The Relationship between Some Haematological Parameters with Length of Stay and Outcome in the Intensive Care Unit of a Tertiary Health Facility in Zaria, Northwestern Nigeria

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Abstract

Introduction: Intensive care units (ICUs) are reserved for critically ill patients that need specialist medical care with close and constant attention provided. Patients admitted into ICUs could have myriads of hematological abnormalities some of which have direct bearing on disease severity and outcome. There is a paucity of data on the relationship between hematological parameters of ICU patients and length of ICU stay as well as outcome in our environment, hence the need for this study. **Materials and Methods:** This study was a prospective observational one, in which patients that are ≥18 years of age and had no blood transfusion within 24 h before ICU admission into the ICU of Ahmadu Bello University Teaching Hospital, Zaria, were recruited over a 3-month period from March 1, 2018 to May 31, 2018. Participants' sociodemographic characteristics, indications for admission, and some hematological parameters were assessed. Length of stay and outcome were also determined. Venous blood was collected from the patients for the determination of full blood count. Data were collated and analyzed using SPSS Version 20.0. Level of statistical significance was set at $P \leq 0.05$. **Results:** Thirty-nine participants were enrolled into the study with a mean ± standard deviation (SD) age of 32.7 ± 15.8 years. Females constituted 21/39 (53.8%) of the participants. The mean ± SD hematocrit (HCT) and blood cell count (WBC) were 28.1% ± 6.1% and 11.5 ± 4.3 (× 10⁹/L), respectively, whereas the median (interquartile range [IQR]) platelet (PLT) count was 125.5 ± 82.4 (× 10⁹/L). There was a positive, moderately strong, and statistically significant correlation between the duration of stay in ICU with WBC count. There were statistically significant differences in HCT, PLT, and WBC across categories of indication for admission into ICU (obstetrics complications, medical conditions, orthopedics/trauma, postoperative cases, and burns). The median (IQR) duration of ICU stay (days) in this study was 3.8 (1.9) days, and 18/39 (46.2%) were discharged home directly from the ICU. **Conclusion:** Anemia, leukopenia, and thrombocytopenia are common and vary according to the indications for admission and are associated with duration of stay and outcome in patients admitted into ICU in Zaria, Northwestern Nigeria.

Keywords: Intensive care unit, length of stay, outcome, some hematological parameters

INTRODUCTION

Critically ill patients are those with life-threatening illnesses and injuries and as such, are managed in intensive care units (ICUs) where close and constant attention by teams of specialists is provided. This category of patients represents a significant source of morbidity and mortality in hospitals, particularly in resource-limited settings, due to inadequate workforce and dearth of supportive facilities.[1] A myriad of hematological abnormalities ranging from anemia, neutropenia, leukocytosis, and thrombocytopenia has been reported in patients admitted in the ICU.[2] The cause of abnormalities in hematological parameters in patients admitted

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to ICU is multifactorial and may result from the underlying disease process or as part of the body's metabolic response to the disease process.[3] Anemia defined based on a local study in Zaria as hematocrit (HCT) of <37% in men or <30% in women, and thrombocytopenia defined as platelet (PLT) count of <156 × 10⁹/L and 136 × 10⁹/L for males and females, respectively.[4] Both anemia and thrombocytopenia have been reported to be inversely related to survival in critically ill patients.[5] Neutropenia, defined as absolute neutrophil count of <1.5 × 10⁹/L in ICU patients, is also known to be associated with life-threatening complications from bacterial and fungal infections and therefore portends poor prognosis, particularly in critically ill patients needing optimal supportive care.[5]

Sustained thrombocytopaenia for morethan 4 days after ICU admission or a drop of platelet count of morethan 50% during ICU stay is associated with 4 to 6 folds increased risk of mortality.[2,6]

Hemoglobin concentration, white blood cell count (WBC), and its differential counts as well as PLT count are very important parameters that need to be assessed at the time of ICU admission and to be followed up throughout the period of stay in ICU. PLT count alone is a stronger independent predictor for ICU mortality than the standard composite scoring systems, such as the Acute Physiology and Chronic Evaluation II score.[7] Although these hematological parameters are readily measurable, there is a paucity of studies on how they affect ICU stay and outcome in our environment. Most of the available reports are from developed western countries. Thus, there is an over-reliance on data generated by studies conducted on Caucasians and in settings that are completely different from ours. This study therefore is aimed at determining the relationship between hematological parameters with length of stay and outcome in ICU patients in Ahmadu Bello University Teaching Hospital (ABUTH), Zaria.

MATERIALS AND METHODS

This was a prospective observational study in which adult patients that are ≥18 years of age and had no history of blood transfusion within 24 h of admission into the ICU of ABUTH Zaria were recruited over a 3-month period from March 1, 2018 to May 31, 2018. Following the acquisition of ethical approval for the study from the Health Research Ethics Committee of ABUTH Zaria, participants' sociodemographic characteristics, indications for admission, and hematological parameters were assessed. Length of stay and outcome were also determined. A pro forma was used to collate information since most patients would not be able to respond to questionnaires at the point of ICU admission. Venous blood samples were collected in EDTA containers for the determination of full blood count (FBC), HCT, white WBC, and PLT count. The patients were followed up for 2 weeks to determine the outcome, and repeat laboratory FBC was done.

Data were collated and analyzed using SPSS Version 20.0 (Armonk, New York, USA). These were summarized using frequencies, means, modes, medians, quartiles, percentiles, and charts where applicable. Mann–Whitney U and Wilcoxon Signed-rank tests were used to determine associations between unpaired and paired observations, respectively. Spearman rank test was used to assess correlations. $P \leq 0.05$ was considered significant.

Definition of terms

The following definitions were utilized for the purpose of this study:

i.   Anemia: A packed cell volume <37% in men or 30% in women[8]
ii. Thrombocytopenia: A PLT count of <156 × 10⁹/L in males or <132 × 10⁹/L in women[8]
iii. Leukopenia: A total white cell count of <2.7 × 10⁹/L[8]
iv. Leukocytosis: Total white cell count of more than 13.7 × 10⁹/L[8]
v.   Prolonged ICU stay: ICU stay for more than 14 days[1]
vi. Outcome/endpoint: Either death or discharge (with or without morbidity).

RESULTS

Thirty-nine participants that are ≥18 years of age and had no blood transfusion within 24 h before ICU admission were enrolled into the study with a mean ± standard deviation (SD) age of 32.7 ± 15.8 years. Females constituted 21/39 (53.8%) of the participants. Majority of the participants were married 20/39 (51.3%), civil servants 11/39 (28.2%), and had tertiary level of education 23/39 (58.9%). Medical conditions were the main reasons for ICU admission [Figure 1] with severe sepsis being the most common medical condition [Table 1].

The prevalence of anemia, leukopenia, leukocytosis, and thrombocytopenia among the participants was 20/39 (51.3%), 2/39 (5.1%), 4/39 (10.3%), and 12/39 (30.8%), respectively. The mean ± SD HCT and WBC were 28.1 ± 6.1% and 11.5 ± 4.3 (×10⁹/L), respectively, whereas the median (interquartile range [IQR]) PLT count was 125.5 ± 82.4 (× 10⁹/L). There was a positive, moderately strong, and statistically significant correlation between the duration of stay in ICU with WBC count [Table 2]. There were statistically significant differences in HCT, PLT, and WBC across categories of indication for admission into ICU (obstetrics complications, medical conditions, orthopedics/trauma, postoperative cases, and burns) [Table 2].
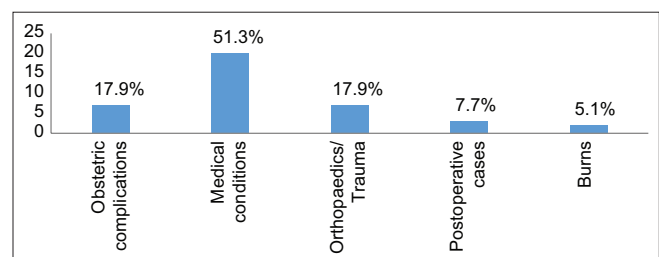
Figure 1: Pattern of categories of indications of admission in to intensive care unit

Series of pairwise *post hoc* analyses were conducted on the parameters with statistically significant differences; those with medical conditions had statistically significant higher HCT compared to those with orthopedic/trauma category. (Kruskal–Wallis test statistic 3.412, $P = 0.006$) [Table 3].

Orthopedic/trauma cases had statistically significant lower PLT count compared to categories 1 (obstetric complications), 2 (medical conditions), and 4 (postoperative cases) (6.71 vs. 26.0, 6.71 vs. 21.05, and 6.71 vs. 37.33, respectively) [Table 4]. Category 1 (medical conditions) has statistically significantly higher WBC count compared to category 3 (orthopedic/trauma) (12.00 vs. 31.50).

The median (IQR) duration of ICU stay (days) in this study was 3.8 (1.9) with a range of 1–7 days, and the major outcome of the ICU admission in this study was discharged home directly from the ICU 18/39 (46.2%) [Figure 2]. There was also a statistically significant correlation between the admitting WBC among the hematological parameters with outcome categories (Df = 2, $P = 0.041$). The WBC count also showed statistically significant with duration of ICU stay ($r = 0.341$, $P = 0.034$).

DISCUSSION

The age of ICU patients observed in this study is lower than the finding of Onyekwulu and Anya in Enugu, Southeastern Nigeria, where a mean age of 38.2 years was reported.[9] In addition, the gender distribution in our study differs from the Enugu study which reported that 65.4% of their participants were males. This cannot be explained by a specific geographic predilection as critical cases are almost always emergencies.

The distribution of cases admitted in the ICU in this study contrast with that of Onyekwulu and Anya in Enugu where neurosurgical cases were the most common indication for admission, whereas postoperative cases were the lowest.[9] Although there are varying definitions of prolonged ICU stay, the average period adopted by most studies is 14 days, so prolonged stay is defined as stay of ≥14 days.[10] Prolonged

stay is associated with increased cost of hospital care, increased resource utilization, and may also contribute to increased morbidity and mortality. Our data reveal that no patient had prolonged ICU stay during the period of the study. This is different from reports by Tobi *et al.*, 2015 and Onyekwulu

Table 1: Distribution of admitted cases under categories

Category	Diagnosis	Frequency (%)
Obstetric complications	Uterine rupture with	2 (5.1)
	PPH	5 (12.8)
	Severe eclampsia	2 (5.1)
Medical conditions	DIC	2 (5.1)
	DKA	1 (2.6)
	MI	2 (5.1)
	DTB with pneumonia	2 (5.1)
	Emphysema	3 (7.7)
	RVD with sepsis	1 (2.6)
	Pulmonary embolism	1 (2.6)
	Septicemia	8 (20.5)
Orthopaedics/trauma	RTA with head injury	3 (7.8)
	Multiply injured patient	2 (5.1)
Postoperative	SCD post cholecystectomy	1 (2.6)
	Ruptured ectopic pregnancy postoperative	2 (5.1)
Burns	Burns	2 (5.1)
Total		39 (100.0)

PPH: Postpartum hemorrhage, DIC: Disseminated intravascular coagulopathy, DKA: Diabetic ketoacidosis, MI: Myocardiac infarction, DTB: Disseminated tuberculosis, RVD: Retroviral disease, RTA: Road traffic accident, SCD: Sickle cell disease

### Table 2: Indication categories with hematological parameters

Indication categories versus	Kruskal-Wallis test statistic	Df	P
HCT	17.674	4	0.001
PLT	20.976	4	<0.001
WBC	11.263	4	0.024
PT	4.712	4	0.318

HCT: Hematocrit, WBC; White blood cells, PLT: Platelets, Df: Degree of freedom, PT: Platelet

Table 3: *Post hoc* pairwise comparison for hematocrit with indication categories

HCT versus indication categories	Test statistic	SE	P
Orthopedic-obstetric complications	4.429	6.079	1.00
Orthopedic-medical conditions	17.043	4.995	0.006
Ortopedic-postoperative	−18.810	7.848	0.165
Orthopedic-burns	−22.643	9.119	0.130
Obstetrics-medical conditions	−12.614	4.995	0.116
Obstetrics-postoperative	−14.381	7.848	0.669
Obstetrics-burns	−18.214	9.119	0.458
Medical conditions-postoperative	−1.767	7.042	1.00
Medical conditions-burns	−6.600	8.436	1.00
Postoperative-burns	−3.833	10.382	1.00

SE: Standard error, HCT: Hematocrit
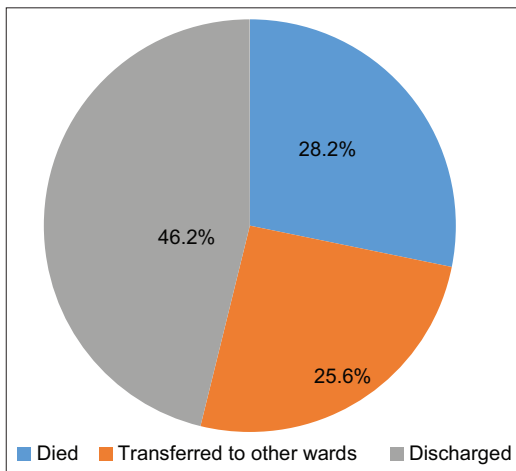
Figure 2: Distribution of outcome in the participants

Table 4: *Post hoc* comparison for platelets across categories of indications

PLT versus indication categories	Test statistic	SE	*P*
Orthopedic-burns	−6.786	9.124	1.00
Orthopedic-medical conditions	16.336	4.917	0.002
Orthopedic-obstetric complications	20.286	6.083	0.009
Orthopedic-postoperative cases	−31.619	7.853	0.001
Burns-obstetric complications	13.500	9.124	1.00
Burns-postoperative cases	24.833	10.388	0.168
Burns-medical conditions	8.550	8.439	1.00
Medical conditions-obstetric complications	4.950	4.997	1.00
Medical conditions-postoperative cases	−16.283	7.046	0.208

SE: Standard error, PLT: Platelets

and Anya, who reported 5.4% and 1.3%, respectively, of their patients that had prolonged stays.[9] These findings are not surprising because ICU is a specialized ward for critically ill patients, and the moment patient feels better and his/her vital parameters normalize, he/she can be transferred to open ward, or even be discharged from the hospital.

The absence of any relationship between the duration of stay in ICU with outcome in this study agrees with the findings of Tobi and Amadasun, 2015 in Benin City, South-south Nigeria, and Williams *et al*.[10,11] This can be explained by the fact that we practice immediate transfer of patients to the open ward when the vital parameters normalize, so the practice can significantly shorten the duration of stay. Our study also indicates that there is no relationship between the age and sex of the participants with indication for admission and outcome. These findings are similar with the studies of Higgins *et al*. and Tobi and Amadasun.[10,12] This can be explained by the fact that admission into ICU is based on the critical nature of the condition and does not rely on the age or sex of the patient.

The high proportion of patients with anemia in this study is an expected finding owing to high poverty rate in Northern Nigeria, so nutritional anemia is not an unexpected finding here. Anemia has been reported as a common problem in ICU patients and associated with poor outcome and numerous factors have been attributed to it which include frequent blood sampling for various tests such as arterial blood gases and other laboratories, blood loss due to trauma or surgery preceding admission to ICU, diminished responsiveness of bone marrow precursors to cells to erythropoietin, and nutrients deficiency, among others.[4,13] Vincent *et al*., 2002 reported a prevalence of anemia in ICU patients at 33% which is higher than what we obtained in our study.[14]

Our study found a mean PLT count of 125×10^9/L which contrasts the findings of Estcourt *et al*, 2015 and Vanderschueren *et al*. 2000 where their mean PLT values were $<100 \times 10^9$/L.[6,15] PLT count of <50 or more than 50% drop in the count during ICU stay correlates with 4–6-fold increase in morbidity in patients admitted to ICU.[3] Thrombocytopenia is reported as an independent predictor of prolonged stay and poor

outcomes in ICU patients.[2] Thrombocytopenia in ICU patients is seen mostly in patients with sepsis, DIC, massive blood loss, thrombotic microangiopathy, heparin-induced thrombocytopenia, idiopathic thrombocytopenia, and drug-induced thrombocytopenia.[16] The reason for the fairly normal mean PLT count in this study could be due to low number of participants in the listed conditions associated with high risk of thrombocytopenia and the study also revealed no statistically significant correlations between the admitting hematological parameters with length of ICU stay and outcome.

Conclusion

Anemia, leukopenia, and thrombocytopenia are common in ICU patients, and they vary according to the indications for admission and are associated with duration of stay and outcome in patients admitted into ICU in Zaria, Northwestern Nigeria. We, therefore, recommend that patients admitted into the ICU shall have the baseline hematological parameters, and these parameters need to be carefully and frequently monitored while in ICU.

Conflicts of interest

There are no conflicts of interest.

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