The clinical study of peptides has been long been considered to be important and crucial research (Fields, et al). Gaining a complete understanding of the operational mechanics of peptides could lead to a wide range of important scientific discoveries. One of the most vital areas of investigation is how peptides can potentially inhibit cancer proteins. (Thundimadathil, J.)

The Functionality of Peptides and Cancer

Peptides are short chains of amino acid monomer molecules linked through a covalent chemical bond (Scitable). They are designed to start, promote, and prohibit several cellular functions through chemical secretion—from paracrine and endocrine signals to various growth factors and neurotransmitters. Operating at the cellular level, peptides secrete elements that promote and regulate a wide variety of cellular systems. (Peptide Guide).

Like peptides, cancer’s origins are also cellular based. It is a disease characterized by uncontrolled cellular division. Production of excess cells have the ability to invade other cellular tissues. This invasion results in the formation of a tumor. If this tumorous mass is left to grow, it develops vascularization (the formation of blood vessels) and eventually metastasis (spreading of the disease throughout the organism). These latter two steps play a major role in transitioning a tumor from a benign into a malignant state. When a tumor reaches malignancy, it can cause serious issues, including death of the organism.

Clinical research has studied the nature of peptides to determine the role that they can play in preventing the cancer from initializing, as well as combating the cancer in the event that it establishes itself inside of the organism and starts to metastatize (Thundimadathil, J.).

Peptides as an Effective Ally

There are several reasons why science is turning to peptides in the search for the control and eradication of cancer, including:

- **Size** – Because peptides are molecular in nature, can infiltrate and interact with the cancer-causing agents at the cellular level.

- **Ease of synthesis and modification** – The nature of peptides is such that they can easily replicate and change behavioral patterns at a cellular level by affecting basic regulatory procedures such as inhibiting or promoting secretions.
• Tumor penetration – Clinical studies of animal test subjects have determined that peptides can infiltrate tumors extremely efficiently, giving them the ability to potentially disrupt cellular production within the tumor after its formation. This would lessen the risk of a tumor transforming from benign to that of a malignant state.

• Excellent biocompatibility – The term biocompatibility refers to the ability of a material or substance to perform with an appropriate host response in a specific situation. The term describes how well a peptide interacts with a host subject. Clinical studies on animal test subjects have shown that peptides do interact efficiently with cancer cells. (Thayer, pg. 13-20)

These attributes indicate that peptides represent a potentially promising therapeutic agent in the fight against cancer. (Thundimadathil, J)

Major Peptide Applications against Cancer

Clinical research on animal test subjects, exploring the complex interactions between peptides and cancer-causing agents, has suggested several different avenues in which peptides may be applied to various cancer scenarios. (Thundimadathil, J)

The most promising application is through peptides that target LHRH (Miller, et al; 231-233). These particular peptides act as an agonist, meaning that they bind to a cell in a way that regulates LHRH receptors. The process of inhibiting the cell receptors suggests that peptides could be beneficial in fighting prostate cancer.

A second application being considered involves peptides as radionuclide carriers (Strowski and Blake, 169-179). A prevalent amount of neuroendocrine tumors are marked by an aggressive overexpression of somatostatin receptors. Somatostain is the peptide hormone secreted to regulate the endocrine system. Their receptors also carry an impact on neurotransmission and cell proliferation; hyperactivity of these receptors may lead to an overabundance in cellular production which may in turn cause tumors to form. The introduction of a peptide that is a radionuclide, or a radioactive nuclide, can help neutralize these overexpressed receptors. Clinical studies on animal test subjects have determined that the neutralization has to do with the somatostatin receptors’ inherent makeup. The somatostatin receptors found in tumor tissues are denser in nature than non-tumor tissues. This difference in density creates a higher rate of attraction to radionuclide peptides, and therefore is subject to targeting by the peptides more readily than non-tumor tissue. Because of its link to the endocrine system, there is particular interest in this application to combat cancers produced by the endocrine system. While this process does have the potential to play a role in the field of nuclear medicine, it should be noted that because of the peptide’s radioactive nature, there are many concerns about this approach.

A third application currently being evaluated is peptide vaccines (Henderson, et al, 2359-2362). This method of active immunization is derived from the concept of introducing immune cells or molecules into the animal test subject. The basis for this potential type of cancer treatment depends on vaccines containing peptides derived from
a protein sequence of antigens produced by the cells of a corresponding tumor. These antigens, which are also known as tumor-associated antigens or TAAs, are typically identified as invaders by the animal test subjects’ immune system. Reintroducing these antigens via a vaccination can potentially induce a systematic immune response by the animal test subject that could result in the destruction of cancers throughout the organism. On a larger scale, this type of treatment may lead to the regression of a tumor. While this approach does show potential, its flaw, according to current research, is that the vaccines tend to have a weak immunogenicity—e.g. the peptides do not provoke a strong enough immune response.

A fourth application that is currently being scrutinized via clinical research is using peptides that contain the property of cytotoxicity (Schally and Nagy, pg. 1-14)—the property of being toxic to cells. These peptides can be designed to form bonds with specific receptors that are known to overexpress the cells that can form tumors, such as somatostatin. This design enables the peptide to target a cell expressing the desired receptor and therefore kill the resultant cancerous cells. These particular peptides are sometimes referred to as homing peptides because they are specifically designed to hone in on and neutralize or eliminate diseased tissue within the organism.

The final major application that is currently undergoing clinical analysis is the deployment of what are known as anticancer peptides (Rosca, et al, pg. 1101-1116). These peptides work by preventing angiogenesis, enzymes, signal transduction pathways, proteins, gene expression, or protein-to-protein interactions from occurring. These preventions can disrupt the process of tumor growth and neutralize the cancer’s growth.

The Importance of Clinical Research

While various forms of clinical research performed on animal test subjects have determined several potential positive avenues in which peptides may be utilized to treat cancer, it should be noted that there is still a host of research that is left to be done on this subject. There is still a significant amount of investigation required before the cancer-battling attributes exhibited by peptides can be considered definitive. Nonetheless, results that clinical studies have produced are encouraging, as these methodologies advance into the future.

Sources

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