

Can DCE MRI Predict Risk of Treatment Failure in Early-stage Favorable-prognosis Cervical Cancer Patients?

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Purpose:

Management strategy for cancer patients heavily relies upon the prognostic factors established by the gold-standard clinical criteria. Intensified treatment regimens are usually reserved for those with unfavorable prognosis, aiming for better outcome, while less aggressive treatment is used for those with favorable prognosis, aiming for less treatment-related morbidity and mortality. Despite favorable prognosis, based on generally accepted clinical prognostic criteria (early stage, no lymph node involvement), many cervical cancer patients ultimately fail therapy. The purpose of this study was to assess, if DCE MRI can predict poor treatment outcome in patients with otherwise favorable clinical prognosis as judged by gold-standard clinical criteria.

Materials and Methods:

Of 62 cervical cancer patients studied with DCE MRI, 33 had favorable (stage I-II, lymphnode-negative) tumors. Serial DCE MR performed pre-therapy and in early therapy (at 2-2.5 weeks after radiation/chemotherapy start) using 3D-gradient echo sequences covering the entire tumor (Fig. 1). Mean signal intensity and lowest 10th percentiles (SI10%) of the signal intensity distribution were derived from the pixel histogram to characterize degree and quantity of poorly-perfused tumor regions. DCE parameters were correlated with primary tumor recurrence and cancer death, determined by long-term post-therapy follow-up.

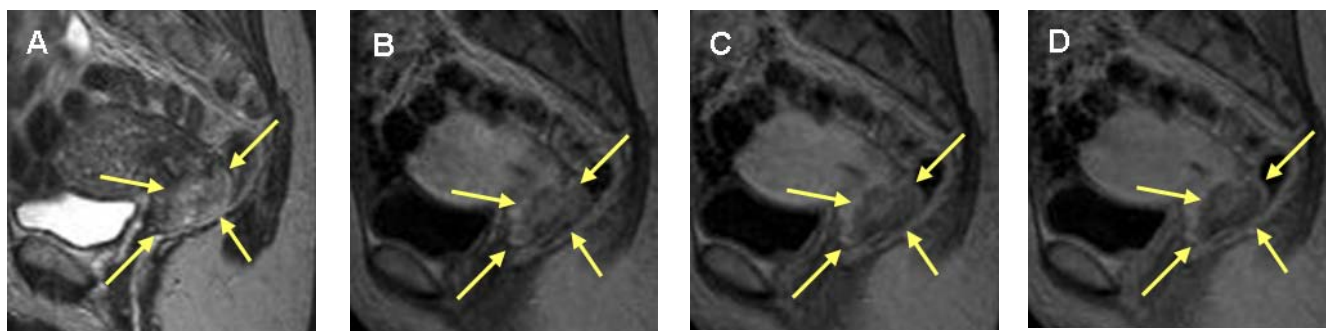


Fig. 1: T2WI shows small tumor (arrows) in this patient with stage IIB cervical cancer without lymph node involvement (A). Early, mid and late plateau phase of the DCE imaging (B-D) shows low-DCE in the tumor region (arrows). SI10% was 1.67. Patient had recurrence within 2 months of treatment completion and died 1 year later.

Results:

In the 33 patients with favorable prognosis, 3 (9.1%) failed therapy. DCE-MRI at 2-2.5 weeks of therapy predicted all recurrences and deaths with a sensitivity of 100% (95% CI:29-100%), specificity of 77% (CI:58-90%) and correct classification of 79% (CI:61%,91%). The 4-year actuarial tumor control rate and disease-free survival rate were 100% for the group with higher DCE (SI10% \geq 1.73) vs. 70% for the low-DCE group (SI10% $<$ 1.73; $p=0.005$). Pre-therapy SI10% and mean SI were less useful in predicting outcome. SI10% of the tumor pixels was overall lower in patients, who failed the treatment (mean SI10%=1.53, Fig. 2, bottom), compared to the group with tumor control (mean SI10%=2.20, Fig. 2, top).

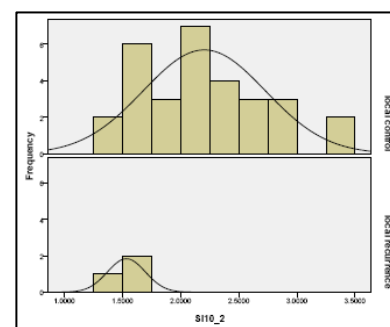


Fig. 2: X-axis; SI10%, Y-axis: Frequency

Conclusion:

DCE MRI can predict treatment failure early in otherwise favorable-prognosis cervical cancer patients and therefore provide a therapeutic window to modify the treatment strategies that can have profound impact to the long term outcome. This predictive ability is likely related to DCE MRI's ability to identify, separate and analyze the subregions of the heterogeneous tumor that likely represent tumor cells resistant to treatment.