

The role of coherence in a systems view of cancer development.

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Abstract

Theories of cancer origin are going through a paradigm shift, opening cancer research to new hypotheses. Accumulating evidence from the tissue microenvironment research, from bioenergetics, epigenetics, systems biology and thermodynamics tends to converge in characterising cancer as essentially a genetically non-deterministic disease. Instead, it is characterised by progressive disorganisation at a variety of organisational levels, from the genome and metabolic networks, to tissue integrity. As biological self-organisation is fuelled by the continuous supply of energy and information, these represent systemic roots of cancer origin, when compromised. The coherence of molecular dynamics has been recognised as an organising principle behind the long-range coordination of biological processes which can explain the remarkable efficiency of biological systems. Recent methodological advances have enabled the rapid accumulation of experimental evidence pointing to coherence as indeed playing an active role in mediating the flow of energy and information in diverse molecular systems, which is sufficient reason to apply it to a systems view on cancer development. We review theoretical models of how impaired coherence dynamics could lead to cancer as well as propose a new hypothesis based on the quantum electrodynamics theory of coherence. We discuss how the concept of coherence could connect different aspects of cancer and possibly represent their underlying theoretical framework, thus combining biological and physical approaches to understanding this complex pathology.

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