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The therapeutic potential of oligonucleotides attached to inorganic nanoparticles has been established.

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Abstract

In comparison to organic materials, inorganic nanoparticles are non-toxic, aqueous, biocompatible, and stable. Drug delivery techniques with improved efficacy and fewer side effects have evolved alongside new materials. Diagnostic procedures, nano medicines and delivery methods, and biomedical applications are just a few of the biomedical applications of nanotechnology. The single biggest market opportunity is nano-enabled medicine delivery, according to estimates. Other inorganic nanoparticles besides calcium phosphates have recently been introduced as good drug delivery matrices thanks to recent advances in nanotechnology. Several inorganic nanomaterials have been exploited as medication carriers since they now exhibit enhanced chemical characteristics. The latest advancements and applications of calcium phosphate nanoparticles, gold nanoparticles, and iron oxide nanoparticles in drug delivery and tissue engineering are discussed in this chapter. The main characteristics of ZF models, as well as the benefits and drawbacks of using them in the creation of ON-based therapy techniques, are also highlighted.

Keywords: Oligonucleotides, Nanoparticles, Zebrafish.

Introduction

Molecular target agents, which include chemically generated antisense oligonucleotides (ASOs), small interfering RNA (siRNA), microRNA (miRNA), aptamers, and decoys, have recently been proposed as promising anticancer therapeutics. Chemically produced oligonucleotides (ONs) having a single- or double-stranded deoxyribonucleic acid (DNA) or ribonucleic acid (RNA) chain and a specified molecular target are used. This target can be a single gene, a protein, or a group of genes or proteins. In this context, the different molecular profiling technologies that have lately been launched in cancer research have greatly increased the number of molecular targets [1].

In the event of anticancer therapy where other conventional or new medications are ineffective, the capacity to be highly specific for a certain molecular target might be quite useful. Various breakthroughs have been made in the possible application domains of ON technologies for both diagnostic and therapeutic reasons over the last two decades, notably because to the ability to operate at various phases of tumour pathogenesis and progression for various modes of action. ASO, siRNA, and miRNA, for example, can operate at the transcription level by targeting specific messenger RNAs (mRNAs), aptamers can directly decrease protein function, and decoys can specifically target DNA coding transcription [2].

As in presence of the RNA-DNA duplex generated by the binding of the DNA-based ONs with their particular mRNA transcripts, the RNase H enzyme RNASEH1 catalyses the destruction of RNA. As a result, the expression of the target gene is turned off. The recently proposed RNase H-competent ASOs are made up of a central DNA-based gap surrounding by flanking sections made up of chemically modified RNA that promote target binding [3]. Because RNASEH1 is active in both the cytoplasm and the nucleus, it can target nuclear transcripts, especially immature pre-mRNAs and long non-coding RNAs, but other technologies, such as siRNA, have a harder time suppressing in the nucleus [4]

In diverse tumour types and clinical conditions, miRNAs are overexpressed or underexpressed. Anti-miRNAs (antagomiRs) and miRNA mimics are two ways for modulating the level of a given miRNA. MiRNA mimic are synthetized as miRNA duplexes with the same sequences as the endogenous miRNA in order to restore the reduced translation of endogenous miRNA associated with tumour suppressor actions. Through specific binding within the RISC complex, specific steric block ASOs, dubbed antagomiRs, can effectively silence miRNAs. Alternatively, the regulatory actions of miRNAs can be suppressed by using steric block ASO to mask the relevant target sequence on the mRNA transcript [5].

Conclusion

ONs are fast gaining popularity as novel therapeutic agents for the treatment of various cancers; their versatility and numerous

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chemical properties ensure that they can target nucleic acids and proteins involved in tumour genesis, progression, or both. Several challenges must be resolved before they can be used in clinical trials, but the development of particular delivery systems based on nanostructures allows them to overcome the majority of them, demonstrating the ON's selective activity in the tumour microenvironment. Further more, the ability to use new in vitro and in vivo models allows for quick characterization of new ON-based therapeutic methods, in this context, ZF is gaining appeal because to its ability to deliver robust results in a short period of time, in a system.

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