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Perspective

The Intricacies of Noncoding RNA in Cellular Function

Elin Bohman*

Department of Epigenetics, Stockholm University, Stockholm, Sweden

DESCRIPTION

In the field of molecular biology, the noncoding RNA (ncRNA) has emerged as a key contributor in the cellular processes. In traditional view, RNA's primary role was only limited to protein synthesis, but now the noncoding RNA has proven to be a multifaceted molecule with diverse functions. This article explores the world of noncoding RNA, and its various actions within the cellular processes.

For decades, the central dogma of molecular biology proclaimed that the flow of genetic information was unidirectional from DNA to RNA to protein. However, this simplistic view overlooked the vast portion of the genome that does not code for proteins. Noncoding RNA, as the name suggests, does not provide a template for protein synthesis, challenging the traditional dogma and urging scientists to re-evaluate their understanding of cellular processes. The pioneers in the field of small noncoding RNAs are transfer RNA (tRNA) and ribosomal RNA (rRNA). These two types of RNA do not encode proteins themselves, but they play indispensable roles in the protein synthesis. tRNA acts as a molecular adaptor, ensuring the accurate translation of genetic information into proteins, while rRNA forms the structural core of the ribosome, the cellular machinery responsible for protein synthesis.

In recent years, small noncoding RNAs have taken center stage for their crucial roles in regulating gene expression. MicroRNAs (miRNAs) and small interfering RNAs (siRNAs) are two prominent classes with the ability to silence or degrade target messenger RNAs (mRNAs), thereby influencing protein production. miRNAs, typically have 21-23 nucleotides, bind to specific mRNAs and either inhibit their translation or promote their degradation. This fine-tuned regulation allows miRNAs to exert control over numerous cellular processes, including development, differentiation, and apoptosis. Aberrant miRNA expression has been implicated in various diseases, making its use in therapeutic targets. siRNAs, on the other hand, are often exogenously introduced into cells to harness the cell's own RNA interference machinery. This technique has been widely adopted in research and holds potential for therapeutic applications, particularly in the realm of gene therapy.

Circular RNAs (CircRNAs) represent a unique class of noncoding RNAs that form covalently closed loops. Initially considered mere byproducts of mis-splicing, circRNAs have emerged as functional molecules involved in gene regulation. They can act as miRNA sponges, sequestering miRNAs and preventing them from repressing their target mRNAs. Additionally, circRNAs have been implicated in regulating alternative splicing and modulating transcription. The dysregulation of noncoding RNAs is increasingly recognized as a contributing factor in various diseases. Aberrant miRNA expression has been linked to cancer, neurodegenerative disorders, and cardiovascular diseases. Similarly, dysregulated lncRNAs have been implicated in conditions such as diabetes, autoimmune diseases, and certain cancers.

CONCLUSION

The unique characteristics of noncoding RNAs make them attractive for therapeutic interventions. RNA-based therapeutics, such as antisense oligonucleotides and small interfering RNAs, are being explored for their potential in treating a range of diseases, including genetic disorders and certain cancers. The ability to modulate gene expression at the RNA level holds impact for precise and targeted therapies. From the pioneering tRNA and rRNA to the small players like miRNAs, the long conductors such as lncRNAs, and the circular performers like circRNAs, each class of noncoding RNA adds a layer of complexity to our understanding of gene regulation. As researchers do further research into the mechanisms and functions of noncoding RNAs in disease pathogenesis opens avenues for the development of novel therapeutic strategies.

Correspondence to: Elin Bohman, Department of Epigenetics, Stockholm University, Stockholm, Sweden, E-mail: bohman@sll.se

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