Original Paper

# Haematological Changes of Critically ill Patients Admitted in CMH, Dhaka

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## Abstract

***Introduction:*** Haematological status is an important parameter for the management of critically ill patients.

***Objective:*** To see the status of the haematological changes of critically ill patients admitted in CMH, Dhaka.

***Materials and Methods:*** This cross sectional study was conducted in the Department of Haematology of Armed Forces Institute of Pathology and Intensive Care Unit of Combined Military Hospital, Dhaka from March 2014 to September 2014 for a period of 6 months. All the patients who were admitted in the Intensive Care Unit of Combined Military Hospital, Dhaka at any age with either sex were included in this study. The complete blood count and coagulation parameters were considered and data sheet was prepared.

***Results:*** A total number of 862 samples were analyzed. Male female ratio was 1.8:1. Anaemia was found in 43.2% patients and 22.3% patients had Erythrocytosis. Normocytic Normochromic Anaemia was the most common morphological subtype of Anaemia. 13.8% patients had Leukopenia and 55.1% patients had Leukocytosis; 7.3% patients had Neutropenia and 49.0% patients had Neutrophilia. 10.0% patients had Eosinophilia. 26.3% patients had Lymphopenia and 14.7% patients had Lymphocytosis. 39.1% patients had Thombocytopenia and 20.3% patients had Thrombocytosis. MCV (Mean Corpuscular Volume) was below normal in 36.5% patients and was above normal in 16.8% patients. MCH (Mean Corpuscular Hemoglobin) was below normal among 49.7% patients and 11.1% patients above normal. MCHC (Mean Corpuscular Haemoglobin Content) was below normal level in 61.8% patients and 3.7% patients had above normal. Abnormal coagulation parameters that is prolonged PT, APTT and raised FDP was found in 36.3%, 18.6% and 35.8% patients.

***Conclusion:*** Critically ill patients were suffering from anaemia and thrombocytopenia with significant changes in other blood cells counts and coagulation parameters.

***Key-words:*** Haematological parameters, critically ill patient.

## Introduction

Organ systems consist of anatomically and/or physiologically related components. The blood and bone marrow constitute the haemopoietic organ system. Unlike other organ systems, haemopoietic organs are distributed in space and provides a variety of seemingly unrelated functions. The haematologic system has both cellular and fluid-phase elements. Cellular elements include erythrocytes, leukocytes and platelets; fluid phase elements include coagulation factors, natural anticoagulants and proteins of the fibrinolytic system. The most common abnormalities of the haematolgic system are anaemia, leukocytosis, leukopenia, thrombocytopenia and imbalance of the haemostatic system. All critically ill patients are at risk for haematological complications during their hospitalization. It is essential that critical care nurses understand the haematological system and common complications such as anaemia, neutropenia, and thromcytopenia and changes in coagulation parameters like PT(Prothrombin Time), APTT(Activated Partial Thromboplastin Time), TT (Thrombin time), D-Dimer, FDP(Fibrin degradation products). Medications and interventions in critical care have impact on the haematologic system[1]. Approximately 80% of the patients admitted into intensive care units survive the acute event and most remain in this unit briefly. However, a subgroup does not recover so quickly to become independent and from then they recover slowly[2].

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The most common change in WBC (white blood cells) parameters in critically ill patients are an increase in the WBC count (leukocytosis). Within hours of the onset of a bacterial infection, the WBC count can increase up to 4 times of the baseline. There are factors other than infection that will cause an increase in the WBC count. Tissue injury due to infarction, burns, convulsion, trauma, haemorrhage, marked hypoxia, or other conditions that lead to an increase in catecholamines will affect the leukocytes that have marginated along the vessel walls and force them to be released into circulation[3]. Severe infections can lead to a leukaemoid reaction in which the WBC count can increase to 1,50,000 to . There are multiple triggers that decrease the WBC count (leukopenia). One of the most common reasons for a neutropenic reaction is drugs. Sepsis, cancer, chemotherapy, radiotherapy can also impact on the neutrophil production causing a significant neutropenia[4].

An increase in the reticulocyte count is usually seen in situations of chronic haemolysis (eg, Hereditary Haemolytic Anaemia). Factors such as haemorrhage, recent chemotherapy, significant infection or other drugs should always be considered. An increase in red blood cell count can occurs due to different causes. One of the more common presentations in critical care would be hypoxic polycythaemia. A decrease in RBCs (Red Blood Cels) can be due to a decrease in production or a loss of cells. Blood loss in critical care is common and has many causes. The gastrointestinal tract is a common source of blood loss although pulmonary bleeding does occur. Colo-rectal and genitourinary cancer may also be a cause of blood loss. Bleeding at a recent surgical site is another source of blood loss[3,4]. One of the most important parameter which usually developed in patients admitted in ICU is Disseminated Intravascular Coagulation which results in changes in all coagulation parameters like platelet count, Bleeding Time, Prothrombin Time, Activated Partial Thromboplastin Time, Thrombin Time, Fibrinogen assay, D-Dimer. haemorrhage, sepsis, burn, malignancy and tissue injury are common causes of DIC. The critical care physicians needs to continually incorporate this information into practice as research continues to enhance the quality of critical care practice. The aim of the study was to find out the pattern of hematological changes in critically ill patients in Dhaka.

## Materials and Methods

This study was conducted as a descriptive cross sectional method from March 2014 to September 2014 at Department of Haematology of Armed Forces Institute of Pathology and Neonatal, Paediatric, Paediatric Cardiac Intensive Care Unit and Critical Care Unit of Combined Military Hospital, Dhaka. Patients who admitted in these ICUs of any ages and of both sex were the population of the study. The subjects meeting the predefined eligibility criteria will be selected purposively from the study population. Patients who left Intensive Care Unit within 24 hours were excluded from the study. Venous blood was collected from all patients. The haematological parameters were measured by automated blood analyzer and were recorded in a predesigned data sheet.

## Results

A total number of 862 samples were analyzed of which majority were male and the rest were female. 23.2% patients were less than 1 month old, 20.8% patients were in age group 1 month to < 12 months and 56.0% patients were equal to or more than 1 year of age. Male (64.3%) were predominant than female (35.7%). Male female ratio was 1.8:1 (Table-I). Among 862 patients, 43.2% patients had anaemia and 22.3% patients had erythrocytosis (Table-II). Out of 372 anaemic patients, 39.8% had microcytic hypochromic, 46.8% had normocytic normochromic and 13.4% had macrocytic anaemia (Table-III). 30.7% patients had below normal and 30.2% patients had above normal Red blood cell count (Table-IV). It was found that 13.8% patients had leukopenia and 55.1% patients had Leukocytosis; 7.3% patients had Neutropenia and 49.0% patients had Neutrophilic Leucocytosis; 10.0% patients had Eosinophilia; 26.3% patients had Lymphopenia and 14.7% patients had Lymphocytosis; 39.1% patients had Thrombocytopenia and 20.3% patients had Thrombocytosis (Table-IV). MCV was below normal in 36.5% patients and was above normal in 16.8% patients. MCH (Mean Corpuscular Hemoglobin) was below normal among 49.7% patients and 11.1% patients above normal. MCHC was measured and was found that 61.8% patients had below normal and 3.7% patients had above normal MCHC. RDW (Red cell distribution width) was below normal among 12.1% patients and 59.3% patients had above normal. MPV (mean platelet volume) was below normal in 19.7% patients and 55.0% patients had above

normal (Table-V). Coagulation parameters were done. Prothrombin Time, Activated Partial Thromboplastin Time, Fibrin Degradation Product were increased in 36.3%, 18.6% and 35.8% cases respectively and decreased Fibrinogen level was found in 1.7% cases (Table-VI).

**Table-I:** Demographic profile of the patients

| Variables | | Frequency | Percentage |
|---|---|---|---|
| Age | 0 Day – <31 Days | 200 | 23.2 |
| | 1 Month – 12 Months | 179 | 20.8 |
| | 1 Year – Adult | 483 | 56.0 |
| Sex | Male | 554 | 64.3 |
| | Female | 308 | 35.7 |

**Table-II:** Distribution of patients according to Haemoglobin

| Haemoglobin | Frequency | Percentage |
|---|---|---|
| Anaemia | 372 | 43.2 |
| Normal | 298 | 34.6 |
| Erythrocytosis | 192 | 22.3 |
| **Total** | **862** | **100.0** |

**Table-III:** Distribution of patients according to morphological subtypes of anaemia

| Type of anaemia | Frequency | Percentage |
|---|---|---|
| Microcytic hypocromic anaemia | 148 | 39.8 |
| Normocytic normochromic anaemia | 174 | 46.8 |
| Macrocyticanaemia | 50 | 13.4 |
| **Total** | **372** | **100.0** |

**Table-IV:** Frequency and Distribution of Blood Cells count (n=862)

| Blood Cells | | Frequency | % |
|---|---|---|---|
| RBC | Below normal | 265 | 30.7 |
| | Normal | 337 | 39.1 |
| | Above normal | 260 | 30.2 |
| WBC | Leucopenia | 119 | 13.8 |
| | Normal | 268 | 31.1 |
| | Leucocytosis | 475 | 55.1 |
| Platelet | Thrombocytopenia | 337 | 39.1 |
| | Normal | 350 | 40.6 |
| | Thrombocytosis | 175 | 20.3 |
| Neutrophil | Below normal | 63 | 7.3 |
| | Normal | 377 | 43.7 |
| | Above normal | 422 | 49.0 |
| Eosinophil | Below normal | 208 | 24.1 |
| | Normal | 568 | 65.9 |
| | Above normal | 86 | 10.0 |
| Lymphocyte | Below normal | 227 | 26.3 |
| | Normal | 508 | 58.9 |
| | Above normal | 127 | 14.7 |

**Table-V:** Morphological Pattern of RBC (n=862)

| RBC Morphology | | Frequency | Percentage |
|---|---|---|---|
| MCV | Below normal | 315 | 36.5 |
| | Normal | 402 | 46.6 |
| | Above normal | 145 | 16.8 |
| MCH | Below normal | 428 | 49.7 |
| | Normal | 338 | 39.2 |
| | Above normal | 96 | 11.1 |
| MCHC | Below normal | 533 | 61.8 |
| | Normal | 297 | 34.5 |
| | Above normal | 32 | 3.7 |
| RDW | Below normal | 104 | 12.1 |
| | Normal | 247 | 28.7 |
| | Above normal | 511 | 59.3 |
| MPV | Below normal | 170 | 19.7 |
| | Normal | 218 | 25.3 |
| | Above normal | 474 | 55.0 |

**Table-VI:** Frequency of abnormal coagulation profile among the study population (n=862)

| Variables | Frequency | Percentage |
|---|---|---|
| PT | 74 | 36.3% |
| APTT | 37 | 18.6% |
| FDP | 24 | 35.8% |
| Fibrinogen | 01 | 1.7% |

## Discussion

This was a descriptive type of cross sectional study. A total number of 862 samples were analyzed of which majority were male and the rest were female. Among 862 patients, 43.2% patients were suffering from anaemia. Two studies were done in the United States showed similar result. In those studies, anaemia is very common among critically ill patients, with 60-66% patients were being anaemic at ICU admission[5,6]. Another study at England showed that anaemia is present at ICU discharge in at least 75% of all patients when considering their last measured haemoglobin levels[7]. Anaemia may also be prolonged after discharge, with a median time to recovery of 11 weeks and more than half of the patients still anaemic 6 months after ICU discharge[8]. Another study was done in the United States showed that anaemia is not only very frequent in critically ill patients, it is also associated with increased transfusion rates and worse outcomes (increased length of stay, increased mortality)[7]. The two main contributing factors for anaemia are inflammation and iron deficiency. Inflammation is frequent in critical illness, whatever the underlying pathology.

The anaemia in critically ill patients is indeed similar to the anaemia of inflammation, with blunted erythropoietic response and activation of RBC destruction by macrophages[8]. In this study, 46.8% patients had normocytic normochromic anaemia, 39.8% patients had microcytic hypochromic anaemia and 13.4% had macrocytic anaemia. Another study showed that Iron deficiency is the main cause of anaemia in critically ill patients[9]. Indeed, daily blood losses are far from negligible, either through repeated sampling, surgical site bleeding, other invasive procedures (drainage, catheter placement, renal replacement therapy) blood loss from trauma or occult bleeding[8]. The median blood loss for anaemic critically ill patients has been estimated to be as high as 128 ml per day 18. This may represent a median iron loss as high as 64 mg per day. As daily iron intake is less than 20 fold iron losses, iron deficiency could easily appear in critically ill patients. Low concentrations of vitamin B12 and Folic acid, which are essential for normal RBC development, also might contribute to ineffective erythropoiesis in critically ill patients. In one study, iron deficiency was reported in 9% of ICU patients, 2% of patients were deficit in vitamin B12, another 2% suffered from folic acid deficiency[9].

In this study, It was found that 55.1% patients had leucocytosis and 13.8% patients had leucopenia; 49.0% patients had neutrophilia and7.3% patients had neutropenia; 10.0% patients had eosinophilia; 26.3% patients had lymphopenia and 14.7% patients had lymphocytosis; 39.1% patients had thrombocytopenia. A study in a tertiary care hospital showed neutrophilic leucocytosis in critically ill patients. Out of 400 patients, 53% had infection. Other causes are medications or drugs (11%), haematological diseases (6%), necrosis or inflammation . In this study, we got thrombocytopenia in 39.1% patients. We had similarity with several studies. Thrombocytopenia is the most common haemostatic disorder in critically ill patients; 14%-44% of these patients develop thrombocytopenia during their ICU stay[10]. Same result found in a systematic review of 24 studies (n=6894 patients) looking at the epidemiology and consequence of thrombocytopenia (defined as a platelet count below 150 X $10^9$/L) in ICU patients. Patients were in medical, surgical, mixed, cardiac and trauma ICUs. The prevalence of thrombocytopenia at ICU admission ranged from 8-68%. The incidence of developing new thrombocytopenia during the course of ICU stay ranged from 13-44%. The most common risk factors were sepsis, renal failure, shock, organ dysfunction and high illness severity[11].

Another study showed that thrombocytopenia was present in 8.3% to 67.6% of adult patients on admission to the intensive care unit (ICU) and acquired by 13% to 44% of patients during their ICU stay[11]. Thrombocytopenia in ICU patients is an independent predictor of mortality in adults[12]. In the ICU setting, platelet counts <100,000/$mm^3$ (<100X$10^9$/L) are identified in 20 to 40% of patients[13,14]. In a muti-centered study of ICU population, where 3746 patients were included; the incidence of mild, moderate, severe thrombocytopenia were 15.3%, 5.1% and 1.6% respectively during ICU stay. Another study on ICU population, sepsis was identified as a major risk factor for thrombocytopenia[13]. Although the cause was not often identified, thrombocytopenia was commonly associated with sepsis, DIC, massive blood transfusion and chemotherapy. Many ICU patients show a significant decrease in platelet counts during their first days in the ICU[15,16]. In this study, we found abnormal coagulation profile that is prolonged PT, APTT, FDP and decreased Fibrinogen level among critically ill patients. This finding is relevant with other studies carried out which showed that a prolonged global coagulation time (such as the prothrombin time (PT) and the activated partial thromboplastin time (aPTT) occurs in 14% to 28% of intensive care patients[17,18]. Trauma patients, in particular, have a high incidence of coagulation time prolongation. APT or aPTT ratio more than 1.5 was found to predict excessive bleeding[17]. Other coagulation test abnormality frequently observed in ICU patients include elevated fibrin split products. Fibrin split products are detectable in 42% of a consecutive series of intensive care patients, in 80% of trauma patients and in 99% of patients with sepsis[19]. Another study in U.K showed that coagulation abnormalities are commonly found in critically ill patients. A myriad of altered coagulation parameters are often detectable, such as thrombocytopenia, prolonged global coagulation times, reduced levels of coagulation inhibitors or high levels of fibrin split products[20].

## Conclusion

There were some changes in haematological parameters in critically ill patients. The most commonly found change was anaemia. Three morphological subtypes of anaemia that is normocytic normochromic, microcytic hypochromic and macrocytic anaemia were reported. Changes in other parameters of the blood cells count like thrombocytopenia and neutrophilic leucocytosis were remarkable in critically ill patients. There were significant changes in coagulation parameters like increased global coagulation times, fibrin split products and decreased Fibrinogen level in critically ill patients admitted in Intensive Care Units.

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