Journal of the Formosan Medical Association (2014) 113, 249–254

Available online at www.sciencedirect.com

SciVerse ScienceDirect

journal homepage: www.jfma-online.com

ORIGINAL ARTICLE

Factors affecting the diagnostic accuracy of ultrasonography in assessing the severity of hepatic steatosis

Chia-Chi Wang [a], Tsung-Cheng Hsieh [b], Tai-Chung Tseng [a], Pin-Chao Wang [a], Ching-Sheng Hsu [a], Hans Hsienhong Lin [a], Li-Yu Wang [c], Jia-Horng Kao [d,*]

[a] *Department of Hepatology, Buddhist Tzu Chi General Hospital, Taipei Branch and School of Medicine, Tzu Chi University, Hualien, Taiwan*
[b] *Institute of Medical Science, Buddhist Tzu Chi University, Taipei, Taiwan*
[c] *School of Medicine, Taipei Medical University, Taipei, Taiwan*
[d] *Graduate Institute of Clinical Medicine and Hepatitis Research Center, National Taiwan University College of Medicine and Hospital, Taipei, Taiwan*

Received 11 March 2012; received in revised form 28 May 2012; accepted 6 July 2012

KEYWORDS
diagnostic accuracy;
hepatic steatosis;
histology;
ultrasonography

Background/Purpose: Ultrasonography has long been recognized as a useful tool for detecting hepatic steatosis in clinical practice. However, whether it can assess the severity of hepatic steatosis and which factors affect its diagnostic accuracy remain unclear.
Methods: A total of 171 patients with various causes of hepatitis undergoing liver biopsies were retrospectively reviewed. The clinical, serologic data and ultrasonographical findings were recorded. Hepatic steatosis was graded as negative, mild, moderate, or severe by ultrasonography and histology. Histology was used as gold standard and the agreement rates were calculated.
Results: Our data showed that the agreement rate of ultrasonography was 61.4% in assessing the severity of hepatic steatosis and 74.3% in diagnosing hepatic steatosis compared with histology (crude kappa = 0.46 vs. 0.46). Using univariate analyses, body mass index and histology activity index score were associated with the agreement in assessing the severity of hepatic steatosis ($p = 0.008$ and 0.035), whereas Ishak fibrosis score had a trend association ($p = 0.066$). Multivariate analyses indicated that age, body mass index, and Ishak fibrosis score could affect the agreement (odds ratio = 0.72, 0.89, and 1.41; 95% confidence interval = 0.54–0.97, 0.83–0.97, and 1.1–1.8).

Conflicts of interest: The authors have no conflicts of interest relevant to this article.

* Corresponding author. Graduate Institute of Clinical Medicine, National Taiwan University College of Medicine, 1 Chang-Te Street, Taipei 100, Taiwan.
E-mail address: kaojh@ntu.edu.tw (J.-H. Kao).

http://dx.doi.org/10.1016/j.jfma.2012.07.004

Conclusion: Ultrasonography could assess the severity of hepatic steatosis with moderate accuracy. Obese patients are difficult ultrasonographically. In addition, age and hepatic fibrosis could affect the performance of ultrasonography in assessing the severity of hepatic steatosis.

Introduction

Hepatic steatosis is commonly observed in daily clinical practice, and the prevalence of hepatic steatosis is increasing in parallel with the pandemics of obesity and type 2 diabetes mellitus.[1] Hepatic steatosis also frequently coexists with chronic hepatitis C, alcoholic liver disease or nonalcoholic fatty liver disease (NAFLD), which has the potential to develop end-stage liver disease including cirrhosis and liver cancer.[2–5] In addition, patients with NAFLD have a higher prevalence of metabolic syndrome and increased risk of diabetes mellitus as well as cardiovascular disease.[6–14] Therefore, hepatic steatosis has been recognized as an emerging global health threat.

The risk of metabolic syndrome has been reported to be positively associated with the severity of hepatic steatosis on ultrasonography.[15] In addition, serum alanine aminotransferase (ALT) abnormalities usually occur in patients with more severe fatty liver.[16] Taking these lines of evidence together, accurate assessment of the severity of hepatic steatosis can help practicing physicians to identify earlier the risk of liver disease progression in patients.

Although needle biopsy remains the gold standard for the diagnosis of hepatic steatosis, several disadvantages have been discussed, such as possible biopsy danger, different sampling area, or interobserver variability.[17,18] Furthermore, it is invasive and often declined by patients. Therefore, it is important for clinicians to develop reliable and specific techniques for noninvasive detection and quantification of hepatic steatosis.

On the basis of increased echogenicity of liver and the presence of contrast as compared to adjacent organs such as kidney, vascular wall, or diaphragm, ultrasonography is the most commonly used modality in diagnosing hepatic steatosis.[19] However, the ability to make an accurate grading or quantification is necessary for longitudinal follow-up of disease progression and assessing the response to treatment.[20] Computed tomography and magnetic resonance imaging have been evaluated for this purpose.[21,22] Because ultrasonography is cheaper and adds no increased exposure to radiation, it is the best candidate to be used in longitudinal monitoring, if the diagnostic accuracy could be confirmed. In this study, we thus retrospectively investigated whether ultrasonography could assess the severity of hepatic steatosis and factors influencing its diagnostic accuracy.

Materials and methods

Patients and methods

A total of 171 patients with various causes of hepatitis receiving liver biopsy between 2007 and 2009 in Tzu Chi General Hospital were included in this study. The causes of chronic liver disease were chronic hepatitis B in 61, chronic hepatitis C in 88, hepatitis B and C coinfection in 9, and other causes in 13 patients including 1 acute hepatitis C infection, 1 drug induced hepatitis, 1 autoimmune hepatitis, and 10 NAFLD. Demographic, clinical, serologic, and biochemical data were obtained from each participant. The ultrasonographical findings in terms of the severity of hepatic steatosis (negative, mild, moderate, and severe) were retrieved from medical records. Hepatic steatosis on histology was categorized as negative ($\leq$5%), mild (6–33%), moderate (34–66%), or severe (>67%). Agreement was defined as having the same results between ultrasonographical and histological findings. The agreement rates in the presence and severity of hepatic steatosis were separately calculated. According to the presence or absence of agreement, the participants were divided into agreement and non-agreement groups. Variables including age, sex, causes of hepatitis, ultrasound machines, operators, body mass index (BMI), aspartate aminotransferase (AST), ALT, creatinine, platelet count, white blood cell (WBC) count, hemoglobin, histology activity index (HAI) score, and Ishak fibrosis score were included in univariate and multivariate analyses for their associations with the diagnostic accuracy of ultrasonography.

Clinical features and biochemical examinations

We retrospectively collected information on age, sex, BMI, creatinine, hemoglobin, WBC count, platelet count, and ALT and AST levels. BMI was calculated as weight in kilograms divided by height squared. The biochemical data were measured by an autoanalyzer (Roche Analytics; Roche Professional Diagnostics, Penzberg, Germany).

Ultrasound examination of the liver

All ultrasonograms were obtained with one of two units: one (LOGIQ-5; GE, Medical System Ltd, Seoul, Korea) with a 4-MHz electronic probe and the other (LOGIQ-7; GE, Medical System Ltd, Seoul, Korea) with a 5-MHz electronic probe. One of the ten hepatologists who were qualified and well experienced in abdominal ultrasonography performed the examinations. The technical parameters, including gain adjustment, use of tissue harmonics, and use of harmonics, were optimized on a case-by-case basis. Routine images were recorded and saved on a PACS system. The severity of hepatic steatosis was recorded as negative, mild, moderate, or severe. If the echogenicity of the liver is the same as that of the renal cortex, it is defined as negative steatosis. A slight increase in liver echogenicity with clear vascular wall and diaphragm defines mild steatosis. In moderate steatosis, visualization of vascular wall and