The Thrombectomers: Update 2

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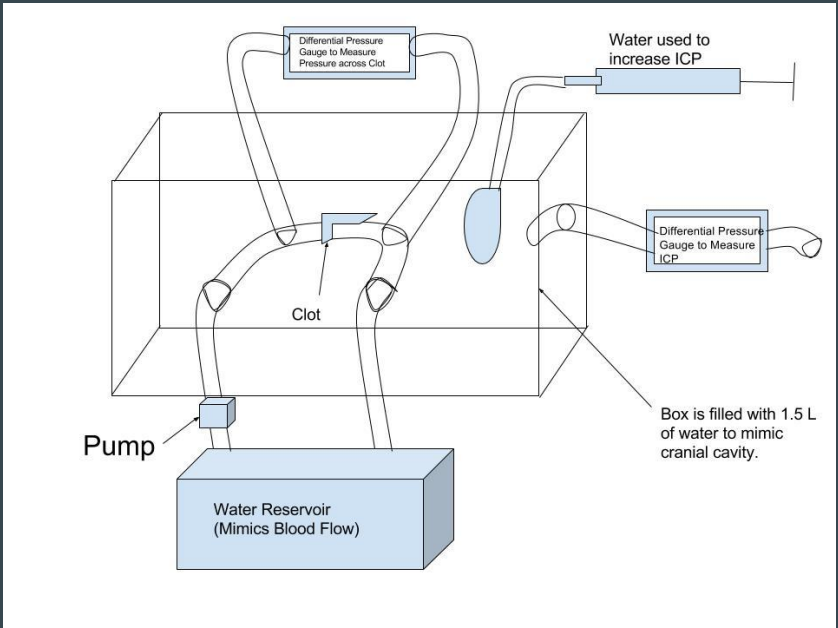
Problem Statement

- Vacuum Thrombectomy: Procedure to remove thrombi using suction pressure
- There remains room for the procedure to be optimized.
- Need a physical model of the cranial cavity that accurately represents ICP, and allows pressure to be altered to determine the suction force at the tip of the catheter.

Movie

Previous Accomplishments

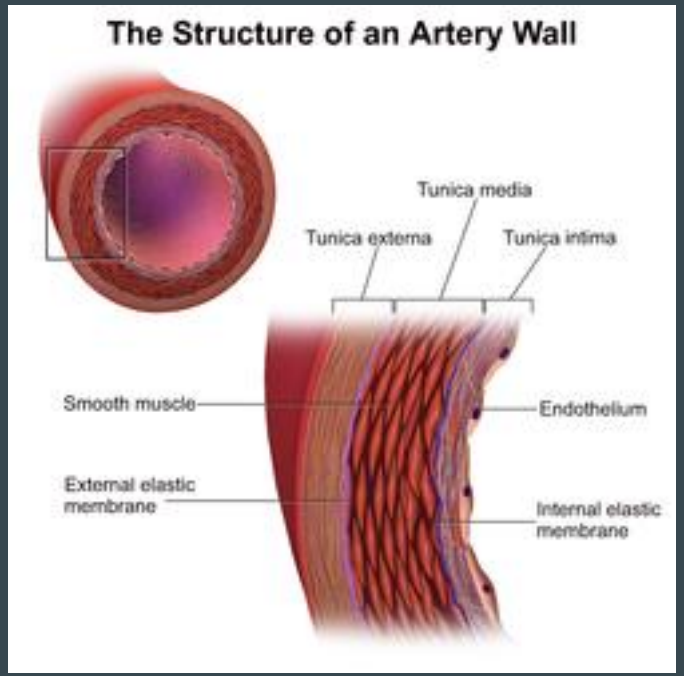
- Parts for first prototypes had been ordered
- Gantt chart created to assure accountability of project
- Future Directions Established



Why create a model?

- Correlations are visible between arterial pressure and intracranial pressure.
  - Gobiet et al. (1975) found that an increase in intracranial pressure correlated with an increase in mean arterial pressure in 39 out of 52 cases.
- The overall efficacy of direct aspiration thrombectomies is questionable, and is better seen in combination with stent retriever techniques.
  - Turk et al. (2014) described direct aspiration thrombectomy success rates at 78%, with combined stent retriever use allowing 95% success.
- Evidence demonstrates ways to increase success of direct aspiration thrombectomies through either ICP increase or other methods.

Modeling ICP Translation



$$\sigma_{\theta} = \frac{P}{\Pi * d * tl^{2}}$$

$$\Delta D = \frac{-\nu P}{\pi t E l^{2}}$$

Average Young's Modulus (E) = 0.185 ± 0.05 MPa

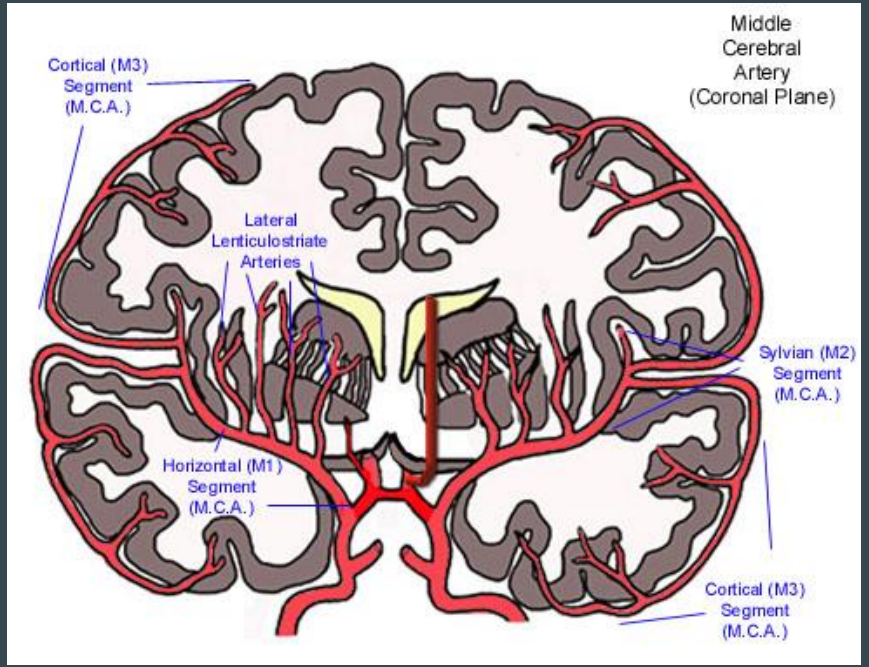
Average Poisson's ratio (ν) = 0.17 ± 0.02

Gantt Chart

Task	Start Date	End Date	Timeline	Hours
Overall time period	9/26	4/23		
Meet with Dr. Froehler weekly	9/26	4/23		160
Brainstorm ideas for model design	9/26	11/21		240
Settle on initial model design	10/18	11/8		30
Order Parts	11/1	11/29		12
Build first prototype	11/14	12/8		32
Evaluate efficacy of first model	12/8	1/10		40
Improve upon model	12/19	3/5		20
Iteratively improve model until it matches our desired function	1/10	3/5		30
Finalize model	3/5	3/22		10
Run experiments with direct aspiration catheter	3/5	3/31		10
Collect and analyze data	3/20	4/7		40
Put together poster for Design Day	4/1	4/23		40
Present at Design Day	4/22	4/23		15

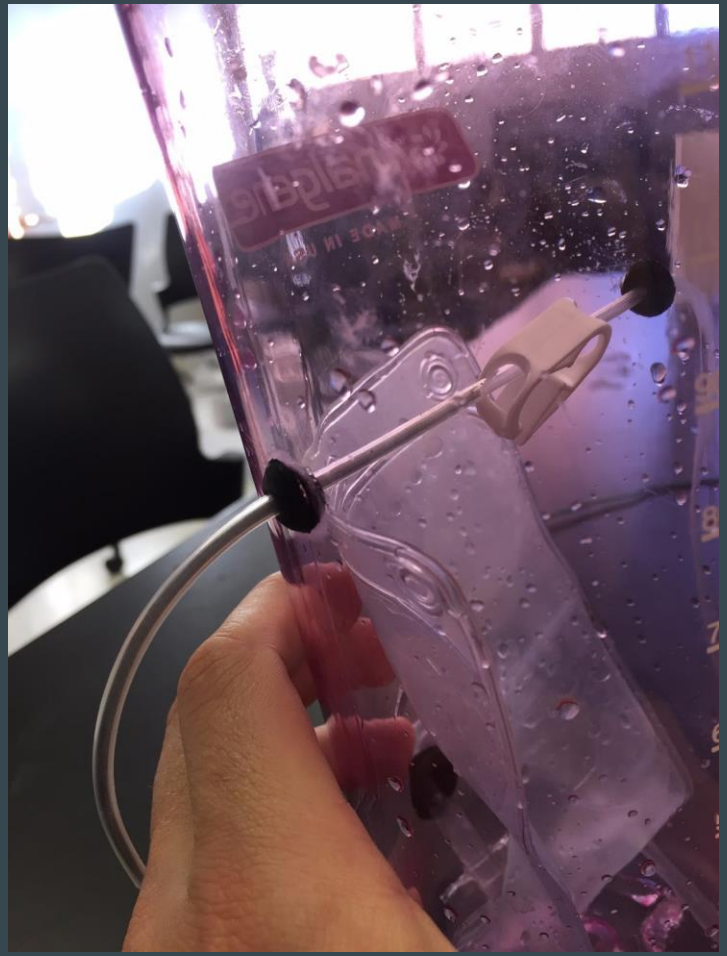
Anatomical Background

- Middle Cerebral Artery (MCA) is a major artery that supplies blood to a large part of the middle of the brain.
- Most commonly affected by cerebrovascular incident (ischemic stroke).
- Multiple sections, but area we are focusing on is the M1 region, from ICA to the start of M2 region.
- Dimensions: Diameter ranges from 3-5mm, Length ranges from 1.5 - 3.0 cm.



Needs Assessment

- Model Efficacy
  - Must accurately model and measure intracranial pressure (ICP)
  - Must accurately model blood vessel shape and size in which the vacuum catheter will be inserted
  - Must respond to an increase in ICP in a manner that accurately replicates physiology and anatomy
  - Must accurately model blood flow through vessels in the brain during normal conditions as well as during elevated ICP conditions.
- Cost Efficacy
- Medical Provider Compatibility



Creation of second prototype

- Made MCA more accessible by moving ports closer to the lid
- Added pressure gauge to measure ICP
- Used 3mm x 5mm tubing
    - More accurate representation of the medial cerebral artery

Future Directions

- Completely seal model - no leaks
- Order thinner walled tubing
- Add differential pressure gauge across the occlusion
    - Waiting on T-tubes - ordered, not yet delivered
- Evaluation of physiological accuracy
- Design clot and technique for thrombectomy efficacy quantification