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Short Communication

Role of Non-Coding RNAs in Cardiac Function

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DESCRIPTION

The human heart, an awe-inspiring organ, is a complex symphony of molecular processes that orchestrate its rhythmic contractions and maintain its intricate structure. Traditionally, the focus of research in understanding cardiac function has centered on protein-coding genes and their roles in regulating various aspects of heart development, homeostasis, and disease [1]. However, the emergence of non-coding Ribonucleic Acid (ncRNAs) as crucial players in gene regulation has opened up a new dimension in our understanding of cardiac biology. In this article, we delve into the fascinating world of non-coding RNAs and explore their pivotal role in maintaining proper cardiac function [2].

The central dogma of molecular biology, which posits that genetic information flows from Deoxyribonucleic Acid (DNA) to Ribonucleic Acid (RNA) to protein, once led scientists to believe that the majority of the genome was dedicated to coding for proteins [3]. However, the advent of high-throughput sequencing technologies has revealed that a significant portion of the genome is transcribed into RNAs that do not encode proteins, giving rise to various classes of non-coding RNAs. These non-coding RNAs are now recognized as important regulators of gene expression and cellular processes [4]. Non-coding RNAs are broadly classified into two main categories: Short non-coding RNAs, including microRNAs (miRNAs) and small interfering RNAs (siRNAs), and long non-coding RNAs (lncRNAs). Both of these classes have been shown to play critical roles in diverse biological processes, including cardiac function.

MicroRNAs

MicroRNAs are short single-stranded RNAs that typically consist of 21-23 nucleotides. They function as post-transcriptional regulators by binding to the 3' Untranslated Region (UTR) of target messenger RNAs (mRNAs), leading to mRNA degradation or translational repression [5]. In the context of the heart, miRNAs have emerged as key players in modulating cardiac gene expression networks involved in development, hypertrophy, contractility, and stress response.

Long non-coding RNAs

Long non-coding RNAs, in contrast, are generally more than 200 nucleotides in length and have diverse mechanisms of action. They can act as scaffolds, guides, decoys, or enhancers to modulate gene expression at transcriptional and post-transcriptional levels [6]. LncRNAs have been implicated in a range of cardiac processes, including chromatin remodeling, epigenetic regulation, and signal transduction. One well-studied lncRNA in the context of cardiac function is Braveheart, which plays a crucial role in heart development by regulating the expression of key cardiac transcription factors [7]. Another example is Wisper, which influences cardiac fibrosis, a common pathological feature of heart diseases. These lncRNAs underscore the intricate web of interactions that govern cardiac biology [8].

Emerging therapeutic implications

The growing understanding of non-coding RNAs' involvement in cardiac function has raised exciting prospects for therapeutic interventions [9]. Researchers are exploring the potential of utilizing ncRNAs as diagnostic markers for cardiovascular diseases and as targets for innovative therapeutic strategies. The development of RNA-based therapies, such as miRNA mimics or inhibitors, holds promise for modulating specific cardiac pathways and mitigating pathological conditions [10].

CONCLUSION

In the journey to decipher the complexities of cardiac function, the role of non-coding RNAs has emerged as a captivating area of study. MicroRNAs and long non-coding RNAs have unveiled a layer of regulatory intricacy that extends beyond protein-coding genes. Their involvement in cardiac development, homeostasis, and disease underscores the importance of a holistic approach to understanding the heart's biology. As research continues to unravel the mysteries of non-coding RNAs in cardiac function, we stand on the brink of a new era in cardiovascular science, one that holds immense potential for therapeutic innovation and improved patient care.

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