CT arterial enhancement fraction (AEF) for hepatocellular carcinoma (HCC) screening in patients with end-stage liver cirrhosis

Christe A, Huber A, Ebner L,

Department of Radiology, Inselspital, Bern University Hospital, University of Bern, Switzerland

Background and aims: Computer tomography imaging with arterial enhancement fraction (AEF) uses a tri-phase CT image acquisition (unenhanced, arterial, portal venous phase) to generate color coded CT-images. The purpose of this study was to investigate if the use of the AEF imaging would supersede the acquisition of a fourth contrast phase (equilibrium phase) and thus allow a 25% reduction of radiation dose. Materials and Methods: 55 patients who underwent liver transplantation between 2010 and 2013 and who had a CT scan acquired in four contrast phases (unenhanced, arterial, portal venous and equilibrium phase) on a Siemens Somatom Sensation 64 were included: 35 patients with 108 histologically proven HCC-, as well as 20 patients without HCC-lesions. 47 lesions were already treated by prior TACE. AEF was calculated using the syngo.via workstation (Siemens, Erlangen, Germany): AEF = [(HU_A - HU_U)/(HU_P - HU_U)] x 100, where HU is the attenuation, A the arterial phase, P the portal phase, and U the unenhanced scan. A total of 6 radiologists read the tri-phase grayscale images in conjunction with the color AEF-maps. For the second read-out, three readers looked at the CT images with four contrast phases and three readers only at three contrast phases (without equilibrium phase). Results: The JAFROC analysis showed a significant difference of the figures of merit (θ) between the tri-phase read-out without (θ = 0.718) and with the AEF-maps (θ = 0.750, p=0.0007). Diagnostic performance with four-phases (θ = 0.775) was significantly better than with tri-phases (θ = 0.718) without using the AEF-map (p = 0.0018), but not different from the tri-phase CT with the AEF-maps (θ = 0.750, p = 0.3053). Sensitivity of tri-phase CT was 36.4% (95% CI: 32.5% to 40.5%) and PPV was 76.5% (95% CI: 71.0% to 81.4%). With the AEF-maps sensitivity and PPV increased to 49.7% (95% CI: 45.6% to 53.9%) and 83.4% (95% CI: 79.0% to 87.1%), respectively. Lesions with and without prior TACE treatment were detected with a sensitivity of 31.9% and 42.3% without the use of the AEF map and with a sensitivity of 48.4% and 51.6% with the AEF map. A normalized AEF cut-off value of 70% for small lesions (<1cm) and 60% for larger lesions (≥1cm) lead to highest HCC-accuracy. Conclusion: In HCC CT-screening the fourth equilibrium phase could be replaced by the calculated AEF-maps. This allows a 25% reduction of radiation dose, which is relevant for patient undergoing repetitive HCC-screening.