Dynamic Tumor Regression during Radiation Therapy Predicts Treatment Outcome in Cervical Cancer

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Purpose/Objective: To study individual tumor regression patterns of cervical cancers during therapy by serial MR imaging and to correlate volumetric regression parameters with tumor control and disease-free survival.

Materials/Methods: Seventy-nine patients with cervical cancer stages IB2-IVA, who were treated with radiation/chemotherapy (RT/CT) underwent serial MRI before (MRI #1) and during RT at 2-2.5 weeks (MRI #2, at 20-25 Gy), at 4-5 weeks of RT (MRI #3 at 45-50 Gy), and 1-2 months post-RT (MRI #4). Mean follow up was 6.2 (0.2-9.4) years. Tumor volume was measured by MRI 3D volumetry, and computed as time/tumor volume regression curves. The volume regression parameters were correlated with local tumor control and disease-free survival.

Results: Regression parameters including volumetric regression rate and area under the curve between MRI #1 and #3 strongly correlated with local tumor control (Table 1). The regression data were well fitted with tumor control model (TCP = exp (-15 exp(-2R)), R – regression rate). Residual tumor volumes of $\geq$20% of the initial volume at 40-50 Gy correlated with poorer local control (45.9% vs. 95.4%, p<0.0001) and disease-free survival rate (48.3% vs. 73.8%, p=0.0075) than smaller residual volumes. All patients with residual post-RT volumes of $\geq$10% had local recurrence and had an only 16.7% disease-free survival, compared to 8.1% local recurrence rate (p<0.0001, Fig.1) and 73.8% disease-free survival in patients with <10% residual volume.

Conclusions: MRI-based volumetric tumor regression pattern predicts long-term local tumor control and survival in cervical cancer. If tumor shows $\geq$10% residual volume at the conclusion of treatment, the risk for local failure and death are so high (> 80%) that aggressive intervention is warranted.

Table 1 Local tumor control prediction by regression rate and area under curve

Regression rate (%/day)	0.75	1.25	1.75	2.25	2.75	3.25
Local Control (%)	0	37.5	64	83	94	100
Area under Curve (%)	7.5	12.5	17.5	22.5	27.5	32.5
Local Control (%)	100	100	89	78	33	0

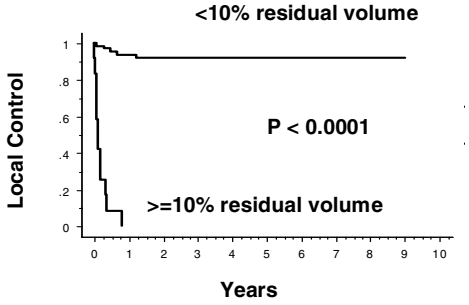

Fig. 1: Kaplan-Meier analysis of local tumor control as function of post-RT residual tumor volume (in %)