Assessment of Packed Cell Volume, Red Cell Indices and Serum Albumin in Patients with Myasthenia Gravis in Owerri, Nigeria

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Abstract

Background: Myasthenia Gravis (MG) is a chronic autoimmune neuromuscular disorder characterized by fluctuating weakness of voluntary muscles, resulting from immune-mediated destruction or functional blockade of acetylcholine receptors at the neuromuscular junction. While MG is primarily viewed as a neurological disease, increasing evidence suggests hematological and biochemical alterations may occur, influencing disease progression and prognosis.

Objective: This study assessed the packed cell volume (PCV), red cell indices (MCV, MCH, MCHC), and serum albumin levels in patients diagnosed with Myasthenia Gravis in Owerri, Nigeria, compared to age- and sex-matched healthy controls.

Methods: A case-control study was conducted involving 30 patients with clinically confirmed Myasthenia Gravis and 30 apparently healthy controls. Venous blood samples (7 mL) were collected under aseptic conditions. Hematological analyses, including PCV and red cell indices, were performed using an automated hematology analyzer, while serum albumin was determined by the bromocresol green (BCG) method. Statistical analysis was conducted using SPSS version 27, with significance set at $p<0.05$.

Results: The mean values of PCV, MCV, MCH, MCHC, and serum albumin in MG patients were significantly reduced compared with controls: PCV (28.00±5.50 vs. 36.90±3.30)%, MCV (76.70±8.50 vs. 83.70±6.90)fL, MCH (24.20±3.50 vs. 27.00±3.20)pg, MCHC (30.40±1.50 vs. 31.50±0.90)g/dL, and serum albumin (2.40±0.40 vs. 3.60±0.60)g/dL, all $p<0.01$. Sex-based analysis showed significantly higher PCV in males than females (30.40±3.50 vs. 26.00±4.20, $p=0.004$), while other indices showed no significant sex difference. Correlation analysis revealed no significant associations between serum albumin and red cell indices.

Conclusion: Patients with Myasthenia Gravis in Owerri exhibit significantly lower PCV, red cell indices, and serum albumin compared to healthy individuals, suggesting the presence of anemia and hypoalbuminemia possibly linked to chronic inflammation, malnutrition, or treatment-related effects. Routine hematological and biochemical monitoring should be incorporated into MG management protocols.

Keywords

Myasthenia Gravis, Packed Cell Volume, Red Cell Indices, Serum Albumin, Hematology, Autoimmune Disease

1. Introduction

Myasthenia Gravis (MG) is a chronic autoimmune neuromuscular disorder that impairs neuromuscular transmission due to circulating autoantibodies directed against the acetylcholine receptor (AChR) or associated proteins such as muscle-specific kinase (MuSK). This results in fluctuating weakness and fatigability of voluntary muscles, with clinical manifestations ranging from ocular symptoms to generalized weakness affecting bulbar, limb, and respiratory muscles. The global prevalence of MG is estimated at 20 per 100,000 population, with incidence increasing in recent decades due to improved diagnostic awareness and survival.

Although MG has been traditionally studied as a neuromuscular disorder, recent evidence indicates systemic manifestations, including hematological and biochemical alterations, that may reflect underlying inflammation, nutritional compromise, or treatment-related side effects. Packed Cell Volume (PCV) and red cell indices, including Mean Corpuscular Volume (MCV), Mean Corpuscular Hemoglobin (MCH), and Mean Corpuscular Hemoglobin Concentration (MCHC)are essential parameters for evaluating erythrocyte morphology and function. Alterations in these indices may indicate anemia, a condition frequently observed in chronic illnesses, including autoimmune diseases.

Serum albumin, a major plasma protein synthesized by the liver, plays critical roles in maintaining oncotic pressure, transporting hormones, fatty acids, and drugs, and serving as an indicator of nutritional and inflammatory status. Hypoalbuminemia is often seen in chronic illnesses and may reflect systemic inflammation, impaired hepatic synthesis,

or increased protein loss. In MG, hypoalbuminemia may exacerbate muscle weakness by impairing metabolic support, reducing drug binding, and signaling underlying malnutrition[7].

Despite global advances in MG research, there is limited data on hematological and biochemical alterations in Nigerian patients with MG. Given the clinical importance of anemia and hypoalbuminemia in chronic diseases, it is essential to investigate their prevalence in local populations to improve disease monitoring and management.

Significance of the Study

Findings from this study will provide valuable insights into hematological and biochemical alterations in Nigerian MG patients, highlighting the role of routine monitoring in clinical management and supporting evidence-based interventions to mitigate complications such as anemia and malnutrition. In addition, the study is expected to bridge existing knowledge gaps regarding the pathophysiological mechanisms underlying these alterations within the Nigerian population, thereby offering a localized understanding of disease progression. By identifying specific hematological and biochemical markers associated with MG severity, the research may contribute to the development of diagnostic and prognostic tools that enhance early detection and personalized treatment approaches.

Furthermore, the outcomes of this investigation have the potential to inform national health policies and clinical guidelines by emphasizing the need for integrated care strategies that combine medical, nutritional, and rehabilitative support for MG patients. On a broader scale, the findings may also stimulate future research on regional variations in MG presentation and management, fostering collaborations between clinicians, researchers, and public health authorities. Ultimately, the study underscores the importance of a holistic, context-sensitive approach to improving patient outcomes and overall quality of life among individuals living with MG in Nigeria [1].

2. Materials and Methods

2.1 Study Design

A case-control study design was adopted to allow a comparative assessment between diagnosed MG patients and apparently healthy individuals serving as controls. This design was chosen because it is well-suited for identifying potential associations between MG and alterations in hematological as well as biochemical parameters. By comparing cases and controls, the study aims to detect significant differences that may be linked to disease progression, severity, and metabolic disturbances observed in MG patients. Additionally, the case-control approach enables efficient data collection within a relatively short timeframe and is highly applicable for investigating rare conditions such as MG, especially in clinical settings within Nigeria.

2.2 Study Area

The study was conducted in Owerri, Imo State, Nigeria, using patients attending the neurology clinic of the Federal Teaching Hospital, Owerri (FTHO). This hospital serves as a major referral center for neurological and internal medicine cases within the southeastern region of Nigeria, providing an appropriate setting for the identification and management of Myasthenia Gravis (MG) cases. The facility is equipped with diagnostic laboratories, specialized neurologists, and support services that enable accurate assessment of hematological and biochemical parameters.

Owerri is an urban city with a diverse population representing various socioeconomic and cultural backgrounds, making it suitable for studies aiming to explore disease patterns that reflect broader community health characteristics. The location also provides accessibility to both rural and urban patients, allowing the study to capture a range of demographic and environmental influences that may affect MG manifestations and associated biochemical changes [2].

2.3 Study Population

Cases: Thirty (30) patients clinically diagnosed with Myasthenia Gravis (MG) were enrolled in the study based on comprehensive neurological evaluation and established confirmatory diagnostic criteria, including antibody testing and electromyographic assessments where applicable. These participants were recruited during their routine clinical visits to ensure the inclusion of stable patients who could provide reliable biochemical data.

Controls: Thirty (30) apparently healthy individuals were recruited as the control group. They were matched with the MG patients for age and sex and had no known history of neuromuscular, hematological, metabolic, or systemic diseases. Prior to recruitment, each potential control participant underwent a brief clinical screening to confirm the absence of conditions that could influence the studied parameters.

Inclusion Criteria: Participants aged 18–65 years with a confirmed diagnosis of MG and who voluntarily provided written informed consent were eligible for inclusion. Only patients capable of understanding the study procedures and able to comply with data collection protocols were enrolled.

Exclusion Criteria: Individuals with other autoimmune diseases, chronic liver disorders, renal dysfunction, hematological abnormalities, or those receiving immunosuppressive or corticosteroid therapy unrelated to MG were excluded to minimize confounding factors that could distort the biochemical outcomes. Pregnant women and patients with recent infections or acute illnesses were also excluded.

2.4 Sample Size Determination

A total of 60 participants (30 cases and 30 controls) were selected using a convenience sampling technique. The sample size was deemed adequate for preliminary comparative analysis based on similar case-control studies assessing hematological and biochemical alterations in MG patients. While convenience sampling was employed due to limited disease prevalence and accessibility of participants, careful matching between cases and controls was maintained to reduce bias [3].

Additionally, the chosen sample size allowed for sufficient statistical power to detect meaningful differences between the study groups, particularly in key biochemical markers such as serum electrolytes, protein levels, and complete blood count indices. Data from this sample were expected to provide baseline evidence that could inform larger-scale investigations and contribute to the understanding of MG-related metabolic changes in the Nigerian context [4].

2.5 Ethical Considerations

Ethical clearance was obtained from the Ethics Committee of the Federal Teaching Hospital, Owerri (FTHO) prior to the commencement of the study. All study procedures adhered strictly to the principles outlined in the Declaration of Helsinki (2013 revision) regarding research involving human participants. Written informed consent was obtained from each participant after a detailed explanation of the study objectives, potential risks, and benefits [5].

Participants were assured of confidentiality and anonymity throughout the study, and data were coded to prevent personal identification. They were also informed of their right to withdraw from the study at any stage without any consequence to their ongoing medical care. All biological samples were handled and disposed of following institutional biosafety and bioethical guidelines to ensure compliance with standard research practices and environmental safety [6].

2.6 Sample Collection

A total of seven milliliters (7 mL) of venous blood was drawn aseptically from the antecubital vein of each participant using sterile disposable syringes and needles. The blood collection was performed by trained laboratory personnel to minimize the risk of hemolysis and ensure sample integrity. Participants were seated comfortably, and tourniquets were applied briefly to facilitate venipuncture [7].

Out of the collected volume, 4 mL of blood was immediately dispensed into an ethylenediaminetetraacetic acid (EDTA) bottle for hematological analysis, including packed cell volume and red blood cell indices. The remaining 3 mL was transferred into a plain vacutainer tube, allowed to clot at room temperature, and then centrifuged at 3000 revolutions per minute (rpm) for 10 minutes to separate serum. The obtained serum was carefully pipetted into sterile microtubes and stored at –20°C until further biochemical analysis was performed.

Special care was taken to label each sample clearly with a unique identification code corresponding to the participant's study number. All samples were analyzed within 48 hours of collection to prevent degradation or alteration of biochemical constituents [8].

2.7 Laboratory Analysis

Hematology:

Packed cell volume (PCV) and red cell indices — including mean corpuscular volume (MCV), mean corpuscular hemoglobin (MCH), and mean corpuscular hemoglobin concentration (MCHC) — were determined using an automated hematology analyzer (e.g., Sysmex KX-21N, Japan) according to the manufacturer's standard operating procedures. Quality control checks were performed daily using control samples to ensure accuracy and reproducibility of results [9].

Serum Albumin:

Serum albumin concentration was measured using the bromocresol green (BCG) colorimetric method on a UV–visible spectrophotometer. In this assay, the albumin present in the serum reacts with the BCG dye under acidic conditions to produce a green-colored complex, the intensity of which is directly proportional to the albumin concentration. The absorbance was read at 630 nm, and results were calculated against a standard calibration curve prepared from known albumin standards [10].

All analytical procedures were performed in duplicate to ensure precision, and internal quality control protocols were strictly maintained throughout the experimental process. The obtained data were recorded systematically and cross-verified prior to statistical analysis.

2.8 Statistical Analysis

Data obtained from the study were systematically coded, entered, and analyzed using the Statistical Package for the Social Sciences (SPSS) version 27.0 (IBM Corporation, Armonk, NY, USA). Prior to analysis, all data were carefully checked for accuracy, completeness, and consistency. Descriptive statistics, including mean, standard deviation (SD), frequency, and percentage distributions, were computed to summarize the demographic characteristics and biochemical parameters of both cases and controls [11].

Normality of continuous variables was assessed using the Shapiro–Wilk test and visual inspection of histograms to ensure the suitability of parametric tests. For variables that met normal distribution assumptions, comparisons between Myasthenia Gravis (MG) patients and healthy controls were performed using the independent samples t-test to determine mean differences in hematological and biochemical parameters. Where appropriate, non-parametric alternatives such as the Mann–Whitney U test were considered for skewed data [12].

In addition, Pearson's product-moment correlation coefficient (r) was employed to evaluate the strength and direction of relationships between serum albumin levels and selected hematological indices (such as PCV, MCV, and MCHC). This analysis provided insight into potential interdependencies between nutritional and hematological status among MG patients.

All statistical tests were two-tailed, and the level of significance was set at $p < 0.05$. Results were presented as mean ± standard deviation (SD) for continuous variables and as proportions for categorical variables. Graphical representations, including bar charts and scatter plots, were used where necessary to visualize trends and correlations. Data interpretation emphasized clinical relevance and the possible physiological mechanisms underlying observed associations [13].

3. Results

Table 1. Mean Values of MCV, MCH, and MCHC in Patients Diagnosed with Myasthenia Gravis and Healthy Subjects

Parameter	Myasthenia Gravis Patients (n = 30)	Healthy Controls (n = 30)	t-value	p-value
MCV (fL)	76.70 ± 8.50	83.70 ± 6.90	3.70	0.001*
MCH (pg)	24.20 ± 3.50	27.00 ± 3.20	3.34	0.002*
MCHC (g/dl)	30.40 ± 1.50	31.50 ± 0.90	3.33	0.002*

Key:

MCV – Mean Corpuscular Volume

MCH – Mean Corpuscular Hemoglobin

MCHC – Mean Corpuscular Hemoglobin Concentration

* – significant p value

Table 1 shows that the Mean Corpuscular Volume (MCV) was significantly lower in Myasthenia Gravis patients (76.7 ± 8.5) fL compared to healthy controls (83.7 ± 6.9) fL ($t = 3.70$, $p=0.001$).The Mean Corpuscular Hemoglobin (MCH) was also significantly reduced in patients (24.2 ± 3.5) pg compared to controls (27.0 ± 3.2) pg, ($t =3.34$, $p = 0.002$). Similarly, Mean Corpuscular Hemoglobin Concentration (MCHC) showed a significant reduction in the patient group (30.4 ± 1.5 g/dl) compared to the control group (31.5 ± 0.9 g/dl), ($t = 3.33$, $p = 0.002$).

Table 2. Mean Values of PCV and Serum Albumin in Patients Diagnosed with Myasthenia Gravis and Healthy Subjects

Parameter	Myasthenia Gravis Patients (n = 30)	Healthy Controls (n = 30)	t-value	p-value
PCV (%)	28.00 ± 5.50	36.90 ± 3.30	7.61	< 0.0001*
Albumin(g/dl)	2.40 ± 0.40	3.60 ± 0.60	9.01	< 0.0001*

Key:

PCV – Packed Cell Volume (significant p value)

Table 2 shows that the mean PCV in Myasthenia Gravis patients (28.00 ± 5.50)% was significantly lower than in healthy controls (36.90±3.30)% ($t=7.61$, $p=<0.0001$). Similarly, the mean serum albumin level in patients with myasthenia gravis (2.4±0.40)g/dl was significantly reduced compared to controls (3.6 ± 0.6) g/dl ($t=9.02$, $p=<0.0001$).

Table 3. Mean Values of PCV, MCV, MCH, MCHC and Albumin in patients with Myasthenia Gravis Based on Sex

Parameter	Male Patients (n = 14)	Female Patients (n = 16)	t-value	p-value
PCV (%)	30.40 ± 3.50	26.0 ± 4.20	3.18	0.004*
MCV (fL)	78.70 ± 6.20	75.00 ± 5.90	1.72	0.096
MCH (pg)	25.00 ± 2.50	23.60 ± 2.70	1.56	0.130
MCHC (g/dl)	25.0 0± 2.50	30.30± 1.10	0.84	0.410
Albumin(g/dl)	2.30 ± 0.40	2.40 ± 0.40	0.59	0.560

Key:

PCV – Packed Cell Volume

MCV – Mean Corpuscular Volume

MCH – Mean Corpuscular Hemoglobin

MCHC – Mean Corpuscular Hemoglobin Concentration (significant p value)

PCV (%) was significantly higher in male patients (30.4%) than in females (26.0%), (t=3.18, p=0.004). MCV (78.70±6.20)fL and MCH (25.00±2.50)pg were also higher in males than females (75.00±5.90)fL and (23.60±2.7)pg respectively with no statistical significance (t=1.72, p=0.096). MCHC(25.00±2.50)g/dl in males showed only a minimal difference when compared to females (30.30±1.10)g/dl, with no statistical significance (t=0.84,p=0.41). Albumin(2.4±0.40) g/dl levels were slightly higher in females than males (2.3±0.40)g/dl, but the difference was not significant (t=0.59, p=0.56).

Table 4. Correlation of Serum Albumin with PCV, MCV, MCH, and MCHC in Patients with Myasthenia Gravis

Variable	No	r	p-value
PCV(%)	30	-0.090	0.640
MCV(fL)	30	+0.110	0.546
MCH(pg)	30	+0.180	0.346
MCHC(g/dl)	30	+0.180	0.339

Key:

PCV – Packed Cell Volume.

MCV – Mean Corpuscular Volume.

MCH – Mean Corpuscular Hemoglobin.

MCHC – Mean Corpuscular Hemoglobin Concentration. (r – correlation coefficient)

Albumin, showed a non - significant negative correlation with PCV(r=-0.090, p=0.640) and a non-significant positive correlation with MCV(r=+0.110,p=0.546), MCH(r=+0.180, p=0.346) and MCHC(r= +0.180, p=0.336) respectively.

4. Discussion

This study revealed significant reductions in PCV, red cell indices, and serum albumin in patients with Myasthenia Gravis compared with healthy controls in Owerri. The findings align with previous studies reporting systemic hematological and biochemical alterations in MG, despite its primary characterization as a neuromuscular disorder.

Anemia in MG Patients: The markedly reduced PCV observed in MG patients (28.0±5.5%) compared to controls (36.9±3.3%, p<0.001) suggests the presence of anemia. This anemia may be multifactorial: chronic inflammation associated with autoimmunity, nutritional deficiencies, or treatment-related effects such as corticosteroid-induced bone marrow suppression[9]. Reduced red cell indices (MCV, MCH, and MCHC) further suggest microcytic, hypochromic anemia, potentially linked to iron deficiency or chronic disease states [14].

Hypoalbuminemia in MG Patients: Serum albumin levels were significantly reduced in MG patients (2.4±0.4 g/dL) compared with controls (3.6±0.6 g/dL, p<0.001). Hypoalbuminemia is a recognized marker of chronic inflammation and malnutrition[11]. In MG, systemic inflammation mediated by autoantibodies may impair hepatic protein synthesis, while corticosteroid therapy may contribute to protein catabolism[12]. Additionally, malnutrition due to dysphagia and impaired mastication in MG patients may lead to inadequate protein intake, exacerbating hypoalbuminemia.

Sex-Based Differences: Male MG patients had significantly higher PCV values than females, while other indices showed no significant difference. This finding may reflect gender-related hematological differences observed in the general population, with men typically having higher PCV due to androgenic stimulation of erythropoiesis [15].

Correlation Analysis: Albumin showed weak, non-significant correlations with PCV and red cell indices. This suggests that anemia and hypoalbuminemia in MG patients may arise from distinct mechanisms, though both conditions reflect systemic involvement beyond the neuromuscular system.

Clinical Implications: Anemia and hypoalbuminemia in MG patients may worsen fatigue, impair immune function, and increase susceptibility to infections. Monitoring these parameters may therefore be valuable in guiding nutritional support, anti-inflammatory therapy, and overall management [16].

5. Conclusion

This study demonstrates that patients diagnosed with Myasthenia Gravis (MG) in Owerri, Imo State, Nigeria, exhibit significantly reduced packed cell volume (PCV), red cell indices, and serum albumin concentrations when compared with apparently healthy controls. These findings underscore the presence of anemia and hypoalbuminemia among MG patients, suggesting possible interactions between the disease process, nutritional status, and systemic inflammation.

The observed hematological alterations may reflect the chronic inflammatory burden associated with autoimmune activity in MG, as well as the catabolic effects of long-term pharmacological management, particularly corticosteroid therapy. Furthermore, reduced albumin levels could indicate nutritional deficiencies, hepatic metabolic alterations, or increased protein turnover resulting from sustained immune activation. Together, these factors highlight the multifaceted nature of MG and its broader physiological implications beyond neuromuscular dysfunction.

Importantly, the results emphasize the need for routine hematological and biochemical monitoring in the clinical management of MG patients to ensure early detection and correction of complications such as anemia and malnutrition. Incorporating nutritional assessment and supportive dietary interventions into patient care may contribute to improved treatment tolerance, recovery, and overall quality of life.

Future studies involving larger sample sizes and multi-center collaboration are recommended to validate these findings and explore longitudinal changes in hematological parameters during disease progression and treatment. Such evidence would strengthen the foundation for evidence-based clinical protocols and guide policy formulation aimed at optimizing comprehensive care for individuals living with Myasthenia Gravis in Nigeria and similar resource-limited settings.

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