

# Peripheral smear and CBC findings in CAD patients- a cross-sectional study

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**Abstract-** Cardiovascular diseases (CVD) are common non communicable disease and have high mortality rate globally, accounting for around 60% of all deaths. Recent studies have proved the association of various hematological parameters with cardiovascular diseases, including Red Cell Distribution Width(RDW), Mean Platelet Volume(MPV) and Neutrophil-Lymphocyte Ratio (NLR).

**Aim-** In this study, we aim to find the alterations in RBC morphology and other Complete Blood Count (CBC) parameters in patients with Coronary Artery Diseases (CAD) by comparing the values and peripheral smear findings with that of normal population.

**Method-** Peripheral smears and CBCs of 44 females and 56 males were reviewed from both normal population and patients with CAD, making a total of 200 cases. Blood samples were processed and evaluated by Auriba ABX Penta xlr hematology analyser.

**Data analysis:** Data was entered and tabulated in Microsoft Excel and analysis was carried out by SPSS software (version 16.0).

**Result-** Among the RBC parameters compared, Mean Corpuscular Volume (MCV) showed no significant change in CAD population as compared to normal population. Other parameters showed significant difference. Among the platelet parameters reviewed, Platelet Distribution Width (PDW) showed a significant increase in CAD patients when compared to normal population. Other parameters showed insignificant change.

**Conclusion-** According to this study, the RBC parameters have been significantly reduced in patients with CAD whereas RDW has been found to be significantly increased indicating increased anisopoikilocytosis. Higher WBC count and NLR has also been documented similar to other studies, while platelet parameters except PDW showed statistically insignificant changes.

**Keywords-** Cardiovascular diseases, Complete blood Count, Peripheral smear

## I. INTRODUCTION

Cardiovascular diseases (CVD) are common non communicable disease and have high mortality rate globally, accounting for around 60% of all deaths. <sup>(1)</sup>According to the Global Burden of Disease study that age-standardised death rate due to CVD has been 235 per 100000 people over the world, while India shows a higher average of 272 per 100000 population. <sup>(2)</sup> The sedentary lifestyle of people with poor diet and sleep habits have led to the early occurrence of modifiable diseases like hypertension, which when left untreated leads to other complications among which cardiovascular diseases are most important.

Recent studies have proved the association of various hematological parameters with cardiovascular diseases, including Red Cell Distribution Width(RDW), Mean Platelet Volume(MPV) and Neutrophil-Lymphocyte Ratio (NLR).<sup>(3,4,5,6)</sup> Increased MPV and NLR have been linked to the inflammatory process and reported as parameters determining the severity and prognosis of patients with cardiovascular diseases. Studies conducted have also shown that higher White Blood Cell (WBC) count is linked with both disease severity and incidence. Immunity and systemic inflammation can be determined by Neutrophil lymphocyte ratio and has been reported to be an important prognostic marker in malignancies and CVD. <sup>(7)</sup>

It has been suggested that Red Blood Cell (RBC) parameters like Hemoglobin (Hb) and RBC count can be used as markers for prediction of chronic myocardial injury but whether the correction of anemia in these patients can prevent disease progression is unclear. <sup>(8)</sup> In this study, we aim to find the alterations in RBC morphology and other Complete Blood Count (CBC) parameters in patients with Coronary Artery Diseases(CAD) by comparing the values and peripheral smear findings with that of normal population.

## II. MATERIALS AND METHOD

**Study area:** The study was conducted in Kerala, India.

**Study design and study period:** A cross –sectional study was carried out among patients who were known cases of coronary artery diseases, attending the out-patient department during the month of January 2023.

### Sample size:

Sample size was calculated using the following formula:

$$N = \frac{(Z_{\alpha/2} + 2\beta)^2 \times 2\sigma^2}{d^2}$$

d<sup>2</sup>

Where  $Z_{\alpha/2}$ =Critical value at 5% level of significance (1.96)  
 $2\beta$ =critical value at 80% power (0.84)  
 $\sigma$ =pooled standard deviation (0.56)  
 $d$ =mean difference (0.23)

Total of 200 subjects were included in this study. 100 patients with CAD attended the OPD during the month and the peripheral smears of these patients were drawn and reported. 100 subjects were selected from the normal population after being age and sex-adjusted. 44 females and 56 males were included in both groups.

**Inclusion criteria:** Patients who were known cases of cardiovascular diseases were included in the study.

**Exclusion criteria:** Patients with liver diseases, renal diseases and malignancies were excluded from this study.

**Study protocol:** Blood samples were sent to be processed and evaluated by Auriba ABX Penta xlr hematology analyser. CBC findings were obtained and peripheral smears were prepared and evaluated.

Data analysis: Data was entered and tabulated in Microsoft Excel and analysis was carried out by SPSS software (version 16.0).

### III. RESULTS

Peripheral smears and CBCs of 44 females and 56 males were reviewed from both normal population and patients with CAD, making a total of 200 cases. Ages ranged from 51 to 98 years.

Peripheral smear findings:

Out of 100 cases reviewed, 52 smears (52%) showed normocytic normochromic anemia with mild to moderate anisopoikilocytosis. Among these, 8 smears showed occasional microcytes and tear drop cells.

21 smears (21%) showed features of microcytic hypochromic anemia, while 6 smears (6%) showed dimorphic blood picture composed of normocytic and microcytic cells.

One smear showed evidence of microangiopathic hemolytic anemia and one case of macrocytic anemia was reported. The rest of the cases were all reported as normocytic normochromic blood picture.

Peripheral smear findings in CAD patients are depicted in Figure 1.

Among the normal population reviewed, 14 cases (14%) were reported as Normocytic normochromic anemia with one smear showing presence of occasional microcytes. 9 cases (9%) of microcytic hypochromic anemia were reported. One case of dimorphic anemia was reported showing normocytes and microcytes. The rest were reported as peripheral smear within normal limits.

Smears studied showed presence of large platelets in 27% of cases (27 out of 100 cases) and platelet aggregates in 9% cases (9 out of 100 cases). Compared to normal population that showed presence of large platelets in 6% of cases (6 out of 100 cases) and platelet aggregates in 4% cases (4 out of 100 cases)

The peripheral smear findings of normal population are depicted in Figure 2.

Figure 1: Peripheral smear findings in CAD patients

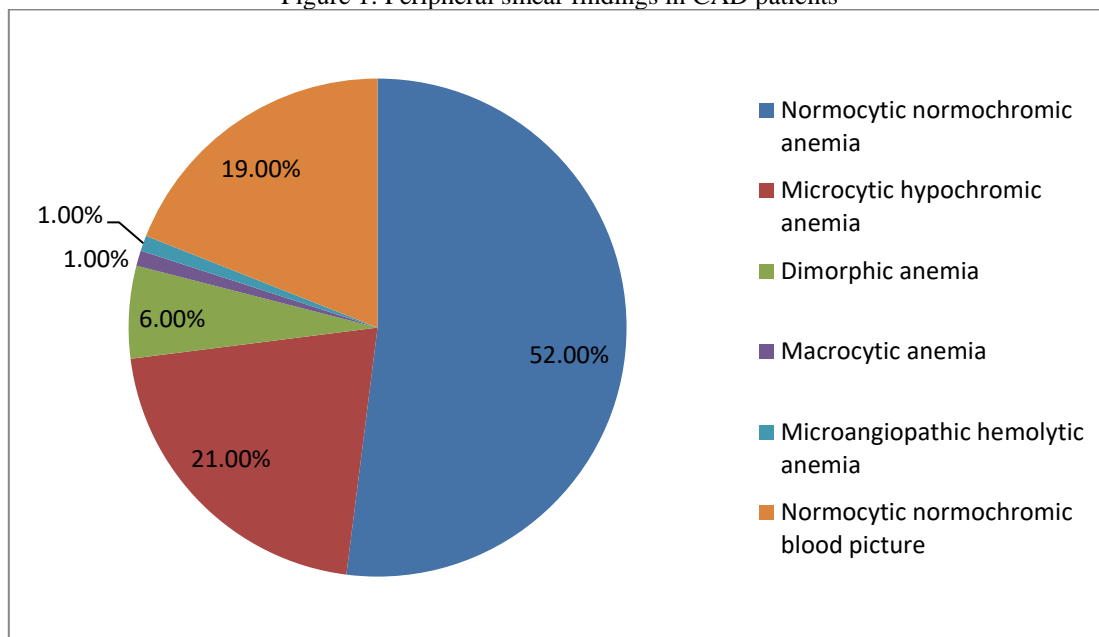
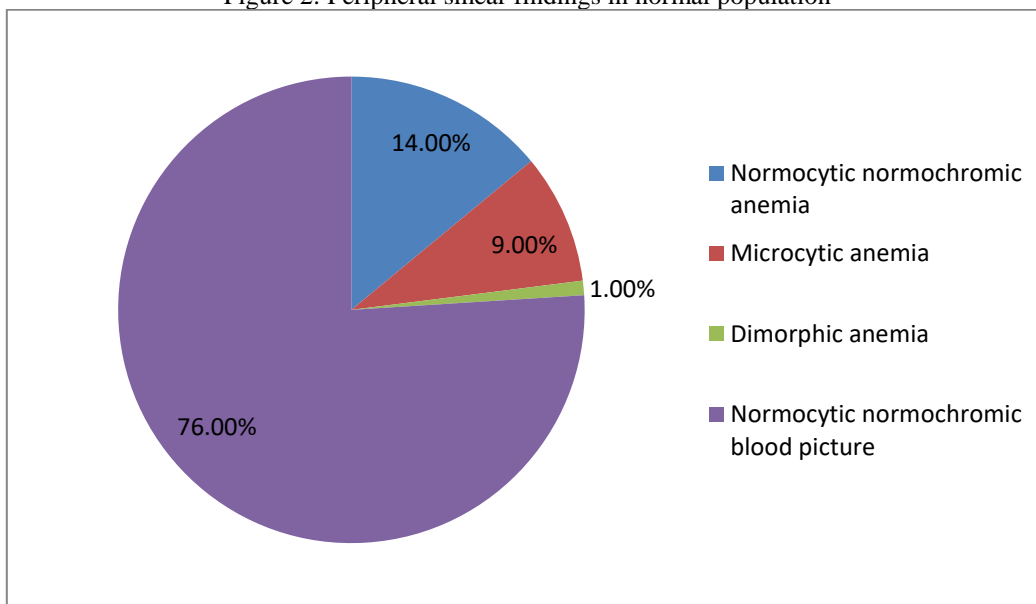


Figure 2: Peripheral smear findings in normal population



Compared to the 100 cases without CAD or other comorbidities, the platelet parameters showed no significant difference, whereas RBC parameters showed significant difference

The RBC parameters are entered in table 1.

Table 1: RBC parameters of both population

Parameters	Mean	Standard deviation	p-value
Hb of CAD patients (g/dl)	9.301282	2.706341	<0.001
Hb of normal population (g/dl)	12.16709	2.170296	
RBC count of CAD patients (x10 <sup>6</sup> /mm <sup>3</sup> )	3.319494	0.852336	<0.001
RBC count of normal population(x10 <sup>6</sup> /mm <sup>3</sup> )	4.154177	0.709237	
HCT of CAD patients (%)	28.15897	7.567024	<0.001
HCT of normal population (%)	35.81139	5.870329	
MCV of CAD patients (µm <sup>3</sup> )	85.16667	8.911421	>0.05
MCV of normal population (µm <sup>3</sup> )	86.58228	7.453458	
MCH of CAD patients (pg)	27.96203	3.494953	<0.05
MCH of normal population (pg)	29.39494	3.236407	
MCHC of CAD patients (g/dl)	32.84051	2.014977	<0.001
MCHC of normal population (g/dl)	33.89367	1.455612	
RDW-CV of CAD patients (%)	13.62152	2.005484	=0.001
RDW-CV of normal population (%)	12.71139	1.358165	
RDW-SD of CAD patients (µm <sup>3</sup> )	41.20253	5.08739	<0.05
RDW-SD of normal population (µm <sup>3</sup> )	39.25316	3.18437	

**Abbreviations:** Hb:Hemoglobin, RBC: Red Blood Cell, HCT: Hematocrit, MCV: Mean Corpuscular Volume, MCH: Mean Corpuscular Hemoglobin, MCHC: Mean Corpuscular Hemoglobin Concentration, RDW-CV : Red Cell Distribution Width – Coefficient of variation, RDW-SD :Red Cell Distribution Width- Standard Deviation

Among the RBC parameters compared, Mean Corpuscular Volume (MCV) showed no significant change in CAD population as compared to normal population. Other parameters showed significant difference with Hb, Hematocrit (HCT), RBC count, Mean Corpuscular Hemoglobin (MCH) and Mean Corpuscular Hemoglobin Concentration (MCHC) showing significant decrease and Red Cell Distribution Width (RDW) showing a significant increase in patients with CAD.

The platelet parameters are shown in table 2.

Table 2: Platelet parameters of both populations

Parameters	Mean	Standard deviation	p-value
Platelet count of CAD patients( $\times 10^5/\text{mm}^3$ )	2.77519	2.055248	>0.05
Platelet count of normal population( $\times 10^5/\text{mm}^3$ )	2.562658	1.056808	
MPV of CAD patients( $\mu\text{m}^3$ )	8.458228	1.161079	>0.05
MPV of normal population( $\mu\text{m}^3$ )	8.149367	0.939159	
PCT of CAD patients (%)	0.211089	0.119519	>0.05
PCT of normal population (%)	0.202127	0.071071	
PDW of CAD patients (%)	15.08228	4.300142	<0.05
PDW of normal population (%)	13.64103	2.953863	

**Abbreviations:** MPV: Mean Platelet Volume, PCT: Plateletcrit, PDW: Platelet Distribution Width

Among the platelet parameters reviewed, Platelet Distribution Width (PDW) showed a significant increase in CAD patients when compared to normal population. Other parameters showed insignificant change.

PDW ranged from 8.8% to 28% in CAD patients with a mean value of 15.08%, while values ranged from 8.5% to 22% in normal population with a mean value of 13.6%.

Total WBC count of CAD patients showed significant difference compared to normal population.

CAD patients showed WBC count ranging from  $3100/\text{mm}^3$  to  $8310/\text{mm}^3$  with a mean value of  $12420/\text{mm}^3$  whereas normal population showed values ranging from  $3615/\text{mm}^3$  to  $15720/\text{mm}^3$  with a mean value of  $7600/\text{mm}^3$ . A comparison between the two groups showed a p value  $<0.001$ , proving the value to be statistically significant.

#### **Neutrophil lymphocyte rati :**

Neutrophil lymphocyte ratio (NLR) of CAD patients showed significant difference compared to normal population.

CAD patients showed values ranging from 1.08 to 29.6 with a mean value of 7.24 whereas normal population showed values ranging from 0.87 to 14.6 with a mean value of 3.3. NLR comparison between the two groups showed a p value  $<0.001$ , proving the value to be statistically significant.

#### **Platelet-lymphocyte ratio:**

Platelet-lymphocyte ratio (PLR) of CAD patients showed no significant difference compared to normal population.

PLR of CAD patients ranged from 10.24 to 673.07 with a mean value of 189.9 whereas normal population 16.6 to 555.5 with a mean value of 153.5. PLR comparison between the two groups showed a p value  $>0.05$ , proving the value to be statistically insignificant.

## **IV. DISCUSSION**

Our study showed that all RBC parameters except MCV was significantly altered in CAD patients. Hb, RBC count, MCH, MCHC and HCT were significantly lower while RDW was significantly higher in patients with CAD. This is similar to other studies conducted by Cleland J G et al<sup>(9)</sup> while study conducted by Camille Lassale et al showed no significant correlation between RBC and CAD.<sup>(10)</sup> Few clinical studies have been initiated to explore the relationship between CAD and RBC parameters but the results have been inconsistent. So, further studies are warranted to establish a relationship between erythrocytes and CAD.

RDW has been identified as an independent prognostic biomarker for CAD in studies conducted by Al-Kindi et al<sup>(11)</sup>, Borne et al<sup>(12)</sup> and Sharma and Agarwal<sup>(13)</sup>. Study conducted by Abrahan et al<sup>(14)</sup> has also stated that lower RDW values are linked with lower risk of cardiovascular events.

The present study also shows an increased RDW value in patients with CAD. This correlates with the higher degree of anisopoikilocytosis seen in the peripheral smear of patients with CAD. In our study majority of cases showed normochytic normochromic cells with moderate anisopoikilocytosis with presence of microcytes and tear drop cells in few of the cases.

Platelet parameters showed no significant difference in CAD patients included in our study except PDW. Other studies have stated a relationship between MPV and disease severity in CAD, while studies conducted by H Wada showed low MPV values were related to worse clinical outcome.<sup>(15)</sup> Study conducted by Camille Lassale et al<sup>(10)</sup> show no significant relationship between MPV and CAD while higher platelet count was found to be associated with a higher risk. Study conducted by G Slavka<sup>(16)</sup> showed that higher MPV values were correlated with a higher risk of death in CAD patients, similar to studies conducted by Demirkol et al which showed elevated MPV in patients with CAD.<sup>(17)</sup>

Our study showed a higher WBC count with an elevated NLR in patients with CAD. The relationship between elevated WBC count and Cardiovascular outcomes have been demonstrated previously.<sup>(18,19)</sup> This finding is in concordance with other studies conducted by Barron et al,<sup>(20)</sup> Zhang et al<sup>(21)</sup> and Balta and Ozturk.<sup>(22)</sup> Elevated WBC count with elevated NLR is a marker of the inflammatory response and indicates a worse prognosis.<sup>(23)</sup> Elevated WBC count causes a decrease in blood flow which leads to coronary heart disease when the cardiac vasculature is affected.<sup>(24)</sup>

Previous studies have showed that increased Platelet-lymphocyte ratio are linked with increased microvascular complications.<sup>(25-29)</sup> But the current study showed no significant difference in PLR values of CAD patients. A study conducted by A Gupta et al showed that PLR was inversely correlated with CAD.<sup>(30)</sup>

Further studies are warranted to establish a relationship between platelet parameters and CAD. This study is limited due to the fact that this is a cross-sectional study and prognostic follow-up could not be evaluated.

## V. CONCLUSION

According to this study, the RBC parameters have been significantly reduced in patients with CAD whereas RDW has been found to be significantly increased indicating increased anisopoikilocytosis. Higher WBC count and NLR has also been documented similar to other studies, while platelet parameters except PDW showed statistically insignificant changes.

## VI. CONFLICTS OF INTEREST:

None

## VII. FUNDING :

None

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