Angle of Insertion of the Ductus Venosus Affects Qualitative and Quantitative Flow Across the Foramen Ovale

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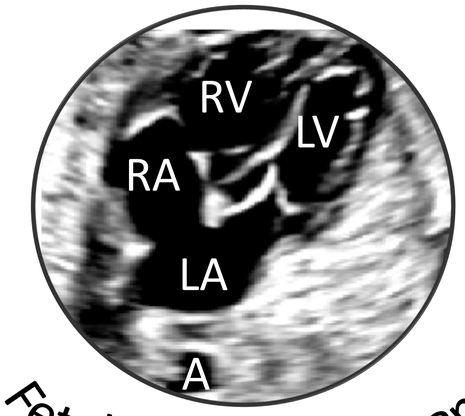
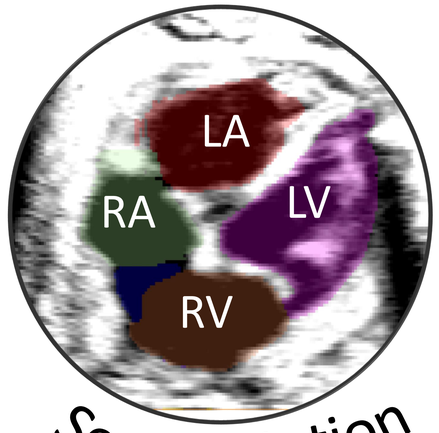


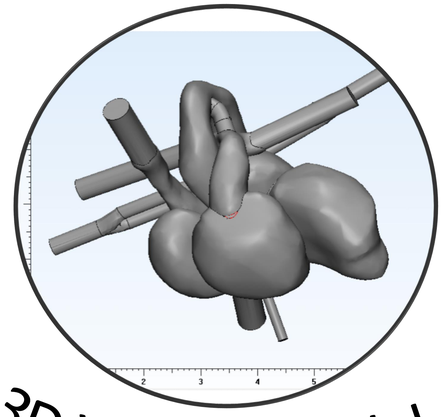
Fetal Echocardiogram

28 week fetal echocardiogram was segmented in Mimics (Materalise)



Segmentation

3D Model is smoothed and meshed in 3-Matic (Materialise)

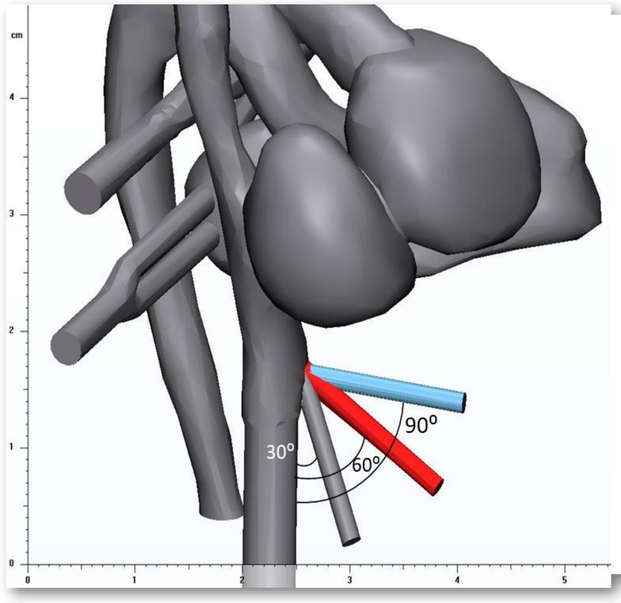


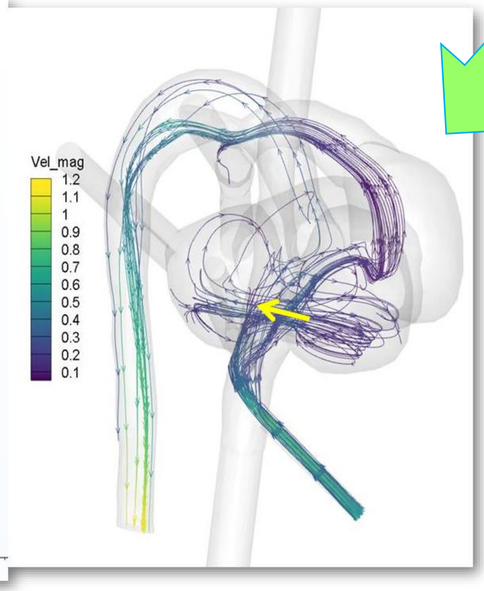
3D Virtual Model

Purpose

- It is suggested that intracardiac flow patterns play a role in fetal cardiac anomaly development[1]
- Patient-specific fetal heart models were successfully created from 3D Fetal Echocardiograms[2]
- Computational Fluid Dynamics (CFD) has been used to study the affect of anatomy on flow patterns[3,4]

→ Goal: To analyze how changing the angle of insertion of the ductus venosus (DV) affects the amount of DV flow across the foramen ovale (FO) with CFD





CFD simulations (Converge) were done with 3 different angles of insertion of the Ductus Venosus (DV). 60º was the actual angle of insertion. % of DV flow across FO (yellow arrow) was calculated

DV angle	% DV Flow Across FO
30º	54.4%
60º (actual)	50.4%
90º	47.8%

→ Changing the angle of insertion changed the % of DV flow that went across the FO.

Future Work: Analyze multiple normal hearts to determine a "normal" angle of insertion and hearts with cardiac anomalies to determine any difference in DV angle of insertion and run the simulations again.

CFD Properties: 2mm CFD grid was used with an adaptive meshing algorithm and a passive scalar transport equation was solved. Inflow boundary conditions were set based on literature.[5,6]

References

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[3] Rutkowski DR, *Compt Methods Biomech Biomed Eng Imaging*, 2017
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