Interobserver agreement in relative liver lesion signal intensity on hepatobiliary phase imaging with gadoxetic acid (Gd-EOB-DTPA)

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Target audience: Radiologists.

Purpose: An assessment of the relative signal intensity (SI) of liver lesions to the liver parenchyma on delayed hepatobiliary phase with gadoxetic acid (Gd-EOB-DTPA/Eovist/Primovist) may help characterize liver lesions[1]. Cut-off points for distinguishing between hypointense and iso- to hyperintense liver lesions have also been proposed[2,3]. The purpose of this study was to assess interobserver agreement in the qualitative and quantitative evaluation of the relative SI of liver lesions on delayed hepatobiliary phase with gadoxetic acid.

Methods: 50 patients with liver lesions, who had MRI with delayed hepatobiliary phase imaging using gadoxetic acid between January 2011 and May 2013, were included in a retrospective IRB approved study. Images were acquired using post contrast 3D T1 weighted sequences at a mean delay from injection of 19 min 20 s, with TR/TE 3.8/1.8 ms, 5 mm slice thickness, 28 to 48 mm FOV, 256 x 128 to 320 x 224 matrix size, and 12 degree flip angle. The single largest representative liver lesion was selected from each patient, and its signal intensity (SI) relative to the adjacent liver parenchyma was qualitatively assessed by 4 separate readers (2 fellows and 2 experts: attending radiologists with at least 6 years of post fellowship experience) using a 4 point scale: 1=very hypointense, 2=mildly hypointense, 3=isointense, 4=hyperintense. Each reader then measured the SI ratio of the lesion to the adjacent liver parenchyma by using the region of interest tool on PACS. For statistical analysis, lesion to liver SI ratio median and range values were calculated for each reader. The intra-class correlation (ICC) was evaluated and kappa statistics with quadratic weights (k) were estimated to assess the agreement between fellows and between expert readers. In addition, a maximally selected rank statistic approach was applied to identify a cutoff point of SI ratio to differentiate between hypointense and iso- to hyperintense lesions.

Table 1. Agreement on qualitative assessment of SI

Fellow 1 Score	Fellow 2 Score 1	2	3	4	Weighted kappa (95%CI)
1	26	1	1	0	0.775
2	4	8	0	0	(0.609, 0.941)
3	2	0	3	1	
4	0	0	2	2	

Expert 1 Score	Expert 2 Score 1	2	3	4	Weighted kappa (95%CI)
1	36	2	0	0	0.908
2	1	3	0	0	(0.810, 1.000)
3	0	0	3	1	
4	0	1	0	3	

Results: 50 patients (23 males, 27 females, mean age 53 years), were included in our study. The 50 selected liver lesions included 35 metastases, 6 FNH, 3 adenomas, 3 cholangiocarcinomas and 1 hemangioma. Two additional lesions were considered either adenoma or FNH by pathology. For the qualitative assessment of liver lesion SI, there was substantial agreement between the fellows, k = 0.775 (CI 0.609, 0.941), and almost perfect agreement between expert readers, k = 0.908 (CI 0.810, 1.000) (Table 1). Similarly, for quantitative assessment of lesion to liver SI ratio, substantial agreement between fellows, ICC = 0.637 (CI 0.440, 0.776) and almost perfect agreement among experts, ICC = 0.889 (CI 0.813, 0.936) was observed. The median SI ratio of hypointense liver lesions and iso- to hyperintense liver lesions for each reader are summarized in Table 2. Based on the agreement among expert readers, a consensus optimal cutoff point of SI ratio to differentiate between hypointense and iso- to hyperintense lesions was calculated to be 0.876.

Discussion: Our results showed substantial agreement among fellows and almost perfect agreement among experienced radiologists on both qualitative and quantitative assessment of relative liver lesion signal intensity on delayed hepatobiliary phase with gadoxetic acid. A cutoff point of lesion to liver SI ratio of 0.876 was found optimal to distinguish hypointense from iso-to hyperintense liver lesions.

Table 2. Lesion to liver SI ratio: median (range)

	All patients	Hypointense (SI = 1 or 2)	Isointense to Hyperintense (SI = 3 or 4)
Fellow1	0.59 (0.16,1.15)	0.57 (0.16,1.14)	1.08 (0.57,1.15)
Fellow2	0.61 (0.19,1.90)	0.56 (0.19,1.90)	1.07 (0.97,1.19)
Expert1	0.57 (0.15,1.15)	0.52 (0.15,0.88)	1.10 (0.91,1.15)
Expert2	0.56 (0.15,1.23)	0.52 (0.15,0.96)	0.99 (0.88,1.23)

Conclusion: Interobserver agreement in qualitative and quantitative assessment of relative liver lesion signal intensity on delayed hepatobiliary phase may improve with radiologist experience. A cutoff point of lesion to liver SI ratio of 0.876 may be useful to distinguish hypointense from iso- to hyperintense liver lesions; however, this would need further validation with future studies.

References: 1. Zech CJ, et al. Consensus report of the Fifth International Forum for Liver MRI. AJR Am J Roentgenol. 2013;201(1):97-107. 2. Mohajer K, et al. Characterization of hepatic adenoma and focal nodular hyperplasia with gadoxetic acid. J Magn Reson Imaging. 2012;36(3);686-96. 3. Kitao A, et al. Hypervascular hepatocellular carcinoma: correlation between biologic features and signal intensity on gadoxetic acid-enhanced MR images. Radiology. 2012;265(3):780-9