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Imaging & Beyond by Jankharia

INNER SPACES
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MRI Elastography

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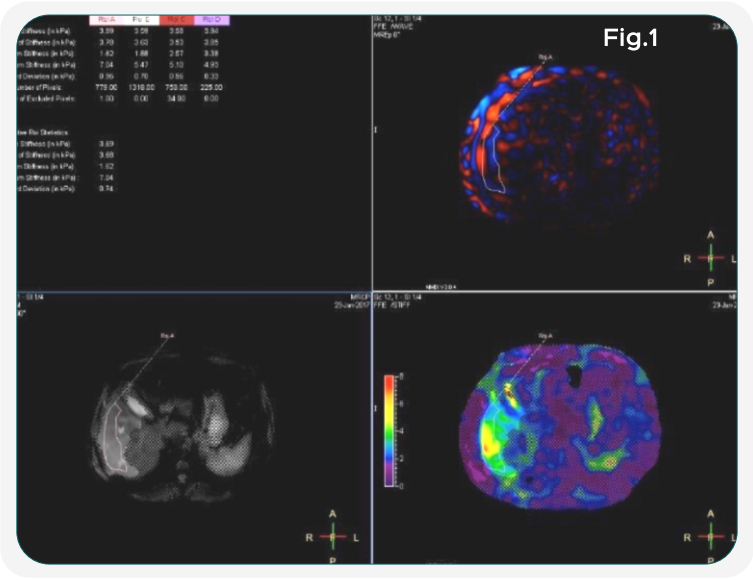

Figure 1: Typical elastogram showing the method of measurement.

MRI Elastography (MRE) is the most accurate, non-invasive and highly sensitive technique for the detection and staging of liver fibrosis.

Chronic liver disease (CLD) with cirrhosis is a leading cause of death, with rising prevalence due to obesity and associated liver disease – non-alcoholic fatty liver disease (NAFLD). Liver fibrosis is the single most important factor determining the outcome of CLD. Early fibrosis is potentially reversible and therefore detection of earlier stages of fibrosis is desirable.

Principle of MRE: MRE determines tissue stiffness of liver indirectly by measuring the speed of propagation of low frequency mechanical shear waves in the liver parenchyma. Shear wave speed is related to tissue stiffness

- Normal liver is viscous, so there is poor propagation.
- Increase in stiffness leads to increase in speed of propagation of shear waves.

MR imaging captures the miniscule movement of the liver tissue, and a special algorithm is used to convert this data into a color scale picture, called elastogram (Fig. 1) that corresponds to level of liver stiffness. Based on the colour scale picture, radiologists can instantaneously determine whether the patient has a healthy or diseased liver.

Normal livers have mean stiffness < 2.5 kPa.
Suggested guidelines for interpretation of liver stiffness with MRE at 60 Hz

- < 2.5 kPa : Normal
- 2.5 to 2.9 kPa : Normal or inflammation
- 2.9 to 3.5 kPa : Stage 1-2 fibrosis
- 3.5 to 4 kPa : Stage 2-3 fibrosis
- 4 to 5 kPa : Stage 3-4 fibrosis
- > 5 kPa : Stage 4 fibrosis or cirrhosis

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At a glance:

- While liver biopsy is currently the gold standard for measurement of liver fibrosis, non-invasive techniques are the need of the day.
- Elastography has been proven to be an accurate technique for the evaluation of liver fibrosis.
- MRI Elastography is superior to all other techniques.

Applications of MRI:

- Detection and staging of liver fibrosis.
- Differentiating simple steatosis from NASH
- Assessing response to treatment with antifibrotic drugs
- Evaluation of focal lesions, as malignant lesions have a higher stiffness as compared to benign lesions.
- To monitor development of liver fibrosis in high risk patients: - on methotrexate therapy or after liver transplant.

Advantages of MRI:

- Conducted as a part of other abdominal MR protocols and is completed with 4 breath holds, in approximately a minute. No complications
- Low inter-observer variability
- Comparatively low cost
- High reproducibility
- Ideal tool for screening, longitudinal monitoring and assessing therapeutic response

Liver biopsy is the current clinical standard of reference for diagnosing liver fibrosis. However, one of the biggest benefits of MRE is that it side steps the need for needle biopsy, which is invasive and expensive, has potential for life threatening complications and is limited by sampling variability.

Advantage over US based elastography: Sonoelastography is the other available non-invasive means for detecting liver fibrosis, but MRE clearly scores over it as per the adjacent table:

MRE	US Elastography
No acoustic window	Acoustic window required
Useful in obese patients	Not useful in obese patients
Operator independent	Operator dependent
Entire liver, including the deeper parenchyma can be assessed	Only a small volume of liver near the surface is assessed

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