

Inflammatory markers in patients with asthma in a tertiary hospital in Uganda

Marcadores inflamatorios en pacientes con asma en un hospital terciario de Uganda

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Abstract

Introduction: Patients with asthma are known with increased hospital visits and sudden deaths. Aim. The study was done to evaluate the changes in hematological parameters and inflammatory markers of patients with asthma in KIU-TH, Ishaka, Uganda.

Methods: A total of 150 subjects were selected for the study comprising of 75 patients with asthma and 75 apparently healthy individuals from Ishaka, Bushenyi District attending KIU-TH.

Results: The results showed increase in total white blood cell count ($P=0.000$), Neutrophil ($P=0.000$) and no significant difference in Lymphocytes ($P=0.406$) of patients with asthma compared to apparently healthy individuals respectively. The results showed increase in hemoglobin ($P=0.004$), red blood cells ($P=0.015$), Packed Cell Volume ($P=0.009$), Mean Cell Volume ($P=0.000$), Red Cell Distribution Width ($P=0.004$) and decrease in MCHC ($P=0.004$) of patients with asthma compared to apparently healthy individuals respectively. The results showed increase in NLR ($P=0.039$), PDW ($P=0.010$), PCT ($P=0.002$), decrease in platelets ($P=0.021$), MPV ($P=0.031$) and no significant difference in PLR ($P=0.066$) in patients with asthma compared with the apparently healthy individuals respectively.

Conclusions: The study revealed increase in total white cell count (WBC), neutrophils and reduced levels of cell lines. It shows serious immunological alterations in the patients with asthma. The inflammatory markers as NLR and PLR were increased which showed increased inflammation in the patients with asthma. These indicators could be used to predict the severity of the disease and as well in improvement as regards prognosis of the patients.

Key words: asthma, hematological parameters, neutrophil to lymphocyte ratio (NLR), platelet to lymphocyte ratio (PLR), inflammation.

Resumen

Introducción: Los pacientes con asma son conocidos por el aumento de las visitas al hospital y las muertes súbitas. Objetivos. El estudio se realizó para evaluar los cambios en los parámetros hematológicos y los marcadores inflamatorios de los pacientes con asma en KIU-TH, Ishaka, Uganda.

Material y métodos: Se seleccionó un total de 150 sujetos para el estudio, compuesto por 75 pacientes con asma y 75 individuos aparentemente sanos de Ishaka, distrito de Bushenyi, que acudían a KIU-TH.

Resultados: Los resultados mostraron un aumento en el recuento total de glóbulos blancos ($P=0.000$), de neutrófilos ($P=0.000$) y ninguna diferencia significativa en los linfocitos ($P=0.406$) de los pacientes con asma en comparación con los individuos aparentemente sanos, respectivamente. Los resultados mostraron un aumento de la hemoglobina ($P=0.004$), de los glóbulos rojos ($P=0.015$), del volumen celular empaquetado ($P=0.009$), del volumen celular medio ($P=0.000$), de la anchura de distribución de los glóbulos rojos ($P=0.004$) y una disminución de la MCHC ($P=0.004$) de los pacientes con asma en comparación con los individuos aparentemente sanos, respectivamente. Los resultados mostraron un aumento de NLR ($P=0.039$), PDW ($P=0.010$), PCT ($P=0.002$), una disminución de las plaquetas ($P=0.021$), MPV ($P=0.031$) y ninguna diferencia significativa en PLR ($P=0.066$) en los pacientes con asma en comparación con los individuos aparentemente sanos respectivamente.

Conclusiones: El estudio reveló un aumento en el recuento total de glóbulos blancos (WBC), neutrófilos y niveles reducidos de líneas celulares. Esto muestra graves alteraciones inmunológicas en los pacientes con asma. Los marcadores inflamatorios como NLR y PLR estaban aumentados, lo que mostraba una mayor inflamación en los pacientes con asma. Estos indicadores podrían utilizarse para predecir la gravedad de la enfermedad y también para mejorar el pronóstico de los pacientes.

Palabras clave: asma, parámetros hematológicos, relación neutrófilos-linfocitos (NLR), relación plaquetas-linfocitos (PLR), inflamación.

Introduction

Hematological parameters are measurable blood indices that can be used as markers in the diagnosis and monitoring of certain physiological and pathological abnormalities. Hematologic parameters can be affected by medical conditions and immune responses that affect hematopoietic physiology. For example, allergic diseases can affect hematological parameters such as eosinophils and neutrophils¹⁻³. Allergy is a disorder of the immune system in the form of hypersensitivity to an allergen. Asthma, allergic rhinitis, and eczema are common allergic diseases. Asthma affects the airways that carry air to and from the lungs. The lining of the airways in people with asthma may become swollen and inflamed. This swelling and inflammation makes the airways very sensitive to irritation and prone to allergic reactions. As airways narrow due to inflammation, less air can flow through them, causing tissue hypoxia and/or hypoxemia^{4,5}.

Asthma is a public health problem in all countries regardless of their level of development with 235 million people currently suffering from asthma⁶. Most asthma-related deaths occur in low- and middle-income countries. Asthma is underdiagnosed and undertreated. It causes significant distress to individuals and families and often limits an individual's activities throughout life^{7,8}. The burden of asthma varies from region to region, depending on environmental and genetic factors. Regarding race and ethnicity, the prevalence of asthma was higher among blacks^{9,10}. Asthma has reported 1.2 to 6.3 cases in most countries, with the highest prevalence (>20%) generally in Latin America and the English-speaking countries of Australia, Europe, North America, and South Africa. The lowest prevalence (<5%) was in the Indian subcontinent, Asia Pacific, Eastern Mediterranean, Northern Europe and Eastern Europe. In Africa, the prevalence is mainly observed at 10-20%, but the burden of asthma has been increasing worldwide over time¹¹. Asthma is known to be an acute disease which presents with sudden onset and can alter the white cell arrangement thereby affecting the immunity of the patients. It shows that asthma affects the levels of WBC and neutrophils and suppresses lymphocytes.

Typical changes in asthma include eosinophilia and reticular thickening, which can increase the size of chronic airway smooth muscle and increase the number of mucous glands. Eosinophils, basophils, and neutrophils play important roles in the pathogenesis of allergic diseases. Therefore, this study aimed to determine hematological parameters and some inflammatory markers in patients with asthma¹².

Materials and methods

Study area

The study was done in Ishaka Uganda at Kampala International University Teaching Hospital, Ishaka, Uganda. Kampala International University Teaching Hospital, Ishaka, Uganda. Is located in the Western part of Uganda and serves both Western Uganda populace and entire Uganda.

Study Design

The study adopted cross-sectional hospital based design with purposive sampling technique where patients who attended the hospital with asthma were selected for the study on purposive sampling technique and the platelets and some inflammation markers were evaluated with the apparently healthy individuals who attended the hospital on other issues not for disease issues.

Sample Size calculation

The sample size was collected according to formulary of Aracye¹³

$$N = z^2 pq/d^2$$

n=sample size, z=95%=1.96, p= prevalence, q=1-p, d=0.05

The prevalence of asthma in Uganda according to Kirenga *et al.*¹⁴ is 11%=0.11,

q=1-0.11, q=0.89

$$n = 1.96^2 \times 0.11 \times 0.89 / 0.05^2$$

$$= 150.437$$

=150 of asthma patients

Therefore, a total of 150 subjects were selected for the study comprising of 75 patients with asthma and 75 apparently healthy individuals from Ishaka who have not presented with history of asthma or obstructive areaway disease who attended KIU-TH, Ishaka, Bushenyi District.

Ethical issues

Ethical approval was obtained from the institution and informed consent obtained from the subjects. The details of the study were fully explained to the subject before they gave their consent and they willing participated in the study and confidentiality assured to them.

Blood Collection and Laboratory Investigations

About 3ml of venous blood was collected from antecubital fossa following aseptic techniques into EDTA containers for FBC determinations. The laboratory investigations were carried out at Hematology Laboratory of KIU-TH, Ishaka, Uganda. The full blood counts of the subjects were determined using MIndray BC-3000 Plus.

Data analysis

The data were analyzed using student t-test and present as mean \pm standard deviation using SPSS version 20 and level of significance set at P<0.05

Results

Table I: Mean values of WBC, Neutrophils and Lymphocytes of patients with asthma and control subjects.

Parameters	Asthma	Control	P-Value
WBC ($\times 10^9/L$)	13.37 \pm 0.72	4.83 \pm 0.35	0.000*
Neu ($\times 10^9/L$)	9.19 \pm 0.21	5.27 \pm 0.40	0.000*
Lym ($\times 10^9/L$)	2.37 \pm 0.60	2.90 \pm 0.79	0.406
HB (g/dl)	16.20 \pm 0.44	14.20 \pm 0.40	0.004*
RBC ($\times 10^{12}/L$)	5.78 \pm 0.40	4.27 \pm 0.50	0.015*
PCV (%)	54.00 \pm 3.26	42.00 \pm 3.00	0.009*
MCV (fl)	94.50 \pm 0.62	83.33 \pm 1.53	0.000*
MCHC (g/dl)	29.47 \pm 1.10	33.67 \pm 0.58	0.004*
RDW (fl)	49.60 \pm 1.05	43.33 \pm 1.53	0.004*

The results showed that increase in WBC (13.37 \pm 0.72 $\times 10^9/L$, 4.83 \pm 0.35 $\times 10^9/L$, $P=0.000$), Neutrophil (9.19 \pm 0.21%, 5.27 \pm 0.40%, $P=0.000$) and no significant difference in Lymphocytes (2.37 \pm 0.60 $\times 10^9/L$, 2.90 \pm 0.79 $\times 10^9/L$, $P=0.406$) of patients with asthma compared to apparently healthy individuals respectively. The results showed increase in hemoglobin (16.20 \pm 0.44g/dl, 14.20 \pm 0.40g/dl, $P=0.004$), red blood cells (5.78 \pm 0.40 $\times 10^{12}/L$, 4.27 \pm 0.50 $\times 10^{12}/L$, $P=0.015$), Packed Cell Volume (54.00 \pm 3.26%, 42.00 \pm 3.00%, $P=0.009$), Mean Cell Volume (94.50 \pm 0.62fl, 83.33 \pm 1.53fl, $P=0.000$), Red Cell Distribution Width (49.60 \pm 1.05fl, 43.33 \pm 1.53fl, $P=0.004$) and decrease in MCHC (29.47 \pm 1.10g/dl, 33.67 \pm 0.58g/dl, $P=0.004$) of patients with asthma compared to apparently healthy individuals respectively.

Table II: Mean values of inflammatory markers of patients with asthma and control subjects.

Parameters	Asthma	Control	P-Value
Platelets ($\times 10^9/L$)	362.67 \pm 32.88	245.67 \pm 43.66	0.021
NLR	4.07 \pm 1.06	1.93 \pm 0.61	0.039
PLR	158.24 \pm 32.08	90.61 \pm 33.94	0.066
MPV (fl)	7.80 \pm 0.46	8.80 \pm 0.26	0.031
PDW(fl)	15.77 \pm 0.32	13.00 \pm 1.00	0.010
PCT (%)	0.25 \pm 0.02	0.14 \pm 0.02	0.002

The results showed increase in NLR (4.07 \pm 1.06, 1.93 \pm 0.61, $P=0.039$), PDW (15.77 \pm 0.32fl, 13.00 \pm 1.00fl, $P=0.010$), PCT (0.25 \pm 0.02%, 0.14 \pm 0.02%, $P=0.002$), decrease in platelets (362.67 \pm 32.88 $\times 10^9/L$, 245.67 \pm 43.66 $\times 10^9/L$, $P=0.021$), MPV (7.80 \pm 0.46fl, 8.80 \pm 0.26fl, $P=0.031$) and no significant difference in PLR (158.24 \pm 32.08, 90.61 \pm 33.94, $P=0.066$) in patients with asthma compared with the apparently healthy individuals respectively.

Discussion

The results showed increase in total white blood cell count ($P=0.000$), Neutrophil ($P=0.000$) and no significant difference in Lymphocytes ($P=0.406$) of patients with asthma compared to apparently healthy

individuals respectively. It shows that asthma may increase stress in the patients which in turn increases the level of WBC and neutrophil. These alterations in the white cell lineages will affect immunity of the patients. The oxidative stress of the patients will be elevated which may affect the red cell lineage too. These results are in agreement with the study of Hailemaryam *et al*¹⁵, which indicated absolute and relative counts of neutrophil, eosinophil and basophil white blood cell and erythrocyte sedimentation rate were significantly high in asthmatic patients compared to control group. On the other hand, absolute and relative counts of monocyte and lymphocyte were significantly low in asthmatic patients. The study also agreed with a study carried out in Southeast of Nigeria on hematological parameters of patients with asthma by Obeagu *et al*.¹⁶ on WBC and decreased red cell line which contradicts the findings in this research here among the patients with asthma.

The study showed increase in hemoglobin, red blood cells, Packed Cell Volume, Mean Cell Volume, Red Cell Distribution Width and decrease in MCHC of patients with asthma compared to apparently healthy individuals respectively. The increase in red cell lines could be attributed to increased hematopoietic activities.

The study showed increase in NLR, PDW, PCT, and decrease in platelets, MPV and no significant difference in PLR in patients with asthma compared with the apparently healthy individuals respectively. The inflammatory markers such as NLR and PLR can be used to predict the frequency of visits to hospitals by the patients with asthma as a sign of inflammation.

Conclusion

The study revealed increase in total white cell count (WBC), neutrophils and reduced levels of cell lines. It shows serious immunological alterations in the patients with asthma. The inflammatory markers as NLR and PLR were increased which showed increased inflammation in the patients with asthma. These indicators could be used to predict the severity of the disease and as well in improvement as regards prognosis of the patients. The clinicians and health workers managing the patients should monitor the white cell levels and the inflammatory markers for prompt recovery and improvement of patients with asthma.

Conflict of Interest

The authors declare that no competing interests exist.

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