An In vivo biocompatibility analysis into a novel tissue regeneration matrix pig model

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Breast cancer is the most common cancer worldwide and the most common cancer diagnosed in the USA. Currently, nearly 4 million women in the US alone have been diagnosed with breast cancer. In 2021, there were an estimated 281,550 new cases of female breast cancer and an estimated 43,600 deaths of this disease. It accounts for approximately 30% of new cancer diagnoses and is one of the leading causes of cancer-related deaths among women in developed countries. Current treatment options for breast cancer include surgery, chemotherapy, and radiation. Unfortunately, there are negative side effects associated with each of these treatment options, and they may not be appropriate for every patient. In addition, local breast cancer recurrence presents a high risk, especially for patients undergoing lumpectomy procedures known as "Breast-conserving surgery".

The goal of this project is to alleviate these problems by developing an injectable bead scaffold to promote tissue regeneration in the void created by lumpectomy, as well as to prevent local recurrence and minimize surgical-related infections. Microbeads were synthesized from collagen type I and crosslinked with tannic acid to form the basis for this injectable therapeutic. Tannic acid acts as a therapeutic anticancer agent. The action mechanisms of tannins in breast cancer cells have been studied with many studies showing tannins to be cytotoxic to cancer cells in a dose-dependent manner;Tannic acid induces apoptosis in breast cancer cells via caspase pathways. Tannic acid has also demonstrated antimicrobial properties. Collagen type I is a biomaterial routinely used in reconstructive surgeries. To provide an effective scaffold for tissue regeneration, a biomaterial must provide structural support for new tissue growth without triggering an immune response. Collagen also plays an important role in maintaining the structural integrity of the ECM. Due to the fact that collagen type I is the most common form of collagen in the human body. The collagen/tannic acid beads were seeded with adipocytes to attach and grow onto the matrix, then release the tannic acid into the surrounding environment as the attached cells remodel the collagen.

To prove the viability of this therapy, an in vivo study is being conducted using a pig model. Beads were injected orthotopically into the mammary glands, each pig received 4 injections, 3 injections of bead with and 1 without cells. Each pig and mammary gland that got an injection was noted, and there were a total of 16 injections given. Mammary glands will be excised at 4- and 8-weeks for histological analysis. Tissue samples will be fixed, embedded in paraffin, sectioned, and stained with various methods to determine cell types present, biocompatibility, inflammation, and tissue growth. Additionally, samples of the kidneys and livers will be collected for toxicity analysis.