

Sperm RNA Code: How many bits of information for epigenetic inheritance?

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Abstract

Once deemed heretical, the idea of “inheritance of acquired characteristics” is now supported by increasing evidence from multiple species, including mammals. Sperm RNA is increasingly recognized as an additional paternal hereditary information beyond DNA. Environmental inputs, including an unhealthy diet, mental stresses and toxin exposure, can reshape the sperm RNA signature and induce offspring phenotypes relating to paternal environmental stressors. The expanding categories of sperm RNAs (e.g., tsRNAs, miRNAs, rsRNAs and lncRNAs) and associated RNA modifications have begun to reveal the functional diversity and information capacity of these molecules. However, the coding mechanism endowed by sperm RNA and RNA modification-induced structure effects remains unknown, and how sperm RNA-encoded information is decoded in early embryos to control offspring phenotypes remains unclear. I discuss these issues in light of emerging data.

Biography

After I graduate from medical school, I've chosen to start a research career by entering a PhD program and was initially trained as a developmental and reproductive biologist using mice as model. After an exciting journey of serendipitous discoveries, now my lab studies how environmental inputs, including unhealthy diets and toxin exposure, can induce offspring diseases (e.g., metabolic disorder) via epigenetic mechanisms beyond sperm DNA sequence. Our studies showed that information from paternal environmental exposure can be encoded in the form of sperm RNAs & RNA modifications as a 'sperm RNA code', which confer paternal phenotypes to the offspring via shaping early embryo development. We also developed novel analytical tools to study emerging small RNAs such as tRNA-derived small RNAs (tsRNAs) and rRNA-derived small RNAs (rsRNAs), and have begun to harness them for intergenerational prevention of diseases susceptibilities and to develop novel biomarkers such as the non-invasive diagnosis of cancers.