SSM08

Gastrointestinal (Loco-regional Therapy Liver Imaging)

Scientific Papers

AMA PRA Category 1 Credits ™: 1.00
ARRT Category A+ Credit: 1.00

Wed, Dec 3 3:00 PM - 4:00 PM Location: E353A

Participants

Moderator
Steven Satish Raman MD: Consultant, Bayer AG Consultant, Covidien AG

Moderator
Michael Ethan Zalis MD: Co-founder, QPID Health Inc Chief Medical Officer, QPID Health Inc Stockholder, QPID Health Inc

Sub-Events

SSM08-01

DWI Can Predict Early Therapy Response in Patients with Hepatocellular Carcinoma after Selective Internal Radiation Therapy (SIRT)

Juliane Schelhorn MD (Presenter): Nothing to Disclose, Marcus Paul Reinboldt: Nothing to Disclose, Guido Gerken: Nothing to Disclose, Thomas C. Lauenstein MD: Nothing to Disclose, Sonja Kinner MD: Nothing to Disclose

PURPOSE

Selective internal radiation therapy (SIRT) with Yttrium-90 (Y90) microspheres is a promising therapy option in patients with advanced hepatocellular carcinoma (HCC). Early detection of therapy response is warranted to ensure adequate ongoing treatment, but size measurements and contrast enhancement are often not conclusive. We aimed to evaluate diffusion weighted imaging (DWI) for early prediction of tumor response in patients with HCC following SIRT.

METHOD AND MATERIALS

42 patients (33 male, 9 female, mean age 61.2 years) with histopathologically proven HCC underwent magnetic resonance imaging (MRI) including DWI before and 30 days (early) and 180 days (late) after Y90 therapy. Morphologic HCC size and apparent diffusion coefficients (ADC) were compared for at all three time points and were correlated with clinical and laboratory parameters to assess response.

RESULTS

SIRT could be successfully performed in all 42 patients (one injection n=25, two injections n=17). Mean tumor size at baseline amounted to 6.7cm; mean baseline ADC amounted to 1.55 x 10^-3 mm^2/s. After 30 days tumor size did not show any difference (mean tumor size d30= 6.5cm) in responders and non-responders while ADC values increased to 1.64 x 10^-3 mm^2/s (p=0.34) in responders and stayed constant in non-responders. After 180 days, tumor size showed a slight decrease (mean tumor size d180= 6.1cm) in responders and a slight increase in non-responders while ADC values turned out to be significantly higher compared to pretherapeutic imaging (1.82 x 10^-3 mm^2/s; p<0.01) in the responder group.

CONCLUSION

Response to SIRT can be documented by DWI in most patients after 30 days and more pronounced after 180 days. However, vital tumor size changed only little in early and late control MRI. Tumor size therefore cannot be used as response indicator.

CLINICAL RELEVANCE/APPLICATION

DWI is an important tool to assess response or non-response to SIRT in patients with HCC and should be used as imaging modality of choice to evaluate therapy response.

SSM08-02

DCE-MRI for Early Prediction of Response in Advanced Hepatocellular Carcinoma after TACE and Sorafenib Therapy

Kazuhiro Saito MD: Nothing to Disclose, Joseph Ledsam MBChB (Presenter): Nothing to Disclose, Katsutoshi Sugimoto MD, PhD: Nothing to Disclose, Steven Sourbron PhD: Nothing to Disclose, Yoichi Araki RT: Nothing to Disclose, Fuminori Moriyasu MD: Nothing to Disclose, Soichi Akata MD: Nothing to Disclose, Koichi Tokuuye MD, PhD: Nothing to Disclose

PURPOSE
To evaluate the efficacy of tracer kinetic modelling of DCE-MRI in early prediction of advanced hepatocellular carcinoma (HCC) response after treatment with transcatheter arterial chemoembolization (TACE) followed by sorafenib therapy.

METHOD AND MATERIALS

This prospective study was institutional review board approved and informed consent was obtained. Sorafenib was administered 4 days after TACE of advanced HCC in eleven patients (21 lesions overall). DCE-MRI was performed pre-, 3 and 10 days after TACE using a 1.5T Siemens system and a 3D VIBE sequence. Gd-EOB-DTPA, used for a secondary objective to look at liver function, was injected at 2ml/s via the antecubital vein. DCE-MRI acquisitions of 5 images over 30 seconds in each phase were taken pre-contrast, at the hepatic arterial-dominant phase and at 60, 120, 180, 240, 330, 420, 510 and 600 seconds post-contrast. Regions of interest were semi-automatically selected for lesions and abdominal aorta. Distribution volume of contrast agent (DV) and transfer constant Ktrans were calculated. The modified response evaluation criterion in solid tumors (mRECIST) one month after TACE was used to group patients into responders [complete response and partial response] and non-responders [stable disease and progressive disease]; recovery of parameter values after sorafenib was compared between the two groups. Angiogenesis factor angiopoietin (ang2) was measured pre-, 3 and 10 days post-TACE.

RESULTS

DV pre-treatment was 30.8ml/100ml, and was decreased at 3 (20.6ml/100ml, p<0.001) and 10 days (20.0ml/100ml, p=0.002). Ktrans was not significantly changed. DV at 10 days was 8.6ml/100ml and 27.0ml/100ml for responders and non-responders respectively (p=0.02). Following sorafenib therapy DV fell by 5.6ml/100ml in responders, but increased by 2.5ml/100ml in non-responders (p=0.026). Ang2 decreased by 705ng/l in responders and 331ng/l in non-responders (p=0.037). A significant correlation (r=0.621, p=0.03) between DV and ang2 was observed.

CONCLUSION

DV 10 days post-TACE is useful in early prediction of therapeutic outcome in HCC. Changes in ang2 suggest this may be due to reduced vascular remodeling in non-responding lesions.

CLINICAL RELEVANCE/APPLICATION

The DCE-MRI parameter DV may offer early prediction of patients unlikely to benefit from sorafenib. Early changes in therapy regime may increase survival in HCC and avoid unnecessary side effects.
Patients with ablated HCC nodule are at high risk of recurrence and require a close, long-term monitorization. Including CEUS in patient follow-up may allow decreasing the number of CT examinations.

**SSM08-04**

**Determining Correlation between Post-radioembolization Y-90 PET/CT Scan, Estimated Lesion Dosimetry, and Radiographic Response of Transcatheter Treated Unresectable Hepatocellular Carcinoma**

Shetal N. Shah MD : Nothing to Disclose, Gordon McLennan MD (Presenter) : Data Safety Monitoring Board, B. Braun Melsungen AG Research Grant, C. R. Bard, Inc Consultant, C. R. Bard, Inc Consultant, Medtronic, Inc Consultant, Siemens AG Consultant, Eli Lilly and Company Scientific Advisory Board, Surefire Medical, Inc Scientific Advisory Board, Rene Medical, Shyam Srinivas MD, PhD : Siemens Healthcare

**PURPOSE**

Radioembolization using Yttrium-90 (Y-90) microspheres is a treatment for unresectable hepatocellular carcinoma (HCC). A post-treatment Y-90 PET/CT scan can help determine microsphere distribution. We studied the correlation of post treatment Y-90 PET/CT hepatic distribution, with calculated radiation dose delivered to tumor and normal liver, and therapy response assessment on subsequent CT and MRI in transcatheter treated HCC patients.

**METHOD AND MATERIALS**

HIPAA compliant, retrospective chart and imaging review of 57 treated patients (101 hepatic tumors) were completed. Specific activities (Bq/mL) for treated tumor and normal liver tissue were calculated from the Y-90 PET/CT scans based on overlay tumor contouring from pre-procedure triphasic liver CT and MRI. Tumor response on subsequent imaging was assessed using mRECIST.

**RESULTS**

The mean dose per tumor was 166.45 Gy (mode 90-120 Gy; treatment dose range 0-570 Gy). Tumor response by mRECIST correlated with dose delivered, with complete response (CR) significantly higher in lesions receiving >300 Gy, and stable disease (SD) being higher in lesions receiving <60 Gy. Normal liver tissue received a mean dose of 66.25 Gy. 8/15 (53%) pts who received a dose of radiation greater than 80 Gy to normal liver displayed signs of hepatotoxicity.

**CONCLUSION**

Radiation dose HCC after Y-90 dose radioembolization is similar to the brachytherapy dose used to treat other cancers. Lesion dose estimated at >300 Gy resulted in CR, while lesions receiving mean dose <60 Gy had SD by mRECIST.

**CLINICAL RELEVANCE/APPLICATION**

To date, few study have reported the correlation between dose injected, microsphere distribution, dose quantification, and radiographic response after Y-90 treatment in unresectable transcatheter treated HCC. This knowledge may help optimize outcomes and reduce adverse events.

**SSM08-05**

**Computer Aided Response Prediction Based on Pre-therapy FDG PET/CT Imaging Biomarkers of Y90-SIRT Therapy in Patients with Primary and Metastatic Liver Cancers**

Rahul Mehta (Presenter): Nothing to Disclose, Nishant Kumar MD : Nothing to Disclose, Hui Lu : Nothing to Disclose, Aladin Mariano MD : Nothing to Disclose, Grace Knuttinen : Nothing to Disclose, Thomas M. Anderson MD : Nothing to Disclose, Yang Lu MD, PhD : Nothing to Disclose

**PURPOSE**

To develop a prediction algorithm capable of determining the effectiveness of Y90-SIRT treatment in patients with primary and metastatic liver cancers through the use of imaging biomarkers extracted from PET/CT scans.

**METHOD AND MATERIALS**

We designed a strategy of associating changes in imaging features of tumors after treatment through the use of pattern recognition and machine learning. We modified a fuzzy clustering algorithm to automatically detect and segment liver tumors to calculate individual tumor features such as SUV, morphology, texture, and gray-level statistics. Next, we built a support vector machine (SVM) and a Bayesian model to identify critical imaging markers relevant to improvement in Y90-SIRT therapy. Finally, we evaluated the prognostic significance of the model on patients to determine whether Y90-SIRT is an effective treatment in the current state of cancer. The strategy was applied on a set of 15 pretherapy FDG PET/CT scans in patients with Cholangiocarcinoma (n=6), or liver metastases from colon cancer (n=8) and ovarian cancer (n=1). Each patient had at least a 6 month follow-up with PET/CT. Additionally, some had contrast CT or MRI studies. Y90-SIRT therapy responses were analyzed with PET/CT based PERCIST criteria.

**RESULTS**

The model was able to predict the effectiveness of treatment with an accuracy of 85%-95% in determining if a patient would improve based on PET/CT scan. The sensitivity was found to be 90%, while the specificity was 100%. We found the Bayesian model to have a higher accuracy rate, most likely because our cohort of data is relatively small. Furthermore, we found tumor volume, number of curves of a tumor, and edge shape had greatest prognostic significance.
CONCLUSION

The model is self-learning. As further data is accumulated, the prediction accuracy will improve. Furthermore, we can add additional imaging biomarkers to increase the sensitivity rate. The ability to predict the outcome of a treatment based on imaging biomarkers may reduce or prevent unnecessary, expensive, and invasive procedures, along with the potential to provide personalized treatments.

CLINICAL RELEVANCE/APPLICATION

The computer aided pre therapy PET/CT based prediction algorithm can predict responsiveness of liver directed Y90-SIRT therapy, thus avoiding ineffective treatment and unnecessary costly procedures.

SSM08-06 Pretreatment Evaluation of Future Remnant Liver Function Using Gd-EOB-DTPA enhanced Magnetic Resonance Imaging in Patients Undergoing Hepatic Resection or Radiofrequency Ablation for Hepatocellular Carcinoma

Jeong Hee Yoon MD (Presenter): Nothing to Disclose, Jeong Min Lee MD: Research Grant, Guerbet SA Equipment support, Siemens AG Research Grant, Bayer AG, So Yeon Kim MD: Nothing to Disclose, Joon Il Choi MD, PhD: Nothing to Disclose, Yong Yeon Jeong MD: Nothing to Disclose, Andrea Schenk PhD: Nothing to Disclose, Longquan Chen MSc: Nothing to Disclose, Hendrik Oliver Arp Laue PhD: Nothing to Disclose

PURPOSE

To determine whether predicted remnant liver function (RLF) on dynamic hepatocyte-specific contrast-enhanced (DHCE)-MRI using Gd-EOB-DTPA correlates with standard liver function (LF) test results (ICG R15) after resection or radiofrequency ablation (RFA).

METHOD AND MATERIALS

This prospective study approved by IRB and informed consent was obtained in all patients. Fifty-five patients with hepatocellular carcinomas who underwent resection (n=50), RFA (n=2), or liver transplantation (n=3), and nine living liver donors were enrolled. All underwent DHCE-MRI and ICG R15 tests within 7 days ahead of treatment. Fifty-one patients underwent follow-up either DHCE- (n=36) or noncontrast (n=15) MRI on post-treatment day 3. Hepatic extraction fraction [HEF] and HEF multiplied by liver volume [HEFmL] were calculated using deconvolution analysis. The predicted HEF and HEFmL were compared with post-treatment ICG R15 to predict RLF. In addition, pre- and post-treatment HEF and HEFmL were compared to pre- and post-treatment ICG R15. Furthermore, critical LF was calculated using HEFmL to predict ICG R15≥20%. Last, intra-individual heterogeneity of HEF was assessed using coefficients of variation (CV) among the hepatic segments.

RESULTS

Predicted HEF and HEFmL obtained from pre-treatment MR imaging showed a statistically significant correlation with post-treatment ICG R15 (r=-0.37, -0.31, respectively, P <0.05). HEF and HEFmL calculated from pre- and post-treatment MR imaging also showed significant correlations with pre- and post-treatment ICG R15 (r=-0.39 to -0.59, respectively, P<0.05). In predicting ICG R15≥20%, HEFmL showed 73.7% sensitivity and 87.2% specificity with a cut-off value of 118.1mL (AUC: 0.78, P<0.001). In addition, 56.1% (55/98) of DHCE-MRI showed CVs of segmental HEF higher than 10% (10~40%). Figure 1 (top row). Semiautomatic volumetry (a) followed by automatic vascular segmentation (b) and identification of vascular territories (c). Figure 2. HEF maps of liver donor(a), Child A5 (b), and Child B7 (c). Note the heterogeneous distribution of HEF in each case.

CONCLUSION

DHCE-MRI provided information of global and segmental LF. In addition, RLF could be predicted using HEFmL which showed a negative correlation with post-treatment ICG R15.

CLINICAL RELEVANCE/APPLICATION

DHCE-MRI may be able to provide global and regional LF, which could be helpful for clinicians in choosing therapeutic strategy for HCC and in planning liver surgery.