An Introduction to the Radioimmunodetection of Cancer

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The beginning of a new science or technology is never a sudden event easily marked or defined but is instead a gradual development from numerous advances. The subject of this workshop, radioimmunodetection of cancer, has its roots in the slowly but constantly expanding field of radiolabeled antitumor antibodies. We are fortunate to be able to present research which spans a period of more than 3 decades, as represented by the contributors to this workshop, in the evolution of the radioimmunodetection of cancer from concept to clinical reality. Viewed from a historical perspective, the clinical development of cancer radioimmunodetection is still in its infancy and is dependent upon the integration of advances in at least 2 other major specialties, immunology and nuclear medicine. Within these are the subspecialties of immunoserology, immunochemistry, and immunogenetics; and radiopharmacy, radiochemistry, scanning and imaging, and computer sciences, respectively. Radioimmunodetection, a term recently coined (1) to describe the hybrid discipline of immunology and nuclear medicine, will now in turn stimulate and foster future developments in its parent disciplines.

Cancer immunology has struggled over the past half-century to identify immune reactions to cancers or even of cancer-distant antigens. Unfortunately, no definitive methods of specific cancer immunodiagnosis or immunotherapy have been achieved, although some important additions to the oncologist's repertoire have resulted from a better understanding of these aspects. For example, 2 so-called oncofetal antigens, \( \alpha \)-fetoprotein and carcinoembryonic antigen, which are not distinct for cancer, are sufficiently increased in certain tumor types as to be useful as serological monitors for progressive or regressive disease activity in patients with tumors known to elaborate these markers. Although many tumor-specific or tumor-associated antigens have been described over the years, none has achieved a role as a cancer-specific test, and it is in this context that there has been a general disappointment in the field of cancer antigens. The in vivo localization of tumors by radioactive antitumor antibodies directed against such markers may provide a potential application for many cancer-associated antigens. Even when these markers are not reliable as serological tests for cancer, the quantitative increase of these substances in or near tumors appears to suffice for the selective accretion of energy-emitting isotopes capable of external detection (2).

The radionuclides used in nuclear medicine for tumor imaging consist almost exclusively of nonspecific substances and, occasionally, certain organ- or tissue-selective radiopharmaceuticals (5). Scanning equipment has been developed principally for lower-energy radioisotopes, such as \( \text{\textsuperscript{99m}Tc} \) and \( \text{\textsuperscript{67}Ga} \). Antitumor antibodies provide another approach for the application of a wider range of radionuclides dependent upon physical and imaging properties and not on the pharmaceutical vehicle. Similarly, sufficient tumor/nontumor ratios could be achieved that permit the use of scintillation cameras and computer-assisted processing for better tumor localization and resolution than by standard nuclear medicine methods now available. Finally, the adaptation of radioimmunologicals to new scanning devices, such as emission tomography, holds promise for another dimension in scanning technology and tumor detection. Earlier and more precise identification and localization of small tumors, for preoperative evaluation and staging, for postoperative follow-up, and for monitoring the effects of therapy, are very real possibilities for this field of cancer radioimmunodetection. Not of lesser consequence is the extension of these principles to the field of therapy, both radioimmunotherapy and chemoimmunotherapy, and the potential realization of a long-standing dream of the cancer chemotherapist, the achievement of a tumor-specific therapy. Antitumor antibodies directed against the current major tumor markers, carcinoembryonic antigen, \( \alpha \)-fetoprotein, and human chorionic gonadotropin (2-4), may now provide an opportunity for developing more tumor-specific therapeutic strategies, even when these markers are not themselves truly tumor distinct.

The objectives of this workshop were to assess the current status and future directions of cancer radioimmunodetection, particularly from the clinical standpoint. Because of the nature of the discipline, the workshop drew together a diverse array of specialists, such as immunologists, radiologists, nuclear medicine specialists, clinical oncologists, chemists, physicists, and experimental pathologists. In order to view immune scintigraphy in its proper clinical perspective, the workshop also included discussions of other modalities of cancer detection, such as ultrasonography and tomography.

I am particularly pleased that this workshop also served to recognize and pay tribute to the pioneering work of David Pressman (Fig. 1) and of William Bale (Fig. 2). The many elegant studies of Pressman, Bale, and their associates stimulated many of us to pursue the field of radioimmunodetection of cancer.

Acknowledgments

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support (NCI-NO1-CB-64011-35) from the Division of Cancer Biology and Diagnosis, National Cancer Institute, NIH, and is dedicated to the memory of William Pomerance (Fig. 3). Dr. Pomerance was the Chief, Diagnosis Branch, Division of Cancer Biology and Diagnosis, National Cancer Institute, when our clinical studies of cancer radioimmunodetection began, and we are indebted to him for the advice and constructive criticism he provided us on many occasions. This was typical of his devotion to studying and combating the disease to which he fell victim.

References

Fig. 1. David Pressman, Ph.D., former Director of Cancer Research in Immunology, Roswell Park Memorial Institute, Buffalo, N. Y.

Fig. 2. William F. Bale, Ph.D., Professor, School of Biology, Georgia Institute of Technology, Atlanta, Ga.

Fig. 3. William Pomerance, M.D. (1906–1978), former Chief, Diagnosis Branch, Division of Cancer Biology and Diagnosis, National Cancer Institute, Bethesda, Md.
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