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The Clinical Usefulness of Neutrophil-Lymphocyte Ratio and Serum Procalcitonin as a Diagnostic and Prognostic Biochemical Markers in Burn Patients Complicated with Sepsis: A Comparative Study

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Abstract

Background: Burn injuries have become a major global health problem, with more than 120,000 burn-related deaths each year.

Aim and Objectives: To compare Neutrophil-lymphocyte Ratio (NLR) and S. Procalcitonin (PCT) level as a diagnostic and prognostic parameter in burn patients complicated with sepsis.

Patients and Methods: This was a prospective cohort study conducted on 40 patients at burn unit of the Plastic, Burn and Maxillofacial Surgery Department in Ain Shams University Hospitals from April to September 2023.

According to the American Burn Association Criteria for the presence of infection, the patients were allocated into two groups: Sepsis and non-sepsis. Also, according to the fate of the patients, they were classified into two groups: Non survivors and survivors (discharged).

We measured NLR and PCT as markers of infection on admission, day 3, day 10 and day 20 for all patients and compared their values in the finding groups.

Results: There was no statistically significant difference between sepsis and non-sepsis patients as well as between survivors and non-survivors as regard NLR. There was Statistically significant increased PCT level on day 3 from admission and statistically highly significant increase on day 10 with sepsis patients when compared with non-sepsis patients (p=0.003 and <0.001 respectively). There was Statistically significant increased PCT level on day 3 and statistically highly significant increase on day 10 with non-survivor when compared with survivor patients (p=0.043 and <0.001 respectively).

Conclusion: Our study demonstrated that PCT level in major burn patients is a promising diagnostic biomarker in detecting sepsis that could facilitate ideal management and initiate proper antimicrobial therapy and good prognostic value as an early predictor of mortality. In contrast, higher NLR cannot be considered as a reliable independent predictor of sepsis.

Key Words: *Neutrophil-Lymphocyte Ratio – Serum Procalcitonin – Burn Patients.*

Ethical Committee: Approved by the ethical committee of the Faculty of Medicine, Ain Shams University FMASU (MS247/2023), on 11/4/2023.

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Introduction

With more than 120,000 burn-related fatalities annually, burn injuries have grown to be a serious worldwide health concern [2].

Severe burns increase the risk of immunological dysfunction, excessive fluid extravasation, and poor tissue perfusion [3].

Burn sepsis brought on by a systemic or localized infection can exacerbate the patient's state and complicate burn injuries [4].

Many other disorders, including trauma, surgery, tissue necrosis, and immune-mediated inflammatory illness, impact the currently utilized indications of early identification of infection, such as CRP. Since severe burn patients do experience a systemic inflammatory response, it is crucial to create new techniques for differentiating between an inflammatory response alone and real sepsis brought on by microbial bloodstream invasion.

Numerous studies have used clinical parameters like temperature, heart rate, blood pressure, and respiration rate as well as laboratory data like leukocytic count, erythrocyte sedimentation rate (ESR), c-reactive protein (CRP), S. procalcitonin (PCT), and interleukin-6 (IL-6) as parameters. In emergency patients, lymphocytopenia and the neutrophil-lymphocyte ratio (NLR) have been shown to predict bacteremia more accurately than traditional infection indicators such leukocytic count, neutrophilic count, and CRP [5].

When compared to traditional indicators, serum procalcitonin (PCT) has been repeatedly reported as the best reliable diagnostic biomarker for sepsis [6].

Aim of the work: To compare the Neutrophil-lymphocyte Ratio and S. Procalcitonin level as predictive and diagnostic markers in burn patients complicated by sepsis, this study was conducted.

Patients and Methods

From April to September 2023, 40 patients participated in this prospective cohort research, which was carried out in the burn unit of the Plastic, Burn, and Maxillofacial Surgery Department at Ain Shams University Hospitals.

The patients were divided into two groups based on the American Burn Association Criteria for the presence of infection: Sepsis and non-sepsis [1]. Also, according to the fate of the patients, they were classified into two groups: Non survivors and survivors (discharged).

We measured NLR and PCT as markers of infection for all patients and compared their values in the finding groups.

Inclusion criteria: Age: Adults equal or older than 18 years old, gender: Both males and females, type of patient: Patients with burn injuries (including flame, scalding, contact, or spark burns) in the range of 20% to 40% of total body surface area (TBSA).

Exclusion criteria: Patients age younger than 18 years old, Pregnant females, electrical, chemical or inhalational burn, Presence of co-morbidities and TBSA <20% and >40%.

Methods:

Clinical assessment:

Generally: Vital signs and level of consciousness.

Burn assessment: Cause, extent, distribution, depth, delay, burn wound infection and sepsis: according to American Burn Association guidelines.

Laboratory investigations:

CBC, Renal and liver function tests, Coagulation profile, Albumin level and Viral Markers. NLR calculation and Procalcitonin Level on admission, day 3, day 10 and day 20 from admission. Blood Culture and CRP sampling at any peak of suspected sepsis.

Sample collection for CBC with differentiations to calculate NLR:

For each measurement, 5ml venous blood was drawn into EDTA tube. Transport: within 60 minutes of venipuncture. Blood specimen was analyzed by Automatic Haematology machine.

Sample collection for procalcitonin measurement:

For each measurement, 5ml venous blood was drawn into a red top tube. Transport: Within 60 minutes of venipuncture. Plasma specimen was analyzed by Automated immune-analyzer (VIDAS®, bioMérieux, Marcy L'Etoile, France).

Resuscitation of the patient:

Proper resuscitation using modified parkland formula to be controlled by urinary output, pulse, temperature, and blood pressure.

Modified Parkland formula: 4ml x weight (kg) x %TBSA Burn = Total fluid over 24 hours. UOP Goal: (0.5-1ml/kg/h) until maintenance is reached for 24 hours post burn.

Caloric and Nutritional requirement: 25 X body weight (kg) + 40 X % TBSA burn.

Follow-up:

Patient's general condition, vital signs, local signs of infection, and signs of wound healing.

Ethical considerations:

All patients signed an informed consent with detailed information about the study. The Medical Ethical Committee of Ain Shams University approved the protocol of this thesis. It will include an explanation of the study aim, research design, and assurance that: All data was confidential (for research purposes only), the name of the patient was omitted from the description of the results. All samples were used in this research only.

Statistical analysis: Our study has divided the studied patients into 2 groups according to the outcome also according to the development of sepsis with qualitative data was done by using the Chi-square test and/or Fisher exact test was used instead of the Chi-square test when the expected count in any cell was found less than 5.

The comparison between two independent groups with quantitative data and parametric distribution was done by using the independent *t*-test.

The confidence interval was set to 95% and the margin of error accepted was set to 5%. The *p*-value was considered significant as the following: $p>0.05$ = Non-significant (NS), $p<0.05$ = Significant (S), $p<0.001$ = Highly significant (HS).

Results

The average age was 37.4±14.7 years, there were 23 males (57.5%) and 17 females. As regard cause, there were 34 patients (85%) due to flame and 6 patients (15%) due to scald in all studied patients. As regard distribution, number of patients with affected neck, chest, upper limb, lower limb, back and abdomen was 31, 36, 35, 18, 14 and 3 respectively. (Table 1).

As regard extent (TBSA%), The average extent for all patients under study was 27.6±7.6%, with a minimum and maximum extent of 20% and 40%, respectively.

As regard depth, there were 22 patients (55%) of superficial partial to deep partial thickness and 18 patients (45%) of deep partial to full thickness depth in the studied patients. As regard sepsis, there were 22 patients (55%) with no sepsis and 18 patients (45%) with sepsis in the study.

Regarding outcome, there were 28 patients (70%) survived and 12 patients (30%) non-survived. (Table 2).

Sepsis and age did not statistically significantly correlate as well as sex and affected site of the studied patients (*p*=0.219, 0.822, >0.05 respectively). There was statistically significant correlation (*p*-value=0.041) between sepsis and cause of burn in the studied patients. In patients with sepsis, there were 13 patients (72.2%) due to flame and 5 patients (27.8%) due to scald. In patients without sepsis, there were 21 patients (95.5%) due to flame and 1 patient (4.5%) due to scald. There was statistically significant correlation between sepsis and extent, depth of burn, and outcome (percentage of non survivors) (*p*=0.029, 0.013, 0.001 respectively). (Table 3).

Patients with and without sepsis did not differ statistically significantly from one another.

as regard Procalcitonin on admission and day 20. There was Statistically significant increased Procalcitonin on day 3 and day 10 (*p*=0.003, <0.001 respectively) in sepsis patients compared to non-sepsis. Regarding procalcitonin on admission, there was no statistically significant difference between survivors and non-survivors.

There was Statistically significant increased Procalcitonin on day 3 and highly statistically significant on day 10 (*p*=0.043, <0.001 respectively) in non-survivors compared with survivors.

There was highly statistically significant (*p*-value <0.001) increased CRP in patients with sepsis when compared with non-sepsis patients. (Table 4).

There was no statistically significant difference between sepsis and non-sepsis patients as regard NLR on admission, day 3, day 10 and day 20 (*p*= 0.144, 0.225, 0.431, 0.544, 0.527, 0.584 respectively). There was no statistically significant difference between survivor and non-survivor patients as regard NLR on admission, day 3 and day 10 (*p*=0.926, 0.494, 0.763 respectively). (Table 5).

Table (1): Summary of the patient demographics' for each subject under study.

	Studied patients (N=40)	
Sex:		
Male	23	57.5%
Female	17	42.5%
Age (years):		
Mean ± SD	37.4±14.7	
Min - Max	18-81	
Cause:		
Flame	34	85%
Scald	6	15%
Distribution:		
Neck	31	77.5%
Chest	36	90%
Upper limb	35	87.5%
Lower limb	18	45%
Back	14	35%
Abdomen	3	7.5%

Table (2): An explanation of the clinical data for each subject under study.

	Studied patients (N=40)	
Extent (%):		
Mean ± SD	27.6±7.6	
Min - Max	20-40	
Depth:		
Superficial partial to deep partial thickness	22	55%
Deep partial to full thickness	18	45%
Sepsis:		
Non	22	55%
Sepsis	18	45%
Outcome:		
Survivors	28	70%
Non-survivors	12	30%

Table (3): Association in the patients under study between sepsis and other variables.

	Sepsis				Stat. test	*p*-value
	Non (N=22)		Sepsis (N=18)			
Age (years):						
Mean	39.9		34.2		$t = 1.25$	0.219 NS
± SD	16.1		12.3			
Sex:						
Male	13	59.1%	10	55.6%	$X^2 = 0.051$	0.822 NS
Female	9	40.9%	8	44.4%		
Cause:						
Flame	21	95.5%	13	72.2%	$X^2 = 4.2$	0.041 S
Scald	1	4.5%	5	27.8%		
Site:						
Neck	16	72.7%	15	83.3%	$X^2 = 0.63$	0.424 NS
Chest	21	95.5%	15	83.3%	$X^2 = 1.61$	0.204 NS
Upper limb	20	90.9%	15	83.3%	$X^2 = 0.51$	0.471 NS
Lower limb	7	31.8%	11	61.1%	$X^2 = 3.4$	0.064 NS
Back	6	27.3%	8	44.4%	$X^2 = 1.28$	0.257 NS
Abdomen	2	9.1%	1	5.6%	$X^2 = 0.17$	0.673 NS
Extent (%):						
Mean	25.3		30.5		$t = 2.27$	0.029 S
± SD	6.7		7.8			
Depth:						
Superficial partial to deep partial thickness	16	72.7%	6	33.3%	$X^2 = 6.2$	0.013 S
Deep partial to full thickness	6	27.3%	12	66.7%		
Outcome:						
Survivors	20	90.9%	8	44.4%	$X^2 = 10.1$	0.001 S
Non-survivors	2	9.1%	10	55.6%		

Table (4): Correlation between sepsis and studied laboratory data in the studied patients.

	Sepsis		*t*	*p*-value
	Non (N = 22)	Sepsis (N = 18)		
Procalcitonin on admission	1.4±1.7	8.7±23.0	1.49	0.144 NS
Procalcitonin on day 3	2.9±2.9	26.7±35.6	3.13	0.003 S
Procalcitonin on day 10	7.5±12.1	56.0±37.6	5.3	<0.001 HS
Procalcitonin on day 20	0.9±0.8	9.1±12.4	1.28	0.225 NS
NLR ng/ml on admission	15.4±8.3	17.5±8.7	0.79	0.431 NS
NLR ng/ml on day 3	14.6±6.1	16.0±8.4	0.61	0.544 NS
NLR ng/ml on day 10	13.5±9.4	15.8±12.7	0.63	0.527 NS
NLR ng/ml on day 20	5.9±2.5	5.2±1.8	0.56	0.584 NS
CRP mg/l	127.6±108.3	257.6±79.2	4.2	<0.001 HS

Table (5): Correlation between Outcome and studied laboratory data in the studied patients.

	Outcome			
	Survivor (N = 28)	Non-survivor (N = 12)	*t*	*p*-value
Procalcitonin ng/ml on admission	4.8±18.7	4.3±3.3	0.094	0.926 NS
Procalcitonin ng/ml on day 3	8.1±19.5	26.5±36	2.09	0.043 S
Procalcitonin ng/ml on day 10	14±25.6	67.7±29.3	5.55	<0.001 HS
NLR on admission	17±9.4	14.9±5.8	0.69	0.494 NS
NLR on day 3	15.4±7	14.7±7.7	0.3	0.763 NS
NLR on day 10	12.8±8.5	18.7±15	1.5	0.143

Table (6): Sepsis criteria according to ABA (American Burn Association), Mann–Salinas novel predictors of sepsis, Sepsis-3 consensus definition for sepsis and septic shock **[19]**.

ABA Sepsis Criteria

To fulfill these criteria, at least three of the following should be present:

- Temperature >39ºC or <36.5ºC.
- Progressive tachycardia (>110bpm).
- Progressive tachypnea.
- Thrombocytopenia.
- Hyperglycaemia.
- Inability to continue enteral feedings 24 hours.

Alongside infection, demonstrated by at least one of the following:

- Culture-positive infection.
- Pathological tissue source identified.
- Clinical response to antimicrobial agents.

Mann-Salinas novel predictors of sepsis score comprises:

- Tachycardia >130bpm.
- MAP <60mmHg.
- Base deficit <–6mEg/l.
- Hypothermia <36ºC.
- Use of vasoactive medications.
- Hyperglycaemia >150mg/dl.

Sepsis-3 consensus definition for sepsis and septic shock score comprises:

- Altered mental status (Glasgow coma scale score <13).
- Systolic blood pressure ≤100mmHg.
- Respiratory rate ≥22 breaths per minute.
- Suspected or documented infection and qSOFA ≥2 and/or SOFA ≥2; SOF variables are PaO2/FiO2 ratio, Glasgow coma scale, mean arterial pressure, vasopressor requirements, serum creatinine or urine output, bilirubin and platelet count.

The criteria for septic shock are:

- Vasopressors required to maintain MAP >65mmHg.
- Lactate >2mmol/l (after adequate fluid resuscitation).

Discussion

In cases of burn, sepsis deteriorates the prognosis and raises the possibility of organ failure and death. Multiple organ dysfunction syndrome (MODS) is the primary cause of death in burn victims and is a direct result of sepsis **[1]**.

Since that survival is decreased by 10% for every six hours delay in sepsis diagnosis, it is imperative to recognise sepsis early. The systemic reaction to the burn itself, which clinically resembles sepsis, makes it difficult to diagnose sepsis in burn patients **[7]**.

Early identification of sepsis enables optimal management and early start of appropriate antimicrobial medication as delaying the treatment of infections has been linked to worse outcomes and higher costs **[8]**.

Our results showed that there was no statistically significant correlation between sepsis, age and sex of the studied patients. There was statistically significant correlation (*p*-value=0.041) between sepsis and cause of burn in the studied patients. In patients with sepsis, there were 13 patients (72.2%) due to flame and 5 patients (27.8%) due to scald. This could be due to the commonness of flame burn in general, as in patients without sepsis, there were 21 patients (95.5%) due to flame and 1 patient (4.5%) due to scald. However, it is well known that in extremes of age, this is not the case as the compromised immune system in these age groups plays a significant role in the incidence of burn sepsis.

Our findings are in line with the findings of Macedo et al. (2003) **[9]** & Tasleem et al. (2023) **[6]**, who found that flame burns were the most prevalent and significant cause of burns in patients with sepsis due to deeper, more widespread lesions that promote increased burn wound colonisation and infection.

Our results showed that there was no statistically significant difference between sepsis and non-sepsis groups regarding affected site of the studied patients (*p*-value >0.05). There was statistical significance (*p*-value=0.029) with increased percentage of TBSA burned in patients with sepsis (30.5±7.8%) when compared with patients without sepsis (25.3±6.7%). There was statistically significant correlation (*p*-value=0.013) between sepsis and depth of burn in the studied patients. In patients without sepsis, there were 16 patients (72.7%) of superficial partial to deep partial thickness burn and 6 patients (27.3%) of deep partial to full thickness burn while in patients with sepsis, there were 6 patients (33.3%) of superficial partial to deep partial thickness burn and 12 patients (66.7%) of deep partial to full thickness burn.

Our findings are corroborated by Cabral et al. (2017) [10] & Cabral et al. (2018) [11] who found a significant difference between the septic and non-septic groups in terms of ABSI The Abbreviated Burn Severity Index (ABSI), which includes TBSA burned and the proportion of a full thickness burn. In the group with sepsis, the score was noticeably higher.

Our current study showed statistically significant (*p*-value=0.001) increase in percentage of death in patients with sepsis (10 patients, 55.6%) when compared with patients without sepsis (2 patients, 9.1%).

Our findings were corroborated by Cabral et al. (2017) [10], Cabral et al. (2018) [11] & Fernandes et al. (2020) [12], who documented a substantial mortality difference between the septic and non-septic groups, with the septic group having a higher death rate.

In the present study, the rise in PCT level was the main finding that can differentiate patients with sepsis from patients without sepsis and can also predict survivors and non survivors within the septic group.

When there are severe bacterial infections, the pathogen's lipopolysaccharide carried PAMPs are recognised by the body's innate immune system, which results in systemic inflammation. The expression of calcitonin genes is up-regulated in a range of tissue cells other than the thyroid under the activation of endotoxin and inflammatory cytokines (e.g., IL-1beta, IL-6, and TNF-alpha), leading to a significant quantity of PCT [13]. PCT synthesis is not triggered in the majority of viral infections because of cytokines generated during the infection that prevent the formation of TNF-alpha [14].

Procalcitonin had been measured in our study on admission of the patient then in day 3, 10 and 20 with doing a blood culture at any suspected event of sepsis.

Our results showed that there was no statistically significant difference (*p*-value=0.144) between sepsis and non-sepsis patients as regard Procalcitonin level on admission. Statistically significant (*p*-value=0.003) increase in Procalcitonin on day 3 in patients with sepsis was evident (26.7±35.6) when compared with non-sepsis patients (2.9±2.9). There was a highly statistically significant (*p*-value <0.001) increase in Procalcitonin on day 10 in patients with sepsis (56±37.6) when compared with non-sepsis patients (7.5±12.1). No statistically significant difference (*p*-value=0.225) between septic and non-septic patients was reported as regard Procalcitonin on day 20.

Consistent with our results, Barati et al. (2008) [15], revealed that the septic group had a higher PCT level (8.45 _ 7.8 vs. 0.5 _ 1.0, respectively, *p*=0.001) than the non-septic group.

In addition to our findings, Cabral et al. (2018) [11] & Fernandes et al. (2020) [12] found that patients who experienced at least one episode of sepsis had higher PCT levels in the first five to seven days following burn damage than patients who did not experience sepsis. Along with additional interventions and a thorough clinical assessment, tracking changes in PCT levels throughout the first week of hospital stay may help to identify sepsis early and perhaps lower morbidity and death.

However, during an ICU stay, PCT can be utilised as a diagnostic tool for patients with infectious problems, whether they have bacteraemia or not. When septic patients' PCT levels were compared to their pre-septic values, they found a statistically significant rise. Patients experiencing septic shock had median PCT values of up to 23.9ng/ml, whereas sepsis patients had median concentrations of 7.2ng/ml. They concluded that measuring PCT consecutively daily might be a useful technique for keeping track of how well antibiotic medication is working [16].

Mokline et al., (2015) [17] monitored drop of PCT concentrations of 27% between day of sepsis diagnosis and 3 days after empiric antibiotic administration.

In our study, prophylactic antibiotics were routinely given on day 1 that make it difficult to study the correlation between post antibiotic improvement and procalcitonin level or the role of procalcitonin in guiding antibiotic therapy.

Our results showed that there was no statistically significant difference (*p*-value=0.926) between survivors and non-survivors as regard Procalcitonin on admission. Statistically significant (*p*-value= 0.043) increased Procalcitonin on day 3 in non-survivors was evident (26.5±36) when compared with survivors (8.1±19.5). Highly statistically significant (*p*-value <0.001) increased Procalcitonin on day 10 in non-survivors (67.7±29.3) when compared with survivors (14±25.6) was monitored.

Our findings, which are corroborated by Barati et al. (2008) [15] & Fernandes et al. (2020) [12], showed that the non-survivor group's first week PCT range and median values were greater than those of the survivors' group. These findings may be helpful for patient classification and the prediction of mortality.

In a similar line, Liu et al., 2015 [18] found that patients with sepsis who had rising PCT levels also had a greater chance of dying. However, he noted that because to PCT's modest diagnostic accuracy, it would not be helpful when used alone to determine prognosis; rather, it might be beneficial when combined with other clinical indices and the patient's general health.

To achieve the aim of the present study that to compare between Neutrophil-lymphocyte Ratio and S. Procalcitonin level as a diagnostic and prognostic parameter in burn patients complicated with sepsis, Neutrophil-lymphocyte Ratio had been calculated on admission of the patient then in day 3, 10 and 20 with doing a blood culture at any suspected sepsis episode.

NLR is superior to other indicators for bacteraemia and severe sepsis diagnosis in burn patients, according to Ljungstrom et al. (2015) [19].

According to our findings, there was no statistically significant difference (*p*-value=0.431) in NLR on admission, day 3 (*p*-value=0.544), day 10 (*p*-value=0.527), or day 20 (*p*-value=0.584) between sepsis and non-sepsis patients. Furthermore, no statistically significant difference (*p*-value= 0.494) was seen in the NLR between patients who non-survived and those who survived at the time of admission, day three (*p*-value=0.763), or day ten (*p*-value=0.143).

Our findings are at odds with those of Bhuyan et al. (2020) [20], who sought to determine whether the parameters of neutrophil to lymphocyte ratio (NLR), platelet count, and red cell distribution width to platelet ratio (RPR) could be used to predict the outcome for burn patients and determine the relationship between these parameters and mortality. They found that NLR was significantly higher in the death group (14.44±6.95) compared to the discharge group (7.23±3.25), (*p*=0.00).

Furthermore, our findings contradict those of Setiawan et al. (2022) [21], who claimed that there was a statistically significant difference in NLR on days 1 and 3 between patients who survived and those who did not.

Furthermore, Rech et al. (2019) [22] found that a greater admission NLR was an independent predictor of a higher death rate even after accounting for a few other contributing variables.

These discrepancies can result from the reduced sample size of our patients.

Our findings corroborated those of Qiu et al., (2021) [23], who examined the potential utility of NLR as a predictor of 90-day mortality, considering patients who passed away between day 7 and day 90 of admission. They found no statistically significant difference in NLR on days 1 and 7 between the survivor and non-survivor groups. Otherwise, they stated that, with reference to NLR on day 3, there was a statistically significant difference between the survivor and non-survivor groups.

Age, acute trauma, exogenous steroid consumption, mental stress, active haematological illnesses including leukaemia, cytotoxic or granulocyte colony stimulating factor (G-CSF) chemotherapies, and HIV are some of the conditions that may cause a "false" rise in NLR [24].

Our findings revealed that, in comparison to patients without sepsis (127.6±108.3), those with sepsis had a very statistically significant (*p*-value <0.001) higher CRP (257.6±79.2).

Our findings are corroborated by Cabral et al. (2017) [10], who found a statistically significant difference in CRP between the septic and non-septic groups, with the septic group having a considerably higher CRP (*p*=0.000). In disagreement with our results, Barati et al. (2008) [15] found no statistically significant difference in CRP (*p*=0.52) between the septic and non-septic groups.

In addition to being significantly impacted by several other illnesses like trauma, surgery, tissue necrosis, and immune-mediated inflammatory disease, CRP is one of the currently utilised indications of early infection detection. Since patients with severe burns do have systemic inflammation, it is critical to develop new techniques to distinguish between sepsis caused by microbial invasion of the blood stream and a pure inflammatory response.

In burn victims, procalcitonin seems to be a potent indicator of sepsis. It is simple to measure, dependable, sensitive, and specific. Its measurement together with clinical assessment is helpful in diagnosis of sepsis and carries promise as a method for reducing antibiotic exposure in the critically ill patient. Additionally, its determination enables burn intensive care specialists to modulate antimicrobial regimens and monitor the response to therapy [17].

Conclusion:

The study admits that PCT levels in major burn patients are a good biomarker in detecting sepsis and good prognostic value as early detection of sepsis can facilitate an ideal management and initiate proper antimicrobial therapy.

While, a few variables (such as age, acute trauma, exogenous steroid consumption, mental stress, and active haematological illnesses) may contribute to a "false" rise in NLR, therefore it cannot be regarded as an independent predictor of sepsis or greater mortality.

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