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Improving image quality of intrahepatic portal veins with dual-energy spectral CT imaging and adaptive statistical iterative reconstruction

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Objective: To investigate the clinical value of dual-energy spectral CT imaging and adaptive statistical iterative reconstruction (ASIR-V) in improving image quality of portal veins.



Methods: Forty patients undergoing abdominal CT angiography of the portal veins using dual-energy spectral imaging mode on a GE Revolution CT were prospectively collected. The 120 kVp-like images were first reconstructed with 40% ASIR-V to simulate the conventional imaging condition in the control group. The spectral monochromatic images at 40-70 keV (intervals of 10 keV, 4 levels) were reconstructed in combination with 40%, 60%, 70%, 80% ASIR-V (4 levels) to generate 16 image sets in the study group. The CT numbers and their standard deviation (SD) of the intrahepatic portal vein were measured to calculate signal to noise ratio (SNR) and contrast to noise ratio (CNR). The subjective image quality was evaluated by two radiologists using a 5-point scoring system. The results were analyzed with one-way analysis of variance, paired sample t-test and Mann-Whitney U test.



Table Objective Evaluation

parameter	40kev	120kvp-Like	P value
Mean CT value of PV trunk (HU)	317.88±41.55	182.16±21.47	0.014
Noise at PV trunk	56.64±11.33	34.16±43.84	0.287
CNR of PV trunk	3.34±1.35	3.19±1.73	0.293
SNR of PV trunk	5.89±1.79	7.17±2.01	0.755
mean CT value of RPV(HU)	310.60±38.80	180.89±19.04	0.002
Noise at RPV	55.71±9.49	27.53±4.50	0.002
CNR of RPV	3.18±1.18	3.13±1.46	0.276
SNR of RPV	5.76±1.35	6.70±1.08	0.278
Mean CT value of LPV(HU)	301.42±48.95	179.88±23.69	0.001
Noise at LPV	54.55±11.18	26.65±5.77	0.003
CNR of LPV	2.99±1.44	3.11±1.75	0.624
SNR of LPV	5.78±1.60	7.02±1.60	0.718

Fig 1 Subjective Evaluation

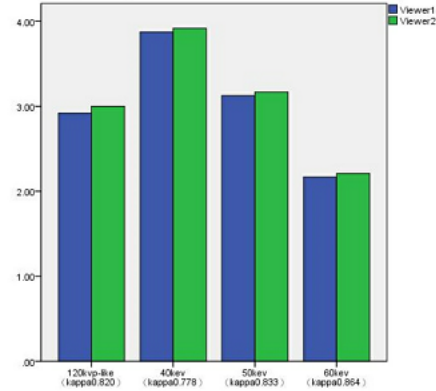
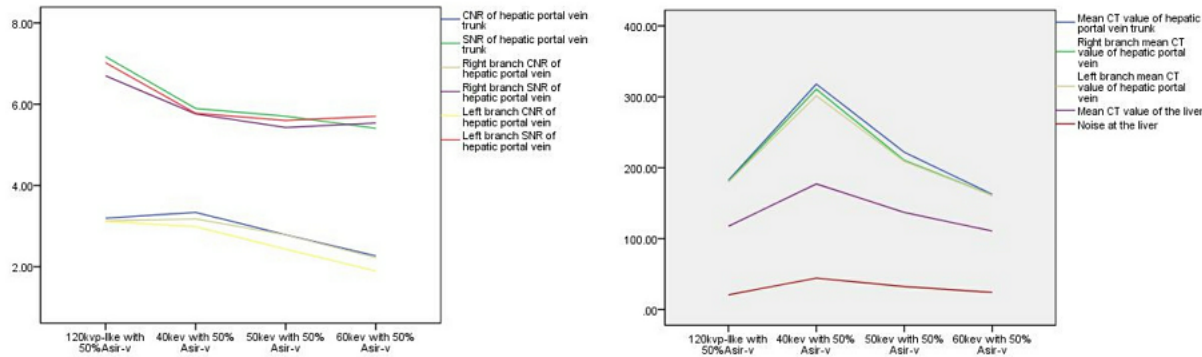


Fig 2 Objective Evaluation of Line Chart



Results: CT values of intrahepatic portal vein increased with the decrease of photon energy. portal vein CNR and SNR at 40 keV reconstructed with 80% ASIR-V (7.20 ± 2.62 , 11.76 ± 3.40) reached the maximal, similar to that at 50 keV with 80% ASIR-V (6.34 ± 2.30 , 11.44 ± 3.29), and higher than those at 120 kVp-like images (2.42 ± 0.96 , 6.15 ± 1.66) (all $P < 0.05$). Images at 50 keV with 80% ASIR-V yielded a maximal subjective image quality score.



Fig3-A,40keV,300mgI/kg,VR

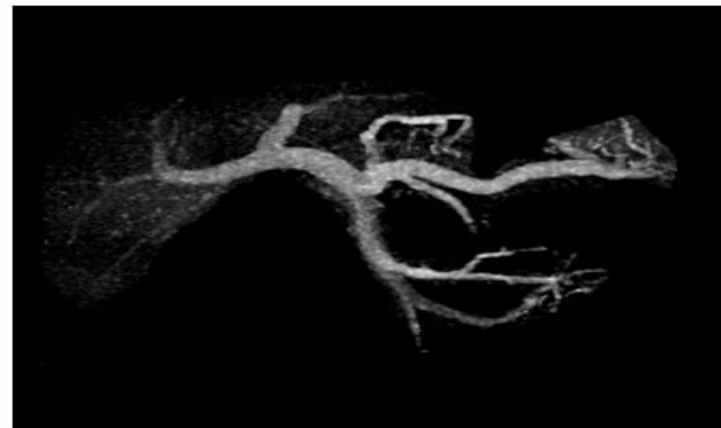


Fig3-B,40keV,300mgI/kg,MIP

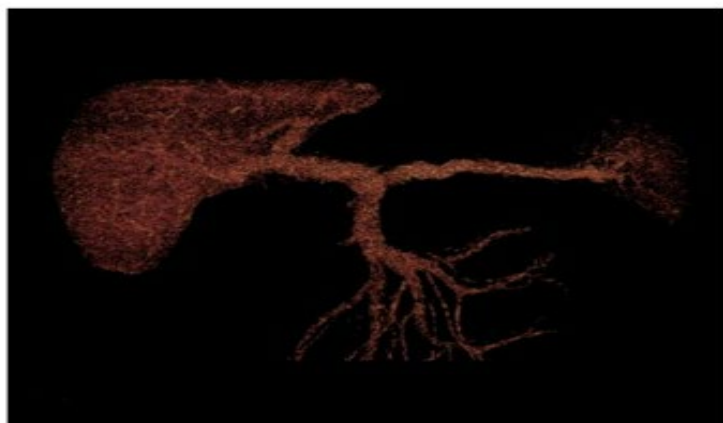


Fig4-A,120kVp-like,600mgI/kg,VR

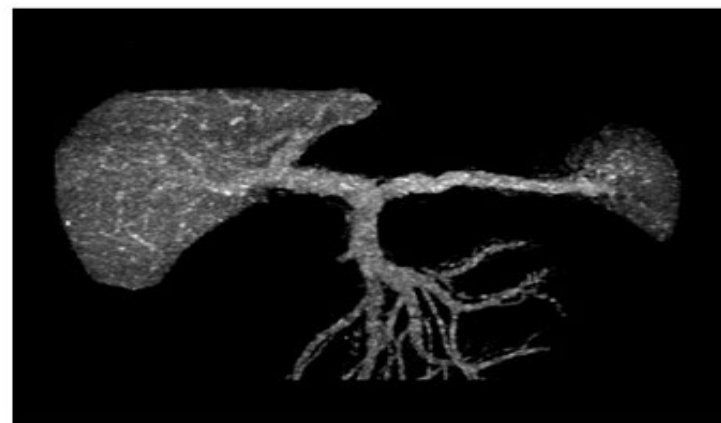


Fig4-B,120kVp-like,600mgI/kg,MIP



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Conclusions: Spectral CT imaging using low energy images (at 50keV) and high-strength ASIR-V (80%) significantly improves the image quality of portal veins, compared with the conventional imaging protocol.