Immunosenescence: Aging and the decline of the immune system.

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Introduction

Aging is an inevitable biological process that affects various systems in the human body, including the immune system. The term "immunosenescence" refers to the gradual deterioration of the immune system associated with aging, leading to increased vulnerability to infections, cancers, and autoimmune diseases. Understanding immunosenescence is crucial for developing strategies to enhance the health span and quality of life in the elderly population [1, 2].

The immune system is a complex network of cells, tissues, and organs that work together to defend the body against pathogens. It consists of two main components: the innate immune system and the adaptive immune system. Both components are affected by aging, but the changes manifest differently in each. The innate immune system is the body's first line of defense, providing immediate but non-specific responses to pathogens. Key components of the innate immune system include physical barriers (such as the skin), phagocytic cells (such as macrophages and neutrophils), Natural Killer (NK) cells, and various cytokines and complement proteins [3, 4].

The ability of macrophages and neutrophils to engulf and destroy pathogens diminishes with age, leading to a reduced capacity to clear infections. NK cells are critical for identifying and eliminating virus-infected cells and tumor cells. In the elderly, NK cell cytotoxicity declines, compromising the body's ability to control viral infections and cancer. Aging is associated with a chronic, low-grade inflammatory state known as "inflammaging". This condition is characterized by increased levels of pro-inflammatory cytokines, such as IL-6 and TNF-α, which can contribute to tissue damage and the progression of age-related diseases. The adaptive immune system provides a specific and long-lasting response to pathogens through the action of T and B lymphocytes. It has a remarkable ability to remember previous encounters with pathogens and mount a stronger response upon re-exposure [5, 6].

The thymus, where T cells mature, shrinks with age, leading to a decreased output of new T cells. This results in a reduced T cell repertoire, limiting the body's ability to respond to new infections and vaccinations. Existing T cells exhibit functional impairments, such as reduced proliferation and cytokine production. The balance between different T cell subsets also shifts, with an increase in memory T cells and a decrease in naïve T cells. The production of new B cells in the bone marrow declines with age. Additionally, there is a reduction in the diversity of the B cell receptor repertoire and a diminished ability to produce high-affinity antibodies [7, 8].

Paradoxically, aging is also associated with an increased risk of autoimmune diseases, where the immune system mistakenly attacks the body's own tissues. This is thought to be related to the dysregulation of immune tolerance mechanisms. Aging is accompanied by genetic and epigenetic alterations that affect immune cell function. These changes can influence the expression of genes involved in immune responses and cellular senescence. Immune cells, like other cells in the body, can enter a state of senescence, characterized by permanent cell cycle arrest and the secretion of pro-inflammatory factors. Senescent cells accumulate with age and contribute to the inflammaging phenotype. Over a lifetime, the immune system is continuously exposed to various antigens, leading to the exhaustion of immune cells and the accumulation of memory cells. This limits the pool of naïve cells available to respond to new infections [9, 10].

Conclusion

Immunosenescence represents a significant challenge for the aging population, impacting their ability to combat infections, respond to vaccinations, and maintain overall health. Understanding the mechanisms underlying immunosenescence and developing effective interventions are crucial for enhancing the health and quality of life of older adults. Ongoing research and advancements in immunology hold promise for mitigating the effects of aging on the immune system and promoting healthy aging.

References

1. Castelo-Branco C, Soveral I. The immune system and aging: a review. Gynecol Endocrinol. 2014; 30(1):16-22.
2. Weyh C, Krüger K, Strasser B. Physical activity and diet shape the immune system during aging. Nutrients. 2020;12(3):622.
3. Fulop T, Larbi A, Dupuis G, et al. Immunosenescence and inflamm-aging as two sides of the same coin: friends or foes?. Front Immunol. 2018;8:328099.
4. Maggini S, Pierre A, Calder PC. Immune function and micronutrient requirements change over the life course. Nutrients. 2018;10(10):1531.

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5. Frasca D, Diaz A, Romero M, et al. B cell immunosenescence. Annu Rev Cell Dev Biol. 2020;36:551-74.
6. Lian J, Yue Y, Yu W, et al. Immunosenescence: a key player in cancer development. J Hematol Oncol. 2020;13(1):151.
7. De Maeyer RP, Chambers ES. The impact of ageing on monocytes and macrophages. Immunol Lett. 2021;230:1-0.
8. Calder PC, Ortega EF, Meydani SN, et al. Nutrition, immunosenescence, and infectious disease: an overview of the scientific evidence on micronutrients and on modulation of the gut microbiota. Adv Nutr. 2022;13(5):S1-26.
9. Ray D, Yung R. Immune senescence, epigenetics and autoimmunity. Clin Immunol. 2018; 196:59-63.
10. McGovern KE, Sonar SA, Watanabe M, et al. The aging of the immune system and its implications for transplantation. Geroscience. 2023;45(3):1383-400.

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