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ORIGINAL ARTICLE

Risk Factors and Outcome of Intra-abdominal Sepsis in Critically Ill Patients in Emergency Intensive Care Unit

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ABSTRACT

Background: Intra-abdominal sepsis that has unique epidemiological characteristics, is accelerated by certain risk factors, and is linked to high rates of morbidity and fatality. Previous studies have been done around the world. However little reports were found at Zagazig University Hospital. **Aim:** To evaluation risk factors and outcome of intra-abdominal sepsis in Emergency intensive care unit (ICU) patients in Zagazig University Hospital. **Methods:** This prospective observational study was performed in Emergency Intensive Care Unit on 266 patients older than 18 years, both sex admitted with Intra-abdominal sepsis and septic shock to intensive care unit. Risk factors and outcome were assessed in all patients. Patients were divided according to outcome to survived group and died group. Also, patients were divided according to severity of disease expression to group I: infection without sepsis, group II: sepsis and group III: septic shock**.** **Results:** There was significant increase of age, need for reoperation, Quick Sequential Organ Failure (qSOFA) and biomarkers in the died group. The incidence of diabetes mellitus and cardiac disease significantly increase in the died group. Regarding to the severity of disease, there was significant difference of qSOFA, need for reoperation, hemodynamic data and incidence of diabetes mellitus and respiratory disease between the studied groups. **Conclusions:** High qSOFA score , need for reoperation, diabetes and respiratory disease are risk factors of septic shock in patients with intraabdominal infection. Factors influencing the prognosis of patients with intraabdominal infection include advanced age , need for reoperation and pre-existing disease as diabetes and cardiac disease.

Keywords: Risk factors; Intra-abdominal Sepsis; Emergency Intensive Care Unit

INTRODUCTION

In the intensive care unit (ICU), severe intra-abdominal infections are a common and significant problem. The abdomen frequently ranks first or second among the origins of infection or sepsis, according to worldwide literature **[1].** Intra-abdominal infections provide a number of unique clinical difficulties. First, there is a wide range in the severity of the disease, from mild cases to multi-organ failure and fulminant septic shock. Secondly, a wide range of pathogens, such as fungi, anaerobes, and aerobic bacteria with both Gram-positive and Gram-negative characteristics, are present **[2]. Third**, the contribution of microbiological diagnostics is not always clear-cut since cultures sometimes struggle to distinguish between infections and benign bacteria **[3]**. An increase in the qSOFA score of more than two points resulting from an intra-abdominal infection is referred to as abdominal sepsis. Septic shock is the clinical condition that occurs when a patient needs to be put on vasopressors in order to maintain a

mean arterial pressure (MAP) of at least 65 mmHg (even with appropriate volume resuscitation) and their blood lactate level is at least 2 mmol/l **[4].** The phrase "severe sepsis" is no longer appropriate and should be dropped. Moreover, source control which includes all measures used to eliminate the infection's source, manage ongoing contamination, and repair anatomical abnormalities and physiological function is crucial for successful clinical therapy but is frequently challenging to do. **[5].** The vast range of clinical entities that fall under intraabdominal infections is the last point. Three forms of peritonitis are distinguished by a traditional method: tertiary (persistent infection despite sufficient source control intervention), secondary (occurring after anatomical damage of the gastrointestinal tract), and primary (associated to peritoneal dialysis or spontaneous bacterial peritonitis). Together with the development of localized abscesses and solid organ infections (such as infected pancreatic necrosis and liver abscesses), **[5].** Furthermore, intra-abdominal infection cases are frequently categorized as either simple or complex. Complex infections are defined as those that spread into the peritoneal cavity from their original source **[6]**. It is challenging to research intra-abdominal infections due to their heterogeneity **[7].** It has been suggested to use a different classification for intra-abdominal infections in an effort to improve language clarity **[2].** This system categorizes intraabdominal infections based on the following factors: the location of the infection (community, healthcare-associated, early onset, or hospital acquired), the degree of disease expression (infection, sepsis, or septic shock), and the existence or lack of anatomical disturbance that could cause broad or localized peritonitis **[4].** It was shown that sepsis and infections had a few common and independent risk factors. Apart from the aforementioned "general" risk factors for sepsis, surgical complications resulting from compromised healing of anastomoses or abdominal closure sutures pose a persistent threat to the surgical patient. Numerous studies have examined the patient-related risk factors that impede healing and raise the risk of intra-abdominal sepsis, surgical site infections, and increased anastomotic leaking. Although these variables sometimes overlap with the overall risk factors, they are crucial for abdominal surgery. A higher anastomotic leakage rate is correlated with patient-related characteristics such as male gender, advanced age, smoking, and diabetes mellitus, in addition to intraoperative complications and episodes of intraoperative hypotension. This also applies to radiation and drugs (such as corticosteroids, chemotherapy, and immunosuppressants). **[8].**

METHODS

This prospective observational study was performed on 266 Patients older than 18 years admitted with Intra-abdominal sepsis and Septic Shock to emergency intensive care units at Zagazig university hospitals during the period between November 2022 and June 2023. patients aged less than 18 years, advanced abdominal malignancy (frozen abdomen) and intra-abdominal infection discovered after ICU admission were excluded from the study. Patients were divided according to outcome to survived group and died group. Also, patients were divided according to severity of disease expression to group I: infection without sepsis, group II: sepsis and group III: septic shock.

All patients in the study were subjected detailed history taking with special stress on age, gender and presence of risk factors as following: related to patient: Diabetes mellitus, Atrial fibrillation, abdominal malignancy, immune disease, immunosuppressive therapy, viral infections (Hepatitis B virus, Hepatitis C virus, Human immunodeficiency virus, smoking, alcohol, drug abuse, central nervous system diseases and risk factors related to surgery: operated or not operated, clean operation or not, first operation or previously operated, open surgery or minimal invasive surgery. Another data collected on admission included systolic, diastolic and mean arterial pressure (MAP), modified qSOFA score, total leucocyte count (TLC), C-reactive protein (CRP),

procalcitonin and measurement of Central venous pressure (CVP).

Quick Sequential Organ Failure Score (qSOFA): The qSOFA uses 3 variables to predict death and prolonged ICU stay in patients with known or suspected sepsis: a Glasgow Coma Score<15, a respiratory rate≥22 breaths/min and a systolic blood pressure≤ 100 mmHg. When any two of these variables are present simultaneously the patient is considered to be qSOFA positive. Data analysis used to support the recommendations of the 3rd International Consensus Conference on the Definitions of Sepsis identified qSOFA as a predictor of poor outcome in patients with known or suspected infection **[9].**

ETHICAL CONSIDERATION

This study carried out after gaining approval of both the scientific committee of anesthesiology department and the Institutional Review Board (IRB) at Faculty of Medicine, Zagazig University code: MZU-IRB #9967-9-10-2022 in 9/10/2022 as the study aims, methodology and measurements are politically accepted and also to facilitate any problem.

STATISTICAL ANALYSIS

SPSS software, version 25 (SPSS Inc., PASW statistics for Windows version 25), was used to analyze the data. The SPSS Inc., Chicago. The student t test, Mann Whitney U test, Fisher exact test, and Chi-Square tests were employed.

RESULTS

In this study the number of died patients was 120 with percentage of 45.1% of the studied patients. There was a statistically significant increase in the age of the died group with **P=0.01**(Table 1). There was a statistically significant increase in clean operation in survived patients when compared with died ones (**P=0.002)**. need for reoperation was significantly increase in died patients group. **P=0.005**. There was significant difference between the two groups regarding qSOFA with **P=0.001** (Table 2). TLC, CRP and Procalcitonin significantly increased in the died patients group with **P=0.007** , **P<0.001** , **P<0.001** respectively. CVP significantly increased in survived patients with **P<0.001**.(Table 3). Table 4 shows that the incidence of diabetes ,non-smokers and cardiac disease increases significantly in the died patients group. The incidence of diabetes mellitus increased significantly in patients with septic shock **P=0.002** , the percentage of smoking patients increased significantly in patients with sepsis **P=0.002** and there was significant increase of respiratory disease in patients with sepsis **P=0.01** (Table 5). There was significant difference in the studied patients regarding to need for reoperation and qSOFA with **P=0.025** and **P=0.001** respectively. (Table 6). There was a statistically significant difference regarding to systolic blood pressure, diastolic blood pressure and MAP **P<0.001**. (Table 7**).**

Table 1: Demographic data in survived and died patients.

	Survived n=144	**Died n=120**	**Test of significance**
Age/years	49.76±15.62	54.58±15.23	**t=2.52 P=0.01***
Sex male female	85(59) 59(41)	67(55.8) 53(44.2)	χ^2=0.273 P=0.601

t:Student t test , χ^2= Chi-Square test

Table 2: Comparison between survived and died patients regarding to operative history , need for reoperation and Qsofa Score.

	Survived n=144(%)	Died n=120(%)	Test of significance
Operation **Not operated** **Operated**	 27(18.8) 117(81.2)	 28(23.3) 92(76.7)	 χ^2=0.834 P=0.361
CLEAN	81(69.2)	44(47.8)	χ^2=9.82 **P=0.002***
need for reoperation No **Yes**	76(65.0) 41(35.0)	42(45.7) 50(54.3)	χ^2=7.81 **P=0.005***
QSOFA **1** **2** **3**	 69(47.9) 60(41.7) 15(10.4)	 6(5.0) 38(31.7) 76(63.3)	 χ^2=97.37 **P=0.001***

χ^2= Chi-Square test , *statistically significant

Table 3: Laboratory investigations and CVP among the studied patients.

	Survived n=144	Died n=120	Test of significance
TLC	13.1(0.7-43.7)	19.05(0.7-53.9)	Z=2.68 **P=0.007***
CRP	96(24-296)	155.85(24.5-391)	Z=38.11 **P<0.001***
PCT	9.12(0.46-69.6)	24.0(0.10-69.9)	Z=45.66 **P<0.001***
CVP	5(0-14)	0(-3 , 16)	Z=153.30 **P<0.001***

Z:Mann Whitney U test , *statistically significant ,parameters described as median (range)

Table 4: Risk factors in survived and died patients.

	Survived n=144(%)	Died n=120(%)	Test of significance
Hypertension	43(29.9)	44(36.7)	χ2=1.37 P=0.241
DM	38(26.4)	46(38.3)	χ2=4.31 P=0.038*
Smoking **-VE** **+VE**	 110(76.4) 34(23.6)	 105(87.5) 15(12.5)	 χ2=5.35 P=0.02*
Alcohol	0	1(0.8)	χ2FET=1.21 P=0.455
Malignancy	14(9.7)	21(17.5)	χ2=3.44 P=0.064
Respiratory	4(2.8)	1(0.8)	χ2FET=1.33 P=0.248
Immune	3(2.1)	5(4.2)	χ2=0.967 P=0.325
drug abuse	0	2(1.7)	χ2=2.42 P=0.120
HCV	9(6.2)	14(11.7)	χ2=2.42 P=0.120

	Survived n=144(%)	Died n=120(%)	Test of significance
HIV	0	1(0.8)	χ2FET=1.21 P=0.455
Cardiac	15(10.4)	25(20.8)	χ2=5.52 P=0.019*
Neurological disease	8(5.6)	12(10.0)	χ2=1.85 P=0.174
Renal disease	7(4.9)	5(4.2)	χ2=0.073 P=0.787

χ2= Chi-Square test , FET: Fisher exact test *statistically significant

Table 5: Risk factors in the studied patients regarding to severity of the disease.

	Infection n=34(%)	Sepsis n=106(%)	Septic shock n=126(%)	Test of significance
Hypertension	7(20.6)	35(33.0)	45(35.7)	χ^2=2.79 P=0.248
DM	4(11.8)	28(26.4)	52(41.3)	χ^2=12.96 **P=0.002***
Smoking **-VE** **+VE**	 27(79.4) 7(20.6)	 76(71.7) 30(28.3)	 113(89.7) 13(10.3)	 χ^2=12.28 **P=0.002***
Alcohol	0	1(0.9)	0	χ^2=1.52 P=0.469
Malignancy	6(17.6)	10(9.4)	19(15.1)	χ^2=2.29 P=0.318
drug abuse	0	0	2(1.6)	χ^2=2.24 P=0.326
HBV	0	0	0	
HCV	2(5.9)	5(4.7)	16(12.7)	χ^2=5.02 P=0.08
HIV	0	0	1(0.8)	χ^2=1.12 P=0.573
Respiratory disease	0	6(5.7)	0	χ^2=9.27 **P=0.01***
Immune	0	4(3.8)	4(3.2)	χ^2=1.28 P=0.527
Cardiac	7(20.6)	9(8.5)	24(19.0)	χ^2=5.96 P=0.051
Neurological disease	2(5.9)	7(6.6)	11(8.7)	χ^2=0.524 P=0.769
Renal disease	2(5.9)	5(4.7)	5(4.0)	χ^2=0.245 P=0.885

χ^2= Chi-Square test , *statistically significant

Table 6: Operative history , need for reoperation and Qsofa Score among the studied patients.

	Infection n=34(%)	Sepsis n=106(%)	Septic shock n=126(%)	Test of significance
Operation **Not operated** **Operated**	 9(26.5) 25(73.5)	 15(14.2) 91(85.8)	 31(24.60) 95(75.4)	 χ^2=4.63 P=0.09
CLEAN	20(80.0)	55(60.4)	50(52.6)	χ^2=4.63 P=0.09
need for reoperation No **Yes**	 18(72) 7(28)	 56(61.5) 35(38.5)	 44(46.3) 51(53.7)	 χ^2=7.34 **P=0.025***
QSOFA **1** **2** **3**	 30(88.2) 4(11.8) 0	 45(42.5) 61(57.5) 0	 1(0.8) 34(27) 91(72.2)	 χ^2=205.88 **P=0.001***

χ^2= Chi-Square test , *statistically significant

Table 7: Hemodynamic data on admission in the studied patients.

	Infection n=34	Sepsis n=106	Septic shock n=126	Test of significance
Systolic blood pressure	119.12±13.11	120.66±16.05	74.05±7.71	F=464.4 **P<0.001***
Diastolic blood pressure	74.41±8.24	75.47±10.79	39.37±7.56	F=518.70 **P<0.001***
Mean arterial blood pressure	89.16±9.18	90.338±12.03	50.81±7.14	F=552.31 **P<0.001***

F:one Way ANOVA test , *statistically significant

DISCUSSION

The age of the patients who passed away was found to have increased statistically significantly in the current study. Previous study suggested that there is a relation between death and age of the studied cases with intra-abdominal sepsis. The worst prognosis was shown in patients who were 80 years or older, and mortality was linked to age greater than 60 **[10].** When comparing patients 60 years of age or older to their middle-aged 283 counterparts (40-59 years), the mortality rate was significantly greater. In comparison to younger patients, patients over 80 years of age showed noticeably increased mortality rates. Mortality seemed abnormally 285 high in very old patients (80 years or more), up to 70% in those presenting with either localized or diffuse peritonitis and/or sepsis or septic shock **[11]. Martin-Loeches at al. [12]** revealed that in a large cohort of 300 septic critically ill patients, 35.6% of whom had peritonitis as the major site of infection, age beyond 80 years is an independent risk factor for mortality. Also, **Sartelli et al. [5]** reported that the course of sepsis may differ from patient to patient depending on the spectrum of etiology and patient factors, including age and comorbidities. The probable reason for the relation between death and age in intra-abdominal sepsis in critically ill patients is that older patients may have weaker immune systems and are more susceptible to infections. In addition, older patients may have more comorbidities, such as chronic heart disease and solid cancer, which can increase the risk of mortality **[13].**

In our study, it was found that there is a significant difference in the studied groups (infection, sepsis and septic shock) regarding to diabetes, smoking, cardiac and respiratory disease. The most frequent detected medical history among studied cases in intra-abdominal sepsis in critically ill patients in the emergency intensive care unit are as follows: hypertensive, diabetic, smokers, cardiac disease, malignancy, hepatitis C virus, and neurological disease **[2].** These medical histories may increase the risk of

developing intra-abdominal sepsis and may also increase the risk of mortality in critically sick individuals experiencing septic shock or sepsis **[14].** Another study reported that the course of sepsis may differ from patient to patient depending on the spectrum of etiology and patient factors, including age and comorbidities. The study also found that several comorbidities and exposures have been associated with increased susceptibility to acute respiratory distress syndrome (ARDS), including diabetes. However, the study did not specifically investigate the relationship between disease severity and the presence of diabetes, smoking, and respiratory disease **[15].**

In the present study, it was found that there was a statistically significant relation between laboratory findings with disease severity. Higher TLC, CRP , procalcitonin (PCT) is detected among cases with septic shock while lower CVP is detected among cases with septic shock. The body maintains a relative equilibrium with very low levels of serum PCT and CRP under normal physiological conditions. The host response to infection results in a significant rise in serum PCT and CRP levels when sepsis is brought on by an inflammatory stimulus brought on by a bacterial infection. In sepsis patients, PCT is a useful biochemical measure of the extent of infection. Sepsis or septic shock are indicated by a PCT of 2 ng/ml. CRP levels can rise more than 100 times over baseline levels, signifying an ongoing illness **[16, 17].** Further research is necessary to determine whether PCT and CRP can be used as benchmarks for the diagnosis of sepsis, despite some studies suggesting that they can. We discovered that elevated PCT levels can discriminate between sepsis and septic shock by comparing changes in the kinetics of serum PCT and CRP levels of individuals with sepsis and those with septic shock. Therefore, PCT can be used as a useful chemical biomarker to assess the level of infection in sepsis patients **[18].** Our results are similar to **Braha et al. [18]** who indicated that there is a statistically significant higher median TLC, CRP, and PCT among died than improved cases in intra-abdominal sepsis. So, TLC, CRP, and PCT are clinically useful biochemical detection indexes that can be used as important reference markers for infection.

In the present study, it was found that there is significant difference of qSOFA in the groups (infection , sepsis and septic shock), higher scores are detected in septic shock group.

Scores > 2 for both scores were highly linked with death, according to a meta-analysis of 8 studies comparing qSOFA and SIRS in the mortality of patients with infections in the ER. SIRS > 2 was more sensitive than qSOFA > 2 in terms of predicting death **[19].**

A prospective multi-center clinical research showed that among patients with suspected infections in the emergency room, qSOFA was less sensitive for in-hospital mortality but marginally better at predicting mortality **[20].**

In our study, it was found that there is a statistically significant difference in blood pressure among the groups of study, with the lowest systolic & diastolic blood pressure is detected among cases with septic shock. **Pierrakos et al. [21]** indicated that there is a statistically significant relation between blood pressure and disease severity with the lowest systolic & diastolic blood pressure is detected among cases with septic shock. Also, **Ospina-Tascón et al. [22**] found that there is a statistically significant relation between Diastolic shock index (DSI) and disease severity among cases with septic shock. Previous studies suggested that the lowest systolic and diastolic blood pressure is detected among cases with septic shock **[23].**

A randomized open-label trial called SEPSISPAM, which had 776 patients within 6 hours of starting vasopressors, revealed that MAP levels beyond 65 mmHg did not significantly lower mortality **[24].**

In this study the number of died patients was 120 which represents 45.1% of the studied patients.

Although it varies depending on the location and disease entity, hospital mortality linked to intraabdominal infection is often high, ranging from 23 to 38%. Moreover, a global cross-sectional ICU survey revealed a 20% point-prevalence of abdominal sepsis, indicating that

treatment for this condition is frequently lengthy and complicated **[25]**.

In the present study, it was found that 47.4% of the studied cases have septic shock, 39.8% sepsis and 12.8% infection. **Luo et al. [26]** stated that when patients with intraabdominal infection of the patients brought to the intensive care unit, 40.1% had septic shock, and 60.9% had acute renal injury to varied degrees. In our study there was higher survival rate in operated patients who had the chance of source control. In fact, there was a decreased survival rate for every hour that passed before care in patients suffering from septic shock brought on by gastrointestinal perforations. However , there is currently little data to determine when therapies should be given to patients who are sepsis. Furthermore, it has been shown that there is a correlation between survival and the apparent (first) success rate of therapies **[27].**

CONCLUSIONS

High qSOFA score, need for reoperation, diabetes mellitus and respiratory disease are risk factors of septic shock in patients with intraabdominal infection .Factors influencing the prognosis of patients with intraabdominal infection include advanced age , need for reoperation and pre-existing disease as diabetes mellitus and cardiac disease.

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