Looking for liver disease in babies with intestinal failure on TPN: can ultrasound replace liver biopsy?

In order to get proper nutrition to grow, a person needs to be able to use their small bowel to absorb nutrients. Some babies and children have diseases that require removal of a significant length of their small bowel. They are left with a shortened amount of bowel, which means they are unable to absorb enough calories and nutrients from food that passes through their intestines. This is called short bowel syndrome with intestinal failure. In order to help patients with intestinal failure get adequate nutrients, they are given supplemental nutrition through their veins that contains a high concentration of fats, carbohydrates, proteins, and other essential vitamins. This is called total parenteral nutrition or TPN. Parenteral nutrition can cause many problems, including liver failure. TPN-associated liver failure is difficult to diagnose with laboratory tests, so patients on long-term TPN often get liver biopsies to make sure they do not have signs of serious liver injury.

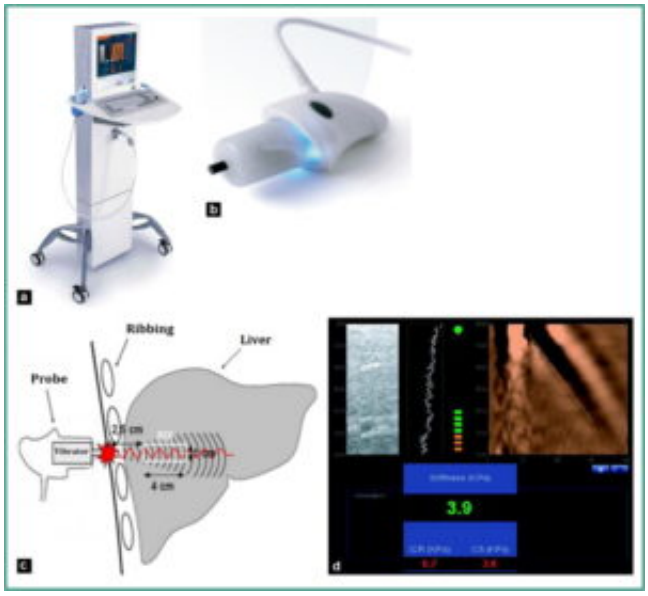

Fig. 1. An example of an ARFI elastography device called Fibroscan. A) The instrument; b) The probe; c) How the probe analyzes the liver; d) Example results from the device. Source: N. Frulio, H. Trillaud, Ultrasound elastography in liver, Diagnostic and Interventional Imaging, Volume 94, Issue 5, 2013, Pages 515-534, ISSN 2211-5684, https://doi.org/10.1016/j.diii.2013.02.005.

A liver biopsy is an invasive procedure that has many risks, including pain, bleeding, infection, bile leak, and collapsed lung. Unfortunately this procedure is currently used for monitoring of liver health in babies with intestinal failure on TPN. Patients often get a biopsy when they have surgery in their abdomen, and may undergo a separate procedure to get a biopsy if they show signs of worsening liver disease.

In adults, some studies have shown that a specific type of ultrasound called acoustic radiation force impulse (ARFI) elastography can monitor liver disease. ARFI elastography is a noninvasive ultrasound test that uses shear waves to characterize what the liver tissue looks like. Our study was the first study using ARFI elastography to evaluate liver disease in children on long-term TPN.

In our study we looked at 12 patients with intestinal failure on TPN. The median age for our patients was 1.4 years. The median patient received 75% of their nutrition through their veins via TPN. Most of the patients underwent liver biopsy during a clinically-indicated operation such as an ostomy takedown (as compared to a separate procedure for liver biopsy). We compared the biopsy findings on pathology to the findings on an ARFI elastography ultrasound that was performed before their operation. We found that elastography was able to differentiate mild liver fibrosis from moderate/severe liver fibrosis almost as well as pathology.

These findings are important because liver injury from parenteral nutrition is important to identify. Laboratory blood tests of liver enzymes do not do a good job of predicting when these patients' livers are getting get sick. Instead, a liver biopsy must be performed. Liver biopsies are procedures that can be associated with serious risks, and even when performed correctly, can only assess a small part of the liver.

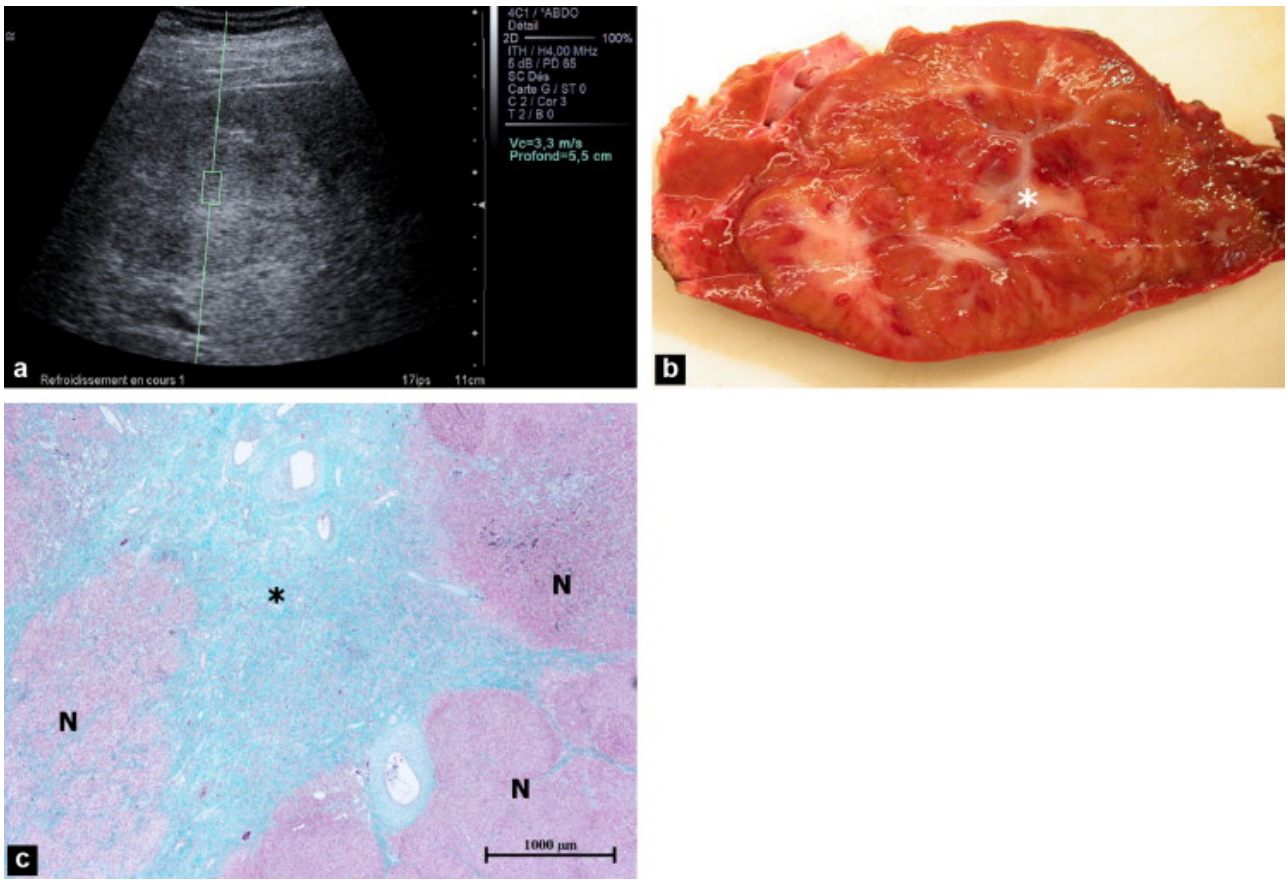

Fig. 2. Liver ultrasound and biopsy results. a) ARFI elastography ultrasound; b) Wedge biopsy of

liver c)Pathology analysis of wedge biopsy . Source: N. Frulio, H. Trillaud, Ultrasound elastography in liver, Diagnostic and Interventional Imaging, Volume 94, Issue 5, 2013, Pages 515-534, ISSN 2211-5684, https://doi.org/10.1016/j.diii.2013.02.005.

ARFI elastography is a non-invasive ultrasound test that could help diagnose liver fibrosis in patients with intestinal failure who rely on intravenous nutrition. This could allow doctors to look at patients' livers earlier and more frequently if they are concerned about disease. We are continuing to collect data for this study. If our results continue to show that ARFI elastography identifies liver disease as well as a biopsy, our goal would be to use elastography to monitor patients' livers and only perform biopsies if there is concern that the liver disease appears to be worsening. These results may help minimize the number of invasive procedures performed in children with intestinal failure.

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