ORIGINAL ARTICLE

The Management and Outcomes of Surgical Sepsis in Limiting Resource during COVID-19 Pandemic

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Background: Sepsis is a life-threatening organ dysfunction caused by the dysregulated host response to infection. Surgical sepsis is a form of sepsis that requires source control. Treating surgical sepsis patients during the COVID-19 pandemic presented several limitations, particularly in terms of source control.

Objective: To evaluate the management of surgical sepsis patients at Ramathibodi Hospital by comparing outcomes before and during the COVID-19 pandemic.

Materials and Methods: Retrospective analysis was conducted on patients diagnosed with sepsis in the Department of Surgery at Ramathibodi Hospital between May 2019 and April 2021. Patients were divided into two groups with Group A that comprised patients diagnosed with sepsis before the COVID-19 pandemic, between May 2019 and April 2020, and Group B that consisted of patients diagnosed with sepsis during the pandemic, between May 2020 and April 2021. Surgical sepsis patients were analyzed to ascertain the mortality rate and conduct multivariate analysis to demonstrate the association of exposure variables with the mortality rate in this group.

Results: Two hundred ninety patients were included, with 145 diagnosed with sepsis in both Group A and Group B. Among them, 49 in Group A and 68 in Group B were classified as surgical sepsis. The mortality rate for surgical sepsis patients in Group A and Group B were 26.53% and 33.82%, respectively. The present study showed no significant difference between the two groups regarding mortality (p=0.399). Multivariable analysis revealed that surgical sepsis patients either not admitted to ICU or admitted for less than 15 days had a lower mortality rate (adjusted OR 0.01 and 0.12, respectively) (p<0.001).

Conclusion: The limited resources during COVID-19 did not appear to impact the mortality rate of surgical sepsis patients. However, it is crucial to acknowledge that there may be other potential confounding factors that cannot be controlled. The mortality rate may differ in contexts different from the present study.

Keywords: COVID-19; Surgical sepsis; Source control

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Sepsis is a life-threatening organ dysfunction caused by a dysregulation of the host's response to infection[1-3]. It affects approximately 751,000 patients each year in the United States, with a mortality rate of 28.6%, resulting in about 215,000 deaths annually[4,5]. The incidence of sepsis doubled in the United States between 2000 and 2008 and the cost associated with sepsis-related care was more than US$ 20.3 billion a year[6,7]. Despite the absence of clinical measurements that can precisely reflect the concept of a dysregulated host response, there are widely used scoring systems, such as the systemic inflammatory response syndrome (SIRS) and the Sequential Organ Failure Assessment (SOFA) score. These systems are employed to evaluate or identify inflammation or organ dysfunction in patients suspected of infection[8-10]. SIRS represents the inflammatory response in patients, while the SOFA score indicates the organ dysfunction status of the patient. The scores were designed for early detection of sepsis, enabling clinicians to implement prompt management strategies, including early administration of broad-spectrum antibiotics, fluid resuscitation, initiation of vasopressors, and early source control. Consequently, appropriate management leads to optimal outcomes, reducing the mortality and morbidity of patients with

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sepsis[11-20].

Septic shock is a life-threatening condition associated with sepsis, characterized by persistent hypotension despite volume resuscitation and requiring vasoactive medication. Recently, the term septic shock has been defined as a subset of sepsis encompassing circulatory, cellular, and metabolic abnormalities, necessitating vasopressor therapy[21,22]. Additionally, patients with septic shock face an increased chance of mortality, approximately 50% higher than that of patients without septic shock[1,23].

Source control is deemed one of the crucial management methods in sepsis, as outlined in the International Guidelines for Management of Sepsis and Septic Shock 2021[3,14]. Sources control include actions such as the removal of infected catheters or drains, drainage of abscesses, and surgical debridement or removal of infected tissues or organs. Adequate sources control contributes to a reduction in organ failure and improvement in hemodynamic stability. Evidence suggests that surgeons should initiate sources control within 12 hours after the diagnosis of sepsis[18,24-26].

Treating surgical sepsis patients during the COVID-19 pandemic presented limitations, particularly in terms of source control. The limitations included factors such as medical personnel availability, medication availability, inpatient ward constraints, and the time-consuming nature of detecting severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) before initiating the procedure. These factors could potentially impact clinical outcomes, including morbidity and mortality. The present study aimed to review the management of surgical sepsis patients at Ramathibodi Hospital, comparing outcomes during and before the COVID-19 pandemic.

Materials and Methods

The present study was a retrospective study involving adult patients diagnosed with sepsis in the Department of Surgery at Ramathibodi Hospital between May 2019 and April 2021. The patients were categorized into two groups with Group A that comprised those treated between May 2019 and April 2020 (one year prior to the COVID-19 pandemic), and Group B that included patients treated between May 2020 and April 2021 (during the pandemic).

All patient data were retrieved from the electrical medical records (EMR). Demographic information, including age, gender, body mass index (BMI), and underlying diseases, was recorded. The severity of sepsis was categorized as sepsis and septic shock. Each patient's condition was defined as surgical sepsis, postoperative sepsis, and medical sepsis. The term "surgical sepsis" was defined as sepsis requiring source control. "Post-operative sepsis" was characterized as an infection occurring after an operation such as pneumonia or urinary tract infection. "Medical sepsis" was defined as sepsis treatable with antibiotics alone. Notably, in the present study, patients with medical sepsis were admitted to the surgical ward for various reasons. The management of sepsis patients was documented based on whether the standard of care was achieved. Recording included the activation of management within ten minutes, initiation of antibiotics within the first hour of diagnosis, and source control management, either through surgery or intervention, within 12 hours. The primary outcome assessed in the present study was the mortality rate of surgical sepsis patients. Additionally, the study conducted multivariate analysis to demonstrate the association of exposure variables with the mortality rate in this group.

Statistical analysis

The dichotomous outcomes were analyzed using the chi-square test and presented by counts and proportions. Continuous outcomes were assessed with student t-tests, and the results were presented by mean with standard deviation (SD). The association of the variables with patient mortality was analyzed using logistic regression. The p-value less than 0.05 was considered statistically significant. All data were analyzed using Stata, version 14 (StataCorp LP, College Station, TX, USA).

Ethical approval

The present study protocol and ethical issues were reviewed and approved by Human Research Ethics Committee, Faculty of Medicine, Ramathibodi Hospital, Mahidol University, Bangkok, Thailand (COA. MURA2021/873).

Results

Two hundred ninety patients were diagnosed with sepsis in the Department of Surgery at Ramathibodi Hospital between May 2019 and April 2021. Among 290 patients, 145 were admitted before the COVID-19 pandemic, in Group A, and the remaining 145 were admitted during the COVID-19 pandemic, in Group B. The mean age in Group A and Group B were 67.45±14.04 and 67.60±15.65 years, respectively. The types of sepsis

Table 1. Baseline characteristics of sepsis patients

	Group A (n=145)	Group B (n=145)	p-value
Sex; n (%)			0.287
Male	86 (59.31)	77 (53.10)	
Female	59 (40.69)	68 (46.9)	
Age (years); mean±SD	67.45±14.0	67.60±15.6	0.930
BMI; mean±SD	22.91±4.51	22.98±4.64	0.901
Underlying disease; n (%)			
Hypertension	84 (57.93)	80 (55.17)	0.636
Diabetes mellitus	47 (32.41)	49 (33.79)	0.901
Dyslipidemia	50 (34.48)	47 (32.41)	0.804
Heart disease	42 (28.97)	38 (26.21)	0.694
Cerebrovascular disease	14 (9.66)	19 (13.10)	0.460
CKD; n (%)			0.695
Stage I	0 (0.00)	1 (0.69)	
Stage II	1 (0.69)	0 (0.00)	
Stage III	9 (6.21)	13 (8.97)	
Stage IV	7 (4.83)	5 (3.45)	
Stage V	21 (14.48)	17 (11.72)	
Type of sepsis; n (%)			0.037
Surgical sepsis	49 (33.79)	68 (46.90)	
Medical sepsis	35 (24.14)	35 (24.14)	
Post-operative sepsis	61 (42.07)	42 (28.97)	
Septic shock; n (%)	69 (47.59)	84 (57.93)	0.078
Mortality; n (%)	39 (26.9)	42 (28.97)	0.695

BMI=body mass index; CKD=chronic kidney disease; SD=standard deviation

were classified as surgical sepsis, medical sepsis, and post-operative sepsis. In Group A, the number of patients for each category was 49 (33.79%), 35 (24.14%), and 61 (42.07%), respectively. In Group B, the corresponding numbers were 68 (46.9%), 35 (24.14%), and 42 (28.97%). Additionally, patients diagnosed with septic shock in Group A and Group B were 69 (47.59%) and 84 (57.93%), respectively. The mortality rate in Group A and Group B were 26.9% (39 patients) and 28.97% (42 patients), respectively. There was no significant difference in mortality between the two groups (p=0.695) (Table 1).

The analysis included 117 surgical sepsis patients, including 49 admitted before the COVID-19 pandemic (Group A), and 68 admitted during the COVID-19 pandemic (Group B) (Table 2). These patients were stratified to assess the association among co-variables with mortality, utilizing logistic regression analysis. Factors known to influence mortality from surgical sepsis, such as gender, age, BMI, activation of management within ten minutes, time to initiate antibiotic, time to source control, and length of intensive care unit (ICU) stay, were

Table 2. Baseline characteristics of surgical sepsis patients

	Group A (n=49)	Group B (n=68)	p-value
Sex; n (%)			0.062
Male	35 (71.43)	37 (54.41)	
Female	14 (28.57)	31 (45.59)	
Age (years); mean±SD	67.44±11.82	66.73±15.80	0.790
BMI; mean±SD	23.33±3.79	22.10±4.34	0.127
Team activation within 10 minutes; n (%)	15 (30.61)	43 (63.23)	<0.001
Time to initiate antibiotic; n (%)			0.305
≤1 hour	17 (34.69)	30 (44.12)	
>1 hour	32 (65.31)	38 (55.88)	
Time to source control; n (%)	0.999		
No intervention	1 (2.04)	2 (2.94)	
≤12 hours	13 (26.53)	17 (25.0)	
>12 hours	35 (71.43)	49 (72.06)	
Length of ICU stay; n (%)			0.163
No ICU admission	10 (20.41)	17 (25.0)	
≤15 days	30 (61.22)	30 (44.12)	
>15 days	9 (18.37)	21 (30.88)	
Septic shock; n (%)	26 (53.06)	41 (60.29)	0.435
Mortality; n (%)	13 (26.53)	23 (33.82)	0.399

BMI=body mass index; ICU=intensive care unit; SD=standard deviation

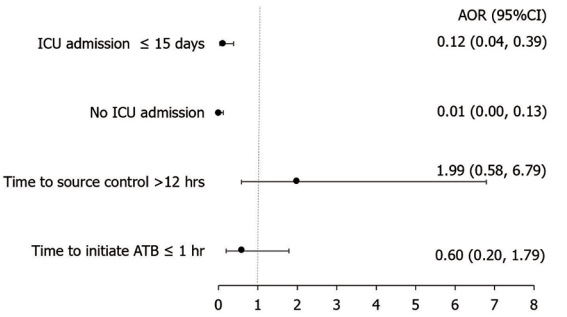

Figure 1. Multivariate analysis demonstrating the association of the exposure variables with mortality rate in surgical sepsis patients.

considered. The final fitted model revealed that only length of ICU stay was significantly associated with the mortality rate. Regarding the length of ICU stay, the results indicated that patients who were not admitted to ICU (adjusted OR 0.01, 95% CI 0.00 to 0.13, p<0.001) or admitted in ICU less than 15 days (adjusted OR 0.12, 95% CI 0.04 to 0.39, p<0.001) had a significantly decreased mortality (Table 3, Figure 1).

Discussion

In the present study, patients with sepsis or septic shock during the COVID-19 pandemic and one year

Table 3. Univariate analysis and multivariate analysis between the independent variables and mortality rate in surgical sepsis patients

Variable	Univariate analysis			Multivariate analysis		
	Odds ratio	95% CI	p-value	Odds ratio	95% CI	p-value
Sex: male	1.97	0.84 to 4.63	0.116			
Septic shock	5.95	2.23 to 15.83	<0.001			
Team activation within 10 minutes	1.02	0.46 to 2.24	0.951			
ICU admission ≤15 days	0.15	0.05 to 0.40	<0.001	0.12	0.04 to 0.39	<0.001
No ICU admission	0.04	0.01 to 0.20	<0.001	0.01	0.00 to 0.13	<0.001
Time to source control >12 hours	1.16	0.45 to 2.96	0.748	1.99	0.58 to 6.79	0.272
Time to initiate antibiotic ≤1 hour	0.65	0.29 to 1.50	0.316	0.60	0.20 to 1.79	0.367

ICU=intensive care unit; CI=confidence interval

before the COVID-19 pandemic were analyzed. The authors hypothesized that COVID-19 might delay the step of sepsis management, especially source control. Although testing for SARS-CoV-2 might prolong the time to source control, it was conducted for the safety of healthcare workers. The length of ICU stay was identified as the sole factor associated with the mortality rate in surgical sepsis patients. Patients admitted to the ICU for less than 15 days and those not admitted to the ICU had significantly decreased mortality (adjusted OR 0.12 and 0.01, respectively, p<0.001). Given that the timing of source control in sepsis patients is still a matter of controversy, there are no strong recommendations in the guidelines. Martinez et al. advocated for early source control procedures in severe sepsis patients[24]. Although the study demonstrated that undergoing source control management could reduce the mortality rate, the appropriate time to initiate the procedure could not be conclusively determined in terms of survival. Reitz et al. showed that undergoing source control within six hours was significantly associated with a reduced risk of 90-days mortality in sepsis circumstance[26]. In this study, no statistical difference was observed between the two groups regarding the time to source control. When comparing the management of sepsis patients before and during the COVID-19 pandemic in Thailand, there was no statistically significant difference in mortality. This finding contradicts the study's hypothesis. One explanation for these results could be fewer patients presenting to the emergency department, making healthcare services more accessible. Another reason may be a reduction in elective surgeries scheduled during the COVID-19 period, enabling faster surgical source control procedures during the pandemic.

The present study has limitations. First, the number of patients in each group was small. Second, being a retrospective study based on medical records, the presence of missing data may confound the findings and compromise the reliability of the results. Finally, the patients in both groups were from different time periods, introducing the potential for time bias.

Conclusion

The limited resources during COVID-19 did not appear to impact the mortality rate of surgical sepsis patients. However, it is crucial to acknowledge that there may be other potential confounding factors that cannot be controlled. The mortality rate may differ in contexts different from this study.

What is already known on this topic?

Sepsis is a life-threatening organ dysfunction caused by a dysregulation of the host's response to infection. Source control is one of the important management methods in sepsis according to the International Guidelines for Management of Sepsis and Septic Shock 2021. There were limitations in treating surgical sepsis patients during the COVID-19 pandemic, particularly concerning source control. These factors could impact clinical outcomes, including morbidity and mortality.

What does this study add?

There was no statistically significant difference in the mortality rate between surgical sepsis patients admitted before the COVID-19 pandemic and those admitted during the pandemic. Despite limited resources during COVID-19, the mortality rate of surgical sepsis patients was not affected as long as prompt management was achieved. Further improvements to achieve a higher standard of care may lead to better outcomes for sepsis patients.

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Conflicts of interest

The authors declare no conflict of interest.

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