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COMPARISON OF HEMATOLOGICAL PARAMETERS IN PRIMARY HYPERTENSIVE AND NORMOTENSIVE INDIVIDUALS

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Abstract:

Background and Objective: Analyze and find out the association between blood pressure and hematological parameters among hypertensive and normotensive individuals.

Methodology: A cross-sectional comparative study was conducted from January to December 2022 on a total of 45 patients diagnosed with primary hypertension and 45 normotensive individuals aged between 25-60 at GMC, Kozhikode. All the participants, after receiving informed consent, were subjected to a detailed history, blood pressure measurement, and hematological analysis. The data were entered and analyzed using Statistical Package for Social Sciences (SPSS) version 22. A statistically significant p-value was defined as one that was less than 0.05.

Results: The mean values of BMI (27.87±5.4), WBC (7.60±1.65), RBC (4.72±0.65), HEMOGLOBIN (13.26±1.12), HEMATOCRIT (40.7±2.81), MCV (87.5±5.3), MCH (28.50±2.36), MCHC (32.66±2.20), RDW-SD (46.22±4.53), RDW-CV (14.02±1.2), Platelet Count (249.8±51.66), PDW (12.7±2.2), MPV (9.3±0.89) , PCT (0.23±0.05) were increased in primary hypertensive group compared to age and sex matched normotensive group. Statistically significant differences were observed in WBC, RBC, Hb, HCT, MCH, RDW, PLT, PDW, MPV, and PCT. However, MCV and MCHC did not show statistically significant differences.

Conclusion: Hypertension has an impact on red blood cells and its indices, white blood cells, platelet count and its indices. Hence, it can be used to monitor the prognosis of the disease and manage hypertensive related complications. It also helps to prevent complications associated with hematological aberrations.

Keywords: Hypertension, RBC, WBC, Hematocrit, Hemoglobin,

INTRODUCTION

Systemic arterial hypertension (HTN) is a common non-communicable multisystem disorder with uncertain aetiology and patho-physiology[1]. The term ‘hyper’ is a Greek word that means over or beyond, and ‘tension’ is a Latin word that means stretching or straining. Hypertension therefore means straining beyond[2]. Based on the 2020 International Society of Hypertension (ISH) global hypertension practice guidelines, normal BP was defined as systolic blood

pressure (SBP) <130 mmHg and diastolic blood pressure(DBP) < 85 mmHg, high normal BP with SBP of 130-139 mmHg and/or DBP 85–89 mmHg, Grade I hypertension with SBP of 140–159 mmHg and/or DBP 90–99 mmHg, and Grade II HTN with SBP ≥ 160 mmHgand/orr DBP ≥ 100 mmHg[3,4].

Hypertension can be categorized into two; primary and secondary hypertension[5]. Primary hypertension is also known as essential hypertension. About 95% of adults with high blood pressure have primary hypertension.

HTN may lead to congestive heart failure, acute myocardial infarction, peripheral vascular disease, stroke and coronary heart disease, which constitute the leading cause of mortality and morbidity in the general population[6,7].

In hypertension, there are important alterations in the rheological, mechanical, and biochemical characteristics of erythrocytes, and changes in blood flow have been shown. The development of HTN is accompanied by a reduction in deformability, and an increase in the number and aggregability of red blood cells,[8] there by alteration in red cell indices like mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), mean corpuscular hemoglobin concentration (MCHC), and red cell distribution width (RDW). These abnormalities of the red cells may worsen the microcirculation and enhances end-organ damage.[9]

MATERIALS AND METHODS

A cross-sectional comparative study was conducted from January to December 2022 on a total of 45 patients diagnosed with primary hypertension and 45 normotensive individuals aged between 25-60 at GMC, Kozhikode. All the participants, after taking informed consent, were subjected to a detailed history, blood pressure measurement, and hematological analysis.

Inclusion Criteria:

Group A (cases): Patients diagnosed with primary hypertension, irrespective of duration of illness (systolic BP >140 mmHg and diastolic BP >90 mmHg), in the age group of 25-60 years, attending the outpatient department of General Medicine Department of Government Medical College, Kozhikode.

Group B (control): subjects with normal BP in the same age group from patient's bystanders, medical and paramedical staff of Government Medical College, Kozhikode.

Exclusion Criteria:

- Subjects already diagnosed with secondary hypertension, systemic diseases like diabetes mellitus, Heart disease, Endocrine disorders, Collagen tissue disease, any chronic illness, Acute and chronic infectious diseases
- Alcoholic patients and smokers.
- Subjects consuming drugs other than anti hypertensives (Antibiotics, NSAIDS, Anti-coagulants, Immunosuppressant)
- Patients with malignancy and hematological disorders.
- Subjects not giving written consent.
- Bystanders genetically related to patients.

SAMPLE SIZE

Sample size was calculated using the formula, $n = \frac{(Z\alpha + Z\beta)^2 \ SD^2 \ X \ 2}{d^2}$, where

n: sample size
Zα: Z value for a α error of 5% (1.96)
Zβ: Z value for a β error of 20% (0.84)
SD: Standard Deviation was found to be 0.85 as per K Ranjith Babu et al[10].
d: effect size (0.5)
To detect a difference in two groups under the study, the sample size required is 45. So, we have 45 participants in each group in our study.

Statistical analysis

For the entry of the statistical data, the computer package used was Microsoft Excel. The data were analysed using Statistical Package for Social Sciences (SPSS) version 22 software on Windows. The significance of the difference in mean of each parameter between the two groups was analysed using the student's 't' test. For all statistical tests, a p value ≤ 0.05 was taken as the level of significance. The results are summarized as figures and tables.

RESULTS

Table 1- Distribution of age among the study groups (n=90)

Age	Hypertensive, n (%)	Controls, n (%)	Total

Range	25-60	25-60	
Mean ± SD	41.78 ±10.60	42.16 ±10.73	
25-33	14 (31.1 %)	14(31.1 %)	28 (31.1 %)
34-42	10 (22.2 %)	9 (20 %)	19 (21.1 %)
43-51	10 (22.2 %)	11 (24.4 %)	21 (23.3 %)
52-60	11 (24.4 %)	11 (24.4 %)	22 (24.4 %)
Total	45 (100 %)	45 (100 %)	90 (100 %)
Independent T Test, p = 0.867, insignificant			

A complete blood count (CBC) was conducted among 90 subjects. Subjects were categorized into two groups: the hypertensive group (cases) and the normal healthy group (controls). There were 45 subjects in each group in the age group 25-60 years

Distribution of age among the study groups.

Table 2: Comparison of Hematocrit between study groups

Hypertensives		**Controls**		**P Value**
Range	Mean±SD	Range	Mean±SD	

36-48	40.7±2.81	33-45	38.58±2.3	0.000

As per Table 2, there was a significant difference in the hematocrit (p value <0.000) in the hypertensive group compared to the controls, and the p value was significant.

Table 3: Comparison of MCH between study groups

Hypertensives		**Controls**		**P Value**
Range	Mean±SD	Range	Mean±SD	
23-37	28.50±2.36	22-33	27.43±2.2	0.027

As per Table 3 there was a significant difference in the mean corpuscular hemoglobin (p value =0.027) in the hypertensive group compared to the controls, and the p value was significant.

Table 4: Comparison of MCHC between study groups

Hypertensives		Controls		P Value
Range	Mean±SD	Range	Mean±SD	
26-38	32.66±2.20	25-37	32±2.02	0.097

As per Table 4 there was no significant difference in the mean corpuscular hemoglobin concentration (p value = 0.097) in the hypertensive group compared to the controls, and the p value was insignificant.

Table 5: Comparison of platelet count between study groups

Hypertensives	Controls	P Value

Range	Mean±SD	Range	Mean±SD	
160-339	249.8±51.66	151-322	225.73±51.01	0.029

As per Table 5 there was a significant difference in the platelet count (p value =0.029) in the hypertensive group compared to the controls, and the p value was significant.

Table 6: Comparison of PDW between study groups

Hypertensives		Controls		P Value
Range	Mean±SD	Range	Mean±SD	
10-17	12.7±2.2	8-16	11.7±2.5	0.041

As per Table 6 there was a significant difference in the platelet distribution width (p value =0.041) in the hypertensive group compared to the controls and the p value was significant.

Table 7: Comparison of MPV between study groups

Hypertensives		Controls		P Value
Range	Mean±SD	Range	Mean±SD	
8-11	9.3±0.89	7-10	8.52±1	0.000

As per Table 7 there was a significant difference in the mean platelet volume (p value <0.001) in the hypertensive group compared to the controls, and the p value was significant.

Table 8: Comparison of PCT between study groups

Hypertensives		Controls		P Value
Range	Mean±SD	Range	Mean±SD	
0.12-0.33	0.23±0.05	0.11-0.31	0.19±0.05	0.000

As per Table 8 there was a significant difference in the Platelet crit (p value <0.001) in the hypertensive group compared to the controls, and the p value was significant.

DISCUSSION

Hypertension remains one of the most significant causes of mortality worldwide. It is broadly classified as primary and secondary hypertension. In this study, out of 45 hypertensive subjects, 21 (46.7%) were males and 24 (53.3%) were females. Out of 45 controls, 21 (46.7%) were males and 24 (53.3%) were females. The mean age among hypertensive groups in this study was 41.78 with a SD of 10.60, and that of the control was 42.16 with a SD of 10.73. Among the study groups, 31.1% belong to the age group of 25-33 years, 21.1% belong to 34-42 years, 23.3% belong to the age group of 43-51 years, and 24.4% belong to 52-60 years. In the present study, the comparison of age and gender between hypertensive subjects and controls did not reveal any significant differences. This suggests that the groups were age and gender matched.

The mean height was closely around 157 cm in both study groups; hence, the heights in the study groups were not statistically significant. The mean weight was found to be higher in the hypertensive group (68.8 ± 13.19) kg than in the control group (63.78 ± 10.13) kg. The mean white blood cell count was 7.60 ± 1.65 x 10^3/µl among the hypertensive group and 6.84 ± 1.61 x 10^3/µl among the control group. The WBC count in hypertension was found to be elevated as compared to that of normotensives. This elevation was statistically significant (p <0.05).

According to the study conducted by K. Ranjith Babu, Nanda Kumar L.G., A.B. Solepure, and Rashid Shaikh, there is an increased WBC count in primary hypertensives compared to normotensives[10].

The increased WBC count in hypertensive patients could be due to the presence of endothelial dysfunction in hypertension, which leads to activation of the cytokine system. Cytokines such as stem cell factor SCF/c-kit are produced to repair the endothelial injury which participates in differentiation and proliferation of hematopoietic cell[14].

In the present study, the mean value of hemoglobin was highly significant ($p < 0.0001$) in the hypertensive group (13.26 ± 1.12) compared to the normotensive group (12.35 ± 1.04). This finding is in agreement with studies from India[10,11,12] The mechanisms that lead to elevated blood pressure in individuals with an increased Hb level are not entirely known, In the past, several biological mechanisms have been proposed for its association. Elevated Hb is strongly related to arterial stiffness, as measured by pulse wave velocity, which increases SBP and DBP[13].

In the present study, the mean value of hematocrit was highly significant ($p < 0.0001$) in the hypertensive group (40.7 ± 2.81) compared to the normotensive group (38.58 ± 2.3). This is similar to the findings of Babu k et al[10]. The greater blood viscosity caused by higher hematocrit and increased peripheral resistance to blood flow appear to be the most reasonable causes underlying the association between hematocrit and blood pressure[14]. In hypertension, higher HCT could reflect a true increase in red blood cell mass as well as hemoconcentration caused by a reduction in plasma volume[15].

In the present study, the mean ± SD of MCV (87.5 ± 5.3; 85.6 ± 5.43), MCH (28.50 ± 2.36; 27.43 ± 2.2), and MCHC (32.66±2.20; 32±2.02) were increased in the hypertensive group compared to the control group, but MCV and MCHC were not statistically significant ($p > 0.05$). It is supported by Emamian et al[11]. There was a statistically significant increase in the MCH value in the hypertensives compared to the normotensives ($p = 0.027$). Study conducted by Enawgaw et al[16] showed significantly higher MCV and MCHC in hypertensive groups but there were no significant differences in MCH.

The level of platelet count in hypertensives was found to be increased as compared to that of controls, and the difference was statistically significant ($p < 0.05$). The mean levels of platelet count in hypertensives were 249.8 ± 51.66 x 10^3/µl and in controls, they were 225.73 ± 51.01 x 10^3/µl.

According to a study conducted in India by K.Ranjith Babu, Nanda kumar L.G, A.B. Solepure and Rashid Shaikh, mean levels of thrombocyte count were found to be significantly higher in the hypertensives[10]

The present study showed that the hypertensive group had significantly higher mean value of PDW (12.7 ± 2.2; 11.7 ± 2.5 fl), MPV (9.3 ± 0.89; 8.52 ± 1 fl) and PCT (0.23 ± 0.05; 0.19 ± 0.05 %) compared to the control group. These findings are familiar to Enawgaw et al[16]. Sileshi et al[17] showed a statistically significant increase in MPV in hypertensives compared to a healthy control group.

Impaired hematological parameters in the present study may be linked to various functional and structural changes in different organs associated with elevated blood pressure. The detection of risk factors in the early stages of the disease will help the patient in improving their health condition and will reduce the morbidity rate. Hypertensive patients can be advised to keep their blood pressure level under prompt control to prevent the complications. Along with clinical evaluation routine blood investigations can be advised to detect hematological abnormalities to prevent the progression of hypertension induced end organ damage.

CONCLUSION

The present study was conducted to assess the hematological abnormalities in subjects with hypertension and compare it with healthy controls. The study group included 90 subjects, of which 45 were hypertensives and 45 were healthy controls. In conclusion, the findings of the present study suggest that hypertension does affect hematological parameters, leading to end-organ damage. This indicates that a CBC may offer early evidence for the presence of end organ damage in patients with hypertension. In hypertension, hematological complications such as a decrease in red blood cell (RBC) deformability and an increase in size, leading to hemolysis, along with elevated hemoglobin levels and high platelet activation, are observed. These factors are associated with cardiovascular risks and an increased likelihood of thrombotic diseases. Therefore, it is crucial to assess changes in hematological parameters among hypertensive patients as this assessment can aid in the prevention of complications associated with hematological disorders.

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