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Dendritic cells: Their functions in immunity and disease

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Abstract

Dendritic cells were first identified among the skin epithelial cells by Langerhans in 1868. Its origin is based on CD34+ cells of the bone marrow progenitor cells or CD14+ cells of the monocytes. It is involved in the formation of primary response and antigen presentation in the immune system. They are also called the professional antigen presenting cells (APC) because their main function is to present antigen. Dendritic cells are generally having the immature intracellular functions in peripheral tissue; in cases where they encounter pathogens such as viruses, bacteria, fungi or tumors, they switch into the mature dendritic cell form to capture the antigen molecule and create an immune response. Due to these effects, dendritic cells are used in cancer immunotherapy applications. In our proceeding review we will further discuss their role in the immunity.

Introduction

Dendritic cells were first identified among the skin epithelial cells by Langerhans in 1868. In the light of this exploration, in a study carried out by Steinman in the early 1970s, its existence was proven in the spleen and lymph nodes in line with their shapes by using light and electron microscopy [1,2].

Antigen-presenting dendritic cells located in the epidermis layer are also called Langerhans cells. This constitutes 5% of all epidermis cells. If a pathogen from any source is evaluated as an antigen and causes inflammation, the secreted interleukins (IL2/IL6) activate Langerhans cells. As a result of this activation, Langerhans cells enter the secondary lymph nodes through the blood and transform into fully differentiated activated dendritic cells. Activated, antigen carrying cells enable T cells to generate a specific antigen-specific response. In this way, dendritic cells present antigen to T cells, enabling T cell activation for an antigen-specific immune response [1-4].

Results

Dendritic cells have their origins as either CD34+ cells of the bone marrow progenitor cells or CD14+ cells of the monocytes. Afterwards, it differentiates with Flt-3L cytokine in tissues such as skin and spleen; it is involved in the formation of primary response in the immune system, antigen presentation, creation of immune response in cancer, expression of MHC class I and class II molecules, stimulation of T cells, activation of B cells, and development of humoral immunity. Since the main function of dendritic cells is to present antigen, they are also called professional antigen presenting cells (APC). Dendritic cells make up the 0.1-1% of mononuclear cells; they are found in all tissues of the body, such as the respiratory and gastrointestinal tract, except the brain, testis and eye. Although there are no peroxidase enzyme activities, ATPase enzyme activities are present in these cells. Their endocytic and phagocytic activities are high, while their pinocytic activities are low. Dendritic cells carry immature

intracellular functions in peripheral tissue; in cases where they encounter pathogens such as viruses, bacteria, fungi or tumors, they migrate to the lymphoid tissues in approximately 48 hours to capture the antigen molecule and form an active mature dendritic cell, which creates an immune response. Chemokines are involved in the differentiation of immature dendritic cells into mature dendritic cells. Chemokines involved in differentiation can be listed as: MIP-1α, MIP-1β, MIP-3α, MIP-5, MCP-3,4, RANTES, TECK, SDF-1, IL-6 Cytokine and MIP-3β [5,6].

Immature and mature dendritic cells have different characteristics from each other. They are actively located on the surface of some organs and tissues in order for immature dendritic cells to detect antigens more easily and contains some activation signals. These activation signals may be caused by pathogens or can also be factors such as cytokines or chemokines secreted from damaged or dead cells [7,8].

Discussion

Using dendritic cells in cancer vaccines has been a trending topic in the field. The concept is based on stimulating CD8+ cytotoxic T cells and CD4+ T cells that can recognize and destroy tumor cells, increasing the cytotoxic activities of NK (natural killer) cells, performing immunomodulatory activations of NK cells correctly and effectively, regulating and strengthening the immune system. Usually, a tumor antigen is loaded on the dendritic cells to make them more tumor specific and given to the system after *ex vivo* treatment to clear the tumor cells by activating the other immune system cells. Currently the main issues can be listed as either over or low activation of dendritic cells and lack of specific antigens for each tumor type [9-11].

Conclusion

Cancer immunotherapy relies on the activation of the immune system specifically against the tumor cells without harming the regular tissue cells. Finding tumor specific antigens to load onto the dendritic cells have been a major issue since these antigens have not been well defined. Future studies should focus on the utilization of the bioinformatics tools to find out the best antigen cocktails to be loaded on the dendritic cells for the cancer immunotherapy applications. In this way a safe therapy regimen can be developed by eliminating the excessive usage of chemotherapy or radiotherapy on the cancer patients [3].

References

1. Sönmez, M. Dendritik Hücre İmmünobiyolojisi. Karadeniz Teknik Üniversitesi, Temel moleküler hematoloji kursu.
2. Söker, S. (2005). Dendritik Hücreler. Dicle Tıp Dergisi, 3, 158-160.
3. Özyurt, E. (2006) Dendritik Hücreler ve İmmünoterapi, Türk Nöroşirürji Dergisi, 16(1), 28-30
4. Steinman, R. M. (1991). The dendritic cell and its role in immunogenicity. *Annu. Rev. bnmunol*, *271*, 296.
5. Pearce, E. J., & Everts, B. (2015). Dendritic cell metabolism. *Nature Reviews Immunology*, *15*(1), 18-29.
6. Wu, L., & Dakic, A. (2004). Development of dendritic cell system. *Cell Mol Immunol*, *1*(2), 112-118.
7. Collin, M., McGovern, N., & Haniffa, M. (2013). Human dendritic cell subsets. *Immunology*, *140*(1), 22-30.
8. Greensmith, J. (2007). *The dendritic cell algorithm* (Doctoral dissertation, University of Nottingham).
9. Steinman, R. M. (2003). Some interfaces of dendritic cell biology. *Apmis*, *111*(7-8), 675-697.
10. Wu, L., & Liu, Y. J. (2007). Development of dendritic-cell lineages. Immunity, 26(6), 741-750.
11. King, P. D., & Katz, D. R. (1990). Mechanisms of dendritic cell function. Immunology Today, 11, 206-211.