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A comparative Study between the Effect of Resuscitation Strategy targeting Capillary Refill Time And Lactate Level To predict Mortality Among Patients With Septic Shock

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Abstract

Background: Septic shock is diagnosed when an individual has sepsis hypotension despite adequate fluid resuscitation and hypoperfusion and requires vasopressor medication to maintain a mean arterial pressure (MAP) of 65 mm Hg or higher.

Aim of the work: To assess early tissue hypoperfusion in adult individuals with septic shock by contrasting lactate level-targeted resuscitation with peripheral perfusion-targeted resuscitation by capillary refill time (CRT).

Patients and methods: A comparative prospective research was performed at Al-Azhar University Hospitals from January 2023 to July 2023. The researchers also acquired permission from the Ethical Committee of the Faculty of Medicine, as well as approval from the Institutional Review Board (IRB). This research comprised 52 intensive care unit (ICU) individuals with a diagnosis of septic shock.

Results: The present study findings indicate that regarding age, sex, BMI, comorbidities, HR, causes of septic shock, serum lactate and CRT, duration of mechanical ventilation, ICU stay, and hospitalization, there was no significant variation among the two groups. Between Group B and Group A, there was not a significant distinction in the occurrence of multiorgan failure or mortality.

Conclusion: The present study showed that the two methods, CRT and lactate level, are accurate and well used in predicting early tissue hypoperfusion among septic shock patients. Multiorgan failure and 28-day mortality were slightly more prevalent in Group A (who had capillary refill time measurements), whereas Group B (who underwent lactate level measurements) was not statistically significant.

Keywords: Mean arterial pressure (MAP); Multiorgan failure; Intensive care unit (ICU); Septic shock; Capillary refill time (CRT)

1. Introduction

Sepsis is presently characterized as a severe condition involving the malfunctioning of vital organs, resulting from an imbalanced immune response to an infection.¹ The World Health Organization has lately acknowledged the significance of this matter as a worldwide health concern.² Sepsis is responsible for or plays a significant role in approximately 50% of all fatalities that occur within hospital settings in the

United States.

On a global scale, the occurrence of sepsis in adults requiring hospital treatment is estimated to be 270 cases per 100,000 individuals, with an associated death rate of approximately 26%. Excluding pediatric cases and instances of sepsis outside of healthcare facilities, the global annual incidence of sepsis amounts to around 19.4 million cases, resulting in approximately 5.3 million fatalities.³

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Septic shock is diagnosed when sepsis and hypotension coexist, and the individual with it needs vasopressor medication to keep their MAP above 65 mmHg and their blood lactate level above 2 mmol/L despite adequate fluid resuscitation. Tissue hypoperfusion is indicated by indicators other than lactate when lactate measurement is unavailable.⁴

Although hyperlactatemia is not considered a definitive indicator of sepsis nor included in the formal definition of sepsis, it serves as a vital indicator of the severity of the disease. Consequently, it continues to play a significant role in numerous effective screening programs and treatment protocols.⁵

On the contrary, fluid unresponsiveness may be employed as a safe approach for fluid removal in hemodynamically stable patients.⁶

The regulation of blood flow in the skin is not under autonomic control, leading to impaired skin perfusion during circulatory dysfunction. This phenomenon can be assessed by evaluating peripheral perfusion. Historically, there has been a correlation between aberrant peripheral perfusion indicators and heightened rates of morbidity and death. Specifically, the presence of a chilly, it has been suggested that clammy skin, mottling, or a lengthy CRT serve as a clinical trigger to start fluid resuscitation in septic shock patients.⁷

Furthermore, the favorable prognosis linked to the normalization of CRT, its prompt response to fluid administration, its relative simplicity, its applicability in settings with limited resources, and its ability to reflect perfusion changes in physiologically significant areas like the hepatosplanchnic region all contribute to the significance of considering CRT as a crucial objective for fluid resuscitation in patients with septic shock.⁸

The objective of this comparative prospective study was to assess early tissue hypoperfusion in adult patients with septic shock by comparing the effectiveness of peripheral perfusion-targeted resuscitation using CRT with lactate level-targeted resuscitation. The secondary outcome of the present study is the additional measure or result that is being assessed in addition to the primary outcome.

This study aims to evaluate the occurrence of multiple organ failure within the initial 72-hour period, the length of time spent in the hospital and the level of care received, the all-cause mortality rate at 28 days, and the maintenance of hemodynamic stability as indicated by systolic blood pressure (SBP), diastolic blood pressure (DBP), mean arterial pressure (MAP), and heart rate (HR).

2. Patients and methods

This comparative perspective was undertaken in the ICU of the Faculty of Medicine at Al-Azhar University Hospitals from January 2023 to July 2023. The present study was conducted on a cohort of 52 cases who were admitted to the ICU due to septic shock. These patients were divided into two distinct groups. Group A consisted of 26 patients who had capillary refill time measurements, whereas Group B comprised 26 patients who underwent lactate level measurements. A comparative analysis was conducted on two methodologies across all patients in order to ascertain the most precise approach for predicting early tissue hypoperfusion in individuals with septic shock.

Inclusion criteria: The study population consists of adult individuals aged 18 years or older who have been diagnosed with septic shock

Exclusion Criteria: Conditions that may affect the management of septic shock within the first 8 hours after diagnosis include pregnancy, planned surgery or dialysis procedure, Active bleeding, acute hematological malignancy, concurrent severe acute respiratory distress syndrome (ARDS), Do-Not-Attempt-Resuscitation status, and the duration since the onset of septic shock criteria surpasses 4 hours. A comprehensive daily screening process was conducted at all the collaborating ICUs to identify possibly eligible patients.

Sample Size (n):

The computation of the sample size was conducted using Epi Info version 7 sample size, taking into account the following assumptions: The confidence levels used in this study were set at 95% for a two-sided test, with a power of 80%. The odds ratio was calculated to be 1.115, with a margin of error of 5%. The ultimate maximum sample size extracted from the Epi-Info output was 46. Consequently, the sample size was augmented to include 52 cases in order to account for any dropouts during the follow-up period.

All the patients were subjected to the following: The initial assessment involves a comprehensive history-taking session from the patient's relatives and a general examination with a specific focus on vital signs such as blood pressure, temperature, HR, and respiratory rate. Additionally, attention is given to identifying indications of pallor, jaundice, cyanosis, and lymph node enlargement.

Examination of blood pressure

Determination of septic shock patient as follows: The presence of an infection, whether confirmed or suspected, was a defining feature of septic shock, along with elevated lactate levels (≥ 2.0 mmol/L) and the need for vasopressor medication to sustain a MAP of 65 mm Hg or above, following the administration of intravenous fluids amounting to at least 30 mL/kg over 3 hours.

Assessment of capillary refill time methodology

Capillary filling time (CFT) was determined by applying pressure to the dorsal surface of the right index finger's distal phalanx utilizing a glass microscope slide. The pressure was gradually elevated until the skin reached a state of full expansion and subsequently sustained at that level for 10 seconds. The duration required for the restoration of the typical skin pigmentation was measured using a clock. An abnormality was defined as a CRT value exceeding 3 seconds.

Lactate measurement

An abnormal lactate measurement was defined as being equal to or greater than 2.0 mmol per liter. The emergency laboratory at Al-Azhar University Hospital measured arterial lactate levels.

Operational design

The researchers presented themselves to the patients who were enrolled in this study and requested their participation after explaining the study's objectives. All volunteers who were chosen were provided with thorough information regarding the study's purpose and the anticipated advantages. Ethical considerations were thoroughly addressed throughout the study.

Administrative design:

Approvals: Prior to conducting the study, the patients were provided with comprehensive information regarding the research objectives and procedures, and their verbal agreement was obtained. Furthermore, measures were taken to ensure the strict confidentiality of all collected data and information. A formal written letter of administrative permission was acquired from the

3. Results

Table 1. The demographic information pertaining to the two groups under investigation.

VARIABLE		GROUP A (N = 26)	GROUP B (N = 26)	T/ X ²	P
AGE (YEARS) MEAN ± SD		37.15 ± 6.29	38.4 ± 6.76	.345	.731
SEX	Male	14 (53.8%)	15 (57.7%)	.078	.780
	Female	12 (46.2%)	11 (42.3%)		
BMI (KG/M ²) MEAN ± SD		26.83 ± 3.79	27.6 ± 3.11	.801	.427

According to the supplied data, there wasn't any significant variation in age, sex, or BMI among the 2 groups that were the subject of the inquiry.

Dean of the Faculty of Medicine at Al-Azhar University, the manager of the hospitals, and the head of the Department of Anesthesia, Pain Management and intensive care. The researchers provided a clear explanation of the study's title and objectives to the parents of the patients in order to secure their involvement.

Ethical committee: The researchers also obtained permission from the ethical committee of the faculty of medicine and approval from the institutional review board (IRB).

Statistical Analysis

The data were gathered, tabulated, and subjected to statistical analysis using SPSS 22.0 for Windows (SPSS Inc., Chicago, IL, USA) and MedCalc 13 for Windows (MedCalc Software bvba, Ostend, Belgium). The Shapiro-Wilk test determined data normality. Qualitative data were frequencies and percentages. The chi-square test (χ^2) and Fisher's exact test were used to evaluate categorical variable differences. Numerical data were reported as mean ± SD for parametric data and median and range for non-parametric data.

For parametric and non-parametric quantitative variables, the Independent T-test and Mann-Whitney test were applied to compare the two groups.

A two-tailed method was applied to all statistical comparisons to assess significance. Statistical significance is shown by a p-value of 0.05 or less, whereas a p-value under 0.001 suggests a highly significant difference. Conversely, a p-value above 0.05 suggests a lack of statistical significance.

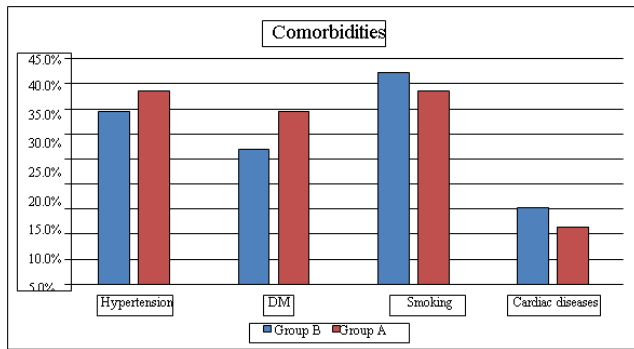


Figure 1: The distribution of comorbidities among the two groups under investigation.

Regarding comorbidities, there was not a significant distinction among the two research groups.

Table (2): The etiological factors contributing to septic shock within the two groups under investigation.

	GROUP A (N = 26)	GROUP B (N = 26)	X ²	P
INTRA-ABDOMINAL INFECTION	10 (38.5%)	9 (34.6%)	1.1	.787
PNEUMONIA	9 (34.6%)	7 (26.9%)		
UTI	5 (19.2%)	6 (23.1%)		
OTHER SOURCES	2 (7.7%)	4 (15.4%)		

According to the table, there was no significant distinction found in the etiology of septic shock among the two groups that were the subject of the study.

Table 3. The vital indicators observed in both groups under investigation.

VARIABLES	GROUP A (N = 26)	GROUP B (N = 26)	T	P
HR (BEAT/MIN) MEAN± SD	107.6 ± 19.41	106.5 ± 21.58	.193	.848
SBP (MMHG) MEAN± SD	102.0 ± 7.63	104.2 ± 7.85	1.1	.310
DBP (MMHG) MEAN± SD	61.2 ± 5.64	60.37 ± 5.32	.545	.588

The data shown in this table indicates that there was not a statistically significant distinction observed amongst the two groups under investigation regarding HR, SBP & DBP.

the two groups under investigation are being compared.

VARIABLE	GROUP A (N=26)	GROUP B (N=26)	Z	P
SERUM LACTATE (MMOL/L) MEAN ± SD	4.51 ± 4.26	4.32 ± 2.69	.203	.843
CAPILLARY REFILL TIME (S) MEAN ± SD	5.24 ± 1.78	4.38 ± 1.42	1.85	.082

There was no statistically significant distinction seen between the two groups under investigation in terms of serum lactate levels and CRT.

Table (5): The secondary result was compared between the two groups under investigation.

VARIABLE	GROUP A (N=26)	GROUP B (N=26)	Z	P
DURATION OF MECHANICAL VENTILATION (DAYS) MEAN ± SD	15.42 ± 10.86	12.34 ± 10.59	1	.306
ICU STAY (DAYS) MEAN ± SD	8.85 ± 8.93	8.46 ± 8.52	.168	.876
HOSPITAL STAY (DAYS) MEAN ± SD	24.73 ± 25.82	19.81 ± 20.58	.762	.451

The presented data indicates that, there was no statistically significant distinction observed between the two groups under investigation in terms of duration of mechanical ventilation, length of stay in ICU and overall hospital stay.

Table 6. The clinical outcome observed in the two groups under investigation.

	GROUP A (N=26)		GROUP B (N=26)		X ²	P
	N	%	N	%		
MUTI-ORGAN DYSFUNCTION	16	61.5	18	69.2	.340	.560
28-DAYS MORTALITY	9	34.6	11	42.3	.325	.569

This table showed that, multiorgan failure and mortality were slightly more prevalent in Group B (who underwent lactate level measurements), whereas Group A (who had capillary refill time measurements) without statistical difference.

Table 4. The clinical characteristics exhibited by

4. Discussion

Sepsis is a condition that arises when the body's immune response to an infection leads to severe dysfunction of vital organs, posing a significant risk to life. Septic shock refers to a condition known as sepsis, which leads to inadequate blood flow to tissues, necessitating the use of vasopressor medications to manage low blood pressure, and is accompanied by increased levels of lactate. Sepsis is a prominent contributor to mortality, morbidity, and financial burden, accounting for a significant proportion of deaths among individuals receiving hospital care, with the exact proportion varying according to the specific criteria used for defining sepsis. The therapy of sepsis presents a complex therapeutic challenge that necessitates prompt identification and treatment of infection, as well as addressing hemodynamic complications and malfunction in several organs.⁹

The prompt highlights that the initiation of resuscitation is a crucial element in mitigating the progression of numerous organ dysfunction and death in septic shock patients. Elevated levels of lactate in the bloodstream and indications of inadequate tissue perfusion, such as aberrant peripheral perfusion,¹⁰ distinguish shock.

Given the significant correlation observed between hyperlactatemia, lactate kinetics, and mortality, as well as the findings from a recent investigation, the Surviving Sepsis Campaign has put out a recommendation to direct hemodynamic resuscitation efforts through the regular monitoring of blood lactate levels for two to four hours until normalization.¹¹⁻¹²

The present research found no statistically significant variations in age, sex distribution, and BMI among the two groups under examination.

The findings of the present study were corroborated by Hernández et al.¹⁰ The objective of this study was to ascertain if a resuscitation approach focused on peripheral perfusion throughout the initial stages of septic shock in adult patients is superior to a lactate level-based resuscitation approach in terms of lowering mortality. The study comprised a cohort of 424 patients who had been diagnosed with septic shock. The participants were allocated at random to two distinct resuscitation methods. A therapeutic intervention aimed at restoring the CRT to a normal range was administered to a cohort consisting of 212 individuals. The alternative protocol aimed to standardize or reduce lactate levels at a pace above 20% per 2 hours, involving a total of 212 individuals. The duration of this intervention phase spanned 8 hours. No statistically significant distinctions were found among the groups under study in terms of age & BMI. Alternatively, it was reported that there existed a significant variation among

the groups under investigation with respect to gender.¹⁰

Our analysis revealed no statistically significant disparity in terms of comorbidities and no substantial disparity in terms of the etiology of septic shock between the two groups under investigation.

The results of the present study supported Hernández et al. It was observed that there existed no significant distinction between the two groups under investigation in terms of comorbidities.¹⁰

Also, the present study was consistent with those of Castro et al. An undisclosed source stated that there was an absence of a substantial distinction in terms of comorbidities between the two groups under investigation.¹³

The findings of our present study indicate that more statistically significant differentiation in terms of HR, SBP, and DBP needs to be made among the two groups under investigation.

The results of the present study supported Hernández et al. The researcher(s) reported that no statistically significant difference was seen between the two groups under study in terms of HR and arterial blood pressure.¹⁰

Also, the present study was consistent with those of Castro et al. An undisclosed source stated that there was an absence of a substantial distinction in terms of comorbidities between the two groups under investigation.¹³

Based on our investigation, we could not find any statistically significant differences in the arterial blood gas (ABG) metrics between the two study groups.

The present study was consistent with those of Castro et al. The individual or individuals that documented that there was no statistically significant distinction between the two examined cohorts in relation to ABG measurements.¹³

The findings of the present study indicate that there was no statistically significant disparity observed between the two groups under investigation in terms of blood lactate levels and capillary refill time.

The results of the present study are supported by Hernández et al. An unidentified source reported the absence of a noteworthy distinction in terms of serum lactate and capillary refill time between the two examined groups.¹⁰

The results of the present study suggest that there was no statistically significant difference seen between the two groups being studied with regard to blood lactate levels and capillary refill time (Hernández et al., The absence of a substantial distinction in terms of hospitalization duration and ICU stay between the two examined cohorts was reported by an undisclosed source.¹⁰

Furthermore, Kattan et al. The individual or individuals who provided information on the observed differences in hospital stay and ICU stay

among the groups under investigation were not specified.¹⁴

The findings of the present study indicate that Group B had a slightly higher incidence of multiorgan failure and 28-day death than Group A, but this difference did not reach statistical significance.

Casserly et al. The study's goal was to evaluate the rise in lactate levels, especially those more than 4 mmol/L, and whether hypotension is present or not as a sign of the clinical prognosis. Their study's conclusions show a direct link between increased lactate levels and post-hospitalization death rates. However, it is important to remember that despite the presence or lack of hypotension, the correlation between mortality in the hospital and lactate readings is just significant for those whose levels surpass 4 mmol/L. Moreover, these higher lactate levels are linked to a significantly larger risk of death compared to intermediate levels ranging from 2 to 3 mmol/L and 3 to 4 mmol/L.¹⁵

5. Conclusion

Multiorgan failure and 28 DAYS mortality were slightly more prevalent in Group B (who underwent lactate level measurements), whereas Group A (who had capillary refill time measurements). The two approaches, namely CRT and lactate level, have demonstrated accuracy and effectiveness in predicting early tissue hypo perfusion in cases with septic shock. Additional research on a wider scale is required in order to validate our findings.

Disclosure

The authors have no financial interest to declare in relation to the content of this article.

Authorship

All authors have a substantial contribution to the article

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