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Using Magnetic Resonance Elastography to Test Breast Tumor Stiffness

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Women with breast cancer rarely die from primary breast tumors, rather, they die from the spread or metastasis of the tumor to other organs. It is now understood that non-tumor cells, growth factors, chemokines and cytokines, and physical properties of the tumor microenvironment/extracellular matrix (ECM), or stroma, all influence tumor progression to metastasis. In breast tumors, these stromal components differ from their normal tissue counterparts in composition, structure, physical properties, and function. My research focuses on testing bulk tumor stiffness in order to better treat tumor metastasis.

Collagen fibers are the most abundant protein in the ECM and in the tumor stroma. Increased collagen typically leads to increased tissue stiffness. This is critically important for cancer etiology and treatment because increased collaged deposition is often associated with poor prognosis for cancer patients. Work from many labs reveals the amount of collagen, the fiber alignment of individual collagen strands, and their thickness all contribute to altered mechanical properties (i.e., increased stiffness) of breast tumors that promotes metastasis.

My research seeks to find a better more comprehensive way to quantify bulk tumor stiffness. We will use magnetic resonance elastography (MRE) to assess tissue stiffness, and specifically, its impact on tumorigenesis. The first part of the experiment which would look at tissue between Col1a1tmJae mice and control FVB mice would provide information to see if MRE is a viable option to detect tumor stiffness, as it should be detected that Col1a1tmJae have increased tissue stiffness. The second part of this experiment which looks at tumors in these mouse models would help to determine if MRE is a viable option in order to test tumor stiffness. The purpose of the final experiment between MMTV-PyMT and Her2(neu) mice would be to develop predictive algorithms in order to comparatively and quantitatively measure tissue or tumor stiffness.