Quantitative US (QUS) for assessing hepatic steatosis in NAFLD

Introduction

Nonalcoholic fatty liver disease (NAFLD) affects approximately 25% of the global population, with the earliest and characteristic histological features of hepatic steatosis [1]. NAFLD may progress to a more advanced nonalcoholic steatohepatitis (NASH), which can contribute to the development of fibrosis, cirrhosis, and hepatocellular carcinoma [2].

Liver biopsy is the current reference standard for diagnosing NAFLD but is invasive and sampling errors may occur [3]. Magnetic resonance imaging (MRI)-based proton density fat fraction (PDFF) is an accurate and reproducible method for liver fat quantification and has been used as a reference standard in several clinical trials [4-5] but lacks cost-effectiveness. In this context, ultrasound (US) could be promising as it is noninvasive, widely available, and cost-effective [6].

Recently, quantitative US (QUS) techniques have been proposed as objective tools for the detection and grading of hepatic steatosis. Jeon et al. have previously demonstrated that two QUS techniques, Tissue Attenuation Imaging (TAI™) and Tissue Scatter distribution Imaging (TSI™), showed good diagnostic performance for detecting hepatic steatosis in patients with chronic liver disease [7-9].

This study was aimed at determining the optimal cutoff values of QUS parameters for the staging and assessment of hepatic steatosis in patients with NAFLD using MRI-PDFF as the reference standard.

Materials and methods

173 participants with clinically suspected NAFLD were enrolled. For each participant, QUS examinations (TAI™ and TSI™) using a RS85 Prestige US system (Samsung Medison Co. Ltd.) with a convex probe (CA1-7S), and MRI-PDFF were performed as previously described [9]. The areas under the receiver operating characteristic curves (AUCs) for TAI™ and TSI™ as well as the sensitivity, specificity, and the cutoff values for different stages of hepatic steatosis are demonstrated in Table 1. MRI-PDFF thresholds of 6.4%, 17.4% and 22.1% were used to define different stages of hepatic steatosis (steatosis grades 1 [S1], 2 [S2], and 3 [S3]) [10].

Results

[Table 1] Diagnostic performance of TAI™/TSI™ parameters

	TAI™				TSI™			
	AUC	**Cutoff(AC)**	**Sens (%)**	**Spec (%)**	**AUC**	**Cutoff(SC)**	**Sens (%)**	**Spec (%)**
MRI-PDFF≥6.4% (≥S1, n=112)	0.921				0.911			
Optimal cutoff		**0.74**	82.1	91.8		**98.08**	79.5	90.2
Cutoff for 90% Sens		**0.70**	90.2	68.9		**95.39**	90.2	72.1
Cutoff for 90% Spec		**0.74**	82.1	91.8		**98.08**	79.5	90.2
MRI-PDFF≥17.4% (≥S2, n=32)	0.867				0.815			
Optimal cutoff		**0.83**	81.3	84.4		**98.36**	90.6	57.5
Cutoff for 90% Sens		**0.79**	90.6	70.2		**98.36**	90.6	57.5
Cutoff for 90% Spec		**0.91**	34.4	91.5		**104.70**	43.8	92.9
MRI-PDFF≥22.1% (≥S3, n=18)	0.883				0.816			
Optimal cutoff		**0.86**	88.9	82.6		**101.43**	83.3	71.6
Cutoff for 90% Sens		**0.81**	94.4	73.6		**98.85**	94.4	33.6
Cutoff for 90% Spec		**0.91**	50.0	91.0		**105.48**	44.44	94.19

*Optimal cutoff = calculated using Youden Index

*Unpublished Data. Jeon S et al, Seoul National University Hospital

Both TAI™ and TSI™ showed good diagnostic performance for detecting MRI-PDFF ≥ 6.4%, 17.4%, and 22.1% (AUCs: 0.921, 0.867, and 0.883 for TAI™; and 0.911, 0.815, and 0.816 for TSI™, respectively).
For TAI™, the optimal cutoff values at MRI-PDFF thresholds of 6.4%, 17.4%, and 22.1% were 0.74, 0.83, and 0.86, providing 82.1%, 81.3%, and 88.9% of sensitivities and 91.8%, 84.4%, and 82.6% of specificities, respectively. For TSI™, the optimal cutoff values at MRI-PDFF thresholds of 6.4%, 17.4%, and 22.1% were 98.08, 98.36, and 101.43, providing 79.5%, 90.6%, and 83.3% of sensitivities and 90.2%, 57.5%, and 71.6% of specificities, respectively. Cutoff values of TAI™ and TSI™ for exceeding 90% of sensitivity and 90% of specificity for different stages of hepatic steatosis are summarized in Table 1.

Conclusion

In conclusion, QUS (TAI™ and TSI™) provided good performance for detecting and assessing the degree of hepatic steatosis, and thus it can be used as a valuable tool in assessing hepatic steatosis in patients with NAFLD.

References

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