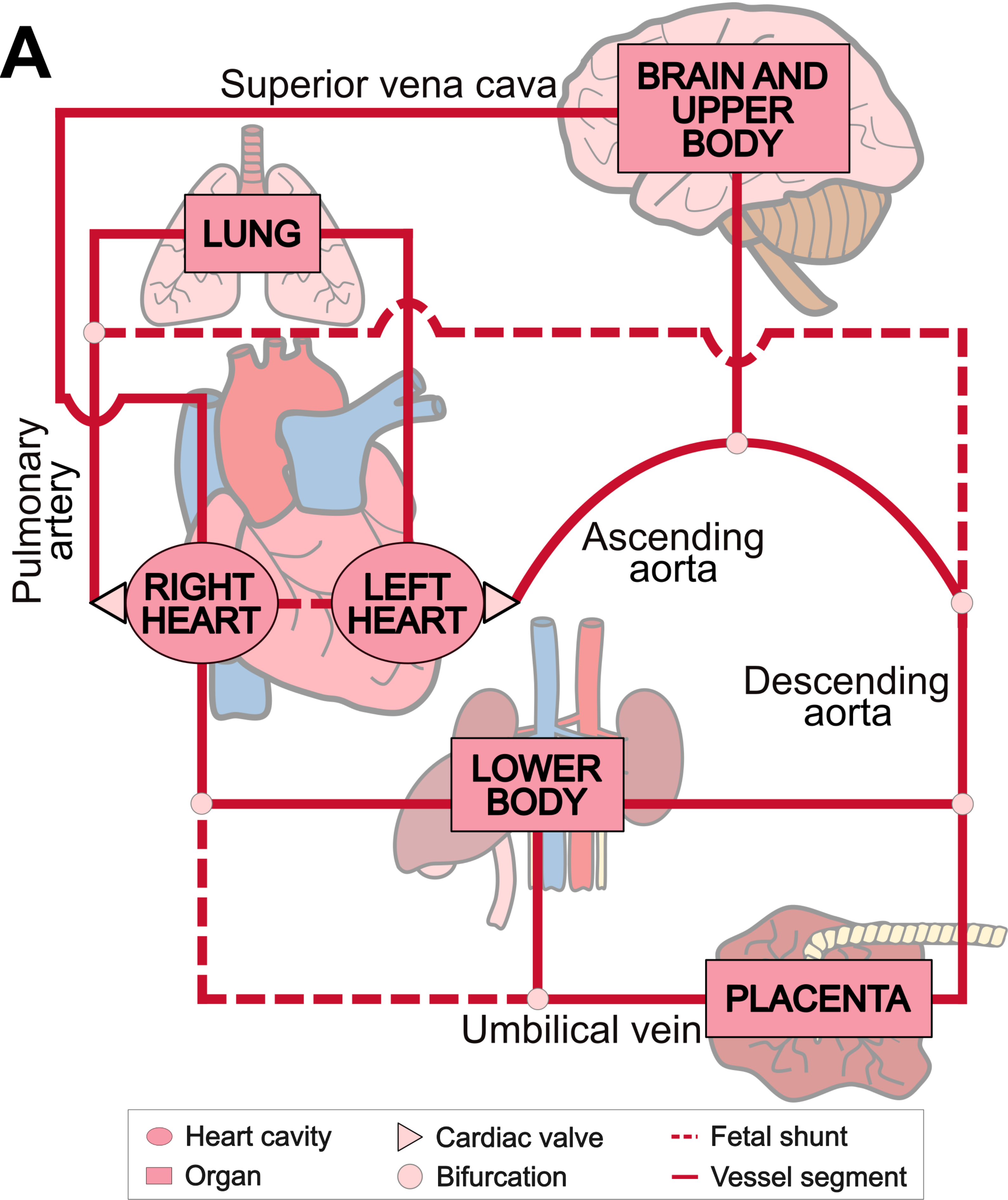
## Results

In the **healthy** case, O<sub>2</sub>-rich blood from the left ventricle supplies the brain and mixes in the descending aorta with lower-saturated blood from the right ventricle.

In **HLHS**, the right ventricle supplies the whole body. Blood mixing in the ventricle and the inefficient placenta reduce overall O<sub>2</sub> saturation, especially in the superior vena cava.

## Conclusion

Our fetal circulation model enables to estimate blood flow and O<sub>2</sub> distribution. It could be used to study birth transition and other cyanotic congenital heart diseases, and serve as a basis for a growth model.



## B

| Anatomical site    | Blood flow (% CO) |           | Oxygen saturation (%) |         |
|--------------------|-------------------|-----------|-----------------------|---------|
|                    | Healthy           | HLHS      | Healthy               | HLHS    |
| Pulmonary artery   | 53 / 53           | 100 / 100 | 51 / 52               | 43 / 41 |
| Ascending aorta    | 44 / 44           | -2 / -3   | 59 / 58               | 43 / 43 |
| Descending aorta   | 53 / 53           | 57 / 57   | 54 / 53               | 43 / 38 |
| Umbilical vein     | 26 / 26           | 28 / 27   | 78 / 80               | 67 / 69 |
| Superior vena cava | 27 / 27           | 25 / 25   | 45 / 44               | 27 / 28 |

Figure. A) Model scheme. B) Simulated (left) blood flow and O<sub>2</sub> saturation compared to Sun *et al.* UOG 2021 (right).