Aptamer Development in Treating Cancers

review of presentation given by Dr. Weihong Tan of the University of Florida

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Dr. Weihong Tan's group at the University of Florida has been working in the field of aptamers with a goal of finding markers for cancer cells such as those found in Lung cancer and Leukemia. These markings can be arrived through many natural methods of recognition pairs: antigen-antibody, ligand-receptor, enzyme-substrate, or DNA/RNA-target nucleic acids/proteins. Each of these involve large or complex molecules that have few examples for being useful as a general treatment paradigm. Taking the last recognition pair employing DNA/RNA, Tan's group instead works with very small fragments of these strands. Here, a series of 15 pair-bond links has a sufficient variety of unique groupings that at least one of these strands, called an aptamer, has a high likelihood of binding to the cancer cell of interest. The application advantage of these marker fragments is in their extremely small molecular weight means that they quickly penetrate tissues, and quickly clear out through the kidneys. This is called their half life, and aptamer half life is measured in minutes and hours.

Aptamers, as developed by Tan's group, are produced through the SELEX (Systematic Evolution of Ligands by Exponential Enrichment) process. It takes only several hours for Tan's laboratory to produce a library of 10^{15} strands of DNA to initiate the selection cycle. Typically, this is a repeated cycle of taking these fragments from a “library” and finding those few that have an affinity with a specific protein molecule. Dr. Tan's group goes beyond a binding to a protein molecule to instead focus on the cancer cells of interest. This means that the selection process from the library of aptamers is used to find those that have a preference for the cancerous cell itself, rather than the specific protein of the cancer cell. Once library aptamers are selected through binding, their unbound fragments are discarded, and the bound fragments are separated from the cell. The process is continued on with amplification, mutation, and reiteration back into selection.

Dr. Tan's group having established selecting aptamers for affinities to cancer cells was not enough. The short strands of DNA are then joined to fluorophores. This rendered the aptamers into visible tags. This coupling allowed the researchers to trace the distribution of selected aptamers visually. When illuminated by light, the fluorophores will flouresce to reveal an infection site where many fluorophore joined aptamers will attach themselves to cancer cells inhabiting a tumor.