Evolution of Image Guidance and Adaptive Radiation Therapy

JOHN WONG, Johns Hopkins University School of Medicine

Imaging is central to radiation therapy (RT) to define the clinical target volume, guide the delivery of radiation and assess the response to treatment. Over the past 60 years, RT has evolved from using textbook anatomic information and simple projection radiographs to employing the full gamut of modern imaging technologies. Most notably, the advent of several imaging technologies, particularly cone-beam CT, in the early 2000s provided 3D anatomic information of the patient at time of treatment and ushered in the current era of image guided radiation therapy. Their increasing use also brings to light the complexities of organ motion and disease response during the course of treatment and necessitates treatment modification, thus adaptive radiation therapy (ART). The challenges of ART are multi-faceted as are their solutions. Fast imaging and delivery are needed to mitigate the effects of organ motion. Molecular imaging, such as using positron emission tomography, provides metabolic and biologic information about the tumor and its environment, so does functional imaging using magnetic resonance imaging with the added advantage of superb anatomic contrast. At present, ART is a highly active and exciting area of research where advances are made by bridging multidisciplinary expertise in computational modeling, physics, engineering and laboratory discovery research.