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Hematological profiles of war trauma patients subjected to long hospital stays at Armed Forces Comprehensive Specialized Hospital Addis Ababa, Ethiopia.

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This is to certify that the thesis prepared by Abebe Daniel, entitled:
"Hematological Abnormalities of War Trauma Patients Subjected to Long Hospital Stays at Armed Forces Comprehensive Specialized Hospital, Addis Ababa, Ethiopia" and submitted in partial fulfillment of the requirements for Master of Science degree in Clinical Laboratory Sciences (Hematology and Immunohematology) complies with the regulations of the University and meets the accepted standards with respect to originality and quality.

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List of abbreviations

AFCSH	Armed Forces Comprehensive specialized hospital
APACHE	Acute physiology and chronic health evaluation
AUC	Area under curve
BMI	Body mass index
BSV	Blood sampling valve
CAP	Community acquired pneumonia
CBC	Complete blood count
EDTA	Ethylene diamine tetra acetic acid
GCS	Glasgow coma score
HR	Hour
ICU	Intensive care unit
LOS	Length of say
MPV	Mean platelet volume
MLR	Monocyte to lymphocyte ratio
NLR	Neutrophil to lymphocyte ratio
PLR	Platelet to lymphocyte ratio
PLT	Platelet
PTSD	Post-traumatic stress disorder
RBC	Red blood cell
RDW	Red blood cell distribution width
RNA	Ribonucleic acid
ROC	Receiver operating characteristics
SIRS	Systemic inflammatory response syndrome
SPSS	Statistical Package for the Social Sciences
VIF	variance inflation factor
LEVT	Left ventricular thrombosis
SOP	Standard operational procedures
TASH	Traumatic associated sever hemorrhage
VCS	Volume conductivity and scatter
WBC	White blood cell

Abstract

Background: Hematological parameters such as leukocytes, neutrophils, hemoglobin, red blood cell distribution width, reticulocytes, and platelets, may be altered due to exposure to trauma. Published study is lacking assessing these values and derivative ratios.

Objective: To determine the Hematological Abnormalities of War Trauma Patients Subjected to long hospital stays at Armed Forces Comprehensive Specialized Hospital (AFCSH), Ethiopia.

Method: A hospital based cross-sectional study was conducted involving 422 patients admitted at AFCSH from December 2023 to March 2024. Socio-demographic data and clinical information was collected using a questionnaire. A complete blood count analysis was done using Beckman coulter Dx800.The significant factors of hematological abnormalities of war trauma patients subjected to long hospital stay were assessed from the data and test result was analyzed by using SPSS version 27 statistical software. P values were deemed statistically significant if they were less than 0.05.

Result: The majority of the patients (94.3%) were male, and their mean age was 23 years (SD=5). Following brain injuries (22.3%), lower extremity injuries (46%) were the most common. Of the patients who reported infections after being admitted, 145 of the patients had wound infections, which accounted for 34.4% of all cases;75.8% received transfusions, and 36% hadsurgeries.The highest mean white blood cell (WBC) (10.7+/-16.7 $x10^9$/L) and neutrophils (7.8+/-13.5$x10^9$/L) were seen in patients with abdominal injury. Mean Neutrophil to lymphocyte ratio(NLR)was highest in those with chest and abdominal double injury (10.1+/-10.2) same with Monocyte to lymphocyte ratio(MLR) 0.5+/-0.2and Platelet to lymphocyte ratio (PLR) 259.3+/-126.5. Bonferroni adjustment post hoc comparisons revealed that patients with wound infections had significantly higher WBC counts than patients without infections (mean difference = 2.252, SE = 0.7287, p <0.001). The absolute neutrophil count (NE#) of patients without infections was significantly lower than that of patients with bed sores (Mean difference = -1.844, SE = 0.877, p =.037) and wound infections (Mean difference = -2.279, SE = 0.694, p =.001).The length of hospital stay was found to have a week to moderately positive significant correlation with the following CBC parameters: WBC r =0.22 (P>0.001), Neutrophil r =0.35 (P>0.001), PLR r =0.34

(P=>0.001), and NLR r =0.49 (P=>0.001). Conversely, there is a significant negative correlation between red blood cell, hemoglobin, hematocrit, lymphocyte and length of hospital stay with a p value of P=0.031 P=0.007,P=0.008, and P=0.001 respectively.

Conclusion- The study highlights the potential of CBC markers in predicting patient prognosis and guiding clinical management. Additionally, it underscores the significance of early intervention to mitigate post-admission infections and the importance of effective infection control measures for improved patient outcomes. Integrating these findings into clinical practice can enhance the standard of care and treatment outcomes for war trauma patients.

Key words-Hematological profile, Complete blood count, Trauma, Lengthy Hospital Stay

1. Introduction

1.1 Background

The clinical utility of the complete blood count (CBC) is extensive; abnormal values may be resulted from mild to severe illness or just due to physiological causes. Leucocytosis, an elevated white blood cell count (WBC) may suggest the existence of a viral or microbial infection when it is accompanied by neutrophilia or lymphocytosis. The WBC biomarker is a useful tool for clinicians to better predict patient outcomes and identify patients who require immediate attention and closer monitoring.Anemia may be inferred from a decrease in hemoglobin and/or red cell count. The etiology of the anemia can be inferred based on the values of the red cell index. The rate at which hemoglobin increases can be used to track anemia treatment and estimate the volume of blood needed for transfusion. An increase or decrease in platelet counts can also indicate problems with hemostasis or liver disease. The platelet count and size can also be used to assess the thrombopoietic activity of the bone marrow(1).

The complete blood count (CBC) is one of the laboratory tests that is used the most frequently. Various CBC components have been linked to the degree of inflammation and the prognosis in a variety of illnesses. Distribution width of red cells (RDW) has been linked to mortality in the general population, sepsis, hepatitis, cancer, and respiratory and cardiovascular diseases.There have also been reports of differences in mean platelet volume (MPV), which measures the average size of circulating platelets, between individuals who have survived and those who have not from septic shock and critical illness(2).

In critically ill patients, the immune-inflammatory response has played a role in determining the outcome. Approximately one-third of trauma patients may experience coagulopathy as a result of severe trauma. About 45.5% of trauma patients with critical injuries exhibited "platelet hypofunction," or a below-normal platelet response to at least one agonist,upon admission, and 91.1% experienced hypofunctioning platelets while in the critical care unit.Furthermore, lymphocyte levels in traumatized individuals are linked to a number of organ dysfunction syndromes.Apart from the quantity of lymphocytes, the quantity of the remaining two kinds of immune cells, including monocytes and neutrophils, can also indicate the state of the immune system as well as the bone marrow's hematopoietic role in these patients. The two circumstances could influence a patient's recovery from a serious trauma. In trauma patients, changes in platelet

counts and the aforementioned WBC subtypes would result in changes toderivative ratios like the monocyte-to-lymphocyte ratio (MLR), neutrophil-to-lymphocyte ratio (NLR), and platelet-to-lymphocyte ratio (PLR). Given that trauma patients are a particular population and that injuries are typically accidental and acute, it would be interesting to find out if the platelets and WBC subtypes MLR, NLR, and PLR have been linked to prognosis of trauma patients with severe injuries(3).

The Complete Blood Count (CBC) is a standard blood test used for screening that measures the concentration of total hemoglobin, Red blood cell, white blood cell, platelet counts per unit volume (PCV), red cell indices (MCHC, MCH, and MCV), and red blood cell distribution width. One of the most often requested laboratory tests is the complete blood count (CBC).The WHO states that sixty percent of all tests are complete blood counts.Variations in a full blood count are indicative of shifts in the body's overall functioning. The condition of the blood is impacted by almost all pathological processes that take place in the body. These analyses play a critical role in the diagnosis process, helping to assess the disease's severity and the efficacy of current therapies(4).

An ethylene-diamine-tetra-acetic acid (EDTA) tube should be used to collect blood samples for CBCs. By chelating calcium and other metal ions, EDTA, an anticoagulant, inhibits the coagulation's enzymatic reactions.By using it, the peripheral blood's cellular components can be preserved for testing in a laboratory. The WBC count, with or without the WBC differential, and the RBC and platelet counts and indices are components of the complete blood count (CBC). Results with an abnormality usually results in an alert, known as a flag. To verify results that have been flagged, a peripheral blood smear review may be necessary(5).

Laboratory tests are vital when it comes to the diagnosis and prognosis of patients. They show elements of the physiological disturbance that the patient's illness state has caused. Laboratory parameters have been added to a number of clinical prediction models, including the systemic inflammatory response syndrome (SIRS) score and the acute physiology and chronic health evaluation (APACHE), to improve their predictive abilities. Many studies in an emergency setting have demonstrated that laboratory parameters at admission have additional value in the clinical prediction of an adverse outcome and may help clinical decision-making directly(6).

Over the course of a patient‘s treatment, routine laboratory testing is frequently done to keep an eye on their condition. Changes in hematological parameters such as leukocytes, neutrophils, hemoglobin, red blood cell distribution width, reticulocytes, and platelets in trauma patients are potential predictive markers of disease prognosis, emergence complications, and mortality in this group of exposed patients (7).

According to Roy, N et.al, 58% of deaths linked to trauma can be avoided. The significance of determining precise prognostic parameters for patients suffering from trauma is underscored by this discovery.Increases in RBC, WBC, and platelets have been linked to combat-related Post-traumatic stress disorder. The clinical significance of these alterations is suggested by the dysregulation of all three major lineages of hematopoietic cells in posttraumatic stress disorder and their strong correlation with inflammation(8,9).Routine hematological parameters are also known to have an impact on the prognosis of hospitalized trauma patients. In these patients, an extended hospital stay (LOS) may lead to new complications. Research has also indicated a connection between neutrophil-to-lymphocyte ratio (NLR) and LOS in a few illnesses and medical conditions, including colorectal cancer and acute appendicitis operation(10–12).

By thoroughly analysing complete blood cell count, this research identified significant changes or abnormalities in the hematological profiles of these patients during their long hospital stays.

1.2 Statement of the problem

Trauma is one of the leading causes of mortality worldwide. According to United States military estimation reports, 15% to 20% of traumatic fatalities are preventable.In the United States alone about 150,000 people pass away from traumatic injuries annually(13).Over the past century, significant advancements have been made in combat trauma surgery and casualty care. Despite increasing injury severity scores, survival has increased due to advancements in aeromedical evacuation, surgical techniques, and resuscitation strategies, as well as a better understanding of the physiologic response to injury. Still, there are gaps to be filled in order to build on prior achievements. It is imperative to remember the lessons learned from past conflicts and to continue basic science and translational research in order to properly comprehend and treat complex combat trauma patients(14).

Increasing the effectiveness of trauma care is a necessary component of the solution to the injury problem. It is estimated that improvements in trauma care capabilities, particularly in low- and middle-income countries, could save over 2 million lives out of the 5.8 million people who die from injuries each year. In many cases, these gains could be made with low-cost planning and organization enhancements(15).

Throughout history records, infections have complicated the care given to those injured in war. Apart from the protection that personal body armor offers, there has been much advancement in the treatment of combat casualties. These include improving the skills and knowledge of combat medics, making it possible to administer life-saving care at the scene of an injury, and expediting the evacuation of victims to nearby surgical facilities. These developments have made it possible for solders to survive near-fatal injuries, but they have also increased the demand on the healthcare system by raising the number of patients in need of long-term care and optimal functional rehabilitation(16).

The majority of injuries received during combat are in the extremities (~65%), followed by injuries to the head and neck (~15%), thorax (~10%), and abdomen (~7%); burns account between 5% and 10% of all combat traumas. These injuries carry the risk of infection from both nosocomial infections linked to long-term care and from initial wound contamination. As evidenced by the ongoing US military conflicts, the latter frequently involves multidrug-resistant

organisms, which are bacteria that are resistant to multiple drugs(16). All these conditions affect the blood parametersin the injured patients.

As a growing and significant cause of morbidity in trauma patients, infections are responsible for 5-8% of post-trauma deaths. Up to 30–50% of multitrauma patients experience an infectious complication as their chances of survival increase early on(17).Statistically, 10,000 people pass away from serious, catastrophic trauma every day. A global report states that 20% of patients with collective traumas result in death in two to three hours;whereas 40% pass away within 48 hours following the injury. Consequently, prompt diagnosis of these patients using appropriate diagnostic techniques can improve their survival and lower mortality rates(18).

Studies on trauma incidents have been carried out in Ethiopia for a number of years. Numerous socio demographic, transportation, environmental, behavioral, Types of Trauma Causes, Types of Injury, and Clinical Presentation factors have been addressed by these studies(19–21).However there has been no study conducted correlating hematological profiles and trauma not only to war causalities but also to the Ethiopian population in general. This is a gap identified and addressed by this study.

1.3 Significance of the Study

By examining the hematological parameters such as white blood cell count, red blood cell parameters, platelet parameters, reticulocyte count, red blood cell distribution width, neutrophil-to-lymphocyte ratio,platelet to lymphocyte ratio, and hemoglobin levels, the study can provide insights into the physiological effects of war trauma on by examining the hematological profiles of these patients and alsoby investigating how the duration of hospital stays affects the hematological profiles of war trauma patients.

In addition, war trauma patients often experience severe injuries, which can lead to various complications and health risks. By assessing the hematological profiles of these patients, the study helped to identify any abnormalities or imbalances in the hematological parameters that may contribute to the management of complications such as anemia, infection, or impaired clotting. By gaining a better understanding of the hematological profiles of war trauma patients, healthcare providers can improve the overall care and outcomes for these individuals. This knowledge can help guide clinical decision-making, optimize treatment approaches, and monitor the progress of patients during their hospital stays.

Finally, the study adds to the existing body of knowledge on the impact of war trauma on hematological profiles. By conducting research in this specific context, the study provides valuable insights that can be used for future studies, medical education, and policy development related to hematological profiles and its effect on war trauma patients.

2. Literature review

A retrospective analysis of 258 cases of stab injuries at an urban Level I Trauma Center from July 2015 to December 2021 was carried out by Maleitzke, Tazio, et alfrom Germany in 2023. They found that the Injury Severity Score (ISS), with a mean of 8.3 ± 7.3, showed a positive correlation ($r = 0.5–0.8$, $p < 0.001$) with the mean ICU and hospital stay duration. From among differnet routine laboratory parmeters anlyzed by their study,they found strongest positive correlation ($r = 0.526$) between the length of ICU stay for organ injuries and erythrocyte count(22).

A systematic review done in 2022 by Ghozy et al examined studies comprising seven retrospective, and one prospective study design. These studies were conducted between January 1, 2004, and December 31, 2017. There were between 144 and 1291 traumatic brain injury patients in their sample sizes.There were participants from a number of nations, including Australia, China, Poland, Turkey, and the United States (US). Multiple severity scores and measurements were employed in the seven retrospective studies.Significant correlations were found in four of the studies between neutrophil-to-lymphocyte ratio (NLR) values and adverse outcomes that predicted the severity of the outcome.In three of the studies, there was a significant prediction of mortality. When the NLR values from studies evaluating their association with the outcome severity (favorable or not) were pooled, NLR values were 37% lower in patients with favorable outcomes than in patients with unfavorable outcomes (RoM=0.63; 95% CI = 0.44–0.88; $p = 0.007$)(23).

Aretrospective observational study conducted by Brown et al in 2021, observed 9,845 patients admitted to the trauma service between 2007 and 2014, comprising patients admitted from the emergency room and those transferred from other hospitals to Loyola University Medical Center in Maywood, Illinois, USA. Majority (2,145; 85.4%) were admitted to the ICU, and 1,131 (45%) developed sepsis during their hospital stay.About 1,131 patients (45%) experienced sepsis while in the hospital, and In the intensive care unit, 2,145 patients (85.4%) were admitted.Nine days was the average LOS (with a range of 4to 128 days). At 120days, the in-hospital mortality rate was 4.7%.A one-unit increase in the Δ RDW value increased the odds of sepsis by 52% (OR=1.52 [1.38–1.67]; $p<0.001$) after holding LOS constant. Similarly, a one-day increase in

LOS was predicted to raise the odds of sepsis by 10% (OR=1.10 [1.08–1.12]; p<0.001), holding constant Δ RDW(24).

A study was conducted by J Chen et al in 2019 at Changzheng Hospital, Second Military Medical University, Shanghai, China. Age, admission GCS score, surgery within the first 24 hours, length of hospital stay, and peak NLR were found to be significantly associated with unfavorable outcomes even after controlling for confounding variables in the multivariate logistic model with a p-value of <0.001, 0.006, 0.021, 0.002, and <0.001, respectively(25).

According to a 2018 study by Lindqvist et alat New York University,on relationships between inflammation and cell counts they found that both unadjusted and adjusted analyses have a p<0.05. WBC positively correlated with inflammation in all subjects as well as in patients with post-traumatic stress disorder (PTSD) and controls separately. All subjects showed a significant correlation between platelet count and inflammation (p<0.05). However, in subgroup analyses, this correlation was found to be significant only in the PTSD group (p<0.01), not in the control group (p>0.43). Only in the unadjusted combined analysis (p<0.01) did RBC exhibit a significant correlation with inflammation; in all other analyses, there was no significant correlation(26).

A retrospective descriptive study by ML Otterman et al in 2009 found a significant correlation between the lowest Hb and the highest reticulocyte count (RC) in trauma patients. They included a total of 241 patients. A total of one to four red blood cells (RBCs) were given to 28 patients (12%), on average. On day three, Hb dropped to 10.9 g/dL ± 2.1 g/dL. At admission, RC was 16 ± 11; on day 13, it was 38 ± 21 promille (p < 0.0001). Univariate analysis revealed an inverse relationship between the maximum reticulocytevalues and the nadir Hb values (Pearson R = -0.62, p < 0.001)(27).

A study conducted by Liu C et al in 2021 atTongji Hospital,Wuhan, P.R. China. A total of 534 traumatic brain injury patients were gathered and evaluated. Out of the 182 patients who were ultimately included in this study, 48 patients (26.4%) and 134 patients (73.6%) were in the favorable group and the unfavorable group, respectively(28).Thirty-two patients (17.6%) underwent decompressivecraniectomy and craniotomy. Sixty patients (33%) and 55 (30.2%) underwent tracheotomy and tracheal intubation, correspondingly. While in the hospital, 31 (17%) patients acquired lower extremity and pulmonary infection. In 30 cases (16.5%), venous thrombosis (LEVT) occurred. Total death rate one dischargewas 25% (13.7%).A mean value of

12.99 ± 4.33 ($\times 10^9$/L) was recorded for white blood cells (WBC), of which 11.43 ± 4.09 (×109/L) were neutrophils and 0.80 ± 0.51 (×109/L) were lymphocytes. Besides, 138 patients (75.8%) had high WBC (>10×10^9/L), while 175 patients (96.2%) had high neutrophil percentage (>75%). In contrast, 54 patients (29.7%) had low lymphocyte percentage (< 120×10^9/L) while 74 patients (40.7%) hadanemia (< 110 g/L). Their findings showed that, among continuous variables, platelets count (OR 0.982; 95% CI, 0.967-0.997; p<0.05) was independently associated with the unfavorable outcome at one month following discharge in addition to other significant factors(28).

A study was carried out by Shams Vahdati S et al on determination of the importance of red cell indicators in predicting progress in trauma patients in 2019at Tabriz University, Iran. They found that hospitalization was the most common clinical outcome for these patients, and that red cell distribution width (RDW) was significantly correlated with the patient's clinical outcome, although not significantly differentiating between male and female patients or in some specific trauma routes. Patients' outcomes included 278 (31.31%) hospitalization cases, 22 (3.78%) ICU admission cases, 263 (29.62%) emergency ward discharge cases, and 120 (13.51%) cases referred to additional hospitals. Besides, 179 cases (20.16%) were released due to a person's request; and 26 cases (2.93%) of death. In the 25th (P<0.001), 50th (P=0.038), and 75th (P=0.003) percentiles, there was a significant relationship between RDW and age. Additionally, a significant correlation was found (p=0.004 for the fifth percentile and P=0.049 for the 25th percentile) between not having a comorbid disease and having a lower level of RDW(29).

A study byKutlucan L et al in 2016 in Turkey found that, all the blood parameters of all the accepted patients were evaluated, and the results showed that the non-survivors had significantly higher WBC values (p = 0.019) and significantly lower Hb levels (p = 0.001) than the survivors , but the platelet counts were similar in both groups (p = 0.156). All the patients MPV levels were within the normal range, but the non-survivors had significantly higher MPV levels (p < 0.05).Additionally, among non-survivors, a significant positive correlation (p = 0.009) was found between the expected mortality rate and MPV. About 42 patients (24.2%) experienced nosocomial infections during follow-up. The NLR and PLR were significantly higher in the 42 nosocomial infection patients (p = 0.031, p = 0.050, p = 0.002, and p = 0.009), as well as thrombocyte and vitamin B12 levels, when they examined the relationship between initial laboratory parameters and the incidence of nosocomial infection. At the conclusion of the follow-

up, each patient's average ICU hospital stay lasted mean ± SD of 11.9 ± 18.7 days. The average lengths of hospital stay for individuals who were survivors and those who were not were 9.2 ± 13.9 days and 15 ± 22.7 days, respectively (p = 0.039).Significant positive correlations between NLR and PLR (p = 0.006 and 0.027, respectively) and the duration of hospitalization were observed(30).

According to my literature search, there is no single published report on the assessment of hematological profiles of war trauma patients undergoing extended hospital stay in the region and also in Ethiopia.

3. Objectives

3.1 General objective

To determine the hematological abnormalitiesof war trauma patients subjected to long hospital stay at Armed Forces Comprehensive Specialized Hospital, Addis Ababa, Ethiopia.

3.2 Specific objective

- To determine variations in hematological parameters among war trauma patients at Armed Forces Comprehensive Specialized Hospital.
- To calculate the correlation between the duration of hospital stays and hematological abnormalities among war trauma patients at Armed Forces Comprehensive Specialized Hospital.

4. Hypothesis

There is no association between hematological profiles, trauma and long hospital stay.

5. Materials and methods

5.1 study area

Armed Forces comprehensive specialized hospital (AFCSH), situated in the Ledeta sub city of Addis Ababa, Ethiopia, served as the study's site. It is a uniformed hospital run by the Ministry of Defense's Health Main Directorate. Emperor Haile Selassie founded this medical facility in 1946, originally named Princess Tsehay Memorial Hospital, as a loving memorial to his daughter. But the hospital changed its name following the events of 1974, and it is currently called the Armed Forces Comprehensive Specialized Hospital (AFCSH).

Serving as a referral hospital, AFCSH is essential in helping patients who are referred from different military hospitals and healthcare facilities throughout Ethiopia to provide medical care. Its services are not limited to military personnel; it also provides healthcare to civilian staff members, retirees, and families of military personnel. With 913 beds spread across various specialty wards, including gynecology, obstetrics, orthopedic, surgical, intensive care unit, and psychiatric departments, the hospital has an impressive capacity. A committed group of about 745 medical professionals support the hospital's efficient operation by working hard to guarantee patients' wellbeing. On an average day, the hospital sees about 550 patients, and each month, it admits about 1000 patients.

In order to deliver high-quality laboratory services and facilitate the efficient and successful provision of diagnostic services, the laboratory has implemented a quality management system. The international standard ISO 15189:2012 served as the foundation for the development of the quality management system and was accredited by the ESA (Ethiopian accreditation service) which is traceable to ILAC (International Laboratory Accreditation Cooperation) since 2020 Ethiopian calendar(31).

5.2 study design and period

A hospital based cross-sectional study design was employed to assess the hematological profiles of war trauma patients subjected to long hospital stay. The overall study period was from December 2023 to March 2024.

5.3. Population:

5.3.1. Source population: all war trauma patients admitted at armed forces comprehensive specialized hospital

5.3.2. Study Population: Admitted patients with war trauma who stay in the hospital for more than two weeks and fulfill the eligibility criteria

5.4. Inclusion and exclusion criteria

5.4.1. Inclusion criteria

Patients with war trauma who have been admitted to an armed comprehensive specialized hospital for longer than two weeks and volunteer to participate were included in this study.

5.4.2. Exclusion criteria

This study was not included patients with other chronic illnesses.

5.5. Study variables

5.5.1. Dependent variables:

- CBC parameters

5.5.2. Independent variables:

- Length of hospital say
- Inflammation
- Type of injury
- Transfusion history
- Medical interventions
- Sex
- Age

5.6. Sample size calculation and Sampling method

5.6.1. 5.6. Sample size calculation and Sampling method Sample size calculation:

Using a single population proportion formula, the maximum number of samples needed for this study were calculated while taking the following assumptions into account: Where- Z, = standard normal distribution (Zα/2=1.96) with a 95% confidence interval was used;

$n= [Z^2p (Q)]/ d^2$

n, = maximum sample size needed for the study

d= tolerable margin of error or absolute precision (d) = 5% (0.05)

Q = (1- p)

p =estimated proportion of the population (0.5)

$n= ((1.96)^2 (0.5) (0.5)) / (0.05)^2 =384$

Therefore, minimum number of study participants was 422 (including 10% contingency)

5.6.2. Sampling Method:

Non Probability convenient sampling method was used to include all samples that met the inclusion and exclusion criteria during the data collection period.

5.7. Measurement and Data collection

5.7.1. Socio demographic data and sample collection

Based on the clinical history listed on their patient history sheet, patients were arranged. We got in touch with every patient whose clinical history indicates one or more traumatic events. A structured questionnaire was used to gather data, such asclinical details, pertinent medical history, and sociodemographic data. Patients completed the questionnaire, and to add to the data collected, medical records were also reviewed. Avacunainer tubewas used to collect 3 ml of venous blood in an ethylene diamine tetra acetic acid (EDTA) tube aseptically, and a Beckman Culter DX800 analyzer was used to perform the complete blood count test. One BSc clinical nurse and three skilled and knowledgeable laboratory technologists took part in the data collection.

5.7.2. Laboratory procedure

Pre-analytical

1. During routine clinical care using 4 ml EDTA vacutainer tubes whole blood was drown from patients suffering from war trauma in different orthopedic, intensive care, and surgical wards.
2. Before being sent to the main laboratory for barcode labeling, identification of every sample that has been collected at the patient's bedside with their name and special medical record number was done.
3. Samples werefirst inspected in accordance with the laboratory's established acceptance and rejection criteria and were labeled with a barcode.

Analytical

4. Daily automated instrument performance and background checks were conducted.
5. A daily internal control was performed.
6. Using a Beckman Cutler DXH 800 Hematology analyzer and following AFCSHL standard ope rating procedure (SOP), each sample was analyzed in the order that it was received. The Beckman coulter automated hematology analyzer DXH 800 employs the VCS technology (Volume, Conductivity and light scatter).Three measurements were used to establish WBC differential technology: individual cell volume, high-frequency conductivity, and laser-light scatter. Light-scattering technology, low-frequency current, and high-frequency current combined to provide multiple parameters (details are annexed).
7. All patient samples that filled out research questionnaires from the instrument were selected during lunch breaks and at the end of each day's scheduled activities using their unique medical re cord number.

Post analytical

8. The principal investigator electronically exported the results into an Excel format.
9. The sample ID and medical record number using was counterchecked before exporting the data to SPSS for analysis.
10. Results were interpreted using the supplier’s provided reference ranges and results communicated to the ordering physicians.

5.8. Data Quality Assurance:

Ten clinically confirmed trauma patients who are admitted to the hospital but not enrolled in this study had completed a pre-test of the questionnaire, which then was modified

accordingly.Thequality of the test was controlled by daily use of three levels commercial or in house patient controls to monitor service and performance. Similar to how patient specimens are analysed, controls are run on a specific system and have known characteristics. These characteristics are evaluated on a regular basis.

Additionally, the researcher verified internal consistency. Standard operating procedures (SOPs) were used for all procedures. The patient's ID number and the specimen ID number were entered into the results using a double identifier system to avoid errors. Every one of the inconsistent results was counterchecked by the principal investigator. Finally, the data was checked for consistency and completeness before being put into computer software for analysis.

5.9. Data analysis and interpretation:

Prior to analysis, the collected data was verified for accuracy, consistency, and completeness. Using SPSS statistical software version 27, data entry and analysis was carried out. In order to determine the relationship between the dependent and independent variables, the data and interpretation was presented by descriptive and analytical statistics using tables and graphs.A multivariate analysis of variance (MANOVA) was carried out to look into how infection after admission affected CBC parameter variables. Whereas, the Pearson correlation analysis matrix was employed to compare the length of hospital stay and the CBC parameters with computed white cell ratios. Statistical significance difference was declared when the p value is less than 0.05.

5.10. Operational definitions:

Hematological profile-refers to CBC including WBC, RBC parameters, Platelet parameters, RDW, NLR, MLR and PLR (neutrophil, Monocyte and platelet to lymphocyte ratios, respectively).

Hematological abnormalities: refers to CBC results outside the reference range provided by the company including Anemia (red blood cells or the hemoglobin concentration within them is lower than normal), leukocytosis (white cell count elevation greater than 11 x 10^9/L). /leucopenia (decrease in the white blood cell count in circulation to less than less than 4 × 10^9/L), Thrombocytosis /Thrombocytopenia (Having more than 450,000 platelets and having less than 150,000 respectively).

War Trauma-is the existence of damage to one or more bodily parts or systems.

Length of stay (LOS) -is a clinical metric that measures the time elapsed between a patient's hospital admittance and discharge.

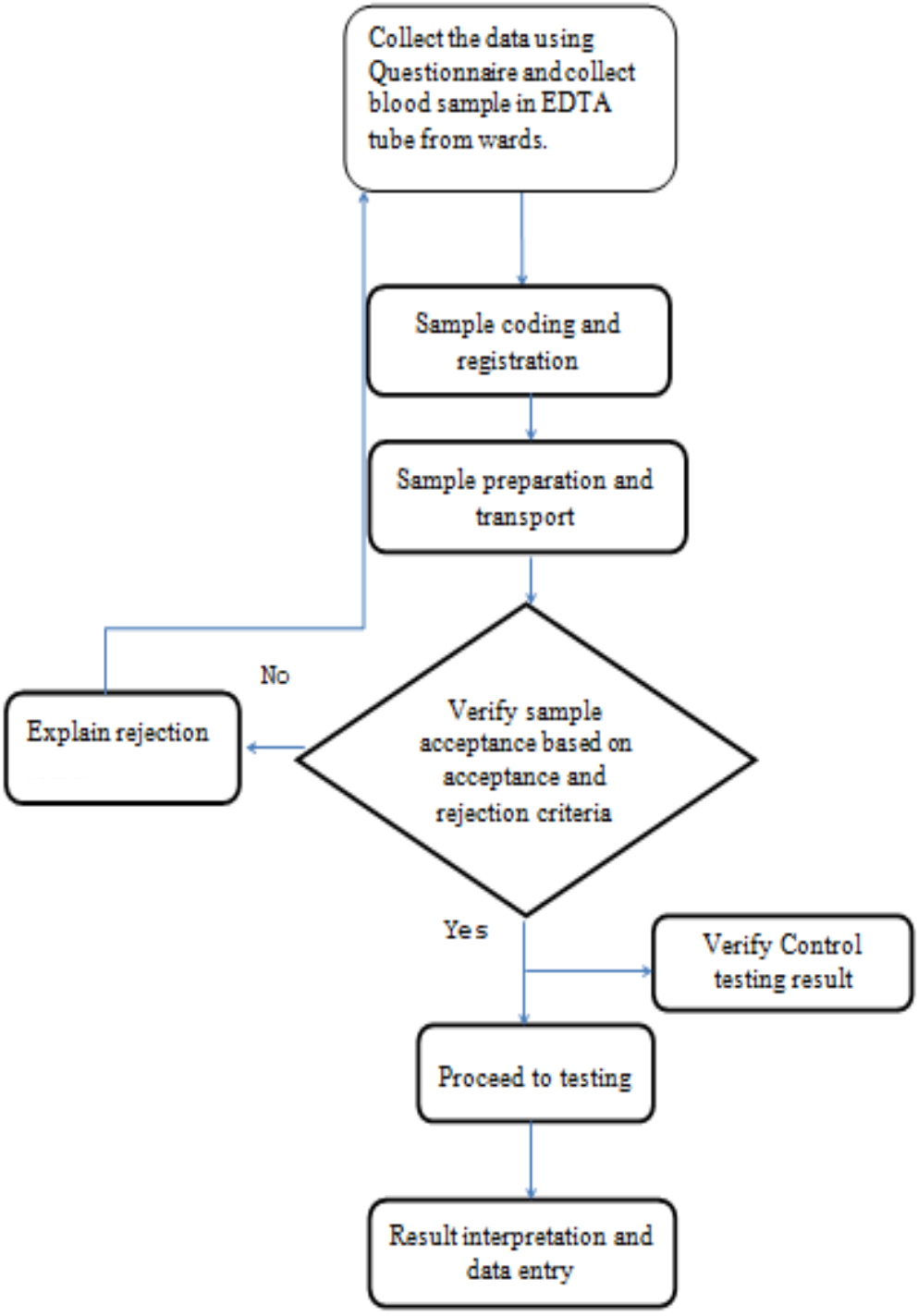
5.11. Ethical considerations

The Department Research Ethics and Review Committee at the Department of Medical Laboratory Sciences, College of Health Sciences, Addis Ababa University, issued an ethical clearance letter after reviewing the study protocol.Permissionwas requested from Armed Forces Comprehensive Specialized Hospital. The goal of the study was explained to the participants including their right not to participate in the study or withdraw anytime, and each were provided with a written informed consent before beginning testing. Unique identity numbers were used. Every patient's sample was coded, and the information gathered was kept private. Participants in the study were informed of their results through their attending physicians. Patients with any significant abnormal and critical (panic) results were connected to doctors for ongoing observation and treatment management.

5.12. Dissemination of the result

On completion this study can be used as a resource by scholars, professionals, or decision-makers for interventions. The final paper will be submitted to the Department and Addis Ababa University's library in order to reach these bodies. Additionally, a copy of this material will becommunicated to the Armed Forces Comprehensive Specialized Hospital. The outcome of this study will be shared through presentations at pertinent workshops and seminars and publication in peer-reviewed regional and international journals.

Work flow


Collect the data using Questionnaire and collect blood sample in EDTA tube from wards.
Sample coding and registration
Sample preparation and transport
Verify sample acceptance based on acceptance and rejection criteria
No
Explain rejection
Yes
Verify Control testing result
Proceed to testing
Result interpretation and data entry

6. Result

6.1 Socio-demographic and clinical characteristic of war trauma patients at Armed Forces comprehensive specialized hospital

The study comprised 422 war trauma patients admitted to the Armed Forces Comprehensive Specialized Hospital from December 2023 to May 2024. With a mean age of 23 and a standard deviation of 5 years, the age of the participants range from 18 to 51.On the other hand the average length of stay in the hospital is 39 days, with a standard deviation of 13 days. The gender distribution of the patients reveals that 24 participants(5.7%) are female and 398 participants (94.3%) are male. Regarding site of injuries, 37 (8.8%) had upper extremity injuries, 194 (46%) lower extremity injuries, 94 (22.3%) brain injuries, 15 (3.6%) brain and neck injuries, 33 (7.8%) chest injuries, 10 (2.4%) chest and abdominal injuries, and 39 (9.2%) abdominal injuries were revealed. Following admission, the following infections have been reported, 50 people (11.8%) had bed sores, 145 people (34.4.0%) had a wound infection, and 227 people (53.8%) had no infections at all. Of a total participants, 320(75.8%) have received transfusions, 152 (36.1%) had operations, and 269 (63.7%) were on medication, based on their medical interventions (Table 1).

Table 1.Socio-demographic and clinical characteristic of war trauma patients at Armed Forces Comprehensive Specialized Hospital Addis Ababa, Ethiopia, December to March 2024(n=422)

Variables	Range	Mean	SD
Age (years)	18-51	23	5
Hospital stay	15-93	39	17
Variables		**Frequency**	**Percentage (%)**
Sex	Male	398	94.3
	Female	24	5.7
Type of injury	upper extremity	37	8.8
	lower extremity	194	46.0
	brain injury	94	22.3
	brain and neck injury	15	3.6
	chest injury	33	7.8
	chest and abdominal injury	10	2.4
	abdominal injury	39	9.2
Infection after admission	Wound infection	145	34.4
	Bed sore	50	11.8
	No infection	227	53.8
Transfusion history	Yes	320	75.8
	No	102	24.2
Medical intervention	Operation	152	36.0
	Medication	269	63.7

6.2 Hematologicalparameters of patients with type of injury in body parts at Armed Forces Comprehensive Specialized Hospital

The distribution of CBC parameters for each kind of injury is statistically analyzed and displayed in table-2. Percentiles for each blood parameter linked to various body part injuries, ranging from the fifth to the ninetieth. The values in each row under Percentiles correspond to particular parameters, such as WBC, RBC, HGB, HCT, MCV, MCH, MCHC, RDW, PLT, MPV, NE#, LY#, MO#, EO#, BA#, NRBC, NLR, MLR, and PLR.

In terms of White Blood Cell Count (WBC), injuries to the upper extremities typically result in higher counts, whereas injuries to the abdomen show a marked increase in the 95th percentile. Conversely, there are comparatively fewer counts across percentiles for injuries to the brain and neck. Red blood cell count (RBC) increases gradually across percentiles and exhibits similar trends for injuries to the upper and lower extremities. On the other hand, RBC counts are marginally lower in abdominal injuries. Whereas brain and neck injuries exhibit lower hemoglobin (HGB) levels, particularly in the lower percentiles, chest and chest with abdominal injuries show higher HGB levels across percentiles. For both upper and lower extremity injuries, hematocrit (HCT) rises with percentile; levels are highest in the 75th and 90th percentiles for the chest and the chest with abdominal injuries.

Chest injuries typically result in higher MCV and MCH values, whereas brain injuries show lower values, particularly in the lower percentiles. In contrast to brain and neck injuries, which have comparatively lower MCHC values, chest and chest with abdominal injuries have higher values. In contrast to brain and neck injuries, which display relatively lower values, RDW displays a wider distribution for chest with abdominal injuries. Abdominal injuries typically result in higher PLT, NE #and NLR values, whereas brain injuries show lower counts. In contrast to brain and neck injuries, which show lower counts, chest injuries have higher MPV, LY#, MO#, EO#, and BA# values. Injuries to the chest and abdomen result in higher NRBC, MLR, and PLR counts; injuries to the brain and neck show lower counts.

Table 2 **CBC parameter mean, standard deviation and percentiles values with types of injuries**

parameters	Type of injury	Mean	SD	5%	10%	25%	50%	75%	90%	95%
WBC (x109/L)	upper extremity	6.9	3.2	3.52	4.44	5	6.6	7.8	10	13.03
	lower extremity	7.2	5.2	3.6	4	4.9	6.35	8.325	10.3	11.9
	brain injury	7.27	5.5	3.4	3.8	4.9	6.1	8.425	10.95	13
	brain and neck injury	7.02	3.8806	0.1	1.42	4.7	7.3	10.3	12.8	
	chest injury	7.194	2.9685	3.19	3.82	4.65	7.4	8.75	11.88	13.52
	chest and abdominal injury	8.41	2.8769	5.8	5.81	6.05	6.85	11.35	13.21	
	abdominal injury	10.7	16.7028	3.9	5.2	6	7.3	9.1	14.3	20.7
RBC (x1012/L)	upper extremity	4.766	1.00097	3.017	3.332	3.925	4.87	5.635	6.042	6.222
	lower extremity	5.005	0.92517	3.105	3.72	4.6175	5.145	5.6325	6.03	6.2275
	brain injury	4.971	1.01162	2.8525	3.405	4.6075	5.155	5.5625	6.065	6.255
	brain and neck injury	5.064	1.48816	0.31	2.644	4.54	5.3	6.03	6.246	
	chest injury	5.132	0.92836	3.12	3.88	4.485	5.17	5.725	6.426	6.588
	chest and abdominal injury	4.98	0.97551	3.21	3.28	4.2175	5.105	5.7925	6.259	
	abdominal injury	5.000	0.97553	2.72	3.62	4.36	5.15	5.71	6.02	6.31
HGB (g/dL)	upper extremity	13.54	3.2441	7.86	9.4	10.55	13.5	16.7	17.64	18.44
	lower extremity	14.35	2.798	9.1	9.9	12.875	14.7	16.525	17.6	18.1
	brain injury	14.14	3.3769	7	9.15	12.2	14.85	16.3	17.65	18.35
	brain and neck injury	14.63	4.2444	0.9	8.28	13.4	15.4	17.4	18.04	
	chest injury	15.05	2.7681	9.44	11.54	13.25	15.2	17	18.66	19.44
	chest and abdominal injury	13.68	3.1467	7.4	7.77	11.775	14.1	15.725	18.38	
	abdominal injury	14.32	3.0303	8	9.4	13.1	14.6	16.9	17.6	18
HCT (%)	upper extremity	41.20	9.0826	26.88	28.76	32.35	41.3	50.2	52.52	54.07
	lower extremity	43.61	8.1105	27.25	32.1	39.4	44.8	50.025	52.8	53.65
	brain injury	43.01	9.7505	23.875	27.75	37.825	45.2	48.75	53.05	55
	brain and neck injury	44.12	12.634	2.5	25.42	41.1	46.5	52.9	53.66	
	chest injury	45.44	8.1089	29.66	35.64	40.15	46	51.45	56.24	59.68
	chest and abdominal injury	41.98	8.5828	25	25.92	36.975	43.25	47.95	54.31	
	abdominal injury	43.59	8.6183	24.2	29.3	38.2	44.4	50.2	52.7	55.7

MCV (fL)	upper extremity	86.91	9.4965	69.16	78.32	83.5	86.6	92.85	97.4	99.14
	lower extremity	87.46	6.8143	76.725	80.45	84.3	87	90.5	94.15	96.55
	brain injury	86.25	7.4268	72.125	77.1	83.2	87.3	91.1	94.35	95.975
	brain and neck injury	87.10	6.6542	69.3	76.08	83.1	88.7	90.9	95.36	
	chest injury	88.73	4.1962	82.22	83.54	85.6	88.4	91.7	94.38	98.17
	chest and abdominal injury	84.26	4.8965	74.7	75.01	81.175	84.75	88.2	89.73	
	abdominal injury	87.37	5.9371	76.2	80.9	83.5	88.6	91	94	95.5
MCH (pg)	upper extremity	28.55	3.7175	21.39	25.6	27.55	28.7	30.5	31.76	33.08
	lower extremity	28.74	2.5995	23.575	26.2	27.6	28.8	29.8	31.3	32.025
	brain injury	28.29	2.9975	22.25	23.95	27.625	29.1	30.2	30.85	31.525
	brain and neck injury	29.08	2.4231	21.7	25.3	28.4	29.4	31.1	31.6	
	chest injury	29.36	1.4508	26.87	27.34	28.25	29.4	30.4	30.96	32.14
	chest and abdominal injury	27.36	2.5163	22.9	22.97	25.55	27.95	29.325	30.51	
	abdominal injury	28.62	2.3525	24.1	26.2	27.2	28.6	30.1	31.8	32.2
MCHC (g/dL)	upper extremity	32.75	1.612	30.77	31.66	32.35	33.1	33.5	33.8	34.13
	lower extremity	32.84	1.0017	31.075	31.6	32.2	33	33.5	34	34.4
	brain injury	32.75	1.2953	30.125	31	32.275	33	33.6	34	34.6
	brain and neck injury	33.38	1.2729	31.3	31.72	32.7	33.3	33.6	35.5	
	chest injury	33.11	0.7442	31.71	32.08	32.75	33.1	33.55	33.9	34.58
	chest and abdominal injury	32.41	1.4896	29.4	29.61	31.575	32.35	33.5	34.55	
	abdominal injury	32.75	1.1715	31.1	31.6	32.2	32.9	33.4	34	34.7
RDW (%)	upper extremity	15.16	2.5405	12.88	13.24	13.55	14.1	16	18.8	21.23
	lower extremity	14.73	2.334	12.8	12.95	13.4	14	15.1	17.6	19.675
	brain injury	15.11	3.055	12.9	13	13.3	14	15.875	18.9	20.425
	brain and neck injury	13.70	1.7605	12.3	12.42	13	13.3	13.8	16.7	
	chest injury	14.13	1.0647	12.74	12.84	13.25	14	14.7	15.8	16.41
	chest and abdominal injury	15.63	3.2455	12.7	12.76	13.45	14.65	16.85	22.82	
	abdominal injury	14.81	2.4902	12.5	12.9	13.5	14	15.2	17.8	20.8
PLT (x109/L)	upper extremity	302.5	150.336	126.5	145.8	214.5	276	334	462.8	684.1
	lower extremity	272.2	111.484	123.25	150.5	200	258.5	331.5	411.5	491.75
	brain injury	274.9	123.884	63	153.5	202	256	336.5	393.5	548.25
	brain and neck injury	241.7	107.449	13	70.6	169	255	322	390.2	

	chest injury	254.2	106.065	113.4	146.4	200	227	286	402.6	504.1
	chest and abdominal injury	240.3	119.799	84	87.3	153.75	212	342.25	457.6	
	abdominal injury	301.3	152.104	152	187	215	269	324	432	652
MPV	upper extremity	8.473	0.9971	6.78	7.2	7.8	8.4	9.1	9.6	10.75
(fL)	lower extremity	8.544	1.0583	6.9	7.3	7.7	8.45	9.3	9.95	10.4
	brain injury	8.371	1.0528	6.775	6.95	7.6	8.3	9	9.8	10.025
	brain and neck injury	8.453	0.9855	7	7.18	7.6	8.2	8.9	10.22	
	chest injury	8.591	1.0141	6.41	7.06	8	8.7	9.2	10.06	10.13
	chest and abdominal injury	8.73	0.8667	6.9	7.02	8.25	8.85	9.15	9.9	
	abdominal injury	8.472	0.7508	7.2	7.4	7.9	8.5	9	9.3	9.8
NE#	upper extremity	4.389	3.2316	1.35	1.88	2.4	3.6	4.55	9.1	10.18
(x109/L)	lower extremity	4.388	2.9354	1.375	1.75	2.675	3.85	5.425	7.45	8.825
	brain injury	4.456	5.5471	1.025	1.4	2.3	3.5	4.825	7.1	8.625
	brain and neck injury	4.66	3.3129	0	0.9	1.9	4.6	7	9.8	
	chest injury	4.642	2.1703	1.67	1.74	2.65	4.5	6.05	7.46	9.15
	chest and abdominal injury	6.77	3.2985	2.6	2.77	4.75	5.25	10.425	12.42	
	abdominal injury	7.759	13.5138	2.9	3.2	3.9	5.1	6.4	13.2	16.4
LY#	upper extremity	1.781	0.9448	0.4	0.68	1.2	1.7	2.15	2.74	3.26
(x109/L)	lower extremity	1.982	3.6824	0.6	0.9	1.3	1.7	2.1	2.65	2.825
	brain injury	1.968	1.0628	0.6	1	1.375	1.85	2.3	2.9	3.65
	brain and neck injury	1.7	0.808	0.1	0.22	1.5	1.7	2.2	2.82	
	chest injury	1.742	0.9953	0.37	0.54	0.85	1.7	2.35	3.18	4.02
	chest and abdominal injury	1.05	0.6311	0.4	0.4	0.625	0.95	1.3	2.47	
	abdominal injury	1.826	1.2729	0.5	0.7	1.2	1.6	2	2.5	6.1
MO#	upper extremity	0.441	0.1787	0.1	0.2	0.3	0.5	0.5	0.7	0.72
(x109/L)	lower extremity	0.599	1.3448	0.2	0.2	0.3	0.4	0.6	0.9	1.125
	brain injury	0.498	0.46	0.2	0.2	0.3	0.4	0.525	0.7	1.025
	brain and neck injury	0.373	0.1624	0	0.12	0.3	0.4	0.5	0.6	
	chest injury	0.439	0.2106	0.07	0.2	0.3	0.4	0.6	0.76	0.83
	chest and abdominal injury	0.48	0.3293	0.2	0.21	0.3	0.4	0.5	1.25	
	abdominal injury	0.754	1.5117	0.1	0.1	0.2	0.5	0.8	1	2.5
EO#	upper extremity	0.23	0.3542	0	0	0.1	0.1	0.2	0.5	1.1

(x109/L)	lower extremity	0.238	0.3888	0	0	0	0.1	0.3	0.5	0.9
	brain injury	0.306	0.4116	0	0	0.1	0.2	0.4	0.9	1.125
	brain and neck injury	0.267	0.453	0	0	0.1	0.1	0.3	1.02	
	chest injury	0.294	0.7323	0	0	0	0.1	0.3	0.56	1.96
	chest and abdominal injury	0.09	0.0994	0	0	0	0.1	0.125	0.29	
	abdominal injury	0.308	0.722	0	0	0	0.1	0.3	0.7	0.9
BA#	upper extremity	0.059	0.1641	0	0	0	0	0.05	0.2	0.45
(x109/L)	lower extremity	0.044	0.0881	0	0	0	0	0.1	0.1	0.2
	brain injury	0.038	0.0689	0	0	0	0	0.1	0.1	0.2
	brain and neck injury	0.027	0.0458	0	0	0	0	0.1	0.1	
	chest injury	0.061	0.1144	0	0	0	0	0.1	0.16	0.32
	chest and abdominal injury	0.01	0.0316	0	0	0	0	0	0.09	
	abdominal injury	0.041	0.1773	0	0	0	0	0	0.1	0.1
NRBC	upper extremity	0.046	0.073	0	0	0	0	0.1	0.12	0.21
(/100 WBC)	lower extremity	0.077	0.1754	0	0	0	0	0.1	0.2	0.2
	brain injury	0.207	0.8339	0	0	0	0.1	0.1	0.2	0.4
	brain and neck injury	0.073	0.1033	0	0	0	0	0.2	0.24	
	chest injury	0.033	0.0595	0	0	0	0	0.1	0.1	0.2
	chest and abdominal injury	0.13	0.2214	0	0	0	0.05	0.15	0.66	
	abdominal injury	0.069	0.103	0	0	0	0.1	0.1	0.1	0.2
NLR	upper extremity	3.556	4.41493	0.3455	0.8606	1.3131	2.3684	3.9722	7.163	18.25
	lower extremity	3.006	2.61269	0.6692	1	1.5221	2.4907	3.4706	5.494	7.6818
	brain injury	3.300	8.86202	0.5087	0.6402	1.1941	2.0333	2.8419	3.9563	8.9286
	brain and neck injury	3.102	2.4478	0	0.3333	1.2	2.3	4.6667	7.4784	
	chest injury	3.986	4.4496	0.9667	1.0297	1.5988	2.6111	4.5184	7.9333	15.45
	chest and abdominal injury	10.13	10.1554	1	1.2308	4.236	6.1181	14.5375	30.925	
	abdominal injury	4.575	3.73863	1.3333	1.6296	2.28	3.25	4.25	11.8333	14.6667
MLR	upper extremity	0.292	0.1752	0.1202	0.1471	0.1914	0.2381	0.3095	0.55	0.7583
	lower extremity	0.493	1.56756	0.0909	0.1154	0.1765	0.2679	0.4178	0.6667	0.8929
	brain injury	0.291	0.26485	0.0897	0.1082	0.1667	0.2181	0.3083	0.5	0.675
	brain and neck injury	0.237	0.14222	0	0.0667	0.1923	0.2222	0.2667	0.4542	
	chest injury	0.312	0.24687	0.0875	0.1358	0.1633	0.2424	0.364	0.55	1

	chest and abdominal injury	0.503	0.23522	0.1538	0.1748	0.3722	0.4365	0.649	0.975	
	abdominal injury	0.368	0.31413	0.0909	0.1111	0.1667	0.2857	0.4737	0.6667	1.3333
PLR	upper extremity	198.3	110.394	74.7037	89.7333	114.520	170.526	244.444	405.741	475.928
	lower extremity	182.7	125.855	74.4231	90	119.225	157.321	211.150	303.977	402.392
	brain injury	164.1	99.1443	60.5172	71.2208	99.875	143.75	196.038	264.732	362.821
	brain and neck injury	174.5	124.306	67	70.4	102.105	130	209.444	395.333	
	chest injury	194.2	142.411	79.1786	84.6993	108.623	145.384	203.706	429.8	590.5
	chest and abdominal injury	259.3	126.530	125.384	127.471	157.716	221	333.035	506.5	
	abdominal injury	218.4	152.299	48.4722	89.4118	123.75	170	259.047	474.285	623.333

6.3- A multivariate analysis of variance (MANOVA) between CBC parameters and infection after admission.

A multivariate analysis of variance (MANOVA) was carried out to look into how infection after admission affected CBC parameter variables. Following admission, infection had a significant multivariate effect, Wilks' Lambda =.842, F (38, 802) = 1.891, p =.001, and partial eta squared =.081. Follow-up univariate testing revealed a significant impact of infection after admission on the following CBC parameters:WBC, NE#, NLR, and PLR, with p-values of p=0.006, p>0.001, p>0.001, and p=0.007, respectively.

Bonferroni adjustment post hoc comparisons revealed that patients with wound infections had significantly higher WBC counts than patients without infections (mean difference = 2.252, SE = 0.7287, p <0.001). In addition, the absolute neutrophil count (NE#) of patients without infections was significantly lower than that of patients with bed sores (Mean difference = -1.844, SE = 0.877, p =.037) and wound infections (Mean difference = -2.279, SE = 0.694, p =.001). Table -3 below displays the descriptive statistics for the dependent variable (CBC parameters) disaggregated by the independent variable (infection after admission).

Table 3 Dependent variable (CBC) disaggregated by the independent variable infectionat Armed Forces Comprehensive Specialized Hospital Addis Ababa, Ethiopia, December to March 2024(n=422).

	Wound infection N(145)		Bed sore N(50)		No infection N(227)	
VARIABLES	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
WBC ($x10^9$/L)	9.062	10.412	6.7	3.023	6.81	4.006
RBC ($x10^{12}$/L)	5.000	0.931	5.059	0.821	4.9644	1.039
HGB (g/dL)	14.338	2.999	14.374	2.759	14.224	3.165
HCT (%)	43.541	8.540	43.6	7.790	43.249	9.220
MCV (fL)	87.108	6.031	86.234	7.04	87.375	7.473
MCH (pg)	28.619	2.3481	28.416	2.880	28.716	2.899
MCHC (g/dL)	32.846	1.1261	32.89	1.265	32.822	1.161
RDW (%)	14.828	2.2905	14.772	2.026	14.789	2.710
PLT ($x10^9$/L)	263.49	103.943	264.64	106.367	284.52	134.915
MPV (fL)	8.531	0.9583	8.342	1.068	8.51	1.037
NE# ($x10^9$/L)	6.283	7.79	4.12	2.822	4.004	3.679
LY# ($x10^9$/L)	1.901	4.272	1.834	0.761	1.907	0.975
MO# ($x10^9$/L)	0.562	0.875	0.474	0.249	0.566	1.243
EO# ($x10^9$/L)	0.248	0.484	0.248	0.258	0.272	0.484
BA# ($x10^9$/L)	0.048	0.119	0.036	0.056	0.043	0.103
NRBC(/100WBC)	0.057	0.101	0.072	0.113	0.134	0.559
NLR	5.225	5.152	2.726	2.485	2.595	5.674
MLR	0.395	0.326	0.289	0.206	0.420	1.449
PLR	211.716	128.901	165.1089	96.844	173.601	123.510

6.4 Pearson's correlation analysis between hospital stay and CBC parameters

Table-4 below displays a Pearson correlation analysis matrix comparing the length of hospital stay and CBC parameters with computed white cell ratios. As a result, the length of hospital stay was found to have a weak to moderately positive significant correlation with the following CBC parameters: WBC r (420) =0.22 (P=>0.001), Neutrophil r (420) =0.36 (P=>0.001), PLR r (420) =0.35 (P=>0.001), and NLR r (420) =0.49 (P=>0.001). Conversely, there is a significant negative correlation between red blood cell, hemoglobin,hematocrit,lymphocyte and length of hospital stay with a p value of P=0.031 P=0.007,P=0.008, and P=0.001respectively. The remaining correlations in the matrix table did not significantly suggest meaningful relationships.

Table 4 Pearson's correlation matrix between hospital stay and CBC parameters

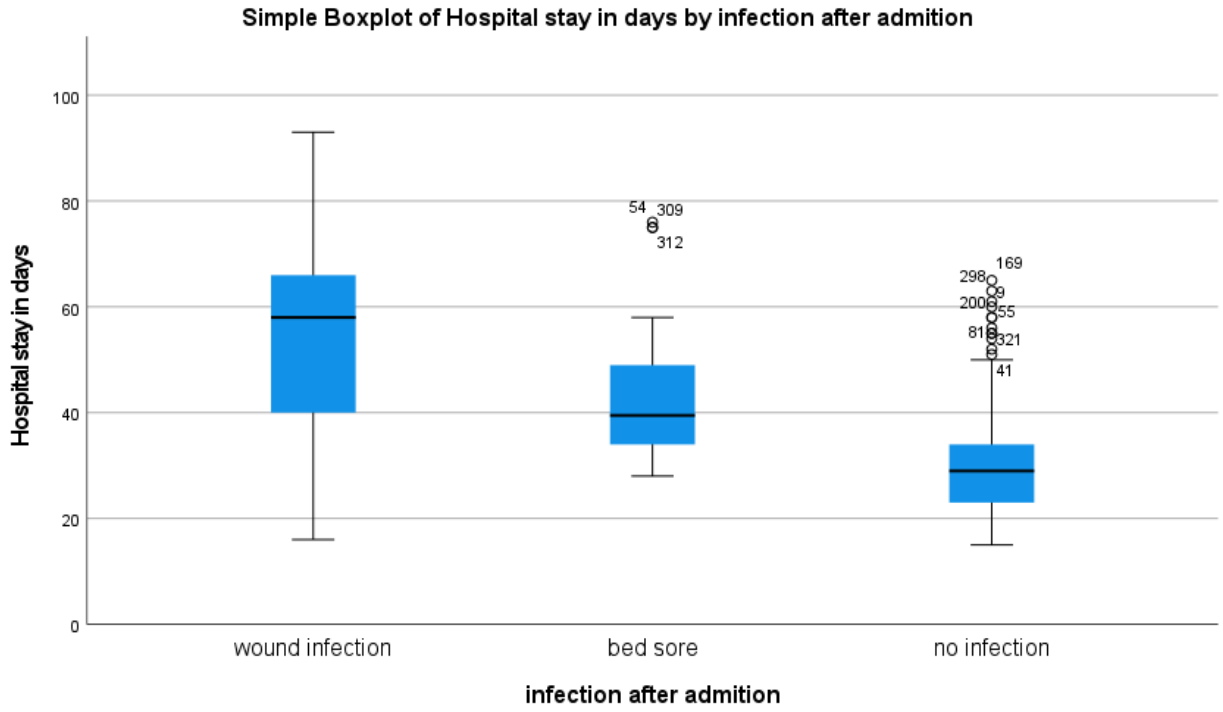
		1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.	14.	15.	16.	17.	18.	19.	20.
1.	LOS																				
2.	WBC	.22**																			
3.	RBC	-.11*																			
4.	HGB	-.13**	-.14**	.91**																	
5.	HCT	-.13**	-.11*	.93**	.99**																
6.	MCV	-.09	.01	-.11*	.27**	.24**															
7.	MCH	-.1	-.10*	-.03	.37**	.30**	.95**														
8.	MCHC	-.07	-.27**	.17**	.43**	.31**	.37**	.65**													
9.	RDW	.09	.23**	-.39**	-.55**	-.51**	-.28**	-.41**	-.53**												
10.	PLT	-.02	.07	.06	-.06	-.04	-.26**	-.26**	-.15**	.12*											
11.	MPV	.	.03	.	.01	.03	.10*	.04	-.10*	.	-.46										
12.	NE#	.36**	.91**	-.14**	-.17**	-.15**	-.01	-.10*	-.25**	.22**	.07	.05									
13.	LY#	-.17**	.49**	.03	.01	.03	.03	-.03	-.13**	.08	.07	-.04	.11*								
14.	MO#	.03	.43**	-.05	-.06	-.05	.02	-.03	-.12*	.08	.07	.05	.30**	.09							
15.	EO#	-.03	.40**	.05	.04	.05	.03	-.02	-.11*	.06	.07	.01	.33**	.10*	.18**						
16.	BA#	.02	.40**	.	-.09	-.07	-.13**	-.19**	-.27**	.16**	.07	.02	.37**	.14**	.18**	.25**					
17.	NRBC	-.09	-.02	-.17**	-.18**	-.19**	-.10*	-.08	-.01	.12*	.07	.08	-.02	-.02	.	-.03	.04				
18.	NLR	.49**	.40**	-.17**	-.17**	-.17**	-.02	-.05	-.10*	.14**	.07	.12*	.58**	-.13**	-.02	-.05	.04	.			
19.	MLR	.05	.08	-.11*	-.10*	-.10*	.01	-.01	-.04	.07	.07	.12*	-.01	-.07	.79**	-.03	-.03	.01	.02		
20.	PLR	.35**	.09	-.16**	-.20**	-.21**	-.16**	-.14**	-.02	.15**	.07	-.24**	.01	-.24**	-.03	-.12*	-.01	.06	.28**	.06	

Note- N=422; *=P<0.05; **=P<0.01

6.5 A nominal by interval analysis of infection after admission and length of hospital stay

The association between the number of days spent in the hospital and the infection that occurs after admission was investigated using cross-tabulation analysis. The distribution of hospital stays for patients with wound infections ranged from 15 to 93 days, with 64 days being the highest frequency. Hospital stays for patients with bed sores varied from 28 to 80 days, with 40 days being the highest count. For patients without an infection, 30 days was the highest count, with a range of 15 to 93 days. An Eta correlation analysis shows a significant positive correlation between the number of days spent in the hospital and infection that occurs after admission with value of Eta =0.672(η =0.4514).

Figure 1LOS and infection after admission



7. Discussion

Changes in hematological parameters in trauma patients are potential predictive markers of disease prognosis, complications, and mortality (6). In the current study, an extensive analysis was conducted in Addis Ababa, Ethiopia, involving 422 patients who were admitted to the Armed Forces Comprehensive Specialized Hospitaldue to war trauma. In addition to examining the patients' clinical and sociodemographic characteristics, this study also examines the patients' level of injuries, post-admission infections, transfusion status, and medical interventions. It also looks at the connections between various CBC parameters, infections that occur after admission, and length of hospital stay.

Several commonly obtained parameters from a standard complete blood count, such as platelets, red blood cells, white blood cells (WBCs), and details on WBC subtypes, along with the derived neutrophil-to-lymphocyte ratio (NLR), monocyte-to-lymphocyte ratio (MLR), and platelet-to-lymphocyte ratio (PLR), have been studied as possible biomarkers in trauma patients. The findings have been conflicting (22-28). Because the subtypes of WBCs can change relative to one another in response to stress or systemic inflammation, the derived ratios may also represent the immune-inflammatory status of these patients and their prognosis(32).

This study included 422 patients with a mean age of 23 years who had suffered from trauma related to war; 94.3% of the patients were men and 5.7% of participants were female. The average hospital stay was 39 days. About 46%of all injuries were to the lower limbs, with brain injuries coming in second (22.3%). 53.8 % of patients did not have any infections after being admitted, 34.4.0%had wound infections, and 11.8% developed bed sores. (36.1%) of patients underwent surgery and (75.8%) received transfusions.The results of the analysis showed that different body part injuries caused different counts of CBC parameters.

By our study CBC parameter variables were examined for the impact of infection after admission using a multivariate analysis of variance (MANOVA). Infection had a substantial multivariate effect after admission, with partial eta squared =.081, Wilks' Lambda =.842, F (38, 802) = 1.891, p =.001. WBC, absolute neutrophil count(NE#), NLR, and PLR were the CBC parameters on which infection after admission had a significant effect, according to follow-up univariate testing,

with p-values of 0.006,0.001,0.001, and 0.007, respectively.According to a review by Hesselink et al distinct neutrophil subtypes exist that play their own role in the recovery and/or development of infectious complications after trauma(33).

Similarly a Ghozy et al.'s Systematic Review done on 2022 reviewed eight studies, involving 144–1291 traumatic brain injury patients. The research was carried out in a number of nations, including the US, Australia, China, Poland, and Turkey. In four studies, the review discovered significant correlations between NLR values and adverse outcomes, and in three studies, there was a significant prediction of mortality. Compared to patients with unfavorable outcomes, those with favorable outcomes had NLR values that were 37% lower(23).

In a related study, Kutlucan L et al. investigated the association between various blood parameters and patients in intensive care units and discovered that patients with nosocomial infections had significantly higher thrombocyte counts ($p = 0.031$), neutrophil/lymphocyte ratios ($p = 0.002$), and platelet/lymphocyte ratios ($p = 0.009$)(30).However, the thrombocyte count finding in their study was not consistent with ours as we noticed no statistically significant difference by infection status.

Additionally, we examined a Pearson correlation analysis matrix that contrasted the duration of hospitalization with the calculated white cell ratios and the Beckman Coulter DXH 800 CBC parameters. Consequently, a week to moderately positive significant correlation was observed between the length of hospital stay and the following CBC parameters: WBC $r = 0.22$, Neutrophil $r = 0.36$, PLR $r = 0.35$, and NLR $r = 0.49$. On the other hand, there wasa significant negative correlation between red blood cell, hemoglobin, hematocrit, lymphocyte, and length of hospital stay. In line with our findings, Kutlucan L et al.'s study discovered that NLR ($p = 0.006$) and PLR ($p = 0.027$) showed significant positive correlations with the length of hospital stay(30). On another note, elevated PLR has been shown to be a very good predictor of unfavorable outcome in trauma patients suggesting the potential of this marker in assessing prognosis in trauma patients(34)Targeted study and recommending this marker which is also indicative of inflammation and the other ratios for routine use in our setup could benefit trauma patients in our country.This recommendation is plausible considering the limited use of various hematological parameters generated by automated hematology analyzers in our country (35)while there is no additional cost. Besides WBC count has been suggested as a prognostic parameter to determine

outcome in trauma patients and in line with this an association of WBC count with injury severity was reported(36).

Maleitzke et al.'s study from 2023 discovered a positive correlation ($p < 0.001$) between the length of the ICU/hospital stay and the Injury Severity Score (ISS).Similarly, a one-day increase in LOS was found by Brown et al. (2021) to increase the odds of sepsis by 10% ($p < 0.001$).According to Chen et al. (2019), there was a significant correlation between unfavorable outcomes and peak NLR ($p < 0.001$) and length of hospital stay ($p = 0.002$). All of these findings are consistent with our Eta correlation analysis, which found a strong positive correlation (Eta =.672 (η =0.4514) between the number of hospital days spent and infections that arise after admission(22,24,25).

The finding of inverse association between hemoglobin levels and hospital stay is supported by the recommendation by Mahajan et al, 2021 who studied the influence of hemoglobin levels during healing in trauma of the extremities. They recommended to maintain Hb above 12 g/dL for early wound healing, less hospital stay and lesschances of infection(37). In sum, in line with the aforementioned studiesthe rise in the inflammatory markers like PLR and NLR, WBC and neutrophils with long hospital stay and that of the associated infections seen in the current study and the inversely related hemoglobin values require attention to improve outcome of war trauma patients.

8. Strength and Limitations

8.1 Strength

- As far as we are aware, this is the first study carried out in Ethiopia that points out gaps in current practices, like the underuse of diverse CBC parameters and the lack of studies relating hematological profiles to trauma in these specific patient populations suffering from war trauma.
- Highlights its potential to advance medical knowledge, enhance patient care, and shed light on the physiological effects of trauma.

8.2 Limitations

- The Armed Forces Comprehensive Specialized Hospital in Addis Ababa, Ethiopia, served as the study's sole site, which may have limited the findings' applicability to other contexts or populations.
- The study was carried out between December 2023 and May2024, which is a relatively short timeframe that may have missed long-term effects or changes in patient outcomes over time.

9. Conclusion and recommendation

9.1 Conclusion

This research on patients with war trauma who were admitted to the Armed Forces Comprehensive Specialized Hospital illuminates a number of issues, including clinical and sociodemographic traits and the relationships between different CBC parameters and outcomes. The study highlights the high prevalence of lower extremity and brain injuries among these patients, who are primarily young men. The analysis of infections that occur after admission also emphasizes how crucial it is to keep a close eye on patients and take preventative measures while they are in the hospital.

The relationships found in the literature between specific blood parameters and patient outcomes are confirmed by the correlation between CBC parameters and injury types, which offers insightful information about the physiological reactions to trauma. This study highlights significant conclusions regarding the association between CBC parameters and hospital stay highlighting the potential value of these markers in predicting patient prognosis and informing clinical management practices.

Furthermore, the observed relationship by this study between the duration of hospital stay and post-admission infections highlights the necessity of early intervention to minimize complications and improve patient outcomes, as well as the necessity of effective infection control measures. Additionally, healthcare professionals can improve the standard of care for patients with war trauma by incorporating these findings into their clinical practices. This will ultimately lead to better treatment outcomes and rehabilitation initiatives.

9.2 Recommendation

- Future studies could examine the reasons behind the preference for particular CBC parameters and their derivative ratios over others and determine how to improve the clinical practice's utilization of comprehensive CBC and calculated white cell ratios such as NLR, MLR, and PLR data, in light of the underutilization of CBC parameters by end users.

- The study's cross sectional design restricts the conclusions that can be drawn about causality. Longitudinal designs may be used in future studies to study the course of recovery over time. Furthermore, investigating additional confounding variables like, comorbidities, outcomes and treatment modalities may offer a more thorough comprehension of the healing process.
- It highlights attention to how crucial hematological parameters are for determining the extent of trauma, predicting complications, and directing treatment.
- The results of the study suggest that healthcare providers should conduct focused interventions, such as customized medical interventions or infection prevention strategies, to address the specific needs identified in the study population.
- In summary, although the study offers insightful information about the connections among CBC parameters, infections, and hospital stay duration in trauma patients, the study's influence and applicability to trauma research can be enhanced by resolving the identified limitations and putting the suggested findings into practice

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11. Annexes

Annex I-Beckman DXH 800 Coulter Principle

By identifying and quantifying changes in electrical resistance that occur when a particle—such as a cell—in a conductive liquid passes through a tiny aperture, the Coulter Method precisely counts and sizes cells as depicted in the diagram below. (38).

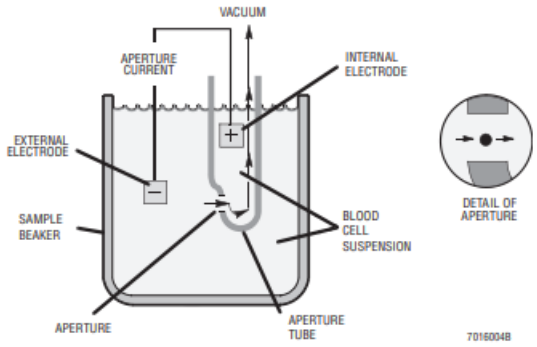


Figure 2Coulter method (taken from Beckman coulter manual)

Every cell suspended in a diluent, or conductive liquid, serves as an insulator. The electrical path between the submerged electrodes on either side of the aperture becomes temporarily more resistant as each cell passes through the aperture. A detectable electronic pulse results from this. In order to count, the diluted cell suspension must be drawn through the aperture using a regulated volume of vacuum. The size of the electrical pulse is proportional to the cell volume, whereas the number of pulses indicates the number of particles counted.(38).

VCS Technology

Three measurements were used by the COULTER VCS to establish WBC differential technology: individual cell volume, high-frequency conductivity, and laser-light scatter. Light-scattering technology, low-frequency current, and high-frequency current combined to provide an abundant cell-by-cell data that the SPM converted into data plots.(38).

Volume Analysis

Low-frequency current has been used for electronic leukocyte volume analysis since 1967. It's been considered a potential supplement to the differential white cell count. (38).

Conductivity Analysis

High frequency current flows through the cell walls as a conductor. The current senses variations in each cell's insulating qualities as it travels through the walls and inside each cell (38).

Light Scatter Analysis

Coulter's background in flow cytometry extends back several decades, to the time when Fulwyler was the first to employ light scatter for cell analysis. The relationship between particle size and refractivity and the angle of light scattered from a laser beam is discussed by Loken et al. and Jovin et al.(38).

TTM Historically, a flow cell was housed in a Triple Transducer Module (TTM), which was first made available for purchase in the 1980s by Beckman Coulter. The processed sample detection took place in the TTM flow cell. Three measurement signals were generated by the TTM: light scatter, conductivity, and volume.(38).

The Multi-transducer Module (MTM), which the DxH 800 uses in place of the TTM, measures additional multiple angles of light scatter, which is a significant improvement over the single light scatter that the TTM measures. (38).

Reticulocyte Analysis

Reticulocytes are non-nucleated, immature erythrocytes that have a small network of protoporphyrin and RNA-containing basophilic organelles. Red cell production and regeneration can be easily and effectively measured by counting reticulocytes.(38).

The most popular method for quantifying reticulocytes is the use of supravital dyes, like Brilliant Cresyl Blue or New Methylene Blue. These dyes cause the basophilic components in the reticulocyte to precipitate and aggregate, producing a granular staining pattern that is visible under a light microscope.(38).

Reticulocyte immaturity is correlated with both light scatter and cell volume. The immaturity of the cell causes an increase in both the cell volume and light scatter because more immature reticulocytes are larger, contain more RNA, and produce more light scatter(38).

CBC Analysis

In hematology, the complete blood count, the CBC, is the fundamental analytical test that evaluates the three main cellular components: white blood cells, red blood cells and platelets. The DxH 800 CBC analysis is based on the Coulter Principle(38).

Specimen Preparation

165 µL of sample is aspirated once the aspiration pump is activated. A second pull of the aspiration pump pulls blood through the BSV pathway after the probe is removed from the specimen tube, confirming a successful aspiration at the blood detectors(38).

Every cycle, the BSV controls the flow of sample and DxH Diluent to the triple aperture baths for WBC and RBC. (38).

For bubble-free delivery and mixing, the RBC diluent and WBC diluent/Lyse dilutions enter the bath through a port at the bottom that is tangential as shown in Figure 2 below to a sloping surface.A final dilution of 1:251 is obtained by mixing ~6.0 mL of DxH diluent, ~28 µL of sample, and ~1.08 mL of DxH Cell Lyse in the WBC bath. A final dilution of 1:6250 is obtained by mixing ~1.6 µL of sample with ~10 mL of DxH diluent in the RBC bath.(38).

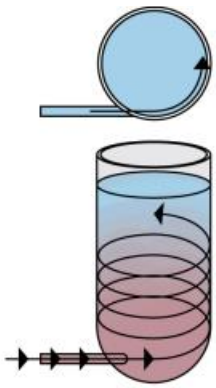


Figure 3**Tangential Mixing**

Detection/Sensing

Following the combination and incubation of the sample and reagents, six inches of vacuum and aperture current are simultaneously applied to the apertures in order to measure the volume and count of cells.Sweep flow is applied during the RBC and PLT count to stop cells from recirculating behind the aperture. The Signal Conditioner Analyzer Card receives all of the pulses produced by the apertures and converts them from analog to digital. The procedure gives the System Manager the following digital measurements and raw counts: Time, Wait time, Count Rate, Volume (amplitude of the pulse peak), and Pulse width(38).

The measurements are processed by the System Manager. Coincidence correction, voting, and the creation of 256 channel histograms for WBC, RBC, and PLT, as well as an analysis of their voting patterns, Pulse width, and Interference correction are all included in the process

Annex II Venous blood Specimen collection procedure with EDTA test tube

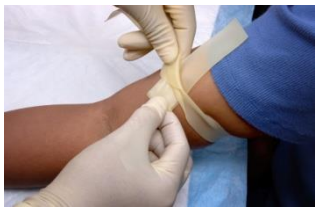
Step	Action
1	Wear protective clothing
2	Explain the blood drawing procedure to the client and reassure him/her
3	Check expiry date of vacutainer citrate(blue top) and K2 or K3 EDTA(lavender top) tube & needle
4	Wear gloves and make the patient a comfortable position
5	Prepare the vacutainer tube and needle
6	Tie the tourniquet around the arm of the patient just above the bend in the elbow. The tourniquet should be positioned 7.5cm to 10cm above the puncture site
7	Tell the patient to clench his/her fist
8	Using the tip of the index finger examine the phlebotomy site, feel the vein, and decide exactly where to place the puncture
9	Disinfect the phlebotomy site by swabbing the skin in small outward circles with alcohol swab or cotton wool soaked in Denatured Ethanol alcohol. Do not touch the prepared puncture site with your fingers after disinfecting the skin.
10	Insert the needle directly into the vein and observe the blood is coming
11	Release the tourniquet
12	Withdraw peripheral blood of approximately >1/3 0f the standard for K2 or K3 EDTA tube but for coagulation test (citrate tube) the exact volume must be drawn.
13	Withdraw the needle from the vein, cover and press the puncture site with cotton for 3 minutes or till bleeding stops.
14	Tell the patient to open his/her clenched fist

15	Gently mix the blood properly by inverting the tube 5-10 times, immediately after collection to avoid formation of small clots
16	Put the barcode label on the specimen container
17	Discard the used materials in appropriate safe container and tell the client to do so
18	Double check the tube labels for accuracy with the sample request form before sending the sample to the lab,

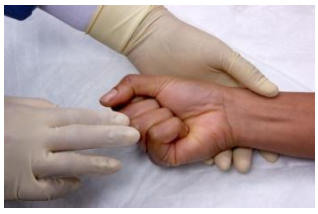
Image supported Specimen collection procedure

1. **Collect supplies.**

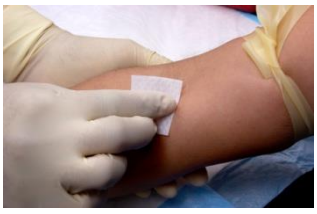
2. **Label tube with the client identification number.**



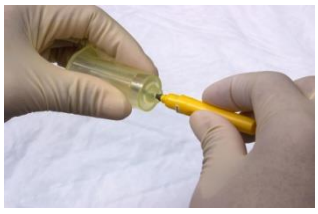
3. **Put tourniquet on client about 3-4” above venipuncture site.**



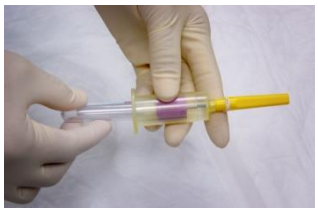
4. Have client form a fist so veins are more prominent.



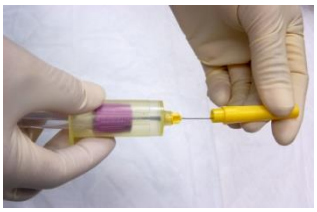
5. After palpating the path of the vein, clean the venipuncture site with alcohol using a circular motion. Allow the area to dry.



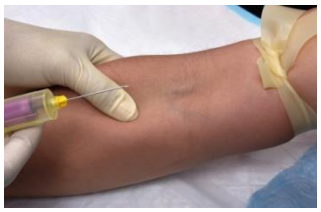
6. Assemble needle and vacuum tube holder.



7. **Insert the collection tube**



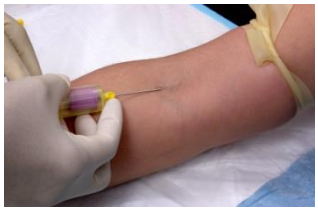
8. **Remove cap from needle.**



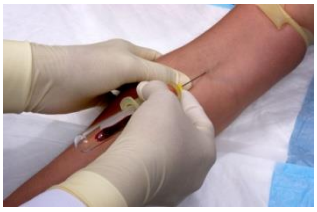
9. **Use your thumb to draw skin**

into the holder until the tube reaches the needle.

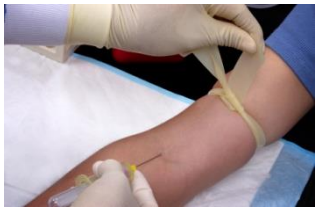
tight about 1- 2” below the venipuncture site. Hold skin tight through Step 10.



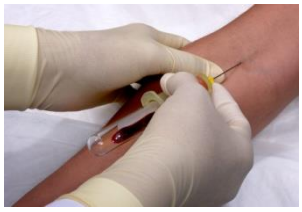
10. Insert the needle, bevel side up, into the vein.



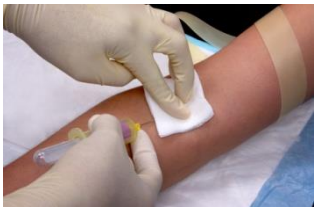
11. Push the vacutainer tube completely onto the needle. Blood should begin to flow into the tube.



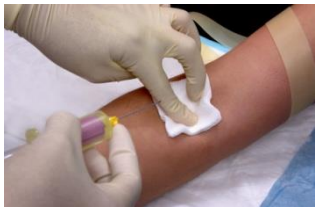
12. Release the tourniquet.



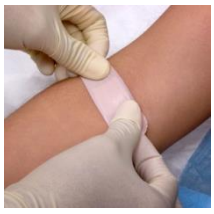
13. **Fill the tube until it is full or until vacuum is exhausted.**

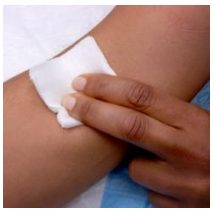


14. **After opening client’s hand, place dry gauze over the venipuncture site.**

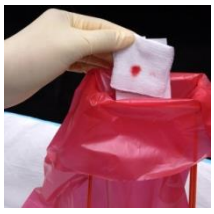


15. **Apply mild pressure to the pad and slowly remove the needle.**





16. **Apply bandage or continue applying mild pressure until bleeding has stopped.**



17. **Properly dispose of all contaminated supplies.**

Annex III. Participant information sheet

A. English Version

Principal investigator: Abebe Daniel

Institution: Addis Ababa University, College of Health Science, Department of Medical

Laboratory Science

Title of the project: Hematological profiles of war trauma patients subjected to long hospital stays at Armed Forces Comprehensive Specialized Hospital Addis Ababa, Ethiopia.

Introduction: Dear study participants: I am an MSc student at Addis Ababa University, School of Medical Laboratory Sciences. You are invited to participate in the study Hematological profiles of war trauma patients subjected to long hospital stays at Armed Forces Comprehensive Specialized Hospital in 2023.

Purpose of the study: The purpose of the study is to assess the hematological profiles of war trauma patients subjected to long hospital stay at Armed Forces Comprehensive Specialized Hospital, Addis Ababa, Ethiopia

Duration: The duration of this study will 2–3 months.

Procedures to be followed: Dear study participant,your CBC will be used in this study if you consent to participate. For this purpose about 3 ml EDTA blood will be collected from you.

Risks and Discomfort: The only risk if you participate in this study will be minor discomfort or pain during blood sample collection. During sample collection, appropriate precautions will be taken, and all samples will be collected by trained health professionals.

Expected Benefit: There will not be any cash payment or direct benefit for participating, but if your result is clinically significant, we will inform you for further diagnosis and treatment.

Confidentiality: Any information that I am going to collect about you during this researchwill be kept confidential. Your name and identity on the request paper will be changed to confidentiality code for the purpose of this study.

Withdrawal from the study: Your participation in this study will be voluntary, and you may drop the participation at any time or refuse to answer some of the questions if you feel uncomfortable. You may withdraw at any time without giving a reason if you are uncomfortable. You can ask any questions regarding this study, and you have a right to get your and your newborn laboratory results. If you have any questions regarding this study, please contact us at the following address:

Principal Investigator: Abebe Daniel

Mobile no: +251913555319

Email: abebeabye@gmail.com

Advisors

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2. MelatworkTibebu (MSc, PhD candidate)

Tel: +25193724956

Email: melatrock@gmail.com

DMLS Ethical review committee +2512755170

B**. Amharic Version**

ለተሳታፊዎችመረጃመስጫያሰነድ

የአጥኝውስም:አበበዳንኤል

የተቋሙስም:አዲስአበባዩኒቨርሲቲየህክምናናጤናሳይንስኮሌጅየሕክምናላቦራቶሪትምህርትክፍል

የጥናቱርዕስ፡-

በጦርኃይሎችኮምፕርሄንሲቭስፔሻላይዝድሆስፒታልውስጥለረጅምጊዜበሆስፒታልየቆዩየጦርነትጉዳትታማ ሚዎችየደምህዋስምርመራመገለጫዎችአዲስአበባ፣ኢትዮጵያ።

መግቢያ፡ውድየጥናትተሳታፊዎች፡እኔበአዲስአበባዩኒቨርሲቲየህክምናላብራቶሪሳይንስትምህርትቤትየማስተ ርስተማሪነኝ።በ2023

በጦርሃይሎችኮምፕሬሄንሲቭስፔሻላይዝድሆስፒታልለረጅምጊዜበሆስፒታልየሚቆዩየጦርነትጉዳትታማሚዎ ችየደምህዋስመገለጫዎችበጥናቱላይእንዲሳተፉተጋብዘዋል።ይህጥናትበአዲስአበባዩኒቨርሲቲላቦራቶሪትም ህርትክፍልየጥናትናየሰነምግባርኮሚቴየጸደቀዉጥናትመሆኑንመግለፅእንወዳለን።በዚህጥናትመሳተፍሙሉ በሙሉበእርስዎፍቃደኝነትላይየተመሰረተበመሆኑበማንኛውምሰአትናቦታየማቋረጥሙሉመብትኣሎት።

የጥናቱዓላማ፡-

የጥናቱዓላማበጦርኃይሎችኮምፕርሄንሲቭስፔሻላይዝድሆስፒታልለረጅምጊዜበሆስፒታልየሚቆዩየጦርነትጉ ዳትህሙማንንደምህዋስገፅታለመገምገምነው።

የጥናቱጊዜ:- የጥናቱግዜከ2-3 ወርሊወስድይችላል።

የጥናቱሂደት:-

ውድተሳታፋዎችእዚህጥናትላይለመሳተፍከወሰናችሁከእርስወላይየደምህዋስምርመራሲታዘዝውጤቱንለጥ ናቱምንወስደውይሆናል:: ከአርስዎየሚወሰደውአንድየሾርባማንኪያ (3ml) የሚያክልየደምናሙናይወሰዳል።

ከጥናቱጋርተያይዞየሚመጣጉዳት:-

የደምናሙናበሚሰጥበትወቅትምንምአይነትየከፋችግርአያጋጥምዎትም።ነገርግንደምሲወስድመጠነኛየህመ

ምስሜትልያስከትልይችላል።ሆኖምግንናሙናዉየሚወሰደዉልምድባላቸዉባለሞያስለሆነየህመምስሜቱየ
ቀነሰነው።

ከጥናቱየሚጠበቀውጥቅማጥቅም:-

ለመሳተፍምንምአይነትየገንዘብክፍያወይምቀጥተኛጥቅማጥቅምአይኖርምነገርግንውጤቱችግርካለውየለበለጠምር
መራእናህክምናእንዲያገኙእናሳውቅዎታለን።ዉጤትላይችግርካለበፍጥነትህክምናይሰጣቸዋል።

ከርስዎየምናገኘዉመረጃእናሚስጥራዊነቱ:-

የእርሶስምበዚህመጠይቅላይአይጠቀስም።በተጨማሪምየሚሰጡትመረጃእናበሰጡትምደምላይየሚደረገውየምርመ
ራውጤትከተባለለትጉዳይውጪእንደማይውልእናሚስጥራዊነቱየተጠበቀእንደሚሆንአረጋግጣለሁኝ።

በዚህጥናትላይያለዎትንጥያቄበሚከተሉትአድራሻበማንኛውምጊዜመጠየቅምይችላሉ።

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ኢሜል:abebeabye@gmail.com

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የህክምናላቦራቶሪት/ቤትየምርምርናስነምግባርቢሮ +251 11 2755170

Annex IIII Questionnaire

A-English version

Addis Ababa University Collage of Health Sciences, School of allied health science department of Medical Laboratory Science. Questionnaire for the demographic characteristics and associated factors of Hematological profiles of war trauma patients subjected to long hospital stays at Armed Forces Comprehensive Specialized Hospital Addis Ababa, Ethiopia.

Year _____ Participant code _____Participants address_____ signature_____

Name of specialty ward _____Block_____

Data collector name_____date_____signature_____

Code		comment
01	Age_____	
02	Sex _____	
03	Initial result on hospitalization _____ WBC with differential_____ RBC count_____ hemoglobin_____ hematocrit _____ red blood cell distribution width_____ platelet count_____ reticulocyte count_____	
04	Name of specialty ward you are admitted _____	

05	Your lengths of hospital stay _____ Why do you think you have stayed this long ? _____	
06	Have you had any disease or infection additional to your injury after you are hospitalized ? A-Yes B-No If your answer is yes can you please describe your disease or infection?_____	
07	Do you have any comorbidity additional you injury? A-Yes B-No If your answer is yes ,please specify_____	
05	Are you taking any medication? A-Yes B-No	
09	What kind of injury have you encountered?_____ if your injuries are multiple please specify _____	
10	Do you have any history of chronic illness? (Tuberculosis kidney disease, liver disease, cancer, anemia)? A-Yes B-No	
11	Have you had any major surgical procedure? _____ A-Yes B-No	
12	Do you have any transfusion history? _____	

	A-Yes B-No If yes. If your answer is yes how many times and what kind of component have you been transfused _____	
11	Do you have a recent disease or infection? A-Yes B-No	

B-የአማረኛጥያቄ

አዲስአበባዩኒቨርሲቲየህክምናናጤናሳይንስኮሌጅየሕክምናላቦራቶሪትምህርትክፍል-

በጦርኃይሎችኮምፕርሄንሲቭስፔሻላይዝድሆስፒታልውስጥለረጅምጊዜበሆስፒታልየቆዩየጦርነትጉዳትታማ ሚዎችየደምህወስምርመራመገለጫዎችጥያቄ

ዓ.ም_____ የተሰተፊኮድየተሳታፊአድረሻ_____ ፊርማ_____

የተኛበትዋርድ----------

ኮድ----------

መረጃሰብሳቢ ---------- ቀን---------- ፊርማ ----------

Code		comment
01	እድሜ _____	
02	ጸታ _____	
03	ሲተኙየነበራቸውየመጅመሪያየCBCውጤት_____ WBC with differential_____ RBC count_____ hemoglobin_____ hematocrit _____ red blood cell distribution width_____ platelet count_____ reticulocyte count_____	
04	ተኝተውየሚታከሙበትልዩክፈል _____	
05	የሆስፒታልቆይታበቀናት_____ ለምንይህንያህልጊዜየቆየህ/ የቆየሽ_____መስልሀል/ሻል?_____	

06	ሆስፒታልከተኛህበኋላከነበረህጉዳትውጭያጋጠመህህመምወይምበሽታነበር ሀ-አወን ለ-አይደለም አወንከሆነመልስወምንአይነትህመምወይምበሽታነበርያጋጠመወት	
07	አሁንካጋጠመህጉዳትውጭተጓዳኝየጤናእክልወይምበሽታአለብህ-ሽወይ ሀ-አዋን ለ-አይደለም አወንከሆነመልስወአይነትተጓዳኝየጤናእክልወይምበሽታነው	
05	መድሀኒትበመውሰድላይነወት ሀ-አዋን ለ-አይደለም	
09	ምንአይነትጉዳትነውያጋጠመህ-ሽ?_____ ያጋጠመወጉዳትብዙከሆነእባክወቢጠቅሱልን _____	
10	ለረጅምጊዜየቆየየበሽታነበረብወትወይ ? ሀ)አዎንለ) አይደለም (ሳምባነቀርሳ፣የኩላሊትበሽታ፣የጉበትበሽታ፣የካንሰርበሽታ , የደምማነስ) ? _____	
11	ትልቅየሚባልየቀዶጥገናሂደትነበረወት? _____ ሀ-አዋን ለ-አይደለም	
12	ደምተለግስዎትያውቃልን ? ሀ)አዎን ለ) አይደለ መልስዎአዎንከሆነምንያህልጊዜእናምንአይነትየደምተዋጽኦወስደዋል_____ _____	
11	በቅርብጊዜያጋጠመወትህመምወይምበሽታነበር ሀ)አዎን ለ) አይደለ	

Declaration

I, the undersigned, declare that this M.Sc. thesis is my original work, has not been presented for a degree in this or any other university and that all sources of materials used for the thesis have been duly acknowledged.

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Date of submission: _____

This thesis has been submitted with our approval as advisors.

Advisor: **Aster Tsegaye(MSc, PhD, Professor of Immuno-Hematology)_**

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.

Advisor: **MelatworkTibebu (MSc, PhD candidate)**

Signature: _____

Date: _____

Place: Addis Ababa, Ethiopia.