Specialty area: ***Bringing Radiation Therapy to the Next Level***

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Highlights

- Management of organ motion during RT with simultaneous MRI-guided delivery
- An overview of the benefits of improved soft tissue imaging provided by MR-guided RT
- Challenges, solutions, and opportunities associated with combining MRI and radiation therapy into a single integrated platform

Title: ***MR-guided RT: Between the Magnets***

Target audience: – Those with interest in applications of magnetic resonance imaging (MRI) radiology to interventions and/or advancements in Radiation Therapy (RT), especially as pertains to organ motion.

OUTCOME/Objectives: – Attendees will learn about the challenges associated with integrating a magnetic resonance imaging system with a therapeutic radiation beam that have a shared isocenter for simultaneous operation, as well gain an understanding of the latest techniques and methods available to overcome these challenges.

PURPOSE: – We describe a FDA 510(k) cleared MR-guided RT system, the ViewRay™ System. The purpose of this technology is to improve the accuracy of radiation therapy in the treatment of cancer by solving the problem of organ motion during delivery directly *via* MR imaging and tracking of soft tissues during radiation delivery—a critical issue that must be addressed to fully realize the benefits of radiation therapy.

METHODS: – This technology solves the problem of organ motion with a patented combination of magnetic resonance imaging (MRI) and radiation delivery technology designed to provide precise and, more importantly, accurate radiation delivery during treatment. The MR-guided RT system captures a continuous stream of soft tissue images during treatment while the beam is on, and tracks the target's location at 4 FPS in one plane or 2 FPS in parallel 3 planes. The system automatically pauses the beam if the target is out of the predefined therapeutic range. When clinicians can clearly see the treatment target, monitor where the dose is being delivered and adapt to changes in the patient's anatomy, they are better equipped to deliver optimized therapy.

RESULTS: – The ViewRay System has obtained FDA clearance, and has been installed at Washington University in St. Louis, with systems under installation at the University of Wisconsin and UCLA. The systems have been undergoing extensive workflow and usability testing over the past year. The entire workflow can be simulated on a R&D system without active radiation sources or radiation from imaging. Radiation phantom testing is performed as well, in a simulated workflow with delivery verification measurements demonstrating that the treatment plans can be delivered as planned within the standard average 15 min treatment window.

DISCUSSION: – With hundreds of scans and simulated treatments performed at two sites, the workflow is being refined to optimize the advantages of on-board MR imaging and the user experience. Further investigation is underway with clinical partners to develop methods and protocols for best leveraging the adaptive capabilities of the system.

CONCLUSION: – With simultaneous imaging and treatment, physicians can determine the dose being delivered and adjust as needed to ensure that the tumor receives the full prescription. Ultimately, improved efficacy of radiation therapy may decrease untoward side effects and lead to better clinical outcomes.