How Cell Biologists Can Contribute to Improving Cancer Outcomes

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Cancer is a devastating disease that kills >6 million people annually worldwide. Research is the hope for the future, with deepening scientific understanding contributing to improvements in risk assessment, detection, diagnosis, treatment, and prevention. More people than ever are surviving cancer, and certain types of cancer are now curable, or at least manageable, diseases.

KNOWLEDGE OF CANCER COMPLEXITY IS KEY TO TARGETED THERAPY

It is now clear that there are hundreds of different types of cancer. This is a dramatic departure from the prevailing view in 1971 when the U.S. "war on cancer" was first launched and it was widely believed that cancers had a common cause and would likewise have a common cure. Knowledge of tumor complexity has fueled optimism for the development of targeted and personalized treatments based on specific tumor characteristics, providing an opportunity to move beyond one-size-fits-all cytotoxic chemotherapy.

UNDERSTANDING THE CELL AS A FOUNDATION FOR IMPROVING CANCER THERAPY

Derangements in signal transduction, mitosis, apoptosis, gene expression, and cytoarchitecture are hallmarks of transformation. Fundamental knowledge of cellular mechanisms governing these facets of cell biology was obtained through decades of basic cell biological research and has provided a foundation for the development of promising new targeted cancer therapies. For example, based on the finding that >90% of patients with chronic myeloid leukemia (CML) harbor a disease-causing chromosomal translocation encoding a Bcr-Abl fusion protein with unregulated tyrosine kinase activity, first line therapy for CML now includes tyrosine kinase inhibitors such as imatinib (Gleevec, Novartis). Also in the clinic for treatment of defined subsets of cancer patients are agents that target the estrogen receptor, the proteasome, and a variety of growth factor receptors that have been studied for decades by cell biologists.

CELL BIOLOGISTS ARE NEEDED TO TACKLE THE CANCER PROBLEM

Translational medicine—taking basic research discoveries and applying them to human disease—has historically been the domain of physician-scientists. These days, the simultaneous challenges of declining clinical reimbursement and tight research funding have made the physician-scientist track increasingly untenable. Ironically, this loss of capacity is occurring precisely at a time when the opportunities for science to impact disease show unprecedented promise.

Collaboration between a cell biologist who thinks deeply about mechanism and a clinician who deeply understands human disease provides a way to "reconstitute" the special function of the physician-scientist. Cell biologists have technical and disciplinary breadth and are well positioned to define cancer mechanisms, identify potential therapeutic targets, develop preclinical models, and participate in the design and conduct of clinical trials in association with physician partners. Cell biologists can expand their knowledge of clinical cancer biology through participation in coursework and specialized scientific meetings, tumor boards, institutional cancer centers, teaching partnerships, and disease-oriented research teams. Cell biologists like scientific challenges, and tackling cancer is a big scientific challenge. Moreover, as clinical departments seek to expand their translational research capacity and impact, many opportunities are likely to exist for cell biologists who seek and seize opportunities to impact human disease through their science.

THE FRONTIER LIEST AHEAD

Thirty years ago, the Ras oncogene, now known to be mutated in the majority of human tumors, was just being identified and its mechanism of action as a key regulator of cell proliferation had yet to be discovered. Adhesion receptors were postulated to exist, but integrins, selectins, and cadherins had not been named. Neither mitotic checkpoints nor the pathways governing programmed cell death were
known. RNA had its place in the central dogma, but we knew nothing of RNA editing, RNA interference, and microRNAs. The discoveries of the past 30 years were unimaginable in 1980, just as the discoveries of the next 30 years are unimaginable today. As the scientific community moves forward to address pressing biomedical research problems such as cancer, we must not lose sight of the facts that we remain at a frontier of knowledge and that a universe of discovery awaits. Both the best basic mechanism work and the best clinical application require scientific rigor and creativity, and both must be valued for their essential and unique contributions. It is both the ongoing discovery and the application of those discoveries that provide hope for future generations of cancer patients and their families, for all of us.