Nucleated red blood cells and eosinopenia as a high risk mortality marker in patients of the intensive care units

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Abstract: Finding a reliable marker for mortality and morbidity in the intensive care will always remain a challenge in our daily ICU practice. Intensivists are always concerned with the appropriate time to stop treatment and when to relocate patients to ward. This mandates further research to find a reliable marker for morbidity and mortality that can guide the course of treatment in ICU. Among all, NRBCs and eosinopenia were the most interesting. Also, eosinopenia showed a strong correlation with infection, which is considered a leading cause of morbidity and mortality in ICU. Thus, in our study, we were interested in investigating the impact of these two available cheap parameters on mortality among intensive care patients. The current study was conducted on 230 patients admitted to ICU over a six month period. Patients below the age of 18, trauma patients and surgical patients were excluded from this study. On the day of admission, informed consents were obtained and APACHE II and SAPS II scores were calculated for all patients. NRBCs and eosinophils were measured using the automated blood analyzer Sysmex XE 2100 and results were confirmed with a peripheral blood smear. Mortality was monitored during the ICU stay period. Our results revealed that 27.39% of ICU patients were NRBC-positive, and nearly 31% of them showed NRBCs in their blood on the day of admission. The total mortality of NRBC-positive patients was 50.8%. When compared to the total mortality of the NRBC-negative patients (8.4%), we realize the high prognostic power of the mechanized NRBCs detection in blood as regards mortality, revealing sensitivity of 69.6% and specificity of 83.2%, thus, increasing the mortality risk by eleven folds. the length of ICU stay of the NRBC-positive patients (12.86 days), which was nearly double that of the NRBC-negative patients (5.42 days). NRBCs appeared around seven days before mortality, thus, could be considered an early marker. Patients with NRBC–positive blood profile or worsening eosinopenia should raise the suspicion for a deteriorating pathology and should not be relocated to ward or discharged to home, even if apparently healthy, unless fully investigated.
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1. Introduction

Being nearly a daily cheap routine investigation in all ICUs, CBC took the first priority in many researches seeking mortality markers. Beside hemoglobin level, hematocrit, WBCs, and platelets, other CBC parameters began to attract physicians' attention.

Under normal conditions, the peripheral blood of healthy adults is free of NRBCs, which tend to be found in patients with severe pathology. Also, eosinopenia showed a strong correlation with infection, which is considered a leading cause of morbidity and mortality in ICU.

Additionally any condition producing haemopoietic stress such as severe infection, or massive acute hemorrhage can result in the appearance of circulating NRBCs (1,2).

Generally when NRBCs are detected in the patient's blood the prognosis is poor.

2. Material and Methods

This prospective cohort study was conducted on 230 patients fulfilling the inclusion criteria.

All intensive care patients admitted to the 30-bed ICU of the Critical Care Department of the Main University Hospital of Alexandria University, from January 2009 to June 2009.

Inclusion criteria

- Patients older than 18 years.

Exclusion criteria

- Patients younger than 18 years.
- Patients undergoing surgery.
- Patients of traumatic injuries.

On admission, and according to medical ethics committee, informed consent was taken from every patient included in our study. Blood sample of each patient was obtained at 9:00 am (by venipuncture using a tourniquet) and serially every 3 days for measuring the following:

- Blood count parameters (NRBCs, leukocytes, hemoglobin, platelets and eosinophils).
- Creatinine.
- Alanine aminotransferase (SGPT).
- C-reactive protein.

Blood count parameters were measured using a Sysmex XE-2100 blood analyzer. A peripheral blood smear, taken from the same sample for blood count, was examined under microscopy for the presence & quantification of the NRBCs using the Wright stain. According to the manufacturer, the blood analyzer's NRBC detection limit is greater than 19/µl(3). For fear of change in blood count parameters with time, although NRBCs and eosinophils showed relative stability at room temperature all blood samples and smears were sent for examination immediately after being withdrawn, and were all examined within five hours in maximum. C-reactive protein was measured using a quantitative fully automated technique(4).

For statistical analysis, a patient was defined as NRBC-positive when NRBCs were detected in the blood at least once. Eosinopenia was considered less than 1% of the total leukocytic count(5). Patients were monitored for mortality during their ICU stay period.

On admission, the severity of illness was evaluated according to the already established risk models; the Acute Physiology and Chronic Health Evaluation II (APACHE II)(6) and the Simplified Acute Physiology Score II (SAPS II)(7).

Data were analyzed using SPSS software version 13.0. Descriptive statistics as proportion, mean and standard deviation were used.

3. Results

The current study consisted of 147 males (63.9%) and 83 females (36.1%), with mean age of 51.54 years and SD = 14.51. Only 59 patients (25.7%) were mechanically ventilated, while 171 patients (74.3%) were not. On average, patients were treated for 7.46 days with SD=5.59. The average APACHE II score was 10.8 (SD= 5.2) and mean SAPS II score was 24.53 (SD=11.25).

As regards the main diagnosis, 144 patients (62.6%) were admitted with cardiac diseases, 49 patients (21.3%) were suffering from sepsis, 47 patients (20.4%) were suffering from respiratory diseases and 36 patients (15.7%) had miscellaneous diagnoses as DKA, NKHC, acute pancreatitis, myasthenic crisis and electric shock.

As regards the measured laboratory parameters of our studied patients, shows the daily variation in each parameter as regards the mean value and the standard deviation. The parameters were the NRBC/µl measured by the Sysmex blood analyzer, eosinophil percentage, hemoglobin (g/dl), WBCs (10^3/µ), platelets (10^3/µ), CRP (mg/l), Creatinine (mg/l) and SGPT (u/l).

Results of measuring NRBCs using the Sysmex XE2100 blood analyzer and the manual microscopic counting in a blood smear showed nearly no difference. The two methods showed significant correlation with P<0.001.

Incidence of NRBCs on the first day of their appearance in blood was 27.4% (63/230). No significant difference was found in incidence between males (26.5%, 39/147) and females (28.9%, 24/83). NRBCs appeared for the first time in the peripheral blood of patients on the first day of ICU admission in 20 patients (31.74%), on the fourth day in 11 patients (17.46%) and on the seventh day in 16 patients (25.4%). NRBCs concentration ranged from 1-100 NRBC/µl in 17.8% of NRBC-positive patients, and in 7% ranged from 101-200 NRBC/µl while 2.6% showed NRBCs concentration >200 NRBC/µl.

NRBCs showed significant relation to age with P=0.014 using Mann-Whitney test. The mean age for NRBC-positive patients was 56.48 years (SD=13.29) while that for NRBC-negative patients was 49.68 years (SD=14.55). The mean ICU stay period of NRBC-positive patients was 12.86 days (SD=6.31) while was 5.42 days (SD=3.6) for NRBC-negative patients, showing a highly significant relation with P<0.001. Also, using Mann-Whitney test, NRBCs showed high significance in relation to APACHE II and SAPS II scores with P<0.001 in both scores. The mean APACHE II and SAPS II scores in NRBC-positive patients were 13.95 and 30.46, respectively, while those of NRBC-negative patients were 9.6 and 22.29, respectively. Similarly, NRBCs showed highly significant relation to mechanical ventilation using chi-square test with P<0.001, where 61% (36/59) of the mechanically ventilated patients were NRBC-positive, while 39% (23/59) were NRBC-negative. (Table 1, Fig. 1)

NRBCs showed significant relation to some disease groups as respiratory diseases, sepsis and cardiac diseases using the chi-square test with P value of 0.001, <0.001and <0.001, respectively. It also showed significant relation with hepatic diseases using Fisher's exact test with P=0.049.

The mortality of NRBC-positive patients was 50.8% (32/63), while that of NRBC-negative patients was 8.4% (14/167) showing high significance using the chi-square test with P<0.001 and odds ratio of 11.28 (95% CI: 5.4-23.58). Thus, NRBCs showed sensitivity of 69.6% and specificity of 83.2%, with predictive value positive = 50.8 and predictive value negative = 91.6. The area under the curve was 0.81. On average, NRBCs appeared 7.5 days before death (ranging from 2-17 days). (Table 2, Figs. 2,3)

Mortality increased with increasing NRBCs concentration. At concentration of 1-100 NRBC/µl, only 36.6% of patients died with odds ratio 6.31, while at concentration of >200 NRBC/ µl 66.7% of patients died with odds ratio of 21.86 and P value of <0.001 using Monte Carlo test. (Table 3, Fig. 4)

As regards the relation between NRBCs and APACHE II score, the incidence of NRBCs increased with higher APACHE II score showing a highly significant relation using the chi-square test with p<0.001. Among patients with APACHE II score <11, NRBCs were detected in blood of 16.4% of patients, while those with APACHE II score of 21-30, NRBCs were detected in 80% of patients. (Table 4)

As regards the SAPS II score, NRBCs showed highly significant relation to the score using chi-square test (P<0.001), with increasing incidence of NRBCs with higher SAPS II scores. Patients with SAPS II score of <21 showed 17.5% of patients with NRBC-positive blood profile, while those with score of 41-60 showed 62.5% of patients having NRBCs in their blood. (Table 5)

On the first day of ICU admission, mortality among eosinopenic patients was 21.1%, while in normal and eosinophilic patients was 17.9% and 23.1%, respectively. Pearson chi-square test showed no significant relation of eosinopenia and mortality (P=0.815). However, starting from the seventh day, mortality among eosinopenic patients becomes significant, reaching 51.6% of patients (33/64 patients, P<0.001) and reaches 78.6% (11/14 patients) with P=0.002 on the sixteenth day of ICU stay.

Incidence of eosinopenia showed significant increase with sepsis, CNS and respiratory diseases. However, using Monte Carlo test, proved it to be not significant in relation to mortality in such diseases, with P value of 0.108, 0.078 and 0.08, respectively. (Table 6)

As regards the relation between eosinopenia and APACHE II and SAPS II scores, Pearson chi-square test showed no significant relation to SAPS II score (P=0.723), while there was a significant relation to APACHE II score (P=0.022). Eosinopenic patients with APACHE II score of <11 formed 60.9% (78/128 patients), while those with score of 21-30 formed 100% of patients (10/10 patients).

Our results showed significant relation of eosinopenia to the length of ICU stay (P<0.001). With longer duration of ICU stay, patients tend to be more eosinopenic and mortality risk tend to increase significantly with eosinopenic patients. Starting from the seventh day, mortality reached 51.6% of patients (33/64 patients, P<0.001) and reached 78.6% (11/14 patients) with P=0.002 on the sixteenth day of ICU stay.

Incidence of eosinopenia in NRBC-positive patients was 69.8% (44/63 patients) while that of NRBC-negative patients was 53.3% (89/167 patients), thus, forming a significant relation with Pearson chi-square=7.825 and P=0.02.

Table (1): Incidence of NRBCs in blood of ICU patients in relation to Mechanical Ventilation.

Mechanical Ventilation	NRBCs				X^2	Total
	Negative		Positive			
	No.	%	No.	%		
No	144	84.2	27	15.8	171	100.0
Yes	23	39.0	36	61.0	59	100.0
Total	167	72.6	63	27.4	230	100.0

X2=45.12 (P<0.001)

Table (2): Fate of NRBC-positive and NRBC-negative patients.

Fate		NRBCs		Total
		Negative	Positive	
Died	**No.**	14	32	46
	%	8.4	50.8	20.0
Survived	**No.**	153	31	184
	%	91.6	49.2	80.0
Total	**No.**	167	63	230
	%	100.0	100.0	100.0

Chi-Square=51.42 (P<0.001)
Odds Ratio=11.28 (95% CI: 5.40 – 23.58)
Sensitivity=69.6 %
Specificity=83.2 %
Predictive value positive=50.8
Predictive value negative=91.6

Table (3): Fate of ICU patients in relation to the concentration of NRBCs in blood on the day of first appearance.

NRBCs	Fate				Total		OR	95% CI
	Died		Survived					
	No.	%	No.	%	No.	%		
0	14	8.4	153	91.6	167	100	1.00	
1-100	15	36.6	26	63.4	41	100	6.31*	2.73 - 14.59
101-200	13	81.3	3	18.8	16	100	47.36*	12.04 - 186.27
>200	4	66.7	2	33.3	6	100	21.86*	3.67 - 130.05
Total	46	20.0	184	80.0	230	100		

Monte Carlo P<0.001
* P<0.05 (Significant)

Table (4): Incidence of NRBCs in blood of ICU patients in relation to APACHE II.

APACHE		NRBCs		Total
		Negative	Positive	
<11	**No.**	107	21	128
	%	83.6	16.4	100.0
11-20	**No.**	58	34	92
	%	63.0	37.0	100.0
21-30	**No.**	2	8	10
	%	20.0	80.0	100.0
Total	**No.**	167	63	230
	%	72.6	27.4	100.0

Chi-Square=25.92 (P<0.001)

Table (5): Incidence of NRBCs in blood of ICU patients in relation to SAPS II.

SAPS II		NRBCs		Total
		Negative	Positive	
<21	**No.**	99	21	120
	%	82.5	17.5	100.0
21-40	**No.**	56	22	78
	%	71.8	28.2	100.0
41-60	**No.**	12	20	32
	%	37.5	62.5	100.0
Total	**No.**	167	63	230
	%	72.6	27.4	100.0

Chi-Square=25.76 (P<0.001)

Table (6): Eosinophil percentage of the studied patients as regards their fate.

Fate		Eosinophil %			Total
		<1%	1 to 3%	>3%	
Survived	**No.**	105	69	10	184
	%	78.9%	82.1%	76.9%	80.0%
Died	**No.**	28	15	3	46
	%	21.1%	17.9%	23.1%	20.0%
Total	**No.**	133	84	13	230
	%	100.0%	100.0%	100.0%	100.0%

Pearson Chi-Square=0.41, P=0.815

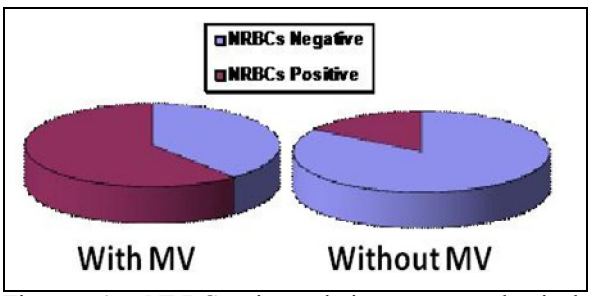

Figure 1. NRBCs in relation to mechanical ventilation.

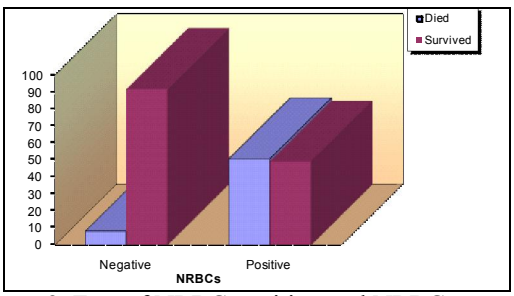

Figure 2. Fate of NRBC-positive and NRBC-negative patients

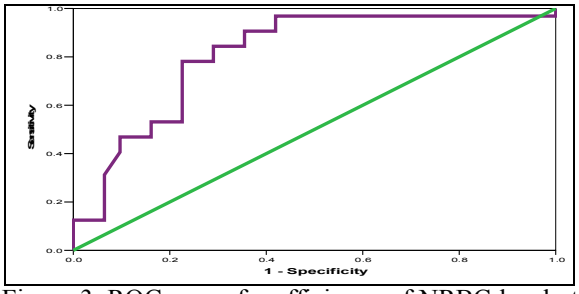

Figure 3. ROC curve for efficiency of NRBC level at first appearance to predict mortality in ICU.

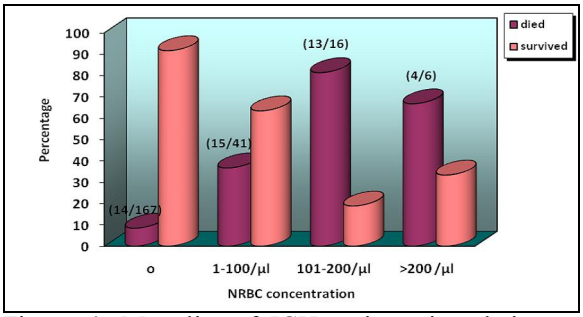

Figure 4. Mortality of ICU patients in relation to NRBC concentration.[Numbers in parenthesis denote the ratio of deceased patients to all patients with respective to NRBC concentration]

4. Discussion

In our study, we investigated the role of NRBCs and eosinopenia as markers of high risk of mortality in the intensive care patients over six months period. We studied 230 patients prospectively for NRBCs, eosinophils, WBCs, platelets, hemoglobin, CRP, creatinine and alanine aminotransferase. All parameters were measured serially every three days and patients were monitored for mortality during their ICU stay period.

As regards the incidence of NRBCs in peripheral blood of ICU patients, the present study revealed that 27.4% (63/230) of all medical intensive care patients were NRBC-positive at least once during their ICU stay, and nearly 31.7% of them showed NRBCs in their blood on the day of admission. No significant difference was found in incidence between males (26.5%, 39/147) and females (28.9%, 24/83).

In agreement with the present study, Sondermann et al (2001)(8) studied the incidence of NRBCs in blood of 1090 hospitalized patients. They found that the highest incidence was among the intensive care patients (23.3%). Also, Imohl et al (2002)(9) studied 4173 patients at a university clinic over the course of 12 weeks. They found the highest incidence was among intensive care patients (20%). Both groups found no significant difference in incidence as regards gender.

The current study showed a significant relation between NRBCs and age (P=0.014). The mean age for NRBC-positive patients was 56.48 years (SD=13.29) while that for NRBC-negative patients was 49.68 years (SD=14.55). The mean ICU stay period of NRBC-positive patients was 12.86 days (SD=6.31) while it was 5.42 days (SD=3.6) for NRBC-negative patients, showing a highly significant relation with P<0.001.

In agree with the current study, Bolulu et al (2005)(10) found significant increase in the incidence of NRBCs with age (P=0.01), with mean age for NRBC-positive patients of 61±1 years in comparison to 56±1 years for NRBC-negative patients. Hospitalization days for NRBC-positive patients were 35±2 days, while those of NRBC-negative patients were 17±1 days.

The current study revealed a strong significant correlation between NRBCs and the previously established risk models; APACHE II and SAPS II scores, with P value of <0.001 for both scores. The mean APACHE II scores for NRBC-positive patients and NRBC-negative patients were 13.95 and 9.6, respectively, while the mean SAPS II scores for the two groups were 30.46 and 22.29, respectively.

Stachon et al (2007)(11) studied NRBCs as a mortality risk parameter in 383 medical intensive care patients over nine months. Their results confirmed the significant relation of NRBCs and APACHE II and SAPS II scores (P=0.001). The mean APACHE II scores for NRBC-positive patients and NRBC-negative patients were 21.5 and 14.9, respectively, while the mean SAPS II scores for the two groups were 47.5 and 32.6, respectively.

Again, Stachon et al (2008)(12) studied the prognostic significance of NRBCs under consideration of the APACHE II and SAPS II scores. They studied 271 surgical intensive care patients and divided them into categories as regards the NRBCs concentration (0/µl; 1-40/µl; 41-80/µl; 81-240/µl, >240/µl). They found that each step-up in the NRBC category is equivalent to approximately 7 APACHE II-score points and 14 SAPS II-score points, respectively.

As regards mechanical ventilation, the present study showed that 61% (36/59) of the mechanically ventilated patients were NRBC-positive, while 39% (23/59) were NRBC-negative, thus, denoting a significant relation with P value of <0.001. This may be attributed to the more burden applied to the mechanically ventilated patients and their longer ICU stay periods. Also, NRBCs showed higher incidence in some disease groups as respiratory diseases, sepsis, hepatic and cardiac diseases.

This relation to disease groups was contradictory to some previous studies. Bolulu et al (2005)(10) found that the relation was significant in COPD (P<0.05) and cardiac insufficiency patients (P<0.05), while not significant in patients with sepsis. In contrast, Abel et al (2007)(13) and Stachon et al (2007)(11) found significant relation of NRBCs with sepsis. This could be attributed to the different factors that affect the appearance of NRBCs as hypoxia and inflammation.

As regards mortality, the results of the current study revealed 50.8% (32/63) mortality among NRBC-positive patients, compared to 8.4% (14/167) mortality among NRBC-negative patients. We realize the high prognostic power of the mechanized NRBC detection in blood as regards mortality (P<0.001), revealing sensitivity of 69.6 % and specificity of 83.2%, and odds ratio of 11.28, thus, increasing the mortality risk by eleven folds. Also, NRBCs appeared 7.5 days, in average, before death (ranging from 2-17 days). Moreover, mortality increased with increasing NRBCs concentration (P<0.001). About 36.6% of patients with NRBC concentration of 1-100/ µl died, while the percentage jumped to 66.7% among NRBC concentration of >200 µl.

Imohl et al (2002)(9) confirmed the prognostic power of NRBCs. According to their results, the mortality of NRBC-positive patients (n=313) was 21.1% (n=66). This was significantly higher (P<0.001) than the mortality of NRBC-negative patients (1.2%, n=3860). Also, mortality increased with increasing NRBC concentration. They found that NRBCs in blood showed sensitivity and specificity of 57.9% and 93.9%, respectively. Actually, the relatively low mortality rates in comparison to our results are due to the vast difference in the number of their studied patients (n=4173) and their shorter period of the study (12 weeks).

In agree with our results, Stachon et al (2004)(14) studied 421 patients treated in intensive care units (medical and surgical). The mortality of NRBC-positive patients (n=81) was 42.0% (n=34); this was significantly higher (p<0.001) than the mortality of NRBC-negative patients (5.9%, n=340). With regard to in-hospital mortality, NRBCs in blood showed sensitivity and specificity of 63.0% and 87.2%, respectively. NRBCs were detected for the first time, on average, 13 days (median 8 days) before death.

Similarly, Stachon et al (2006)(15) monitored NRBCs in blood of 284 surgical intensive care patients. With regard to intensive care mortality, NRBCs in blood showed sensitivity and specificity of 83.3% and 78.9%, respectively. Also, NRBCs were detected for the first time, on average, 9 days (median 5 days) before death.

Again, Stachon et al (2007)(11) studied NRBCs for their prognostic significance as regards in-hospital mortality, but this time in 383 medical intensive care patients over 9 months. The study revealed 50.7% (34/67) mortality of the NRBC-positive patients, with strong correlation to NRBC concentration, while mortality among NRBC-negative patients was 9.8% (31/316; P<0.001). As regards in-hospital mortality, NRBCs showed sensitivity and specificity of 52.3% and 89.6%, respectively. NRBCs appeared for the first time in blood of patients who died 13.6±3.8 days (median=3 days).

Abel et al (2007)(13) performed a retrospective study on 46522 patients who were admitted to a hospital in Chicago over 10 years. Among the different CBC variables studied, the presence of NRBCs was associated with a 30-day mortality rate of 25.5% across a range of diagnoses, with an increase in mortality risk by three folds than NRBC-negative patients. Again, the difference in their mortality rate and current study could be explained by the vast difference in the number of studied patients and the period of study. In addition to this, Abel used a 30 day mortality target, recognizing deaths from electronic medical records and Indiana State death records. Such records when used over such a long period of time may give some inaccuracy, together with the possibility that patients may have died outside Indiana State and consequently not recorded among the deceased patients.

And recently, Al-Nassir et al. (2009)(16) performed another retrospective study on 594 medical intensive care patients concerning their in-hospital mortality and its relation to the presence of NRBCs in blood. The results of their study confirmed our results, as the mortality for NRBC positive patients was 77.4% (48/62) and for NRBC negative patients was 19.9% (106/532) (p < 0.001).The first appearance of NRBCs was noted less than 7 days prior to death.

As regards the correlation of increasing NRBC concentration with different laboratory parameters, our results revealed significant correlation with regard to leukocytosis (P<0.001), eosinopenia (P=0.004) and increased CRP (P=0.001). This denotes that NRBC-positive patients are more burdened than the NRBC-negative patients. But in contrast to what was expected, there was no significant correlation of NRBCs and hemoglobin (rs=-0.218, p=0.084). The concentrations of platelets, creatinine and SGPT were not significantly correlated to NRBC concentration.

This partially agrees with the results of Bolulu et al (2005)(10) which showed that NRBCs significantly correlated with leukocytes (P<0.001), CRP (P<0.001), platelets (P<0.001), creatinine (P<0.001) and SGPT (P<0.001). On the other side, hemoglobin showed no correlation with the NRBCs concentration.

Stachon et al (2007)(11) showed that NRBCs significantly increased with leukocytes (P<0.01) and creatinine (P=<0.05), while concentrations of hemoglobin, platelets, CRP and SGPT were not significantly correlated to NRBCs concentration.

As regards eosinopenia, the current study investigated the impact of eosinophil percentage on admission to ICU on mortality. Our results showed no significance in relation to total ICU mortality, age, gender or mechanical ventilation. Also, eosinopenia showed no significance with SAPS II score, while was significant with the APACHE II score (p=0.022). But with careful analysis of the results, we realize that eosinopenic patients with APACHE II score of <11 formed 60.9%, while this percentage drops to 48.9% in patients with score of 11-20 then rises to 100% with score of 21-30. In fact, patients included in our study with score of 21-30 were only 10 patients. This small number, although affected the statistical analysis, couldn't be relied on. Therefore, the discrepancy between the significance of the two scores in relation to eosinopenia appears to be of no value. This problem was not encountered when assessing the relation between NRBCs and APACHE II score as all the results confirmed NRBCs' significance synergistically.

To our knowledge, this is the first time eosinophils were investigated for their prognostic value in patients of intensive care units. The only three studies concerned with studying the prognostic role of eosinophils were performed on subgroups of in-hospital patients.

Perello et al (2008)(17) failed to find any significant prognostic value for eosinopenia in HIV-infected patients diagnosed as community acquired pneumonia.

Also, Abidi et al (2008)(18) proved no significance for eosinopenia in differentiating between sepsis, severe sepsis and septic shock.

In contradiction, Holland et al (2010)(19) proved that eosinopenia is a useful marker of severity in patients with COPD exacerbations. When the eosinopenic group compared to those with normal eosinophils, significant differences were seen in mortality (4/23) (17.4%) versus (1/42) (2.4%), respectively, with P = 0.049. However, this study was performed retrospectively on 65 patients; only 23 of them were eosinopenic. The small number of patients included in this study renders weakness to the statistical results.

However, our results showed significant relation of eosinopenia to the length of ICU stay (P<0.001). With longer duration of ICU stay, patients tend to be more eosinopenic and mortality risk tend to increase significantly with eosinopenic patients. Starting from the seventh day, mortality reached 51.6% of patients (33/64 patients, P<0.001) and reached 78.6% (11/14 patients) with P=0.002 on the sixteenth day of ICU stay. Therefore, even if not significant on the day of ICU admission, serial follow up of the eosinophilic count may be of value.

In agree with our results, Holland et al (2010)(19) showed that eosinopenia significantly correlated with the length of hospital stay (P=0.005). Eosinopenic patients stayed in hospital for 8 days in average, while those with normal eosinophilic count stayed for only 5 days in average.

In the present study, incidence of eosinopenia increased significantly with some disease groups as CNS diseases (P=0.013), respiratory diseases (P<0.001) and sepsis (P<0.001). However, still there was no added significance for eosinopenia as regards mortality in these disease subgroups.

Most of the previous studies were mainly concerned with the relation of eosinophilic count and infection. Dipiro et al (1998)(20) found that sepsis induced eosinophilia in one hundred trauma patients admitted to the ICU. In contrast, Gil et al (2003)(21) and Abidi et al (2008)(18) proved that eosinopenia could be considered a reliable marker of infection with a specificity of 80% and sensitivity of 80%. Despite this, they agreed with us that eosinopenia adds no extra significance as regards mortality.

In contradiction, Smithson et al (2009)(22) failed to find any diagnostic value for eosinopenia in infection. However, their study was a retrospective study that lacked important data as the criteria upon which infection was defined. Also, Smithson's study didn't include a non-SIRS group as that included in Abidi's study.

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