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Advantages and Limitations of Point Shear Wave Elastography and 2-Dimensional Shear Wave Elastography against Percutaneous Liver Biopsy for Assessing Focal Liver Lesions

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Abstract

BACKGROUND: Ultrasound based noninvasive techniques for the evaluation of tissue elasticity are becoming popular in practice. An accurate diagnosis of focal liver lesions (FLLs) is very important and essential for the adequate treatment and management of different conditions.

AIM: The study aims to evaluate the advantages and limitations of Point Shear Wave Elastography and 2-dimensional Shear Wave Elastography against percutaneous liver biopsy for assessing focal liver lesions.

METHODS: This document reviews the advantages and limitations of point shear wave elastography (pSWE) and 2-dimensional shear wave elastography (2D-SWE) against percutaneous liver biopsy for assessing focal liver lesions.

RESULTS: Ultrasound elastography has shown promising results and plays an important role in the assessment of focal liver lesions but the lack of histological confirmation is a limitation, especially in cases of suspected FLLs. The Tru cut percutaneous liver biopsy has been proven as a very helpful method for an accurate histological diagnosis. The main disadvantage of this procedure is that is invasive and the complications may be life threatening.

CONCLUSION: Noninvasive methods to aid clinical decisions are preferred by patients rather than liver biopsy. US elastography, in the form of pSWE, as well as 2D SWE has proved reliable for the evaluation of liver parenchyma. The investigation of pSWE and 2D-SWE for assessing the elasticity of focal liver lesions and their differentiating is still a challenging goal. Percutaneous liver biopsy provides an option for accurate histological confirmation of liver pathologies, particularly FLLs. It continues to be an important tool in the diagnosis, prognosis, and treatment of those affected with liver disorders.

Introduction

Nowadays, non-invasive ultrasound-based techniques for the evaluation of tissue elasticity are becoming more popular in clinical practice [1], [2], and [3]. An accurate diagnosis of focal liver lesions (FLLs) is very important and essential for the adequate treatment and management of different conditions. FLLs are divided into two main groups: benign and malignant. Imaging modalities, particularly ultrasonographic, are accepted for assessing the elasticity of FLLs, but the investigation of their potential is continuing. This document reviews the advantages and limitations of point shear wave elastography (pSWE) and 2-dimensional shear wave elastography (2D-SWE) against percutaneous liver biopsy for assessing FLLs.

Conventional imaging techniques do not provide information on tissue mechanical properties. Elastography replaces the palpation performed by physicians and adds liver stiffness quantification. It measures tissue behavior when an external mechanical actuation or an internal acoustic radiation force is applied and can be monitored by ultrasound. Ultrasound elastography has shown promising results and plays an important role in the assessment of FLLs [4], [5], and [6], but the lack of histological confirmation is a limitation, especially in cases of suspected FLLs. The Tru-Cut percutaneous liver biopsy has been proven to be a very helpful method for an accurate histological diagnosis. The main disadvantage of this procedure is that it is invasive, and the complications may be life-threatening.

Shear Wave Imaging

Acoustic radiation force impulse techniques, which use an acoustic internal push, can be divided into pSWE and 2-D 2-D SWE techniques. The shear wave-based techniques measure the speed of shear waves in tissues. SWE imaging can be performed with a single conventional probe. The operator can visualize

the hole in the liver directly and the region of interest (ROI). The literature suggests that 10 measurements should be obtained with a validation criterion-median interquartile range (IQR/M) < 30. The upper edge of the measurement box should be placed 1.5–2.0 cm apart from the liver capsule to minimize the effect of the reflection artifact.

Advantages of pSWE

- Low cost, real-time imaging, repeatability, and lack of radiation exposure.
- pSWE, compared to liver biopsy, is a non-invasive method without any possible complications.
- A pSWE ultrasound beam emitted by a standard convex transducer produces a single point of energy within the liver and targets a certain ROI, which usually measures 10 × 5 mm [7].
- It permits visualization of the liver tissue and selects a region without blood vessels, bile ducts, or rib shadows.
- Shear wave speed is expressed in m/s and converted to Young's modulus in kPa for the estimation of tissue stiffness.
- pSWE has been confirmed as a reliable diagnostic modality for evaluating the tissue stiffness of various abdominal structures [8], including the measurement of liver fibrosis.

Limitations of pSWE

- Measures only a fixed area without displaying a color image in a ROI.
- The allowed depth of transmission of an acoustic radiation impulse was only up to 10 cm from the skin.
- The accuracy results of the shear wave's speed decreased when the lesion was close to the heart and large vessels, or when patients had poor breath-holds.
- The accuracy of pSWE is affected by the presence of severe steatosis [9], [10].

Advantages of 2D-SWE for assessing FLLs

- Allows real-time measurements of liver stiffness over a larger ROI (35 × 25 mm), resulting in a significantly larger sampling volume, and a color-coded elastogram is also obtained. Stiffer tissues appear red, and softer tissues appear blue on the display [11], [12].
- 2D-SWE, compared to liver biopsy, is a non-invasive method without any complications, low cost, repeatability, or lack of radiation.
- The mean shear wave speed (m/s) is derived from multiple measurements obtained from tissue within the ROI.
- The measured shear wave speed can be algebraically converted to Young's modulus (kPa).

Disadvantages of 2D-SWE for assessing FLLs

- The maximum detection depth of two-dimensional SWE compared to pSWE could be deeper, but it depends on the type of probe.
- The accuracy results of the shear wave's speed decreased when the lesion was close to the heart and large vessels, or when patients had poor breath-holds.
- The sampling time may be longer than that associated with pSWE because larger tissue volumes are assessed.
- Elastography is not to be considered a method to substitute histological confirmation for malignant FLLs.

Advantages of Percutaneous Liver Biopsy

The most common type of liver biopsy is called a percutaneous liver biopsy. Liver biopsy should follow guidelines. The low mortality (0.01–0.17%) and the relatively low morbidity of this procedure have meant that liver biopsy has become widely used [13].

Three major roles of percutaneous liver biopsy:

1. Establishing a diagnosis
2. Assessment of disease staging and prognosis
3. Assisting with treatment options and clinical management [14], [15], [16].

A liver biopsy is commonly performed to help diagnose different FLLs and stage certain liver diseases. It is the "gold" standard for the diagnosis of malignancies and determining the therapeutic approach. It may be performed by radiologists, gastroenterologists, hepatologists, or surgeons.

Preparation for the procedure

Before performing a percutaneous liver biopsy, patients should understand the risks, benefits, and alternatives to the procedure. Informed consent should be obtained. The physician conducts a medical history, a physical examination, routine laboratory studies, and an ultrasound examination of the abdomen. Some medications, including aspirin, NSAIDs, and anticoagulants, must be stopped because they may increase the risk of bleeding. Patients are required to fast for at least 6–8 h before the procedure. The skin over the liver region is cleaned and prepared by applying an antiseptic. Patients receive local or general anesthesia. During the manipulation, the doctor places

a needle through the skin of the right upper abdomen into the liver and takes small pieces of tissue to send to a pathologist for analysis.

Following the procedure, the patient's blood pressure, heart rate, and pain level are measured every 15 min for the first hour, every 30 min for the next hour, and every hour thereafter until ready for discharge. Patients are typically observed between 2 and 4 h post-procedure.

Disadvantages of percutaneous liver biopsy

Complications include pain (most commonly located at the biopsy site), hemorrhage, hemobilia, bile peritonitis, pneumothorax and/or pleural effusion, and biopsy of nearby organs. Bleeding is the most common complication that manifests in the background of an already damaged liver [17].

Conclusion

During the past two decades, elastography has been developed as a quantitative, non-invasive method for the assessment of liver fibrosis that can be used in place of a liver biopsy. pSWE and 2D-SWE are non-invasive and easy to perform and repeat. The cost is low, there is a lack of radiation exposure, and the image is in real time. Non-invasive methods to aid clinical decisions are preferred by patients rather than liver biopsy [18]. US elastography, in the form of pSWE, as well as 2D-SWE, has proved reliable for the evaluation of liver parenchyma [19]. The investigation of pSWE and 2D-SWE for assessing the elasticity of FLLs and their differentiating is still a challenging goal. Percutaneous liver biopsy provides an option for accurate histological confirmation of liver pathologies, particularly FLLs. It continues to be an important tool in the diagnosis, prognosis, and treatment of those affected by liver disorders, and the procedure is relatively safe.

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