Shear Wave Elastography in Assessment of Liver Fibrosis

Thesis

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By

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Dedication…

This work is dedicated to:

My family; my father, my mother, my sister and my brother.

My lovely husband and my children (Ghaith and Taha).

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List of Contents

List of Abbreviations

Abbr.	Full term
1D	Mono Dimensions
2D	Two Dimensions
AICD	An Implantable Cardioverter Defibrillator
AILDs	Autoimmune Liver Diseases
ALD	Alcoholic Liver Disease
ALT	Alanine Transaminase
ARFI	Acoustic Radiation Force Impulse
AST	Aspartate Aminotransferase
AUC	Area Under Curve
AUROC	Area under ROC curve
BMI	Body mass index
CBD	Common Bile Duct
CLD	Chronic Liver Disease
EASL	European Association for the Study of the Liver
EGD	Esophago gastro Dudenoscopy
EGVB	Esophageal and Gastric Variceal Bleeding
EV	Esophageal avarices
FLLs	Focal Liver Lesions
FNH	Focal Nodular Hyperplasia
HA	Hepatic Artery
HB	Hemoglobin
HBV	Hepatitis B Virus
HCC	Hepatocellular Carcinoma
HCV	Hepatitis A Virus

HIV	Human Immunodeficiency Viruses
HPVG	Hepatic Venous Pressure Gradient
HV	Hepatic Vein
HZ	Hertz
INR	International Normalizd Ratio
IQR	Interquartile Range
IQR/M	Interquartile Range / median
IVC	Inferior Vena Cava
KPa	Kilopascal
LHA	Left Hepatic Artery
LN	Lymph Node
LS	Liver Stiffness
LSE	Liver Stiffness Evaluation
LSM	Liver Stiffness measurement
LT	Liver Transplantation
MHz	Mega hertz
MRE	Magnetic Resonance Elastography
NAFLD	Nonalcoholic Fatty Liver Disease
NASH	Nonalcoholic Steatohepatitis
NPV	Negative predictive value
PCR	Polymerase Chain Reaction
PH	Portal Hypertension
PPV	Positive predictive value
PV	Portal Vein
RHA	Right Hepatic Artery
RNA	Ribonucleic Acid
ROC	Receiver operator characteristic curve

ROI	Region Of Interest
RTE	Real-Time Elastography
SCD	Sub Cutaneous Density
SD	Standard deviation**.**
SFL	Simple Fatty Liver
SMA	Superior Mesenteric Artery
SWE	Shear-Wave Elastography
TE	Transient Elastography
US	Ultrasound
USSS	Ultrasonographic scoring system

List of Tables

List of Figures

ABSTRACT

Background: Liver fibrosis is major medical issues in patients with chronic hepatitis C (CHC). It may lead to cirrhosis, hepatocellular carcinoma (HCC) and liver-related death. Therefore, assessing the degree of fibrosis in patients with chronic liver diseases, especially before the advanced stage, is clinically important to allow early care and prevent fatal liver disease.

Objective: The plan was to do shear-wave Elastography after fibroscan (TE) in order to assess the stiffness of the liver, detect the changes occurred in hepatitis C patients and measure diagnostic accuracy of 2D-SWE by using TE as reference standard.

Methods: A cross-section study included 30 persons with positive hepatitis C. They were referred to Radiology department at National Hepatology and tropical medicine research institute.

Results: Our study included (30) patients who have hepatitis C positive, their ages ranged from (18) years old to (60) years old with mean ± SD of 52.97 ± 9.43. They were 17 females (56.7%) and 13 males (43.3%). Different liver fibrosis stages were observed by 2D-SWE as following: (F0) 4 patients (13.3%), (F1) 4 patients (13.3%), (F2) 9 patients (30.0%), (F3) 10 patients (33.3%), (F4) 3 patients (10.0%). While TE (fibroscan) shows (F0) 6 (20.0%), (F1) 3 patients (10.0%), (F2) 7 patients (23.3%), (F3) 8 patients (26.7%) (F4) 6 patients (20.0%). Our study showed that the relation between TE (fibroscan) and SWE finding had positive correlation of most patients with liver fibrosis with (p-value = 0.006 and r-value 0.487). Because the important of significant fibrosis for initiate antiviral protocol therapy, 30 patients classified into F0–F1 (non-significant liver fibrosis) versus F2–F4 (significant liver fibrosis). Our study show significant discrimination was found between no/mild fibrosis (F0-F1) and significant fibrosis (F2-F4), shows the sensitivity of SWE in detection of significant fibrosis results is 95.2% and the specificity is 77.8%, PPV 90.91%, NPV 87.5% and the accuracy 90.0% with cutoff value >5.7kPa.

Conclusion: SD-SWE is accurate in prediction significant fibrosis (≥F2), Thus is expected to overcome the limitation of TE as a reliable method to assess fibrosis induce by hepatitis.

Keywords: *Shear wave elastography, Liver fibrosis, Chronic Hepatitis C, Fibroscan (TE).*

INTRODUCTION

Chronic liver disease is a substantial worldwide problem. Its major consequence is increasing deposition of fibrous tissue within the liver, leading to the development of cirrhosis with its consequences, portal hypertension, hepatic insufficiency, and hepatocellular carcinoma (HCC) As fibrosis progresses, there is increasing portal hypertension, loss of liver function, and higher risk of HCC ***(Regev et al., 2002).***

The stage of liver fibrosis is important to determine prognosis and surveillance and to prioritize for treatment and potential for reversibility ***(Marcellin et al., 2013)***. The process of fibrosis is dynamic, and studies have shown that a regression of fibrosis is possible with treatment of the underlying condition (eg, antiviral therapy in viral hepatitis and immunosuppression in autoimmune hepatitis) ***(Martinez et al., 2012).***

Previously, the only method of staging the degree of fibrosis was liver biopsy. Liver biopsy is considered the reference standard for fibrosis assessment and stage classification and also allows grading of steatosis, necrosis, and inflammatory activity ***(Seeff et al., 2010).*** However, biopsy is invasive, with potential complications that can be severe in up to 1% of cases ***(Stotland and Lichtenstein, 1996).***

Further, tissue obtained via biopsy represents roughly only 1/50 000 of the liver volume, which may result in sampling error and is associated with considerable interobserver variability at microscopic evaluation, Therefore, noninvasive methods for liver fibrosis assessment have been an intense field of research, including elastographic methods ***(Goodman, 2007).***

Elastography is a technique which has the ability to estimate hepatic fibrosis based on the assessment of tissue stiffness. Among the available armamentarium, transient elastography (TE), was the earliest and most extensively used ***(Ferraioli et al., 2015)***.

TE is difficult to perform in patients with obesity, ascites, shrunken liver, or those with narrow intercostal spaces ***(Tatsumi et al., 2007)***.

Further technological advances led to the emergence of a novel technique of Shear wave elastography (SWE) ***(Friedrich-Rust et al., 2007)***. This uses information of acoustically generated shear wave propagation speed through the liver to provide qualitative (stiffness-based color-coded maps) and quantitative assessment (average value in the region of interest in terms of the Young modulus, kilopascals) of liver fibrosis ***(Li et al., 2016)***.