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Original Article

The correlation of controlled attenuation parameter results with ultrasound-identified steatosis in real-world clinical practice

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Controlled attenuation parameter;
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Background/Purpose: Controlled attenuation parameter (CAP) is a method for measuring steatosis based on FibroScan. Despite observer dependency, ultrasound (US) robustly diagnoses moderate and severe steatosis. Here, we aimed to evaluate the correlation of CAP with US-identified steatosis in real-world clinical practice.
Methods: CAP and US were performed for 1554 chronic liver disease (CLD) patients. CAP was performed by two technicians, and US was performed by 30 hepatologists. The performance of the CAP as compared with the US results was assessed using the area under the receiver operating characteristic curve (AUROC).
Results: 532 (34.2%) of the patients had hepatitis C virus (HCV) infection, 723 (46.5%) of the patients had hepatitis B virus (HBV) infection, and the rest were patients with metabolic risk factors. CAP values were significantly correlated with the steatosis grades identified by US for all the patients ($\rho = 0.497$, $P < 0.001$), for the HBV-infected patients ($\rho = 0.495$, $P < 0.001$), for the HCV-infected patients ($\rho = 0.343$, $P < 0.001$), and for the patients with metabolic risk factors ($\rho = 0.515$, $P < 0.001$). Using CAP, the AUROC values were 0.759, 0.795, 0.715, and 0.716 for $\geq$moderate steatosis identified by US in, respectively, all the patients, the HBV-infected patients, the HCV-infected patients, and the patients with metabolic risk factors. The AUROC values were 0.791, 0.868, 0.807 and 0.701 for severe steatosis identified by US in, respectively, all the patients, the HBV-infected patients, the HCV-infected patients, and the patients with metabolic risk factors.

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Conclusion: CAP values were well correlated with the steatosis grades assessed by US in real-world clinical practice.

Introduction

As the incidence of obesity increases in the general population, non-alcoholic fatty liver disease (NAFLD) is emerging as a disease of significant concern. NAFLD affects more than 30% of adults in developed countries and its incidence is increasing.[1] Today, NAFLD is the most common chronic liver disease (CLD) worldwide.[2] NAFLD constitutes a major risk factor for progression to end-stage liver disease.[3,4]

Because of the high prevalence of risk factors for NAFLD, it is not uncommon for patients with other CLDs to exhibit co-existing histological features of NAFLD.[5] Coexistent hepatic steatosis is common in cases of chronic hepatitis C virus (HCV) infection and chronic hepatitis B virus (HBV) infection and is strongly associated with more advanced cases of liver disease.[6–8]

The current gold standard for evaluating steatosis is liver biopsy. However, this procedure is invasive, carries a risk of sampling errors,[9] and cannot be readily repeated for long-term patient follow-up. Steatosis can also be diagnosed by noninvasive means, typically with radiographic techniques such as ultrasound (US), computed tomography, and magnetic resonance imaging. Among these imaging modalities, US is the most commonly used imaging tool for detecting hepatic steatosis. In a previous study, US was found to have a 92% sensitivity and 100% specificity for the detection of hepatic steatosis compared to the use of biopsy as the standard method.[10] The main limitation of US is observer dependency. Despite observer dependency, US robustly diagnoses moderate and severe steatosis.[11]

The controlled attenuation parameter (CAP) is a technology used to measure the degree of US attenuation by hepatic fat at the central frequency of the FibroScan (Echosens, Paris, France).[12] A recent meta-analysis showed that the CAP has good sensitivity and specificity for detecting hepatic steatosis.[13]

Until now, however, there have been no studies investigating the correlation between CAP results for hepatic steatosis and those assessed by US in chronic viral hepatitis patients in real-world clinical practice. Thus, the aim of this study was to evaluate the correlation between CAP results for hepatic steatosis and those assessed by US for a large cohort of patients with CLD in real-world clinical practice, most of whom were patients with chronic viral hepatitis.

Materials and methods

Between January 2013 and April 2014, all the patients who presented with CLD in our hepatology department were enrolled consecutively. The patients with chronic viral hepatitis received regular follow-up for liver disease, while the patients without chronic viral hepatitis were referred from endocrinologists to survey for NAFLD; all these patients had at least one metabolic risk factor, according to the definitions for such risk factors provided by the Health Promotion Administration of the Ministry of Health and Welfare in Taiwan, such as waist circumference $\geq$90/$\geq$80 cm for men/women, arterial pressure $\geq$ 130/85 mmHg or being treated for hypertension, fasting glucose $\geq$ 100 mg/dl (5.6 mmol/L) or being treated for type 2 DM, serum triacylglycerols $>$ 150 mg/dl, HDL cholesterol $<$ 40/50 mg/dl for men/women.[14]

The exclusion criteria preventing enrollment in the study were as follows: use of drugs known to induce steatosis, alcohol consumption ($>$21 drinks per week in men and $>$14 drinks per week in women over the preceding 2-year period),[15] the presence of hepatic malignancy, or technical problems (i.e., "failure of the FibroScan").

All procedures followed were in accordance with the ethical standards of the responsible committees on human experimentation (institutional and national) and with the Helsinki Declaration of 1975, as revised in 2008. This study was approved by the Institutional Review Board of Kaohsiung Chang Gung Memorial Hospital (IRB no. 103-5518B). The requirement for informed consent was waived by the IRB.

Liver stiffness and CAP measurements

Liver stiffness measurements (LSM) and CAP measurements were performed with the FibroScan (Echosens, Paris, France) by two experienced operators. In all patients, these measurements were performed using the 3.5 MHz standard M probe. Only results with 10 valid shots and an IQR/median liver stiffness ratio $<$ 30% were included. The final CAP value was the median of the individual CAP values and was expressed in dB/m.

Ultrasound

US was performed by 30 hepatologists in our department with five different US machines, including an SSA-580A Nemio XG Color doppler ultrasonic (TOSHIBA, Japan), an Aplio XU MdlSSA-700A (TOSHIBA, Japan), a Xario™XG SSA-680A (TOSHIBA, Japan), a Hitachi Hi Vision Preirus Ultrasound Machine (Japan), and a Philips/ATL HDI 5000 ultrasound (Netherlands). Predefined criteria were used to determine the severity of hepatic steatosis. These included the presence of bright echoes or increased hepatorenal contrast for steatosis grade 1 (S1) (mild steatosis); the presence of both bright echoes and increased hepatorenal contrast as well as vessel blurring for steatosis grade 2 (S2) (moderate steatosis);

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