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S-SS criteria: Novel criteria for septic shock and new subset septic shock supported with invasive respiration or vasopressor (SIRV)

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ABSTRACT

Purpose: Novel definitions and criteria (S-SS criteria) for diagnosing septic shock via the incorporation of individual organ shock and a subgroup referred to as septic shock supported by invasive respiration and vasopressor (SIRV) were proposed.
Methods: 818 patients who visited the hospital because of an infectious cause were enrolled. Individual organ shock was defined as follows: circulatory shock: < 90 mmHg; respiratory shock: PF ratio ≤100; neurologic shock: new onset of altered mentality, excluding hypoglycaemia, intoxication, or drug abuse; and cellular/metabolic shock: serum lactate level ≥4 mmol/L. Per S-SS criteria, septic shock was diagnosed as any of the above parameters. SIRV was diagnosed as any of following: requiring invasive respiratory support or vasopressor support. Primary outcome was in-hospital mortality.
Results: 53 (6.5%) patients died prior to hospital discharge. Of the 248 sepsis patients, 30 died (12.1%); of the 32 Sepsis-3 septic shock patients, 16 died (50%); of the 106 S-SS septic shock patients, 28 died (26.4%); and of the 53 Septic shock SIRV patients, 20 died (37.7%). Individual shock criteria showed an acceptable degree of overlap.
Conclusion: The distribution and corresponding mortality rates of patients diagnosed with septic shock based on the novel S-SS criteria and Sepsis-3 criteria were evaluated.

1. Introduction

Recently, the traditional definition of sepsis and septic shock was revisited by an international task force of the Society of Critical Care Medicine (SCCM) and the European Society of Intensive Care Medicine (ESICM) [1] [2]. According to the aforementioned third international consensus for the definition of sepsis and septic shock (Sepsis-3), sepsis is defined as life-threatening organ dysfunction caused by a dysregulated host response to infection and organ dysfunction is defined as an acute change in the total Sequential Organ Failure Assessment (SOFA) score of ≥2 points consequent to the infection [2] [3]. Septic shock is defined as a subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are sufficiently profound to substantially increase mortality and can be identified via a clinical construct of sepsis that includes persistent hypotension requiring vasopressors to maintain mean arterial pressure (MAP) at ≥ 65 mmHg and a serum lactate level of >2 mmol/L (18 mg/dL) despite adequate volume resuscitation [2]. Per the sepsis criteria, a SOFA score of ≥2 reflects an overall mortality risk of approximately 10%. Regarding the Sepsis-3 septic shock criteria, the hospital mortality risk typically exceeds 40%.

The SOFA score reflects the following six organ systems: neurological, cardiovascular, respiratory, hepatic, renal, and coagulation. Thus, the definition of sepsis includes multi-organ dysfunction as represented by SOFA. However, the definition of septic shock includes only circulatory and cellular/metabolic abnormalities, whereas septic shock represents a subset of sepsis. The current Sepsis-3 septic shock definition does not incorporate other imperative body systems, such as the neurological and respiratory systems. Furthermore, from a more general perspective, the term ‘shock’ indicates more than a substantial drop in blood pressure and encompasses deteriorated organ status beyond a specific

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degree of organ dysfunction, which is similar to the end stage of organ dysfunction.

Moreover, the current definition of Sepsis-3 septic shock includes the concept of failure without a prerequisite reason. Additionally, assessing the volume status and performing adequate fluid resuscitation remain challenges for critical care [4]. Therefore, coupling a failure to perform fluid resuscitation with septic shock is not appropriate, and other distinct subsets that represent organ support status are more practical and should be discussed.

In this study, the authors suggest a novel definition and identification criteria for septic shock referred to as S-SS criteria (Table 1). Per S-SS criteria, septic shock is defined as any of the following: circulatory shock, respiratory shock, neurologic shock, and cellular/metabolic shock. We propose a new term 'Septic Shock Supported with Invasive Respiratory device and Vasopressor (SIRV)', which is defined as the use of an invasive respiratory device and vasopressors. In the present study, we investigated the distribution and corresponding mortality rates of patients diagnosed with septic shock based on the S-SS septic shock criteria, septic shock SIRV criteria and the current Sepsis-3 septic shock criteria among patients visiting the emergency department (ED) with an infection cause.

2. Methods

2.1. Study design and setting

We performed a post hoc analysis based on our previous study evaluating the performance of the national early warning score − lactate (NEWS-L) score among general ED patients using administrative data [5]. This study was approved by the Institutional Review Board (IRB) of the study hospital, and the IRB waived the requirement of informed consent for all subjects in this study. The present study is funded by Chonbuk National University. The study hospital is a 1200-bed urban academic, tertiary-care, university hospital.

2.2. Selection of participants

Information of all patients 18 years of age or older who visited the study hospital over two consecutive months (September 1 to October 31, 2014) who were enrolled in our previous study was used in the present study [5]. Among the 4624 enrolled patients, 818 (17.7%) patients visited the ED because of an infection, and these patients are the subjects of the present study.

3. Methods and measurements

In the present study, we defined individual organ shock as follows: circulatory shock: SBP <90 mmHg; respiratory shock: PF ratio ≤100; neurologic shock: new onset of altered mentality, excluding hypoglycaemia, intoxication or drug abuse; and cellular/metabolic shock: serum lactate level of ≥4 mmol/L (36 mg/dL). S-SS septic shock was identified as any case of circulatory, respiratory, neurologic, or cellular/metabolic shock. In addition, we proposed the new term Septic Shock SIRV in the present study, and it identifies any use of invasive respiratory support or vasopressor support. Details are shown in Table 1.

According to Sepsis-3, which is the currently used definition, septic shock is defined as a subset of sepsis in which the underlying circulatory and cellular/metabolic abnormalities are sufficiently profound to substantially increase the risk of mortality and can be identified via a clinical construct of sepsis that includes persistent hypotension requiring vasopressors to maintain mean arterial pressure (MAP) at ≥ 65 mmHg and a serum lactate level of >2 mmol/L (18 mg/dL) despite adequate volume resuscitation [2].

3.1. Outcome measures

The primary outcome was in-hospital mortality.

3.2. Data collection and processing

The following data were collected based on our previous study: age; gender; visit modality (direct visit, transfer from another facility, or transfer from an outpatient department (OPD)); emergency medical service (EMS) use; triage acuity (immediate, emergent, urgent, semi-urgent, or non-urgent); disposition (discharge or admission to the ICU or ward); ED length of stay (LOS); ward LOS; systolic blood pressure at presentation to the ED (T = 0 hr); mental status (T = 0 hr); the NEWS score (T = 0 hr); serum lactate level (T = 0 hr); the NEWS-L score (T = 0 hr); and survival status at hospital discharge. We also collected data on co-morbidity and diagnoses. Co-morbidities included hypertension (HTN), diabetes mellitus (DM), chronic liver disease (CLD), chronic kidney disease (CKD), heart failure, malignancy, previous stroke, chronic airway disease, and smoking status (including ex-smokers). New data were collected by a trained abstractor who used standardized data collection techniques according to the guidelines of Gilbert et al. [6].

Infection sources were classified as follows: respiratory; liver,

Table 1
Terms and definitions in the SEPSIS-3 and S-SS criteria in the present study.

Sepsis	Definition	Life-threatening organ dysfunction caused by a dysregulated host response to infection.
Sepsis-3	Identification Criteria	Acute change in total SOFA score ≥2 points consequent to the infection. The baseline SOFA score can be assumed to be zero in patients not known to have preexisting organ dysfunction.
Septic Shock Sepsis-3	Definition	Subset of sepsis in which underlying circulatory and cellular/metabolic abnormalities are profound enough to substantially increase mortality.
	Identification Criteria	Persisting hypotension requiring vasopressors to MAP ≥65 mmHg and having a serum lactate level ≥2 mmol/L (18mg/dl) despite adequate volume resuscitation.
Septic Shock S-SS criteria in the present study	Definition	Subset of sepsis in which most severe organ dysfunctions including at least circulatory, respiratory, neurologic and cellular/metabolic shocks are associated with a greater risk of mortality than with sepsis alone.
	Identification Criteria	Any of followings - Circulatory shock: SBP <90 mmHg - Respiratory shock: PF ratio ≤100 - Neurologic shock: new onset altered mentality, excluding hypoglycemia, intoxication or drug abuse - Cellular/metabolic shock: serum lactate level ≥4 mmol/L (36mg/dl)
Septic Shock SIRV	Definition	Subset of septic shock in which patients are in organ support
S-SS criteria in the present study	Identification Criteria	Any of followings - Invasive respiratory device use - Vasopressor use

Abbreviations SOFA, Sequential Organ Failure Assessment; MAP, mean arterial pressure; SBP, systolic blood pressure; PF ratio, PaO2/FiO2 ratio; SIRV, supported by invasive respiratory and vasopressor.

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