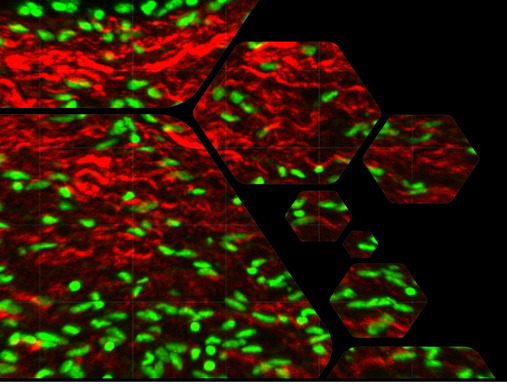

Pregnancy-Induced Aortic Remodeling: Collagen Orientation and its Impact on Aortic Stiffness

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INTRODUCTION

Cardiovascular complications are the leading cause of **maternal mortality—**responsible for more than 33% of pregnancy related deaths [1].

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NORMOTENSIVE PREGNANCIES

Hemodynamics [2,3]

↑cardiac output
↑ heart rate
↓ peripheral resistances

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Attenuations of the hemodynamics parameters have been linked to the pathogenesis of cardiovascular disease and mortality [4].

The decrease in structural stiffness of the aorta may stem from changes in applied loads, geometry, and intrinsic tissue properties, the latter being largely unknown.

MAIN QUESTION

1. Does the maternal aorta undergo **adaptive remodeling** during normal pregnancy to accommodate for the hemodynamic changes?

To what extend does this remodeling occur?

What are the underlying physical mechanisms?

METHODS

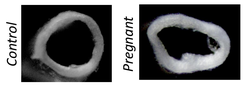
1 Hemodynamics & Sample Collection

Late-gestation C57BL/6 mice
Age-matched control

FINDINGS

- Cardiac output increases by ~50%.
- Blood pressure remains comparable between groups.

2 Functional Assessment of the Thoracic Aorta[5,6]



FINDINGS

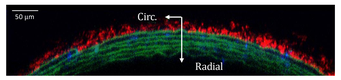
- Increase in wall thickness and diameter.
- Decrease in tissue stiffness.
- Decrease in circumferential stress.
- Maintenance of vascular function.

3 Structural Assessment of the Thoracic Aorta

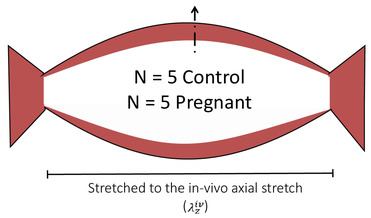
ONGOING

Microstructural analysis of the tissue as a function of mechanical loading

Multiphoton Microscopy Imaging



Pressures:
20 - 140 mmHg



RESULTS

Adventitia Remodeling

Collagen fiber orientation distribution was assumed to follow a Von Mises Distribution [7] – a function of θ.

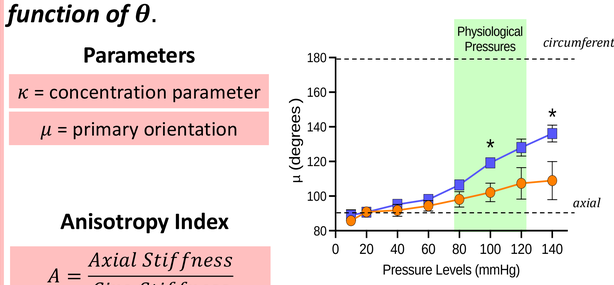
Parameters

κ = concentration parameter

μ = primary orientation

Anisotropy Index

$$A = \frac{Axial\ Stiffness}{Circ.Stiffness}$$



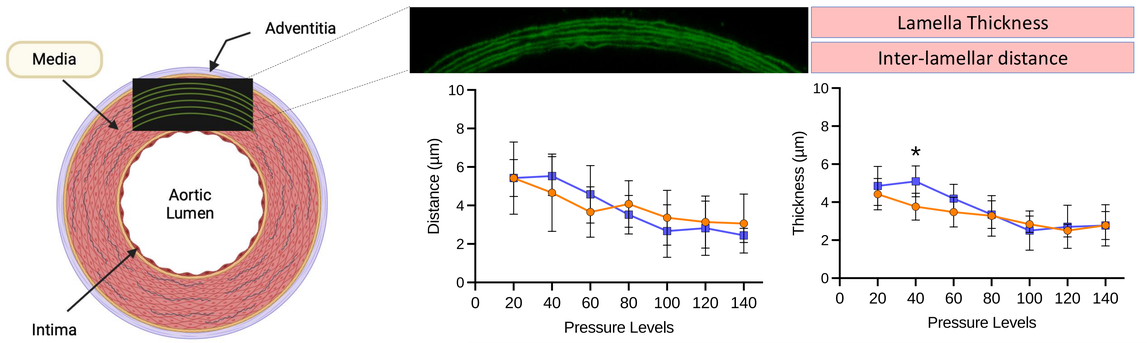
More rapid orientation towards the circumferential direction

Fibers are less uniformly organized

More rapid gain in circumferential stiffness

Media Remodeling

Preliminary data do not show differences between groups



Elastic fibers do not change significantly during pregnancy

CONCLUSIONS

- The microstructural changes observed in this study are consistent with macro-scale alterations in the aorta previously reported [6,7].
- These microstructural and mechanical changes in the pregnant aorta, characterized by collagen reorientation and a more rapid gain in circumferential stiffness, may help accommodate the hemodynamic demands of pregnancy.
- These changes could also have implications for postpartum aortic function and maternal health.

ACKNOWLEDGMENTS

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