



Korean Shock Society septic shock registry: a preliminary report

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Objective To evaluate the clinical characteristics, therapeutic interventions, and outcomes of patients with septic shock admitted to the emergency department (ED).

Methods This study was a preliminary, descriptive analysis of a prospective, multi-center, observational registry of the EDs of 10 hospitals participating in the Korean Shock Society. Patients aged 19 years or older who had a suspected or confirmed infection and evidence of refractory hypotension or hypoperfusion were included.

Results A total of 468 patients were enrolled (median age, 71.3 years; male, 55.1%; refractory hypotension, 82.9%; hyperlactatemia without hypotension, 17.1%). Respiratory infection was the most common source of infection (31.0%). The median Sepsis-related Organ Failure Assessment score was 7.5. The sepsis bundle compliance was 91.2% for lactate measurement, 70.3% for blood culture, 68.4% for antibiotic administration, 80.3% for fluid resuscitation, 97.8% for vasopressor application, 68.0% for central venous pressure measurement, 22.0% for central venous oxygen saturation measurement, and 59.2% for repeated lactate measurement. Among patients who underwent interventions for source control (n=117, 25.1%), 43 (36.8%) received interventions within 12 hours of ED arrival. The in-hospital, 28-day, and 90-day mortality rates were 22.9%, 21.8%, and 27.1%, respectively. The median ED and hospital lengths of stay were 6.8 hours and 12 days, respectively.

Conclusion This preliminary report revealed a mortality of over 20% in patients with septic shock, which suggests that there are areas for improvement in terms of the quality of initial resuscitation and outcomes of septic shock patients in the ED.

Keywords Sepsis; Septic shock; Mortality; Patient care bundles



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Capsule Summary

What is already known

Mortality in patients with sepsis or septic shock remains high, while compliance with the sepsis bundle metrics remains low and variable.

What is new in the current study

This is the first, multi-center study on septic shock in the emergency departments of Korea. The results of this preliminary report suggest that initial sepsis care and the outcomes of septic shock patients need to be improved.

INTRODUCTION

Shock refers to circulatory failure with inadequate tissue perfusion and cellular oxygen utilization.¹ Sepsis is the most common cause of noncardiogenic shock, which is accompanied by life-threatening organ dysfunction due to dysregulated host response to infection.¹⁻³ Despite current advances in intensive care and sepsis therapy, the incidence of sepsis continues to rise and mortality rates in patients with septic shock exceed 20%.^{4,5} With no specific superior therapeutic options being developed, further research and clinical quality improvement are needed to increase the survival of patients with septic shock.^{6,7}

The Korean Shock Society (KoSS) was established in 2013 to research and improve clinical quality in the diagnosis and treatment of shock, which is a principal topic in emergency and critical care medicine. The KoSS has been prospectively collecting data in a septic shock registry since October 2015 as a first step towards future research on shock. The KoSS septic shock registry data include clinical characteristics and initial management of, and early outcomes in patients presenting to emergency departments (EDs) with septic shock. This study is a preliminary, descriptive analysis of the KoSS septic shock registry.

METHODS

Study design

This prospective, multi-center, observational study was designed to evaluate the clinical characteristics, therapeutic interventions, and outcomes of patients with septic shock in EDs. Among hospitals in the KoSS, 10 EDs participated in the KoSS septic shock registry from October 2015 to June 2016 (Table 1). Patients aged 19 years or older who visited one of these EDs and met the eligibility criteria were enrolled. The inclusion criteria included suspected or confirmed infection and evidence of refractory hypotension or hypoperfusion.⁸⁻¹⁰ Systemic inflammatory response

Table 1. Participating hospitals

Hospital	No. of patients (%)	Enrollment period
A	78 (16.7)	December 2015 to April 2016 (5 mo)
B	39 (8.3)	November 2015 to April 2016 (6 mo)
C	31 (6.6)	March 2016 to April 2016 (2 mo)
D	14 (3.0)	December 2015 to April 2016 (5 mo)
E	57 (12.2)	November 2015 to June 2016 (8 mo)
F	103 (22.0)	November 2015 to June 2016 (8 mo)
G	27 (5.8)	January 2016 to June 2016 (6 mo)
H	66 (14.1)	January 2016 to June 2016 (6 mo)
I	32 (6.8)	November 2015 to January 2016 (3 mo)
J	21 (4.5)	January 2016 to April 2016 (4 mo)

syndrome criteria were not obligatory for enrollment.¹¹ Hypotension was defined as a systolic blood pressure < 90 mmHg, a mean arterial pressure < 70 mmHg, or a systolic blood pressure decrease > 40 mmHg.⁶ Refractory hypotension was defined as persistent hypotension after intravenous fluid challenge (1 L or more administered over 30 minutes) or as the need for vasopressors after fluid resuscitation. Hypoperfusion was defined as a serum lactate concentration of 4 mmol/L or greater. Patients who signed a "Do not attempt resuscitation" order before ED arrival or at the time of diagnosis, met the inclusion criteria 6 hours after ED arrival, were transferred from other hospitals without meeting the inclusion criteria upon ED arrival, or were directly transferred from EDs to other hospitals were excluded from this study. The study was approved by the institutional review boards of the individual participating centers and informed consent was obtained according to local institutional review board policy.

Data collection

All data were anonymized and collected using standardized case report forms by research coordinators or physicians at each participating hospital. For data quality control, data were centrally reviewed at the coordinating hospital and case report instructions were provided via manuals and training meetings. The following

data were included in the registry: demographic characteristics, comorbidities, vital signs, suspected infection source, and laboratory data. We investigated interventions including the Surviving Sepsis Campaign (SSC) bundle: lactate measurement, blood culture, fluid resuscitation, central venous pressure (CVP) measurement, central venous oxygen saturation (ScvO₂) measurement, vasopressor use, transfusion, mechanical ventilation, renal replacement therapy, and interventions for infection source control.⁶ The outcome variables included in-hospital, 28-day, and 90-day mortality; ED disposition; and length of stay in the intensive

care unit and hospital. Maximum sepsis-related Organ Failure Assessment (SOFA) and Acute Physiology and Chronic Health evaluation (APACHE) II scores were evaluated using the worst parameters within 24 hours after ED arrival.^{12,13}

Statistical analyses

The results are presented as medians with interquartile ranges (IQRs) for continuous variables and as the numbers of patients and percentages for categorical data. Continuous and categorical variables were analyzed using Wilcoxon rank-sum and chi-square

Table 2. Baseline characteristics

Variable	Overall (n = 468)	Survivor (n = 361)	Non-survivor (n = 107)	P-value
Age (yr)	71.3 (59.9–78.9)	71.3 (58.7–78.4)	72.2 (61.8–80.3)	0.15
Sex (male)	258 (55.1)	186 (51.5)	72 (67.3)	<0.01
Initial presentation				
Refractory hypotension	388 (82.9)	312 (86.4)	76 (71.0)	<0.01
Hyperlactatemia without hypotension	80 (17.1)	49 (13.6)	31 (29.0)	<0.01
Comorbidities				
Hypertension	214 (45.7)	167 (46.3)	47 (43.9)	0.67
Diabetes	142 (30.3)	102 (28.3)	40 (37.4)	0.07
Cardiac disease	65 (13.9)	49 (13.6)	16 (15.0)	0.71
Cerebrovascular disease	77 (16.5)	61 (16.9)	16 (15.0)	0.63
Chronic lung disease	31 (6.6)	22 (6.1)	9 (8.4)	0.40
Chronic renal disease	51 (10.9)	33 (9.1)	18 (16.8)	0.03
Liver cirrhosis	44 (9.4)	36 (10.0)	8 (7.5)	0.44
Metastatic solid cancer	82 (17.5)	59 (16.3)	23 (21.5)	0.22
Hematologic malignancy	23 (4.9)	11 (3.1)	12 (11.2)	<0.01
Transplant	4 (0.9)	3 (0.8)	1 (0.9)	0.92
Dementia	38 (8.1)	29 (8.0)	9 (8.4)	0.90
Transfer from another hospital	169 (36.1)	130 (36.0)	39 (36.5)	0.93
Referred from long-term care facilities/hospitals	51 (10.9)	39 (10.8)	12 (11.2)	0.90
Suspected infection focus				
Respiratory infection	145 (31.0)	92 (25.5)	53 (49.5)	<0.01
Intra-abdominal infection	115 (24.6)	98 (27.1)	17 (15.9)	<0.01
Urinary tract infection	99 (21.1)	86 (23.8)	13 (12.2)	<0.01
Mixed	60 (12.8)	45 (12.5)	15 (14.0)	<0.01
Other or unknown	49 (10.5)	40 (11.1)	9 (8.4)	<0.01
Initial vital signs				
Systolic blood pressure (mmHg)	95 (80–122)	96 (80–120)	91 (79–131)	0.72
Respiratory rate (/min)	20 (20–24)	20 (20–24)	22 (19–28)	0.01
Heart rate (/min)	106 (91–125)	104 (90–124)	112 (96–128)	0.02
Body temperature (°C)	37.4 (36.5–38.4)	37.6 (36.6–38.5)	37.0 (36.2–37.8)	<0.01
Vital signs at enrollment				
Systolic blood pressure (mmHg)	84 (74–94)	84 (74–94)	82 (72–96)	0.58
Respiratory rate (/min)	20 (18–24)	20 (18–24)	21 (20–26)	0.01
Heart rate (/min)	102 (89–119)	100 (88–118)	108 (95–122)	<0.01
Body temperature (°C)	37.2 (36.5–38.0)	37.4 (36.6–38.2)	36.8 (36.3–37.6)	<0.01
Culture positive				
Blood	198 (42.4)	158 (43.8)	40 (37.4)	0.37
Other	247 (52.8)	183 (50.7)	64 (59.8)	0.10
Resistant to initial antibiotics	48 (10.3)	36 (10.0)	12 (11.3)	0.71
Maximum SOFA score in 24 hours	7.5 (5–10.5)	7 (5–10)	9 (7–12)	<0.01
APACHE II score	18.5 (13–25)	17 (12–24)	22 (18–29)	<0.01

Data are shown as median (interquartile range) or number (%).

SOFA, Sepsis-related Organ Failure Assessment; APACHE, Acute Physiology and Chronic Health Evaluation.

tests, respectively. P-values less than 0.05 were considered statistically significant. STATA ver. 13.0 (STATA Corp., College Station, TX, USA) was used for statistical analysis.

RESULTS

Baseline characteristics and laboratory data

A total of 468 patients with suspected septic shock were enrolled. We excluded patients with "Do not attempt resuscitation" orders (n = 60), those who met the inclusion criteria six hours after ED arrival (n = 44), those who were directly transferred from EDs to other hospitals (n = 32), those who were transferred from other hospitals without meeting the inclusion criteria upon ED arrival (n = 13), and those who had not provided informed consent (n = 460).

The baseline characteristics and comparisons between survivors and non-survivors according to hospital mortality are shown in Table 2. The median age was 71.3 years (IQR, 59.9 to 78.9) and

258 (55.1%) patients were male. Of the enrolled patients, 388 (82.9%) had refractory hypotension and 80 (17.1%) had hyperlactatemia without hypotension on initial presentation. Respiratory infections (31.0%), intra-abdominal infections (24.6%), and urinary tract infections (21.1%) were the most common sources of infection. Bacteremia was present in 198 (42.4%) patients. The median maximum SOFA score was 7.5 (IQR, 5 to 10.5) and median APACHE II score was 18.5 (IQR, 13 to 25). Between survivors and non-survivors, there were significant differences in variables including sex, initial presentation, chronic renal disease, hematologic malignancy, suspected infection focus, respiratory rate, heart rate, body temperature, SOFA score, and APACHE II score.

The laboratory results are shown in Table 3, including complete blood count, blood chemistry, and lactate level. The median lactate level was 3.1 mmol/L (IQR, 1.8 to 5.0) on initial measurement (n = 458) and 2.5 mmol/L (IQR, 1.6 to 4.5) at the second measurement (n = 353).

Table 3. Laboratory test findings

Variable	Overall (n = 468)	Survivor (n = 361)	Non-survivor (n = 107)	P-value	No. of measurements
Initial lactate (mmol/L)	3.1 (1.8–5.0)	2.9 (1.8–4.7)	4.4 (2.5–7.5)	<0.01	458
Second lactate (mmol/L)	2.5 (1.6–4.5)	2.3 (1.5–3.9)	3.4 (1.9–6.8)	<0.01	353
White blood cell count ($\times 10^3/L$)	11.60 (6.34–18.35)	12.06 (7.00–19.30)	8.58 (3.50–14.90)	<0.01	468
Hemoglobin (g/dL)	11.1 (9.4–12.6)	11.3 (9.7–12.7)	10.3 (8.6–11.9)	<0.01	468
Hematocrit (%)	33.7 (28.9–38.0)	34.2 (29.9–38.3)	31.5 (26.4–36.9)	0.01	468
Platelet count ($\times 10^3/L$)	154 (89–244)	162 (95–246)	124 (57–221)	0.03	468
Sodium (mmol/L)	135 (131–138)	135 (132–138)	135 (131–139)	0.81	468
Potassium (mmol/L)	4.1 (3.6–4.6)	4.0 (3.6–4.5)	4.3 (3.7–4.8)	0.01	468
Chloride (mmol/L)	100 (96–105)	100 (97–105)	99 (94–105)	0.13	467
Blood urea nitrogen (mg/dL)	27.0 (18.9–43.4)	26.0 (18.0–40.0)	32.1 (21.0–49.0)	<0.01	466
Creatinine (mg/dL)	1.37 (0.91–2.27)	1.31 (0.90–2.15)	1.70 (1.01–2.67)	0.02	466
AST (U/L)	40 (25–85)	39 (25–80)	41 (27–116)	0.17	467
ALT (U/L)	26 (14–56)	27 (14–59)	24 (13–43)	0.35	467
Albumin (g/dL)	3.0 (2.6–3.4)	3.1 (2.6–3.5)	2.8 (2.3–3.2)	<0.01	455
Prothrombin time (INR)	1.27 (1.12–1.46)	1.23 (1.11–1.42)	1.32 (1.20–1.55)	<0.01	455
C-reactive protein (mg/dL)	14.47 (5.91–23.44)	14.27 (5.57–23.01)	15.43 (7.28–26.38)	0.17	468
Glucose (mg/dL)	136 (106–190)	136 (105–187)	137 (109–212)	0.52	467
Arterial pH	7.43 (7.36–7.47)	7.43 (7.38–7.48)	7.38 (7.26–7.46)	<0.01	461
PaCO ₂ (mmHg)	29.0 (24.7–34.0)	29.0 (25.0–33.7)	29.0 (23.5–37.9)	0.85	461
PaO ₂ (mmHg)	77.1 (62.3–95.7)	79.0 (63.8–95.7)	72.8 (57.0–96.0)	0.11	461
Bicarbonate (arterial, mmol/L)	19.0 (15.6–22.4)	19.5 (16.4–22.6)	17.7 (12.8–21.2)	<0.01	461
Initial ScvO ₂ (%)	69.4 (59.0–77.9)	69.2 (56.0–80.1)	70.7 (59.0–76.8)	0.70	121
Procalcitonin (mmol/L)	6.73 (0.96–26.80)	6.37 (0.98–26.66)	7.75 (0.78–30.56)	0.50	389
D-dimer (mcg/mL)	3.67 (2.12–8.87)	3.52 (2.04–7.84)	4.20 (2.64–11.30)	0.10	295
Troponin I or T (ng/mL)	0.047 (0.020–0.179)	0.041 (0.018–0.146)	0.075 (0.022–0.300)	0.06	384
NT-proBNP (pg/mL)	2,426 (928–6,808)	2,499 (877–6,881)	2,335 (1,032–6,734)	0.90	116
BNP (pg/mL)	195 (79–568)	135 (70–429)	303 (131–949)	<0.01	145

Data are shown as median (interquartile range).

AST, aspartate transaminase; ALT, alanine transaminase; INR, international normalized ratio; ScvO₂, central venous oxygen saturation; NT-proBNP, N-terminal pro-brain natriuretic peptide; BNP, brain natriuretic peptide.

Interventions

The interventions or procedures for the diagnosis and management of septic shock are shown in Table 4. The median time from

ED arrival was 0.4 (IQR, 0.2 to 0.8) hours for lactate measurement, 1.6 (IQR, 0.5 to 3.6) hours for blood culture, and 2.2 (IQR, 1.3 to 3.3) hours for first antibiotic administration. Within the

Table 4. Interventions

Variable	Overall (n=468)	Survivor (n=361)	Non-survivor (n=107)	P-value
Lactate measurement	458 (97.9)	354 (98.1)	104 (97.2)	0.59
Time from ED arrival to initial Lactate Measurement (hr) ^{a)}	0.4 (0.2–0.8)	0.4 (0.2–0.9)	0.3 (0.1–0.7)	< 0.01
Measured within 3 hours ^{b)}	427 (91.2)	329 (91.1)	98 (91.6)	0.88
Repeated lactate measurement within 6 hours from the first measurement	277 (59.2)	208 (57.6)	69 (64.5)	0.2
Blood culture	464 (99.4)	358 (99.2)	107 (100)	0.34
Time from ED arrival to blood culture (hr)	1.6 (0.5–3.6)	1.5 (0.5–3.0)	2.2 (0.5–7.0)	0.02
Blood culture within 3 hours ^{b)}	329 (70.3)	270 (74.8)	59 (55.1)	< 0.01
Antibiotics				
Time from ED arrival to first antibiotic administration (hr) ^{a)}	2.2 (1.3–3.3)	2.1 (1.3–3.2)	2.5 (1.5–3.4)	0.2
Administered within 3 hours ^{b)}	320 (68.4)	254 (70.4)	66 (61.7)	0.09
Fluid resuscitation				
Fluid administration (30 mL/kg of crystalloid) within 3 hours ^{b,c)}	376 (80.3)	289 (80.1)	87 (81.3)	0.78
Fluids for initial resuscitation				
Normal saline	387 (82.7)	297 (82.3)	90 (84.1)	0.66
Ringer's lactate	14 (3.0)	12 (3.3)	2 (1.9)	0.44
Plasma-lyte	158 (33.8)	116 (32.1)	42 (39.3)	0.17
Other crystalloids	6 (1.3)	4 (1.1)	2 (1.9)	0.54
Albumin	9 (1.9)	9 (2.5)	0 (0)	0.1
Synthetic colloids	45 (9.6)	27 (7.5)	18 (16.8)	< 0.01
Central venous catheter insertion within 6 hours ^{c,d)}	318 (68.0)	240 (66.5)	78 (72.9)	0.21
CVP measurement within 6 hours ^{b,d)}	253 (54.1)	193 (53.5)	60 (56.1)	0.63
ScvO ₂ measurement within 6 hours ^{b,d)}	103 (22.0)	76 (21.1)	27 (25.2)	0.36
Application of vasopressors for achievement MAP ≥ 65 mmHg ^{b,e)}	458 (97.9)	354 (98.1)	104 (97.2)	0.59
Vasopressors				
Time from ED arrival to first vasopressor administration (hr) ^{a)}	1.9 (1.0–3.5)	2.0 (1.2–3.5)	1.4 (0.7–2.4)	< 0.01
First vasopressor	431 (92.1)	333 (92.2)	98 (91.6)	0.83
Norepinephrine	413 (88.2)	320 (88.6)	93 (86.9)	0.63
Dopamine	17 (3.6)	12 (3.3)	5 (4.7)	0.51
Other	1 (0.2)	1 (0.3)	0 (0)	0.59
Second vasopressor	79 (16.9)	46 (12.7)	33 (30.8)	< 0.01
Norepinephrine	16 (3.4)	12 (3.3)	4 (3.7)	0.84
Dopamine	10 (2.1)	4 (1.1)	6 (5.6)	0.01
Vasopressin	51 (10.9)	28 (7.8)	23 (21.5)	< 0.01
Epinephrine	2 (0.4)	2 (0.4)	0 (0)	0.44
Dobutamine use within 24 hours	18 (3.9)	11(3.1)	7 (6.5)	0.1
Arterial cannulation within 6 hours ^{d)}	233 (49.8)	171 (47.4)	62 (57.9)	0.06
Transfusion within 24 hours ^{d)}				
Red blood cells	70 (15.0)	39 (10.8)	31 (29.0)	< 0.01
Fresh frozen plasma	44 (9.4)	18 (5.0)	26 (24.3)	< 0.01
Platelets	52 (11.1)	31 (8.6)	21 (19.6)	< 0.01
Mechanical ventilation	151 (32.3)	76 (21.1)	76 (71.0)	< 0.01
Time to mechanical ventilation (hr) ^{a)}	2.4 (0.6–9.4)	2.3 (0.6–7.0)	2.5 (0.6–11.0)	0.93
Duration of mechanical ventilation (day) ^{a)}	4 (2–9)	5 (2–9)	3 (1.5–9)	0.21
Renal replacement therapy	73 (15.6)	25 (6.9)	48 (44.9)	< 0.01
Intervention for source control	117 (25.1)	99 (26.4)	18 (16.8)	0.03
Time from ED arrival to initial source control ^{a)}	15.6 (7.2–47.9)	15.2 (7.2–36.0)	20.9 (7.1–96.1)	0.59
Intervention within 12 hours from ED arrival	43 (9.2)	38 (10.5)	5 (4.7)	0.07

Data are shown as number (%) or median (interquartile range).

ED, emergency department; CVP, central venous pressure; ScvO₂, central venous oxygen saturation; MAP, mean arterial pressure.

^{a)}Missing data: one case, time to lactate measurement; five cases, time to antibiotics; six cases, time to vasopressors; 11 cases, time to mechanical ventilation; three cases, duration of mechanical ventilation; and seven cases, time to source control. ^{b)}The sepsis bundle components. ^{c)}Two cases with central venous catheter insertion at other hospitals were not included. ^{d)}Time zero was considered as the time of hypotension or lactate elevation ≥ 4 mmol/L. ^{e)}Cases without hypotension were considered as the bundle component was achieved.

initial three hours of ED arrival, lactate measurement was performed in 427 (91.2%) patients, blood culture was done in 329 (70.3%) patients, and initial antibiotics were administered to 320 (68.4%) patients. Repeated lactate measurements were performed in 277 (59.2%) patients within six hours of the first measurement. Initial fluid resuscitation (more than 30 mL/kg of crystalloid) was performed in 376 (80.3%) patients, most often using normal saline (82.7%). CVP and ScvO₂ were measured in 318 (68.0%) and 103 (22.0%) patients within six hours of the time of hypotension or lactate elevation, respectively. The compliance with the application of vasopressors for achievement of mean arterial pressure \geq 65 mmHg was 97.9%. The median time from ED arrival to first vasopressor administration, most commonly norepinephrine, was 1.9 (IQR, 1.0 to 3.5) hours. Mechanical ventilation was applied in 151 (32.3%) patients and renal replacement therapy was used in 73 (15.6%) patients. The median time from ED arrival to first source control was 15.6 (IQR, 7.2 to 47.9) hours. Among patients who underwent intervention for source control, 43 (36.8%) received intervention within 12 hours of their ED arrival. Between survivors and non-survivors, there were significant differences in interventions, including time to lactate measurement, time to blood culture, use of synthetic colloids, time to the first vasopressor, use of a second vasopressor, transfusion, mechanical ventilation, and renal replacement therapy.

Outcomes

The in-hospital, 28-day, and 90-day mortality rates were 22.9%, 21.8%, and 27.1%, respectively (Table 5). The intensive care unit admission rate from the ED was 64.5%. The median length of

stay in the ED, intensive care unit, and hospital ward were 6.8 (IQR, 4.0 to 14.6) hours, 4 (IQR, 2 to 8) days, and 12 (IQR, 7 to 21) days, respectively.

DISCUSSION

This preliminary analysis of a prospective, observational registry of 10 EDs participating in the KoSS is the first multi-center study about septic shock in EDs of Korea. The study mainly investigated the demographic characteristics, interventions, and clinical outcomes of patients with septic shock presenting with refractory hypotension or hyperlactatemia.

Mortality rates vary according to inclusion criteria and septic shock definition.¹⁴ Overall, the mortality trend in sepsis or septic shock patients is declining, but mortality remains high.^{4,5,15} Recent large clinical trials (the Australasian Resuscitation in Sepsis Evaluation study and the Protocolised Management in Sepsis trial), multi-center, ED-based studies for patients with septic shock, have reported 15.0% to 25.1% in-hospital mortality and 15.3% to 24.6% 28-day mortality.^{8,10} Our study, with similar inclusion criteria to these trials, showed comparable mortality rates.

According to a global observation study (the International Multicentre Prevalence Study on Sepsis, including 1,794 patients from 62 countries), compliance with the sepsis bundle metrics remains low and variable.¹⁶ Compliance rates were comparable in interventions including blood culture, antibiotic administration, application of vasopressor, CVP measurement, and repeated lactate measurement. However, higher compliance rates were observed for initial lactate measurement and initial fluid resuscitation. ScvO₂ was relatively underused; the practice was probably affected by the current trials for early goal-directed therapy.⁸⁻¹⁰

There are some controversies regarding whether sepsis bundle compliance directly improves outcomes and whether specific interventions or protocols are superior to management by clinical assessment.³ However, considering the clinical importance of early recognition and timely management of septic shock, compliance to the sepsis bundle might be associated with clinical improvement in the quality of initial treatment and better outcomes.^{17,18} From this perspective, we observed that some interventions for sepsis care might need to be improved, including obtaining a blood culture, antibiotic administration, and source control interventions.

Our inclusion criteria varied from the new definition of septic shock from Sepsis-3.¹⁹ However, the new definition is relatively specific and difficult to apply in the ED. Refractory hypotension and hyperlactatemia are criteria currently recommended by the SSC guidelines for the initiation of aggressive management.⁶ In

Table 5. Outcomes and lengths of stay

Variable	Value
Hospital discharge ^{a)}	
Discharge	305 (65.1)
Transfer to another hospital	56 (12.0)
In-hospital mortality	107 (22.9)
28-Day mortality	102 (21.8)
Loss to follow-up	20 (4.3)
90-Day mortality	127 (27.1)
Loss to follow-up	68 (14.5)
Emergency department disposition	
Intensive care unit	302 (64.5)
General ward	163 (34.8)
Discharge	2 (0.4)
Death	1 (0.2)
Length of stay	
Emergency department (hr)	6.8 (4.0–14.6)
Intensive care unit (day)	4 (2–8)
Hospital (day)	12 (7–21)

Data are shown as number (%) or median (interquartile range).

^{a)}Eight cases with withdrawal of supportive care were included.

addition, we have been collecting data about the Sepsis-3 definition and future studies from the KoSS registry will include these results.

There are some changes in the updated 2016 SSC guidelines.²⁰ CVP and ScvO₂ are no longer recommended as the initial goals of resuscitation. However, the use of these targets may be considered because current trials including less severely ill patients have reported that no harm was associated with the interventional strategies.^{8-10,20} The guidelines also recommend frequent reassessment of hemodynamic status using available physiologic variables and that dynamic rather than static variables be used to predict fluid responsiveness. The KoSS registry needs to reflect these recent changes.

This study has several limitations. Further data collection and analysis are needed because this is a preliminary, descriptive study; thus, the observed findings are limited. We hope that this study will lead to a large-scale study involving more hospitals and patients that will contribute to advances in the diagnosis and treatment of septic shock. Second, a number of patients were excluded from this study for several reasons and we focused on early septic shock patients in the ED, which might have led to selection bias. Third, the enrollment periods and case volumes varied according to hospital. Institutional characteristics should also be investigated in future studies.

In conclusion, in the KoSS septic shock registry, which included 10 EDs, the mortality rate of patients with septic shock exceeded 20%. The results of this preliminary report suggest that there are areas for improvement in terms of the quality of initial resuscitation and the outcomes of patients with septic shock in the ED.

CONFLICT OF INTEREST

No potential conflict of interest relevant to this article was reported.

ETHICAL DISCLOSURE

The study was approved by the institutional review boards of the individual participating centers. The institutions and IRB approval numbers are as follows: Asan Medical Center, S2015-1918-0002; Gangnam Sacred Heart Hospital, 2015-11-142; Gangnam Severance Hospital, 3-2015-0227; Hanyang University Hospital, HYUH 2015-11-013-007; Korea University Anam Hospital, HRPC2016-184; Korea University Kuro Hospital, KUGH15358-001; Samsung Medical Center, SMC2015-09-057-001; Seoul National University Hospital, J-1408-003-599; Seoul National University Bundang Hospital, B-1409/266-401; Severance Hospital, 4-2015-0929.

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