Beyond the Hallmarks: Mechanisms of Cancer’s Genesis and Persistence

The journey of a healthy cell through oncogenesis and tumorigenesis involves the activation and inactivation of numerous mechanisms and processes—acute and chronic, cellular and systemic. Understanding how cancer alters physiologic homeostasis and hijacks integral innate mechanisms for its own benefit is critical to the conception and development of novel therapeutic strategies against the disease.

Invasion and Metastasis
Cancer cells dissociate from the tumor mass and proteolytically degrade extracellular matrix components. The invading cell enters and migrates through the lymphatic or circulatory system, potentially forming a secondary tumor at a new location.

Genome Instability, Mutation, & Epigenetic Modifications
Cancer cells accumulate numerous and varied genetic and epigenetic alterations during oncogenesis and tumorigenesis. This genomic instability confers a proliferative advantage, allowing tumors to compensate for stresses, bypassing the standard checks that prevent cellular immortality, facilitating tumor formation and malignant transformation.

Metabolic Reprogramming
Cancer cells reprogram their metabolic pathways to increase nutrient uptake and utilization, favoring survival and proliferation. This metabolic shift is collectively termed “Warburg effect.”

Angiogenesis and Altered Microenvironment
Cancer cells induce cytokine, chemokine, growth factor, and protease secretion by non-cancer cells in the tumor microenvironment (TME). Excessive production of VEGF and ANG2 causes abnormal vascular development, resulting in immature vessels with poor flow and excessive permeability. Stromal and vasculature modifications play an integral role in facilitating cancer cell migration and proliferation.

Immune Modulation
The immune system is designed to identify and eliminate cancer cells to prevent metastasis. For cancer cells to proliferate and thrive, they must circumvent or deactivate the immune mechanisms designed to remove them. Immune cell phenotypes can be categorized into pro-invasion, pro-growth signals and resistance to anti-growth signals.

Altered Growth Signals and Response
Cancer cells can resist chemo- and radiotherapy by remaining in G0 phase, accumulating mutations over time facilitating malignant transformation, or autonomously driven or be promoted by stromal cells. Additionally, self-renewing cancer stem cells (CSCs) have been identified within tumor cell populations and are capable of tumorigenesis.

Resistance to Stress and Cell Death
Cancer cells can avoid cell death and apoptosis through multiple mechanisms (e.g., increased autophagy, increased Bcl-2 family members, increased tumor necrosis factor (TNF) receptor family members, increased Akt), allowing tumors to compensate for stresses like nutrient scarcity that can impact survival. Adaptive mechanisms allow tumors to compensate for these stresses, further exacerbating cancer progression.

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The race to discover new treatments for disease is on. With IVIS® Lumina S5 and X5 2D benchtop in vivo imaging systems, the workflow for data acquisition and analysis has been completely streamlined to help you get robust data—and answers—on anatomical and molecular aspects of disease much sooner. Higher throughput, combined with unique handling accessories, subject recognition, and RFID support, means less time spent setting up and running experiments and more time getting results. Plus, an all-new camera with greater field of view lets you capture more subjects simultaneously. IVIS Lumina benchtop systems: 2D imaging and analysis that's focused on discovery.

For more information visit www.perkinelmer.com/invivo, and see us at AACR, booth #2612.

Phenoptics™ research solutions enable you to:

- Dilute your cancer analysis workflow for greater productivity
- Conduct cancer biomarker detection with automated workflows that support high-throughput screening
- Conduct experiments with different antibodies and conditions
- Track animal growth from photobonding to estimation of cancer cells with our high-resolution imaging systems
- See how tumor growth is regulated in terms of molecular and cellular functions
- Analyze tumor progression in vivo with clinical imaging systems and integrators
- Understand cancer in its environment by imaging and analyzing tissue samples to identify disease outcomes and validate targets

For more information visit www.perkinelmer.com/phenoptics, and see us at AACR, booth #2612.

PerkinElmer, Inc. is committed to supporting the needs of oncology research. Our full solutions, including reagents, instrumentation, and software, for in vitro, ex vivo and in vivo models, enable cancer researchers to make more targeted discoveries, faster.

Exploration of immuno-oncology, epigenetics, and kinase-related growth factors has led to new and more effective cancer treatments. Advancing these approaches requires effective cancer biomarker detection, imaging and cancer analysis, all of which can be improved with the right cancer research tools.

Combining a complex condition like cancer presents challenges to detection, imaging, and workflows in a variety of environments. PerkinElmer’s cancer research solutions span the entire clinical workflow from drug screening to studies in preclinical animal models to imaging of tumor samples in clinical research studies.

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For more information on PerkinElmer’s comprehensive solutions for cancer research, please visit us at AACR 2018 (Booth #2612)

PerkinElmer: Advancing Cancer Research from Concept Through Translation