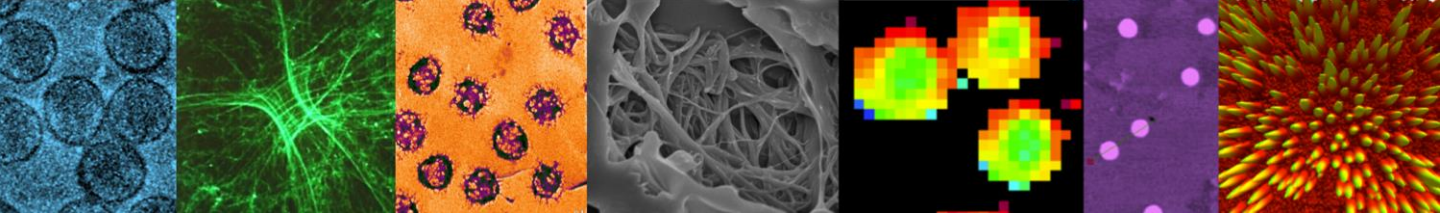

Structural Analysis of Neonatal Clots

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Advanced Wound Healing Lab

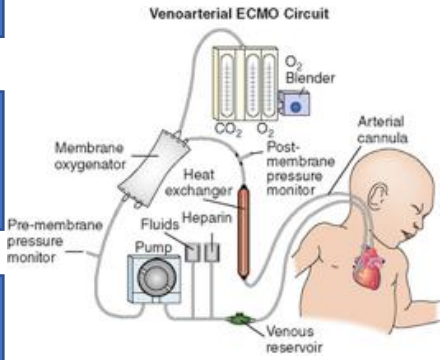
Neonatal Bleeding Complications

Many neonates are born with congenital heart defects and require corrective surgery with cardiopulmonary bypass (CPB)

Neonates are especially prone to post-operative bleeding, which often results in bleeding complications

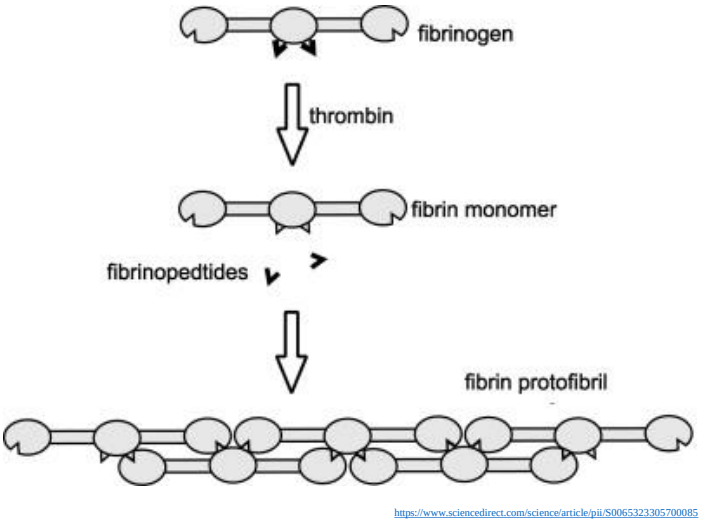
Currently addressed through adult blood transfusion products

Inconstant Efficacy and Not always sufficient to restore Hemostasis



Neonatal Fibrinogen

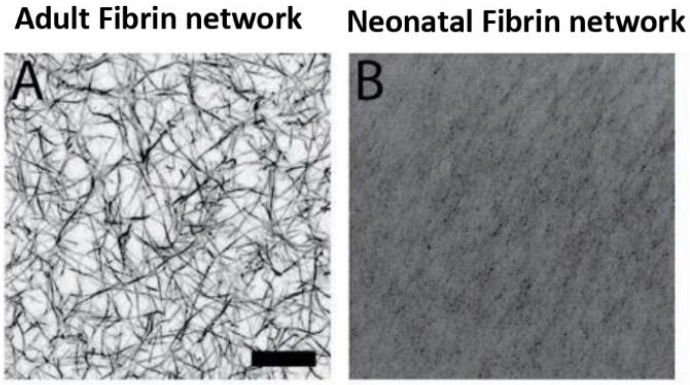
- Quantitative and Qualitative differences in clot structure between neonates and adults
- Possess immature form of fibrinogen
- Normally not an issue for a healthy neonate



https://www.sciencedirect.com/science/article/pii/S0065323305700085

Differences in Clot Structure

- Immature Coagulation System leads to distinct differences in clot properties



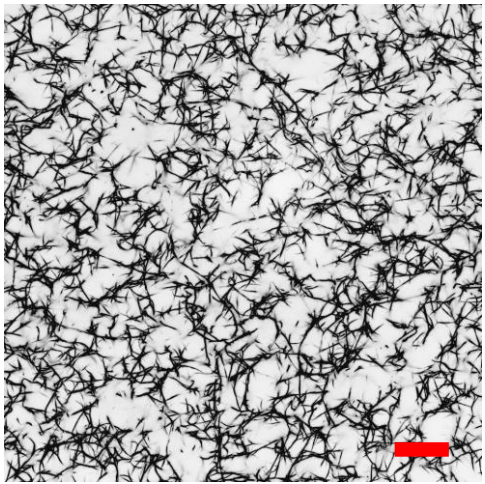
Confocal Microscopy. Scale bar= 20 um

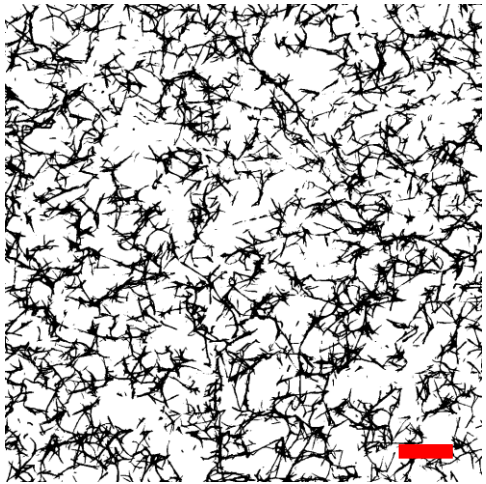
Modified from Brown et al. *Anesthesiology*.(2016)

How are these properties quantified?

Simple Methods of Quantification

- Density
- Porosity

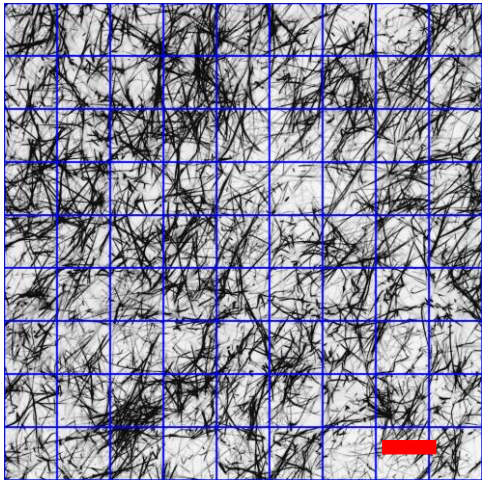




Confocal Microscopy. Scale Bar = 25 um

Initial Branching Quantification

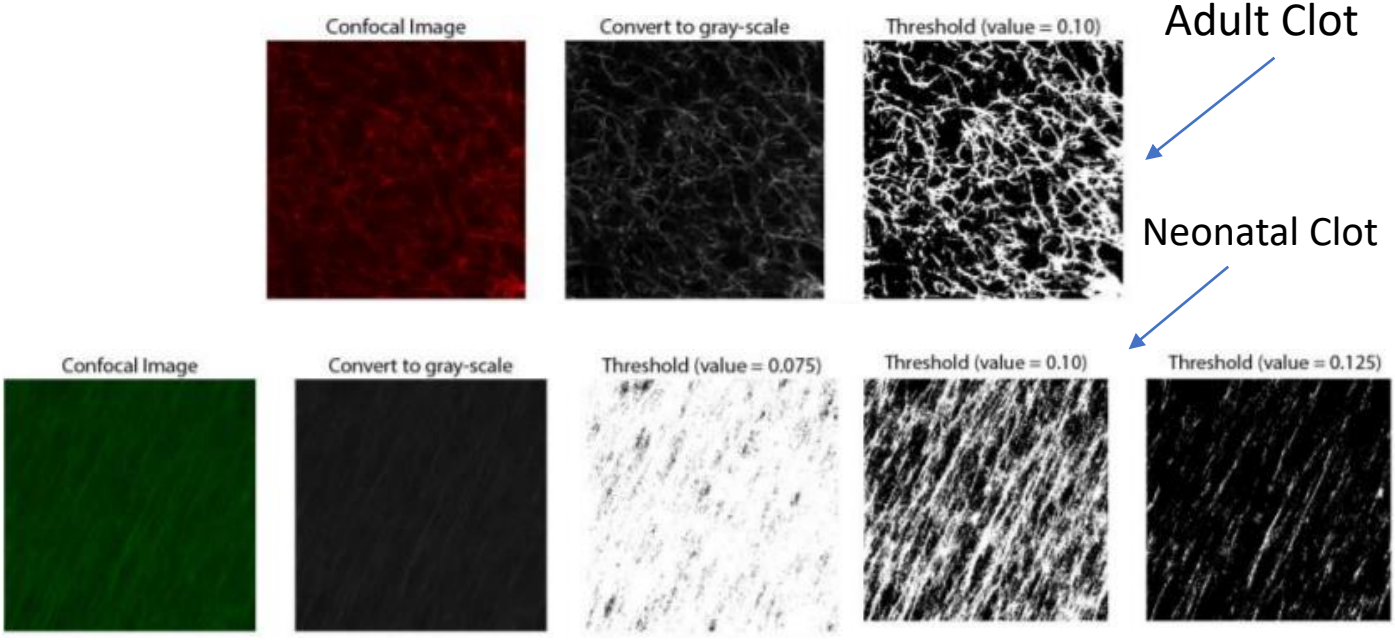
Hand-counting



Confocal Microscopy. Scale Bar = 25 um

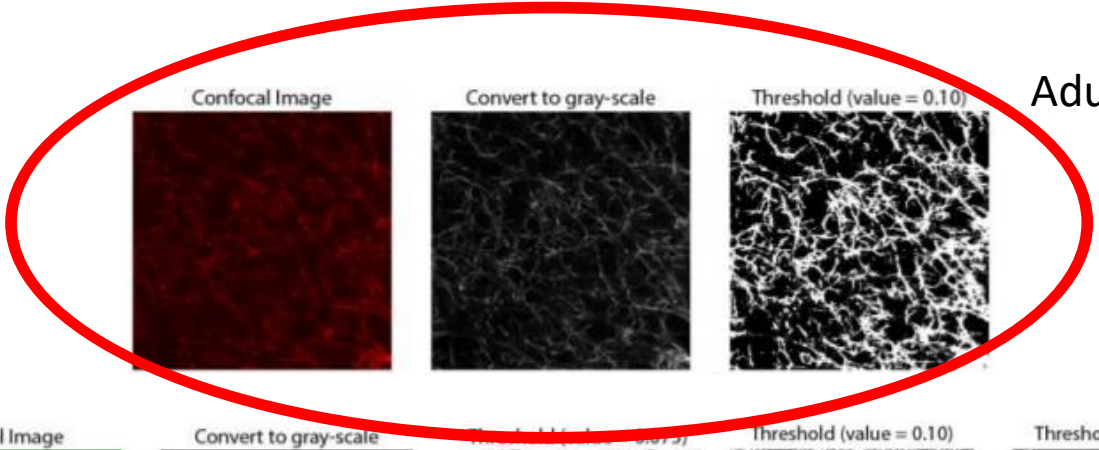
How do you effectively automate this process?

The Binarization Problem



Modified from Brown et al. *Anesthesiology*.(2016)

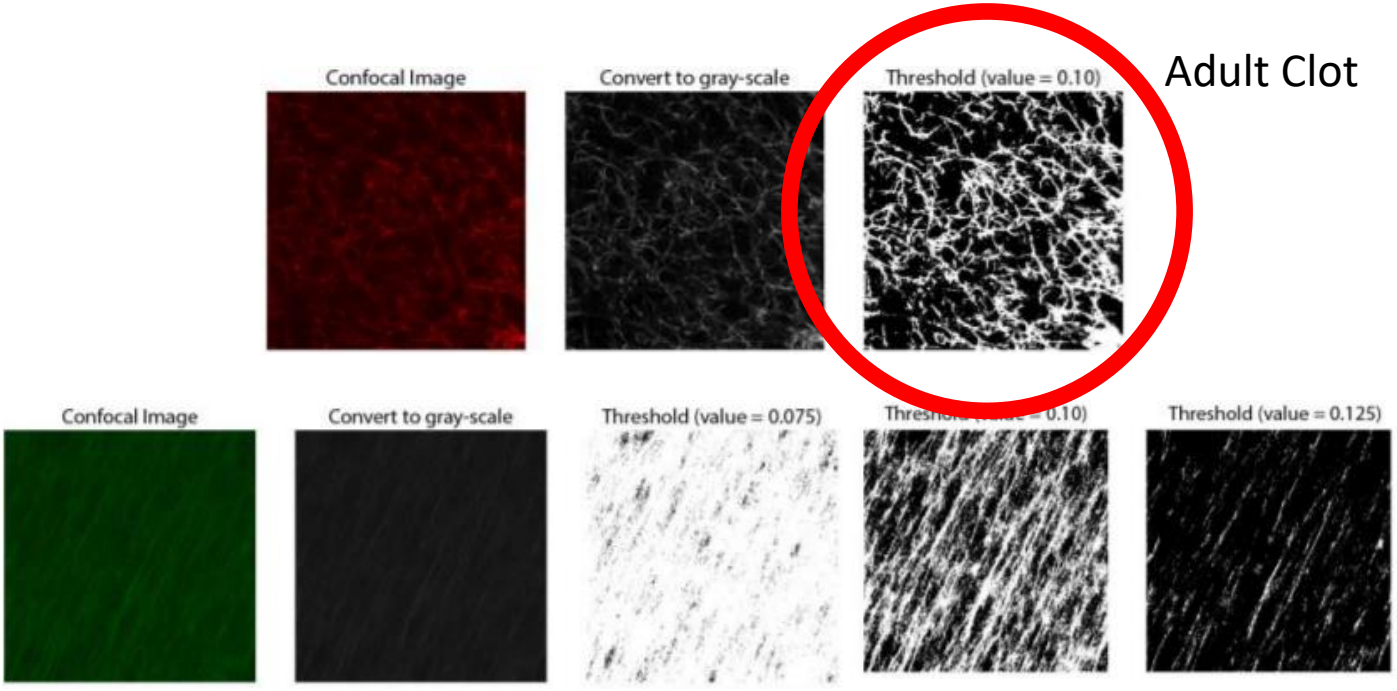
The Binarization Problem



Adult Clot

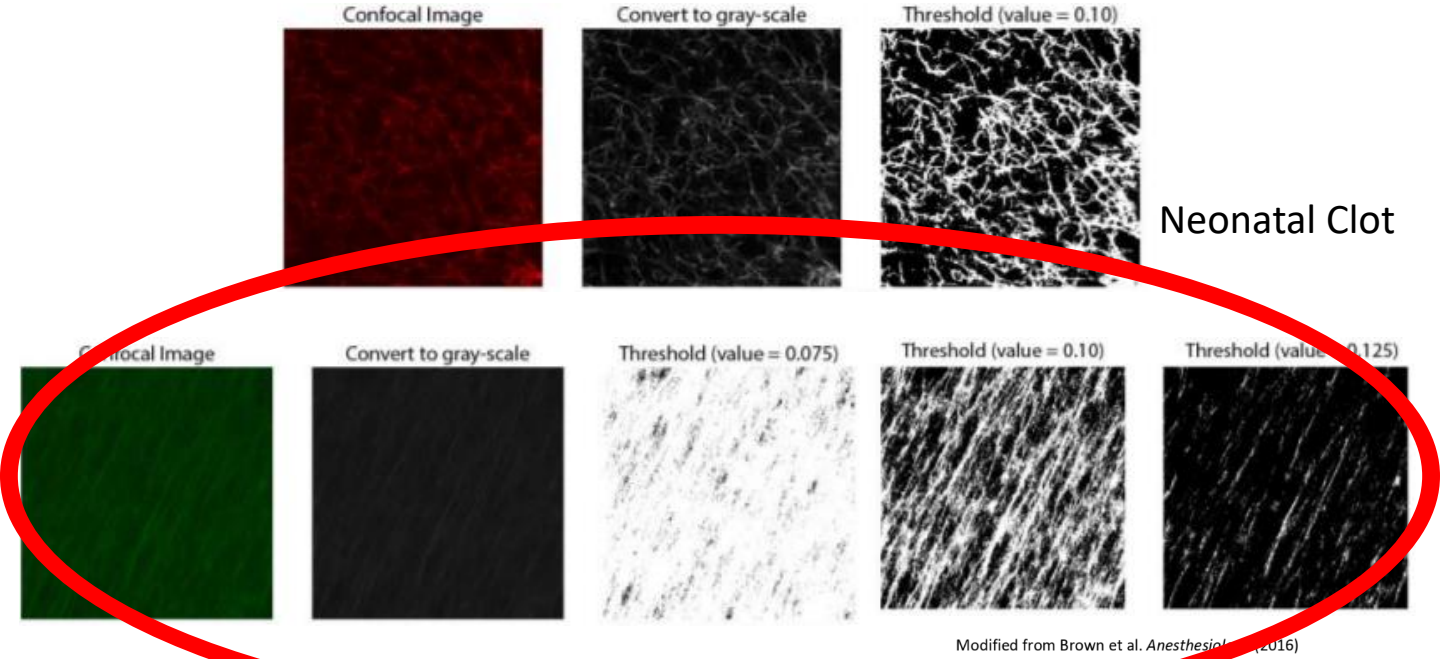
Modified from Brown et al. *Anesthesiology*.(2016)

The Binarization Problem



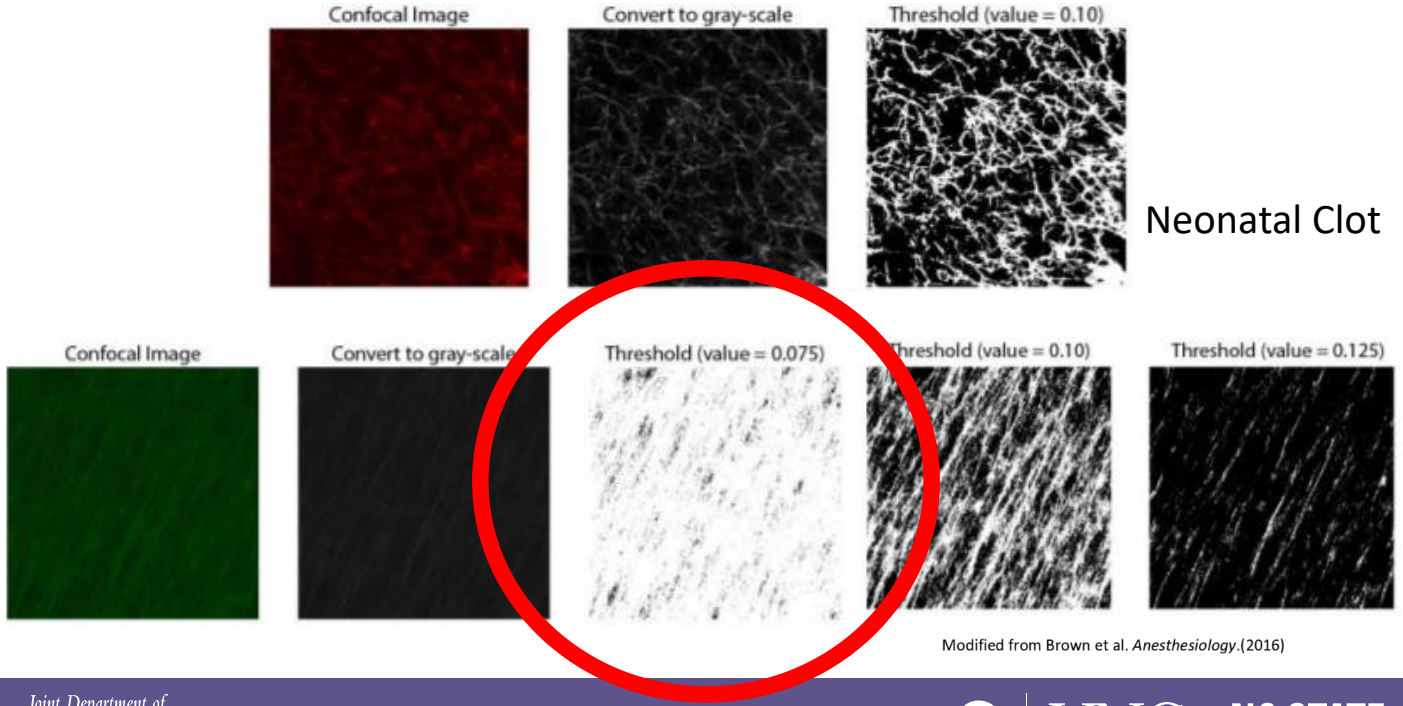
Modified from Brown et al. *Anesthesiology*.(2016)

The Binarization Problem



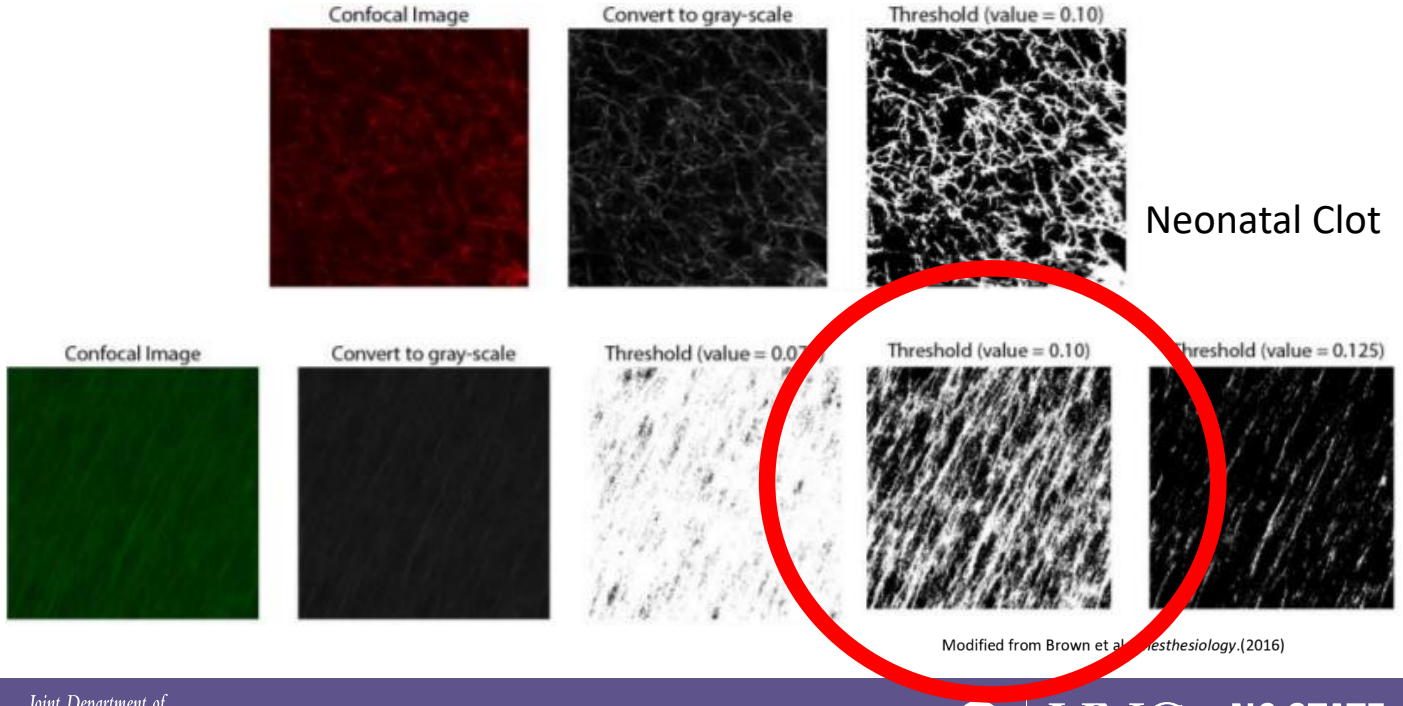
Modified from Brown et al. *Anesthesiol* (2016)

The Binarization Problem

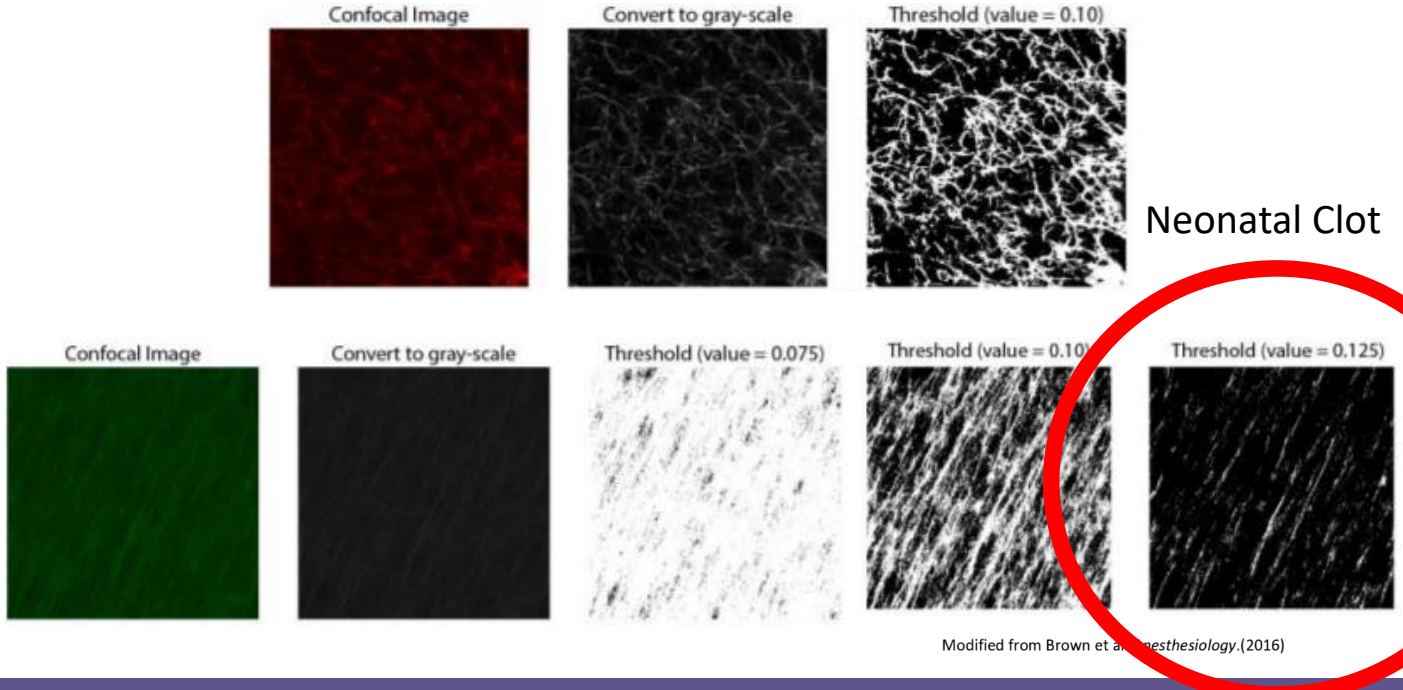


Modified from Brown et al. *Anesthesiology*.(2016)

The Binarization Problem



The Binarization Problem

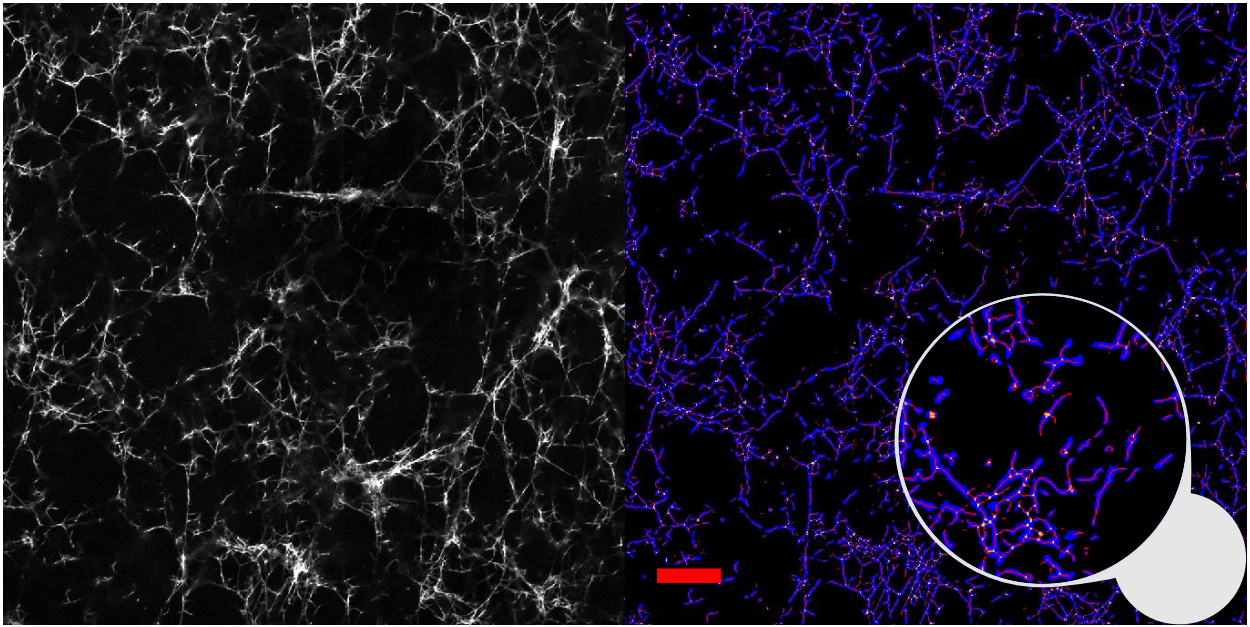


Modified from Brown et a[illegible] *esthesiology*.(2016)

Solution?

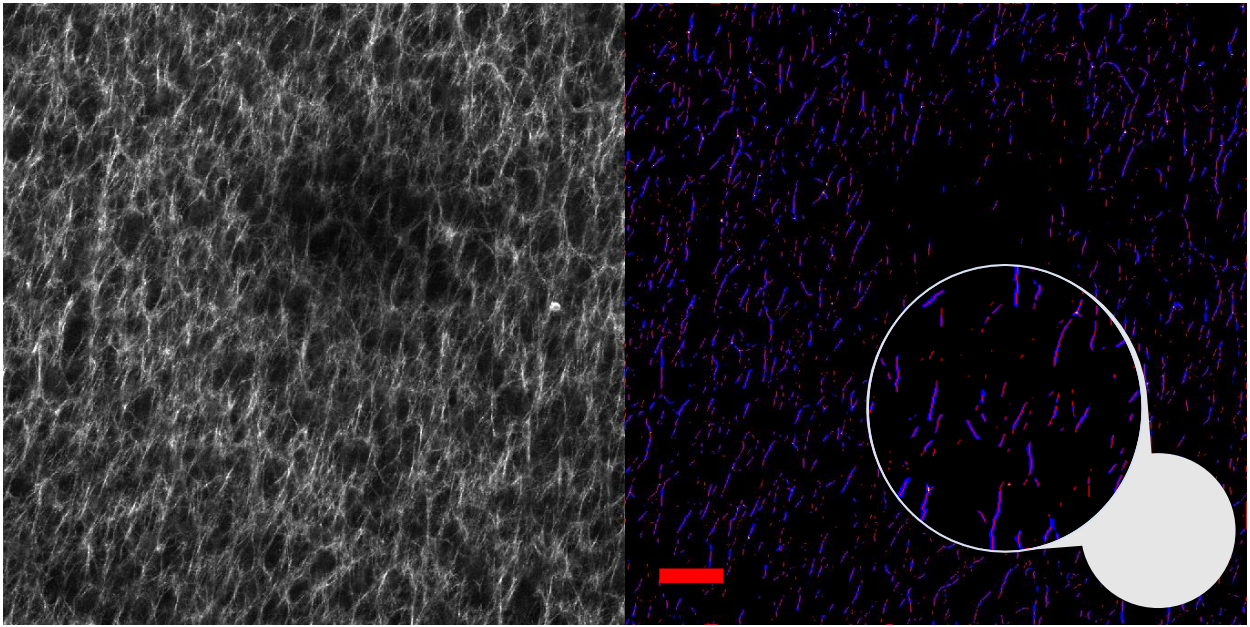
Solution?
Thresholding based on Intensity Distribution

3D Adult Quantification



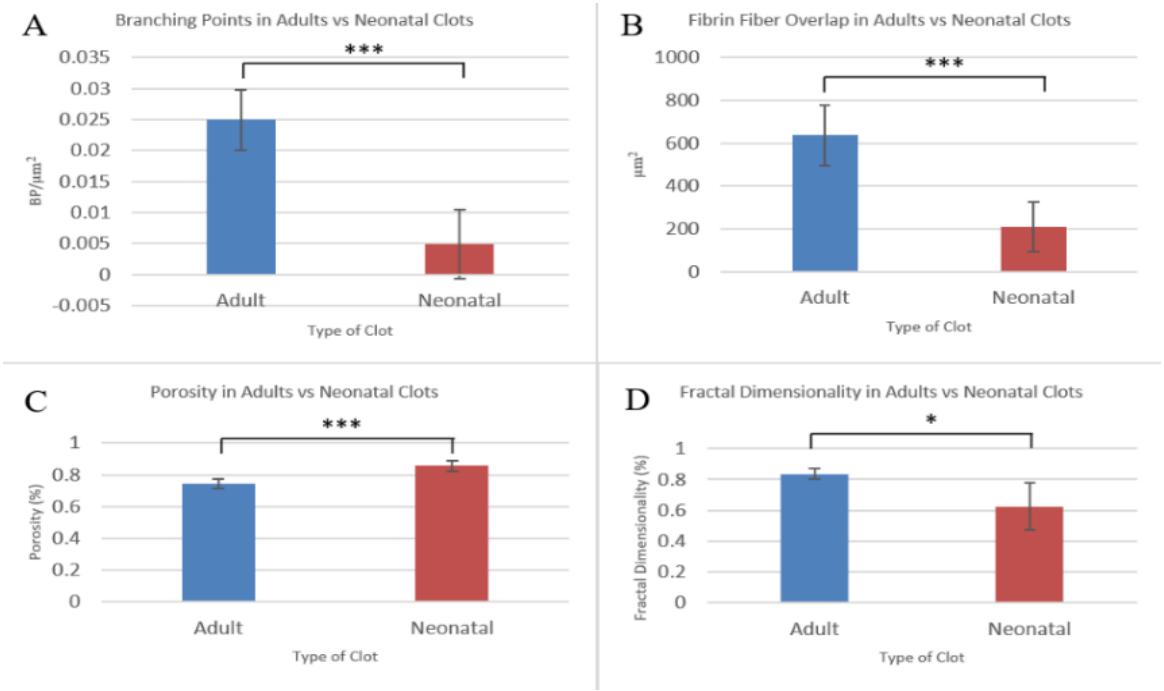
Confocal Microscopy. Scale Bar = 25 um

3D Neonatal Quantification



Confocal Microscopy. Scale Bar = 25 um

Clot Quantification



Takeaways

1. Neonates that go under cardiopulmonary bypass surgery are at an extreme risk for blood loss
2. Immature coagulation proteins in neonates
3. Limited image analysis techniques to characterize clot structure
4. This image processing method could potentially revolutionize clot structure quantification

Acknowledgements

<u>Principle Investigator:</u>

Dr. Ashley Brown

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Kimberly Nellenbach

Advanced Wound Healing Lab

<u>Professor:</u>

Dr. Naji Husseini

Questions?