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Response assessment using the ViewRay MRIdian Linac

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Affiliations/ Disclosures / Conflicts 🕲

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- Member of ViewRay Scientific Advisory Board
- Consulting, MR Guidance, LLC, co-founder



Learning Objectives

- 1. Understand the concepts of MRI-guided radiation therapy that enable tumor response assessment during RT.
- 2. Understand the magnitude and frequency of occurrence of tumor volume changes during RT.
- Understand the clinical advantages and limitations of target volume changes during MRI-guided radiotherapy.

Improved Soft Tissue Image Quality



Improved Soft Tissue Image Quality





K. Mittaser, B. Paliwal, P. Hill, J. E. Bayouth, M. W. Geurts, A. M. Baschnagel, K. A. Bradley, P. M. Harari, S. Rosenberg, J. V. Brower, A. P. Wojcieszynski, C. Hullett, R.A. Bayliss, Z. E. Labby, M. F. Bassetti, "A New Ern of Image Guidance with Magnetic Resonance-guided Radiation Therputy for Addominal and Thencie Malgunetics," Cures 2018.

Renal Cell Carcinoma SBRT Lower Pole Left Kidney



10 Gy per fraction to a total of 50 Gy

Eovist MRI shows Metastasis the Best

Non-Contrast CT

Iodine Contrast CT Eovist Contrast MR







Image Quality for setup at other disease sites



Using Water as Contrast in the Stomach





Using Gel as Contrast in the Rectum



Mayr *et al.*: Method and timing of tumor volume measurement for outcome prediction in cervical cancer using magnetic resonance imaging

Nex A. Merr, M.D.,* Tomuse Toox, M.D.,* Wallawi, T.C. Yun, M.D., M.S.E.E.,* Last M. Disessoi, Wareso K. Zhen, M.D.Y. Assence C. PALLEO, M.D.? Remert, C. Garton, D.D.*, Jenn, L. Shoare, M.D.? Sorsen L. Maras, P.D.? Isou L. WALER, M.D.? Remert S. Mossen, M.D.? assence I. Maras, P.M.? Isolance Outory Grave Physical Technical and Stream Conf. and The Conf. Minima Conf. of Conf. Amount. Minima Annual Conf. (2014) Conf. and Conf. Minima Conf. (2014) Conf. Conf. Conf. Conf. Conf. Conf. Conf. Conf. Minima Conf. (2014) Conf. Conf. Conf. Conf. Conf. Conf. Conf. Conf. Minima Conf. Conf. (2014) Conf. C

Conclusion



Tumor Regression at 45-50 Gy

 Serial MRI in 60 patients with advanced cervical cancer at the start of RT, during early RT (20–25 Gy), mid-RT (45–50 Gy), and at follow-up (1-2 months post-RT).

 The <u>best method</u> and time point of tumor size measurement to predict outcome was tumor regression rate in the <u>mid-therapy MRI</u> (at 45–50 Gy) <u>using 3D ROI volumetry over simplistic</u> <u>diameter measurement with film.</u>

 Mid-therapy MRI are needed to quantify tumor regression rate for prediction of treatment outcome.

Rectal ca - Simulation







W







Bladder ca - 3 Gy/fx - 10 of 20







W





Oligometastatic Liver ca – 10 Gy/fx - 5 of 5 🔞





Simulation

Prior to Fx 5



















CLINICAL INVESTIGATION SURVIVAL PREDICTION IN HIGH-GRADE GLIOMAS BY MRI PERFUSION BEFORE AND DURING EARLY STAGE OF RT

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Departments of "Radiation Oncology, "Radiology, and "Neurology, University of Michigan, Ann Arbor, MI Int. J. Radiation Oncology Biol. Phys., Vol. 64, No. 3, pp. 876-885, 2006



Conclusion

Early temporal changes during RT in heterogeneous regions of high and low perfusion in gliomas might predict for different physiologic responses to RT. This might also open the opportunity to identify tumor sub-volumes that are radioresistant and might benefit from intensified RT

Tyagi et al.: Weekly assessment of lymph nodes using diffusion-weighted MRI Med. Phys. 43 (1), January 2016



Conclusion

Physiological changes in LNs represented by changes in ADC evaluated using DWMRI are evident sooner than the morphological changes calculated from T2w MRI. The decisions for adaptive re-planning may need to be individualized and should be based primarily on tumor functional information

Repeated diffusion MRI reveals earliest time point for stratification of radiotherapy W response in brain metastases

Faisal Mahmood^{1,3}, Helle H Johannesen², Poul Geertsen¹ Phys. Med. Biol. 62 (2017) 2990 and Rasmus H Hansen²





Conclusion

ADC derived using high b-values may be a reliable biomarker for early assessment of radiotherapy response for brain metastases patients. The earliest response stratification can be achieved using two DW-MRI scans, one pre-treatment and one at treatment day 7–9 (equivalent to 21 Gy).



Yang et al. "Longitudinal diffusion MRI for treatment response assessment: Preliminary experience using an MRI-guided tri-cobalt 60 radiotherapy system," 2016 Medical Physics



mia 90093

N=6 patients (3 HN and 3 Sarcoma) The tumor ADC values changed throughout therapy: ranging response of 40% drop in ADC to gradually increasing ADC throughout RT. Consistent brainstem ADC indicates acceptable reproducibility of technique on a 0.345 T MRgRT system.



Larger patient cohort studies are warranted and may enable response-guided adaptive radiotherapy.

Summary

- 1. Daily imaging and careful patient positioning during MRI-guided radiation therapy enables tumor response assessment during RT.
- 2. The magnitude and frequency of occurrence of tumor volume changes during RT vary between diseases.
- 3. While MRgRT shows volume changes, clinical trials are needed to determine effective forms of intervention.

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