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Editorial

Technological Advances in Brain and Spine Radiosurgery

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A section of this issue of TCRT focuses on four articles dealing with technological advances in brain and spine radiosurgery. With the evolution of radiation technology to allow for high precision image-guided radiotherapy as an integrated part of mainstream linear accelerators, the practice of stereotactic radiosurgery (SRS) is commonly applied to the brain and is rapidly developing as an attractive therapy for selected body targets. We start this section with a comprehensive review of the radiobiologic principles of SRS focused on how high dose stereotactic radiation delivered in a single, or few fractions, differs biologically from conventional fractionated radiotherapy.

In particular, the application of SRS principles to the spine has been increasingly reported in the literature. Spine SRS [also known as spine stereotactic body radiotherapy (SBRT)] has developed in a similar way to brain radiosurgery some 20 years ago, such that it was frequently indicated as a salvage modality for failed prior conventional radiotherapy, and has since developed into an alternative to conventional radiation in the previously un-irradiated patient. However, spine SBRT is distinct from brain radiosurgery in that the disease is inherently adjacent to the critical neural structure to be spared, namely the spinal cord. As experience with spine SBRT for metastatic disease increases, we have learned that disease adjacent to the spinal cord (epidural disease) is at increased risk for failure because of the need to maintain dose to the spinal cord within a safe range. The consequence of epidural disease progression is serious as it may lead to spinal cord compression. Therefore, the presence and degree of epidural disease has become a major factor to consider when selecting the appropriate patient for this technique. Moreover, we are also learning about serious adverse effects on bone secondary to high dose per fraction radiation, and we are increasingly faced with managing radiation-induced vertebral compression fractures (VCF). In order to address the limitations of epidural disease, and stabilize the vertebrae to manage and/or prevent VCF, this issue highlights a small series from the University of Toronto that uniquely applied a minimally invasive day-surgery to achieve spinal cord decompression and stabilization followed by spine SBRT. The complexity of this therapeutic strategy is a reflection of competing considerations in patients with spinal metastases.

As brain radiosurgery evolved, so did the indications to treat benign brain tumors. We have learned that radiosurgery is an effective and safe alternative to surgery, or conventional fractionated radiotherapy, for selected benign intracranial tumors. Moreover, we have learned that a relatively low single fraction dose is required in some cases, as opposed to the higher SRS doses commonly used in the metastatic

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setting. Similarly, the field of spine SBRT is evolving to treat benign spinal tumors. We present in this issue a relatively large series (considering the rarity of benign spinal meningiomas and schwannomas) from the European Cyberknife Center, Munich, Grosshadern. This series is one of the few to be reported in the literature, and there is no doubt that spine SBRT will have a role in the management of these complex tumors as the evidence accumulates.

This section ends with a paper illustrating the complexity of the dose distribution within the normal tissues associated with high dose per fraction and inhomogeneously delivered radiation. Based on an analysis of radiation myelopathy cases, as compared to controls, the authors model the dose volume histogram data and illustrate the potential for differences in dose hot spot characteristics within small inhomogenously irradiated volumes of spinal cord to impact spinal cord tolerance.