Nano/Micro-materials for Immunomodulation: A Promising Strategy for Development of Vaccine and Cancer Immunotherapy

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The immune system is activated when it encounters immunogens such as micro-organisms or cancerous cells. The diversity in the size, shape and surface properties of these disease causing entities influence the type and magnitude of the immune response. Thoughtful engineering of nano/micro-particle systems based on the knowledge of interactions of immunogen and immune system has led to the development of efficient vaccines against infectious diseases and immunotherapeutic regimens for cancer treatment. These nano/micro-particulate systems impart various advantages such as enhanced cellular uptake, capability to enhance cross-presentation, adjuvanticity, controlled release, polyvalent presentation and co-delivery of adjuvant and/or antigen.[1] Herein, poly-(gamma glutamic acid)(γ-PGA) based micro-dispersion and poly (lactic acid-co-glycolic acid)(PLGA) nanoparticles were explored as delivery agents for combination immunotherapy against cancer. A convenient, reproducible, single step synthesis process using γ-PGA and water insoluble drugs- chemotherapeutic agent (paclitaxel) and immune-stimulating agent imiquimod a toll like receptor 7 (TLR7) agonist was developed. Micro-dispersions formed were stable up to 6 months and the combination treatment illustrated improved tumor inhibition and presence of memory response in mice melanoma model (Fig. A).[2] In another study, PLGA nanoparticles mediated delivery of gardiquimod (TLR7/8 agonist) was used for enhancing activation of dendritic cells and was tested in combination with vasculature disrupting agent DMXAA (5,6-Dimethyl-9-oxo-9*H*-xanthen-4-yl)-acetic acid) (Fig. B, unpublished data). The combinations lead to improved tumor regression and survival in mice. Immuno-stimulation using nano/micro-materials have demonstrated potential for becoming versatile platform for achieving improved therapeutic effect.

References

[1] Anushree Seth, Doo-Byoung Oh, Yong Taik Lim, Nanomedicine, **10** (2015), 595
[2] Anushree Seth, Min Beom Heo, Yong Taik Lim, Biomaterials, **35** (2014), 7992

Figures