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Comparison of Predisposition, Insult/Infection, Response, and Organ dysfunction, Acute Physiology And Chronic Health Evaluation II, and Mortality in Emergency Department Sepsis in patients meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle☆

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Abstract

Purpose: The aim of the study was to examine the performance of the Predisposition, Insult/Infection, Response, and Organ dysfunction (PIRO) model compared with the Acute Physiology and Chronic Health Evaluation (APACHE) II and Mortality in Emergency Department Sepsis (MEDS) scoring systems in predicting in-hospital mortality for patients presenting to the emergency department (ED) with severe sepsis or septic shock.

Materials and Methods: This study was an analysis of a prospectively maintained registry including adult patients with severe sepsis or septic shock meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle over a 6-year period. The registry contains data on patient demographics, sepsis category, vital signs, laboratory values, ED length of stay, hospital length of stay, physiologic scores, and outcome status. The discrimination and calibration characteristics of PIRO, APACHE II, and MEDS were analyzed.

Results: Five-hundred forty-one patients with age 63.5 ± 18.5 years were enrolled, 61.9% in septic shock, 46.9% blood-culture positive, and 31.8% in-hospital mortality. Median (25th and 75th percentile) PIRO,

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APACHE II, and MEDS scores were 6 (5 and 8), 28 (22 and 34), and 12 (9 and 15), with predicted mortalities of 48.5% (40.1 and 63.9), 66.0% (42.0 and 83.0), and 16.0% (9.0 and 39.0), respectively. The area under the receiver operating characteristic curves for PIRO was 0.71 (95% confidence interval, 0.66-0.75); APACHE II, 0.71 (0.66-0.76); and MEDS, 0.63 (0.60-0.70). The standardized mortality ratio was 0.70 (0.08-1.41), 0.70 (−0.46 to 1.80), and 4.00 (−8.53 to 16.62), respectively. Actual mortality significantly increased with increasing PIRO score in patients with APACHE II 25 or more ($P < .01$).
Conclusions: The PIRO, APACHE II, and MEDS have variable abilities to early discriminate and estimate in-hospital mortality of patients presenting to the ED meeting criteria for early goal-directed therapy and the severe sepsis resuscitation bundle. The PIRO may provide additional risk stratification in patients with APACHE II 25 or more. More studies are required to evaluate the clinical applicability of PIRO in high-risk patients with severe sepsis and septic shock.

1. Introduction

Despite recent therapeutic advances, severe sepsis continues to be associated with high mortality and accounts for more than 500 000 emergency department (ED) visits per year [1-4]. In addition, there is a direct relationship between intensive care unit (ICU) overcrowding and ED length of stay (LOS). As the ICU overcrowding increases, ED LOS for critically ill patients steadily increases [2,4-6]. With respect to severe sepsis, the first 6 hours of disease presentation now often occurs in the ED and has been recognized as the crucial period for early intervention [7-9].

Accurate identification of patients in the ED who are at high risk (R) of death and in need of intensive therapeutic measures such as early goal-directed therapy (EGDT) is crucial, but such a precise method is currently unavailable [10,11]. On the other hand, physiologic scoring systems have been used over the last several decades to predict mortality in the ICU patient population. In addition, scoring systems have been useful for research purposes to assess disease severity, patient enrollment criteria, and subject equivalency in sepsis clinical trials [12]. Specifically, the Acute Physiology and Chronic Health Evaluation (APACHE) II scoring system is currently used in the United States to determine patient severity and therapeutic indication for recombinant human activated protein C (rhAPC) as part of the severe sepsis bundle [13]. For the ED setting, the Mortality in Emergency Department Sepsis (MEDS) score has been evaluated in patients with suspected infection, but its accuracy in predicting mortality in the very high-R patients with severe sepsis and septic shock is limited [14,15]. Furthermore, the MEDS score requires the clinician to subjectively determine if the patient is to succumb from illness within the next 30 days [16]. Thus, improvements in the accuracy and practicality of scoring systems for the ED setting are needed before their use can become standard practice.

The Predisposition, Insult/Infection, Response, and Organ dysfunction (PIRO) model was previously proposed as a new classification system for sepsis [17]. Several derivation studies have been published to provide a scoring system applying the PIRO concept in community-acquired pneumonia, ventilator-associated pneumonia, suspected sepsis, and severe sepsis [18-21]. The variables required for a PIRO score can be easily obtained from patient chart review. However, the "I" variable requires ascertainment of infection source and causative organism, an answer that can only be known after culture results are available.

The purpose of the this study is to compare the ability of the PIRO, APACHE II, and MEDS scoring systems to accurately predict mortality outcomes among patients meeting criteria for initiating EGDT and the severe sepsis resuscitation bundle (SSRB). We selected the PIRO scoring system as defined by Rubulotta et al [21] to examine in our patient population. We also hypothesized that the PIRO model may complement APACHE II as a prognostication tool in the ED to identify patients with severe sepsis with a higher R of death.

2. Materials and methods

2.1. Design and setting

This study was an analysis of a prospectively maintained registry of patients presenting to an academic ED meeting criteria for EGDT and SSRB from October 2003 through September 2009. The study and sepsis registry were approved by the institutional review board at our institution with waiver of consent. The PIRO, APACHE II, and MEDS scores were calculated for each patient using previously defined criteria [16,21,22]. The ED contains 51 beds, with approximately 70 000 patient visits and 2500 ICU admissions annually.

2.2. Patient selection

Patients were enrolled into the sepsis registry using a 2-level process. The initial level includes a monthly review of patient charts seeking patients who were admitted to the hospital from the ED and had an *International Classification of Diseases, Ninth Revision*, diagnosis of a disease along the sepsis spectrum. The second level of the process included a review of the medical charts obtained from the initial review.