Evaluation of Full Blood Count in Patients With Cushings Syndrome Attending Federal Teaching Hospital, Owerri, Nigeria.

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Abstract

Cushing's syndrome is a hormonal disorder caused by prolonged exposure to high cortisol levels, either produced naturally by the body or introduced through steroid medications. While its effects on metabolism and hormonal balance are well known, it can also lead to significant changes in blood parameters. This study was carried out to investigate those haematological changes in patients with Cushing's syndrome in Owerri, Imo State, Nigeria, with the goal of improving clinical understanding and patient care at the Federal Teaching Hospital, Owerri.

A total of 30 patients diagnosed with Cushing's syndrome were compared with 30 healthy individuals of similar age and sex. Blood samples were collected and analyzed for red blood cell indices, white cell counts, and platelet levels. The data was processed using SPSS version 27. Results showed that patients with Cushing's syndrome had lower levels of haemoglobin (8.64 ± 1.63 g/dL), packed cell volume (25.53 ± 4.88%), red blood cell count (3.28±0.68 × 10^{12}/L), mean cell volume (74.63 ± 11.29 fL), mean cell haemoglobin (25.93 ± 3.15 pg), and lymphocyte percentage (28.30±10.99%) compared to the control group. In contrast, red cell distribution width (15.70 ± 2.29%), total white blood cell count (10.55 ± 4.04 × 10^9/L), neutrophils (66.23 ± 12.93%), and platelets (310.10 ± 108.33 × 10^9/L) were significantly higher in the Cushing's group. When haematological parameters were compared between patients aged 20-40 years and those above 40 years, no significant differences were found, indicating that age did not appear to significantly influence the blood profile in this cohort.No significant differences were also observed among males and females with cushing'ssyndrome.Mean cell volume showed a non-significant positive relationship with PCV, haemoglobin, RBC, MCH, MCHC, and neutrophils, and a non-significant negative relationship with RDW, white blood cells, lymphocytes, monocytes, eosinophils, and platelets.

Key words: Cushing's Syndrome, Full Blood Count, Cortisol, Owerri

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Introduction

Cushing's syndrome is a chronic endocrine disorder characterized by prolonged exposure to excessive levels of cortisol, either due to endogenous overproduction or exogenous administration of glucocorticoids. Endogenous causes include pituitary adenomas (Cushing's disease), adrenal tumors, and ectopic ACTH-producing tumors, while exogenous causes are often linked to long-term corticosteroid therapy for conditions like asthma, rheumatoid arthritis, or autoimmune disorders[1,2]. The syndrome is relatively rare, with an estimated incidence of 1–3 cases per million annually, but its clinical impact is profound due to the multi-system involvement[3].

Clinically, Cushing's syndrome is associated with central obesity, moon face, muscle weakness, purple striae, hypertension, glucose intolerance, osteoporosis, and psychiatric disturbances[4]. However, in addition to these metabolic and structural effects, cortisol plays a critical role in modulating the immune system and hematopoiesis. High cortisol levels can cause lymphocytopenia, neutrophilia, eosinopenia, and suppression of inflammatory responses[5]. It also affects red blood cell production, sometimes contributing to anemia and alterations in red cell indices like mean corpuscular volume (MCV) and mean corpuscular hemoglobin (MCH)[6].

Despite the known systemic effects of cortisol, haematological abnormalities in Cushing's syndrome remain underexplored, particularly in African populations. Most available studies have been conducted in Western or Asian countries, with limited focus on African cohorts. In Nigeria, published research on the haematological profile of patients with Cushing's syndrome is scarce, and there is virtually no data from the southeastern region, including Owerri. Given potential ethnic and regional variations in disease expression and healthcare access, it is important to generate localized data.

This study aims to evaluate the hematological parameters such as red and white blood cell counts, platelet levels, and differential white cell distributions in patients with Cushing's syndrome attending the Federal Teaching Hospital, Owerri. By comparing findings with those of healthy individuals, this research seeks to provide insights into disease mechanisms and support better diagnosis and management in local clinical settings

Materials and Methods

Study Area

The research was conducted at the Federal Teaching Hospital, Owerri (FTHO), a tertiary healthcare facility in Imo State, southeastern Nigeria. The hospital offers specialist services, including endocrinology and haematology, and has functional diagnostic laboratories essential for the study.

Study Design

This was a cross-sectional, comparative study carried out between February and April 2024 Two groups were involved: 30 patients with clinically and biochemically confirmed Cushing's syndrome and 30 age- and sex-matched healthy individuals serving as controls.

Study Population

Participants were aged between 20 and 60 years. Patients diagnosed with Cushing's syndrome were recruited from the Endocrinology Clinic of FTHO. Healthy volunteers from the hospital community were recruited as controls. Individuals with chronic illnesses, recent infections, or known haematologic disorders were excluded.

Ethical Considerations

Ethical approval for this study was obtained from the Ethics and Research Committee of the Federal Teaching Hospital, Owerri (March, 19, 2024: FTH/OW/HREC/VOL.1/070). All participants were informed about the study's purpose, procedures, and potential risks. Written informed consent was obtained before enrollment. Participants were assured of confidentiality, and their decision to participate or withdraw at any point was respected without consequences to their care.

Sample Collection

Five milliliters of venous blood were collected aseptically from each participant using a sterile

syringe and needle. The blood was drawn from the antecubital vein and immediately transferred into EDTA tubes to prevent clotting. All samples were labeled and analyzed within two hours of collection to ensure result accuracy and sample integrity.

Laboratory Procedures

The collected blood samples were analyzed using an automated haematology analyzer (e.g., Mindray BC-5300). The parameters measured included haemoglobin (Hb), packed cell volume (PCV), red blood cell (RBC) count, mean cell volume (MCV), mean cell haemoglobin (MCH), mean cell haemoglobin concentration (MCHC), red cell distribution width (RDW), total white blood cell count (TWBC), differential white cell counts (neutrophils, lymphocytes, monocytes, eosinophils), and platelet count.

Results

Table 1: Mean Values of PCV, Haemoglobin, RBC, MCV, MCH, MCHC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Cushing's Syndrome Patients Versus Controls.

Parameters	Test n 30	Control n 30	t-value	P-value
Haemoglobin (g/dl)	8.64 ± 1.63	11.78. ± 2.45	5.84	0.000*
PCV (%)	25.53 ± 4.88	35.83 ± 3.14	9.72	0.000*
RBC ($x10^{12}$/L)	3.28 ± 0.68	3.80 ± 0.48	3.41	0.001*
MCV (%)	74.63 ± 11.29	95.27 ± 9.06	7.81	0.000*
MCH (%)	25.93 ± 3.15	32.33 ± 3.17	7.85	0.000*
MCHC (%)	33.87 ± 10.36	34.27 ± 1.74	0.21	0.836
RDW (%)	15.70 ± 2.29	12.10 ± 1.92	6.59	0.000*
TWBC ($x10^9$/L)	10.55 ± 4.04	8.56 ± 3.92	1.93	0.050*
Neutrophils (%)	66.23 ± 12.93	41.20 ± 9.64	8.50	0.000*
Lymphocytes (%)	28.30 ± 10.99	53.30 ± 10.05	9.19	0.000*
Monocytes (%)	3.70 ± 3.16	3.57 ± 3.02	0.17	0.868
Eosinophils (%)	1.63 ± 1.03	1.87 ± 1.36	0.75	0.457
Platelets ($x10^9$/L)	310.10 ± 108.33	225.37 ± 88.36	3.32	0.002*

Key:
PCV - Packed Cell Volume
RBC - Red Blood Cell
(*) - Significant p value
MCV – Mean Corpuscular Volume
MCH – Mean Corpuscular Haemoglobin
MCHC - Mean Corpuscular Haemoglobin Concentration
RDW – Red Cell Distribution Width
TWBC – Total White Cell Count
S.D - Standard Deviation

Table 1 shows the Mean Values of PCV, Haemoglobin, RBC, MCV, MCH, MCHC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Cushing's syndrome Patients Versus Controls. The mean values of haemoglobin (8.64 ± 1.63)g/dl, PCV (25.53 ± 4.88)%, RBC (3.28 ± 0.68) x 10^{12}/L, MCV (74.63 ± 11.29)%, MCH (25.93 ± 3.15)% and lymphocytes (28.30 ± 10.99)% were significantly reduced in Cushing's

Syndrome Patients when compared to controls (11.78. ± 2.45)g/dl, (35.83 ± 3.14)%, (3.80 ± 0.48) x 10^{12}/L, (95.27 ± 9.06)%, (32.33 ± 3.17)% and (53.30 ± 10.05)% (t = 5.84, p = 0.000; t = 9.72, p = 0.000; t = 3.41, p = 0.001; t = 7.81, p = 0.000; t = 7.85, p = 0.000; t = 9.19, p = 0.000).

The mean values of RDW (15.70 ± 2.29)%, TWBC (10.55 ± 4.04) x10^{12}/L, neutrophils(66.23 ± 12.93)% and platelets (310.10 ± 108.33) x 10^{9}/L were significantly increased in Cushing's Syndrome Patients when compared to controls (12.10 ± 1.92)%, (8.56 ± 3.92) x 10^{12}/L, (41.20 ± 9.64)% and (225.37 ± 88.36) x 10^{9}/L (t = 6.59, p = 0.000; t = 1.93, p = 0.050; t = 8.50, p = 0.000; t = 3.32, p = 0.002).

There was no significant decrease in the mean values of MCHC (25.93 ± 3.15)%, and eosinophils (1.63 ± 1.03)% in Cushing's Syndrome Patients when compared to controls (34.27 ± 1.74)%, and (1.87 ± 1.36)% (t = 0.21, p = 0.836; t = 0.75, p = 0.457).

However, a non-significant increase in the mean value of monocytes (3.70 ± 3.16)% was observed in patients with Cushing's Syndrome when compared to the controls (3.57 ± 3.02)% (t = 0.17, p = 0.868).

Table 2: Mean Values of PCV, Haemoglobin, RBC, MCV, MCH, MCHC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Male and Female Patients with Cushing' Syndrome.

Parameter	Male	Female	t-value	p-value
Haemoglobin (g/dl)	8.49 ± 1.45	9.05. ± 2.11	0.83	0.416
PCV (%)	25.13 ± 4.49	26.62 ± 6.02	0.73	0.470
RBC (x10^{12}/L)	3.18 ± 0.65	3.55 ± 0.75	1.31	0.202
MCV (%)	74.64 ± 12.93	74.62 ± 5.18	0.02	0.998
MCH (%)	26.32 ± 3.40	24.87 ± 2.17	1.11	0.275
MCHC (%)	34.05 ± 12.13	33.38 ± 1.84	0.15	0.879
RDW (%)	15.45 ± 2.46	16.38 ± 1.68	0.97	0.339
TWBC (x10^{9}/L)	11.11 ± 3.85	9.00 ± 4.39	1.28	0.210
Neutrophils (%)	67.41 ± 13.64	63.00 ± 10.85	0.82	0.418
Lymphocytes (%)	26.82 ± 11.45	32.37 ± 9.02	1.24	0.227
Monocytes (%)	3.95 ± 3.08	3.00 ± 3.51	0.73	0.475
Eosinophils (%)	1.63 ± 1.09	1.62 ± 0.92	0.03	0.979
Platelets (x10^{9}/L)	321.27 ± 115.09	279.38 ± 86.05	0.94	0.358

Key:
PCV - Packed Cell Volume
RBC - Red Blood Cell
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MCV – Mean Corpuscular Volume
MCH – Mean Corpuscular Haemoglobin
MCHC - Mean Corpuscular Haemoglobin Concentration
RDW – Red Cell Distribution Width
TWBC – Total White Cell Count
S.D - Standard Deviation

Table 2 shows the Mean Values of PCV, Haemoglobin, RBC, MCV, MCH, MCHC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Male and Female Patients with Cushing Syndrome. There was no significant decrease in the mean values of Haemoglobin (8.49 ± 1.45)g/dl, PCV (25.13 ± 4.49)%, RBC (3.18 ± 0.65) x 10^{12}/L, RDW (15.45 ± 2.46)%, Lymphocytes (26.82 ± 11.45)%, in males Cushing's Syndrome Patients when compared to females (9.05. ± 2.11)g/dl, (26.62 ± 6.02)%, (3.55 ± 0.75) x 10^{12}/L, (16.38 ± 1.68)%, (32.37 ± 9.02)%, (t = 0.83, p = 0.416; t = 0.73, p = 0.470; t = 1.31, p = 0.202; t = 0.97, p = 0.339; t = 1.24, p = 0.227)

The mean values of MCV (74.64 ± 12.93)%, MCH (26.32 ± 3.40)%, MCHC (34.05 ± 12.13)%, TWBC (11.11 ± 3.85) x 10^9/L, Neutrophils (67.41 ± 13.64)%, Monocytes (3.95 ± 3.08)%, Eosinophils (1.63 ± 1.09)%, and Platelets (321.27 ± 115.09) x 10^9/L in males with Cushing's syndrome were not significantly increased when compared to female patients (74.62 ± 5.18)%, (24.87 ± 2.17)%, (33.38 ± 1.84)%, (9.00 ± 4.39) x 10^9/L, (63.00 ± 10.85)%, monocytes (3.00 ± 3.51)%, (1.62 ± 0.92)% and (279.38 ± 115.09) x 10^9/L. (t = 0.02, p = 0.988; t = 1.11, p = 0.275; t = 0.15, p = 0.879; t = 1.28, p = 0.210; t = 0.82, p = 0.418; t = 0.73, p = 0.475; t = 0.03, p = 0.979; t = 0.94, p = 0.358).

Table 3: Mean Values of PCV, Haemoglobin, RBC, MCV, MCH, MCHC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Cushing's Syndrome Patients of ages (20-40) years and (>40) years.

Parameter	(20-40)yrs	(>40)yrs	t-value	p-value
Haemoglobin (g/dl)	9.06 ± 1.78	8.30. ± 1.89	1.13	0.268
PCV (%)	26.67 ± 5.60	24.33 ± 5.59	1.14	0.263
RBC (x10^{12}/L)	3.37 ± 0.82	3.17 ± 0.75	0.72	0.476
MCV (%)	76.20 ± 8.57	76.53 ± 8.37	0.11	0.915
MCH (%)	25.87 ± 2.79	26.00 ± 2.27	0.14	0.887
MCHC (%)	31.93 ± 6.22	32.33 ± 6.39	0.17	0.863
RDW (%)	15.60 ± 2.29	14.93 ± 2.15	0.82	0.419
TWBC (x10^9/L)	9.97 ± 3.35	10.81 ± 5.13	0.53	0.600
Neutrophils (%)	65.80 ± 11.58	68.00 ± 14.97	0.45	0.656
Lymphocytes (%)	28.27 ± 10.95	26.13 ± 11.99	0.51	0.615
Monocytes (%)	4.00 ± 2.93	3.87 ± 3.27	0.12	0.907
Eosinophils (%)	1.93 ± 0.96	1.47 ± 1.19	1.18	0.247
Platelets (x10^9/L)	321.27 ± 101.48	292.47 ± 100.29	0.54	0.595

Key:
PCV - Packed Cell Volume
RBC - Red Blood Cell
(*) - Significant p value
MCV – Mean Corpuscular Volume
MCH – Mean Corpuscular Haemoglobin
MCHC - Mean Corpuscular Haemoglobin Concentration
RDW – Red Cell Distribution Width
TWBC – Total White Cell Count
D - Standard Deviation

Table 4: Correlation of MCV with PCV, Haemoglobin, RBC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Cushing's syndrome Patients.

Variable	N	r	P-value
PCV	30	0.07	0.702
Haemoglobin	30	0.11	0.572
RBC	30	0.02	0.919
RDW	30	–0.06	0.741
TWBC	30	–0.03	0.862
Neutrophils	30	0.32	0.085
Lymphocytes	30	–0.28	0.138
Monocytes	30	–0.33	0.078
Eosinophils	30	–0.11	0.576
Platelets	30	–0.36	0.064

Key:
PCV - Packed Cell Volume
RBC - Red Blood Cell
MCV – Mean Corpuscular Volume
RDW – Red Cell Distribution Width
TWBC – Total White Cell Count

Table 4 shows the Correlation of MCV with PCV, Haemoglobin, RBC, RDW, TWBC, Neutrophils, Lymphocytes, Monocytes, Eosinophils and Platelet Count in Cushing's syndrome Patients. There was a non-significant positive correlation of MCV with PCV, haemoglobin, RBC, MCH, MCHC and neutrophils in Cushing's Syndrome Patients ($r = 0.07$, $p = 0.702$; $r = 0.11$, $p = 0.572$; $r = 0.02$, $p = 0.919$; and $r = 0.32$, $p = 0.085$).

There was a non-significant negative correlation of MCV with RDW, TWBC, lymphocytes, monocytes, eosinophils and platelet count in Cushing's Syndrome Patients ($r = –0.06$, $p = 0.741$; $r = –0.03$, $p = 0.862$; $r = –0.28$, $p = 0.138$; $r = –0.33$, $p = 0.078$, $r = –0.11$, $p = 0.576$ and $r = –0.36$, $p = 0.064$).

Statistical Analysis

All data collected were entered into Microsoft Excel and analyzed using IBM SPSS version 27. Descriptive statistics were used to summarize the data. Independent sample t-tests were used to compare the means of haematological parameters between Cushing's patients and controls. Pearson's correlation analysis was used to assess relationships between MCV and other blood parameters. A p-value of less than 0.05 was considered statistically significant.

Discussion

The results from this study reveal significant haematological changes in patients with Cushing's syndrome. Lower haemoglobin, PCV, RBC count, and MCH levels in the patients suggest the presence of mild anemia, possibly due to suppressed bone marrow activity or impaired iron metabolism caused by high cortisol levels[11]. The reduced MCV values observed in many patients further indicate that the anemia may be normocytic or microcytic in nature.

These findings align with previous studies. For example, Sibal et al., 2006, observed that patients with endogenous Cushing's syndrome often present with anemia that may not always be overt but shows subtle reductions in haemoglobin and red cell indices, likely due to cortisol's inhibitory effects on erythropoiesis[15].

Similarly, Arafah et al., 2007, found a mild normocytic anemia in a large proportion of patients with Cushing's syndrome, attributing it to functional iron deficiency and reduced erythropoietin response[16].

Lymphocyte counts were also significantly reduced, which is consistent with the well-documented immunosuppressive effects of cortisol, including lymphocyte apoptosis andredistribution[12]. This finding mirrors those of Arnaldi et al., 2005, who reported markedly decreased lymphocyte and eosinophil counts in Cushing's syndrome patients, reflecting cortisol's role in modulating immune surveillance[17].

Conversely, the elevated total white blood cell count and neutrophil percentages observed in our study likely reflect cortisol-induced demargination of neutrophils into the circulation[13]. This pattern is similar to what was reported by van der Pas et al., 2013, who described leukocytosis and neutrophilia as hallmark features of hypercortisolism, often resolving after treatment[18].

The significant increase in platelet count observed may reflect stress-induced thrombocytosis or a hyperactive marrow response to cortisol exposure. This is corroborated by findings from Kumari et al., 2021 who noted a mild but consistent thrombocytosis in Cushing's patients, potentially linked to chronic low-grade inflammation and endothelial activation[19].

Interestingly, while MCV showed a non-significant positive correlation with PCV, haemoglobin, RBC, MCH, MCHC, and neutrophils, it had a negative (though not significant) association with RDW, TWBC, lymphocytes, monocytes, eosinophils, and platelets. This may suggest a subtle trend in which larger red blood cell volumes occur in patients with better red cell health but lower immune and platelet activation. Similar non-significant trends have been noted in smaller observational studies, such as one conducted by Choudhury et al., 2019, where red cell indices showed variable correlations with immune and platelet parameters in Cushing's disease patients undergoing clinical evaluation[20].

Altogether, our findings support the utility of full blood count analysis in the routine evaluation of Cushing's syndrome patients, particularly in resource-limited settings where access to hormonal assays and imaging may be constrained. Moreover, the consistency of our findings with prior studies reinforces the need for haematological monitoring in the broader clinical management of these patients.

Conclusion

Cushing's syndrome leads to noticeable changes in blood composition. These include features of mild anemia, higher white blood cell and platelet counts, and a reduced number of lymphocytes. These findings highlight the importance of routine blood testing in the management and follow-up of patients with Cushing's syndrome, particularly in the Nigerian clinical setting.

Conflict of Interest

The authors declare that there is no conflict of interest regarding the publication of this paper.

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