

Specialty Area: Post Treatment Liver
Speaker Name: Ihab R. Kamel, M.D., Ph.D.

Highlights:

Current response criteria (RECIST, mRECIST, EASL) are limited after intra-arterial therapy
Volumetric functional MR criteria can stratify patients into responders and non-responders
Early (3-4 weeks after therapy) functional MR criteria can predict patient survival

Target Audience: Practicing radiologists; clinical researchers

Outcome/Objectives: To accurately assess treatment response to intra-arterial therapy.

Purpose: To demonstrate the potential of volumetric multiparametric quantitative functional MR imaging techniques as a non-invasive tool for the assessment of response to treatment in patients with cancer.

Methods: Response to treatment was evaluated in several patient populations with primary or metastatic liver cancer using diffusion-weighted imaging (DWI) and contrast enhanced MR imaging (CE-MRI).

Results: After segmentation and intra-study co-registration DWI and CE-MRI could be analyzed in the entire tumor volume. DWI provides information about tissue cellularity and integrity of cellular membranes. CE-MRI assessed the vascularity and blood supply of a cancerous lesion. The combination of these two functional measures can provide an early assessment of treatment response. Patients with primary or metastatic liver cancer categorized as responders showed significantly improved overall survival compared to non-responders. Response according to volumetric multiparametric quantitative functional MRI resulted in a clear stratification of patients as early as 3-4 weeks after treatment, while most patients were classified as Stable Disease according RECIST, mRECIST or EASL measurements at this time. Volumetric measurements of functional MRI parameters before and after treatment also show a very good interobserver agreement. The evaluation of functional changes assessed based on whole-lesion segmentation results in an improved reproducibility compared to axial size measurements or region of interest based measurements.

Discussion: Volumetric analysis of multiparametric MRI data of the entire tumor before and after treatment is now possible. Most treated tumors demonstrate reduced enhancement on CE-MRI. Changes in ADC values after therapy are more variable. While the ADC is likely to rise after conventional TACE treatments, novel anti-angiogenic agents like Sorafenib appear to result in an unchanged or even decreased ADC. Furthermore, the ADC can undergo an initial increase followed by an equilibrium or decrease phase. Assessing changes in both enhancement and ADC after therapy, especially in the entire tumor volume, is better in predicting response using one or both of these metrics as measured on a single axial plane. Also, assessing response based on the combined changes in both metrics (enhancement and ADC) is generally better than response based on a single metric.

Conclusion: The combination of two volumetric functional quantitative MRI measurements can provide a reliable imaging biomarker of treatment response which predicts patient survival, and could potentially be utilized to assess treatment response in clinical trials. Additionally, this approach may become a tool to help identifying non-responding patients early in treatment, allowing these patients to be considered for alternative treatment strategies, thus contributing to the development of individualized cancer therapy.

References:

1. Gowdra Halappa V, Corona-Villalobos CP, Bonekamp S, Li Z, Reyes D, Cosgrove D, Pawlik TM, Diaz LA, Bhagat N, Eng J, Geschwind JF, Kamel IR. Neuroendocrine liver metastasis treated by using intraarterial therapy: volumetric functional imaging biomarkers of early tumor response and survival. *Radiology*. 2013 Feb;266(2):502-13. PubMed PMID: 23192780.
2. Halappa VG, Bonekamp S, Corona-Villalobos CP, Li Z, Mensa M, Reyes D, Eng J, Bhagat N, Pawlik TM, Geschwind JF, Kamel IR. Intrahepatic cholangiocarcinoma treated with local-regional therapy: quantitative volumetric apparent diffusion coefficient maps for assessment of tumor response. *Radiology*. 2012 Jul;264(1):285-94. PubMed PMID: 22627601.
3. Bonekamp S, Jolepalem P, Lazo M, Gulsun MA, Kiraly AP, Kamel IR. Hepatocellular carcinoma: response to TACE assessed with semiautomated volumetric and functional analysis of diffusion-weighted and contrast-enhanced MR imaging data. *Radiology*. 2011 Sep;260(3):752-61. PubMed PMID: 21771960.