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REFRAMING CANCER THROUGH A PROCESSUAL ONTOLOGY

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Abstract

Cancer research has long been dominated by a gene-centric, substantialist ontology that reduces the disease to static mutations, overlooking its dynamic, relational nature. This letter proposes a processual ontology, inspired by Alfred North Whitehead's philosophy, to reframe cancer as a system of interactions across genetic, epigenetic, and environmental scales. Evidence highlights non-genetic plasticity in resistance, tissue context in tumor behavior, and ancient survival programs in cancer's origins. Shifting to this perspective fosters holistic research and adaptive therapies, offering a more comprehensive understanding of cancer's complexity and promising improved outcomes beyond traditional models.

Keywords

cancer • process philosophy • whitehead • dynamic systems • oncology

Cancer's complexity defies the gene-centric lens that has long shaped oncology. The somatic mutation theory (SMT) posits cancer as a product of static genetic defects (1), yet sequencing reveals vast mutational diversity with no consistent drivers (2), and oncogenic mutations in healthy tissues often fail to trigger malignancy (3). This suggests that mutations are neither the sole nor sufficient cause, challenging the substantialist view of cancer cells as isolated entities. Evidence like teratocarcinoma cells reverting in embryonic contexts (4) underscores cancer as a tissue-level, relational phenomenon, molded by the tumor microenvironment (TME) (5).

Whitehead's (6) process philosophy provides a fitting alternative: reality as a network of dynamic events, not fixed substances. Cancer, in this light, emerges as a process – continuous interactions across genetic, epigenetic, and environmental domains. Its hallmarks, like uncontrolled growth, stem from systemic dynamics, not isolated mutations (7). Non-genetic plasticity drives treatment resistance (8), stromal cells fuel oncogenesis (9), and cancer may reflect unleashed evolutionary survival mechanisms (10). Unlike SMT's static focus, a processual ontology captures these fluid, multi-scale relationships.

This shift carries weight. It urges holistic research, weaving in epigenetics and TME dynamics often sidelined by gene-centric models. It also backs adaptive therapies, like differentiation strategies, to tackle resistance (11). By viewing cancer as a living process, not a genetic artifact, we unlock richer insights and practical advances, moving beyond reductionist limits to address its true nature.

This letter advocates a processual ontology for cancer research, shifting from gene-centric reductionism to a dynamic, relational view inspired by Whitehead. Highlighting cancer as a multi-scale process, it integrates evidence of non-genetic drivers and tissue interactions, offering a more complete picture than traditional models. This perspective not only deepens understanding but also supports innovative, adaptive treatments, marking a significant leap toward addressing cancer's complexity effectively.

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