

## Investigation of hematological indices in Cardiac Patients

Khadija-Tul-Kubbra<sup>1</sup>, Zahed Mahmood<sup>1,2\*</sup>, Naveed Munir<sup>2</sup>, Muhammad Qamar Bilal<sup>3</sup>,  
Iqra Khalid<sup>1</sup>, Tahira Batool<sup>4</sup>, Muhammad Jahangeer<sup>2</sup>

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### Abstract

#### **Objective:**

Cardiovascular disease (CVD) is a major and growing contributor to morbidity and mortality in Asian countries including Pakistan. This study was designed to examine the variations in various hematological indicators in cardiac patients.

#### **Material and Methods:**

The study population included fifty subjects including healthy individuals as control group (n=20) and cardiac patients as test group (n=30). The blood samples taken from subjects were investigated for hematological indices using an Automated Hematology Analyzer Sysmex KX-21.

#### **Results:**

Significant variations in hematological indices were observed between the control group and test group individuals. Results showed that mean corpuscular volume, total white blood cells, packed cell volume and platelets count were increased significantly ( $p < 0.05$ ) in test-group individuals than in control-group. Erythrocyte sedimentation rate (ESR) was also increased in test group individuals. It was also found that hemoglobin concentration and percent neutrophil count were decreased significantly ( $p < 0.05$ ) in test-group as compared to control-group.

#### **Conclusion:**

This study concluded that investigating hematological indices is a useful indicator for evaluating the health status of cardiac patients along with other specific markers for cardiovascular diseases.

**Key Words:** Cardiovascular disease, Hemoglobin, White Blood Cells Count, ESR

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<sup>1</sup>Department of Biochemistry, University of Agriculture, Faisalabad, Pakistan.

<sup>2</sup>Department of Biochemistry, Government College University Faisalabad, Faisalabad, Pakistan.

<sup>3</sup>Institute of Animal & Dairy Sciences, University of Agriculture Faisalabad, Sub-campus Toba Tek Singh, Pakistan.

<sup>4</sup>Institute of Biochemistry and Biotechnology, University of the Punjab, Lahore, Pakistan.

\*Corresponding author Email: drzahiduaf2003@gmail.com

## **INTRODUCTION**

Cardiovascular disease (CVD) refers to any disease that affects the cardiac vessels involving both the heart and the blood vessels. Cardiac diseases are encompassing a range of cardiovascular conditions, and lives of millions across the globe are widely affected by the prevalence of these diseases. Despite recent advancements in the health sector, acute myocardial infarction (AMI) – an outcome of cardiovascular disease (CVD) – is one of the leading causes of mortality and morbidity in both developed and developing countries in the world (Järup et al., 2003; Anderson et al., 2017). Several factors such as increasing age, genetic predisposition, systemic arterial hypertension, dyslipidemia, smoking, excessive use of alcohol, diabetes, obesity, stress, and sedentary lifestyle contribute in the development of CVD (Cardiovascular-disease, 2009 and Li L, 2016). Additionally, certain dietary factors can help in lowering the risk of cardiac diseases such as decrease in the level of homocysteine through vitamin supplementation like vitamin B6, folic acid, and vitamin B12, and also with the consumption of vegetables and fruits which are the richest source of antioxidants (Rainwater et al., 1999). Hematological parameters are well known diagnostic and prognostic parameters having important role in many cardiovascular diseases, attributable to inflammation and systemic hypoxemia as underlying

mechanism, and leading to chronic cardiac insufficiency, circulatory failure and consequently, organ dysfunction (Budzianowski et al., 2017; Monteiro et al., 2015). Leukocytes play vital role in the patho-physiology of CVD and many studies indicated an increase in the total leukocyte count in CVD patients with increased mortality (Grau et al., 2004). Neutrophil and lymphocytes count in combination offer superior prognostic value than each individual parameter (Duffy et al., 2006). Red cell distribution width (RDW) measures the variations in red blood cells volume and the term anisocytosis is used to represent the elevation in RDW. Patients deficient in folate, vitamin B12 and iron showed elevation in RDW (Sertoglu et al., 2015). Numerous studies have documented the association between increased levels of RDW and the increased risk of developing adverse cardio-vascular consequences in people with myocardial infarction (Tonneli et al., 2008; Dabbah et al., 2010). Similarly, platelets distribution width (PDW) is a measure of the variations in the size of platelets. Increased bone marrow activity during thrombocytopoiesis causes the release of large immature platelets in excessive amount in patients with acute coronary syndrome (ACS). Measuring PDW at the time of admission is an inexpensive and routinely available biomarker allowing to predict the developing heart failure in cardiac patients after cardiac

intervention (Kowara et al., 2017). The present study was designed with the aim of investigating hematological indices in predicting the health status of cardiac patients.

## **MATERIALS & METHODS**

### **Study population:**

This study included fifty subjects including healthy individuals as control group (n=20) and cardiac patients as test group (n=30). Twenty healthy volunteers were selected from University of Agriculture, Faisalabad, Pakistan as control group while thirty cardiac patients were selected from Faisalabad Institute of Cardiology, Faisalabad, Pakistan and categorized as test group. Venous blood (5 mL) of all the study subjects was collected, and samples processing and analyses were done in the research laboratory of the Department of Biochemistry in the University of Agriculture, Faisalabad. All the test group patients selected for this study were suffering from cardiovascular disease. All the procedures in this study were carried out as framed by the research ethics committee of the University and the study plan was approved by the Directorate of Graduate Studies, University of Agriculture, Faisalabad, Pakistan. Informed consent had been taken from all subjects in the study population before inclusion in the study.

### **Sample collection and analysis:**

Blood samples from all the study population were collected in BD

syringes and transferred to EDTA anticoagulated vacutainers to inhibit the blood from clotting and well mixed. The well mixed anticoagulated whole blood collected from all the study subjects were analyzed for hematological indices following the procedure described by Patel et al. with the help of an automated hematology analyzer Sysmex KX-21. Hematological indices measured through analysis of whole blood with the help of automated hematology analyzer include total white blood cells (WBCs) count, differential white blood cells count including neutrophils, lymphocytes, monocytes and eosinophils, total red blood cells (RBCs) count, hemoglobin, packed cell volume (PCV), red cells indices including mean cell volume (MCV), mean cell hemoglobin (MCH), mean cell hemoglobin concentration (MCHC) and the total platelets counts (Patel et al., 2016). Erythrocyte sedimentation rate; ESR was measured through Westergren method following the principle of red cells sedimentation based on the cells medium and their differential densities measured in millimeter fall in first hour upon standing undisturbed (Cheesbrough, 2006).

### **Statistical analysis:**

The obtained data of hematological indices were statistically analyzed by applying analysis of variance (ANOVA) test for evaluating statistical significance between the study groups

with the help of SPSS version 11.5 (SPSS Inc., Chicago, IL, USA). Statistical significance level was considered at  $p$  value  $<0.05$ .

## RESULTS

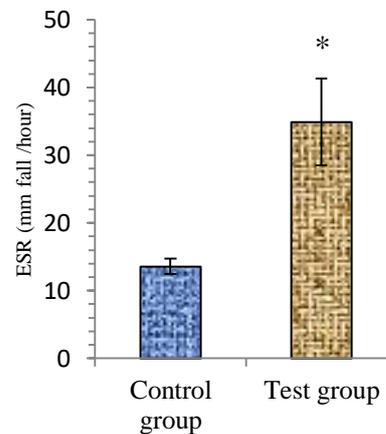
In this study we selected ( $n=50$ ) individuals, control group ( $n=20$ ) and cardiac patients as test group ( $n=30$ ). No significant difference was observed in total RBCs count between the study groups while hemoglobin concentration was found decreased in cardiac patients compared to healthy volunteers.

MCV was found increased in cardiac patients than in healthy volunteers. The results of hematological indices are given in Table 1. Total WBCs count was found to be significantly increased in test group compared to control group. The results of hematological indices are given in Table 1 which ESR is compared between the study groups in Figure 1.

## DISCUSSION

This study aimed to investigate differences in hematological indices in cardiac patients ( $n=30$ ) compared to healthy controls. Hematological indices play significant role in treatment strategies influencing the patient's health status. Results of the present study showed significant variations in hematological indices between the groups in the study population. When compared to control group (healthy volunteers), total WBC count was found to be significantly increased in

test group (cardiac patients). In agreement with our findings, previous studies also indicated an increase in the total leukocyte count (TLC) in CVD patients with increased mortality (Grau et al., 2004). Observing the differential WBCs count, it was found that percent neutrophil count was increased significantly whereas percent lymphocyte count was decreased in cardiac patients than in healthy volunteers.



**Figure 1: Mean  $\pm$  SE of erythrocyte sedimentation rate (ESR) in control group and test group individual from the study population. Note: Asteric above the bar represent statistical at  $p<0.05$ .**

Observing the differential WBCs count, it was found that percent neutrophil count was increased significantly whereas percent lymphocyte count was decreased in cardiac patients than in healthy volunteers. Monocytes and eosinophils count did not differ significantly in between the study groups. Previous studies reported that

neutrophils and lymphocytes count in combination provide better prognostic value than individual parameter (Duffy et al., 2006). It was demonstrated that neutrophil to lymphocyte ratio is related

to the coronary atherosclerosis progression which is an independent and strong predictor of future coronary events (Kalay et al., 2012).

In another study by Lassale et al. reported an association of increased

literature. In line with present study results of elevated platelets counts in

| Biochemical Parameters                   | Control group   | Test group     | P-value             |
|--|-----------------|----------------|---------------------|
|  | (n=20)          | (n=30)         |                     |
|  | Mean ± SE       | Mean ± SE      |                     |
| Hb (g/dL)                                | 12.80 ± 0.32    | 10.73 ± 0.37   | 0.0001*             |
| Total RBC (10 <sup>12</sup> cells/L)     | 4.56 ± 0.12     | 4.48 ± 0.11    | 0.15 <sup>NS</sup>  |
| PCV (L/L)                                | 47.3 ± 0.75     | 38.36 ± 1.27   | 0.030*              |
| MCV (fL)                                 | 81.1 ± 0.79     | 85.53 ± 0.87   | 0.0004*             |
| MCH (pg)                                 | 27.67 ± 1.86    | 28.26 ± 1.90   | 0.82 <sup>NS</sup>  |
| MCHC (g/dL)                              | 31.3 ± 0.20     | 31.63 ± 0.25   | 0.15 <sup>NS</sup>  |
| Total Platelet count (/mm <sup>3</sup> ) | 184250 ± 5705.7 | 290300 ± 164.0 | 0.000*              |
| Total WBC (/mm <sup>3</sup> )            | 6484 ± 173.8    | 13203 ± 213.4  | 0.000*              |
| Neutrophils (%)                          | 52 ± 0.85       | 61 ± 1.54      | 0.0009*             |
| Lymphocyte (%)                           | 44 ± 0.70       | 35 ± 1.29      | 0.000*              |
| Monocytes (%)                            | 2 ± 0.09        | 3 ± 0.09       | 0.794 <sup>NS</sup> |
| Eosinophils (%)                          | 2 ± 0.11        | 1 ± 0.12       | 0.04*               |

**Table 1: Hematological indices in cardiac patients and healthy volunteers**

total WBCs and differential WBCs count with higher risk of CVD (Lassale et al., 2018). In present study, total platelets count was found to be significantly increased in test group individuals compared to healthy volunteers. The findings of present study are analogous to the findings of previous studies published in the

cardiac patients, published studies reported higher risk of CVD mortality in top quartile of total platelets count (Thaulow et al., 1991, Lassale et al., 2018). Another study observed the higher risk of CVD incidence for increased platelets count (Sharp et al., 2005). No significant difference was observed in total RBCs count between

the study groups while hemoglobin concentration was decreased in cardiac patients compared to control group. MCV was found increased in cardiac patients than in healthy volunteers. Rogival and colleagues conducted experimental animal research to evaluate the total RBCs count, hemoglobin concentration, red cells indices, total WBCs count and the activity of lysozyme, and reported no significant differences in these parameters among study subjects (Rogival et al., 2006).

The results of the present study exhibited that ESR in the blood of cardiac patients increased significantly as compared to that of healthy controls. Importantly, an increased ESR is due to an increased amount of acute phase response in the body due to plasma proteins i.e., acute phase globulins, and is less commonly to inherent characteristics of red blood cells (RBCs) (Lee and Wintrobe, 1993). This study has certain limitations lacking the measurement of specific biomarkers for cardiac disease and small sample size. Thus, our results cannot be generalized to whole population.

## **CONCLUSION**

This study concluded that investigating hematological indices is a useful indicator for evaluating the health status of cardiac patients along with other specific markers for cardiovascular diseases. Significantly increased total WBCs count displayed an association

of higher risk for cardiac diseases. Investigating hematological indices is inexpensive, widely available and routinely used that may help to identify patients at risk of cardiac diseases. Further studies with large sample size of the study population are required to investigate the role of hematological indices and their association with specific biomarkers for evaluating the health status of cardiac patients.

## **Conflict of interest**

Authors declare that there is no conflict of interest.

## **Ethical approval**

Ethical and other necessary approvals were taken from Ethical Review Board of the University of Agriculture, Faisalabad, Pakistan.

## **Consent for Publication**

All author approved manuscript for publication.

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