

Prognostic value of using neutrophil-lymphocyte ratio in patients with burn injury for the diagnosis of sepsis and bacteraemia

Authors' Contribution:
A – Study Design
B – Data Collection
C – Statistical Analysis
D – Data Interpretation
E – Manuscript Preparation
F – Literature Search
G – Funds Collection

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ABSTRACT:

Objective: Despite the progress in the treatment of burn injuries, the mortality rate among seriously ill patients still remains high nowadays. The main causes of fatal cases with extensive deep burns are generalized infectious complications, the major of which is sepsis. According to the authors, 25%–85% of those who died of burn injuries in later periods, died from sepsis. The frequency and severity of infectious complications in patients with burn injuries requires an accurate diagnosis of infection that will determine the tactics of therapeutic and surgical treatment of such patients (Di Lonardo A. et al., 1993). However, the clinical diagnosis of wound infection in patients with burn injuries is quite difficult.

Materials and methods: The clinical material included 188 patients with burn injuries. The average age of those patients ranged from 20 to 59 years. Men - 98 (52.1%), women - 90 (47.9%). The survey was conducted from April 2014 to July 2016.

Results: In our opinion, the strength of NLR (neutrophil-lymphocyte ratio) is the possibility of implementing this parameter simply by using already available biomarkers (neutrophil count and lymphocyte count). Therefore, this ratio is easy to integrate in clinical practice and cost effective.

Conclusion: The application of NLR for the diagnosis of sepsis in patients with burn injuries is the option of choice, since its determination requires only a general blood test.

KEYWORDS:

burns, sepsis, diagnostic, procalcitonin, neutrophil-lymphocyte ratio.

INTRODUCTION

Over the years researchers have distinguished the following signs of burn wound infection: focal or diffuse discoloration of the wound to dark brown or black colour, deepening of necrosis, early rejection of scab, swelling with hyperaemia or cyanosis of surrounding tissues, gangrenous erythema, bleeding or discoloration, haemorrhage under scabby tissue, green pigment visible in the hypodermic tissue (1, 2). Despite a high number of local and general signs of wound infection, all of them are not specific enough, which requires the application of additional diagnostic methods. Moreover, difficulties in the differential diagnosis of infections require daily wound assessment, which allows to timely detect the local signs of infection as well as patient's general condition (3, 4).

An important aspect in terms of diagnosis and treatment of infection is the microbiological examination of the patient. According to Diem E. (1995), a burn clinic needs to control infection, including swabs, biopsy, contact cultures of inpatients. At the same time, the qualitative bacteriological study provides extensive information about the microflora that colonizes the patient, its sensitivity to antibiotics, but does not answer the question of its existence [5].

According to many researchers, increase of the number of microorganisms above the critical level is considered as only a possibility of burn wound infection and its composition can only point to those organisms that are present in the wound. A high degree of microbial contamination correlates with histological evidence of invasive infection in patients with burn injuries in less than 50% of biopsies (3, 5).

A single most important feature of wound infection according to Pruitt BA (1982) is the presence of microorganisms in non-burnt tissue that may be accompanied by inflammatory reactions.

As based on the foregoing, it is urgent to obtain data on the diagnostic value of such inflammatory markers for diagnosis of sepsis as PCT (procalcitonin), C-reactive protein and neutrophil-lymphocyte ratio, which are used to diagnose patients in burn units (6, 7, 8).

MATERIALS AND METHODS

The clinical material includes 188 patients with burn injuries. The average age of patients ranged from 20 to 59 years. Men - 98 (52.1%), women - 90 (47.9%). The survey was conducted from April 2014 to July 2016.

All patients underwent determination of the type and depth of the burn and the area of injury. In accordance with the purpose of assignment, the patients were divided into two groups, with 94 patients in each, and for their diagnosis the following methods were used: in the first group for the diagnosis of sepsis the objective examination data (body temperature, heart rate and respiratory movements) and the results of laboratory tests (erythrocyte sedimentation rate, C-reactive protein, procalcitonin and neutrophil-lymphocyte ratio) were used. In the second group, objective examination data were also used, while laboratory tests to determine the level of procalcitonin were not conducted. For determination of blood cultures the Signal blood culture system (Oxoid Ltd., Basingstoke, United Kingdom) and diffuse environment (bio-

Tab. I. Types of burn injuries.

TYPES OF BURN INJURY	NUMBER OF PATIENTS	PERCENTAGE
Scald burn	14	14
Flame burn	12	12
Thermal burn	99	99
Chemical burn	19	19
Electrical burn	44	44
Total	188	

Tab. II. TBSA- total body surface area.

TBSA (%)	NUMBER OF PATIENTS	PERCENTAGE
<18	44	23.4
18–36	94	50
>36	50	26.6

Tab. III. Clinical and laboratory findings of sepsis.

DATA	NUMBER	PERCENTAGE
Clinical findings		
Fever	187	99.5%
Dyspnea	94	50%
Hypotension	65	34.6%
Oliguria	65	34.6%
Icterus	27	14.4%
Hemorrhages	22	11.7%
Laboratory findings		
Hemoglobin < 10 g/dl	167	88.8
Leukocytosis > 12,000 cells/ml	158	84
Serum albumin < 2.5 g/dl	97	51.6
Thrombocytopenia < 100,000/ml	64	34
Total bilirubin > 2 mg/dl	25	13.3
Serum creatinine > 2 mg/dl	23	12.2

Merieux, Paris, France) were used. Blood sampling for bacteriological examination was carried out with conventional methods.

RESULTS AND DISCUSSION

Most of the injuries occurred due to thermal burn (n = 99), followed by electrical (n = 44), chemical (n = 19), scald (n = 14), and flame burn (n = 12) (Table I).

A majority of the cases had burn of total body surface area between 18–36% (94/188) (Table II). The most common laboratory findings of these patients were anemia, leukocytosis, and thrombocytopenia (Table III).

During the study period, there were 188 consecutive patients and all of those patients had complete data available for the primary outcome. The baseline laboratory characteristics of the patients are elaborated in Table IV.

A range of microorganisms distinguished from blood is shown in Figure 1.

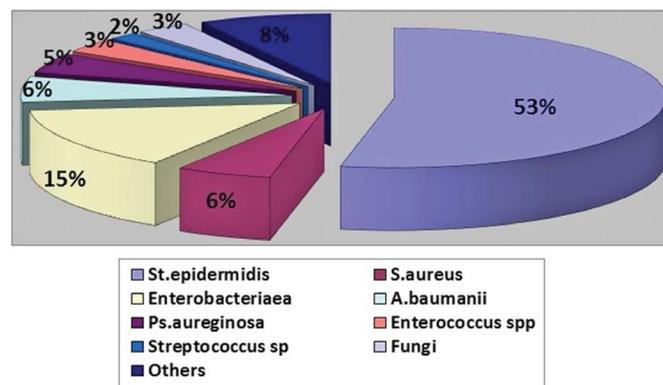


Fig. 1. Range of microorganisms distinguished from blood.

Coagulase-negative staphylococci, representatives of the Enterobacteriaceae family continue to occupy key positions among pathogenic agents of bacteraemia and sepsis. Staphylococcus epidermidis, Staphylococcus haemolyticus, Staphylococcus hominis and Staphylococcus warneri on one hand may be contaminants in case of violation of material collection in patients without risk factors for bacteraemia and sepsis development. On the other hand, they may have etiological significance, especially in patients with burn injuries. Among the enterobacteriaceae Escherichia coli emission frequency for the last two years has remained at about the same level and Klebsiella pneumoniae emission has decreased significantly due to the use of rational antibiotics therapy. It is established that patients of both first and second group had increased levels of indicators such as ESR (erythrocyte sedimentation rate) and C-reactive protein. In the first group of patients, an increase of PCT and NLR levels was observed, in the second group - increased NLR level.

DISCUSSION

Thermal injury is associated with anatomic, physiologic, and immunologic alterations, which require specialized care. Cutaneous injury results in significant fluid loss as well as release of multiple inflammatory mediators. When disseminated by the circulation, bacteria and inflammatory mediators can cause sepsis, and, ultimately, multiple organ failure [9].

The flame burn was the predominant cause of burns amongst patients who had sepsis due to the fact that this agent produces deeper and more extensive lesions than other agents, leading to more extensive colonization of burn wound and sepsis [10].

The majority of septic episodes being due to Staphylococcus might reflect the fact that Burn Units are the major source of these bacteria, as confirmed by other authors. Furthermore, coagulase-negative Staphylococcus should be considered an important pathogen for sepsis in burns. With an organism being ubiquitous in a hospital environment, and with burn wounds being the ideal medium for its multiplication, it is hardly surprising that these bacteria are the cause of 20.7% of septic episodes [11].

A low incidence of Pseudomonas sepsis (only 6.9%) in burned patients indicates a decline of septic episodes due to this organism, as confirmed by other authors.

The appropriate knowledge of clinical findings, epidemiological, laboratorial, and microbiological aspects of sepsis in burned patients permits an adequate diagnosis and treatment of this complication [12].

A number of acute-phase reactants are used in the diagnostics of sepsis, including leukocyte count, ESR, CRP (C-reactive protein), PCT, but the diagnostic role of those factors in burn patients has not been investigated intensively. The objective of this study was to evaluate the usefulness of measuring a series of inflammatory markers in order to diagnose sepsis in burn patients. The results of our study revealed that NLR and PCT were more accurate markers in differentiating sepsis from SIRS (systemic inflammatory response syndrome) in comparison to ERS, CRP, or WBC count [13, 14].

Determination of NLR is simple and easy to incorporate into daily general practice. However, a false negative or positive result may cause a series of potentially harmful policies for the patients. We compared the NLR levels in burn patients with sepsis and SIRS. Our data showed a significant higher level of NLR in burn patients with sepsis, which may help the physicians at the time of initial diagnosis [15, 16].

On the other hand, CRP is another acute-phase reactant, produced by the liver in response to inflammation or infection. Several studies have focused on the diagnostic test abilities of CRP in diagnosing sepsis [17].

In our opinion, the strength of NLR is the possibility of implementing this parameter simply by using the already available biomarkers (neutrophil count and lymphocyte count). Therefore, this ratio is easy to integrate in clinical practice and cost effective [18].

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Tab. IV. Baseline laboratory characteristics of the study subjects.

CHARACTERISTICS	GROUP A	GROUP B	P VALUE
WBC count (109/l)	14.28 ± 6.14	15.89 ± 5.87	0.000
Neutrophil (109/l)	12.80 (9.78–15.41)	13.20 (9.74–18.33)	0.001
Lymphocyte (109/l)	0.82 (0.59–1.42)	0.86 (0.57–1.42)	0.002
NLR	18.22 (9.74–27.21)	15.75 (6.84–23.45)	0.000
Hemoglobin (g/l)	121.13 ± 21.88	124.54 ± 22.13	0.290
Platelet (109/l)	193.15 ± 69.48	186.47 ± 59.13	0.475
Albumin (g/l)	34.25 ± 5.09	35.58 ± 6.10	0.000
RBC count (109/l)	4.20 ± 0.79	4.22 ± 0.82	0.534
Lactic acid (mmol/l)	2.1 (1.2–2.8)	1.7 (1.0–2.4)	0.002
AST (U/l)	38.0 (25.0–67.0)	37.0 (25.0–61.0)	0.056
ALT (U/l)	31.0 (19.0–48.9)	30.0 (18.0–57.0)	0.075
Hematocrit (%)	37.47 ± 6.61	39.34 ± 6.21	0.066
PCT (ng/ml)	19.54 ± 6.27	18.89 ± 7.53	0.521
CRP (mg/l)	102.05 ± 48.10	99.45 ± 49.43	0.140

NLR - neutrophil-lymphocyte ratio; AST - aspartate aminotransferase; ALT - alanine aminotransferase; PCT - procalcitonin; CRP - C-reactive protein.

CONCLUSION

The application of NLR for the diagnosis of sepsis in patients with burn injuries is the option of choice, since its determination requires only a general blood test.

This is a simple and inexpensive method for diagnosis of inflammation processes in patients with burn injuries, especially if there is no possibility to determine the level of procalcitonin.

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