**Breast Cancer Immunity**

Author: Lauren Janak  
Major: Animal Science  
Department of Microbiology and Molecular Genetics, Oklahoma State University, Stillwater, OK 74078, USA

Breast cancer has become a prevalent issue is todays society. Immunotherapy methods have only recently become available and under review. The way the world sees breast cancer has changed over the last 20 years. Like the goal of the hundreds of other cancers, breast cancer clinicians and researchers strive towards immunity. Recent studies on what factors go into killing the cancer cells are brought into light and the future of breast cancer medicine is underway. The more solutions and ideas that come about immunity will only advance the goal towards treatment.

**Key Words:**

Breast cancer, immunology, immunotherapy, immunity

**Introduction**

It is not required for an individual to be an expert in immunology to understand that cancer is becoming an ever-growing issue in our world. With over 200 types of cancer, there are people in research, clinics, and labs that are trying to find a cure. One of the more prevalent cancers under intense study today is breast cancer. Little was known about breast cancer and its relation to immunology 20 years ago. In immunology, there are two types of immune responses responsible for protecting the body against foreign material. The innate immune response and the adaptive immune response are the two responses that can be triggered when hazardous material penetrates the body’s defenses. The adaptive immune response plays a key role in recognizing certain cancer cells and preventing tumor growth. T-cells, B-cells, and lymphocytes comprise some of the agents involved in the adaptive immune response. These specific agents can develop immunologic memory, which aid in their ability to recognize and quickly respond if faced with a threatening substance. The knowledge of the adaptive immune response mechanism and information brought by recent studies allow scientists to find ways to treat and prevent breast cancer. Furthermore, research into immunotherapy methods like chemotherapy and radiation continues in search of answers to treatment or cancer prevention.

**Recent Progress**

Breast cancer immunotherapy methods primary goal is to sustain immunity against the cancer cells that cause the disease. Before diving into studies and progress made in immunotherapy, one should fully understand the events leading up to the elimination of cancer cells. The cyclic process of immunity can be explained through a sequence of steps. The first step in this process is the release of cancer antigens, which is stimulated by immunogenic cell death and inhibited by apoptotic cell death (Chen 4). Following this is the cancer antigen presentation. This presentation is stimulated by proinflammatory cytokines, endogenous adjuvants from dying tumors and inhibited by interleukin 10, 4 and 13 (Chen 4). The third step is priming and activation, which is stimulated by various cluster of differentiation (CD) proteins and inhibited by programmed death (PD) receptors and programmed death ligands (PDL) (Chen 4). The fourth and fifth steps are trafficking and infiltration of T cells into tumors (Chen 4). The sixth step is the recognition of cancer cells by T cells, which is stimulated by T cell receptors and inhibited by reduced peptide-MHC (major histocompatibility complex) expression on cancer cells. The final step is killing of the cancer cells, which is stimulated by (IFN-g) interferon gamma and inhibited by various PD receptors.

When this process can be achieved, the patient can be cured and maintain a cancer-free life. What is difficult is finding out what step needs to be altered or focused on depending on the particular patient’s production of proteins and receptors. Due to the rapid advancement of studies in breast cancer, identification methods of breast cancer associated antigens have been developed. The first antigen to come of knowledge was glycoprotein MUC-1 or mucin-1. This lead to the first experiment conducted. Serum was collected from “288 non-metastatic breast cancer patients prior to therapy” and tested to see the presence of “increased titers of MUC1 specific IgG antibodies” (Disis 196). This study showed that the presence was “an independent predictor of improved overall survival” (Disis 196). The second study conducted focused on HER2 (human epidermal receptor 2) specific T-cells and antibodies present in the sera of 100 women. The study concluded that the serum antibody levels and HER2 specific T-cells increased alongside the “increasing levels of expression of the HER2 protein” (Disis 197).  This led to further pursuit of the role of HER2 specific antibodies. 500 women with invasive breast carcinoma showed that the HER2 specific antibodies were correlated with “recurrence free survival” when compared to women with no detectable HER2 antibodies (Disis 197). Because of the discovery of breast cancer antigens, researchers began to look into the tumor specific immune response. After assessing standard therapy methods, researchers saw that many patients were lacking CD4 T-cells that were able to secrete IFN-g, which stimulates cancer cell death. This lead to the conclusion that new immunotherapeutic methods should be focused on “reversing the phenotype of the immune response to one that is rich in Type I cells” (Disis 197). The final study discussed the use of trastuzumab therapy. This form of chemotherapy has shown to produce high levels of Type I HER2 specific CD4+ T-cells in the blood of breast cancer patients.

**Discussion**

Each study has been conducted in order to alter a step in the immunity cycle. Every breast cancer patient is unique, differences arise not only in one’s height, weight or age but also in one’s blood composition and the tumors that he or she possesses. These studies take scientists, clinicians and other researchers closer to finding a cure. A method to increase tumor-infiltrating lymphocytes (TIL) is a vaccine. The vaccine proved to be successful in increasing the TIL count. While this is only one aspect of the immunity cycle, it shows promise for future developments. This article explored the antibody and protein levels in the blood, and then what is expressed by tumors. The variability of the patient is one aspect that needs to be examined but also the variability of the application of the immunotherapy. Chemotherapy or radiation can take an enormous toll on the individual. There may not be a “one size fits all” cure yet, but there is a possibility that several immunotherapies working in tandem may prevent cancer growth. Differences can arise in a patient’s profile, selected immunotherapy method. The stage or degree of breast cancer is variable depending on who the patient is. It is common knowledge that the stage of cancer detected can reveal information on the severity of that cancer and the patient’s chance of survival. Significant strides have been achieved recently, thanks to the contribution of studies conducted within the past twenty years. More research and experiments must be conducted in order to eradicate breast cancer cells in patients. With the potential in future research, one can hope that a time will come when scientists deem these therapeutic methods to no longer be necessary.

**References**

Disis, Mary L, and Sasha E Stanton. “Immunotherapy in Breast Cancer: An Introduction.” *The Breast*, vol. 37, Feb. 2018, pp. 196–199. *ScienceDirect*, [www.sciencedirect.com/science/article/pii/S0960977617300139](http://www.sciencedirect.com/science/article/pii/S0960977617300139).

Chen, Daniel S, and Ira Mellman. “Oncology Meets Immunology: The Cancer-Immunity Cycle.” *Immunity*, vol. 39, no. 1, 25 July 2013, pp. 1–10. *ScienceDirect*, [www.sciencedirect.com/science/article/pii/S1074761313002963](http://www.sciencedirect.com/science/article/pii/S1074761313002963).