Nucleic acid aptamers and its applications in microbial infections.

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Abstract

Due to the rising prevalence of germs that are resistant to a wide range of drugs, the complexity of treatment and rising healthcare expenditures, treating bacterial infections is a significant challenge today. Furthermore, there aren't many novel antibacterial therapies. Monoclonal antibodies are being replaced by oligonucleotide aptamers, which are single-stranded DNAs or RNAs having a target-selective high-affinity property. The use of aptamer-based systems in drug delivery systems and the reduction or inhibition of the effects of bacterial toxins have been proven to be effective methods for treating microbial illnesses. They also exhibit promising anti-biofilm and antibacterial capabilities. The therapeutic uses of aptamers in infections are the main subject of this review.

Keywords: Aptamers, Oligonucleotide aptamers, Therapeutic uses, Anti-biofilm, Antibacterial.

Introduction

Aptamers are short synthetic single-stranded oligonucleotides that specifically bind to various molecular targets such as small molecules, proteins, nucleic acids, cells and tissues. Antibiotic-resistant bacteria cause numerous deaths every year and have a direct impact on the economy. New strategies for infection control and developing of novel antibiotics with less serious side effects, low toxicity and high efficacy seem necessary [1]. Three different groups concurrently devised a ground-breaking *in vitro* selection technique for synthetic RNAs that could bind specifically to their target molecules three decades ago. The Latin words "aptus" (fitting) or "aptare" (to fit) and the Greek word "meros" (part) were combined to form the term "aptamer" for the structured RNA motifs. Systematic evolution of ligands by exponential enrichment (SELEX), which relies on alternate cycles of ligand selection from pools of variable sequences and amplification of the bound species, was used to isolate high-affinity nucleic acid ligands for a protein [2]. The population of organisms with the highest affinity that may be clonally isolated and defined was exponentially enriched after several rounds of selection. Because RNA can easily build secondary structures and fold into three-dimensional structures that have high affinity to their particular targets, RNA libraries were frequently used in an earlier stage of aptamer research. Recent reviews have examined the improvements in aptamer generation, applications in biosensing, biotechnology, and medicine, as well as the drawbacks and potential future uses of aptamers for target-specific delivery and real-time detection [3].

HIV and adenovirus contain several small RNA sequences or regions which can specifically bind to viral or cellular proteins with high affinity. Functional studies indicated that these viral RNA-protein interactions could be exploited as competitive anti-viral therapeutics. In 1990, decoys of a small HIV RNA region, called TAR, could be used to inhibit HIV virus replication in cellular models. With the development of SELEX in the 1990s, aptamers were quickly developed against important clinical targets. These included von Willebrand Factor (vWF), PDGF and Vascular Endothelial Growth Factor (VEGF).

Some of these are now being tested in clinical trials and one has been approved by the US FDA. Aptamers have many advantages over traditional targeting molecules and antibodies. Diverse molecules such as chemotherapy drugs, toxins, siRNAs, imaging probes, and nanomaterials can be conjugated to aptamers. Many new SELEX methods have been developed to easily and rapidly select for an aptamer.

Aptamers can be effective in antiviral therapy through several methods. They can suppress viral nucleic acid replication by inhibiting nucleocapsid assembly that reduces extracellular DNA. Antiviral drugs can cause severe side effects or may interfere with other drug agents and lead to low efficacy. Aptamers could provide a strong tool for the expansion of new therapeutic factors with the ability to block the function of pathogen microorganisms. They are simple and cheap therapeutic agents with fewer side effects compared to traditional antibiotics [4-6]. Different therapeutic approaches of aptamers application have been reported in the field of microbial infections.

References

1. Afrasiabi S, Pourhajibagher M, Raoofian R, et al. Therapeutic applications of nucleic acid aptamers in microbial infections. J Biomed Sci. 2020;27(1):1-3.

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2. Ni X, Castanares M, Mukherjee A, et al. Nucleic acid aptamers: clinical applications and promising new horizons. Curr Med Chem. 2011;18(27):4206-14.

3. Byun J. Recent progress and opportunities for nucleic acid aptamers. LIFE. 2021;11(3):193.

4. Gopinath SC, Sakamaki Y, Kawasaki K, et al. An efficient RNA aptamer against human influenza B virus hemagglutinin. J Biochem. 2006;139(5):837-46.

5. Fukuda K, Vishnuvardhan D, Sekiya S, et al. Isolation and characterization of RNA aptamers specific for the hepatitis C virus nonstructural protein 3 protease. Eur J Biochem. 2000;267(12):3685-94.

6. Berezovski MV, Lechmann M, Musheev MU, et al. Aptamer-facilitated biomarker discovery (AptaBiD). J Am Chem Soc. 2008;130(28):9137-43.

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