Chapter 4

Big Data Approaches to Improve Stereotactic Body Radiation Therapy (SBRT) Outcomes: Big Data for SBRT

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ABSTRACT

‘Big data’ approaches carry promise for advancing our understanding of stereotactic body radiation therapy (SBRT) (also termed stereotactic ablative radiotherapy, SABR) and is guiding the design of clinical trials using hypofractionated radiotherapy. However, the field of big data in radiotherapy, or in combination with other therapies, is still in its infancy and will likely benefit from multidisciplinary collaborative teams including physicians, physicists, radiobiologists, biostatisticians, bioinformaticists and other data scientists analyzing shared data. We herein review opportunities to use the Big data (including dosimetry, clinical factors, imaging and biomarkers/genomics) to improve SBRT outcomes.

INTRODUCTION

Achieving an understanding of the radiobiology of hypofractionation has been the subject of intense interest, and has been driven by recent clinical successes, and resulting comparative effectiveness considerations, favoring shortened treatment courses. A flagship example is SBRT for stage I non-small cell lung cancer (NSCLC) - where multiple studies report impressively-high local control and cure rates (Timmerman et al., 2010), rivaling the efficacy of surgical resection (Chang et al., 2016). Similarly, excellent local control has been reported following SBRT for other malignancies; e.g. oligometastases to organs such as the liver (Timmerman & Cho, 2014). This has been made possible by the innovative developments in image-guided radiotherapy and advanced delivery systems. Moreover, there is a strong interest in combining SBRT with immunotherapeutic agents that could complement or even synergize with local therapy to limit distant failures (Zeng et al., 2014; Rekers et al., 2014). However, this success has presented challenging uncertainties including: identifying optimal SBRT prescription doses from a very wide pool of diverse clinical practices; understanding the underlying tumor and normal tissues radiobiology at such doses; knowing how to combine SBRT with other therapeutic agents and in designing clinical trials using hypofractionation; the use of SBRT for retreatment; and adopting criteria to support decision making in a multi-modality treatment clinic (Navarria & Ascolese, n.d.; Salama & Chmura, 2014; Amini et al., 2014).

The available SBRT data, including that from prospective/randomized trials, are somewhat limited, and reports are often missing relevant elements that can affect outcomes. In addition, different analytic approaches might interpret the same set of data differently. Computer technology now allows for much more information to be acquired and processed, enabling so-called “big data” analyses. This approach perhaps can be leveraged to accelerate research related to SBRT.
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