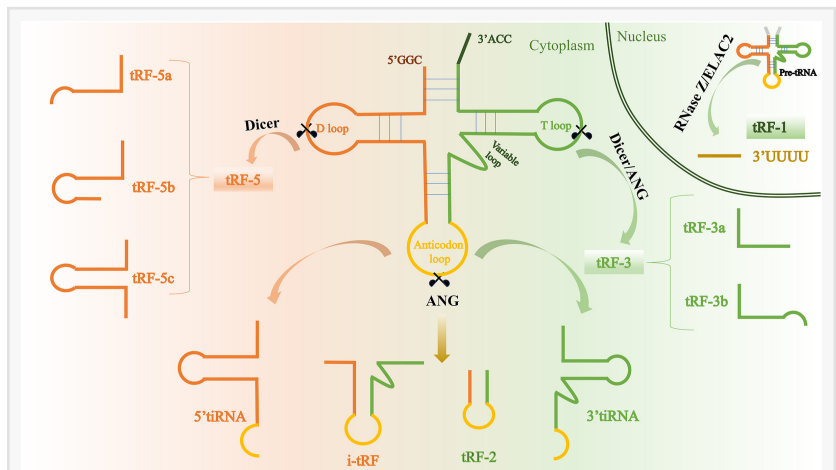


Hidden Regulators: Small Noncoding RNAs Redefine Cardiovascular Disease Mechanisms

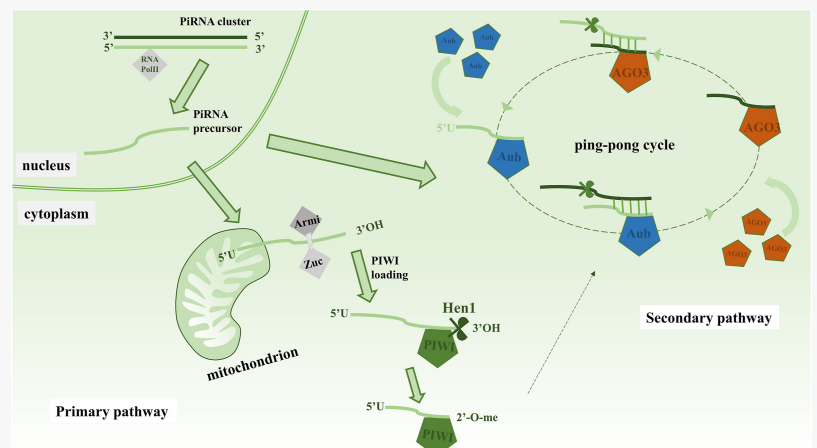
SHANNON, CLARE, IRELAND, April 20, 2025 /EINPresswire.com/ --

In a transformative review, small noncoding RNAs (sncRNAs) have emerged as pivotal regulators in the complex landscape of cardiovascular diseases. These RNA molecules, which do not encode proteins, were long overshadowed by their well-studied counterparts such as microRNAs. However, new insights highlight the substantial biological impact of lesser-known sncRNA subclasses including transfer RNA-derived fragments (tsRNAs), PIWI-interacting RNAs (piRNAs), Y RNAs (yRNAs), small nucleolar RNAs (snoRNAs), and small nuclear RNAs (snRNAs).

Each of these RNA types exhibits unique biological functions in modulating gene expression, cell signaling, and physiological homeostasis. Their roles in cardiovascular health are particularly significant as they engage in processes like inflammation, apoptosis, vascular remodeling, and cardiac hypertrophy. For example, tsRNAs influence myocardial cell survival and proliferation, regulate endothelial cell functions, and have been linked to disorders such as myocardial infarction, hypertension, and diabetic cardiomyopathy. They serve as critical responders to cellular stress, modulating gene transcription and mitochondrial pathways that can protect cardiac tissue.

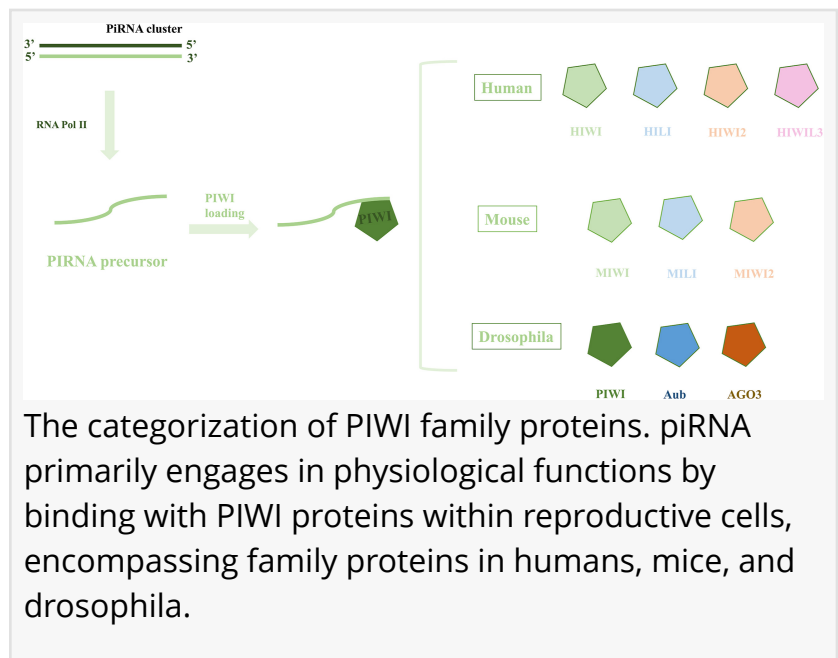


The classification of tsRNAs. tsRNAs include tiRNA and tRF. Under stress, angiogenin cleavage of the tRNA anticodon loop generates tiRNAs that are further categorized as 5' tiRNA and 3' tiRNA.



piRNA biogenesis pathways in drosophila. The biogenesis pathways of piRNA involve primary and secondary pathways.

Meanwhile, piRNAs have advanced from their original association with reproductive biology to being recognized as influential actors in cardiovascular systems. These molecules orchestrate cell apoptosis, manage oxidative stress, and mediate gene methylation, impacting disease processes like heart failure, aortic dissection, and pulmonary hypertension. Notably, specific piRNAs such as HAAPIR and CHAPIR are involved in promoting or mitigating cardiac damage through transcriptional and epigenetic mechanisms.



The regulatory potential of yRNAs lies in their interplay with immune responses and cell death pathways. They are enriched in extracellular vesicles, suggesting utility as biomarkers and therapeutic agents, particularly in conditions like coronary artery disease and hypertrophic cardiomyopathy.

Equally compelling are the roles of snoRNAs and snRNAs, which modulate ribosomal function, RNA methylation, and mRNA splicing. Dysregulation of these molecules correlates with adverse cardiovascular events, from vascular remodeling to electrophysiological imbalances in myocardial tissue.

Collectively, these findings open new frontiers in cardiovascular medicine. The distinct expression patterns and mechanisms of sncRNAs underscore their diagnostic and therapeutic potential.

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