Cardiovascular Topics

Assessment value of the modified early warning score for long-term prognosis of older patients with chronic heart failure

Yin Yin, Jie Chen, Shijiu Jiang

Abstract

Aim: The aim of the study was to explore the assessment value of the modified early warning score (MEWS) for the long-term prognosis of older patients with chronic heart failure (CHF).

Methods: A total of 180 CHF patients, treated from January 2016 to January 2018, were divided into a grade I group (n = 28), a grade II group (n = 37), a grade III group (n = 68) and a grade IV group (n = 47) according to the New York Heart Association (NYHA) functional classification. The MEWS was compared on admission and discharge. Based on the clinical outcomes during follow up, the patients were divided into a non-survival group (n = 48) and a survival group (n = 132). Their general clinical data and the MEWS were compared. The predictive values of the MEWS, troponin I (cTnI) and B-type natriuretic (BNP) peptide for long-term prognosis were assessed using receiver operator characteristic (ROC) curves.

Results: The MEWS on patient discharge was significantly lower than that on admission, and it increased with increasing NYHA grade ($p < 0.05$). The MEWS in the non-survival group was significantly higher than that in the survival group. Different clinical outcomes were positively correlated with NYHA grade, MEWS, six-minute walking distance and left ventricular ejection fraction ($r = 0.368$, $r = 0.471$, $r = 0.387$, $r = 0.423$, $p < 0.05$), and negatively correlated with cTnI and BNP ($r = –0.411$, $r = –0.425$). The area under the ROC curve of the MEWS was 0.852, indicating higher accuracy. The optimal cut-off value, sensitivity and specificity of the MEWS for determining prognosis were 5.6, 0.854 and 0.797 points, respectively.

Conclusion: The MEWS rose with increasing NYHA grade and reflected the severity of CHF in older patients, which has higher predictive value for long-term prognosis.

Keywords: modified early warning score, older patient, chronic heart failure, long-term prognosis, NYHA functional classification

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Chronic heart failure (CHF) is a comprehensive clinical cardiovascular disease with weakened myocardial contractility, ventricular filling and weakened pump function caused by changes in the myocardial structure and function due to cardiomyopathy, inflammation and long-term ventricular pressure, primarily manifested as fluid retention and dyspnoea.[1,2]

CHF frequently occurs in older people, and its incidence rate increases with age. The incidence rate of CHF in patients aged above 65 years is five to 10 times that in younger adults.[3] It is reported that CHF patients have a poor long-term prognosis. Both death and rehospitalisation rates are at high levels, and the five-year mortality rate is up to 50%,[4,5] seriously threatening the health of older people. Therefore, accurate diagnosis, prompt and effective treatment, and enhancement of long-term prognostic evaluation and prediction are crucial for the prevention of further worsening of CHF in older patients.

Thyroid hormone level,[6] plasma brain natriuretic peptide[7] and chronic health score[8] are associated with the prognosis of CHF, but they are inaccurate in a long-term prognostic evaluation. Therefore, it is of great importance to search for other indices for long-term prognostic evaluation of CHF patients.

The modified early warning score (MEWS) is a fast, simple and scientific prediction tool for accurately identifying critically ill patients and assessing the risk of disease. It can timeously detect changes in the condition of patients through assessing the systolic blood pressure, heart rate, respiration, body temperature and consciousness of patients, thereby greatly improving the rescue success rate and prognosis.[9] Currently, the MEWS has been widely applied in prediction and nursing interventions for severe asthenia,[10] acute craniocerebral injury,[11] stroke[12] and trauma,[13] achieving satisfactory effects. However, there are few reports about the MEWS in the long-term prognostic evaluation of older patients with CHF.

In this study, the clinical data of 180 CHF patients admitted to our hospital from January 2016 to January 2018 were collected, their MEWS was analysed, and the value of the MEWS for assessing the severity of disease and long-term prognosis of CHF patients was explored, so as to provide references for effective prevention and control of CHF in the clinic.

Methods

A total of 180 CHF patients treated from January 2016 to January 2018 were selected as the subjects. Inclusion criteria were as follows: patients meeting the diagnostic criteria for CHF in the *Chinese Guidelines for the Diagnosis and Treatment of Heart Failure 2014*;[14] those aged ≥ 60 years; and subjects with complete medical data. Exclusion criteria were as follows: patients with congenital heart disease or acute myocardial infarction; those with malignancies; patients with severe liver or kidney diseases; or those with incomplete medical data.

This study was approved by the ethics committee of our hospital. All patients and their families gave informed consent.

The clinical data, such as age, gender, smoking and drinking habits, diabetes mellitus, hypertension, coronary heart disease and indices after admission, such as troponin I (cTnI), B-type natriuretic peptide (BNP), six-minute walking distance (6MWD) and left ventricular ejection fraction (LVEF), were collected.

The severity of CHF was assessed using the MEWS. Systolic blood pressure, heart and respiration rate, body temperature and consciousness were measured and scored 0–3 points for each. The total score (0–14 points) of the five indices was the MEWS. The higher MEWS points corresponded to a more severe condition of disease. The MEWS scoring criteria[15] are shown in Table 1.

CHF patients were followed up for three years by the out-patient clinic, rehospitalisation and telephone, and the clinical outcome during follow up was recorded, based on which the patients were divided into a survival group and non-survival group.

The MEWS was compared among the four NYHA groups on admission and discharge, and the predictive value of the MEWS for the severity of disease and long-term prognosis was observed.

Statistical analysis

SPSS22.0 software was used for statistical analysis. Numerical data are expressed as numbers and percentage, and measurement data are expressed as mean and standard deviation. The *t*-test or chi-squared test was performed for univariate analysis, and Spearman's correlation analysis was conducted. Long-term prognosis was assessed using receiver operator characteristic (ROC) curve analysis, and the area under curve (AUC) ≥ 0.70 indicated certain accuracy. The Youden index was calculated and the cut-off value was determined based on the sensitivity and specificity. A $p < 0.05$ was considered to be statistically significant.

Results

There were 102 males and 78 females aged 65–81 years old, with an average of 70.36 ± 10.41 years. They were divided into a grade I group ($n = 28$), a grade II group ($n = 37$), a grade III group ($n = 68$) and a grade IV group ($n = 47$) according to their New York Heart Association (NYHA) functional classification.

The general data such as age, gender and history of disease had no statistically significant differences among the groups ($p > 0.05$). The MEWS on discharge was significantly lower than that on admission in the four groups, and the higher the NYHA grade, the higher the MEWS value ($p < 0.05$) (Table 2).

After a three-year follow up, 48 out of the 180 patients had died, with a death rate of 26.67%. There were no statistically significant differences in age, gender, smoking, drinking, diabetes, hypertension and coronary heart disease between the non-survival and survival groups ($p > 0.05$). cTnI, BNP, 6MWD, LVEF, NYHA grade and the MEWS affected the clinical outcomes of patients. Compared with the survival group, the MEWS, cTnI and BNP levels of the non-survival group were significantly higher, and the 6MWD and LVEF were lower ($p < 0.05$) (Table 3).

Different clinical outcomes were positively correlated with NYHA grade, MEWS, 6MWD and LVEF ($r = 0.368$, $r = 0.471$, $r = 0.387$, $r = 0.423$, $p < 0.05$), and negatively correlated with cTnI and BNP values ($r = –0.411$, $r = –0.425$).

Table 1. MEWS scoring criteria

Variables	*0 points*	*1 point*	*2 points*	*3 points*
Systolic blood pressure (mmHg)	101–199	81–100	≥ 200 or 71–80	≤ 70
Heart rate (beats/min)	51–100	41–50 or 101–110	≤ 40 or 111–129	≥ 130
Respiration (times/min)	9–14	15–20	21–29 or < 9	≥ 30
Body temperature (°C)	35	35–38.4	< 35 or ≥ 38.5	
Consciousness	Clear	Respond to sound	Respond to pain	No response

MEWS: modified early warning score.

Table 2. MEWS of four groups

NYHA class	n	*MEWS on admission (mean ± SD)*	*MEWS on discharge (mean ± SD)*	t/p-*value (admission and discharge)*
I	28	1.25 ± 0.84	0.78 ± 0.75	2.209/0.031
II	37	3.47 ± 0 .98[1]	2.28 ± 0.96[1]	5.276/0.000
III	68	5.48 ± 0.94[1,2]	4.23 ± 1.24[1,2]	6.624/0.000
IV	47	7.78 ± 2.14[1,2,3]	6.58 ± 1.87[1,2,3]	2.895/0.005

[1]$p < 0.05$ vs grade I, [2]$p < 0.05$ vs grade II, [3]$p < 0.05$ vs grade III.
MEWS: modified early warning score; NYHA: New York Heart Association.

Table 3. General data of patients with different clinical outcomes

Variables	*Non-survival group (n = 48)*	*Survival group (n = 132)*	t/χ^2	p-*value*
Age (years), mean ± SD	71.52 ± 10.24	69.94 ± 9.47	0.968	0.334
Gender (male/female)	25/77	23/55	0.560	0.454
Smoking (yes), *n* (%)	13 (27.08)	32 (24.24)	1.402	0.237
Drinking (yes), *n* (%)	10 (20.83)	25 (18.94)	0.081	0.776
Diabetes mellitus (yes), *n* (%)	17 (35.42)	31 (23.48)	2.563	0.109
Hypertension (yes), *n* (%)	15 (31.25)	36 (27.27)	0.274	0.601
Coronary heart disease (yes), *n* (%)	19 (39.58)	35 (26.51)	2.863	0.091
NYHA class, *n* (%)			28.540	0.000
I	2 (7.14)	26 (92.86)		
II	6 (16.22)	31 (83.78)		
III	14 (20.59)	54 (79.41)		
IV	26 (55.32)	21 (44.68)		
MEWS, mean ± SD	7.52 ± 2.31	4.30 ± 2.27	8.377	0.000
cTnI (ng/ml), mean ± SD	2.52 ± 0.48	1.72 ± 0.45	10.361	0.000
BNP (ng/ml), mean ± SD	447.79 ± 27.33	359.18 ± 30.78	17.578	0.000
6MWD (min), mean ± SD	311.28 ± 19.30	375.37 ± 21.02	18.477	0.000
LVEF (%), mean ± SD	43.31 ± 3.09	50.28 ± 4.76	9.438	0.000

6MWD: six-minute walking distance; BNP: B-type natriuretic peptide; cTnI: troponin I; LVEF: left ventricular ejection fraction; MEWS: modified early warning score; NYHA: New York Heart Association.

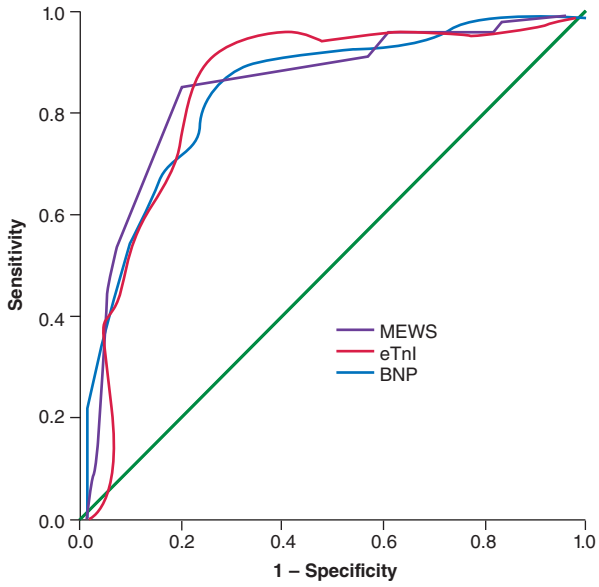

Fig. 1. ROC curves of MEWS, cTnI and BNP for predicting long-term prognosis.

To further evaluate the assessment value of the MEWS for the long-term prognosis of patients, MEWS was subjected to ROC curve analysis. It was found that the AUC was 0.852 (95% CI 0.785–0.919, $p < 0.001$), indicating higher accuracy. The optimal cut-off value of the MEWS in judging the condition of patients was 5.6 points, in which case the Youden index was the highest (0.65), and the corresponding sensitivity and specificity were 0.854 and 0.797%, respectively.

The AUC of cTnI was 0.845 (95% CI 0.764–0.904, $p < 0.001$), the optimal cut-off value was 2.05 ng/ml, the Youden index was 0.62, the sensitivity was 0.842%, and the specificity was 0.775%. The AUC of BNP was 0.824 (95% CI 0.731–0.875, $p < 0.001$), the optimal critical value was 413.23 ng/ml, the Youden index was 0.62, the sensitivity was 0.836%, and the specificity was 0.732%. The AUC values of MEWS, cTnI and BNP were similar, exhibiting high predictive values for the prognosis of patients (Fig. 1).

Discussion

CHF is characterised as a severe, recurring condition with a high fatality rate, and clinically manifests as heart failure caused by left ventricular dysfunction, which is associated with underlying diseases such as hypertension and coronary heart disease. Older people have weakened organ function and many complications, so they are prone to CHF.[16,17]

Searching for reliable indices for assessing the severity of disease and predicting the long-term prognosis, and close monitoring and intervention for high-risk groups are the key to reducing the mortality rate and raising the quality of life of older patients with CHF.[18] However, there are few markers for prognostic evaluation currently, or they have low accuracy, sensitivity and specificity, so their predictive value for prognosis is low. Therefore, markers valuable for long-term prognostic prediction are urgently needed.

The MEWS scoring system, through comprehensive scoring of a patient's systolic blood pressure, heart and respiration rate, body temperature and consciousness, and transformation of the severity of disease into scores, can quickly predict the severity of disease, unrestricted by instruments, personnel and sites. It is easily operated and widely used in the emergency department and intensive care unit.[19,20]

NYHA functional classification not only assesses the cardiac function, but also serves as an objective index to judge the condition of heart failure.[21] In our study, the MEWS was determined in patients with different NYHA grades before and after treatment.

It was found that the MEWS on discharge was significantly lower than that on admission in the four groups, and the higher the NYHA grade, the higher the MEWS. This is consistent with the findings of van der Woude *et al.*[15] that the levels of soluble suppression of tumorigenesis-2 (sST2) and N-terminal pro-B-type natriuretic peptide (NT-proBNP) rose with the increase in NYHA grade.

It can be seen that the MEWS was able to reflect the severity of impaired cardiac function in older patients. Moreover, the results in this study showed that NYHA grade and MEWS were the influencing factors for the clinical outcome of patients, and patients with a higher MEWS were more likely to die, indicating that MEWS can reflect the severity of CHF.

To further evaluate the assessment value of the MEWS for the long-term prognosis of patients, it was subjected to ROC curve analysis. It was found that the AUC was 0.852, and the optimal cut-off value, sensitivity and specificity of MEWS in judging the condition of patients were 5.6 points, 0.854 and 0.797%, respectively, suggesting that MEWS has certain predictive value for the long-term prognosis of CHF. This cut-off value was basically consistent with that predicted by Chen *et al.*[22] (5.3 points) for the prognosis of older patients with severe pneumonia and that predicted by Xie *et al.*[23] (5 points) for patients with acute cerebral haemorrhage. Control of various complications and targeted care are necessary.[24]

This study, however, was a single-centre study with a small sample size, leading to certain limitations, so further multi-centre, large-sample studies are needed for validation.

Conclusions

The MEWS increased with an increase in NYHA grade, and it could reflect the severity of CHF in these older patients. This meant it has higher predictive value for the long-term prognosis of patients, and can be used to assess the severity of CHF, help develop effective intervention strategies based on specific quantitative values, and provide a theoretical basis.

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