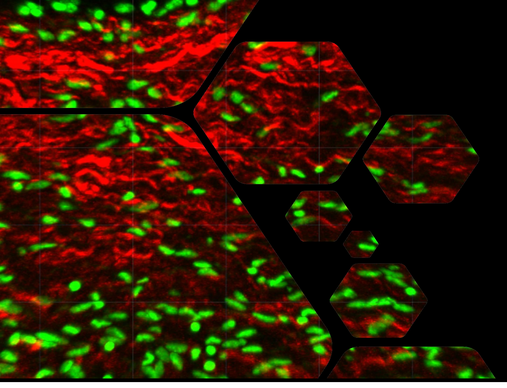

On the Pressure-induced Nuclear Deformation of Murine Vascular Cells: The Effects of Pregnancy-induced Remodeling

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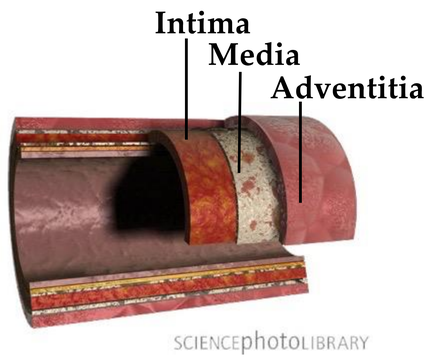
Introduction

Cardiovascular (CV) complications are responsible for >33% of pregnancy related deaths in the US [1]

- 7.7% Cerebrovascular Accidents
- 11% Cardiomyopathy
- 15.7% Other CV Conditions

Maternal vascular complications are associated with an increased risk of vascular disease later in life [2]

Structure of the Aorta



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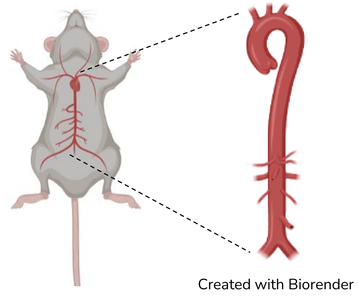
Fibroblasts | Smooth Muscle Cells

Hypothesis: During pregnancy, the cells in the aortic wall will experience deformation due to stretching and increased wall tension [3]

Methods



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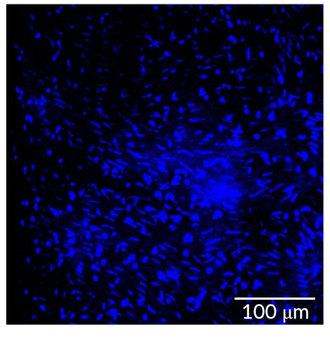
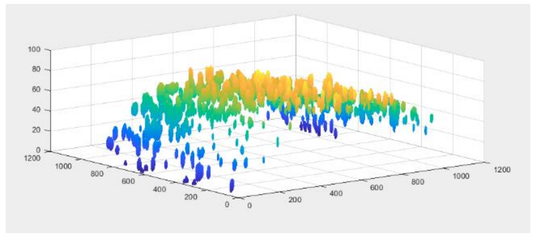
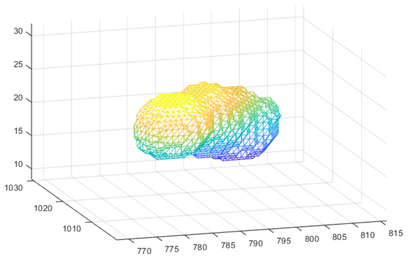
Aortic wall was imaged in sex- and age-matched nulligravida control mice (6 control, 4 pregnant)

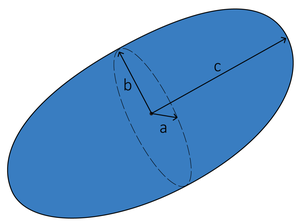


Max Z. Projection of image stack with smooth muscle cells and fibroblasts





The smooth muscle cells and fibroblasts are then segmented using Gaussian smoothing, background subtraction, and small volume removal



$$NAR = \frac{c}{a}$$ → Longest Axis; → Shortest Axis

For each segmented cell, the nuclear aspect ratio (NAR) is calculated for both smooth muscle cells and fibroblasts

Why quantify cellular deformation?

Indicator of cellular morphology	Structural remodeling
Cellular response to mechanical stress	Biological & Pathological Insights

Changes in NAR can alter gene expression, impacting cellular functions and tissue remodeling [4].

Results

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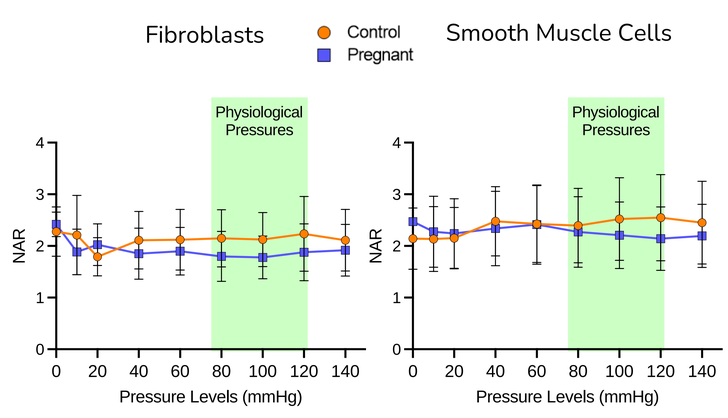

Effect of pressure: minimal changes in nuclear shape within the physiological pressure

Effect of pregnancy: no difference in nuclear shape between groups

Conclusions

- Minimal changes in the NAR were found within physiological pressure ranges in both pregnant and nulligravida mice, indicating that nuclear shape is preserved despite mechanical stresses.
- No significant differences in NAR between groups suggest that cellular adaptations during pregnancy maintain nuclear homeostasis despite differences in luminal diameter and tissue stresses.
- These findings underscore the importance of nuclear integrity for vascular health during pregnancy, with implications for maternal cardiovascular health and strategies for addressing pregnancy-related vascular complications.

References

[1] Petersen et al., (2019). MMWRMorb Mortal WklyRep [2] Sattar et al., (2002). Bmj [3] Vargas et al., (2003). *Curr Res Phys* [4] Chatterjee et al., (2022) Biomech model mechan.

Acknowledgments: Support for this work was provided in part by the National Science Foundation (NSF CAREER award 204088).
We acknowledge Umass Medical School, Cardiovascular & Surgical Core for collecting cardiac echocardiographs.