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REVIEW ON INTERACTION OF NANOPARTICLES/NANODRUG WITH IMMUNE SYSTEM

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ABSTRACT

The immune system protects the body by detecting and eliminating foreign invaders, as well as identifying and rejecting ancient cells and aberrant endogenous organisms. Proteins that have misfolded or been degraded are considered cellular trash. As a result, the susceptible system may detect chemical and biological features with a spatial resolution of several nano meters. Molecular patterns found in a wide range of illnesses, such as viral and bacterial proteins and nucleic acid sequences. The susceptible system can either rejoice or pass nanoparticles undetected. Once honored, they can evoke a seditious or anti-inflammatory response. When nanoparticles enter the body, they virtually always interact with cells. The interactions between nanoparticles and immune cells may have a negative impact, increasing susceptibility to infectious infections, autoimmune disorders, and cancer. The nanoparticles Interact with various types of Immune cells such as Interaction of nanoparticles with monocytes/ macrophages, interaction of nanoparticles with Lymphocytes.

KEYWORDS: *Immune System-immune cells, immune toxicity, Nanoparticles no particles.*

1.INTRODUCTION

Immune system is defined as a system which includes the cells, tissues, organs, and the substances they make that helps the body fight infections and other diseases. Nanoparticles are defined as small particles with size range is between 1 and 100 nm. The immune system consists of Immune cells, Immune organs, Immune molecules. Currently, Nanoparticles formulation mainly affects the immune system through specific interaction with various types of Immune cells and molecules. Nanoparticles can be designed on the basis of the targeting cellular and molecular components based on their own characteristics and give accurate modulating function.

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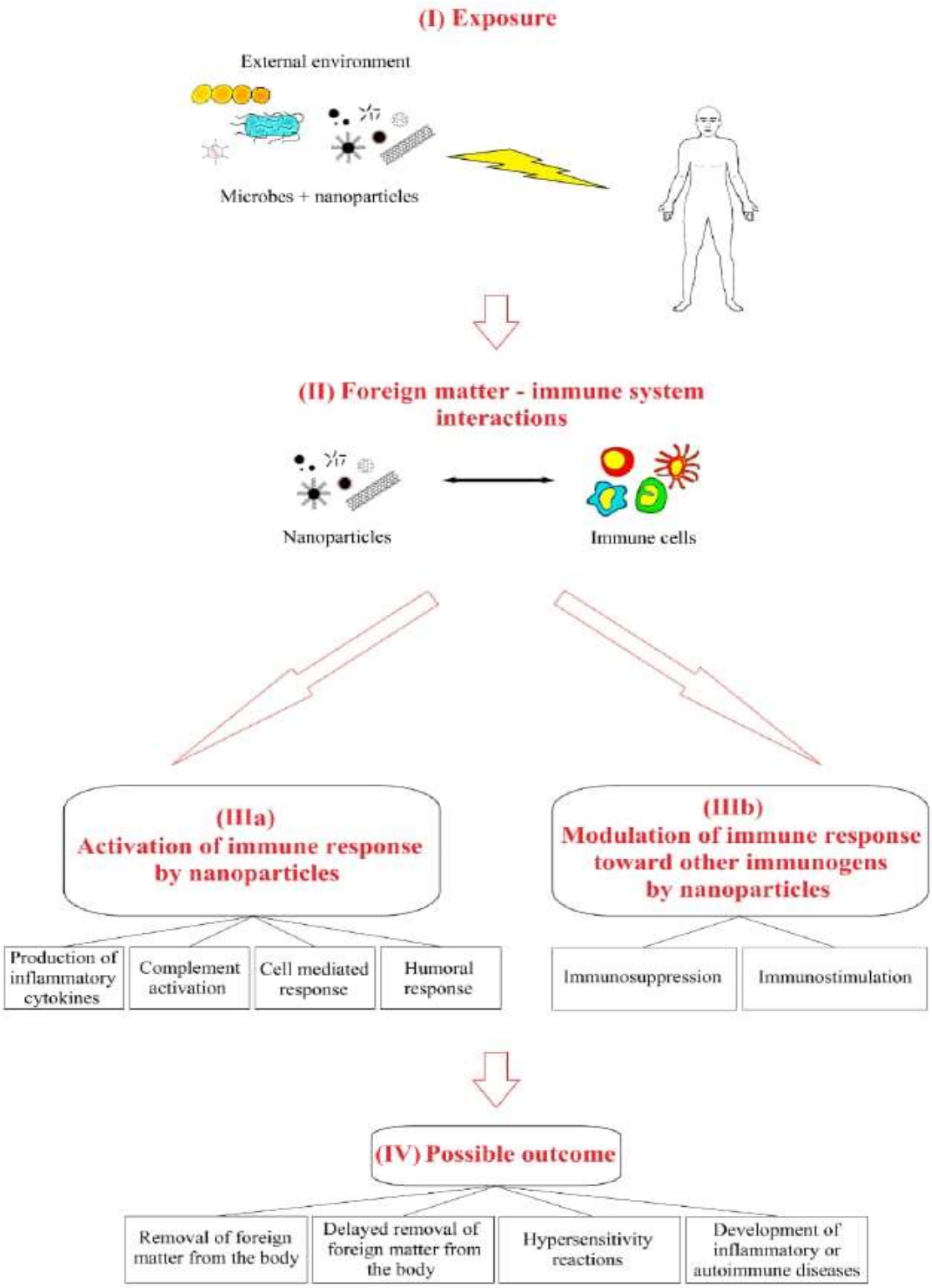

Fig. No.1. Fig. shows how nanoparticles interact with the immune system and give various effects.(1)

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2. The interaction of nanoparticles with the Immune system: The nanoparticles interact with various types of immune cells, such as followings;

1. The interaction of nanoparticles with macrophages.

2.The interaction of nanoparticles with lymphocytes.

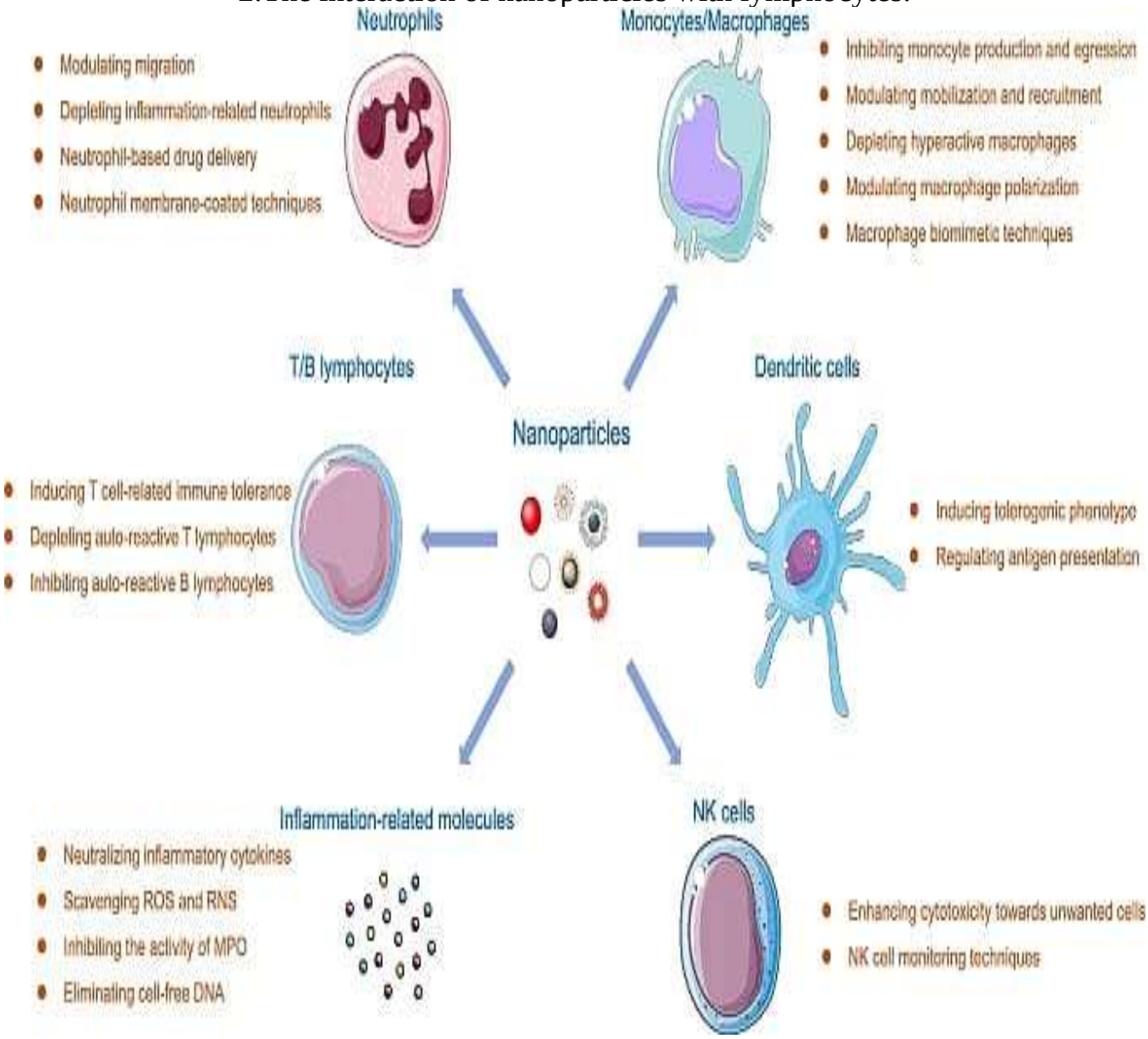

Fig.No.2. Nanoparticle interact with different cells of immune system.(2)

2.1Interaction of nanoparticles with macrophages:

In the innate immune system, macrophages are important cellular components. The functions of macrophages are to degrade and ingest foreign substances and dead cells, tumour cells. **(**3**)**. Macrophages are classified on the basis of their activation and function characteristics - M1 (classically activated) and M2 (alternatively activated). (4). Currently, macrophages play an important role in multiple pathogenic processes. Various nanoparticle formulations interact with these cellular components. Nanoparticles target specific macrophages and achieve their functions. (5).Nanoparticles require designing various ligands on their surface, such as monoclonal antibodies, oligomers, peptides, etc. Then they are binding to certain receptors of macrophages and over express on the surface of macrophages. Resulting, it gives modulating bone marrow activation, monocyte mobilization, and polarization modulation. (6).

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Inhibiting monocyte production and regression in bone marrow

Bone marrow activation is one of the important characters in inflammatory diseases. (7). In inflammatory conditions, increases level of inflammatory cytokines, toll-like receptor agonist and noradrenaline which shows effect the proliferation of hematopoietic stem cells, resulting to large production of inflammatory monocytes, and then which will accumulate in the inflammatory lesions. (8). The bone marrow environment, the interaction of chemokine C-C motif ligand 2 and C-C motif receptor 2, which leads to increased blood vessel permeability, will increase the motivation/egression of inflammatory monocytes. The nanoparticles can be designed to target different levels of inflammatory monocyte production and egress, and diagnosis and treatment of inflammatory diseases. (9).

2.2Interaction of Nanoparticles with Lymphocytes

Lymphocytes is obtained from hematopoietic stem cells (HSCs) present in bone marrow. HSCs firstly differentiate into common myeloid progenitor (CMP) and common lymphoid progenitor (CLP) cells. Granulocytes, macrophages, and erythrocytes are the origins of CMP cells. T and B lymphocytes are the main component and major effector of the adaptive immune system. (10). Lymphocytes play an important role in adaptive immunity. Various nanoparticles platforms have been developed to modulate the target of cellular components. Thus, the resulting management of inflammatory diseases. The mechanisms include T cell-related immune tolerance. (11).

Induce T-cell related immune tolerance

It is a key role in the pathogenesis of variety of inflammatory diseases. The primary goal for the treatment of such conditions involves the reestablishment of immune tolerance. Relevant antigen delivery is considered as a reliable method to produce immune tolerance. Nanoparticles consist of encapsulated antigen [PLG(Ag)] to treat Th2-mediated allergic airway inflammation. (12).

CONCLUSION

Studies show that nanoparticles interact with different components of the immune system. The fast development of nanotechnology has given us a new tool for the nodulation of immune responses. Nanoparticles show great potential to target and give various effects. Nanoparticles are able to target pathogenic substances of different types of diseases, such as inflammatory diseases. The nanoparticles give immunosuppression and immunostimulant.

REFERENCE

1. *Kononenko, Veno & Narat, Mojca & Drobne, Damjana. (2015). Nanoparticle interaction with the immune system. Archives of Industrial Hygiene and Toxicology. 66. 97-108. 10.1515/aiht-2015-66-258.*
2. *Liu, J., Liu, Z., Pang, Y. et al. The interaction between nanoparticles and immune system: application in the treatment of inflammatory diseases. J Nanobiotechnol 20, 127 (2022). https://rdcu.be/dUPS.*
3. *Wynn TA, Chawla A, Pollard JW. Macrophage biology in development, homeostasis and disease. Nature. 2013;496:445–55.*
4. *Funes SC, Rios M, Escobar-Vera J, Kalergis AM. Implications of macrophage polarization in autoimmunity. Immunology. 2018;154:186–95.*
5. *Gaspar N, Zambito G, Löwik C, Mezzanotte L. Active nano-targeting of macrophages. Curr Pharm Des. 2019;25:1951–61.*
6. *Poupot R, Goursat C, Fruchon S. Multivalent nanosystems: targeting monocytes/macrophages. Int J Nanomedicine. 2018;13:5511–21.*
7. *Heidt T, Sager HB, Courties G, Dutta P, Iwamoto Y, Zaltsman A, et al. Chronic variable stress activates hematopoietic stem cells. Nat Med. 2014;20:754–8.*
8. *Mendelson A, Frenette PS. Hematopoietic stem cell niche maintenance during homeostasis and regeneration. Nat Med. 2014;20:833–46.*
9. *Shi C, Jia T, Mendez-Ferrer S, Hohl TM, Serbina NV, Lipuma L, et al. Bone marrow mesenchymal stem and progenitor cells induce monocyte emigration in response to circulating toll-like receptor ligands. Immunity. 2011;34:590–601.*
10. *Orkin SH, Zon LI. Hematopoiesis: an evolving paradigm for stem cell biology. Cell. 2008;132:631–44.*
11. *Seifert M, Küppers R. Human memory B cells. Leukemia. 2016;30:2283–92.*
12. *Smarr CB, Yap WT, Neef TP, Pearson RM, Hunter ZN, Ifergan I, et al. Biodegradable antigen-associated PLG nanoparticles tolerize Th2-mediated allergic airway infammation pre- and postsensitization. Proc Natl Acad Sci USA. 2016;113:5059–64.*