Thesis Project Portfolio

Analysis Methods on Imaging Endothelial Adaptation Under Flow

Assessing How the Understanding of Housewives' Stress Changed Before and After WWII

An Undergraduate Thesis

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Sociotechnical Synthesis

Cerebral cavernous malformations (CCMs) are mulberry-like structures in cerebral veins, formed from clusters of small blood vessels in the central nervous system. When they form, the endothelial permeability in the blood-brain barrier is increased, disrupting the formation of cell-to-cell junctions and resulting in a greater risk of neurological disorders. One in 500 people have at least one CCM present, which can lead to inflammation, seizures, headaches, and strokes. To improve knowledge of CCM and its effect on endothelial cells, it is important to recognize that blood flow contributes to maintaining endothelial permeability and tight junction integrity. To advance this understanding, my partner and I constructed a flow apparatus that mimics what an endothelial cell monolayer experiences in a blood vessel, in hopes of documenting and analyzing cellular shape change and junction integrity.

Throughout the year, we cultured monolayers of cells to fit against a parallel plate flow chamber, creating a two dimensional model of a cerebral vein. We applied 24 hours of flow by running tubes, filled with cell media, from the chamber through a peristaltic pump which created a consistent flow rate. After the apparatus was taken down, we stained for cell nuclei and actin, looking for alignment. Comparing before and after flow images of the cells, it was clear to see that they aligned, or stretched out, in the direction the flow was applied. Prior capstone groups in this lab have further continued by looking at specific proteins, but we developed an image analysis technique to demonstrate just how much these cells aligned, and how different the pre and post flow slides looked.

Using the microscopic images, we ran them through a bandpass filter and binarized them to easily identify what was a cell and what was negligible. These images were run through an algorithm that measures their angle of alignment to the horizontal and plots them in a histogram.

Comparing these histograms makes it very easy for us to tell if the cells adapted to flow or not. Finally, to confirm that the pre and post flow data are not from the same distribution, we used a nonparametric statistic to confirm that the data were from separate distributions with the same direction.

Our findings show that cells will adapt to flow and align to its direction. With this information, we can expand on changes in blood flow rate and pressure on cells. A common cause of increased blood pressure is stress, and while researching how stress can affect cellular adaptation to its flow, we can also research how people are affected by stress to cause this increased blood pressure in the first place. An example of this is looking at housewives before and after World War II (WWII).

There was a large transformation of societal understanding regarding housewives' stress in the 1940's. Prior to the war, stress in housewives was medicalized and attributed to personal failings, tagged as hysteria and an internal issue. WWII created a temporary shift in gender roles, drawing women into the workforce and potentially altering perceptions of their stress from domesticity to industry. While the absence of men was a push for females to take up manufacturing jobs, the need for war materials was greater. With over 34 percent of United States women working male-dominated jobs, there was an expectation for long term employment. However, the post-war period saw a strong push for women to return to their duties in the home. The sudden shift from housewife to manufacturer and back created immense amounts of stress in women at the time. Media reinforced this, creating images in magazines and advertisements depicting women as in charge of nothing more than their domestic confines. One accepted market for women to work in was the temp industry, though it was presented as

supplemental to their housewife role. Even then, women were made receptionists and typists to men in higher positions.

Shifting cultural norms and economic pressures shaped the experience and interpretation of stress in housewives during this period. Moving from hysteria and general nervousness to a body's response to changing environmental pressures created a new way for how stress is defined. Though feminist movements were set back due to societal relapse into traditional roles, a new approach to recognizing and dealing with stress prevailed. Understanding and learning from the effects of WWII on women is important in recognizing the past historical factors to better support women's well-being and gender equality today.