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ROLE OF ULTRASOUND GUIDED ATTENUATION PARAMETER (UGAP) AND SHEAR WAVE ELASTOGRAPHY (SWE) IN VISUALLY GRADED FATTY LIVER CASES

Radiology

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ABSTRACT

Background: Fatty liver disease encompasses a spectrum of liver conditions, from simple hepatic steatosis to steatohepatitis, which can progress to inflammation, fibrosis, cirrhosis, and liver cancer. Accurate assessment of liver steatosis and fibrosis is essential for early intervention and management. While traditional ultrasound provides a visual grading system, it lacks the precision needed for comprehensive evaluation. This study explores the role of Ultrasound Guided Attenuation Parameter (UGAP) and Shear Wave Elastography (SWE) in enhancing the assessment of fatty liver in patients with visually graded steatosis. This prospective study included 50 patients over the age of 18 with varying Body Mass Index (BMI). UGAP and SWE demonstrated significant complementary roles in diagnosing and staging fatty liver disease. UGAP's quantifiable attenuation values correlated well with visual grades, though certain Visual Grade I cases exhibited normal UGAP values. SWE reliably distinguished fibrosis stages. The integration of UGAP and SWE into clinical practice could significantly improve the management of patients across the fatty liver disease spectrum.

KEYWORDS

UGAP, Shear Wave Elastography, Fatty Liver, Steatosis, Fibrosis, Ultrasound

INTRODUCTION

Utilization of advanced ultrasound techniques in hepatic assessment has attracted attention all around the world due to the rise of diagnostic precision requirements. Fatty liver disease encompasses a spectrum of liver conditions, from simple hepatic steatosis to steatohepatitis, which can progress to inflammation, fibrosis, cirrhosis, and liver cancer.

Accurate assessment of liver steatosis and fibrosis is essential for early intervention and management. Traditional ultrasound provides a visual grading system, but it lacks the precision needed for comprehensive evaluation. Visual grading of hepatic steatosis may be subject to wide interobserver and intraobserver variability [3].

Ultrasound-Guided Attenuation Parameter (UGAP) and Shear Wave Elastography (SWE) are emerging tools for non-invasive assessment of hepatic steatosis and fibrosis [1]. UGAP offers quantifiable metrics for liver fat, complementing visual grading, while SWE measures liver stiffness, aiding in fibrosis detection [4].

Studies have demonstrated UGAP's correlation with MRI-PDFF and SWE's accuracy in fibrosis staging [2,4]. Comparative analyses show UGAP's utility in early steatosis detection and SWE's role in differentiating advanced liver disease stages [3,4]. However, gaps remain in understanding their combined efficacy in routine clinical workflows and their predictive value in visually graded fatty liver cases.

Visual Grading of Fatty Liver

The visual grading system for fatty liver assessment includes four categories:

- Absent (Score 0): Normal echotexture; clear diaphragm and portal vein wall.
- Mild (Score 1): Slight echogenicity increase; diaphragm and portal vein wall clear.
- Moderate (Score 2): Moderate echogenicity increase; slightly impaired diaphragm and portal vein wall.
- Severe (Score 3): Marked echogenicity increase; poor/no diaphragm, portal vein wall visibility.

UGAP Methodology

Ultrasound waves weaken as they travel through tissue like the liver due to diffusion, scattering, and absorption. This is called attenuation, and it makes images darker with depth [1]. Healthy livers appear uniformly bright due to time-gain compensation (TGC), which adjusts signal gain by depth. In fatty livers, lipid droplets significantly increase attenuation, sometimes resulting in weak signals in deeper areas [2].

UGAP measurements are classified into three grades based on Attenuation rate cut-offs (dB/m) [1]:

- S1: >228 dB/m (Attenuation coefficient cut-off value 0.65)
- S2: >249 dB/m (0.71)
- S3: >270 dB/m (0.77)

2D Shear Wave Elastography

2D shear wave elastography provides grading based on METAVIR stage from Stage F0 (absent to mild fibrosis) to F4 (Cirrhosis) [4]. This technique measures liver stiffness to assess the degree of hepatic fibrosis and has shown high accuracy in fibrosis staging [4].

MATERIALS AND METHODS

This prospective study included 50 patients (Male-29, Female-21) over the age of 18 with varying Body Mass Index (BMI). Patients underwent visual fatty liver grading, UGAP measurement and 2D shear wave elastography using the GE LOGIQ P10 ultrasound machine (curvilinear probe), all performed in the same session.

UGAP Technique: Patients were positioned supine with UGAP measurements obtained through intercostal approach in the right hepatic lobe, avoiding major vessels. Multiple breath-hold measurements were taken and median values recorded in dB/cm/MHz [1].

2D Shear Wave Elastography Technique: SWE measurements were performed in the same position with elastography box placed in the right hepatic lobe. A minimum of 5 valid breath-hold measurements were obtained, expressed in kilopascals (kPa), with reliability indicators >60% [4].

Exclusion Criteria:

- Patients Below 18 years
- Existing advanced Chronic liver disease

RESULTS

Patient Demographics: 29 males and 21 females, Mean age: 48.6 years (±12.3). BMI: Median: 26.7 kg/m^2

Our study revealed UGAP's quantifiable attenuation values correlated well with visual grades, though certain Visual Grade I cases exhibited normal UGAP values. In a few cases, UGAP showed a higher grading than visual grading, suggesting early-stage fatty liver not visually apparent.

Table 1: Distribution of Patients by Visual Fatty Liver Grades

Visual Fatty Liver Grade	Number of Patients
Grade I	24
Grade II	20
Grade III	6

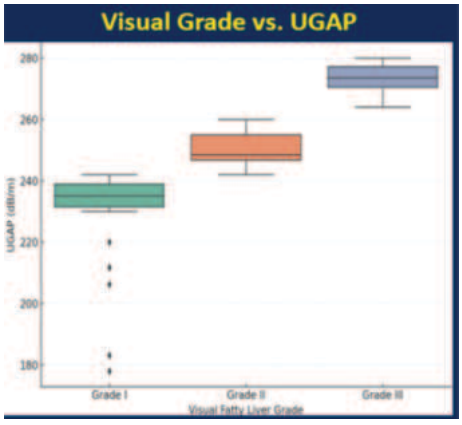
Table 2: Distribution of Patients by UGAP Grade

UGAP Grade	Number of Patients
S2	21
S1	15
S3	9
Normal	5

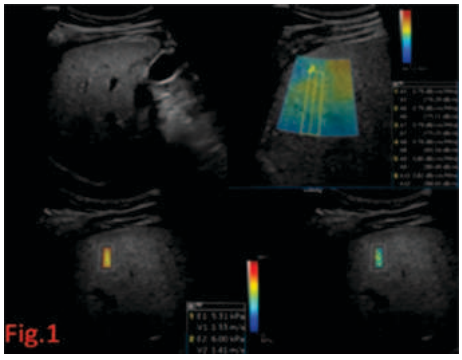
Table 3: Distribution of Patients by Fibrosis Grade

Fibrosis Stage	Number of Patients
F0-F1	38
F2	10
F3	2

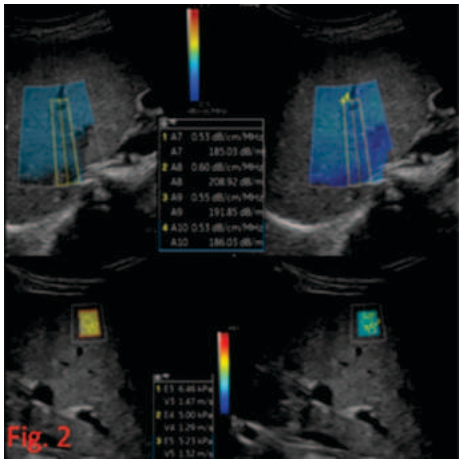
Table4: Visual Grade vs. UGAP



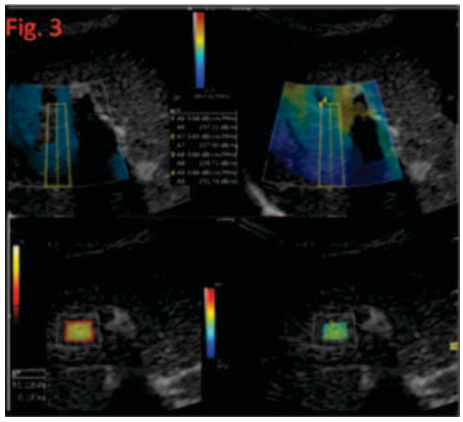
Case Illustrations:



Case 1(Figure 1): Visual Fatty Liver Grade: 2 UGAP shows a higher grading than visual grade corresponding to S3 (>270dB/m) 2D shear wave elastography shows METAVIR STAGE F0-Absent/mild fibrosis



Case 2(Figure 2): On UGAP correlation, showed normal attenuation parameters corresponding to Visual grade - Grade I Fatty liver grade S0. 2D shear wave elastography also showed normal liver stiffness corresponding to F0-F1 (Absent or mild fibrosis)



Case 3(Figure 3): Visual Fatty Liver Grade: 1 Visually graded as Grade I Fatty liver. UGAP score corresponded to S2 grade. However, 2D shear wave elastography showed significant fibrosis corresponding to METAVIR Stage F3.

DISCUSSION

UGAP and SWE demonstrated significant complementary roles in diagnosing and staging fatty liver disease [1,4]. UGAP's quantifiable attenuation values correlated well with visual grades, consistent with findings from previous studies [2]. Discrepancy analyses underscored UGAP's superior sensitivity for detecting subtle steatosis and SWE's utility in fibrosis staging [1,4]. SWE reliably distinguished fibrosis stages, as reported in literature [4].

It is essential to recognize that not all diffusely echogenic livers are due to fatty liver. Pathologies such as cirrhosis can produce similar appearances [3]. In such cases, UGAP and SWE serve as valuable problem-solving tools by providing objective measures to differentiate between steatosis and other conditions [1,4].

Clinical Implications

The integration of UGAP and SWE into clinical practice could significantly improve the management of patients across the fatty liver disease spectrum.

Combining these techniques enhances diagnostic accuracy and allows for more informed patient management decisions, leading to timely and targeted interventions.

Device-specific UGAP/SWE thresholds may restrict reproducibility across different ultrasound systems. Standardization across ultrasound machines and vendors is needed to enhance clinical applicability.

Limitations

The study group was small. Visual grading of hepatic steatosis may be subject to a wide interobserver and intraobserver variability. The study correlates UGAP and SWE with visual grading, but it doesn't compare these techniques to a gold standard invasive techniques like liver biopsy.

CONCLUSIONS

UGAP is a reliable, non-invasive, quick, and reproducible method for objectively grading fatty liver [1,2]. It enhances the accuracy of steatosis assessment beyond traditional visual grading. 2D shear wave elastography is crucial for the early identification and differentiation of simple steatosis from more progressive stages like steatohepatitis, facilitating timely and targeted treatment planning [4].

The integration of UGAP and SWE into clinical practice could significantly improve the management of patients across the fatty liver disease spectrum [1,4]. Combining these techniques enhances diagnostic accuracy and allows for more informed patient management decisions, leading to timely and targeted interventions.

Device-specific UGAP/SWE thresholds may restrict reproducibility across different ultrasound systems [3]. Standardization across ultrasound machines and vendors is needed to enhance clinical applicability.

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