Spencer Cutlip

Immunology Essay Paper – Cancer

Cancer is one of very few diseases that cannot be cured at this point in our society. Millions are diagnosed with cancer each year with most being too late to treat. Cancer is one of the most studied diseases in the world as researchers are always searching for a cure. However, first they need to understand how cancer works and how the body’s immune system is responding to cancer cells. The studying of immunotherapy started after the discovery of “Coley’s toxin” which was one of the first pillars in cancer treatment (1). Cancer immunotherapy began to progress after the discovery of immune checkpoints (1).

Cancer is the second leading cause of death in the world and death rates are continuing to rise (2). Cancer treatment is continuing to evolve however many are related with limited response and are very toxic to the patient receiving the treatment (2). Now cancer treatment is attempting to be more focused on the tumor cell molecules or the tumor’s environment in which it is in. This is beneficial as it directly focuses on the cancer rather than having the treatment affecting the entire body essentially killing the cancer along with the patient.

Showing of T cells inside tumors is a good sign most of the time as the T cells are recognizing that those cells are abnormal to the body. T cells are able to recognize a large group of tumor antigens, this is being studied to attempt to produce a vaccine with one of the antigens recognized by our immune system (3). T cells are heavily reliant on Dendritic cells to present the tumor cells in the lymph where they can recognize the antigens and become activated. Dendritic cells engulf the tumor cells or even pathogens and take the cell to the lymph area to present the antigen and recruit other white blood cells. This is dependent on dendritic cells following their pathway which includes “cDC1 subclass, the Batf3-dependent type, a specialized cross-presenting cell, and on physiological pathways integrating CD4 T cell activity to ‘license’ cDC1s for optimal CD8 T cell priming” (4).

Cancer immunotherapy heightens the immune response against cancer. This type of treatment has seen significant growth largely due to the advancements in understanding immune checkpoint inhibitors. Recent evidence shows that tumor necrosis factor receptor type 2 (TNFR2) has a distinct role in the activation of Tregs and other immunosuppressive cells (5). TNFR2 is likely a good therapeutic target to improve natural or immunotherapeutic triggered anti-tumor immune responses (5). Animal models are largely used as test subjects to study the effect of these treatments on various versions of cancer. With tumor necrosis factor receptors being linked to activating cell death and inducing factors that are involved in cell survival they are largely studied in cancer treatment. TNFR1 was studied using a B16.F1 melanoma mouse model and mice deficient for the TFNR1, and found with the deficiency it delayed the B16.F1 melanoma growth and reduces B16.F1 cell proliferation by “decreasing the proliferating cell nuclear antigen expression in the tumor mass” (6).

Cancer is largely studied via models to see growth and study treatments. To study the cancer-immune cell interactions many researchers will lean toward 2-D culture systems or murine models (7). Three-dimensional culture systems can provide a more accurate model as they are more “physiologically relevant and better replicate tumor complexities” (7). This largely turns back to how the tumor necrosis factor receptors were studied and what models or methods they used to find their results. The progress in cancer immunotherapy is largely related to immune checkpoint blockade which has drastically changed cancer care for the better with improving survival rates in metastatic tumors, and improved outcomes in beginning stages of the disease (8). Studying cancer and its immune response starts at the very beginning with dendritic cells and its pathway. That leads to T cells and how they can improve a natural immune response or even express tumor antigens to be targeted for other treatment options. More recent studies are focusing on the effects of tumor necrosis factor receptors and how they are affecting cancer, whether that is increasing or decreasing the growth of these tumors.

References

1. Ren, X. 2021. Cancer immunology and immunotherapy. *Cancer Biology & Medicine* 18: 931–933.

2. Sarasola, M. de, M. A. Táquez Delgado, M. B. Nicoud, and V. A. Medina. 2021. Histamine in cancer immunology and immunotherapy. current status and New Perspectives. *Pharmacology Research & Perspectives* 9.

3. Bullock, T. N. 2020. Fundamentals of Cancer Immunology and their application to cancer vaccines. *Clinical and Translational Science* 14: 120–131.

4. Murphy, T. L., and K. M. Murphy. 2021. Dendritic cells in cancer immunology. *Cellular & Molecular Immunology* 19: 3–13.

5. Yang, Y., M. S. Islam, Y. Hu, and X. Chen. 2021. TNFR2: Role in cancer immunology and immunotherapy. *ImmunoTargets and Therapy* Volume 10: 103–122.

6. Mattei, F., C. Alfaro, and Y. Keisari. 2022. Cancer immunology: From molecular mechanisms to therapeutic opportunities. *Cells* 11: 459.

7. Fitzgerald, A. A., E. Li, and L. M. Weiner. 2020. 3D culture systems for exploring cancer immunology. *Cancers* 13: 56.

8. Lichterman, J. N., and S. M. Reddy. 2021. Mast Cells: A new frontier for cancer immunotherapy. *Cells* 10: 1270.