Summary

Transient elastography (FibroScan) is a non-invasive method proposed for the assessment of hepatic fibrosis in patients with chronic liver disease by measuring liver stiffness. It can be easily performed at the bedside or in the outpatients clinic with immediate results and good reproducibility. Limitations include failure (no value) in around 5% of cases, mainly in patients with substantial thoracic fat. In France, FibroScan or FibroTest are recommended for the initial evaluation of liver fibrosis in previously untreated patients with chronic hepatitis C and no concomitant health disorders. FibroScan is validated for the diagnosis of significant fibrosis and cirrhosis in chronic hepatitis C, recurrence of hepatitis C after liver transplantation, co-infections in HIV-HCV patients and chronic cholestatic diseases, but needs further evaluation in other chronic liver diseases. FibroScan is an excellent tool for early detection of cirrhosis and evaluation of portal hypertension, for which it may have prognostic value as well. Studies are needed using FibroScan for the follow-up of patients with and without treatment, and for the screening of patients at risk of liver disease. However, although FibroScan is a good method for the evaluation of fibrosis in patients with chronic liver disease, it has to be borne in mind that FibroScan evaluates liver stiffness. Therefore, FibroScan values have to be interpreted according to clinical, biological and morphological data. © 2008 Elsevier Masson SAS. All rights reserved.

Résumé

L’élastographie impulsionnelle (FibroScan) est une méthode non-invasive de diagnostic de la fibrose hépatique chez les patients pris en charge pour maladie hépatique chronique en mesurant l’élasticité hépatique. C’est une technique facilement réalisable en consultation, avec un résultat immédiat et une bonne reproductibilité. Ses limites sont l’échec (absence de valeur) dans environ 5% des cas, principalement chez les malades avec une surcharge en graisse thoracique. En France, le FibroScan ou le FibroTest sont recommandés pour l’évaluation initiale de la fibrose hépatique au cours de l’hépatite C sans co-morbidité. Le FibroScan est validé pour le diagnostic de la fibrose significative et
Introduction

Over the past decade, several investigative groups have developed methods for imaging tissue elasticity, recognizing the incremental diagnostic value of characterizing mechanical properties when assessing the presence of disease. Transient elastography (TE) was the first method used, around five years ago, in patients with chronic liver disease. Many studies have evaluated the performance of this method for the diagnosis of fibrosis and cirrhosis, and FibroScan is now a tool used by hepatologists all over the world. In France, either FibroScan, FibroTest or liver biopsy can be used for the initial evaluation of patients with chronic hepatitis C without comorbidity [1].

Characteristics of transient elastography

The underlying principle

FibroScan is a non-invasive method for measuring liver stiffness (Figure 1). An ultrasound transducer probe is mounted on the axis of a vibrator. Vibrations of mild amplitude and low frequency are transmitted from the vibrator to the tissues via the transducer, thereby inducing an elastic shear wave that propagates through the tissue. In the meantime, pulse-echo ultrasound acquisitions allow the propagation of the shear wave to be followed and its velocity to be measured, as these are directly related to tissue stiffness: The stiffer the tissue, the faster the shear wave is propagated [2]. The results are expressed in kilopascals (kPa).

Measurements are taken in the right lobe of the liver through the intercostal spaces with the patient lying in dorsal decubitus, the right arm in maximum abduction (Figure 2). The tip of the probe transducer is covered with coupling gel and placed on the skin between the rib bones at the level of the right lobe. The operator, assisted by ultrasound time-motion images, locates a portion of the liver that is at least 6-cm thick and free of large vascular structures. Once the area to be measured has been located, the operator presses the probe button to begin acquisition. Acquisitions that do not have the correct vibration shape or do not correctly follow-up the vibration propagation are automatically rejected by the software.

TE is painless, rapid (it takes less than 5 minutes) and easy to perform at the bedside or in the outpatients clinic. The examination is performed on a non-fasting patient lying flat on his back. TE measures liver stiffness in a volume that approximates a cylinder 1-cm wide and 4-cm long lying between 25 mm and 65 mm below the skin surface (Figure 3). The volume is at least 100 times larger than a biopsy sample and is, therefore, far more representative of the hepatic parenchyma. The success rate is calculated as the number of successful measurements divided by the total number of acquisitions. The median value of successful acquisitions is considered representative of liver stiffness.
probes for obese patients is ongoing. Nevertheless, at this time, clinical research into specific ultrasound, making liver stiffness impossible to measure. The fatty thoracic belt attenuates both elastic waves and for success. Indeed, in overweight or obese patients, presence of a fatty thoracic belt that is the limiting fac-

tory parameters.

with the further input of additional information, including patient demographics, disease etiology and essential labora-
tory parameters.

Limitations and reproducibility

Liver stiffness measurements can be difficult to obtain in obese patients or in those who have narrow intercostal spaces, and is impossible to achieve in patients with ascites [3]. Failure rates have ranged from 2.4% to 9.4% in different studies. In multivariate analyses, the only factor associated with failure was a body mass index (BMI) > 28 kg/m² (odds ratio 10.0; 95% confidence interval 5.7 - 17.9, p = 0.001) [3]. However, it is not the BMI, but the presence of a fatty thoracic belt that is the limiting fac-
tor for success. Indeed, in overweight or obese patients, the fatty thoracic belt attenuates both elastic waves and ultrasound, making liver stiffness impossible to measure. Nevertheless, at this time, clinical research into specific probes for obese patients is ongoing.

On the other hand, a BMI < 19 kg/m² may be associated with discordance between FibroScan and liver biopsy in HCV patients.

Reproducibility of TE is another important prerequisite for its widespread application in clinical practice. In a study by Fraquelli et al., in which 800 TE examinations were performed by two operators in 200 patients with various chronic liver diseases, its reproducibility was excellent for both inter- and intraobserver agreement, with intraclass correlation coefficients (ICC) of 0.984. Interobserver agreement was significantly decreased in patients who had lower degrees of hepatic fibrosis (ICC for F0 - F1 0.60 vs 0.99 for ≥ F2), hepatic steatosis (ICC for steatosis of ≥ 25 % of hepatocytes 0.90 vs 0.98 for < 25%) and/or an increased BMI (ICC for BMI ≥ 25 kg/m² 0.94 vs 0.98 for < 25 kg/m²).

In 935 patients, Kettaneh et al. found that the success rate of TE measurements (‘shots’) decreased with age, and was lower in obese patients than in other patients. After adjusting for age and obesity, an operator with at least 50 prior FibroScan exams had a higher success rate of shots [5].

Normal values of fibroscan

‘Normal’ liver stiffness values have recently been examined in 429 healthy subjects who had no overt causes of liver disease and normal liver enzymes, and were undergoing a medical check-up [6]. The mean liver stiffness value in these patients was 5.5 ± 1.6 kPa. Age had no influence, but stiffness values were higher in men than in women (5.8 ± 1.5 vs 5.2 ± 1.6 kPa, respectively; p = 0.0002), and in subjects with a BMI > 30 kg/m² (6.3 ± 1.9 vs 5.4 ± 1.5 kPa, respectively; p = 0.0003). However, even after adjustment for gender and BMI, liver stiffness values remained higher in patients with the metabolic syndrome (n = 59; 13.7%) than in those without it (6.5 ± 1.6 vs 5.3 ± 1.5 kPa, respectively; p < 0.0001).

Transient elastography in patients with acute hepatitis

Three studies suggest that liver stiffness results are influenced by alanine aminotransferase (ALT) flare-ups [7-9]. Coco et al. reported a 1.3- to 3-fold increase in liver stiffness values at the time of ALT flares, with a later progressive return to baseline values in 10 patients with chronic viral hepatitis and acute exacerbations (nine with hepatitis B). Arena et al. reported similar results in 18 patients with acute viral hepatitis without a history of liver disease. Also, in this study, progressive normalization of liver stiffness values was observed in parallel with a decrease in aminotransferase levels. Sagir et al. reported high liver-stiffness values suggestive of cirrhosis in 15 out of 20 patients with acute liver damage, but no signs of liver cirrhosis on physical examination, ultrasound examination or liver histology.
Transient elastography (FibroScan) (performed in 11 patients). In six patients in whom a follow-up was available, liver stiffness values decreased to values below the cutoff for cirrhosis on normalization of aminotransferase levels.

It should be borne in mind, however, that apart from the setting of acute viral hepatitis and acute reactivation of chronic HBV, liver stiffness values have not been shown to correlate with histological activity in multivariate analyses in patients with chronic hepatitis C in whom ALT flares are unusual.

Transient elastography in chronic liver disease

The first issue in the evaluation of a novel diagnostic tool for measuring liver fibrosis is its validation against the current clinical gold standard (liver biopsy) to determine its sensitivity, specificity and predictability. The standard expression of the effectiveness of a test is to look at the area under the receiver operator characteristic curve (AUROC), which plots the sensitivity over 1-specificity. The perfect test will score 1.0.

In a recent meta-analysis based on seven studies, the pooled estimates for the diagnosis of significant fibrosis were good: sensitivity 70% (95% CI, 67 - 73%), specificity 84% (95% CI, 80 - 88%), positive likelihood ratio 4.2 (95% CI, 2.4 - 7.2), and negative likelihood ratio 0.31 (95% CI, 0.23 - 0.43) [10].

The imperfections of liver biopsy as the reference standard can influence the diagnostic capacity of TE. Thus, the inclusion criteria for such studies need to be stringent and should only include cases with adequate histological samples fulfilling the recommended guidelines for liver histology.

FibroScan in chronic hepatitis C

The results show that liver stiffness values correlate strongly with METAVIR fibrosis stages. AUROCs ranged from 0.79 to 0.83 for significant fibrosis (Tables 1 and 2). However, despite high AUROC values, a substantial overlap of liver stiffness values was observed between adjacent stages of hepatic fibrosis, particularly for the lower fibrosis stages [11,12]. The correlation between liver stiffness and fibrosis stage did not appear to be affected by steatosis. However, as none of the patients in these studies had massive steatosis, further specific studies assessing liver stiffness values in patients stratified according to the degree of steatosis are needed. The interpretation of stiffness values for the diagnosis of fibrosis in chronic hepatitis C is indicated in Figure 4A.

To our knowledge, there is only one prospective study of liver stiffness evolution during and after HCV treatment according to virological response. This pilot study showed that anti-HCV treatment was associated with a fall in FibroScan and FibroTest values, whatever the virological response [13]. In multivariate analyses, treatment was the only factor independently associated with a decrease in the FibroScan value.

However, there have been no studies comparing FibroScan values and liver fibrosis according to liver biopsy after HCV treatment. The correlation between FibroScan/FibroTest values and liver fibrosis after treatment requires further assessment, especially in comparison to liver biopsy.

Given its excellent patient acceptance and simplicity, TE may also be a useful tool for the screening of high-risk populations. In street-based outreach programs for drug users, the acceptance of FibroScan has been excellent [14]. In that study, the usefulness of FibroScan in association with multifaceted interventions for HCV screening in a difficult-to-manage population was evaluated. Also, in this case, the outreach program led to FibroScan screening of mostly

**Figure 4.** Concordance between liver stiffness (kPa) and fibrosis stage according to METAVIR score: (A) Hepatitis C; (B) HCV-HIV co-infection; (C) hepatitis C recurrence after liver transplantation; (D) hepatitis B; (E) chronic cholestatic diseases.

Concordance entre les valeurs d'élasticité hépatique (kPa) et les stades de fibrose selon METAVIR: (A) Hépatite C; (B) co-infection VHC-VIH; (C) récidive virale C après transplantation hépatique; (D) hépatite B; (E) maladies cholestatiques chroniques.
patients with HCV infection, including patients (18%) who had never had, or did not remember having had, a blood sample for HCV screening.

**FibroScan in HCV-HIV co-infected patients**

Only two studies have evaluated the performance of FibroScan in the diagnosis of fibrosis in HCV-HIV co-infected patients (Tables 1 and 2) and, in these cases, the performance was the same as in HCV patients [15,16]. However, there has been no study looking specifically at the correlation between liver stiffness and liver disease due to HIV alone (such as cholangiopathy and regenerative nodular hyperplasia). Moreover, the...
effect of HAART (highly active antiretroviral therapy) on liver stiffness remains unknown. The interpretation of stiffness values for the diagnosis of fibrosis in HCV-HIV co-infection is indicated in Figure 4B.

FibroScan for HCV recurrence after liver transplantation

FibroScan is also useful for the diagnosis of liver fibrosis after liver transplantation for HCV infection (Tables 1 and 2) [17,18]. The cutoff points for the diagnosis of significant fibrosis are around 6.9 and 8.5 kPa [17,18]. With these cutoffs, the sensitivity, specificity, positive predictive value (PPV) and negative predictive value (NPV) are 83%, 70%, 85% and 68%, and 90%, 81%, 92% and 79%, respectively. For the diagnosis of cirrhosis, the cutoff is between 11.9 and 14.5 kPa, with a sensitivity, specificity, PPV and NPV of 82%, 96%, 86% and 94%, and 95%, 91%, 56% and 99%, respectively. The interpretation of stiffness values for the diagnosis of fibrosis in HCV infection after liver transplantation is shown in Figure 4C. During a post-liver transplantation follow-up (6 - 21 months) of 40 patients with paired liver biopsies, liver stiffness results changed in parallel with fibrosis staging (r = 0.71), showing 86% sensitivity and 92% specificity in predicting staging increases [17].

FibroScan and hepatitis B

In patients with hepatitis B, TE performed similarly to that reported with hepatitis C. For the diagnosis of significant fibrosis, severe fibrosis and cirrhosis, the AUROCs were 0.81, 0.93 and 0.93, respectively (Tables 1 and 2). For diagnosis of significant fibrosis with a cutoff point of 7.2 kPa, the sensitivity, specificity, PPV and NPV were 70%, 83%, 80% and 73%, respectively. However, more precise staging may be required in patients with chronic HBV infection who are candidates for antiviral treatment, as the decision to start therapy and the type of drugs prescribed may be influenced by fibrosis stage. Also, studies are needed in HBV inactive carriers, in HBV flare-ups and in HBV infection in Asians. The interpretation of stiffness values for the diagnosis of fibrosis in HBV infection is shown in Figure 4D.

FibroScan in chronic cholestatic diseases

There is a strong correlation between liver stiffness and liver fibrosis in chronic cholestatic diseases (primary biliary cirrhosis, primary sclerosis, cholangitis) [20,21]. For the diagnosis of significant fibrosis, severe fibrosis and cirrhosis, the AUROCs are 0.92, 0.86 - 0.95 and 0.96, respectively (Tables 1 and 2). For each stage of fibrosis, cutoffs are higher than in chronic hepatitis C either because of the nature of the liver fibrosis or because of cholestatics. The interpretation of stiffness values for the diagnosis of fibrosis in chronic cholestatic disease is presented in Figure 4E.

FibroScan and methotrexate treatment

FibroScan also has value in the follow-up of patients treated with methotrexate [22,23]. In one study of patients with Crohn's disease, no difference in liver stiffness was observed in patients who had received a cumulative dose of methotrexate > 1,500mg compared to those taking a total dose < 1,500mg. In another study, 24 patients with psoriasis (median dose 1,635mg) underwent FibroScan, FibroTest and liver biopsy. FibroScan evaluated 88% of patients as not having significant fibrosis (FibroScan value < 7.1 kPa), while FibroTest identified 83% of patients as having significant fibrosis (FibroTest > 0.31). As previously reported, no correlation between liver fibrosis and total methotrexate dose was observed.

FibroScan and hemochromatosis

Recently, a pilot study showed that FibroScan may be useful in patients with hemochromatosis [24]. However, other studies are needed before liver stiffness can be considered a new marker of fibrosis in this disease.

FibroScan in children

In 2007, the first study evaluating FibroScan in the diagnosis of cirrhosis in children with chronic liver disease was published. In this population, liver stiffness correlated with platelet count, total bilirubin level, albumin, gamma-glutamyl transferase, alkaline phosphatases, AST and ALT [25]. For the diagnosis of cirrhosis in 33 children with a liver biopsy, the AUROC was 0.88. Subsequently, a probe specifically designed for children was tested—with similar results.

FibroScan and alcoholic or non-alcoholic fatty liver disease

To our knowledge, there has been no specific study to evaluate FibroScan in the diagnosis of fibrosis in alcoholic patients, and only one study of FibroScan for the diagnosis of fibrosis in patients with non-alcoholic liver disease [26]. For the diagnosis of significant fibrosis, severe fibrosis and cirrhosis, the AUROCs were 0.88, 0.91 and 0.99, respectively. However, other large studies are needed to increase our knowledge of FibroScan in such patients and the effect of severe steatosis on liver stiffness.

Fibrosan and cirrhosis

In a meta-analysis including nine studies, the pooled estimates for the diagnosis of cirrhosis with FibroScan were excellent: sensitivity was 87% (95% CI, 84 - 90%); specificity was 91% (95% CI, 89 - 92%); the positive likelihood ratio was 11.7 (95% CI, 7.9 - 17.1); and the negative likelihood ratio was 0.14 (95% CI, 0.10 - 0.20) [10]. Thus, TE appears to be an excellent tool for the early detection of cirrhosis.
whatever the causal disease. In cirrhotic patients, liver stiffness ranges from 13 - 15 kPa to 75 kPa. Liver stiffness values are significantly correlated with the Child - Pugh score, and with clinical parameters (past history of bleeding varices or ascites, hepatocellular carcinoma), biological parameters (platelets, prothrombin time, factor V, albumin and bilirubin) and other relevant parameters (stage 2/3 esophageal varices, splenomegaly on ultrasonography) of liver disease severity [27]. For instance, the cutoff values of 27.5, 37.5, 49.1, 53.7 and 62.7 kPa had a > 90% NPV for the presence of stage 2/3 esophageal varices, Child - Pugh scores B or C, past history of ascites, hepatocellular carcinoma and esophageal bleeding, respectively (Figure 5).

Clearly, however, it is in portal hypertension that FibroScan may be of particular value (Table 3) [18,28-30]. Liver stiffness is correlated with the presence of esophageal varices and with the hepatic venous pressure gradient. For the diagnosis of esophageal varices, the AUROCs range from 0.76 to 0.84 [28,29]. For the diagnosis of variceal stage 2/3, the sensitivity, specificity, PPV and NPV of a cutoff point of 19 kPa is 91%, 60%, 48% and 95%, respectively [28]. However, other studies are needed before liver stiffness can be used as a factor in deciding whether or not to screen for esophageal varices with endoscopy.

For the diagnosis of portal hypertension (hepatic venous pressure gradient > 6 mmHg), the cutoff is around 8 kPa. The sensitivity, specificity, PPV and NPV with a cutoff of 8.7 kPa is 90%, 81%, 81% and 90%, respectively [18]. For the diagnosis of significant portal hypertension (hepatic venous pressure gradient ≥ 10 mmHg), the cutoffs range from 11.7 to 21 kPa [29, 30]. With a cutoff of 11.7 kPa, the sensitivity, specificity, PPV and NPV are 94%, 74%, 77% and 93%, respectively. With a cutoff of 21 kPa, the sensitivity, specificity, PPV and NPV are 90%, 93%, 92% and 91%, respectively [30].

**Table 3.**

<table>
<thead>
<tr>
<th>Author</th>
<th>Disease</th>
<th>Number of patients</th>
<th>AUROC for the diagnosis of large varices</th>
<th>AUROC for the hepatic portal pressure gradient *</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kazemi28</td>
<td>All</td>
<td>165</td>
<td>0.83</td>
<td>-</td>
</tr>
<tr>
<td>Carrion18</td>
<td>HCV</td>
<td>124</td>
<td>-</td>
<td>0.94</td>
</tr>
<tr>
<td>Vizzutti29</td>
<td>HCV</td>
<td>47</td>
<td>-</td>
<td>0.99</td>
</tr>
<tr>
<td>Bureau30</td>
<td>HCV - alcohol</td>
<td>150</td>
<td>0.76</td>
<td>0.94</td>
</tr>
</tbody>
</table>

* Hepatic portal pressure gradient > 10 mmHg

**Quality of FibroScan examination**
The IQR should not exceed 30% of the median value (20% is better) and 10 liver stiffness measurements should be obtained. The results should always be interpreted by an expert clinician and according to the clinical context (taking into account the patient’s demographics, disease etiology and laboratory parameters). Liver stiffness measurements should be repeated when results are discordant with the clinical context, and a liver biopsy should be performed when the discordance cannot be explained.

**The liver disease**
At this time, FibroScan should not be used in patients with acute hepatitis. In patients with chronic hepatitis, the expert clinician has to know the disease as well as all the clinical, biological and morphological parameters of the disease. In the largest series so far of 1007 patients with chronic liver disease of various causes, it has been suggested that TE cutoff values could be optimized if they are specifically defined for each etiology [31]. Liver stiffness value has to accord with clinical, biological and morphological parameters; this means that, in cases of discordance, the FibroScan or a blood sample should be repeated. Finally, if the FibroScan result is discordant with all other clinical, biological and morphological parameters, it should be left out.

**Fibroscan at bedside**
To justify the use of TE (FibroScan) in clinical practice, there are three important pieces of relevant information:  
- quality of FibroScan examination has to be checked;  
- liver disease has to be known;  
- choice of cutoff point will depend on the reason for the examination.
The choice of cutoff points

To predict the severity of fibrosis, it is better to use a range of values rather than a single cutoff point. For example, in HCV infection when liver stiffness values range from 2.5 to 7 kPa, mild or absent fibrosis is likely, whereas cirrhosis is more likely when values are > 13 - 15 kPa. However, in clinical practice, it is not the extrapolation of fibrosis score that is used, but the exact value of liver stiffness as expressed in kPa. Moreover, a yearly measurement of liver stiffness may be useful as, then, the patient becomes his own control.

Cutoffs are different for each chronic liver disease (Table 4).

The reported TE cutoffs for cirrhosis range from 10.3 kPa in chronic hepatitis B to 17.3 kPa in chronic cholestatic diseases. Because HBV is the main cause of macronodular cirrhosis, it is possible that the amount of fibrosis is lower in the cirrhotic liver of patients with HBV infection than it is in patients with cholestatic diseases. However, it must be borne in mind that these cutoff values have been defined by ROC curves to maximize sensitivity and specificity. Differences between cutoffs may simply be related to differences in cirrhosis prevalence in the studied populations, as was recently suggested with other non-invasive methods [32]. Indeed, across different studies, the prevalence of cirrhosis has varied from 7.5% to 38.5%. Although a cutoff value defined for a given population may be relevant, it may not be applicable to another population with a different rate of prevalence.

Table 4.
Cut-offs of liver stiffness for the diagnosis of cirrhosis
 Valeurs seuils d’élasticité hépatique pour le diagnostic de cirrhose

<table>
<thead>
<tr>
<th>Cutoff (kPa)</th>
<th>Author</th>
<th>Number of patients</th>
<th>Disease</th>
<th>Sensitivity (%)</th>
<th>Specificity (%)</th>
<th>Positive predictive value (%)</th>
<th>Negative predictive value (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>8.4</td>
<td>Wong</td>
<td>133</td>
<td>All</td>
<td>96</td>
<td>63</td>
<td>58</td>
<td>96</td>
</tr>
<tr>
<td>9.4</td>
<td>Ganne-Carrié</td>
<td>775</td>
<td>All</td>
<td>95</td>
<td>78</td>
<td>44</td>
<td>99</td>
</tr>
<tr>
<td>11</td>
<td>Marcellin</td>
<td>173</td>
<td>HBV</td>
<td>93</td>
<td>87</td>
<td>38</td>
<td>99</td>
</tr>
<tr>
<td>11.7</td>
<td>Ganne-Carrié</td>
<td>775</td>
<td>All</td>
<td>91</td>
<td>87</td>
<td>57</td>
<td>98</td>
</tr>
<tr>
<td>11.9</td>
<td>Rigamonti</td>
<td>90</td>
<td>HCV</td>
<td>92</td>
<td>96</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>12.5</td>
<td>Castera</td>
<td>183</td>
<td>HCV</td>
<td>87</td>
<td>91</td>
<td>77</td>
<td>95</td>
</tr>
<tr>
<td>12.5</td>
<td>Carrion</td>
<td>124</td>
<td>HCV</td>
<td>100</td>
<td>87</td>
<td>50</td>
<td>100</td>
</tr>
<tr>
<td>13.4</td>
<td>Wong</td>
<td>133</td>
<td>All</td>
<td>55</td>
<td>93</td>
<td>80</td>
<td>79</td>
</tr>
<tr>
<td>14</td>
<td>Coco</td>
<td>228</td>
<td>HBV-HCV</td>
<td>78</td>
<td>98</td>
<td>98</td>
<td>82</td>
</tr>
<tr>
<td>14.5</td>
<td>Carrion</td>
<td>124</td>
<td>HCV</td>
<td>95</td>
<td>91</td>
<td>56</td>
<td>99</td>
</tr>
<tr>
<td>14.6</td>
<td>Vergara</td>
<td>169</td>
<td>HCV-HIV</td>
<td>93</td>
<td>88</td>
<td>86</td>
<td>94</td>
</tr>
<tr>
<td>14.6</td>
<td>Ziol</td>
<td>251</td>
<td>HCV</td>
<td>86</td>
<td>96</td>
<td>78</td>
<td>97</td>
</tr>
<tr>
<td>15.6</td>
<td>Gomez-Dominguez</td>
<td>94</td>
<td>Primary biliary cirrhosis</td>
<td>88</td>
<td>98</td>
<td>88</td>
<td>98</td>
</tr>
<tr>
<td>16</td>
<td>Gomez-Dominguez</td>
<td>94</td>
<td>All</td>
<td>89</td>
<td>96</td>
<td>80</td>
<td>98</td>
</tr>
<tr>
<td>17.1</td>
<td>Ganne-Carrié</td>
<td>775</td>
<td>All</td>
<td>76</td>
<td>95</td>
<td>73</td>
<td>96</td>
</tr>
<tr>
<td>17.3</td>
<td>Corpechot</td>
<td>95</td>
<td>Cholestatic diseases</td>
<td>93</td>
<td>95</td>
<td>78</td>
<td>99</td>
</tr>
<tr>
<td>17.6</td>
<td>Foucher</td>
<td>354</td>
<td>All</td>
<td>77</td>
<td>97</td>
<td>91</td>
<td>92</td>
</tr>
<tr>
<td>17.6</td>
<td>Vergara</td>
<td>169</td>
<td>HCV-HIV</td>
<td>87</td>
<td>91</td>
<td>88</td>
<td>89</td>
</tr>
<tr>
<td>18.2</td>
<td>Marcellin</td>
<td>173</td>
<td>HBV</td>
<td>57</td>
<td>97</td>
<td>67</td>
<td>96</td>
</tr>
</tbody>
</table>
Conclusion

Liver stiffness measurement using FibroScan is an important tool in the practice of hepatology. The focus should now shift from cross-sectional diagnoses to the use of TE in longitudinal studies to look at disease progression, regression and clinical outcomes, with priority given to large-scale validation studies in particular.

Given its excellent patient acceptance and its simplicity, TE may also be a valuable tool in the screening of high-risk populations (such as alcohol abusers, drug users and diabetics) to identify patients with liver disease. Further studies are needed in this particular area of research.

Conflicts of interest:
Vitor de Ledinghen and Julien Vignol have no conflict of interest.

References


