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Impact of anemia in patient with asthma

Abstract

Background: Asthma varied in severity of exacerbations based on symptoms and pulmonary function. Anemia and functional iron status can significantly modulate its presentation.

Objectives: This study aimed to define the clinical impact of anemia in asthma patient and to assess its correlation with severity of presentation.

Patients and method: This is a cross sectional study conducted from the 1st of February 2017 until the 1st of December 2018 in the medical ward and the outpatient respiratory clinic at different general hospitals. Fifty patients with bronchial asthma were included. Every eligible patient was sent for complete blood count (CBC) and iron profile for anemic patient, in addition to assessment of pulmonary function test (PFT) and peak expiratory flow rate (PEF) with oxygen saturation.

Results: The mean age of patients was 44 years with female predominance .Twenty five patients were anemic. Iron deficiency anemia proved in 16 of them. The mean level of hemoglobin was 13.37±2.07 g/dl. Forced expiratory volume in 1st second (FEV1), oxygen saturation and PEF were lower in patients with acute exacerbation than chronic stable group, the mean value was (47.01±21.93 L), (93.06 ±3.15%) and (147.68±79 L) respectively. PEF rate showed significant statistical difference between asthmatic anemic patients and those who were non anemic (P = 0.026). Serum Iron was significantly lower in acute than chronic presentation (P= 0.019). There was no relationship between the state of anemia and severity of asthma.

Conclusion: The presence of anemia and lower iron status may associate with lower peak expiratory flow rate especially in acute asthma presentation.

Keywords: anemia, iron deficiency, asthma, pulmonary function, oxygen saturation

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Waseem F Al-Tameemi,[1] Rafid Th Habeeb[2]
[1]Department of Medicine (Hematology), College of Medicine, Al-Nahrain University, Iraq
[2]Department of Medicine, Al Emmamian Al Kadhmain Medical City Hospital, Iraq

Correspondence: Professor Dr. Waseem F Al Tameemi, Department of Medicine, section of Hematology, College of Medicine, Al-Nahrain University, Baghdad, Iraq, P.O.Box 14222, Tel + 964 7901555115, Email drwaseem2@gmail.com

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Background

Asthma is a prevalent chronic health condition, affecting approximate 7.7 % of adults working age that is characterized by variable respiratory symptoms and variable airflow limitation induced by chronic airway inflammation.[1] Acute exacerbations are characterized by decrease in expiratory airflow (PEF or FEV1) that may range from mild to life threatening state as according to measurement of PEF, FEV1[2,3] as well as the need to use systemic corticosteroids.[4,5] Normally, about 97 percent of the oxygen transported from the lungs to the tissues in the red blood cells based on Oxygen – Hemoglobin Dissociation Curve.[6] WHO had defined anemia as less than 130 g / L for men and 120 g / L for women, without the distinction between age and race.[7]

Iron deficiency is also one of the most common nutritional deficiencies is thought to be more prevalent in population at greatest risk for asthma assuming that these tow conditions may be linked.[8] In animal models, a low iron diet resulted in pronounced asthma in mouse model of allergic asthma, that is mediated by increased mast cell reactivity in the setting of low iron.[9]

Objectives

This study aimed to define the clinical impact of anemia in asthma patient and to assess its correlation with severity of presentation.

Patients and method

Study design and setting

A hospital based cross sectional study was conducted over the period of ten months from the 1 st of February 2017 till the 1st of December 2018 in the medical -ward and the outpatient respiratory clinic at Al-Emmamian Al- Kadhimain Medical city and Baghdad teaching hospital.

Population and work up

A total of 50 bronchial asthma patients as confirmed by specialist based on clinical ground and pulmonary function with reversibility were included in this study. They were presented either as chronic stable asthma for follow up or in acute exacerbation. Data were collected from each patient using a questionnaire that included age, gender, duration of disease, and treatment lines in addition to assessment of severity using PEFR (peak expiratory flow rate) as well as pulmonary function test by FEV1 (forced expiratory volume in 1st second). Those patient with history of COPD (chronic obstructive pulmonary disease), bronchiectasis, blood loss, hemolysis and primary hematological malignancy were excluded from this study in addition to those with smoking history.

Every eligible patient was assessed to define FEVI in addition to PEF (peak expiratory flow) rate and Oxygen saturation which

assessed by the researcher team. Complete blood count was offered to determine red blood cells (RBC) indices: hemoglobin (Hb), packed cell volume (PCV), mean corpuscular volume (MCV), mean corpuscular hemoglobin concentration (MCH), and mean corpuscular hemoglobin concentration (MCHC). Anemic Patients sent for iron study (S.iron, total iron biding capacity (TIBC) and S.ferritin).

Results

The mean age was 44 ±15.56 year with a range of (15-78) year. Females comprise 66%. Sixty four percent of them were in chronic stable asthma. Anemia found in twenty five patients (50%) but only 16 of them proved to have iron deficiency anemia (Table 1).

Table 1 Demographic Features of Participants

Parameter		No.	%
Age Distribution (years)	≤20	2	4
	21-30	8	16
	31-40	14	28
	41-50	13	26
	>50	13	26
Gender	Male	17	34
	Female	33	66
Clinical Presentation	Acute exacerbation	18	36
	Chronic	32	64
Severity Modes	Mild	18	36
	Moderate	21	42
	Severe	11	22
Anemia Presentation	Yes	25	50
	No	25	50

It is shown that Hb ranged from 8.9 to 17.1 g/dl with mean of 13.37±2.07 and mean PCV of 40.8±6.29%. Other RBC indices (MCV, MCH and MCHC) with mean of (83±6.46fl, 28.69±9.44pg and 31.67±4.75g/dl) respectively. For those anemic patients ,the mean level of serum ferritin was within normal level (107.33+ 68 ng/ml) , and the range varied from 6 .8 – 186.8 ng/ml while the transferrin saturation % ranged from 3.77 – 77.69% with mean 23.31±8.4 % indicating state of iron deficiency that overcame by serum ferritin level (Table 2).

Table 2 RBC parameters and Iron Profile Study of Anemic patients

Parameter	Mean±SD	Range
Hb (g/dl)	13.37±2.07	8.9 – 17.1
PCV (%)	40.8±6.29	27.8 – 53
MCV (fL)	83±6.46	69.9 – 97
MCH (pg)	28.69±9.44	20 – 90
MCHC (g/dL)	31.67±4.75	9.4 – 36.6
Iron (µmol/L)	51.30±38.1	16 -110
TIBC (µmol/L)	249.56±78.1	72 - 450
Transferrin saturation (%)	23.31±8.4	3.77 – 77 .69
Ferritin (ng/mL)	107.33±68.1	6 .8 – 186.8

Most patient were as mild asthma with a mean of FEV1/FVC ratio 76.1+17 % (range: 36.6–150%) and similarly oxygen saturation which is in average level of 95% (range: 88– 99%), but in contrast the PEF rate which was 161.56+91 l (Table 3). However, there is significant difference between acute presentation and chronic presentation in term of oxygen saturation (P=0.000) in contrast to other parameters FEV1/FVC and PEF (P=0.123 and 0.425) respectively (Table 4).

Despite the observation of lower RBC parameters in those presented in acute exacerbation compared with chronic stable presentation but this didn't give any statistical significance concerning Hb, PCV (P = 0.226, 0.420 respectively) as well as other RBC indices including MCV (P= 0.231), MCH (P= 0.437) and MCHC (P=0.352), unlike the significant association of presentation mode with lower serum iron (P =0.019) apart from serum ferritin level (P =0.105) (Table 5).

Table 3 Pulmonary Function Parameters for study sample

Pulmonary measurement	Range	Mean±SD
FEV 1 (%predicted)	20.1 – 108	54.33±21.42
FVC(%predicted)	24– 97	60.33±18.25
FEV 1 / FVC (%)	36.6– 150	76.1±17.52
PEF (l/min)	100– 400	161.56±91.1
O2 saturation (%)	88– 99	95.24±2.85

Table 4 Comparison of Pulmonary Function Parameters in Acute Versus Chronic Presentation

Parameters	Acute (18)	Chronic (32)	P-value
FEV1(%predicted) (Mean±SD)	47.01±21.93	58.36±20.39	0.072
FVC (%predicted) (Mean±SD)	57.40±20.16	61.88±17.29	0.411
FEV1/FVC (%) (Mean±SD)	70.92±12.30	78.91±19.50	0.123
O2 Saturation (%) (Mean±SD)	93.06±3.15	96.41±1.88	0.000
PEF (L/min) (Mean±SD)	147.68±79.83	169.37±97.16	0.425

Table 5 Comparison of RBC Parameters and Iron Profile in relation to Acute Versus Chronic Presentation

Parameters	Acute (18)	Chronic (32)	P-value
Hemoglobin g/dL (Mean±SD)	12.71±2.35	13.74±1.84	0.226
PCV % (Mean±SD)	39.45±7.25	41.55±5.66	0.420
MCV fL (Mean±SD)	81.62±7.06	83.78±6.12	0.231
MCH pg (Mean±SD)	26.04±3.24	30.18±11.35	0.437
MCHC g/ dL (Mean±SD)	31.26±2.61	31.91±5.64	0.352
Iron µmol/L (Mean±SD)	39.66±31.88	59.07±40.9	0.019
TIBC µmol/L (Mean±SD)	260±87.26	242.6±73.69	0.766
Ferritin ng/mL (Mean±SD)	140.42±260.36	85.27±59.61	0.105

There was a highly significant statistical difference between the hemoglobin and PCV level between the anemic and non anemic patients (P=0.000) in contrast to other indices MCV (P= 0.063), MCH (P= 0.076) and MCHC (P= 0.244), however; the impact of anemia in relation to alteration of pulmonary function parameters had demonstrated that lower PEF rate is associated significantly with presence of anemia compared with non anemia state (P = 0.026) unlike other pulmonary function parameters ; including O saturation that did not show similar associations (Table 6).

Table 6 Comparison of Pulmonary Function Parameters Between Anemic and Non anemic Asthmatic Patients

Parameter	Anemic	Non Anemic	P-value
FEV1 (%predicted) (Mean±SD)	51.49±19.64	57.18±23.1	0.353
FVC (%predicted) (Mean±SD)	57.32±18.82	63.33±17.52	0.248
FEV1/FVC (%) (Mean±SD)	73.47±12.33	78.73±21.45	0.292
O2 Saturation (%) (Mean±SD)	94.8±2.99	95.68±2.7	0.280
PEF (L/min) (Mean±SD)	133.11±91.9	190±82.48	0.026

There were no significant correlation among any of pulmonary parameters, oxygen saturation or PEF rate with neither of hemoglobin nor ferritin level (Table 7). Iron profile in relation to clinical presentation of asthma showed a statistical significant relationship between PEF rate and serum iron level (P 0.019) but no relationship between the state of asthma with severity of anemia (P 0.835).

Table 7 Correlation between PF parameters and State of Anemia

		FEV1	FVC	FEV1/FVC	PEF	O2 Saturation
Hemoglobin	R	0.175,	0.020,	0.129, (0.540)	-0.165,	-0.052, (0.805)
	P	-0.403	-0.924		-0.432	
Ferritin	R	-0.037,	0.131,	-0.175, (0.403)	0.175,	-0.132, (0.529)
	P	-0.86	-0.532		-0.402	

Discussion

In this study 16 patients had iron deficiency anemia (IDA) out of 25 total anemic asthmatic patients. The definition of anemia and it type based on a minimum level of Hemoglobin≤ 12g/dl (10) as well as serum ferritin. Pulmonary function test parameters were lower in acute presentation than in chronic disease state and similarlily in anemic compared with non-anemic asthmatic patients but of no statistical significant differences except for PEF rate between asthmatic anemic patients with those who were non anemic (P 0.026).

The links between iron status and pulmonary disease remain relatively unexplored. In one study, iron supplementation in iron deficient women led to resolution of chronic cough and bronchial hyper reactivity. Notably 41% of those women had normal baseline hemoglobin prior to iron supplementation, implicating that iron replacement has a primary role in symptoms improvement.[11] Another study about children had suggested that anemia associated with asthma, especially due to iron deficiency.[12]

In this study, the only significant statistical association was in peak expiratory flow rate between iron deficiency anemia which is further supported by an assumption that higher iron stores were associated a lower prevalence of asthma in US women 20-49 years of age as well as a decrease in body iron is linked to a decrease in FEV1 due to increase in tissue iron demands suggesting that tissue and body iron may influence lung function.

Conclusion

In conclusion, the presence of anemia whether iron deficiency or not can be associated with more severe clinical course of acute exacerbation presentation in asthmatic patients.

Acknowledgments

None.

Conflicts of interest

The authors declare no conflict of interest.

Authors' contribution

Both authors shared data collection, analyses and interpretation.

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