Cell & Gene Therapy

Bunnell Lab Research and Innovation

The lab of **Bruce Bunnell** studies cell and gene therapies for diseases of the central nervous system, as well as autoimmune diseases. They are also studying the correlation between the increased rates of obesity and the prevalence of breast cancer. Most recently, the lab has developed a new graft to aid the in reconstruction of the nipple-areolar complex after a mastectomy.

BPAN

In the family of disorders called Neurodegeneration with Brain Iron Accumulation (NBIA), Beta-propeller Protein Associated Neurodegeneration, or BPAN, is one of the most recently discovered and least studied of these genetic conditions. Pathology in BPAN results from a shortage of a protein crucial for the initiation of the autophagy pathway called WIPI-4. Autophagy, literally translating to "self-eating", is a necessary homeostatic function which clears damaged proteins and organelles to support cell survival. The goal of this research is to develop and characterize new *in vitro* disease models to determine how loss of this protein affects different cell types involved in disease pathology.

Adult Stem Cells for Multiple Sclerosis

Cell and gene therapies for diseases of the central nervous system (CNS), currently working on a project that has provided strong evidence to support the use of stem cell therapies from adipose, or fat, for neurodegenerative disease. Primarily, these adipose-derived stem cells (ASCs) have demonstrated potent therapeutic effects in a model of human Multiple Sclerosis (MS), one of the most common autoimmune, neurodegenerative diseases.

Role of ASC's in Breast Cancer

Obesity has dramatically increased over the last few decades. The lab researches the direct correlation between the prevalence of obesity and the increased incidence of obesity-associated cancers. Specifically, obese women have an increased incidence and mortality of breast cancer. Past lab studies have determined that adipose stem cells (ASCs) from lean (lnASCs) or obese (obASCs) individuals possess distinguishing biological properties. Evidence suggested dysregulation of several genes involving migration, invasion, and inflammatory signaling are

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Role of ASC's in Breast Cancer *(cont'd)*

enhanced in obASCs compared to lnASCs. Data also indicates that obASCs increase tumor growth and metastasis in animal models.

Tissue Engineered Nipple-Areolar Complex

Currently, there are more than 230,000 women diagnosed with breast cancer every year in the United States; and there are approximately 180,000 female mastectomies that occur each year due to cancer. These patients, mostly women, have several options in the way they could have their nipple-areolar complex (NAC) reconstructed. The Bunnell Lab has developed a graft that would regrow the NAC after a mastectomy. The patient's body uses this NAC graft as a building frame to regenerate their own NAC. As an overall goal to this concept, an off-the-shelf ready NAC graft would be made available to the plastic and reconstructive surgeons.

Sample Publications

Bunnell et al. Characterization of an Acellular Scaffold for a Tissue Engineering Approach to the Nipple-Areolar Complex Reconstruction. *Cells Tissues Organs.* 2017 Jan 27. doi: 10.1159/000455070.
http://bit.ly/2k0PyrJ

Bunnell et al; Adipose Stromal Vascular Fraction-Mediated Improvements at Late-Stage Disease in a Murine Model of Multiple Sclerosis. *Stem Cells.* 2016 Oct 12 doi: 10.1002/stem.2516.
http://bit.ly/2kBGtoq

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