Osteosarcoma: preliminary results of in vivo assessment of tumor necrosis after chemotherapy with diffusion- and perfusion-weighted magnetic resonance imaging.

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Abstract

We sought to evaluate diffusion and perfusion weighted 1.5 T magnetic resonance imaging (MRI) in detecting tumor necrosis with histologic correlation after preoperative chemotherapy.Eight patients (ages 11-19 years) with histologic proven osteosarcoma of the limbs underwent T1- and fat-suppressed T2-weighted spin echo and diffusion-weighted EPI sequences (b value = 700) after 5 cycles of standard chemotherapy. Tumor volume and apparent diffusion coefficients (ADC) were calculated. Tumor signal intensities were measured in dynamic contrast enhanced T1-weighted fast gradient echo-sequences obtained every 3 seconds after an intravenous injection of gadolinium-DTPA. Perfusion parameters of first-pass tracing of contrast medium (time-to-peak, slope of contrast enhancement curve) were calculated, and perfusion maps were established. After MRI, all patients underwent limb resection, and the specimens were investigated macroscopically and histologically. The degree of tumor necrosis was assessed using the histologic Salzer-Kuntschik classification (grades 1-6) after chemotherapy.Necrotic areas, which were confirmed by macroscopic/histologic examination, showed ADC values up to 2.7 (mean, 2.3 +/- 0.2). Viable tumor areas revealed lower apparent diffusion coefficients (mean, 0.8 +/- 0.3). The differences in ADC between viable and necrotic tumor were highly significant (paired t test; P = 0.01). Slopes of necrotic areas ranged from 0.1 up to 5.2%/min (mean, 1.5%/min) and those of viable tumor areas from 2.8 to 31.5%/min (mean, 16.1%/min). The time-to-peak-values (TTPs) ranged from 40 to 210 seconds (mean, 131 seconds, SD 60 seconds) in necrotic tumors and from 30 to 96 seconds (mean, 55 seconds, SD 21) in viable areas of sarcomas. The differences in slope and TTP between viable and necrotic tumor were highly significant. In necrotic areas, the linear correlation between slope (%/min) and ADC (mm/s) and between TTP (s) and ADC were weak, respectively.Both dynamic contrast-enhanced MRI and diffusion-weighted MRI permit recognition of tumor necrosis induced by chemotherapy in osteosarcomas. We hypothesized that diffusion-weighted imaging is correlated directly with tumor necrosis. Perfusion-weighted imaging is correlated with microvessel density, vascular permeability, local blood volume, and flow. Therefore, perfusion weighed MRI depicts areas of tumor cell necrosis indirectly.