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Performance assessment of the SAPS II and SOFA scoring systems in Hanta virus Hemorrhagic Fever with Renal Syndrome

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ABSTRACT

Background: Hemorrhagic Fever with Renal Syndrome (HFRS), caused by the hantavirus, is a natural infectious disease characterized by fever, hemorrhage and renal damage. China is the most severely endemic area for HFRS in the world. In recent years, critical scoring systems based on quantitative classification have become an important clinical tool for predicting and evaluating the prognosis of critical illness, and provide guidelines for clinical practice.

Methods: The sample comprised 384 patients with HFRS treated in the Taizhou Hospital from January 2006 to February 2017. The patients were divided into the severe group and the mild group according to their clinical characteristics. By comparing the differences in clinical symptoms, signs and laboratory data between the two groups, the clinically relevant indicators of severe HFRS were explored. According to the previous studies, we incorporated the positive fecal occult blood test (FOBT) into the sepsis-related organ failure assessment (SOFA) tool and formulated a new scoring system specifically for HFRS, named H-SOFA. By comparing the simplified acute physiology score II (SAPS II), SOFA and H-SOFA scores of the two groups, their predictive values for the progression of HFRS were assessed.

Results: Compared to the mild group, patients in the severe group had longer hospital stays; higher frequencies of nausea, vomiting, abdomen pain, signs of congestion and hemorrhage; and more pronounced impairment of liver and renal function. The levels of PLT, PCT, TB, and FOBT were positively correlated with the progression of HFRS ($P < 0.001$). Patients with HFRS in the severe group got significantly higher scores on the SAPS II, SOFA, and H-SOFA scoring systems ($P < 0.001$). The values of SAPS II, SOFA and H-SOFA, were significantly correlated with the severity of HFRS, and the AUC values were 0.90, 0.96, and 0.98, respectively.

Conclusion: PLT, PCT, TB, and FOBT were independent predictors of severe HFRS; SAPS II, SOFA, and H-SOFA had high predictive value for the progression of severe HFRS, with H-SOFA being the highest.

Abbreviations: AIDS, acquired immunodeficiency syndrome; ALB, albumin; ALT, alanine aminotransferase; AMV, Amur virus; APTT, activated partial thromboplastin time; ARDS, acute respiratory distress syndrome; ARF, acute renal failure; AST, aspartate transaminase; AUC, area under the ROC curve; B, Independent variable coefficient; BUN, blood urea nitrogen; Ca, serum calcium; CD3, cluster of differentiation 3; CD4, cluster of differentiation 4; CD8, cluster of differentiation 8; CI, confidence interval; CK, creatine kinase; CRP, C reactive protein; CRRT, continuous renal replacement therapy; df, degrees of freedom; DIC, disseminated intravascular coagulation; DOBV, dobrava virus; ELISA, enzyme-linked immunosorbent assay; Fib, fibrinogen; FOBT, fecal occult blood test; GCS, glasgow coma scale; GFR, glomerular filtration rate; HB, hemoglobin; HCO3-, bicarbonate ion; HFRS, Hemorrhagic Fever with Renal Syndrome; HTNV, hantaan virus; ICU, intensive care unit; IHD, intermittent hemodialysis; K, serum potassium; LDH, lactate dehydrogenase; MODS, multiple organ dysfunction syndrome; MV, mechanical ventilation; Na, serum sodium; OR, odds ratio; PCT, procalcitonin; PLT, platelet; PT, prothrombin time; PUUV, Puumala virus; ROC, receiver operating characteristic; SAPS II, simplified acute physiology score II; SCr, serum creatinine; SE, standard error; SEOV, Seoul virus; SOFA, sepsis-related organ failure assessment; TB, total bilirubin; UA, uric acid; UOBT, urine occult blood test; WBC, white blood cells.

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Introduction

Hemorrhagic fever with renal syndrome (HFRS), caused by hantaviruses, is a natural infectious disease characterized by fever, hemorrhage and kidney damage (Ermonval et al., 2016). HFRS has been a major epidemic mainly in Asia and Europe; about 100,000 cases of HFRS are documented annually, most of which occur in China, Korea, and Russia (Yu et al., 2014). Among all the countries, China is the most seriously affected one and accounts for over 90% of the total number of HFRS cases around the world (Jiang et al., 2017). Due to positive prevention efforts of the government, the prevalence of HFRS had been lowered in recent years, but the high incidence persisted in some areas (Zou et al., 2016). The prevalence of HFRS in China is characterized by a large number of affected patients and high mortality of critical cases. Also, the incidence of atypical cases with unusual clinical manifestations has increased, and some new hantavirus genotypes have been found recently, hindering the early diagnosis and treatment of HFRS (Jonsson et al., 2010). Similar to other critical illnesses, exploring early and new biomarkers, and combining clinical features with laboratory parameters to detect the severity and prognosis of HFRS in advance are very important to guide clinicians to initiate effective treatment and improve the remedy achievement ratio.

In recent years, severity scoring systems based on quantitative classification have become an important clinical tool for the prediction and evaluation of the prognosis of critically ill patients, and serve as a guide to clinical practice (Routsi et al., 2007). The scoring systems commonly used in clinical settings include the Simplified Acute Physiology Score II (SAPS II) and the Sepsis-related Organ Failure Assessment (SOFA) score, which is widely used in many Western countries. For example, it has been reported that whereas the SAPS II is positively associated with mortality in acute renal failure (ARF) (Strand et al., 2010), the SOFA score is widely used in the management of severe sepsis, and can be used to predict the duration of admission and risk of mortality (Siddiqui et al., 2017). Some studies showed that although both the SAPS II and SOFA score could predict the prognosis of septic shock, the SAPS II was a little worse in doing so compared to the SOFA score, which was more reflective of the patient's circulatory system (Kim et al., 2013; Perren et al., 2012). Currently, there are few reports about the application of the SAPS II and SOFA in the prediction of HFRS.

Methods

Study participants

384 patients with HFRS who were treated in the Affiliated Taizhou Hospital of Wenzhou Medical University from January 2006 to February 2017 were selected randomly and reviewed. The diagnosis of HFRS was made based on the detection of specific IgM antibodies to hantavirus by enzyme-linked immunosorbent assay (ELISA).

Based on the criteria for the clinical classification of HFRS (Bai and Xu, 2013), the patients were divided into two groups: the severe group consisted of serious and critical cases, and the mild group consisted of mild and moderate cases (Table 1).

Symptoms and signs

The positive symptoms and signs of two groups were compared and analyzed, including cough, nausea and vomiting, dizziness and headache, abdominal pain, backache, diarrhea, conjunctival congestion, pharynges congestion, flush, subconjunctival hemorrhage, cervico-thoracic hemorrhage, underarm hemorrhage, renal percussive pain, and abdominal tenderness.

Laboratory parameters

Twenty-seven clinical laboratory parameters were detected and analyzed, including blood tests performed using an auto-analyzer (Sysmex-2100, Sysmex Corp., Japan), biochemical and immune examination performed using an autoanalyzer (Architect *ci*16200, Abbott Corp., USA), blood coagulation detected by hematology analyzers (STA Compact, Stago Corp., France), lymphocyte subgroup examination detected by flow cytometry (Becton-Dickinson FACSCalibur, BD Biosciences, CA, USA), and routine urine performed using an autoanalyzer (UF-1000i, Sysmex Corp., Japan). The detailed laboratory parameters were white blood cell (WBC) count; platelet count (PLT); levels of hemoglobin (HB); C-reactive protein (CRP), procalcitonin (PCT), alanine aminotransferase (ALT), aspartate transaminase (AST), total bilirubin (TB), serum sodium (Na), serum potassium (K), serum calcium (Ca), albumin (ALB), uric acid (UA), creatine kinase (CK), lactate dehydrogenase (LDH), urea, serum creatinine (SCr), glomerular filtration rate (GFR), prothrombin time (PT), activated partial thromboplastin time (APTT), fibrinogen (Fib), cluster of differentiation 3 (CD3), cluster of differentiation 4 (CD4), and cluster of differentiation 8 (CD8); albuminuria; urine occult blood test (UOBT); and fecal occult blood test (FOBT).

SAPS II

The SAPS II includes 17 variables, including age, physiological variables (heart rate, blood pressure, temperature, PaO_2/FiO_2 ratio, urine volume, blood urea nitrogen (BUN), WBC, K, Na, bicarbonate ion ($HCO3^-$), TB, and Glasgow coma scale (GCS) score), type of admission (emergency surgery, elective surgery, medical patient), and chronic diseases (acquired immunodeficiency syndrome

Table 1
The criteria for the clinical classification of HFRS.

Group	Type	Temperature	Effusion	Hemorrhage	Shock	Kidney Injury
Mild Group	Mild	<39 °C	mild	skin and mucous membranes	none	albuminuria+–++ without oliguria
	Moderate	39–40 °C	moderate chemosis	ecchymosis	hypotension susceptibility	albuminuria ++–+++ and oliguria
Severe Group	Serious	≥40 °C	serious and toxic psychiatric symptoms	ecchymosis and gastrointestinal hemorrhage	shock	oliguria ≤5 days anuria ≤2 days
	Critical	have one or more of the following complications in addition to the criteria for serious cases: refractory shock ≥2days, visceral hemorrhage; oliguria >5 days or anuria >2 days, BUN >42.84 mmol/L; pulmonary edema; heart failure; severe infection; cerebral hemorrhage, brain edema or herniation.				

Abbreviations: BUN, blood urea nitrogen.