

The Future of Radiotherapy

Yes, radiotherapy has a future. Cancer, like aging is an affliction involving multiple somatic mutations. It will be many decades into the future whereby a single mutation will be reversed in all the cells afflicted, let alone multiple repairs to all cells. Aging will be reversed before cancer (anti-aging is a much bigger market!). Cancer therapy will continue to utilize agents that damage tumors more than they damage normal tissues. Radiation is our most effective current tumorcidal agent and its utility will be steadily improved in the coming decades.

The main improvement in the last quarter century in radiotherapy has been the advent of three-dimensional imaging. The specificity and sensitivity of image-based cancer detection will improve dramatically with better imaging systems and more specific tumor seeking agents. The best of these agents will be used for diagnostic and therapeutic agents when tagged with a radioisotope (e.g., NM404). Imaging is also beginning to play a bigger role in verifying the setup of the patient. CT-guided therapy will become the rule, not the exception in a decade. The use of multimodality imaging for accurate follow up will be justified because recurrences or metastases will be found early when they can be more effectively treated. Multiple courses of radiotherapy to widespread areas of the body will be accomplished by conformally avoiding critical normal tissue using image-guided radiotherapy. Image-guidance will blur the boundaries between surgery and radiotherapy. The use of brachytherapy will evolve to be much more image-guided as well. Brachytherapy will be combined seamlessly with intensity-modulated radiotherapy and radiolabelled tumor-seeking agents. Interventional radiologists will partake in both surgery and radiosurgery to the body.

Ten to twenty years from now all potentially curative patients will have image-guided intensity-modulated radiotherapy. The most common radiotherapy device being sold then will be housed in a ring gantry to provide stability for the CT imaging system and with stationary covers providing protection from the rapidly rotating gantry components. The energy of the linacs will be low but their intensity will be much higher than today. The number of fractions delivered in a course of therapy will shrink from an average of about 20 today to an average of 10 in twenty years. Intensity-modulated radiotherapy will be dominated by the tomotherapy or intensity-modulated arc therapy paradigms. The use of protons and light ions like carbon ions will be growing as the costs of the facilities are lowered by standardization of manufacture.

Fifty years ago, radiotherapy was part of radiology. It is ironic that as the role of imaging grew in radiotherapy the desire to seek a separate home outside of radiology grew also. Radiotherapy is not the only specialty of medicine in which imaging has become ubiquitous; so too has it happened in cardiology, surgery and neurology. In the coming years, radiologists will see their monopoly on imaging continue to slip away as specialty imaging systems supplant multipurpose systems. We should reach out to these colleagues and make them feel at home in oncology departments.