Thesis Project Portfolio

Designing Ultrasound Image Analysis Techniques for DC101-treated Tumors in Mice

(Technical Report)

Effect Of Socioeconomic Background On Breast Cancer Mortality Rates

(STS Research Paper)

An Undergraduate Thesis

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Sociotechnical Synthesis

Breast cancer is one of the most common cancers in women with more than 40,000 annual estimated deaths in the United States alone. Current treatment options such as surgery and radiation pose potentially extensive side effects. The use of focused ultrasound and lipid-shelled microbubbles in combination with anti-angiogenic drugs is a potential solution to difficult patient treatment processes. As our technical project, we developed a MATLAB program to analyze microbubble perfusion in ultrasound images of 4T1 breast cancer tumors in mice. This program provides output for the fractional perfusion area. Additionally, we built a 3D modeling system that can produce three-dimensional images of tumors using cross-sectional ultrasound images of tumors. The two programs we developed can be used by researchers to gather more information about both microbubble perfusion and tumor vasculature normalization. Eventually, this will lead to more efficient chemotherapeutic drug delivery because less drug dosage will be needed. This means breast cancer treatment would be cheaper and reduce side effects and complications for patients.

Before the mid-1980s, breast cancer was a disease that had a reversed disparity across socioeconomic groups (SEGs), where women in lower SEGs had a lower incidence rate and lower mortality rate relative to women from higher SEGs. However, with the development of better and more expensive treatments, the mortality rate disparity has shifted to be higher in lower SEGs. To ensure that all patients are receiving the quality of care necessary to enable recovery, analysis will be conducted to identify disparities in the mortality rates and outcomes of treatment across different SEGs, and through that determine to what extent cost and accessibility has an impact on an individual's chance to survive breast cancer. The analysis can then be then be used to inform potential discourse on how best to develop future treatments or technologies in

order to address the disparity, decreasing the mortality rate of women with breast cancer from lower SEGs.

The technical project and tightly coupled STS research project being proposed will address the high mortality rate from breast cancer. The objective of the technical design project is to create an image analysis program that would work through an existing ultrasound machine, is coded using MATLAB, and would output statistics relating to the blood flow in the tumor as well as what percentage of the tumor is accessible through the blood vessels. By doing so, breast cancer researchers will be better able to collect data of the effects that different drugs have on tumor blood vessels. The development of this treatment would help decrease the required chemotherapy dosage needed for the treatment to be effective, while also decreasing the duration of treatment. This would make cancer treatment more accessible to women from lower income groups, who have been found to have higher mortality rates when compared to higher income groups.