

Aptamers and their biomedical applications

Aptamers (Aps) are short RNA or single-stranded DNA that comprise 20–80 nucleotides and can fold into unique three-dimensional structures to specifically bind to their targets such as small molecules, proteins, receptors, and tumor biomarkers. Aps can be synthesized through a systematic evolution of ligands by exponential enrichment (SELEX) technique, and have several advantages over commonly used ligands (such as antibodies), including excellent tissue permeability, low toxicity, good stability, easy preparation, and higher modifiability. Aps have been identified as candidates for the construction of various smart systems for targeted drug delivery, diagnosis, and bioimaging due to their high affinity and specificity toward target molecules. The development of sensing tools with high accuracy and sensitivity to detect cancer cells can increase the chances of successful treatment. In this context, several types of Ap-based biosensors have been fabricated for the detection of various cancer biomarkers. In therapeutic fields, various nanocarriers decorated with Aps have been designed to deliver drugs/genes to the target cells/tissues without affecting normal cells, resulting in improved treatment of cancer. Also, Ap-based chimeric systems in which targeting Aps are conjugated to therapeutic molecules (e.g., siRNA/miRNA, Ap, toxins, chemotherapeutic agents), are other targeted drug delivery systems to induce cytotoxicity and diminish the side effects of drugs to normal cells/tissues. Furthermore, designing bispecific Aps which can concurrently bind to two different targets, could be an effective potential approach to induce anti-tumor immunity and overcome tumor heterogeneity. The present lecture takes a look at the diagnostic and therapeutic applications of Aps in biomedical fields.