The association between the MELD-XI score and heart failure in patients with acute myocardial infarction after coronary artery stenting-a retrospective study

Difang Chen[1#], Mei Lu[2#], Zhaoming Fu[1], Kejun Ding[1], Peng Liang[3]

[1]Department of Cardiology, Zhuji People's Hospital of Zhejiang Province, Zhuji, China; [2]Department of Intensive Care Unit, Huai'an Hospital of Huai'an City, Huai'an, China; [3]Internal Medicine-Cardiovascular Department, The People's Hospital of Dazu, Chongqing, China

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[#]These authors contributed equally to this work

Correspondence to: Peng Liang, MD. Internal Medicine-Cardiovascular Department, The People's Hospital of Dazu, Chongqing, No. 1073 The Second Ring of South Road, Dazu District, Chongqing 402360, China. Email: liangpeng202223@sina.com.

Background: The model for end-stage liver disease (MELD) score is a marker used to evaluate end-stage liver disease in patients with liver failure and is suggested to be valuable in evaluating heart diseases such as heart failure. Because patients with heart failure and myocardial infarction often use anticoagulants, there is an impact on the international normalized ratio (INR). Therefore, removing the INR from MELD score to form MELD-XI score may help to more accurately evaluate the cardiac function in patients with heart failure. This study was conducted to examine the predictive value of MELD-XI score in patients with acute myocardial infarction after coronary artery stenting, as there is a lack of literature in this area.

Methods: The data of 318 patients with acute myocardial infarction admitted to The People's Hospital of Dazu from January 2018 to January 2021 was retrospectively collected. According to the MELD-XI score on admission, the patients were divided into a high-MELD-XI score group (n=159) and a low-MELD-XI score group (n=159). The patients were followed up for 1 year after surgery to observe the long-term prognosis and the long-term prognosis of the 2 groups was compared.

Results: Compared with that in the low-MELD-XI score group, the left ventricular ejection fraction in the high-MELD-XI score group was significantly reduced (51.61%±7.66% *vs.* 60.48%±5.94%; P<0.001), while the level of N-terminal pro-B-type natriuretic peptide (NT-proBNP) increased significantly (821.58±461.81 *vs.* 723.51±335.16 ng; P=0.031). The MELD-XI score had a certain predictive value for heart failure in patients with acute myocardial infarction after coronary artery stenting, and the area under the curve was 0.730 (95% CI: 0.670–0.791; P<0.001). The MELD-XI score had a predictive value for death in patients with acute myocardial infarction after coronary artery stenting, and the area under the curve was 0.704 (95% CI: 0.564–0.843; P=0.022). MELD-XI score was significantly negatively correlated with left ventricular ejection fraction in patients with acute myocardial infarction after coronary artery stenting (r=–0.444; P<0.001).

Conclusions: MELD-XI could evaluate the cardiac function of patients with acute myocardial infarction after coronary artery stenting, which was valuable in predicting the prognosis.

Keywords: MELD-XI; acute myocardial infarction; heart function; prognosis; coronary artery stenting

Introduction

In recent years, with the increasing incidence of hypertension, diabetes, hyperlipidemia, and other diseases, the incidence of acute myocardial infarction has gradually risen in kind (1,2). Coronary artery stenting is the main means of treating acute myocardial infarction, with the main purpose being to restore blood flow to the ischemic myocardium, preventing recurrent myocardial infarction, and thus improving the prognosis of patients. Although medical technology has been greatly improved, acute myocardial infarction is still one of the main factors of death in middle-aged and older adult patients, mainly because heart failure or recurrent myocardial infarction can occur after acute myocardial infarction, resulting in death (3-5). Therefore, it is crucial to predict the long-term prognosis of patients with acute myocardial infarction after coronary artery stenting and to identify the risk factors of poor prognosis. N-terminal pro-B-type natriuretic peptide (NT-proBNP) was the most commonly used predictor in patients with acute myocardial infarction after coronary artery stenting. However, the predictive value of NT-proBNP was limited in patients complicated with renal insufficiency. The model for end-stage liver disease (MELD) score is a marker used to evaluate end-stage liver disease in patients with liver failure, and existing researchers have found that the MELD score is also valuable for evaluating heart diseases such as heart failure (6). Patients with heart failure and

myocardial infarction often use anticoagulants, but this can affect the international normalized ratio (INR). Therefore, removing the INR from the MELD score to form the MELD-XI score may more accurately evaluate the cardiac function in patients with heart failure (7). Due to a lack of data in this area, this study was conducted to determine the association between the MELD-XI score and heart failure in patients with acute myocardial infarction after coronary artery stenting. We present this article in accordance with the STARD reporting checklist (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-562/rc).

Methods

General information

This was a retrospective study. The data of 318 patients with acute myocardial infarction admitted to The People's Hospital of Dazu from January 2018 to January 2021 was retrospectively collected. According to the MELD-XI score on admission, the patients were divided into a high-MELD-XI score group (n=159) and a low-MELD-XI score group (n=159). The inclusion criteria were the following: (I) acute myocardial infarction, (II) coronary artery stenting implantation, (III) age ≥18 years old, and (IV) complete data. Meanwhile, the exclusion criteria were the following: (I) hepatic and renal insufficiency, (II) malignant tumors, (III) congenital heart disease, (IV) biliary tract diseases, (V) history of liver and kidney transplantation, (VI) chronic blood system diseases, and (VII) other major diseases. This study was approved by the Ethics Committee of The People's Hospital of Dazu (No. c20210048) which exempted this study from informed consent. This study was conducted in accordance with the 2013 revision of the Declaration of Helsinki.

MELD-XI score

On admission, the MELD-XI score was calculated for each patient as follows: MELD-XI = $5.11 \times \ln(\text{Natural logarithm})^{\text{bilirubin}} + 11.76 \times \ln^{\text{creatinine}} + 9.44$. If the result was less than ≤1, the MELD-XI value was always treated as 1.

Data collection

Data on age, sex, body mass index, smoking history, history of alcoholism, hypertension, diabetes, hyperlipidemia,

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Highlight box

Key findings
- The model for end-stage liver disease (MELD) score shows good ability in assessing the cardiac function of patients with acute myocardial infarction.

What is known and what is new?
- The MELD score is a marker used to evaluate end-stage liver disease in patients with liver failure, and existing scholars have found that the MELD score is also valuable in evaluating heart diseases such as heart failure.
- The MELD score without international normalized ratio (MELD-XI) can better evaluate cardiac function in patients with acute myocardial infarction, which is of certain significance in predicting the prognosis of patients.

What is the implication, and what should change now?
- MELD-XI may be useful for clinicians to determine the severity of the condition in patients with acute myocardial infarction.

Table 1 Comparison of general data between 2 groups

Characteristic	High-MELD-XI score group (n=159)	Low-MELD-XI score group (n=159)	t/χ^2 value	P value
Age (years)	63.73±4.82	64.02±5.01	0.526	0.599
Gender (male)	80 (50.31)	86 (54.09)	0.454	0.501
Body mass index (kg/m^2)	24.58±1.92	24.81±1.85	1.088	0.278
History of smoking	21 (13.21)	25 (15.72)	0.407	0.524
History of alcoholism	18 (11.32)	21 (13.21)	0.263	0.608
Hypertension	102 (64.15)	108 (67.92)	0.505	0.477
Diabetes	43 (27.04)	35 (22.01)	1.087	0.297
Hyperlipidemia	134 (84.28)	131 (82.39)	0.204	0.652

Data are presented as mean ± standard error or n (%). MELD-XI, model for end-stage liver disease with no international normalized ratio.

left ventricular ejection fraction, NT-proBNP, recurrent myocardial infarction, stent thrombosis, heart failure, and death were collected. Patients were followed up for 1 year after surgery by clinical visits and cellphone.

Treatment methods

Patients in both groups were given coronary artery stenting, and dual antiplatelet therapy was administered up to 1 year after surgery. Patients with hypertension, diabetes, or hyperlipidemia were provided with hypoglycemic, hypotensive, or lipid-lowering treatment, respectively.

Statistical analysis

SPSS 26.0 (IBM Corp., Armonk, NY, USA) software was used to complete the data analysis, with a P value <0.05 indicating a statistical difference (2-sided test). The count data of the 2 groups are expressed as the number and percentage, and the difference between groups was analyzed with the chi-squared test. The measurement data of both groups are expressed as mean ± standard deviation, and the difference between groups was analyzed with the independent samples *t*-test. The predictive value of the MELD-XI for the prognosis of patients with acute myocardial infarction after coronary artery stenting was analyzed using the receiver operating characteristic (ROC) curve.

Results

Comparison of general data between 2 groups

There was no significant difference in age, gender, body

mass index, smoking history, alcohol history, hypertension, diabetes mellitus, or and hyperlipidemia between the 2 groups (P>0.05; *Table 1*).

Comparison of left ventricular ejection fraction and NT-proBNP between the 2 groups

Compared with that in the low-MELD-XI score group, the left ventricular ejection fraction in the high-MELD-XI score group was significantly reduced (51.61%±7.66% *vs.* 60.48%±5.94%; P<0.001), while the level of NT-proBNP increased significantly in the high-MELD-XI score group (821.58±461.81 *vs.* 723.51±335.16 ng/L; P=0.031; *Table 2*).

Comparison of prognosis between the 2 groups

Compared with that in the low-MELD-XI score group, the incidence of recurrent myocardial infarction in the high-MELD-XI score group was significantly increased (10.69% *vs.* 3.77%; P=0.017); the incidence of heart failure was significantly higher in the high-MELD-XI score group (24.53% *vs.* 2.52%; P<0.001), as was mortality (5.66% *vs.* 1.26%; P=0.032; *Table 3*).

Predictive value of MELD-XI score for recurrent myocardial infarction in patients with acute myocardial infarction after coronary artery stenting

The MELD-XI score had no significant predictive value for recurrent myocardial infarction in patients with acute myocardial infarction after coronary artery stenting, and the area under the curve was 0.596 (95% CI: 0.474–0.728;

Table 2 Comparison of left ventricular ejection fraction and NT-proBNP level between 2 groups

Characteristic	High-MELD-XI score group (n=159)	Low-MELD-XI score group (n=159)	t value	P value
Left ventricular ejection fraction (%)	51.61±7.66	60.48±5.94	11.534	<0.001
NT-proBNP (ng/L)	821.58±461.81	723.51±335.16	2.167	0.031

Data are presented as mean ± standard error. NT-proBNP, N-terminal pro-B-type natriuretic peptide; MELD-XI, model for end-stage liver disease with no international normalized ratio.

Table 3 Comparison of prognosis between 2 groups

Characteristic	High-MELD-XI score group (n=159)	Low-MELD-XI score group (n=159)	χ^2 value	P value
Recurrent myocardial infarction	17 (10.69)	6 (3.77)	5.671	0.017
Stent thrombus	12 (7.55)	11 (6.92)	0.047	0.829
Heart failure	39 (24.53)	4 (2.52)	32.943	<0.001
Mortality	9 (5.66)	2 (1.26)	4.614	0.032

Data are presented as n (%). MELD-XI, model for end-stage liver disease with no international normalized ratio.
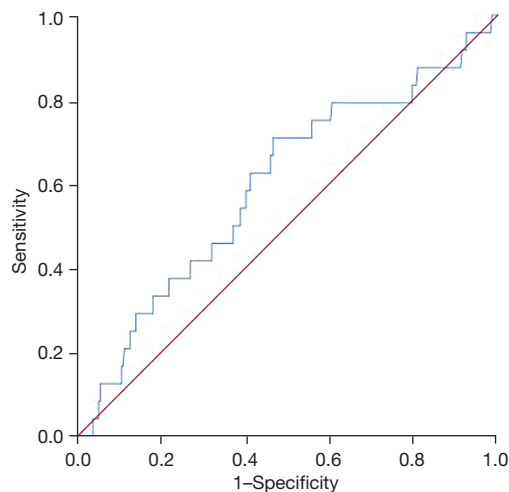

Figure 1 The predictive value of MELD-XI score for recurrent myocardial infarction in patients with acute myocardial infarction after coronary artery stenting. MELD-XI, model for end-stage liver disease with no international normalized ratio.

P=0.118; *Figure 1*).

Predictive value of MELD-XI score for stent thrombosis in patients with acute myocardial infarction after coronary artery stenting

The MELD-XI score had no obvious predictive value for stent thrombus in patients with acute myocardial infarction after coronary artery stenting, and the area under the curve was 0.491 (95% CI: 0.368–0.613; P=0.877; *Figure 2*).

Predictive value of MELD-XI score in patients with acute myocardial infarction after coronary artery stenting

The MELD-XI score had a degree of predictive value for heart failure in patients with acute myocardial infarction after coronary artery stenting, and the area under the curve was 0.730 (95% CI: 0.670–0.791; P<0.001; *Figure 3*).

Predictive value of MELD-XI score for death after coronary artery stenting in patients with acute myocardial infarction

The MELD-XI score had a degree of predictive value for death after coronary artery stenting in patients with acute myocardial infarction, and the area under the curve was 0.704 (95% CI: 0.564–0.843; P=0.022; *Figure 4*).

Correlation between MELD-XI and left ventricular ejection fraction and NT-proBNP in patients with acute myocardial infarction after coronary artery stenting

The MELD-XI score was significantly negatively correlated with left ventricular ejection fraction (r=–0.444; P<0.001). There was no significant correlation between MELD-XI and NT-proBNP (r=0.068; P=0.224; *Figure 5*).
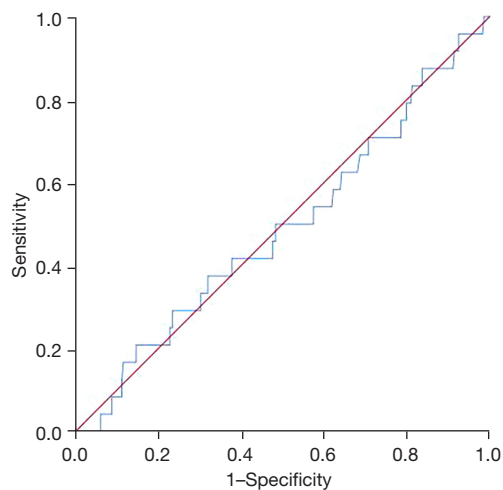
Figure 2 Predictive value of MELD-XI score for stent thrombosis in patients with acute myocardial infarction after coronary artery stenting. MELD-XI, model for end-stage liver disease with no international normalized ratio.
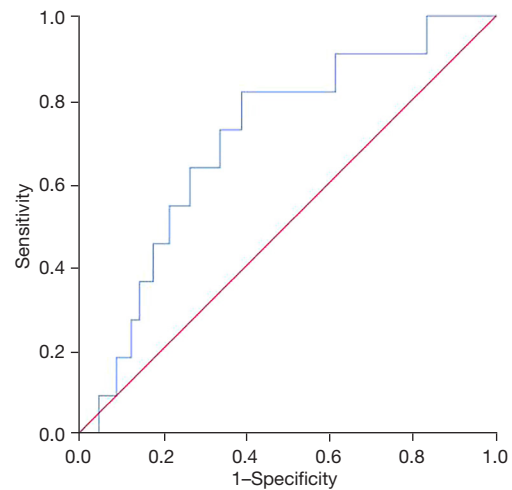

Figure 4 Predictive value of MELD-XI score for death after coronary artery stenting in acute myocardial infarction patients. MELD-XI, model for end-stage liver disease with no international normalized ratio.
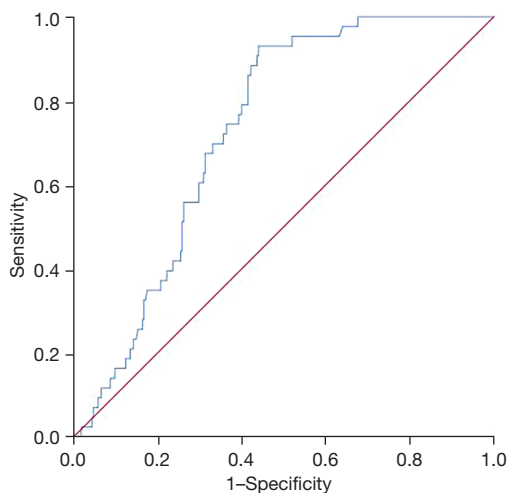

Figure 3 Predictive value of MELD-XI score in patients with acute myocardial infarction after coronary artery stenting. MELD-XI, model for end-stage liver disease with no international normalized ratio.

Discussion

Different biological indicators have been investigated for determining the early prognosis of different diseases to enable early treatment and the discovery of new therapeutic targets for improving prognosis (8-11). In order to predict the prognosis of patients after coronary artery stenting in patients with acute myocardial infarction, researchers have studied a variety of indicators, including NT-proBNP (12-15). However, these have thus far proven insufficient; for instance, NT-proBNP is elevated in patients with renal insufficiency, and thus it is difficult to accurately predict the prognosis of patients; consequently, the development of better biological indicators is needed. The present study examined the predictive value of MELD-XI score in patients with acute myocardial infarction after coronary artery stenting and found that the MELD-XI score correlated with left ventricular ejection fraction and had certain value in predicting postoperative heart failure and death.

In 2010, at the 61st annual meeting of the American Association for the Study of Liver Disease, it was proposed that the MELD score can predict the prognosis of patients with heart failure, with a higher MELD score indicating a worse the prognosis (6). The MELD score is calculated using a formula based on INR, creatinine, and bilirubin levels. Because patients with heart disease often use anticoagulants that can affect INR levels, INR was removed in the MELD to form the MELD-XI scores. When heart failure occurs, cardiac output decreases, blood supply to the liver decreases, and ischemic damage occurs. Furthermore, venous blood stasis can also lead to congestion, resulting in liver cell damage and elevated bilirubin. In addition, in heart failure patients, renal hypoperfusion causes the body
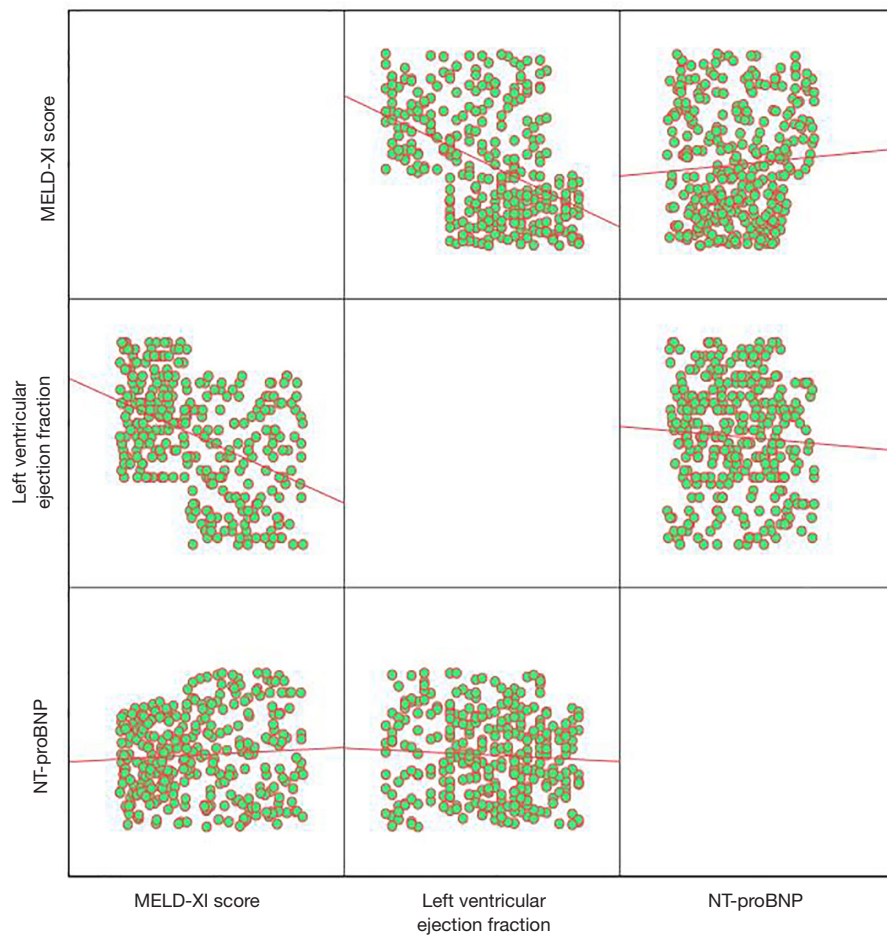
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Figure 5 Correlation of MELD-XI score with left ventricular ejection fraction and NT-proBNP in patients with acute myocardial infarction after coronary artery stenting. NT-proBNP, N-terminal pro-B-type natriuretic peptide; MELD-XI, model for end-stage liver disease with no international normalized ratio.

to activate the neurosympathetic system, resulting in further reduction of renal blood flow and eventually elevated creatinine, which is how the MELD-XI score predicts patient prognosis. One study found that the MELD-XI score can be used as a risk stratification tool for older adult patients with ST-segment elevation myocardial infarction requiring coronary artery stenting, with MELD-XI ≥13 being a risk factor of poor prognosis (7). Another study showed that the MELD-XI score had a good predictive value in the prognosis of older adult patients with non-ST-segment elevation myocardial infarction (16), which is consistent with the findings of our study. We further found that the MELD-XI score correlated with the left ventricular ejection fraction, which has certain value in predicting postoperative heart failure and death, as left

ventricular ejection fraction is an important measure of cardiac function. Reduced left ventricular ejection fraction indicates a decrease in cardiac function (17-20), and thus an increased MELD-XI score may be associated with reduced cardiac function after coronary artery stenting in patients with acute myocardial infarction, and ultimately with a poor prognosis.

Limitations

This study employed a retrospective clinical design with a postoperative follow-up of only 1 year, and thus fewer deaths occurred than might be expected with a longer follow-up. Moreover, this was a retrospective study, therefore the results may be subject to selection bias and

confounding factors. In addition, this was a single center study. Large-sample studies with long-term follow up are needed to confirm the predictive value of MELD-XI score for the long-term prognosis of patients with acute myocardial infarction. Finally, the study did not provide information on the interobserver variability in MELD-XI score calculations. Future studies should evaluate the interobserver agreement of MELD-XI score calculations to ensure its reliability and validity.

Conclusions

The MELD-XI score can better evaluate the cardiac function of patients with acute myocardial infarction after coronary artery stenting implantation and may thus be valuable for predicting prognosis.

Acknowledgments

Footnote

Reporting Checklist: The authors have completed the STARD reporting checklist. Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-562/rc

Data Sharing Statement: Available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-562/dss

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Conflicts of Interest: All authors have completed the ICMJE uniform disclosure form (available at https://jtd.amegroups.com/article/view/10.21037/jtd-23-562/coif). The authors have no conflicts of interest to declare.

Ethical Statement: The authors are accountable for all aspects of the work in ensuring that questions related to the accuracy or integrity of any part of the work are appropriately investigated and resolved. This study was approved by the Ethics Committee of The People's Hospital of Dazu (No. c20210048) which exempted this study from informed consent. This study was conducted in accordance with the 2013 revision of the Declaration of Helsinki.

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