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A Novel Nanoparticle Adjuvant for Cancer Vaccines

A novel cancer vaccine uses sweet corn-derived nanoparticles to deliver an immune-stimulating adjuvant and a tumor antigen, effectively overcoming resistance to traditional therapies and allowing for personalized and versatile cancer treatment.

Traditional cancer therapies such as chemotherapy and radiotherapy can cause severe side effects and are often not sufficient in eliminating cancers entirely. Cancer cells may develop resistance to these therapies. Additionally, certain cancer types, such as melanoma and bladder cancer, are often difficult to treat effectively with these approaches. These issues with traditional cancer therapies are coupled with a lack of personalization in treatment. This lack of customization can exacerbate treatment difficulties, as universal treatments don't account for individual variability in cancer type, stage, and patient health status. Therefore, there is need for more effective, personalized, and less invasive cancer treatment methods.

Purdue Researchers have developed a cancer vaccine that can stimulate an anti-cancer CD8+ T cell response. The vaccine uses an agonist of the stimulator of interferon genes (STING) and a tumor antigen, both of which are adsorbed onto cationic phytoglycogen (PG) nanoparticles. This approach employs ADU-S100 as the STING agonist and derives the PG nanoparticles from sweet corn, achieving a synergistic effect that shows promise in cases where cancers are resistant to chemotherapy or radiotherapy. The vaccine can be tailored for the treatment of various types of cancer, such as melanoma, bladder, breast, cervical, and colon cancer. The vaccine can be administered through multiple devices, including a microneedle injector, microneedle patch, or needle-free delivery device, and it is compatible with a range of existing cancer therapies, from surgery and chemotherapy to gene therapy.

This technology uses PG nanoparticles derived from sweet corn modified through two sequential chemical processes to create a technology called Nano-11. The Nano-11 nanoparticles are combined with the STING agonist ADU-S100 to create NanoS100, an adjuvant that robustly stimulates the

Technology ID
2023-HOGE-70112

Category
Biotechnology & Life Sciences/Biomarker Discovery & Diagnostics
Biotechnology & Life Sciences/Cell & Gene Therapy Platforms
Pharmaceuticals/Drug Discovery & Development
Biotechnology & Life Sciences/Analytical & Diagnostic Instrumentation
Pharmaceuticals/Drug Delivery & Formulations

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immune system. The vaccine formulation is created by combining these NanoS100 with a tumor antigen and has been successfully tested in mice using a protocol of repeat injections. The researchers demonstrated flexibility in employing a variety of agonists and antigens to assess the vaccine's efficacy, showcasing the flexibility of the developed vaccine for use in the various cancers mentioned above.

Technology Validation:

- DC2.4 cells were stimulated with NanoS100, which induced SIINFEKL-specific B3Z CD8+ T cell activation compared to unadjuvanted-OVA

- C57BL/6J mice were inoculated subcutaneously in the flank and tumor size and volume were measured for vaccine efficacy, showing a decrease in mice immunized with the vaccine

- NanoS100 adjuvant elicited substantially activation of NF-?B and IRF signaling pathways

- Quantitative analysis of lysed target cells in mice immunized with NanoS100 suggests significant enhancement in vivo cross-priming of antigen-specific cytotoxic CD8+ T lymphocytes

Advantages:

- Adsorption of a STING agonist and tumor (neo)antigen(s) together on the nanoparticles stimulates the anti-cancer immune response, providing enhanced efficacy over traditional cancer vaccines

- Greater versatility due to the technology being designed to work in conjunction with other cancer therapies, making it a versatile tool in the fight against cancer.

Applications:

- Cancer vaccines that can stimulate an immune response against specific types of cancer

- Personalized treatment using different agonists and antigens, allowing for a modular vaccine that can personalized to the individual

- Non-invasive vaccine delivery using microneedle patches and or a needle-free injector

Publication:

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Hernandez-Franco, J.F., Jan, I.M., Elzey, B.D. et al. Intradermal vaccination with a phytoglycogen nanoparticle and STING agonist induces cytotoxic T lymphocyte-mediated antitumor immunity. npj Vaccines 9, 149 (2024). https://doi.org/10.1038/s41541-024-00943-8

TRL: 3

Intellectual Property:

Provisional-Patent, 2023-03-31, United States | NATL-Patent, 2024-04-01, Europe | PCT-Patent, 2024-04-01, WO | NATL-Patent, 2025-09-18, United States

Keywords: Cancer vaccine, STING agonist, phytoglycogen nanoparticles, anti-cancer CD8+ T cell response, NanoS100 adjuvant, personalized cancer treatment, non-invasive vaccine delivery, microneedle patch, needle-free injector, cytotoxic T lymphocyte-mediated antitumor immunity