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RESEARCH ARTICLE
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POST-OPERATIVE SEPSIS AND SEPTIC SHOCK IN OBSTETRIC SURGERY & GENERAL SURGERY PATIENTS; MICROBIOLOGICAL PROFILE OF THE BACTERIAL ISOLATES.

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Abstract

Background

Sepsis and Septic shock manifest as multiple organ failure and are major cause of morbidity and mortality globally. Sepsis and septic shock are major complications leading to mortality post-operatively in the intensive care unit. The aim of present study is to study the incidence, risk factors, mortality rate, for sepsis and septic shock in emergency obstetric and general surgeries post-operatively.

Methods

The study is a record based cross sectional study design. The medical records of patients who underwent emergency obstetric and general surgery in a Tertiary care centre, South India were evaluated from the year July 2020 to August 2023.

Results

There was a total of 1459 patients who underwent emergency surgeries, out of which 945 were emergency obstetric surgeries and 514 were emergency general surgeries. Of the emergency obstetric surgeries 79(8.35%) patients had sepsis and 49(5.18%) had septic shock. Whereas 51(9.92%) patients had sepsis and 36(7%) patients had septic shock in the emergency general surgery group. The in-hospital mortality for obstetric group was 44.89% for septic shock and 18.98% for sepsis and for surgery group 54.9% for septic shock and 30.61% for sepsis. The risk of sepsis and septic shock was higher in patients older than 60 years in the surgery group (OR: 2.5, 95% Confidence Interval 2.3-2.7) and age more than 35 years in the obstetric group (OR: 1.8, 95% Confidence interval 1.7-1.9). The presence of comorbidity increased risk of sepsis and septic shock 3 fold (OR= 3.1, 95%Confidence Interval, 2.8-3.4) in obstetric group and 5 fold(OR= 5.3, 95%Confidence Interval,

1.8-14.5) fold in general surgery group. There was significant difference in the incidence of sepsis and septic shock between general surgery and obstetric surgery patients, X2 (1, N = 1459) = 9.33, p =.002. General Surgery patients were more likely to have sepsis than the obstetric surgery patients postoperatively. In-hospital mortality also showed difference between the two groups, X2(1, N =1459) = 12.72, p <.001. General Surgery patients had more in-hospital mortality than the obstetric surgery patients. *Staphylococcus aureus* (40%) was predominant pathogen and least was *Enterococcus spp* (2.8%).

Conclusion

The incidence of sepsis and septic shock post operatively following general surgery is higher than the obstetric surgery. The in-hospital mortality is also higher in emergency general surgery patients with sepsis and septic shock compared to emergency obstetric surgery patients post-operatively. Patients with comorbidities who had either of the surgeries were more likely to have sepsis, septic shock and mortality post-operatively. Advanced age also increases the likelihood of sepsis and septic shock. Early recognition of perioperative complications, warning signs and prompt management with evidence-based guidelines is imperative for better outcomes post-operatively.

Keywords- post operative, sepsis, septic shock, surgery.

INTRODUCTION

The presence of pyogenic or other pathogenic organisms and their toxins in tissues or blood is referred to as sepsis. Whatever the underlying reason, shock results from the circulatory system's incapacity to sustain sufficient cellular perfusion.[1] Cell death, metabolic disturbance, and membrane malfunction are the results of inadequate perfusion at the cellular level. First and foremost, hypotension—generally defined as a systolic blood pressure (BP) of less than 90 mmHg or a decline in BP of more than 40 mmHg from baseline—is included in the clinical definition of shock. This condition may also be accompanied by laboratory evidence of multiple organ impairment. Inadequate care will cause the patient's condition to worsen steadily and eventually lead to multiple organ failure and death. Septic shock is the term used to describe shock syndrome that results from sepsis.[2]

One major factor contributing to multiple organ dysfunction and in-hospital death is post-operative sepsis [3-5]. Individuals who are hospitalized and either acquire sepsis or are admitted with it also have a higher chance of dying after being released from the hospital [6,7]. This type of sepsis-related mortality risk is greater than in the whole population and continues to be higher up to five years after hospital release [8,9]. Moreover, sepsis survivors have greater long-term medical expenses. According to a recent study, 42.7% of patients who survived severe sepsis were readmitted to the hospital within 90 days [10].

Sepsis patients are a very diverse patient population because the medical disease is common and has multiple manifestations that are seen in different hospital departments [11,12]. Individual differences occur in patients with regard to the pathogens involved, the site of prior infection, preexisting comorbidities, and the state of their immune response. However, treatment plans are still restricted to non-individualized supportive care [11].

Within this larger sepsis population, the subgroup of individuals with postoperative sepsis comprises a unique subpopulation. The complexity and clinical characteristics of patients with postoperative sepsis are influenced by a number of distinct elements that are brought about by the form of surgical intervention, including immune response changes, perioperative stress, and surgical site infections [12-14].

Examining the risk factors for mortality and sepsis as well as the pathogen connected to the patient is essential to comprehending the unique difficulties encountered in hospital. Hence the present study was conducted with an aim to study the incidence, risk factors, mortality rate, for sepsis and septic shock in emergency obstetric and general surgeries post-operatively.

MATERIAL & METHODS

The record based cross sectional study was conducted among patients who had undergone emergency obstetric and general surgery in a Tertiary care centre, South India were evaluated from the year July 2020 to August 2023.

Data collected from hospital records in the time frame of July 2020 to Aug 2023 There were a total of 1459 patients who underwent emergency surgeries, out of which 945 were emergency obstetric surgeries and 514 were emergency general surgeries. Patients were included and excluded on the basis of following criteria:
Ethical permission was taken from institutional ethical committee before the commencement of study. As it was a record based cross sectional study patient informed consent was not needed.

Inclusion criteria

All patients of age above 18 years and undergone emergency obstetric and general surgery in the hospital during the study time period with a longer hospital stay of more than four days were included in the study. All those satisfy the inclusion criteria were recruited consecutively to the study. Those with missing data was excluded.

Exclusion criteria

Patients with age less than 18 years, had hospital stay of less than 4 days and if there was missing data on discharge status, sex, age, year or principal diagnosis.

Data was collected using semi structured questionnaire. Patient demographic information included age, sex, country of birth, marital status, severity of illness/co-morbidity was recorded. Hospital characteristics included type of surgery undergone, prevalence of sepsis and septic shock, days spent in hospital, type of pathogen associated their culture and sensitivity and mortality rate.

In order to maximize recovery, the pus swabs were sub-cultured on MacConkey agar, blood agar, and chocolate agar upon receipt and incubated at 37ºC. Additionally, chocolate agar plates were incubated at 37°C in a candle jar. In order to detect possible infections based on their distinctive morphological appearance on the corresponding plates were screened for aerobic growth. After doing Gram staining, the pathogen's identity was verified using a number of readily available conventional biochemical tests. Members of the Enterobacterales family and other Gram-negative rods were identified using in-house Triple Sugar Iron (TSI), citrate, urease utilization test chromogenic agar, oxidase and indole test. In contrast, bound coagulase, catalase, and chromogenic agar were used to identify Gram-positive bacteria. The Kirby- Bauer disc diffusion test was used to test for antibiotic sensitivity on Mueller Hinton agar. Using a sterile cotton swab, bacterial suspensions standardized to a 0.5 McFarland standard were equally inoculated on the Mueller Hinton agar (MHA) plates. The setup was then incubated aerobically at 37°c for a full day. Antibiotic specific panels were used for Gram positive & Gram negative isolates in accordance with the latest CLSI guidelines. Using an antibiotic zone measuring scale, the zone of inhibition diameter is measured. The results were classified as Resistant or Sensitive based on the zone sizes provided in the latest Clinical and Laboratory Standards Institute (CLSI) guidelines.

The pertinent co-variables were taken into account when doing a multiple logistic regression. To quantify the descriptive connections with individual traits, odds ratios (ORs) were used. These were presented with the associated p values and 95% confidence intervals (Cis). A value of $P < 0.05$ was deemed statistically significant. Logistic regression was used to establish associations for problems that occurred after surgery. A strong set of standard errors was employed to prevent model misspecification. P values for numerous comparisons were not modified.

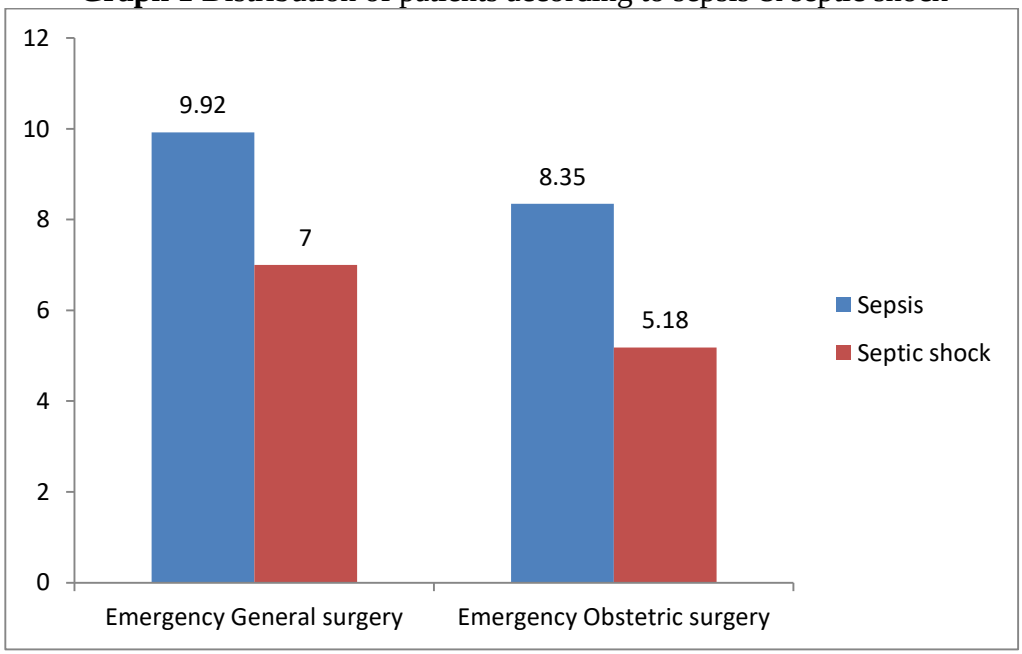
RESULTS

There were a total of 1459 patients who underwent emergency surgeries, out of which 945 were emergency obstetric surgeries and 514 were emergency general surgeries. Of the emergency obstetric surgeries 79(8.35%) patients had sepsis and 49(5.18%) had septic shock. Whereas 51(9.92%) patients had sepsis and 36(7%) patients had septic shock in the emergency general surgery group. There was significant difference in the incidence of sepsis and septic shock between general surgery and obstetric surgery patients, X2 (1, N = 1459) = 9.33, p =.002. General Surgery patients were more likely to have sepsis than the obstetric surgery patients postoperatively as shown in table 1, graph 1.

Table 1 Distribution of patients according to sepsis & septic shock

Type of surgeries	N (%)	Sepsis	Septic shock	P value
Emergency general surgery	945 (64.7)	51(9.92%)	36(7%)	0.002
Emergency Obstetric surgery	514 (35.3)	79 (8.35%)	49(5.18%)	
Total	1459 (100)	130 (8.91)	85 (5.82%)	

Graph 1 Distribution of patients according to sepsis & septic shock

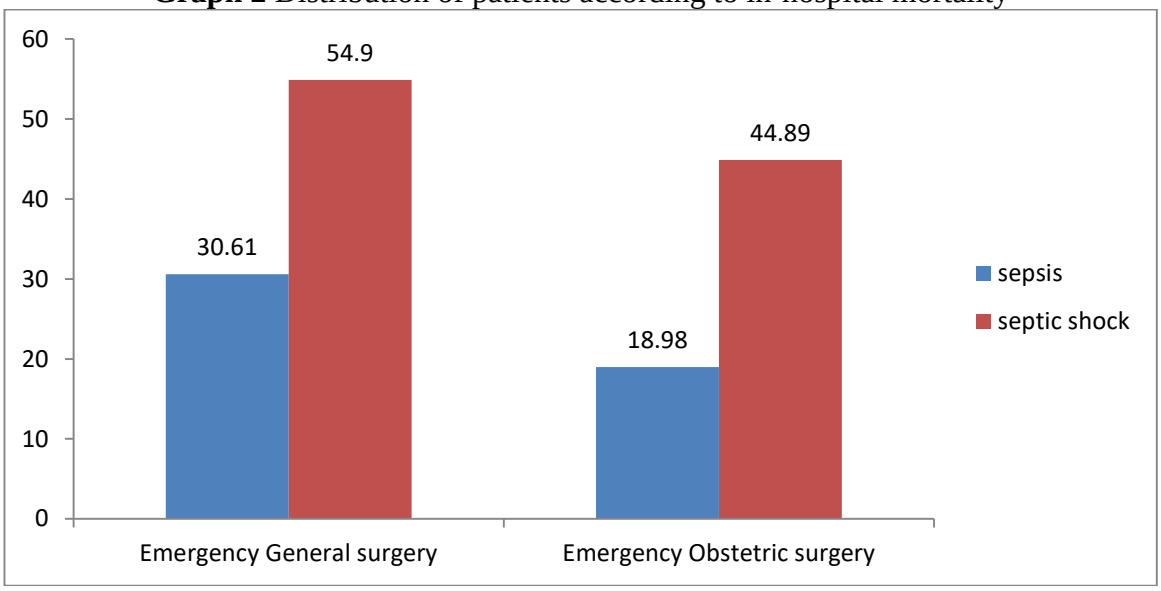


The in-hospital mortality for obstetric group was 44.89% for septic shock and 18.98% for sepsis and for surgery group 54.9% for septic shock and 30.61% for sepsis. In-hospital mortality also showed difference between the two groups, X2(1, N =1459) = 12.72, p <.001. General Surgery patients had more in-hospital mortality than the obstetric surgery patients as shown in table 2, graph 2.

Table 2 Distribution of patients according to in-hospital mortality

Type of surgeries	In – hospital mortality		
	Sepsis	Septic shock	P value
Emergency General surgery	16 (30.61%)	20 (54.9%)	<.001
Emergency Obstetric surgery	15 (18.98%)	38 (44.89%)	
Total	31 (23.8%)	58 (68.2%)	

Graph 2 Distribution of patients according to in-hospital mortality



The risk of sepsis and septic shock was higher in patients older than 60 years in the surgery group (OR: 2.5, 95% Confidence Interval 2.3-2.7) and age more than 35 years in the obstetric group (OR: 1.8, 95% Confidence interval 1.7-1.9). The presence of comorbidity increased risk of sepsis and septic shock 3 fold (OR= 3.1, 95%Confidence Interval, 2.8-3.4) in obstetric group and 5 fold(OR= 5.3, 95%Confidence Interval, 1.8-14.5) fold in general surgery group as shown in table 3.

Table 3 Distribution of patients according to risk factors

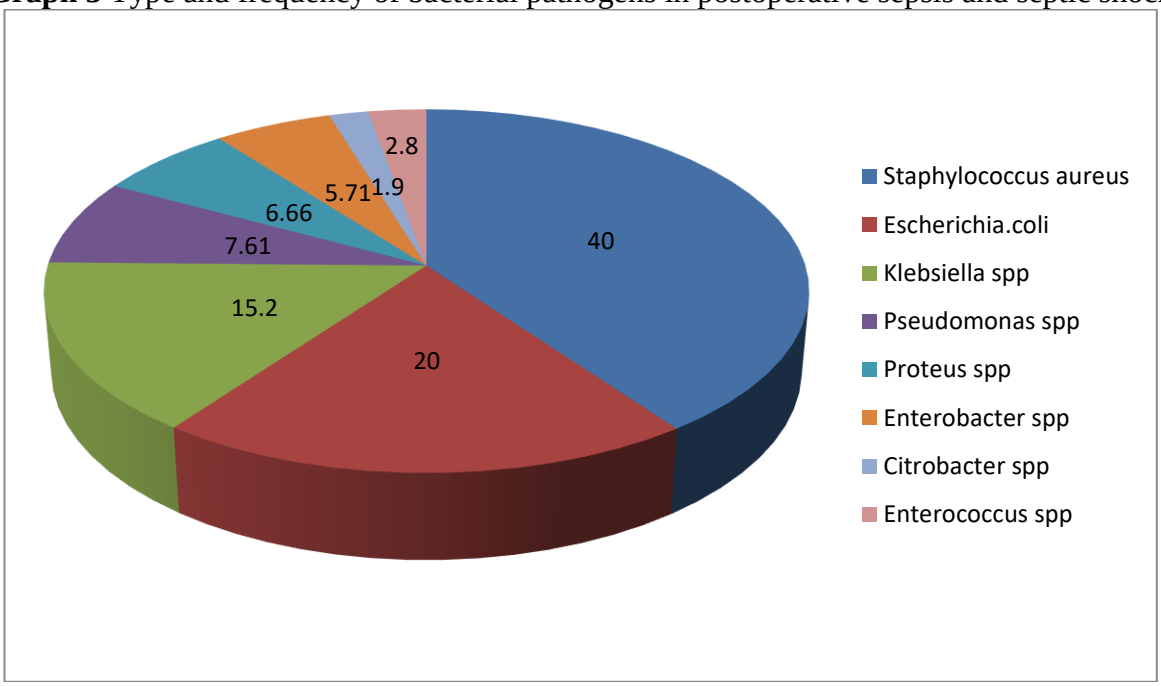
Risk factor		General surgery group		Obstetric group		OR	CI
		Sepsis	Septic shock	Sepsis	Septic shock		
Age	<35 years	10 (19.6)	9 (25)	12 (15.1)	9 (18.3)	1.6	1.3-1.4
	35-60 years	11 (21.5)	10 (27.7)	49 (62)	30 (61.2)	1.8	1.7-1.9
	>60 years	30 (58.8)	17 (47.2)	18 (22.7)	10 (20.4)	2.5	2.3-2.7
Co morbidity	3 fold	11 (21.5)	10 (27.7)	60 (75.9)	38 (77.6)	3.1	2.8-3.4
	5 fold	40 (78.4)	26 (72.3)	19 (24.1)	11 (22.4)	5.3	1.8-14.5

Type and frequency of bacterial pathogen in postoperative sepsis and septic shock was calculated and it was found that *Staphylococcus aureus* (40%) was predominant in number and least were *Enterococcus spp* (2.8%) as shown in table 4.

Table 4 Pathogen isolated and frequency of bacterial pathogen in postoperative sepsis and septic shock

Pathogen isolated	**Frequency (%)**
Staphylococcus aureus	42 (40)
Escherichia coli (E.coli)	21 (20)
Klebsiella spp.	16 (15.2)
Pseudomonas spp.	8 (7.61)
Proteus spp.	7 (6.66)
Enterobacter spp.	6 (5.71)
Citrobacter spp.	2 (1.90)
Enterococcus spp.	3 (2.8)
Total	105 (100)

Graph 3 Type and frequency of bacterial pathogens in postoperative sepsis and septic shock



Frequency of antimicrobial susceptibility patterns of the isolated Gram-positive bacterial pathogens during the study was calculated and it was found that analysis of species specific resistance rates indicated that *Staphylococcus aureus* was resistant to Penicillin (76.1%), Erythromycin (69%) and Cefoxitin (66.6%), Ciprofloxacin (59.5%) and Gentamicin (52.3%) were observed. Both *Staphylococcus aureus* and *Enterococcus spp*. were susceptible to Linezolid as shown in table 5.

Table 5 Antibiotic resistance pattern for Gram positive bacteria

Antibiotic tested	*Staphylococcus aureus* N (%)	*Enterococcus spp* N (%)
Penicillin	32 (76.1)	1 (33.3)
Cefoxitin	28 (66.6)	NA
Gentamicin	22 (52.3)	0
Ciprofloxacin	25 (59.5)	0
Erythromycin	29 (69)	1(33.3)
Doxycycline	8 (19)	0
Linezolid	0	0

Frequency of antimicrobial susceptibility patterns of the isolated Gram-negative bacteria pathogens during the study was calculated and it was found that all Gram-negative bacteria were susceptible to Imipenem, except 9% and 25% of the *Pseudomonas species* and *Escherichia coli* respectively. Most of the Gram negative bacteria isolated showed a multi-drug resistance pattern as shown in table 6.

Table 6 Antibiotic resistance pattern for Gram negative bacteria

Antibiotic tested	*E coli* N (%)	*Klebsiella spp* N (%)	*Pseudomonas spp* N (%)	*Proteus spp* N (%)	*Enterobacter spp* N (%)	*Citrobacter spp* N (%)
Gentamicin	16 (72.7)	14 (87.5)	6 (75)	6 (85.7)	5 (83.3)	0
Ceftriaxone	19 (86.3)	14 (87.5)	6 (75)	3 (42.8)	3 (50)	0
Ciprofloxacin	7 (31.8)	14 (87.5)	5 (62.5)	3 (42.8)	3 (50)	1 (50)
Imipenem	2 (9)	0	2 (25)	0	0	0
Tetracycline	19 (86.3)	13 (81.2)	6 (75)	4 (57.1)	2 (33.3)	0
Cotrimoxazole	20 (90.9)	15 (93.7)	6 (75)	7 (100)	3 (50)	1 (50)

DISCUSSION

Sepsis is a complicated illness that carries a significant fatality risk and is linked to organ dysfunction. Patients who progress to septic shock are thought to have a death rate of between 40% and 60%, while the rate for patients who acquire sepsis is closer to 25%–30% [15,16]. Sepsis not only has a high fatality rate but also a significant financial cost [17,18]. Sepsis is currently present in 2% of hospital admissions due to an increasing incidence of the condition. Approximately one-third of sepsis cases are surgical patients [19-21].

In the present study all, 1459 patients had emergency surgery performed; 945 of those procedures were emergency obstetric procedures, and 514 were emergency general procedures. 5.18% of patients who underwent emergency obstetric surgery had septic shock, while 8.35% of patients had sepsis. In contrast, the emergency general surgery group saw 7% of patients experience septic shock and 9.92% of patients had sepsis. Patients undergoing obstetric surgery and general surgery had significantly different incidences of sepsis and septic shock ($p = .002$). Patients undergoing general surgery had a higher risk of sepsis following surgery compared to those undergoing obstetric surgery. The in-hospital mortality rates for septic shock and sepsis were 44.89% and 18.98%, respectively, for the obstetric group and 54.9% and 30.61%, respectively, for the surgery group. Additionally, there was a difference in in-hospital mortality between the two groups ($p < .001$). Compared to obstetric surgery patients, general surgery patients experienced higher in-hospital mortality. Previous studies have shown that post-discharge 1-year mortality in patients with the general diagnosis of sepsis ranged from 21.5% for those admitted through emergency departments [21] to 71.9% for those discharged from an ICU [22].

In present study the surgery group who were older than 60 years (OR: 2.5, CI:2.3-2.7) and the obstetric group who were older than 35 years (OR: 1.8, CI:1.7-1.9) had a higher risk of sepsis and septic shock. In the obstetric group, the presence of comorbidities raised the risk of sepsis and septic shock threefold (OR=3.1, CI: 2.8-3.4) and fivefold (OR=5.3, CI: 1.8-14.5) in the general surgery group. According to these results, patients with medical sepsis frequently have severe chronic comorbidities at presentation, and surgeons are less willing to operate on severely disabled patients who have a high risk of perioperative morbidity and mortality [23]. Furthermore, patients who are not surgical candidates may have restricted access to early detection and treatment of sepsis, which is crucial for patient outcomes. While surgical patients are commonly admitted to the hospital prior to surgery, they often arrive at the hospital at a later stage of the disease, and sepsis frequently appears during the clinical stay following the intervention.[24]

Among the bacterial pathogens isolated, *Staphylococcus aureus* (40%) was predominant in number and least were *Enterococcus spp* (2.8%). *Staphylococcus aureus* was resistant to Penicillin (76.1%), Erythromycin (69%), Cefoxitin (66.6%) , Ciprofloxacin (59.5%) & Gentamicin (52.3%) were observed. All Gram-negative bacteria were susceptible to Imipenem, except 9% and 25% of the *Pseudomonas species* and *Escherichia coli* respectively in the present study. Similarly high rates of isolation—80% and 86.13%, respectively—were observed by studies done in Nepal and Nigeria elsewhere [25,26]. Similar prevalence rates for Gram positive and Gram negative organisms were found in studies conducted in Ethiopia and Iran [27,28]. Nonetheless, studies from affluent nations like the US [29] showed that the most isolated pathogens were Gram positive bacteria. Consistent with findings from other research, the majority of post-operative wound infections were caused by the bacterial pathogens *Staphylococcus aureus* 41/104 (39.4%) and *Escherichia coli* 22/104 (21.2%) [30].

There are restrictions on this study. Although the experiment was conducted in a single center, using a multi-center approach might have improved the data' generalizability. Even though the data were gathered prospectively, a retrospective study design was used for the analysis. We also acknowledge the possible influence of unmeasured factors on the reported results, including differences in clinical care regimens and the precise nature and timing of surgical interventions. We also need to be aware of some limitations brought about by the lack of analyses about source control and the etiology of sepsis. Although the primary goal of our study was to compare the features and outcomes of patients

undergoing general and obstetric surgery, we did not look into the precise management of infection sources or pinpoint the microorganisms that caused sepsis in our cohorts.

CONCLUSION

Compared to obstetric surgery, there is a greater post-operative incidence of sepsis and septic shock after general surgery. In addition, emergency general surgery patients with sepsis and septic shock have a greater in-hospital death rate than emergency obstetric surgery patients after operation. Following either of the procedures, patients with comorbidities had a higher risk of sepsis, septic shock, and fatality. Sepsis and septic shock are thus more common in older adults. Better post-operative outcomes depend on early detection of perioperative problems, warning indications, and quick management using evidence-based guidelines.

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