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Impact of length of stay in emergency department on the outcome in patients with severe sepsis

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Abstract

***Objective*: The impact of emergency department length of stay (EDLOS) on outcome in critically ill patients is debatable. The factors that impact on mortality and the measures to improve survival have been widely studied. However, the association between EDLOS and outcome in the group of critically ill patients with severe sepsis requiring intensive care has not been investigated.**

***Methods*: We performed a retrospective observational study over a 3-year period in a metropolitan 360-bed teaching hospital that has a 10-bed general intensive care unit (ICU). Adult patients presenting to emergency department during the study period with severe sepsis requiring ICU admission were included. The effect of EDLOS on in-hospital mortality, intensive care unit length of stay (ICULOS) and hospital length of stay (HLOS) was investigated.**

***Results*: During the study period 117 patients were admitted to ICU from the emergency department (ED) with severe sepsis. The mean age of the patients was 64.7 years and the sex ratio was comparable (51% male patients). The mean APACHE II score was 18.3. The median EDLOS was 8.3 hours. The median ICULOS and HLOS were 3 and 12 days respectively. The hospital mortality was 21.3%. There was no association between EDLOS and in-hospital mortality, ICULOS or HLOS.**

***Conclusion*: Our study revealed that in patients with severe sepsis, the duration of EDLOS had no effect on in-hospital mortality, ICULOS or HLOS.**

Key words: Sepsis, mortality, length of stay.

Introduction

Prolonged emergency department length of stay (EDLOS) is common in emergency departments worldwide and it may be related to sustained and increasing overcrowding. (1) EDLOS may be associated with a prolonged hospital length of stay (HLOS) and may adversely affect patient outcome. (1-4) EDLOS has been widely studied in the last two decades. However, in the critically ill patients there are few studies that have addressed the effect of EDLOS on outcome. (5-7) The results of these studies are variable with some studies reporting an increased mortality in patients staying for longer periods in emergency department (ED) (5) and some reporting no increased mortality. (6,7) Furthermore, the patients in those studies were heterogeneous and those with severe sepsis were included but were not studied separately.

Severe sepsis is one of the common reasons for intensive care unit (ICU) admission and has a high mortality. In Europe the estimated mortality from sepsis is 36%, (8) and in the USA mortality is between 28-50% with an average estimate of 29%. (9) The data from the Australasian Resuscitation in Sepsis Evaluation (ARISE) investigators and the Australian

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and New Zealand Intensive Care Society (ANZICS) Adult Patient Database revealed an increase in ICU admission to the contributing ICUs from 368 in 1997 to 1409 admissions in 2005. (10) The Australasian mortality for sepsis and septic shock from the ARISE investigators was reported to be 27.6%. (10)

In a single centre study of sepsis, early management initiated in the ED aiming for specific goals has been shown to improve outcome. (11,12) However, with high patient acuity, overcrowding and the increased workload of staff, the provision of early and longitudinal one to one focused care may not always be feasible during the period the patients are in ED. Therefore, a prolonged EDLOS is potentially deleterious to patient outcome. In this study we aimed to review the association EDLOS in patients with severe sepsis or septic shock, on in-hospital mortality, ICULOS and HLOS.

Methods

The Human Research and Ethics Committee at Peninsula Health approved the study. We performed a retrospective observational study in a university affiliated 360-bed metropolitan hospital. The hospital has a level 2 (based on classification of Critical Care Services in Victoria's Public Hospitals), 10-bedded ICU that admits over 700 patients a year. The ED has over 50,000 presentations per year.

Data were extracted from our database and from the patients' medical records. The variables included in the analysis were age, gender, acute physiology and chronic health evaluation (APACHE) II score, physiological and biochemical data (worst values) during the first 24 hours of presentation, EDLOS (time from triage in ED to arrival in ICU), intensive care unit length of stay (ICULOS) (time from arrival in ICU to time from discharge from ICU), HLOS (time from triage in ED to time of discharge from the hospital) and in-hospital mortality. The physiological variables were heart rate, respiratory rate, temperature, systolic blood pressure and Glasgow coma score (GCS). The laboratory variables were pH, partial pressure of carbon dioxide (PCO2), serum bicarbonate (HCO3) and white cell count. Furthermore, we evaluated time to resuscitation and time to antibiotics.

Time to resuscitation was defined as the time from ED presentation to when resuscitation was commenced (not when intravenous fluids at a slow rate were commenced). Patients were resuscitated with colloid or crystalloid fluid (run rapidly) or with vasopressors if not fluid responsive. As patient management was not protocol driven, the volume and nature of the fluid administered and the use of vasopressors was determined by the treating clinician. Time to antibiotics was defined as the time from ED presentation to when antibiotics were first administered.

We have followed the definitions according to 2001 SCCM/ESICM/ACCP/ATS/SIS International Sepsis Definitions Conference in identifying and classifying patients with sepsis. (13) Accordingly we defined:

> Sepsis: Clinical syndrome defined by the presence of both infection and a systemic inflammatory response.
>
> Severe sepsis: Sepsis complicated by organ dysfunction.
>
> Septic shock: Acute circulatory failure characterized by persistent arterial hypotension unexplained by other causes.

Statistical analysis

Statistical analysis was performed using SAS version 9.1 (SAS Institute Inc., Cary, NC, USA). Variables were initially assessed for normality, with EDLOS, HLOS and ICULOS all found to be well approximated by log-normal distributions. Comparisons between groups were made using Chi-square test for proportions, Student's T-test for continuous normally distributed variables and Wilcoxon Rank-Sum test for non-parametrically distributed data. Proportions were reported as percentage (n), normally distributed data were reported as means (standard error) and non-normally distributed data were reported as medians (inter-quartile range).

Following log-transformation, linear regression was used to determine relationships with EDLOS, HLOS and ICULOS, with results reported as parameter estimates (std error), R-square statistics to show variation explained and a p-value. Predictors of mortality were determined using logistic regression, with results reported as odds ratios (OR) and 95% confidence interval (CI). Multivariate models were constructed using both stepwise selection and backwards elimination procedures, before undergoing a final assessment for clinical and biological plausibility. A two-sided p-value of 0.05 was considered to be statistically significant.

Results

There were 117 patients with a diagnosis of severe sepsis or septic shock admitted to the ICU from the ED from July 1st 2004 to September 30th 2007. The mean age was 64.7 years and 51% were male.

Sites of infection were identified with pulmonary sepsis as the most common (33.3%), followed by urinary tract (25%), gastrointestinal tract (13%), other sites (including cardiac, neurological, bone, ENT, gynaecological) in 14.5%. The source of sepsis was not clear in 13.6% patients.

In-hospital mortality was 21.3%. The median EDLOS was 8.3 hours and the median ICULOS and HLOS were 3 and 12 days respectively (**Table 1**). There was no significant association between EDLOS and in-hospital mortality (p=0.54), or EDLOS and ICULOS or HLOS (p=0.41 and 0.13 respectively).

There was a significant association between ICULOS and HLOS. Patients who stayed longer in ICU had a longer HLOS (p=0.007). There was a significant association between APACHE II scores and ICULOS (p=0.02). Respiratory rate was higher in patients with longer ICULOS (p=0.003). Furthermore, the physiological measurements associated with HLOS were pH and HCO3. HLOS increased in patients with a lower pH and lower HCO3 (p=0.01 and 0.02 respectively). Multivariate analysis showed that temperature was the only variable that was associated with mortality, in that mortality increased with lower temperature (OR 0.81, 95% CI 0.65-0.99).

Comparing survivors and non-survivors (**Table2**), non-survivors had a shorter HLOS. Non-survivors had a trend towards longer ICULOS. Non-survivors had a lower temperature, a lower pH and a lower HCO3. APACHE II score was significantly higher in non-survivors. Time to resuscitation did not significantly differ between survivors and non-survivors.

Discussion

In this study of patients with severe sepsis, EDLOS was not associated with in-hospital mortality, ICULOS or HLOS.

Previously published studies have revealed conflicting results regarding the impact of EDLOS on outcome in all critically ill patients admitted from ED. A few previous studies in which critically ill medical patients admitted to ICU from ED revealed similar results to our study where there was no relation between EDLOS and mortality. (6,7) Tilluckdharry and co-workers demonstrated that in critically ill patients who were transferred from the ED to medical ICU within 24 hours, mortality and HLOS were no better than those who had a delayed transfer from ED. (7) Similarly, Saukoken showed that EDLOS was neither associated with poor outcome of critically ill medical patients nor on health related quality of life at six months. (6)

Contrary to these reports, Chalfin and colleagues demonstrated that critically ill patients with a six hours or longer delay in transfer to intensive care unit from ED had an increase in HLOS. Furthermore, this delay resulted in a higher intensive care unit and in-hospital mortality (a 4.5% increased absolute risk mortality). (5) It is possible that our study and the study by Tilluckdharry (7) and Saukoken (6) may be underpowered to detect a difference in the outcome if one really existed given the smaller sample size as compared to the sample size of over 50,000 patients in Chalfin's study. To show an absolute reduction in mortality of 4.5 % for our study we would need approximately 2200 patients [α 0.05 and power of 80%]. It is also possible that the differences in outcomes could be due to the fact that our study , the study by Tilluckdharry (7) and Saukoken (6) where the results are only from university and teaching hospitals EDs (with resources and experience in dealing with critically ill patients pending ICU admission for longer periods) as compared to the study by Chalfin (5) which was a multi-centre study involving several emergency departments in the US. The study by Chalfin (5) had several limitations in spite of being a large study. The number of patients compared in both groups was dissimilar (2% of patients in the delayed group versus 98% in the non delayed group), the APACHE II scores (or any other severity scores) were not available for all the patients included in the study to assess if both groups were comparable in terms of severity of illness. The incidence of sepsis (which is known to be associated with an increased mortality in ICU) was significantly higher in the delayed group that could potentially have impacted on the outcome. There was a significantly increased requirement for central venous catheter insertions and the need for mechanical ventilation in the delayed group suggesting that these patients are sicker than the non delayed group and are likely to have an increased mortality irrespective of the delay in the ED. Finally and importantly the data of this study comes from a variety of sources including community hospitals in rural and suburban areas and from intensive care units where there are no intensivists.

The average age in our study was 65 years, which is 5 years older than recently reported figures with regard to age of critically ill patients admitted to ICU with sepsis. (10) Similarly the source of sepsis in our study was different from the published Australasian data. In spite of the variations in the case mix, the hospital mortality was comparable with previously published Australasian data. (10)

The study by Nguyen and co-workers, including patients with septic shock revealed that the care delivered to critically ill patients during their ED stay impacts significantly on the progression of organ failure and mortality. (14) The study was not entirely comparable with ours as patient cohort differed. Furthermore, the management of patients in Nguyen study differed from ours in that there were centre specific policies and protocols. In our study the management of patients with severe sepsis or septic shock is not by protocol and is determined by the attending physician. Monitoring of intra-arterial blood pressure, central venous pressure and central venous saturation are performed when considered clinically appropriate.

In our patient cohort, neither age nor gender significantly differed between survivors and the non-survivors. The results were consistent with previously published data that age alone is not an important predictor of mortality. (15-17)

Early institution of antibiotics in patients with septic shock was shown to improve outcome. (11,18) In our study the time to antibiotics showed a trend towards shorter time in the group of patients who survived as compared to those who died (111 minutes vs 136 minutes; $p=0.27$). The lack of statistical significance may be due to the smaller sample size in our study (a sample size of about 2000 patients would be required [α 0.05 and power of 80%] to show the difference to be statistically significant).

Conclusion

In patients with severe sepsis EDLOS had no effect on in-hospital mortality or on ICU and HLOS.

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Table 1. Patient characteristics at presentation and outcomes

Variable	n=117
Age (years) (SE)	64.7 (1.4)
Male (%)	51
Death (%)	21.3
APACHE II score (SE)	18.3 (0.7)
Heart rate (SE)	116.9 (2.4)
Respiratory rate (SE)	29 (0.80)
Systolic blood pressure (mmHg) (SE)	79 (1.6)
Temperature (^oC) (IQR)	38.2 (36.5-39.0)
pCO2 (torr) (SE)	42.6 (1.5)
pH (SE)	7.26 (0.01)
HCO3 (mmol/L) (SE)	19.4 (0.6)
White blood cell count ($x10^9/L$) (SE)	15.6 (1.0)
Time from arrival to antibiotics (minutes) (IQR)	114 (51-233)
Time from arrival to resuscitation (minutes) (IQR)	49 (19-132)
EDLOS (hours) (IQR)	8.3 (6.0-14.0)
ICULOS (days) (IQR)	3 (2-6)
HLOS (days) (IQR)	12 (7-22)

Legend: ICULOS=intensive care unit length of stay; HLOS=hospital length of stay; EDLOS=emergency department length of stay; APACHE II score=acute physiology and chronic health evaluation II score; SE=standard error; IQR=inter-quartile range

Table 2. Comparison between survivors and non-survivors

Variable	Survivors (n=92)	Non-survivors (n=25)	P value
Age (years) (SE)	63.7 (1.62)	68.36 (2.79)	0.18
Male (%)	51 (48)	48 (12)	0.71
Systolic blood pressure (mmHg) (SE)	80.13 (1.91)	76.16 (2.39)	0.31
Temperature (^oC) (IQR)	38.3 (37.15-39.05)	37.7 (34.3-38.4)	0.011
Heart rate (SE)	116.83 (2.29)	117.32 (7.86)	0.94
Respiratory rate (SE)	28.77 (0.95)	30.04 (1.45)	0.52
GCS (SE)	13.15 (0.34)	13.04 (0.51)	0.87
White blood cell count ($x10^9/L$) (SE)	14.8 (0.83)	18.57 (3.71)	0.13
pH (SE)	7.29 (0.01)	7.16 (0.04)	<0.0001
HCO3 (mmol/L) (SE)	20.43 (0.61)	15.94 (1.37)	0.002
pCO2 (torr) (SE)	42.32 (1.71)	43.8 (2.93)	0.68
APACHE II score (IQR)	16.93 (0.67)	23.82 (1.59)	<0.0001
ICULOS (days) (IQR)	3 (1.5-6.5)	4 (2-6)	0.52
HLOS (days) (IQR)	12 (8.5-22.5)	7 (2-20)	0.011
EDLOS (hours) (IQR)	8.7 (6.33-14.29)	8.03 (5.71-12.93)	0.45
Time to resuscitation (minutes) (IQR)	50.5 (16.5-137.5)	38 (28-102)	0.88
Time to antibiotics (minutes) (IQR)	111 (48.5-233)	136 (64-259)	0.27

Legend: ICULOS=intensive care unit length of stay; HLOS=hospital length of stay; EDLOS=emergency department length of stay; GCS=Glasgow coma score; APACHE II score=acute physiology and chronic health evaluation II score; SE=standard error; IQR=inter-quartile range

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