

Early Imaging Biomarkers for Predicting Outcome following Stereotactic Body Radiotherapy in the Management of Primary Liver Tumors and Oligometastatic Liver Disease - Is There A Role for Magnetic Resonance Imaging Texture Analysis?

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Abstract

Objectives: Radiological response evaluation post SBRT can prove challenging even in the hands of experienced radiologists. This retrospective study was carried out to assess the potential of early imaging biomarkers and image feature analysis to predict clinical outcome including risk of recurrence and death following stereotactic body radiotherapy (SBRT) in the treatment of unresectable hepatocellular carcinoma (HCC), intrahepatic cholangiocarcinoma (CC) and oligometastatic liver disease.

Methods: This retrospective study included patients who received SBRT for HCC, CC or oligometastatic liver disease and underwent early (max 12 weeks, median 8.8weeks) Gadaxetate disodium enhanced MRI. First, second and higher order whole tumour image heterogeneity features were derived from a volume of interest (VOI) outlined in reference to baseline imaging and SBRT target volumes on T1-weighted VIBE sequences and axial diffusion weighted (DWI) sequences.

In addition, radiological response was assessed according to EASL guidelines at a median of 18 weeks. Primary outcome measures included disease progression and death. Subjects, who did not progress, were censored at their last clinic appointment. Univariate and multivariate analysis was used with Bonferroni correction for multiple testing.

Results: A total of 29 lesions in 23 patients were treated with SBRT between 2014 and 2016. Early MRI was available for heterogeneity feature extraction for 9 out of 23 subjects. Median age was 64.5 (range 53-73). 7 subjects were treated for primary liver malignancies (5 HCC and 2 CC) and 2 for metastatic disease. The median lesion size was 2.95 cm (range 2-5.3cm). Median GTV volume was 70.2 cc (range 8.2-220.4). Median prescribed SBRT dose was 50Gy (range 45-60Gy) delivered in 5-10 fractions. Median follow-up was 8.83 months (range 2-32). 1-year overall survival was 67%; 1 -year disease free survival was 34%. 2 patients died and 3 patients

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progressed during follow-up. On re-staging scans performed at a median of 18 weeks, 1 patient achieved a complete radiological response, 5 a partial response and 2 stable disease. Radiological response was not predictive of the risk of recurrence or death (p 0.5 and p 0.4, respectively) First order Kurtosis and Energy, higher order GLZLSM: Long Zone Low Intensity Emphasis and GLRL: Short Run Emphasis were significantly associated with higher risk of death in univariate analysis (unadjusted p values 0.007, 0.02, 0.02, 0.04, respectively), however, FDR p-value was >0.05. Low kurtosis = median was associated with lower 1-year OS (50% compared to 67% in all comers) and reduced time to disease progression (11 versus 25 months, p=0.1). There was no difference in clinical or radiotherapy planning variables between patient subsets. On DWI, higher first order mean values were associated with higher risk of death (median 69 versus 143, p value 0.04).

Conclusions: Early imaging biomarkers including image heterogeneity feature analysis following stereotactic body radiotherapy (SBRT) may have an adjunctive role in predicting adverse clinical outcome in patients with primary liver tumours and oligometastatic liver disease and warrants further investigation in an expanded patient cohort.