

THE PREDICTIVE VALUE OF INDEPENDENT RISK FACTORS OF MODS AND MODS EARLY WARNING SCORE ON MODS OCCURRENCE IN SEVERE TRAUMA PATIENTS

XIAOGONG GONG¹, WEI YUAN¹, HELONG LI¹, BO MENG¹, YALING NIE², BIN PENG^{2,*}

¹Department of Emergency Surgical Ward, Hainan Provincial People's Hospital, Haikou, PR China - ²Department of ICU, Yunyang County People's Hospital, Chongqing, PR China

ABSTRACT

Objective: To analyse the predictive value of the independent risk factors of multiple organ dysfunction syndrome (MODS), and MODS early warning score on the occurrence of MODS in severe trauma patients.

Methods: 180 trauma patients admitted to our hospital's intensive care unit (ICU) from August 2016 to August 2018 were selected, and the general data, vital signs, laboratory indicators, related scores, cause and location of injury, and the occurrence of shock, blood transfusion, intubation, and infection after admission of all patients were collected. Single factor analysis was used to analyse MODS-related factors of in severe trauma patients, and logistic regression was used to analyse the independent risk factors that affected MODS; the ROC curve was used to analyse the predictive value of MODS warning scores.

Results: The heart rate, the levels of blood Na⁺, sCr, aPTT, and the ISS, SOFA, NISS, and APACHEII scores of patients in the MODS group were higher than those in the non-MODS group ($P < 0.05$); the scores for RBC, ALB, PLT, blood PH, and GCS were lower than those of non-MODS group ($P < 0.05$). The number of patients with multiple injuries, shock, transfusion, intubation, and infections after admission in the MODS group was higher than in the non-MODS group ($P < 0.05$). There was no significant difference in other indicators between the two groups ($P > 0.05$). An APACHEII ≥ 15 points, a SOFA score of 4-6 points, a SOFA score ≥ 7 points, an aPTT > 40 s, injury sites ≥ 3 , and hospital shock were independent risk factors that affected MODS in patients with severe trauma ($P < 0.05$). The sensitivity score of the MODS warning score was 66.24%, the specificity was 85.05%, and the area under the curve (AUC) was 0.823, which was superior to those of the APACHEII and SOFA scores.

Conclusion: An APACHEII ≥ 15 points, a SOFA ≥ 4 points, an aPTT > 40 s, injury sites ≥ 3 , and hospital shock are independent risk factors for MODS in patients with severe trauma. The MODS warning score composed of the above indicators in predicting the occurrence of MODS is better than the APACHEII and SOFA scores, which can be used as a scoring system for the clinical prediction of MODS.

Keywords: Severe trauma, MODS, independent risk factors, early warning score for MODS, predictive value.

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Introduction

Trauma is the destruction of human tissues or organs caused by mechanical factors. With the rapid development of industry and transportation, the trauma caused by various accidents is increasing. WHO shows that trauma has a lethal rate of 10% and a disability rate of 16% worldwide. Trauma injuries are severe and complex, and can cause systemic reactions, shock, suffocation, and disturbance of consciousness⁽¹⁻²⁾. Of these results, the occurrence of multiple organ dysfunction syndrome (MODS) is the main cause of death in patients with severe trauma.

The occurrence of MODS is closely related to the immune system dysfunction caused by the release and ischemia of damage-related molecules during the tissue damage process⁽³⁾. The related pathophysiology mechanism is as follows: the body's inflammatory response is out of control after the trauma, and the host's anti-inflammatory mediators or endogenous inhibitors become abnormal, disrupting the balance of pro-inflammatory and anti-inflammatory response; the inflammatory response is often accompanied by endotoxemia after severe trauma, which increases intestinal mucosal permeability and impairs the body's immune function⁽⁴⁻⁵⁾. At present,

clinical scholars have proposed various scoring systems for predicting the occurrence of MODS, such as the acute physiology and chronic health status scoring system II (APACHE II).

The scores are often used to evaluate the physiological indicators of multiple organ dysfunction, but as the relevant indicators included in the scoring system are insufficient, it is necessary to develop a reasonable scoring system to predict the occurrence of MODS⁽⁶⁾. The purpose of this study was to analyse the predictive value of the independent risk factors and MODS warning scores for MODS in severe trauma patients.

Materials and methods

Research subject

180 trauma patients treated in our hospital's intensive care unit (ICU) from August 2016 to August 2018 were selected as the research subjects. This study was approved by the hospital ethics committee.

The inclusion criteria were:

- For all patients, injury severity score (ISS) ≥ 16 points, which indicates a severely traumatized patient;
- All patients were healthy before injury;
- For all patients, age ≥ 16 years old;
- All patients were clearly aware and expressed themselves normally;
- All patients were transferred to ICU directly within 24 h after injury, without external hospital diagnosis and treatment;
- All patients and their families agreed to participate in this study and signed a consent form.

Exclusion criteria:

- Patients who died within 24 h because of severe haemorrhagic shock or severe trauma;
- Patients who stayed in ICU < 48 h;
- Patients who had mental illness;
- Non-traumatic event admission patients;
- Women who were pregnant or lactating;
- Patients who were discharged from hospital or who had abandoned treatment.

There were 132 males and 48 females in 180 severely traumatized patients aged 18 to 95 years, with an average age of (48.47 ± 18.75) years. The causes of injury were as follows: 77 cases of fall from height injury, 68 cases of car accident injury, and 35 cases of other causes of injury. According to the clinical outcome of the patients, they were divided into 132 cases in the MODS group and 48 cases in the non-MODS group.

Data collection

The general data, such as gender and age, and vital signs such as measured heart rate, temperature, and blood pressure of all patients after admission were recorded; laboratory indicators were recorded, including white blood cell (WBC) count, red blood cell (RBC) count, platelet (PLT) count, albumin (ALB), blood Na^+ , blood K^+ , blood PH, serum creatinine (sCr), activated partial thromboplastin time (aPTT), haemoglobin (FIB); ISS score, APACHEII score, Glasgow Coma Scale (GCS) score, sequential organ failure assessment (SOFA), and New Injury Severity Score (NISS) within 24 h of diagnosis. The cause and location of the injury, and any shock, blood transfusion, intubation, or infection of patients after admission were recorded.

Research methods

The differences in the above indicators were compared between the two groups of patients. A one-way analysis of variance was used to analyse the MODS-related factors in patients with severe trauma. Single factors that were statistically significant were included in the logistic regression analysis model to analyse the independent risk factors that affected MODS. The receiver operating characteristic (ROC) curve was used to analyse the predictive value of the MODS warning score on MODS occurrence.

Statistical methods

The measurement data in this study are expressed by $(\bar{x} \pm s)$, and the t test was used to compare the data between the MODS group and the non-MODS group. All count data are expressed by $[n (\%)]$, and the comparison between the two subject groups is tested using χ^2 , $P < 0.05$ to consider statistical differences. All data were analysed using the SPSS 21.0 software package.

Results

Factors related to MODS in patients with severe trauma were analysed using a one-way analysis of variance

The heart rate, blood Na^+ , sCr, aPTT level, ISS score, SOFA score, NISS score, and APACHEII score of patients in the MODS group were higher than those in non-MODS group ($P < 0.05$); RBC, ALB, PLT, blood PH, GCS scores in the MODS group were lower than those in the non-MODS group ($P < 0.05$). Patients with multiple injuries, shock, transfusion, intubation, and infection after admission

in the MODS group were higher than in the non-MODS group ($P<0.05$). The difference in other indicators between the two groups was not statistically significant ($P>0.05$). See Table 1.

Related factors		Non-MODS group (48 cases)	MODS group (132 cases)	t	P
Age (years)		48.59±18.62	53.16±16.71	1.537	0.118
Vital signs	Heart rate (beats/min)	86.88±19.20	98.29±23.37	3.030	0.003
	Temperature (°C)	36.80±0.48	36.74±0.70	0.548	0.587
	Systolic pressure (mmHg)	128.49±26.31	125.77±29.85	0.557	0.578
	Diastolic pressure (mmHg)	72.58±12.15	71.18±15.57	0.563	0.574
Laboratory indicators	WBC ($\times 10^9/L$)	11.51±4.49	11.25±5.22	0.306	0.760
	RBC ($\times 10^{12}/L$)	3.74±0.69	3.30±0.89	3.101	0.002
	ALB (g/L)	32.32±8.35	27.10±8.38	3.699	<0.001
	PLT ($\times 10^9/L$)	163.49±70.46	123.44±81.71	3.012	0.003
	Blood PH	7.45±0.06	7.39±0.10	3.905	<0.001
	Blood Na ⁺ (mmol/L)	137.49±4.12	139.02±4.32	2.127	0.035
	Blood K ⁺ (mmol/L)	3.97±0.66	3.98±0.47	0.113	0.911
	sCr ($\mu\text{mol/L}$)	69.10±20.57	88.54±64.23	2.161	0.032
	aPTT (s)	31.88±0.60	36.74±0.71	42.237	<0.001
FIB (g/L)	2.90±1.28	2.67±1.43	0.980	0.328	
Related scores	ISS (points)	18.58±10.23	25.87±13.50	3.406	0.001
	GCS (points)	13.30±2.84	10.18±4.20	4.762	<0.001
	SOFA (points)	4.02±2.13	6.91±2.87	6.364	<0.001
	NISS (points)	22.35±13.28	29.95±15.04	3.089	0.002
	APACHE II (points)	11.57±5.12	16.52±5.45	5.474	<0.001
Cause of injury	Falling accident	25 (52.08)	52 (39.39)	6.191	0.045
	Traffic accident	11 (22.92)	57 (43.18)		
	other	12 (25.00)	23 (17.42)		
Injury locale	1 site	25 (52.08)	36 (75.00)	10.663	0.005
	2 sites	10 (20.83)	30 (22.73)		
	≥ 3 sites	13 (27.08)	66 (50.00)		
Multiple injuries	25 (52.08)	93 (70.45)	5.261	0.022	
Shock after admission	6 (12.50)	62 (46.97)	14.565	<0.001	
Transfusion after admission	32 (66.67)	107 (81.06)	5.342	0.021	
Intubation after admission	35 (72.92)	116 (87.88)	5.830	0.016	
Infections after admission	24 (50.00)	99 (75.00)	10.167	0.001	

Table 1: Factors related to MODS in patients with severe trauma were analysed using a one-way analysis of variance.

Logistic regression analysis of independent risk factors affecting MODS in patients with severe trauma

The statistically significant single factors in Table 1 were included in the logistic regression analysis. The results showed that an APACHE II ≥ 15 points, a SOFA score of 4-6 points, a SOFA score of

≥ 7 points, an aPTT >40 s, number of injury sites ≥ 3 , and hospital shock were independent risk factors that affected MODS in severe trauma patients ($P<0.05$). See Table 2.

Related factors	SE	β	χ^2	P	OR	95%CI
APACHEII ≥ 15 points	1.029	1.0	10.477	0.001	2.811	1.515–5.210
SOFA score 4-6 points	0.843	1.0	6.343	0.011	2.237	1.244–4.649
SOFA score ≥ 7 points	1.415	1.5	13.339	<0.001	4.488	2.023–10.285
aPTT >40 s	1.235	1.5	8.879	0.002	3.739	1.482–9.172
Injury sites ≥ 3	1.020	1.0	9.012	0.003	2.662	1.313–5.287
Hospital shock	1.049	1.0	8.162	0.004	2.752	1.287–5.852

Table 2: Logistic regression analysis of independent risk factors affecting MODS in patients with severe trauma.

ROC curve analysis of the predictive value of MODS warning scores on MODS occurrence

The results of the ROC curve analysis showed that the sensitivity of the MODS early warning score was 66.24%, specificity was 85.05%, and the area under the curve (AUC) was 0.823. Its predictive value for MODS occurrence was better than the APACHEII and SOFA scores. See Table 3, Figure 1.

	Cut-off value	Youden index	Sensitivity	Specificity	AUC
MODS early warning score	2.5	0.513	66.24	85.05	0.823
APACHEII score	13.8	0.293	61.46	71.42	0.697
SOFA score	4.0	0.414	81.70	62.73	0.768

Table 3: ROC curve analysis of the predictive value of MODS warning scores on MODS occurrence.

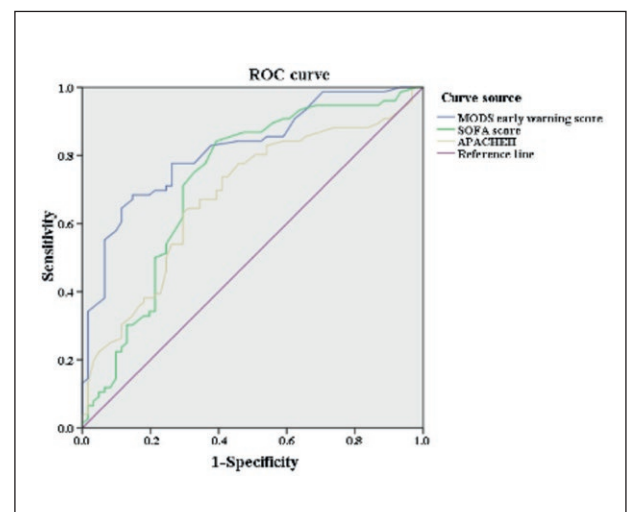


Figure 1: ROC curve analysis of the predictive value of MODS warning scores on MODS occurrence.

Discussion

Severe trauma often involves multiple systems and organs. MODS refers to organ failure when two or more organs or systems have dysfunction at the same time or successively 24 h after acute injury, caused by severe trauma, infection, shock, acute poisoning, or other causative factors. The pathogenesis of MODS has not been fully defined, and most clinicians believe that it is related to endotoxins, low blood perfusion, redox, and gastrointestinal barrier disorders⁽⁷⁻⁸⁾. All injuries can release a large number of inflammatory mediators and cytokines, resulting in a systemic inflammatory cascade response. Related data show that in fact, MODS is a systemic inflammatory response syndrome and organ dysfunction⁽⁹⁻¹⁰⁾. Some foreign scholars have analysed the mortality and death factors of ICU patients and found that the death caused by MODS accounts for 47% of the total mortality of patients, and has become the first cause of death in ICU patients⁽¹¹⁾. Therefore, the timely prediction of MODS is very important to reducing the mortality of patients.

The results of this study showed that the heart rate, blood Na⁺, sCr, aPTT levels, ISS score, SOFA score, NISS score, and APACHEII score of patients in the MODS group were higher than those in the non-MODS group ($P < 0.05$); RBC, ALB, PLT, blood PH, and GCS scores in the MODS group were lower than those of non-MODS group ($P < 0.05$). The number of patients with multiple injuries, shock, transfusion, intubation, and infections after admission in the MODS group was higher than that in the non-MODS group ($P < 0.05$). The above factors were included in the logistic regression analysis, and the results showed that an APACHE II ≥ 15 points and a SOFA score of 4-6 points, a SOFA score ≥ 7 points, an aPTT > 40 s, a number of injury sites ≥ 3 , and hospital shock were independent risk factors affecting MODS in patients with severe trauma ($P < 0.05$).

The APACHEII score is a system that can reflect the severity of the severe patient's condition and can give a prognosis and predict the risk of death in patients before treatment, which is superior to the GCS score in assessing the complications and mortality of patients with multiple injuries, and has a wide range of clinical applications⁽¹²⁾. The SOFA score is objective, simple, and reliable, with the purpose of describing the occurrence, development, and evaluation of the incidence of MODS⁽¹³⁾. Many clinical studies have confirmed the ability of SOFA scores to assess the occurrence and severity of organ

failure in patients. The aPTT is generally used in the clinical diagnosis of diseases related to endogenous procoagulant deficiency⁽¹⁴⁾. The occurrence and severity of complications in patients with severe trauma is closely related to the trauma itself. The more injured the site and the more severe the injury, the higher the risk of MODS⁽¹⁵⁾.

An APACHEII ≥ 15 points, a SOFA score of 4-6 points, a SOFA score ≥ 7 points, an aPTT > 40 s, a number of injury sites ≥ 3 , and admission shock were included in the MODS early warning score, and it was found that the predicted MODS early warning score had a sensitivity of 66.24% and a specificity of 85.05%, and that the AUC was 0.823, indicating that the predictive value of MODS occurrence was better than the APACHEII and SOFA scores.

In summary, an APACHEII ≥ 15 points, a SOFA ≥ 4 points, an aPTT > 40 s, a number of injury sites ≥ 3 , and hospital shock are independent risk factors for MODS in patients with severe trauma. The predictive value of a MODS early warning score composed of the above indicators is superior to the APACHEII and SOFA scores for the occurrence of MODS, and can be used as a scoring system for the clinical prediction of MODS.

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Corresponding Author:
BIN PENG
Email: wqktj3@163.com
(China)