



RECENT ADVANCES IN CANCER VACCINE DEVELOPMENT

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The possibility for the development of cancer vaccines was first recognized in 1893 by the New York surgeon William Coley who reported the regression of several human tumors following immune stimulation with a bacterial toxin. Renewed interest in cancer vaccines today is based on several recent advances, which have allowed the design of more potent and specific therapeutic vaccines for cancer.

Among the body's potential defenses are white blood cells called cytotoxic T lymphocytes (CTL). CTL can recognize and kill cancer cells, but only if they see complexes of protein fragments (peptides) attached to special molecules (MHC molecules) on the surface of the cancer cells. The peptide-MHC complexes are made inside the cancer cells and are then exported to the cancer cell surface. The same process occurs in a normal antigen-presenting cell of the immune system, which can stimulate CTL against the tumor.

The identification of peptides derived from tumor-associated antigens (TAA) in melanoma and other cancers has been an important development in the field of tumor immunology. We used a number of modern approaches to identify several new TAA and a variety of peptides derived from these antigens.

Because most attempts to treat cancer patients with TAA-derived synthetic peptides have not been successful, further research aimed at enhancing the stability and potency of the peptides used for vaccination of patients with cancer is essential. In order to design synthetic vaccines, suitable for clinical application we utilized several new methods to develop optimized vaccines based on TAA-derived peptides.

Significant advances in biotechnology and biochemistry have led to the discovery of a large number of cancer vaccines based on peptides and proteins. However, the development of suitable and efficient carrier systems remains a major challenge since the vaccine bioavailability is limited by enzymatic degradation. To circumvent this difficulty we suggested a new vaccine design utilizing very small non-toxic particles, called nanoparticles. These particles allow encapsulation of the peptides inside, protecting them against degradation. In addition, the nanoparticle vaccine approach offers the possibility of providing tailor-made properties of the vaccine materials that may improve their function significantly. Therefore, we designed and prepared a variety of nanoparticle-based vaccines formulated with different tumor peptides, encapsulated inside the nanoparticles.

This lecture summarizes the most recent findings and the future directions in designing cancer vaccines. The most promising approaches to cancer vaccine development and the possible clinical applications of the new vaccines will be discussed.