
Preface

Radiation oncology is one of the first specialties to offer personalized approaches to cancer care using CT-based image guided therapy to sculpt dose to the unique anatomic characteristics of each patient's tumor and surrounding anatomy. Cancer medicine is now extending this personalized approach by tailoring treatment to the unique characteristics of each patient's cancer. The molecular signature of a tumor can now better predict prognosis and guide selection of appropriate therapy. Therapies are more targeted towards specific molecular targets for a given tumor type. The next decade will see a rapid expansion of this patient-specific approach through the incorporation of advances in our understanding of cancer biology, DNA damage and repair, cancer immunology, tumor microenvironment, tumor genomics and biomarkers, systems and mathematical biology, molecular imaging and molecular targeted therapeutics. In the future, radiotherapy will not only be image guided but also molecular and biologically guided, with therapy optimized not only to the anatomic features but also to the unique physiologic, biologic, phenotypic, and genotypic characteristics of a given cancer which predict prognosis and radiosensitivity. As the number of variables that predict for response increase, systems and mathematical oncologic modeling will be critical in analyzing and optimizing how these data are best used in the clinic.

Advances in newer imaging modalities such as multi-parametric MRI and PET using FDG and other novel agents allow for better visualization of these physiologic and phenotypic radio biomarkers to help better target therapy and assess response, and are now at the forefront of new image guided radiotherapy (IGRT) approaches. The next generation IGRT photon therapy devices will incorporate MRI guidance. CT image guidance and intensity modulation which transformed photon therapy delivery are now being integrated into proton and particle beam therapy.

These advances coupled with advances in the technologies to deliver radiation therapy have recently created new opportunities to treat patients with localized and metastatic disease. Tumors are no longer viewed simply as homogenous static collections of aberrant cells, but as a dynamic process with regions of changing viability and radiosensitivity that can vary over space and time. Intra-tumoral boost doses to these pockets of radioresistance are actively being explored. Radiotherapy is playing an increasingly important role in patients with metastatic disease in combination with systemic therapies. Patients with limited or oligometastatic

disease may represent a subset of patients where a more aggressive use of IGRT to each metastatic site in combination with systemic therapies may prolong disease free intervals and possibly cure a subset of these patients. IGRT dose sculpting to large target regions is now possible and its use to deliver targeted total marrow irradiation has shown promise in patients with hematopoietic cancers undergoing hematopoietic stem cell transplantation. Molecular targeted or immunoguided systemically delivered radiopharmaceuticals also continue to show promise. Radiotherapy to tumor sites in combination with immunotherapy may have broader immune-stimulatory effects through localized changes in the tumor microenvironment and increased antigen presentation to antigen presenting cells.

In “Advances in Radiation Oncology”, each chapter presents a concise review of these new and important areas, which will provide the practicing radiation oncologist with a fundamental understanding of each topic and an appreciation of its impact on the future of radiation oncology.

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