# STENT-ASSISTED TECHNIQUE TO CURE BRAIN ANEURYSMS


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## About me

I am a first year masters student in the Department of Mechanical Engineering specializing in fluid mechanics at Keio University. I currently live in Minatomirai area of Yokohama and I have been here for almost 11 months now. University life experience in Japan has been very enriching and fulfilling. I have had an opportunity to meet people from various nationalities and share mutual interests and cultural differences. Research has been slow and steady over the year. My research supervisor, Prof. Obi, has been very supportive and has always encouraged me for out of the box ideas. I have been learning Japanese language at the university and have reached the N4 level of JLPT. I hope to get N3 level in the next one year. Life in Japan, overall, has been quite enjoyable. I have travelled to places like Fukuoka, Kyoto, Iida, Hakone and many places around Tokyo. Because of the polite and helpful nature of Japanese people, I never had any communication problems. Looking forward for another amazing year ahead in Japan.

## Introduction

My research is concerning the stent-assisted treatment technique for brain aneurysms. Aneurysms are caused due to abnormal ballooning or expansion of brain arteries. They cause various bodily dysfunctions like vision impairment, continuous headache, etc. The highest risk associated with aneurysms is that of rupture. Rupture leads to blood-spill inside the brain and in 60% cases causes the patient's death. Depending on the dome size, aneurysms are classified as small and large while depending on the neck-size, they are classif-

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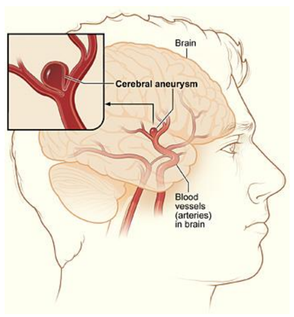
-cked. The risk of aneury-

-sm rupture is the highest

for large sized and wide ne

-cked aneurysms.

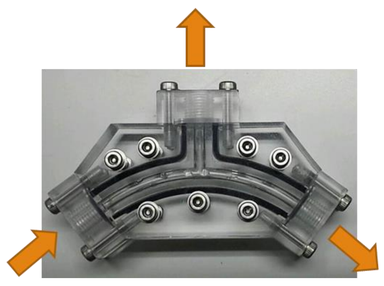



## Scope and Objective

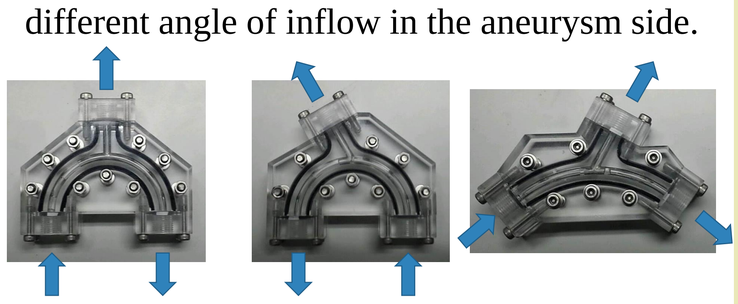
- Stent assisted treatment technique is used for large sized and wide necked aneurysms. In this technique, a porous stent (pipe) is placed at the neck of the aneurysm to reduce the blood flow entering the aneurysm and cause blood clotting.
- It has been observed over the years that after the stent is placed at the neck of the aneurysm, it leads to the aneurysm rupture causing blood-spill inside the brain.
- The possible reasons maybe high pressure or high shear stress on the aneurysm wall or a combination of both. Over the years research has shown that shear stress cannot be the major cause for rupture.
- The aim of this research is to calculate the pressure values on the aneurysm walls and thus, determine the cause of rupture and help improve the existing treatment technique.

## Methodology

- This project involves an experimental as well as simulation aspect. My research focuses on the experimental part. I am trying to mimic the actual human blood flow in the experiment.
- First of all, an analogous model of artery is manufactured with an aneurysm output. For a fixed total inflow, the flow output on the aneurysm and artery side are measured.

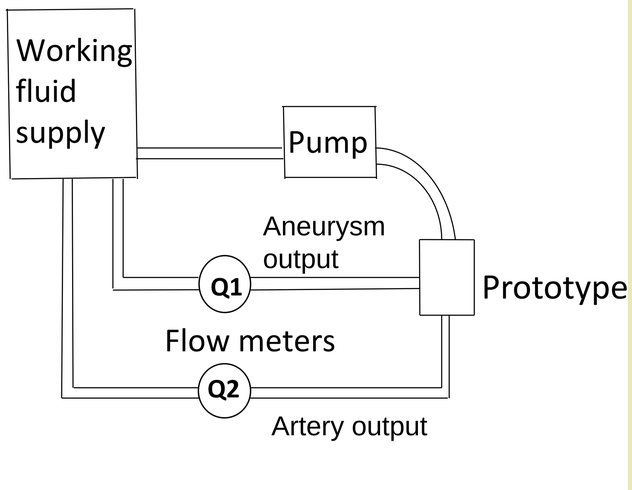


- This initial experiment is repeated with the stent placed at the neck of the aneurysm and the results are compared. This study is aimed at gauging the resistance of the stent to the flow going through the aneurysm side
- The resistance values can be used in the simulation study as well.
- The above study is repeated for models with different radius of curvature arteries and different angle of inflow in the aneurysm side.



- In future work, the analogous models of aneurysm dome based on the angiography images are to be manufactured.
- The same experiment will be repeated with these models and the pressure values on the aneurysm walls will be calculated using pressure sensors. Although, the methodology for calculation of the pressure on the walls is still to be established.

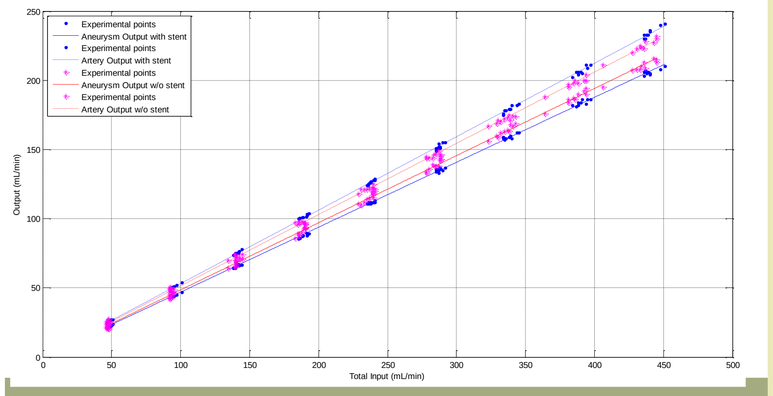
## Experimental Setup




- Working fluid: water
- Range of inflow: 0 to 450 mL/min
- Sampling time (for flow meter): 30 sec
- Sample size (for checking repeatability): 10

## Results and Discussion

Experiments conducted till now, with the first model, show that the aneurysm and artery output have a linear relationship with total inflow. As expected, the artery output is greater than aneurysm output in both cases, with and without stent. However, the aneurysm output lowers even more in the case when the stent is placed inside the prototype. In the case without stent, the aneurysm output is 48.17% of the total inflow while in the case of with stent, it is 46.72%. Following graph shows the linear variation in the output, for with and without stent, which are diverging as the total inflow increases.




## Future work

- The same experiment will be repeated with other models for varying radius of curvature and angle of inflow for aneurysm.
- As human blood flow is not continuous but fluctuating, a pulsating flow input will be generated with the pump.
- Analogous models of aneurysm dome will be manufactured and the experiment will be repeated to measure pressure values.
- Methodology for accurate pressure calculation on the dome will be established.
- Analysis of the data to reach a conclusion on the reason for aneurysm rupture and possible suggestions as to avoid the rupture.

## Statistics & Conclusion

- Aneurysms are caused by ballooning of brain arteries and have a high risk of rupture in cases of large and wide necked aneurysms when treated with a stent assisted technique.
- In the US, it is observed among 1 in 10,000 with 27000 cases a year. Tendency is more in 30 to 60 year olds with women to men ratio of 3:2. Similar is the case with India.
- Improving the technique will help save many lives.

## References


Tateshima et al., "Intraaneurysmal flow dynamics study featuring an acrylic aneurysm model manufactured using a computerized tomography angiogram as a mold", J Neurosurg 95: 1020-1027, 2001.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