American Journal of Emergency Medicine xxx (2018) xxx–xxx

Contents lists available at ScienceDirect

American Journal of Emergency Medicine

journal homepage: www.elsevier.com/locate/ajem

Emergency department sepsis screening tool decreases time to antibiotics in patients with sepsis

Tanvi Shah *, Ethan Sterk, Megan A. Rech

Department of Pharmacy (Shah, Rech), Department of Emergency Medicine (Sterk), Loyola University Medical Center, Maywood, IL, USA

ARTICLE INFO

Article history:
Received 19 May 2017
Received in revised form 10 January 2018
Accepted 21 January 2018
Available online xxxx

Keywords:
Sepsis
Bundle compliance
Emergency medicine management
Antibiotics
Fluid resuscitation

ABSTRACT

Recent literature has highlighted the importance of early identification and treatment of sepsis; however, limited data exists to help recognize sepsis in the emergency department (ED) through use of a screening tool. The purpose of this study was to evaluate the impact of a sepsis screening tool implemented in an academic medical center ED on compliance with the 3-hour sepsis bundle.

This was a retrospective cohort study that included a total of 115 patients, of which 58 were in the pre-tool group and 57 were in the post-tool group. There was no difference in 3-hour bundle compliance between groups (36.2% vs. 47.4%, $P = 0.26$). There was no difference in the following bundle components: lactate (79.3% vs. 80.7%, $P = 0.85$), blood cultures (86.2% vs. 96.5%, $P = 0.09$), blood cultures before administering antibiotics (91.4% vs. 100%, $P = 0.57$) and adequate fluids administration (44.7% vs. 41.9%, $P = 0.820$). A significantly higher number of patients received antibiotics within 3 h in the post-tool group (58.6% vs. 89.5%, $P < 0.001$). Statistically significant secondary outcomes included average time to antibiotics ($P = 0.04$), administering antibiotics within an hour ($P > 0.001$), and ICU length of stay ($P = 0.03$). There was no difference in 30-day mortality, however mortality was numerically lower in the post-tool group (36.2% vs. 26.3%, $P = 0.25$).

Although implementation of an ED sepsis screening tool did not increase 3-hour bundle compliance, it did increase the proportion of patients receiving timely antimicrobial therapy and demonstrated a trend towards decreased mortality.

1. Introduction

Sepsis is a dysregulated host response to infection which may lead to organ dysfunction. Septic shock occurs with progression to organ dysfunction and is associated with a high risk of mortality [1,2]. Sepsis is a common cause for hospitalization with >750,000 cases annually, with majority of cases presenting through the emergency department (ED) [3,4]. In order to increase recognition and decrease sepsis-related mortality, the Surviving Sepsis Campaign (SSC) guidelines specify care bundles, at 3 and 6 h after recognition, targeting early management of severe sepsis and septic shock. The 3-hour bundle includes measuring a serum lactate level, obtaining blood cultures prior to antibiotics administration and administering broad spectrum antibiotics in addition to a bolus of 30 mL/kg of crystalloids for hypotension or a serum lactate ≥ 4 mmol/L. [5] The guidelines recommend administering antibiotics within the first hour of recognizing severe sepsis and septic shock [5].

Early recognition and compliance with the SSC bundle has demonstrated a mortality benefit [1,5-7]. While some intensive care units (ICU) and inpatient floors have implemented a sepsis screening tool to help health care providers identify septic patients, there is limited data on the use of screening tools in the ED setting. A commonly used inpatient screening tool, the modified early warning score (MEWS), is based on five physiologic parameters to detect clinical deterioration [8]. MEWS helps identify patients who require increased level of care early, which can increase compliance with the 3-hour bundle. Some ICUs have developed unit-specific sepsis screening tools. One retrospective study in a surgical ICU (SICU) observed a decrease in mortality rate from 35.1% to 23.3% in 136 patients after implementation of a sepsis screening tool [9].

While several screening tools have been evaluated in an inpatient setting, [7-9] few studies have explored the impact of a sepsis screening tool in the ED. One retrospective study assessed the impact of a sepsis quality improvement project on compliance with the SSC bundle in the ED [10]. The project utilized a computer-assisted screening algorithm that generated a pop-up alert to healthcare providers along with a sepsis order set to assist with initial management. The study found a statistically significant improvement in time to antibiotics, time to intravenous fluids and 3-hour bundle compliance; however,

* Corresponding author at: Loyola University Medical Center, 2160 S. 1st Ave, Maywood, IL 60153, USA.
E-mail address: tanvi.shah@lumc.edu (T. Shah).

https://doi.org/10.1016/j.ajem.2018.01.060
0735-6757/

there was no difference in mortality. Currently, there are no widely-used, validated ED sepsis screening tools. The purpose of this study was to evaluate the impact of the sepsis screening tool implemented in our ED to determine its impact on 3-hour bundle compliance in patients with sepsis.

2. Methods

This retrospective cohort study conducted at Loyola University Medical Center, an academic medical center with approximately 23,800 admissions and >48,000 ED visits annually. ED patients ≥ 18 years of age, admitted to either the general floor, medical ICU (MICU) or SICU and diagnosed with severe sepsis and septic shock were included in this study. The pre-tool period was from August 2012 to January 2013 and post-tool period was from January 2015 to June 2015. Patients admitted from 2013 and 2014 were excluded as the screening tool was being implemented and modified to its current form this time. The following patients were excluded: trauma, admitted to units other than the general floor, MICU and SICU, without sepsis at time of presentation to the ED, and pregnant women. International Classification of Diseases (ICD) -9 diagnoses codes were used to identify patients and manual chart review was conducted within the electronic medical records to validate accuracy of coded data and collect baseline variables and bundle compliance data.

The sepsis screening tool was first implemented in May 2013 and updated and automated in December 2014. The screening tool comprised of two parts: five vital signs and three dichotomous questions. The vital signs were automatically populated each time they were entered by the nurse. Recorded measures included: temperature, systolic blood pressure (SBP) or mean arterial pressure, respiratory rate, oxygen saturation, and pulse. The dichotomous questions answered by the nurse included the following: rigors present, suspected infection and altered mental status present. If three or more values out of the eight collected were abnormal or present, the patient was considered positive for the sepsis screen. The ED had an electronic track board which could be viewed by all health care providers. It displayed all the patients in the ED and waiting room along with acuity level, age, sex, room number, and chief complaint. The acuity level is presented in a circular icon that changes to a square upon screening positive for sepsis to alert providers. The physician then evaluated the patient and initiated the sepsis order set if sepsis is suspected. The sepsis order set was available during the entire study period, and provided physicians the ability to quickly order appropriate laboratory testing, blood cultures, diagnostic procedures, intravenous fluids, and medications.

The primary outcome of this study was the percentage of patients who had the 3-hour bundle completed within 3 h. Secondary outcomes included the individual bundle endpoints (time to lactate, blood cultures, broad-spectrum antibiotics, and adequate infusion of fluids [30 mL/kg] if required for hypotension or a lactate ≥ 4 mmol/L), as well as number of patients who received antibiotics within an hour, time to vasopressors, number of vasopressors, hydrocortisone use, length of stay (LOS) in the ED, ICU and hospital, and 30-day mortality. Data collection included the following: age, sex, race, comorbidities, sequential organ failure assessment (SOFA) score, admitting unit, ED shift, systemic inflammatory response syndrome (SIRS) criteria, severity of sepsis, 3-hour bundle components, screening tool components, and secondary outcomes. Sepsis time zero for all patients was when the triage nurse obtained the first set of vitals.

Data were analyzed using SPSS version 23 (Chicago, IL). Baseline variables displayed using descriptive statistics, including medians, interquartile ranges (IQR) and percentages. Continuous variables were analyzed using a *t*-test if parametric or Mann-Whitney *U* test if non-parametric. Chi-square and Fisher's exact test were used for categorical data as appropriate. A multivariate logistic regression analysis was conducted using variables with a p-value < 0.2 to determine independent predictors of 30-day mortality. A post-hoc analysis was conducted to evaluate the new proposed sepsis identification criteria, quick sequential organ failure assessment (q-SOFA), which is comprised of three variables: RR, altered mental status and SBP [1]. Results were considered statistically significant if the p-value < 0.05.

3. Results

A total of 293 patients were reviewed, of which 115 patients (39.2%) met inclusion criteria, ($n = 58$ pre-tool group, $n = 57$ post-tool group; Fig. 1). Baseline characteristics were similar between the two groups including admission time of day, baseline serum lactate, diagnosis and admitting unit (Table 1). The most common comorbidities in both groups were hypertension and diabetes. Source of infection was similar between the two groups, however genitourinary infections were common in the post-tool group (18.9% vs. 36.8% patients, $P = 0.028$).

There was no difference in the primary outcome of 3-hour bundle compliance between the pre-tool and post-tool groups (36.2% vs. 47.4%; $P = 0.225$) (Table 2). For the secondary endpoints of individual bundle components, the only significant difference was observed in the proportion of patients receiving broad spectrum antibiotics within 3 h (58.6% vs. 89.5%; $P < 0.001$). Receipt of antibiotics at 1h after sepsis recognition was also statistically significant between groups (10.3% pre-tool vs. 89.5% post-tool; $P < 0.001$). The median time to antibiotics was also significantly faster in the post-tool group (144 [IQR 96–234] min vs. 60 [IQR 30–96] min, $P < 0.001$).

There were no differences in other secondary endpoints between groups, including vasopressor use within 6 h, hydrocortisone administration, appropriate selection of antibiotics according to suspected source of infection, ED LOS, hospital LOS or 30-day mortality (Table 3). ICU LOS was significantly shorter in the post-tool group (4 [IQR 1.5–14] days vs. 3 [IQR 0–6] days, $P = 0.027$).

A multivariate analysis was performed to determine independent predictors of 30-day mortality. Variables included from the univariate analysis were blood cultures within 3 h, elevated lactate levels, adequate fluid resuscitation as determined by the SSC guidelines (if hypotensive or serum lactate ≥ 4 mmol/L) and sepsis screening tool group. The analysis demonstrated that initial lactate level > 4 mmol/L significantly impacts 30-day mortality, (95% CI, 1.52 to 7.92; $P = 0.003$), however the screening tool did not appear to affect mortality.

4. Discussion

Our study evaluated the impact of an ED sepsis screening tool. While an increase in compliance with the SSC 3-hour bundle was not observed, there was a numerical increase in bundle compliance. Importantly, we observed an increase in antibiotic administration within 1 h and 3 h by 30.9% and 79.2%, respectively, in the post-tool group. This has important implications as delayed antimicrobial therapy following documented hypotension has been associated with increased mortality. One study demonstrated administration of antibiotics within the first hour of septic shock was associated with a 79.7% survival to hospital discharge as opposed to 60% survival rate if antibiotics were administered within 3 h [6]. Delayed antibiotic therapy has also been associated with increased LOS, acute kidney injury, acute lung injury and increased severity of illness as determined by SOFA score [6,11-15].

This study evaluated the impact of an ED sepsis screening tool on adult patients. The tool was created using triage nurse assessment and electronic cues to the ED clinicians in an effort to expedite recognition and treatment of sepsis. A similar retrospective cohort study evaluated a sepsis screening tool ($n = 624$), and found an increase in bundle compliance post-implementation ($p < 0.001$), though no difference was observed in mortality. This study utilized SIRS criteria in the screening tool, which is non-specific and less accurate than SOFA-based assessments. Our assessment tool utilized a combination of vital signs and screening questions, which allowed for faster assessment as it was not reliant on laboratory parameters (e.g. white blood count) [10]. This previous

Please cite this article as: Shah T, et al, Emergency department sepsis screening tool decreases time to antibiotics in patients with sepsis, American Journal of Emergency Medicine (2018), https://doi.org/10.1016/j.ajem.2018.01.060