Thesis Project Portfolio

Engineering Immunogenic Focused Ultrasound (FUS) Paradigms for Breast Cancer through Incorporation of Adenosine Receptor Blockade

(Technical Report)

Body Image Concerns and Psychological Outcomes of Different Surgical Treatment of Breast Cancer

(STS Research Paper)

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Executive Summary

From diagnosis to treatment breast cancer (BrCa) patients experience both physiological and psychological challenges that affect quality of life and their respond to the treatment. The technical part of this study aims to offer innovative treatment approach that combines various methods to effectively address both primary and widespread tumor lesions, all while prioritizing the comfort and quality of life for BrCa patients. While the technical part is answering physiological needs, Science, Technology, and Society (STS) portion examines the impact of current surgical treatments on BrCa patients' psychological well-being. It is believed that analyzing BrCa and its treatment from both physiological and psychological aspects would improve further studies and enhance BrCa patients' quality of life.

Focused ultrasound (FUS) is a non-invasive, non-ionizing method that precisely targets tumors while preserving surrounding healthy tissues. Cell disruption due to FUS induces the release of endogenous danger signals, such as ATP and leads to immunosuppressive effect. The technical part of this study aims to combine this innovative technology with adenosine receptor blockers to unleash the immunogenicity of FUS. In order to achieve that, effects of two different FUS paradigms, thermal (T-FUS) and mechanical (BH) ablation, on tumor outgrowth were examined. Additionally, ATP level in tumor microenvironment were measured following the FUS treatment. To determine the most effective adenosine receptor blocker among four options, the impact of the blockers alone on primary and distal lesions were examined.

Results revealed that FUS treated groups showed lower tumor outgrowth compared to control. T-FUS group showed more efficiency in reducing tumor outgrowth compared to BH. Measuring ATP levels in tumor microenvironment confirmed elevated ATP levels following the FUS treatment. The monotherapy study demonstrated ADO-5030 (A2B) blocker showed lower tumor size and less lung metastasis compared to control group. Among the blockers, it also showed the highest effect on reducing tumor outgrowth compared to others. In reducing lung metastasis, another A2B blocker ADO-5047 showed the most effective result compared to both control and drug groups. It is concluded that both FUS

and adenosine receptor blockers showed effective results in reducing tumor outgrowth and distal lesions. Further experiments will investigate the effects of combined therapy involving FUS and A2B adenosine blockers.

STS research paper examines the psychological effects of different surgical treatments for BrCa from body image and stress levels aspects. Previous studies have highlighted that BrCa surgery patients showed increased stress levels due to body image concerns, resulting in reduced quality of life. In order to assess body image differences between mastectomy and lumpectomy patients, several studies conducted on psychological outcomes following BrCa surgical treatment were reviewed and analyzed.

Analyzed results revealed that type of the surgery is correlated with body image concerns. All selected studies demonstrated that BrCa patients who underwent mastectomy showed higher body image concerns compared to lumpectomy patients. Two different studies showed a significant relationship between increased anxiety levels and poor body image scores. It is also realized that younger cancer patients experience higher body image concerns due to surgical treatments they receive. Additionally, results showed that stage of the cancer and physical side effects of the treatments negatively affect body image scores. It is concluded that BrCa patients experience higher body image concerns and anxiety levels as they receive more extensive surgical treatment.