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Complete Blood Count Abnormality in Acute Severe Asthma Patient Attending ED Compare to Stable Asthmatic Patient in Emergency Department

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Annotation: Asthma is a chronic inflammatory disorder of the airways characterize by variable airflow limitation and recurrent exacerbations. Inflammation plays a central role in its pathophysiology, making inhaled corticosteroids the cornerstone of long-term management. Despite advances in treatment, asthma remains a significant global health problem, affecting more than 300 million individuals worldwide.This study aimed to evaluate abnormalities in complete blood count (CBC) parameters in patients with acute severe asthma, compare these findings with stable asthmatic patients, and assess their association with disease severity. A comparative cross-sectional study was conducted on 100 asthmatic patients attending the emergency departments of Marjan Teaching Hospital and Al-Imam Al-Sadiq Hospital in Babylon, Iraq, between October 2025 and March 2026. Participants were divided into two groups: 50 patients with acute severe asthma and 50 patients with stable asthma. CBC parameters and pulmonary function tests (PFTs) were analyzed for all patients. The results demonstrated significant increases in white blood cell count, neutrophil count, neutrophil-to-lymphocyte ratio (NLR), and platelet count in patients with acute exacerbations compared to stable patients. Conversely, lymphocyte count and red blood cell count were significantly reduced. Pulmonary function parameters, including FVC, FEV1%, FEF 25–75%, and peak expiratory flow

rate (PEFR), were markedly decreased in the acute exacerbation group. Regression analysis revealed that body mass index (BMI), platelet count, and mean platelet volume (MPV) were significant predictors of FEV1, while WBC was the only significant predictor of FEF 25–75%.

In conclusion, acute severe asthma is associated with significant systemic inflammation and impaired lung function. CBC-derived indices, particularly NLR, may serve as simple, cost-effective biomarkers for assessing disease severity in emergency settings, especially in resource-limited healthcare systems.

Keywords:

Asthma, Exacerbation, CBC, Biomarkers, Spirometry.

Introduction

Asthma is a chronic inflammatory disease of the airways characterized by intermittent bronchospasm. [1] Bronchodilators relieve bronchospasm and symptoms but do not treat the underlying airway inflammation, which is the main component of asthma. Corticosteroids are currently the most effective anti-inflammatory agents for bronchial asthma.

Inhaled corticosteroids at low doses act locally in the airways with minimal systemic exposure [2]. They reduce airway inflammation, [3] improve symptom control, decrease exacerbations, enhance lung function, and reduce hospitalizations and mortality [4][5]. However, systemic side effects may increase with higher doses [6]. Studies indicate that most clinical benefits occur at low-to-medium doses of inhaled fluticasone propionate, [7] with similar findings when compared to beclomethasone dipropionate [8] not needed remove

Very high doses are mainly beneficial for patients with severe chronic asthma resistant to conventional therapies and requiring long-term oral corticosteroids [9][10] [11]. Although inhaled corticosteroids may suppress the hypothalamic–pituitary–adrenal axis, clinically significant adrenal insufficiency is rare [12]. They may temporarily reduce growth velocity in prepubertal children without affecting final height, [13] and may cause skin bruising, particularly in the elderly [14].

Long-term use of high doses can lead to systemic effects such as osteopenia, myopathy, cataracts, growth retardation, and Cushing's syndrome [15] [16]

Objective of study:

1. To identify abnormalities in Complete Blood Count (CBC) parameters in patients with acute severe asthma attending the Emergency Department (ED).

2. To compare CBC parameters between patients with acute severe asthma and stable asthmatic patients.

3. To evaluate the association between CBC abnormalities and the severity of acute asthma attacks.

4. To determine whether CBC parameters can be used as supportive indicators in assessing acute severe asthma in the Emergency Department.

Methodology

Patients and methods

2.1The Study Design :

This study employed a cross-sectional design

2.2Data setting and collection time :

This comparative cross-sectional study was conducted in the Emergency Departments of Marjan Teaching Hospital and Al-Imam Al-Sadiq Hospital in Babylon Province / Al-Hilla City, Iraq, during the period of (study period if available)

Demographic and clinical data were collected from all participants after obtaining their consent to participate in the study. were recruited for the study between 1st October 2025 and March 5 th , 2026

2.3 Sample size and sampling method:

A total of 100 asthmatic patients attending the emergency department were included in this study. The participants were divided into two main groups

• Group 1: 50 patients diagnosed with Acute Severe Asthma.

• Group 2: 50 patients with Stable Asthma

All participants were selected based on predefined inclusion and exclusion criteria, to ensure the study's reliability and validity

Following the assessment in the emergency department, the patient was sent for the required laboratory investigations.

Venous blood samples were collected from all participants under sterile conditions. Complete Blood Count (CBC) analysis was Using an automated hematology analyzer in the hospital laboratory. The measured parameters included:

•White Blood Cell count (WBC)

•Red Blood Cell count (RBC)

•Hemoglobin (Hb)

•Hematocrit (HCT)

•Platelets

•Differential White Blood Cell count

Pulmonary Function Test

Pulmonary function was evaluated for all patients using the Pulmonary Function Test (PFT) according to the standard procedures followed in the hospital pulmonary function unit

SPIROMETER

is a hand-held equipment for checking lung conditions, adopts the infrared mode for measuring relative items, and is applicable for hospital, Clinique, family for routine test.

2.4 The selection criteria:

2.4.1 Inclusion criteria:

Patients presenting with acute severe asthma and patients with stable asthma to the Emergency Department. Patients aged between 18 and 65 years. Voluntary participation with informed consent.

2.4.2 Exclusion criteria:

Patients younger than 16 years or older than 65 years, as well as those with heart failure, malignancy, interstitial lung disease, COPD, or other significant comorbidities, were excluded from the study.

2.5 Data collection methods:

2.5.1 Questionnaire:

A structured questionnaire was used to collect the required data from the participants. The questionnaire included demographic characteristics (such as age and gender), medical history, duration of asthma, family history, smoking status, exposure to allergens, frequency of asthma attacks, history of hospital admission, and current asthma medications. The collected data were used to evaluate and compare patients with acute severe asthma and those with stable asthma

2.5.2 Ethical approval:

All individuals involved in this study were informed and the agreement was obtained verbally from each one before the collection of samples. This study is approved by the committee on publication ethics at college of medicine, University of Babylon ,Iraq

Results

Demographic Characteristics A total of 100 participants were included in this study, divided equally into two groups: controlled asthma (n = 50) and acute exacerbation asthma (n = 50). In the controlled asthma group, males constituted 46% (n = 23) and females 54% (n = 27). Similarly, in the acute exacerbation group, males accounted for 48% (n = 24) and females 52% (n = 26), indicating no significant gender difference between the two groups. Table (1,2)

Table 1. Demographic data of controlled asthma grouo

sex		Frequency	Percent
Valid	male	23	46.0
	female	27	54.0
	Total	50	100.0

Table 2. Demographic data of acute exacerbation group.

		Frequency	Percent
Valid	MALE	24	48.0
	FEMALE	26	52.0
	Total	50	100.0

Comparison of Clinical and Laboratory Parameters The comparison between controlled asthma patients and those with acute exacerbation revealed several significant differences. There was no statistically significant difference in age (31.56 ± 8.68 vs. 34.00 ± 9.17, p = 0.193), weight (68.40 ± 15.43 vs. 73.76 ± 11.13, p = 0.09), or height (169.76 ± 8.58 vs. 168.82 ± 10.35, p = 0.67). However, body mass index (BMI) was significantly higher in the acute exacerbation group (25.57 ± 2.12) compared to the controlled group (23.40 ± 3.06) ($p < 0.001$). White blood cell count (WBC) was significantly elevated in the acute exacerbation group (11.75 ± 1.76) compared to the controlled group (7.88 ± 1.13) ($p < 0.001$). Similarly, neutrophil count was significantly higher (80.21 ± 12.43 vs. 71.29 ± 5.98, $p < 0.001$), while lymphocyte count was significantly lower in the acute group (13.68 ± 12.72 vs. 24.76 ± 5.43, $p < 0.001$). The neutrophil-to-lymphocyte (N/L) ratio was markedly increased in acute exacerbation patients (7.80 ± 2.71) compared to controlled patients (3.08 ± 1.06) ($p < 0.001$). Platelet count was also significantly higher in the acute exacerbation group (346.50 ± 50.87 vs. 320.36 ± 36.50, p = 0.008). However, mean platelet volume (MPV) showed no significant difference between the groups (p = 0.33). Red blood cell (RBC) count was significantly lower in the acute exacerbation group (4.28 ± 0.30) compared to the controlled group (5.04 ± 0.38) ($p < 0.001$).

Pulmonary Function Tests (PFTs) No significant difference was found in FEV1 (L/s) between the two groups (p = 0.782). However, FVC was significantly reduced in the acute exacerbation group (2.21 ± 0.42) compared to the controlled group (3.42 ± 0.30) ($p < 0.001$). FEF 25–75% was also significantly lower in acute exacerbation patients (1.00 ± 0.27 vs. 2.19 ± 0.40, $p < 0.001$). FEV1% showed a marked reduction in the acute exacerbation group (50.42 ± 9.40) compared to the controlled group (86.54 ± 4.82), with a highly significant difference ($p < 0.001$) . according to table (3)

Table 3. Relation between different variables between controlled group and acute exacerbation.

Variable data		Mean	Std. Deviation	P value
Pair 1	Age controlled group	31.5600	8.68299	0.193
	AGE acute exacerbation group	34.0000	9.17850	
Pair 2	Weight controlled group	68.4000	15.43651	0.09
	Weight acute exacerbation group	73.7600	11.13839	
Pair 3	Height controlled group	169.7600	8.58941	0.67

	Height acute exacerbation group	168.8200	10.35826	
Pair 4	BMI controlled group	23.4034	3.06745	0.000
	BMI acute exacerbation group	25.5724	2.12824	
Pair 5	WBC controlled group	7.8880	1.13167	0.000
	WBC acute exacerbation group	11.7564	1.76145	
Pair 6	Neutrophil count controlled group	71.2960	5.98355	0.000
	Neutrophil count acute exacerbation group	80.2172	12.43319	
Pair 7	Lymphocyte count controlled group	24.7640	5.43810	0.000
	Lymphocyte count acute exacerbation group	13.6884	12.72185	
Pair 8	N/L ratio controlled group	3.0840	1.06950	0.000
	N/L ratio acute exacerbation group	7.8008	2.71905	
Pair 9	Platelet count controlled group	320.3600	36.50483	0.008
	Platelet count acute exacerbation group	346.5000	50.87931	
Pair 10	MPV Controlled group	10.0140	.54248	0.33
	MPV acute exacerbation group	11.7030	12.32390	
Pair 11	RBC Count controlled group	5.0400	.38386	0.000
	RBC count acute exacerbation group	4.2848	.30249	
Pair 12	FEV1 L/s Controlled group	3.3878	3.99170	0.782
	FEV1 L/S acute exacerbation group	4.1668	19.31501	
Pair 13	FVC L/s Controlled group	3.4298	.30708	0.000
	FVC L/S acute exacerbation group	2.2156	.42203	
Pair 14	FEF 25-75% L/S CONTROLLED group	2.1902	.40179	0.000
	FEF 25-75 % L/S acute exacerbation	1.0048	.27067	
Pair 15	FEV1 % CONTROLLED group	86.5400	4.82853	0.000
	FEV1 % ACUTE EXACERBATION group	50.4200	9.40493	

*PAIRED T TEST P VALUE <0.05 STASTICAL SIGNIFICAN

Linear Regression Analysis Linear regression analysis demonstrated a significant association between FEV1 (L/s) in acute severe asthma and several variables. BMI ($p = 0.007$), platelet count ($p = 0.002$), and MPV ($p < 0.001$) were significant predictors of FEV1. Other variables, including WBC, neutrophils, lymphocytes, N/L ratio, and RBC, did not show statistically significant associations . according table (4,5) and fig 1

Table 4. linear regression between FEV1 l/s in acute severe asthma and BMI and complete blood count.

Model	Unstandardized Coefficients		Standardized Coefficients			95.0% Confidence Interval for B	
	B	Std. Error	Beta	t	Sig. p value	Lower Bound	Upper Bound
1 (Constant)	-11.894	3.367		-3.533	.001	-18.693	-5.095
BMIS	-.128	.045	-.014	-2.841	.007	-.219	-.037
WBCS	.115	.099	.010	1.155	.255	-.086	.316
NEUTRS	.015	.008	.009	1.727	.092	-.002	.031
LYMPHS	.013	.012	.009	1.088	.283	-.011	.037
NLS	-.065	.057	-.009	-1.150	.257	-.180	.049
PLATS	-.012	.004	-.032	-3.258	.002	-.020	-.005
MPVS	1.567	.011	1.000	137.163	.000	1.544	1.590

RBCS	.706	.586	.011	1.203	.236	-.478	1.890

a. Dependent Variable: FEV1L/S * Anova test P VALUE <0.05 STASTICALLY SIGNIFICANT

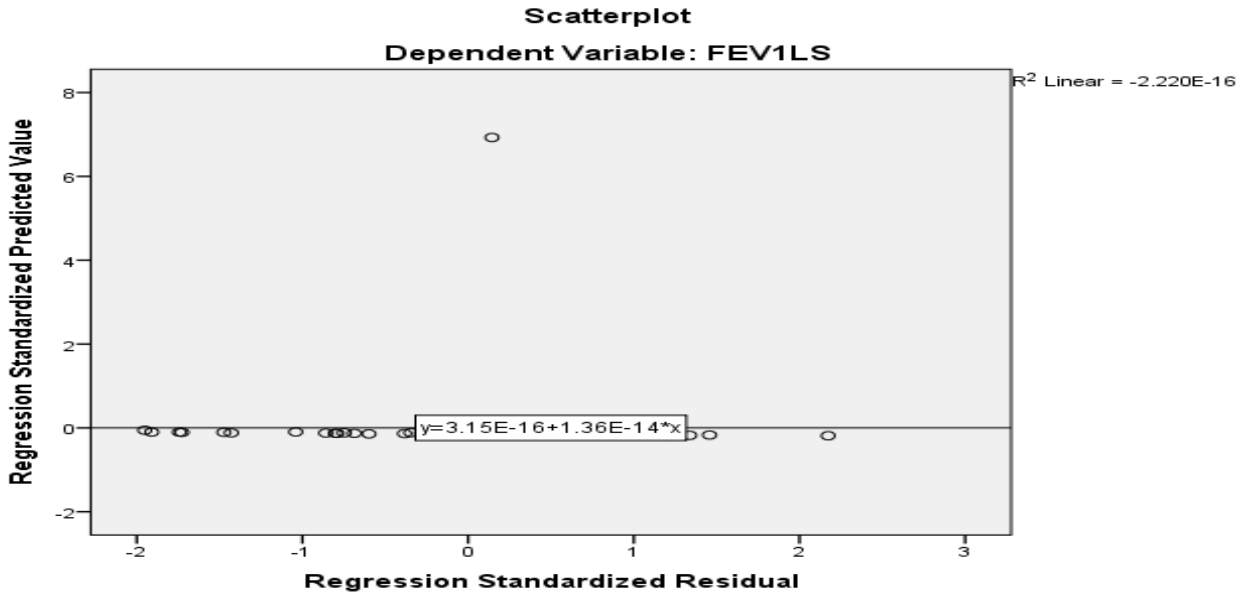

Figure 1. linear regression between FEV1 l/s in acute severe asthma and BMI and complete blood count Anova test P VALUE <0.05 STASTICALLY SIGNIFICANT

FEF 25–75%, WBC was the only significant predictor (p = 0.027), while other variables did not show significant relationships fig 2

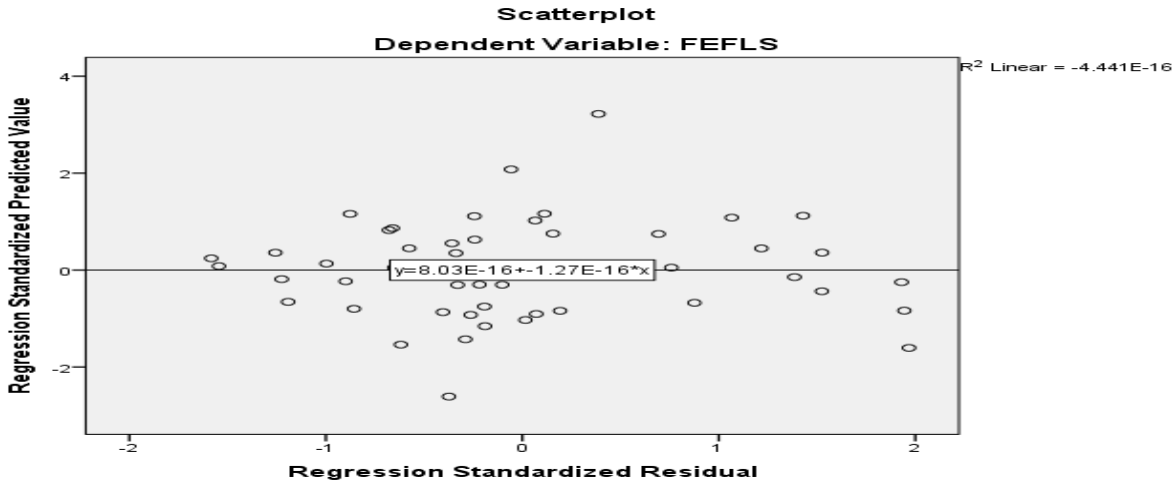

Figure 2. linear regression between FEF 25-75% l/s in acute severe asthma and BMI and complete blood count Anova test P VALUE 0.096

Peak Expiratory Flow Rate (PEFR) PEFR (%) was significantly decreased in the acute exacerbation group (47.30 ± 9.60) compared to the controlled group (86.52 ± 4.85) ($p < 0.001$).

Similarly, PEFR (L/s) was significantly lower in acute exacerbation patients (4.03 ± 0.71) compared to controlled patients (8.42 ± 0.62) ($p < 0.001$). table 6

		Mean	Std. Deviation	P VALUE
Pair 1	PEFR % CONTROLLED	86.5200	4.85395	0.000
	PEFR % ACUTE EXACEBATION	47.3000	9.60708	
Pair 2	PEFR L/S CONTROLLED	8.4242	.62337	0.000
	PEFR L/S ACUTE EXACEBATION	4.0314	.71887	

Table 6. Paired T Test P Value <0.05 Stastical Significant.

Discussion

The present study demonstrated significant differences in several hematological and pulmonary function parameters between patients with controlled asthma and those presenting with acute severe exacerbation [17][18][19][20]. Patients with acute exacerbation had significantly higher BMI, WBC count, neutrophil percentage, neutrophil-to-lymphocyte ratio (NLR), platelet count, and lower lymphocyte count and RBC count compared with controlled asthma patients. In addition, pulmonary function indices including FVC, FEF 25–75%, FEV1%, and PEFR were markedly reduced during exacerbation, reflecting substantial airflow limitation and increased disease severity. These findings support the concept that acute asthma exacerbation is associated with both systemic inflammation and significant deterioration in lung function [21][22][23][24][25][26].

The significantly elevated WBC and neutrophil counts observed in the acute exacerbation group are consistent with recent evidence showing that neutrophilic inflammation is common during severe asthma attacks, especially in patients requiring emergency treatment [27][28][29][30][31]. Neutrophils contribute to airway edema, mucus hypersecretion, and corticosteroid resistance, particularly in severe phenotypes of asthma. Similar findings were reported by Tokgoz Akyil et al., who found that higher neutrophil counts were associated with recurrent emergency department visits and rehospitalization in patients hospitalized for asthma exacerbation. Other recent studies also demonstrated that peripheral neutrophilia correlates with poor asthma control and increased exacerbation frequency [32][33][34][35][36][37].

A major finding of this study was the marked increase in NLR among acute exacerbation patients. NLR is increasingly recognized as an inexpensive and rapidly available biomarker reflecting systemic inflammatory stress. In the present study, NLR was more than doubled in exacerbation patients compared with controlled asthma, indicating heightened inflammatory activity. This agrees with several investigations that identified elevated NLR as a predictor of severe exacerbation, hospitalization, and prolonged emergency department stay (53). Because CBC testing is routinely available even in resource-limited hospitals, NLR may be particularly useful in Iraqi emergency settings for rapid risk stratification [38][39][40].

Platelet count was also significantly higher in the exacerbation group, while MPV did not differ significantly between groups. Platelets play an important immunomodulatory role in asthma through release of inflammatory mediators and interaction with eosinophils and leukocytes. Recent studies have shown that thrombocytosis and altered platelet activation may accompany acute asthma attacks and correlate with disease severity Although MPV was not significantly different in group comparison, regression analysis in this study identified MPV as a significant predictor of FEV1, suggesting that platelet size/activity may influence airflow limitation during severe attacks.

Interestingly, RBC count was significantly lower in the acute exacerbation group. This may reflect chronic inflammation, nutritional factors, hemodilution, or reduced oxygen-carrying reserve in patients with more severe disease. Similar associations between lower hemoglobin/RBC indices and poorer respiratory outcomes have been described in recent respiratory literature, where anemia was linked to worse symptom burden and hospitalization risk [41][42][43][44].

Pulmonary function testing revealed profound reductions in FVC, FEF 25–75%, FEV1%, and PEFR among exacerbation patients. These findings are expected in acute severe asthma and reflect bronchospasm, airway obstruction, dynamic hyperinflation, and small airway dysfunction. FEF 25–75% is considered a sensitive marker of small airway impairment, while PEFR provides rapid bedside assessment of airflow limitation. Current GINA-based studies emphasize the usefulness of PEFR and FEV1% in assessing severity and monitoring response to treatment in emergency departments.

Regression analysis showed that BMI, platelet count, and MPV were significant predictors of FEV1 in acute severe asthma. Obesity is now recognized as an important modifier of asthma severity through mechanical restriction, low-grade systemic inflammation, and reduced treatment responsiveness. Recent meta-analyses confirmed that higher BMI is associated with lower lung function and more frequent exacerbations. Therefore, the significant relationship between BMI and reduced FEV1 in this study is biologically plausible and clinically relevant.

For FEF 25–75%, WBC was the only significant predictor, suggesting that generalized inflammatory burden may particularly affect small airway function during exacerbation. This aligns with newer evidence indicating that systemic inflammation contributes to distal airway obstruction and ventilation heterogeneity in severe asthma.

However, some limitations should be acknowledged. The sample size was modest, the study was single-center, and eosinophil count, CRP, IgE, smoking status, medication adherence, and treatment history were not fully analyzed. In addition, cross-sectional comparison cannot establish causality. Future multicenter Iraqi studies with larger populations and longitudinal follow-up are recommended.

Conclusion

In conclusion, the present study confirms that acute severe asthma exacerbation is associated with significant systemic inflammatory changes and marked deterioration in pulmonary function. Elevated WBC, neutrophils, NLR, platelet count, and reduced PEFR/FEV1% may serve as practical indicators of disease severity. CBC-derived markers, especially NLR, may represent valuable low-cost tools for emergency asthma management in resource-limited healthcare settings such as Iraq.

Recommendation

An important strength of the current study is that it provides local data from Babylon Governorate, Iraq, where studies evaluating CBC-derived inflammatory markers in asthma remain limited. In many Iraqi hospitals, access to advanced biomarkers such as FeNO, sputum eosinophils, or biologic phenotyping is restricted. Therefore, simple CBC-based indices such as NLR, platelet count, and WBC may offer practical and affordable tools for severity assessment and monitoring.

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