Role of neutrophils to lymphocytes ratio in identification of bacterial infection in adult population

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ABSTRACT

Background: Bacterial infection are difficult to distinguish from viral infection. Neutrophils are the first cells mobilize to infectious site caused by bacteria and also apoptosis of lymphocytes in response to cell mediated immunity hence raised in neutrophils and decrease in lymphocyte count. The goal of this study is to determine the neutrophil to lymphocyte ratio in patient with positive blood culture for bacteria in patients admitted in hospital.
Patients and methods: This cross-sectional study was conducted at Department of Pathology, Hamdard University Karachi, Pakistan from 1st January to 31st June 2022. Total 123 adult patients with positive blood cultures admitted in ward or ICU were enrolled in the study. CBC Samples were collected from patients admitted in ward or ICU and blood culture were already sent due to clinical condition, the organism isolated in blood culture were recorded As blood culture is a gold standard investigation to detect bacterial infection .In this study we will record neutrophil to lymphocyte ratio in patients admitted with positive blood culture for bacteria. Age less than 15 years, pregnant female, OPD patients, negative blood cultures and patients on antibiotic therapy were excluded. Complete blood count (CBC) was performed in Beckman coulter model DxH 520 made by Germany. Age and ward of patient, organism isolated from blood culture, CRP, neutrophil to lymphocyte ratio were recorded from patient file .Neutrophil and lymphocyte count were recorded and NLR was calculated by dividing absolute neutrophil with absolute lymphocyte count. Data was entered and analyzed by SPSS version 25.
Results: A total of 123 patients with positive blood culture were enrolled in the study. Out of 123 patients 61.8% (n=76) were male and 38.2% (n=47) were female. Mean NLR was 5.9± 13.1. Total 45.5% patients presented with high NLR. Mean CRP was 58.5± 68.7. Out of 123 positive blood culture 39.0% (n=48) were gram positive and 61.0% (n=75) were gram negative blood cultures were recorded. Staphylococci were the most common gram positive organism isolated and recorded in 32.1% (n=18) cases in patients with high N:L. Kleibsella was most common gram negative organism isolated in 32.1%(n=18) cases in patients with high N:L
Conclusion: High NLR was seen in 45.5% which shows NLR is an important indicator of bacterial infection. More studies are needed to define true significance of NLR in all ages and negative blood cultures.
Keywords:
Blood cultures, bacterial infections, neutrophil to lymphocyte ratio, NLR

INTRODUCTION

Bacterial infections have large effect on people wellbeing.[1] Serious bacterial infections need the patient to be hospitalized and the most common cause of hospital related morbidity and mortality.[2] This is a diagnostic challenge to the clinician.[3] Blood culture is the gold standard test to identify blood stream infections but it is time consuming and takes 24-48 hours for result which limits the initial treatment decision and there is also a possibility of contamination of specimen.[4-6]. However, there are different biomarkers which indicate bacterial infection such as C-reactive protein, procalcitonin and neutrophil-lymphocyte ratio.[7] CRP is inexpensive and often used screening test to detect bacteremia and this test is available in many laboratories.[8] Some studies found that CRP have high clinical value in early diagnosis of sepsis.[9]

Within hours of bacterial infection CRP levels are elevated.[10] IL6 is the major mediator which triggers CRP production.[11] Procalcitonin (PCT) in normal condition is present in C-cells of the thyroid gland [12] but in bacterial infection procalcitonin levels are raised in blood and it is one of the sensitive marker of bacterial infection.[13] PCT is involved in apoptosis and facilitate cell damage. It is expensive and not available in all health related facilities.[14]

Neutrophil:Lymphocyte ratio (NLR) in CBC is a determinant of bacterial infection and high levels are seen in bacteremia.[15] It is a simple cheap, quick, easily measurable laboratory marker and one of the routine tests for hospitalized patients.[16] It is a ratio between absolute neutrophil and absolute lymphocyte count and it is easily derived from commonly performed peripheral blood differential count.[17] NLR has high sensitivity but low specificity.[18] Some studies shows that NLR is useful tool to monitor outcome and management of sepsis.[19] Serial measuring of these markers are also helpful in the effective management and tailoring therapy to individual.[20]

In this study we determine that how helpful neutrophil to lymphocyte ratio in diagnosis of bacterial infection in patients with positive blood culture so antibiotic therapy can be started earlier in order to treat the patient

PATIENTS AND METHODS

This is cross-sectional performed in Hamdard University Hospital at Department of Pathology. Data was collected from January till June 2022. Inclusion criteria were age range 16-75 years and positive blood cultures. Exclusion criteria were patient < 16 years or > 75 years, pregnant women, and negative blood cultures. OPD patients and patients on antibiotic therapy. Total 123 patients admitted in ward and ICU and blood culture which was sent for medical condition of patients and was positive for bacterial infection were enrolled in the study. CBC was performed in Beckman coulter model DxH 520 made by Germany. NLR is calculated by dividing absolute neutrophil with absolute lymphocyte count. Normal NLR values are 1-3. NLR more than 3 is considered high[21]. Age and ward of patient, organism isolated from blood culture, CRP, neutrophil to lymphocyte ratio were recorded from patient file. Statistical analysis was performed using SPSS 25. Continuous variables like age and NLR were reported as mean values with standard deviation. Frequency and percentages were calculated for categorical values including gender, gram positive or gram negative bacteria.

RESULTS

A total of 123 patients with positive blood cultures were analyzed. The age range of patient was 16-75 years with mean age of 32.2 ± 17.2 years. Out of 123 patients 76 (61.8%) were male and 47 (38.2%) were female. The range of NLR was 0.3-134 with mean NLR of 5.9±13.1. Mean CRP was 58.5± 68.7. Out of 123 patients 39.0%

(n=48) gram positive bacteria isolated in blood culture and 61.0% (n=75) gram negative organism isolated in blood culture. Correlation of NLR with age was significant i.e. p value <0.001. Correlation of NLR was not found to be significant p-value = 0.522.

Out of total 123 positive blood culture 56 patients (45.5%) had high NLR (Table 1). Out of 56, 25 (44.6 %) female and 31 (55.3%) male presented with high NLR.(Table 1). 23 (41.0%) gram positive and 33 (58.9%) gram negative present with high NLR (Table 1) Staphylococci (32.1%) was most common gram positive organism isolated with high NLR and Klebsiella (32.1%) was most common organism isolated with high NLR

Table 1: Characterstic of Patients with N: L >3 (n=56)

Variables	n	%	Mean N:L	Mean CRP
Male	31	55.35		
Female	25	44.6		
Gram positive organism	23	41.0	9.03	58.72
Staphylococci	18	32.1	9.967	65.50
Streptococci	05	8.9	5.700	34.34
Gram negative organism	33	58.9	11.76	75.47
Klebsiella	18	32.1	13.5	77.40
Pseudomonas	03	5.3	5.46	20.16
E coli	06	10.7	8.48	82.40
Salmonella	02	3.5	7.4	57.1
Enterobacter	04	7.1	13.5	89.70

Correlation of NLR with age

Mean NLR	Mean Age	p-value
5.9	32.4	0.001

Correlation of NLR with CRP

Mean NLR	Mean CRP	p-value
5.9	58.5	0.522

DISCUSSION

In this study, mean NLR was 5.9± 13.1. Previous studies showed high NLR ranging from 8.27 to 31.4 in acute bacterial infections.[3,22-25] High NLR was found in 55.3% male which is similar to one previous report.[26] According to this study, 41% gram positive isolated in blood culture presented with high NLR and 58.9% gram negative isolated in blood culture presented with high NLR. In contrast, one previous report described 69.2% gram positive and 30.7% gram negative isolated in blood culture.[27] Another study showed that 16.6% gram positive and 3.8% gram negative bacteria isolated.[28] In this study staphylococci was isolated in 32.1% and streptococci was isolated in 8.9% cases in patients with high NLR. In one previous study, 19.1% gram positive and 35.1% were gram negative bacteria isolated.[29] In another study, 47.1% staphylococci and 14.1% streptococci were isolated.[30] In another study streptococci were isolated in 1.9% cases.[31] In present study, 32.1% blood culture showed Klebsiella with high

NLR . Mean NLR Klebsiella in our study was 13.58.Other studies reported 11.9% to 20.3% Klebsiella isolates.[32,33] . In other study mean NLR for Klebsiella infection was 5.84.[33] Pseudomonas was isolated in 5.3% cases in this study. In this study mean NLR for pseudomonas was 5.46.In other study pseudomonas was isolated in 1.9% to 4.4% cases with high NLR.[31,32] In other study mean NLR was 10.8[34] .

In this study, Enterobacter positive cases were 7.1% with high NLR. In other study Enterobacter cases were 3.7%.[31] In present study. E-coli was isolated in 10.7% cases. Other study showed that 35.0% cases E coli was isolated.[32] In this study 3.5% salmonella isolated in blood culture with raised NLR however one previous report demonstrated only 1.0% salmonella in blood culture.[29]

This study had several limitations. First this study was a single center study. Second, NLR was only documented at the time of admission. Third, non-bacterial infections were not addressed.

CONCLUSION

NLR is an effective, simple, quick and cheap indicator of bacteria in blood. Although blood culture is gold standard but it is a time consuming test. In order to give immediate treatment to prevent complications antibiotic can be started if NLR of patient is high. To determine true significance of NLR in different age groups and patients with negative blood cultures more studies are required

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