Validating, deconstructing and refining Baveno criteria for ruling out high-risk varices in patients with compensated cirrhosis

Parastoo Jangouk 1,2 | Laura Turco 1,2,3 | Ana De Oliveira 1,2,4 | Filippo Schepis 3 | Erica Villa 3 | Guadalupe Garcia-Tsao 1,2

1 Section of Digestive Diseases, VA-Connecticut Healthcare System, West Haven, CT, USA
2 Section of Digestive Diseases, Yale School of Medicine, New Haven, CT, USA
3 Division of Gastroenterology, Azienda Ospedaliero-Universitaria di Modena and University of Modena and Reggio Emilia, Modena, Italy
4 Department of Medicine, Federal University of Sao Carlos, Sao Carlos, Brazil

Correspondence
Guadalupe Garcia-Tsao, Section of Digestive Diseases, Yale University School of Medicine, New Haven, CT, USA and Section of Digestive Diseases at the Veterans Administration-Connecticut Health Care System, West Haven, CT, USA.
Email: guadalupe.garcia-tsao@yale.edu

Funding information
Yale Liver Center NIH P30 DK34989.

Handling Editor: Christophe Bureau

Abstract

Background: Guidelines recommend variceal screening in patients with cirrhosis to identify varices at high risk of bleeding requiring primary prophylaxis. Non-invasive criteria to rule out high-risk varices will avoid unnecessary endoscopies. Recent Baveno VI criteria define patients with compensated cirrhosis in whom endoscopy can be avoided as those with a liver stiffness by transient elastography <20 kPa and a platelet count >150 000/mm³.

Aims: To validate Baveno criteria in two cohorts with a different prevalence of high-risk varices and to determine whether alternate parameters not including liver stiffness would be equal/more accurate in ruling out high-risk varices.

Methods: Retrospective study evaluating patients with liver stiffness >10 kPa who had liver stiffness and endoscopy within 1 year of each other.

Results: This study included 161 patients from the US cohort (14 [9%] with high-risk varices) and 101 patients from an Italian cohort (17 [17%] with high-risk varices). Of patients meeting Baveno criteria (41 in the US, 16 in Italy), none had high-risk varices and therefore 26% (US) and 16% (Italy) endoscopies could have been avoided. Sensitivity and negative predictive value were 100%. A stepwise strategy using platelet count >150 000 and MELD=6, increased the number of endoscopies avoided to 54% (US) while maintaining a sensitivity and negative predictive value of 100%. Excellent sensitivity and negative predictive value were validated in the Italian cohort and in another cohort of patients with a clinical diagnosis of cirrhosis.

Conclusions: This study validates Baveno VI criteria, particularly in sites with a low prevalence of high-risk varices and describes a new accurate strategy that does not include liver stiffness.

Keywords
cirrhosis, endoscopy, high-risk varices, non-invasive, transient elastography

1 | INTRODUCTION

Variceal haemorrhage is a complication of cirrhosis that defines decompensation and is associated with significant morbidity and
mortality. First variceal haemorrhage can be prevented through the use of non-selective beta-blockers or endoscopic variceal ligation. However, not all patients with varices are candidates for the prevention of first variceal haemorrhage. Guidelines recommend prophylactic therapy in patients with high-risk varices (HRV), that is, those that are more likely to bleed, specifically patients with medium/large varices or patients with small varices with red wale marks on their surface or small varices occurring in Child C patients.

Determining the presence and size of varices and the presence of red wale marks requires upper endoscopy, an invasive and expensive procedure that is not free of risks. Many studies have looked for non-invasive ways of determining the presence of HRV, so as to circumvent the need for screening endoscopy in some patients. Although a number of laboratory/imaging-derived markers have been proposed, the most significant being the platelet/spleen size ratio, these studies have combined patients with both compensated and decompensated cirrhosis. Finding non-invasive predictors of the presence of HRV is more relevant in patients with compensated advanced chronic liver disease (cACLD), definition that includes patients with advanced fibrosis/compensated cirrhosis because the prevalence of varices in these patients is significantly lower than in those with decompensated cirrhosis in whom the presence of varices is almost universal. More recently, measurements of liver stiffness by transient elastography (TE) have been shown to be useful in discriminating patients with cirrhosis with and without HRV, particularly when combined with variables such as platelet count and spleen size.

In fact, the most recent Baveno consensus conference, based on a body of evidence from the literature and a recent multicentre study in patients with compensated advanced chronic liver diseases defined patients unlikely to have HRV as those with cACLD with a liver stiffness measurement (LSM) less than 20 kPa (determined by TE) and a platelet count >150,000/mm³. These criteria require validation as they were based on evidence that was mostly acquired in European centres where TE has been available for many more years than in the USA and where the prevalence of obesity (which could alter stiffness measurements) in patients with compensated cirrhosis is lower. In fact, TE is not available in most medical centres in the USA and trying to define non-invasive criteria that do not include TE would be desirable.

Our study had two aims: (i) the primary aim was to validate the criteria proposed at the Baveno VI Consensus conference in two cohorts of patients with cACLD, one in the USA and one in Europe and (ii) to determine whether alternate parameters (not including TE) would be equally or more predictive than Baveno criteria in ruling out HRV.

2 | PATIENTS AND METHODS

This is a retrospective cohort study. The US cohort consisted of patients with chronic liver disease that attended the outpatient liver clinics at the Division of Gastroenterology, University of Modena and Reggio Emilia, Modena, Italy who had TE performed in the period between May 2010 and April 2016. This study was approved by the VA Connecticut institutional review board (VA CT IRB) in the USA and by the University of Modena and Reggio Emilia Ethics Committee in Italy. As this is a retrospective study, obtaining informed consent was not applicable.

Patients were included in the study if they had a LSM ≥ 10 kPa and had laboratory tests and upper endoscopy performed within 12 months of TE. Exclusion criteria were decompensated cirrhosis (defined as the history or presence of overt ascites, overt encephalopathy or variceal haemorrhage); portal or splenic vein thrombosis, history of splenectomy and liver transplantation. Patients with LSM ≥ 10 were selected because, in the absence of other clinical signs, LSM < 10 kPa excludes the presence of cACLD and we wanted to be more inclusive. Patients who had LSM with a success rate < 60% or an IQR/median > 30% were also excluded.

TE was performed after at least 4 hours of fasting by experienced practitioners. LSMs were performed in the right lobe of liver as previously described and 10 successful measurements were obtained in each patient. In patients who had more than one LSM in the study period, the one with the lowest variability (IQR/median) was selected. LS measurements were performed initially using the M probe but if values were not obtainable because of obesity, they would be performed using the XL probe.

Our first goal was to determine the sensitivity of the Baveno definition (LSM < 20 kPa and platelet count > 150,000/mm³), that is, its ability in ruling out the presence of HRV and to determine the number of endoscopies that would have been safely avoided by using this definition. Because we did not include Child C patients, HRV were defined as medium/large varices or small varices with red wale marks on their surface.

For our second objective, we used data from the US cohort (training cohort) to identify and test other variables that would be helpful in ruling out HRV. We first compared routine laboratory values between patients with and without HRV. For variable(s) that would be most significantly different between groups, the cutoff selected would be the...
one that would avoid missing even one patient with HRV. Sensitivity, NPV, potential number of endoscopies avoided were then calculated for the following variables: LSM<20 kPa alone, platelet count >150 000 alone, any new variable uncovered with above analysis, combinations of variables in a stepwise approach. Results of the new variables/combinations of variables obtained in the US cohort were then validated in the Italian cohort (validation cohort).

2.1 | Statistical analysis

Statistical analysis was performed using SPSS package v.22 (SPSS Inc., Chicago, IL, USA). Comparisons between groups were performed using Mann-Whitney U test for non-parametric tests and Fisher’s exact test for proportions. Because the main objective of this study was to determine parameters or combinations of parameters to rule out HRV, the main results calculated were sensitivity, negative predictive value (NPV) and their 95% confidence intervals (CIs) as well as the number of endoscopies that could have been circumvented. As we were not interested in analysing specificity/positive predictive value, AUROC curves were not constructed.

3 | RESULTS

3.1 | US cohort

A total of 839 patients were screened at the VACHS in the study period, of which 296 had a LSM≥10 kPa. Of these, 135 patients were excluded because they did not have an upper endoscopy performed within 1 year of TE. Therefore, 161 patients were analysed. The median time between LSM and endoscopy was 3 months (range 0-363 days) and between LSM and laboratory data was 1 month (0-300 days).

There was no significant difference between the LSM measured by M probe vs XL probe in this population (19.6 with M probe vs 21.3 with XL probe). Demographic and clinical characteristics of these patients are shown in Table 1. Notably, only one patient was female and the main aetiology of cirrhosis was hepatitis C. In patients with hepatitis C, both LSM and upper endoscopy were performed before the initiation of direct acting antiviral therapy. Endoscopically, 106 (65.8%) patients had no gastroesophageal varices, 41 (25.5%) had small varices and 14 (8.6%) had medium/large varices (HRV). There were no patients with varices (any size) and red wale marks. As shown in Table 1, 41/161 (25.5%) patients fulfilled Baveno criteria predicting the absence of HRV and would have circumvented screening endoscopy. None of these patients had medium/large varices, that is, no patient with HRV would have been missed. The sensitivity of Baveno criteria was 100% (95% CI 77%-100%) with a NPV of 100% (95% CI 91%-100%).

3.2 | Italian cohort

This cohort consisted of 101 patients with chronic liver disease with a LS≥10 kPa. The cohort differed from the US cohort regarding gender (more females); a lower BMI and a higher prevalence of varices and HRV and the fact that all LSMs were obtained using the M probe (Table 2). Endoscopically, 48 (47.5%) patients had no varices, 36 (35.6%) had small varices and 17 (16.8%) had medium/large varices (HRV). The median time between LSM and endoscopy was 2 months (range 0-357 days) and between LSM and laboratory data was 2 months (0-273 days). Similar to the US cohort, the only HRV were those that were medium/large-sized. As shown in Table 2, 16/101 (15.8%) patients fulfilled Baveno criteria predicting the absence of HRV and would have circumvented screening endoscopy. None of these patients had medium/large varices, that is, no patient with HRV would have been missed. The sensitivity was 100% [95% CI 80%-100%] with NPV of 100% [95% CI 79%-100%].

3.3 | Deconstructing/refining Baveno criteria

As shown in Table 3 and as analysed in the US cohort, platelet count and MELD score were the two parameters that most differed between patients with and without HRV. Because MELD was not assessable in

| TABLE 1 | Characteristics of patients with compensated cirrhosis (LSM≥10 kPa) in the US Cohort |
|----------|----------------------------------------|
| Characteristics | US Cohort (N=161) |
| Age-years | 62 (40-80) |
| Male-sex (%) | 99.4 |
| Aetiology of liver disease (%) | |
| HCV | 73.3 |
| ETOH | 13.0 |
| NASH/NAFLD | 10.6 |
| Miscellaneous | 3.1 |
| BMI | 29 (17-47) |
| Albumin g/L | 3.6 (2.4-4.6) |
| Bilirubin mg/dl | 0.78 (0.23-3) |
| INR (n=159) | 1.1 (0.9-1.6) |
| Creatinine mg/dL (n=158) | 0.9 (0.6-2.1) |
| AST IU/ml | 46 (14-198) |
| Platelet count×103/mm3 | 139 (25-383) |
| Child Pugh score (n=159) | 5 (5-9) |
| Child Pugh class (%) (n=159) | |
| A | 92.4 |
| B | 7.6 |
| MELD score (n=156) | 9 (6-17) |
| Liver Stiffness (kPa) | 20.4 (10-75) |
| M probe used (%) | 49.3 |
| Patients with varices (any size) n (%) | 55 (34.1) |
| Patients with high-risk varices n (%) | 14 (8.7) |
| Patients fulfilling Baveno criteriaa | 41 (25.5%) |
| Patients fulfilling Baveno criteria who had HRV | 0/41 |

.Results are expressed as median (range) if not stated otherwise.

aDefined as LSM<20 kPa and platelet count >150×103/mm3, patients fulfilling the criteria would have circumvented screening endoscopy.
TABLE 2  Characteristics of patients with compensated cirrhosis (LSM≥10 kPa) in the Italian cohort

| Characteristics                      | Italian Cohort (n=101) |
|--------------------------------------|------------------------|
| Age-years                            | 63 (23-80)             |
| Male-sex (%)                         | 72.3                   |
| Aetiology of liver disease (%)       |                        |
| HCV                                  | 66.4                   |
| ETOH                                 | 11.8                   |
| NASH/NAFLD                           | 3.0                    |
| Miscellaneous                        | 18.8                   |
| BMI                                  | 25 (19-30)             |
| Albumin g/L                          | 3.9 (2.5-4.8)          |
| Bilirubin mg/dl                      | 0.96 (0.37-3)          |
| INR                                  | 1.17 (0.9-1.8)         |
| Creatinine mg/dL                     | 0.78 (0.44-1.57)       |
| AST IU/ml                            | 44 (10-198)            |
| Platelet count×10^3/mm³              | 98 (36-340)            |
| Child Pugh score                     | 5 (5-9)                |
| Child Pugh class (%)                 | 91.1                   |
| MELD score                           | 8.9                    |
| Liver Stiffness (kPa)                | 17.6 (10-75)           |
| M probe used (%)                     | 100                    |
| Patients with varices (any size) n (%)| 53 (52.4)             |
| Patients with HRV n (%)              | 17 (16.8)              |
| Patients fulfilling Baveno criteria³| 16 (15.8)              |
| Patients fulfilling Baveno criteria who had HRV| 0/16 |

Results are expressed as median (range) if not stated otherwise.

五名患者，其中三名因为它们是慢性肾病的慢性肝硬化的患者，另外两名因为它们是抗血小板的患者。

对于切点的使用，我们决定保留一个已经由Baveno标准（>150 000）建立的版本。这个版本已经在Baveno之外的其他研究中被建立。因为在我们的美国队列中，没有一个患者MELD为6，而1/56的患者MELD为7，我们使用了MELD切点作为6。我们随后分析了美国队列，以评估≥150 000/mm³的切点值²，MELD=6和Baveno criteria/MELD=6，这是添加MELD=6作为不能有HRV的Baveno criteria接续点，如果MELD=6在超过150 000但没有MELD=6的情况下是不可能有HRV的（图1）。这些结果说明

五名患者，其中三名因为它们是慢性肾病的慢性肝硬化的患者，另外两名因为它们是抗血小板的患者。

或者，通过实验室检测和成像，但谁没有使用TE（1）来确定。

因为这些患者在这些队列中被筛选使用了TE，我们分析了一组从大部分患者的外周肝脏中目的性队列的患者。

在意大利队列中有一个更高的HRV的百分比，最好的策略就是使用Baveno/TE策略，尽管在这一科目的数量的内镜检查避免了右20%（30/101）和一个患者可能不会被遗漏（sensitivity 94%，95% CI 71-100%；NPV 100%，95% CI 96-100%）是唯一在选择患者和切点的数>150 000的患者中被遗漏的。这些患者中的一个MELD=6（图1）。
Identifying patients with a low probability of having high-risk gastroesophageal varices (i.e., those requiring prophylactic therapy) is important to be able to circumvent the performance of screening endoscopies due to the time, costs, and importantly, possible risks associated with the procedure. This is particularly relevant for patients with cACLD who have a low probability of having high-risk varices (HRV). In this sense, the Baveno VI consensus workshop, based on a large body of evidence and a recent multicentre study, took a big step forward by defining patients having a low probability of having HRV as those with cACLD, a liver stiffness <20 kPa and a platelet count >150,000/mm$^3$.

We were able to validate these criteria in two separate cohorts with cACLD (defined as a liver stiffness ≥10 kPa and no decompensating events): one in a male Veteran population with a high prevalence of obesity in the USA and one in a general population in northern Italy. Because prevalence affects the predictive value of any test, we chose two cohorts with different prevalence of varices/HRV. The US cohort had a lower prevalence of varices (34%) and of HRV (9%) compared to the Italian cohort (52% varices, 17% HRV). Despite these differences, none of the patients that met Baveno criteria in either cohort were found to have HRV. However, endoscopy would have been circumvented in a larger number of patients in the US cohort (26% vs 16%).

The sensitivity of the definition was 100% in both cohorts with a 100% NPV. Because the number of patients included is not large, lower limit of the confidence intervals for the NPV indicates that, theoretically, up to 9% (in the low prevalence cohort) to 21% (in the higher prevalence cohort) could have HRV.

Differences in the prevalence of varices between the two cohorts are not explicable since they were both selected using the same criteria. Since this is a retrospective study, we cannot be sure that these were unselected patients. In fact, our third cohort of patients, in whom a clinical diagnosis of cirrhosis had been established clinically and who did not have TE performed, had an even larger prevalence of varices.

In a recently published retrospective study that included 310 patients with an even lower prevalence of HRV (5%), 33% of patients met Baveno criteria (and could have circumvented endoscopy) but they missed two patients with HRV for a sensitivity of 87% and NPV 98%, lower than our results. Notably, one of the two misclassified patients had had a splenectomy and excluding this patient could have made results comparable to ours.

It must be mentioned that in the Baveno consensus, ruling in cACLD required a LSM>15 kPa so there is a possibility that patients without cACLD could have been included in our study. We wanted to be inclusive so as not to miss any patient with cACLD. We performed an analysis (results not shown) restricted to patients with LSM >15 (122 in the US cohort and 70 in the Italian cohort). As expected, the prevalence of varices was a bit higher (10% in the US cohort, 24% in the Italian cohort) but the number of endoscopies avoided was essentially unchanged (27% and 19% respectively).

The second objective of our study was to identify additional or alternate parameters that would increase the number of endoscopies that could be circumvented and that could be applicable in sites where TE is not available. Platelet count and MELD score were the most likely candidates as they were significantly different between those with and without HRV.

Platelet count alone has been shown to be a strong predictor of HRV in studies that have included patients with both compensated and decompensated cirrhosis with a suboptimal diagnostic accuracy. In patients with compensated cirrhosis, one study showed...
that none of eight patients with large varices had a platelet count above 150,000/mm$^3$ while in another study this occurred in 1/13 patients with medium/large varices for a negative predictive value of 99%. These findings are not unlike our results where none of 14 patients with HRV in the US cohort and only 1/17 in the Italian cohort had a platelet count > 150,000/mm$^3$.

Although MELD score has been explored as a predictor of varices, these studies have all included a significant proportion of patients with decompensated cirrhosis. To our knowledge, this is the first study that shows the value of MELD in predicting HRV in patients with compensated cirrhosis. We found that none of 14 patients with HRV in the US cohort and none of 17 patients with HRV in the Italian cohort had a MELD score of 6. However, the number of endoscopies avoided just using the MELD score is quite low.

Adding MELD=6 to Baveno criteria, the number of endoscopies that could have been avoided increased from 26% to 38% in the US cohort and from 16% to 28% in the Italian cohort, while maintaining the same sensitivity and NPV. However, this requires TE and this is not widely available.

In fact, the largest proportion of endoscopies that could be avoided resulted from a stepwise combination of a platelet count > 150,000/mm$^3$ and a MELD=6 (in those with a platelet count < 150,000) as depicted in the Figure. With this combination, 54% of endoscopies could be avoided (compared to 26% using Baveno criteria) while maintaining a sensitivity and NPV of 100%. Results from our US training cohort were validated in the Italian cohort in whom we found that we could avoid 30% of endoscopies (compared to 16% using Baveno criteria) with a somewhat lower but still acceptable sensitivity of 94% and a NPV of 97% because one patient with HRV was missed. Because one could argue that the two original cohorts were selected based on TE, we analysed a third cohort of patients with a clinical diagnosis of compensated cirrhosis in whom TE was not performed and were able to further validate this strategy.

This study is retrospective and the interval between endoscopy and LSM was as large as 12 months. However, per recent guidance the minimal interval for repeat screening endoscopy in patients with no or small varices is 1 to 2 years which indicates that patients are unlikely to develop HRV in this interval. Sample size was not large, most patients were male and most patients had untreated hepatitis C. Therefore, our new strategy requires validation in a larger number of patients with a more equal gender distribution and in the growing population of patients with cirrhosis caused by non-alcoholic steatohepatitis.

In conclusion, this study validates non-invasive criteria defined by the Baveno consensus workshop in the identification of patients with compensated cirrhosis unlikely to have HRV requiring prophylactic therapy and who can therefore safely avoid screening endoscopy. Recognizing that TE is not widely available in the USA and worldwide, we also found that stepwise combination of platelet count > 150,000/mm$^3$ and a MELD score=6 has the potential of avoiding more endoscopies particularly in centres with a low prevalence of high-risk varices. This simple model requires validation in other larger cohorts with different aetiologies of cirrhosis.

### TABLE 4 Refining Baveno criteria

| Group                  | US cohort (n=161) – 9% HRV | Italian Cohort (n=101) – 17% HRV |
|------------------------|-----------------------------|----------------------------------|
| EGDs avoided           | 41 (26%)                    | 60 (54%)                         |
| Baveno criteria        | 0.14                        | 0.14                             |
| MELD = 6               | 0.14                        | 0.14                             |
| Baveno/MELD = 6        | 0.14                        | 0.14                             |
| EGD, esophagogastroduodenoscopy; HRV, High-risk varices; PLT, platelet count (×1000/mm$^3$); Baveno/MELD adds patients who do not fulfil Baveno criteria (PLT < 150 and LSM > 20) but have a MELD < 7; PLT/MELD adds patients with a platelet count < 150,000 but have a MELD = 6. |
CONFLICT OF INTEREST

No conflict of interest.

REFERENCES

1. Garcia-Tsao G, Abraldes J, Berzigotti A, et al. Portal Hypertensive Bleeding in Cirrhosis: Risk Stratification, Diagnosis and Management - 2016 Practice Guidance by the American Association for the Study of Liver Diseases. Hepatology 2017;65:310-335.
2. De Franchis R, Baveno VIF. Expanding consensus in portal hypertension: Report of the Baveno VI Consensus Workshop: stratifying risk and individualizing care for portal hypertension. J Hepatol. 2015;63:743-752.
3. Giannini EG, Zaman A, Kreil A, et al. Platelet count/spleen diameter ratio for the noninvasive diagnosis of esophageal varices: results of a multicenter, prospective, validation study. Am J Gastroenterol. 2006;101:2511-2519.
4. Kovalak M, Lake J, Mattek N, et al. Endoscopic screening for varices in cirrhotic patients: data from a national endoscopic database. Gastrointest Endosc. 2007;65:82-88.
5. Kim BK, Han KH, Park JY, et al. A liver stiffness measurement-based, noninvasive prediction model for high-risk esophageal varices in B-viral liver cirrhosis. Am J Gastroenterol. 2010;105:1382-1390.
6. Berzigotti A, Seijo S, Arena U, et al. Elastography, spleen size, and platelet count identify portal hypertension in patients with compensated cirrhosis. Gastroenterology. 2013;144:102-111. e1.
7. Ding NS, Nguyen T, Iser DM, et al. Liver stiffness plus platelet count can be used to exclude high-risk oesophageal varices. Liver Int. 2016;36:240-245.
8. Augustin S, Milan L, Gonzalez A, et al. Detection of early portal hypertension with routine data and liver stiffness in patients with asymptomatic liver disease: a prospective study. J Hepatol. 2014;60:561-569.
9. Abraldes JG, Bureau C, Stefanescu H, et al. Noninvasive tools and risk of clinically significant portal hypertension and varices in compensated cirrhosis: The “Anticipate” study. Hepatology 2016;64:2173-2184.
10. Berzigotti A, Garcia-Tsao G, Bosch J, et al. Obesity is an independent risk factor for clinical decompensation in patients with cirrhosis. Hepatology. 2011;54:555-561.
11. Maurice JB, Brodkin E, Arnold F, et al. Validation of the Baveno VI criteria to identify low risk cirrhotic patients not requiring endoscopic surveillance for varices. J Hepatol 2016;65:899-905.
12. Sharma P, Mishra SR, Kumar M, et al. Liver and spleen stiffness in patients with extrahepatic portal vein obstruction. Radiology. 2012;263:893-899.
13. Tafarel JR, Tolentino LH, Correa LM, et al. Prediction of esophageal varices in hepatic cirrhosis by noninvasive markers. Eur J Gastroenterol Hepatol. 2011;23:754-758.
14. Qamar AA, Grace ND, Groszmann RJ, et al. Platelet count is not a predictor of the presence or development of gastroesophageal varices in cirrhosis. Hepatology. 2008;47:153-159.
15. Sanyal AJ, Fontana RJ, Di Bisceglie AM, et al. The prevalence and risk factors associated with esophageal varices in subjects with hepatitis C and advanced fibrosis. Gastrointest Endosc. 2006;64:855-864.
16. Zambam De Mattos A, Alves De Mattos A, Daros LF, et al. Aspartate aminotransferase-to-platelet ratio index (APRI) for the non-invasive prediction of esophageal varices. Ann Hepatol 2013;12:810-814.
17. Burton JR. Jr, Liangpunsakul S, Lapidus J, et al. Validation of a multivariate model predicting presence and size of varices. J Clin Gastroenterol 2007;41:609-615.

How to cite this article: Jangouk P, Turco L, Oliveira AD, Schepis F, Villa E, Garcia-Tsao G. Validating, deconstructing and refining Baveno criteria for ruling out high-risk varices in patients with compensated cirrhosis. Liver Int. 2017;37:1177-1183.