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Renal Function Tests Predictors in Asthmatic Patients

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Abstract

Background: Bronchial asthma can cause many morbidities such as heart disease, diabetes mellitus, and hypertension, but the impact of asthma on renal function is not yet verified. This study aims to clarify the association between bronchial asthma and the risk of developing renal dysfunction.

Methods: The study was conducted in Merjan Medical City in the period from April 2015 to August 2016, it included 75 patients with asthma and 70 control healthy subjects who completed medical questionnaires, pulmonary function tests, measurement of blood urea, serum creatinine, and creatinine clearance in addition to measurement of oxygen saturation (SPO2) by oximeter. Hypoxic patient has level of SPO2 less than 95%. Statistical analysis was done, P values ≤0.05 were considered to be clinically significant.

Results: There was no significant difference in mean age and gender between both groups. There was significant difference in the mean values of blood urea ($_{Bur}$), serum creatinine ($_{Scr}$) and creatinine clearance (Ccr) before and after treatment for all patients, Bur increased and $_{Scr}$ decreased significantly in hypoxic group in comparison with non-hypoxic group ($P < 0.05$). In addition, the study showed a significant correlation between blood urea and creatinine clearance (Ccr) with SPO2 (before treatment) ($p < 0.05$), while non-significant negative correlation between serum creatinine and SPO2 (before treatment) ($r = 0.1$, $P > 0.05$). The results revealed that while C_{cr} decreased while the $_{Bur}$ and $_{Scr}$ increased significantly in male group in comparison to female group ($P<0.05$). Also there was no significant correlation between blood urea, creatinine clearance (Ccr) and serum creatinine with forced expiratory volume in first second (FEV1) (before treatment) ($P > 0.05$).

Conclusions: The study showed high percentage of asthmatic patients admitting in the hospital wards had abnormalities of renal function tests at the first days of admission to hospital, but most patients return to normal state gradually after getting treatment. The mechanisms and clinical implications of kidney dysfunction in patients with asthma need further investigation in addition to follow up for those patients to determine who of them will get chronic renal failure at future.

INTRODUCTION

Bronchial asthma is a chronic inflammatory lung disease with exacerbations, which may be a factor in its morbidity and mortality. The Global Initiative for Asthma (GINA) 2004 report states that nearly 300 million people suffer from asthma worldwide [1,2].The urban living and lower income are risk factors for asthma and that the environment, regardless of indoor or outdoor, also impacts on patients with asthma [3]. Bronchial asthma also influences other chronic diseases involving the cardiovascular and carbohydrate metabolism systems. Patients with asthma have higher risks of coronary heart disease (CHD) diabetes mellitus, and hypertension, although the impact of asthma on other vital organs are not yet verified [4].

The diagnosis of bronchial asthma bases on characteristic clinical history such as intermittent breathlessness, wheezing, troublesome night time cough and chest tightness, aided by lung function tests in some cases [5,6], which is similar to criteria of the Global Initiative for Asthma (GINA) guidelines [7,8].

Studying the association between asthma and disturbance in kidney function is important because asthma is highly common and studying associated comorbidities should be highlighted.

This study aimed to assess the extent of renal dysfunction in patients with asthma.

PATIENTS AND METHODS

The study was conducted in Merjan Medical City in Babylon Province in the period from April 2015 to August 2016, it consisted of 75 patients with history of asthma for more than six months who were admitted in the ward due to acute exacerbations and they were compared with 70 control healthy subjects. All subjects (patients and healthy controls) were subjected to full history (age, gender, duration of disease, smoking and chronic diseases), with complete physical examination.

Some needed investigations were done for patients and controls including: electrocardiography (ECG), echocardiography, chest x-ray (CXR), random blood sugar (RBS), renal function tests (RFTs), liver function tests (LFTs), pulmonary function tests (PFTs), and oxygen saturation by using oximeter to assess hypoxia. Renal function tests included blood urea, serum creatinine and creatinine clearance.

Pulmonary function testing was performed according to the recommendations of the American Thoracic Society and measured values were compared with standard population-derived predicted values.

Exclusion criteria were as follows: smokers, COPD, bronchiectasis, inability to perform spirometry or if they had a restrictive pattern on spirometry, other significant lung disease, previous kidney or cardiovascular diseases, prior thoracic surgery, or a body mass index (BMI) > 35 kg/m^2 .

Statistical analysis:

All analysis was performed using the Statistical Package for the Social Sciences (SPSS version18). Student's 't' test was used to compare mean of continuous variables between two groups. Chi square test was used to analyze categorical data. For all tests $p \leq 0.05$ was considered statistically significant. Simple linear regression was used and the correlation coefficient (r) was calculated.

RESULTS

The mean age of patients were 52.03±9.07 years, duration of symptoms ranged from six months to 30 years with mean 16.19±2.82 years. There was no significant difference in age, gender, socio-economic state between patients and control groups.

The study showed more increase in the levels of blood urea and serum creatinine in patients group than control group with significant difference between active and control groups as shown in table (1)

The mean values ± SD for blood urea ($\mathbf{B_{ur}}$), serum creatinine ($\mathbf{S_{cr}}$) and creatinine clearance ($\mathbf{C_{cr}}$)before and after treatment of all patients included in this study were presented in table (2). The mean values of $\mathbf{B_{ur}}$ and $\mathbf{S_{cr}}$, were significantly lower after treatment than that before treatment; while there was a significant increase in the mean of $\mathbf{C_{cr}}$ after treatment in comparison with the pretreatment values ($P < 0.05$).

The patients included in this study were divided according to their sex into two groups: male group (43 patients), and female group (32 patients). The mean values ± SD for $\mathbf{B_{ur}}$, $\mathbf{S_{cr}}$ and $\mathbf{C_{cr}}$ before and after treatment of both sex groups were given in (table 3). The

results showed the B_{ur} and S_{cr} increased; while C_{cr} significantly decreased in male group in comparison to female group, ($P<0.05$).
The oximeter was used to classify the patients for two groups according to hypoxia: hypoxic group (52 patients) and non-hypoxic group (23 patients). The mean values ± SD for B_{ur}, S_{cr} and C_{cr} before and after treatment of both groups included in this study were given in (table 4). The results showed the B_{ur} increased and C_{cr} decreased significantly in hypoxic group in comparison with non-hypoxic group ($P < 0.05$); while no significant changes in S_{cr} ($P = 0.1$).
Patients were classified by using spirometer according to severity of disease depending on FEV1 into four groups, these groups were: mild (6 patients), moderate (26 patients), severe (30 patients) and very severe group (13 patients). The mean values ± SD for B_{ur}, S_{cr} and C_{cr} before and after treatment of all groups included in this study were given in (table 5). The results revealed no significant differences among groups ($P > 0.05$).
The study showed a significant negative correlation between blood urea and oxygen saturation (SPO_2) (before treatment) ($r = 0.4$, $p < 0.05$), also there was a significant positive correlation between creatinine clearance and SPO_2 (before treatment) ($r = 0.2$, $p < 0.05$) while there was non-significant negative correlation between serum creatinine and oxygen saturation (SPO_2) (before treatment) ($r = 0.1$, $P > 0.05$) as shown in figures (1), (2) and (3).
Regarding the correlations between renal function tests and forced expiratory volume in one second (FEV1), there was no significant correlation between FEV1 with blood urea, serum creatinine and creatinine clearance (before treatment) as shown in figure (4) and (5) and (6).

Table (1): Percentage of renal function tests in patients and control groups

Type	Total no.	Increased blood urea	Increased serum creatinine	P value
Patient group	75	32 (42%)	20 (26%)	0.000
Control healthy group	70	7 (10%)	2 (3%)	

Table (2): The mean values ± SD and P- Values for serum parameters of renal functions in patient group (before and after treatment)

Parameters		Mean ± SD	P- value
Blood urea(mmol/L)	before treatment	11.7 ± 4.5	0.000
	after treatment	6.5 ± 2.5	
Serum creatinine(µmol/L)	before treatment	104.8 ± 54.8	0.000
	after treatment	66.2 ± 29.1	
Creatinine clearance(ml/min/1.73m2)	before treatment	61.1 ± 20.6	0.0001
	after treatment	108.1 ± 41.6	

Table (3): The mean values ± SD and P- values for serum parameters of renal functions in patient group according to sex groups

Parameters		Gender groups (N=75)		P values
		Females (n=32)	Males (n=43)	
Blood urea (mmol/L)	before treatment	7.4 ± 2.5	12.3 ± 4.1	0.001
	after treatment	5 ± 1.4	7.2 ± 2.7	0.001
Serum creatinine (µmol/L)	before treatment	95.2 ± 30	142.7±40.3	0.006
	after treatment	56.7±15.1	80.7 ± 25.2	0.001
Creatinine clearance (ml/min/1.73m2)	before treatment	68.2 ± 19	57.9 ± 16.3	0.03
	after treatment	115.4±34.5	100.7±34.3	0.05

Table (4) : The mean values ± SD and P- values for serum parameters of renal functions in hypoxia and non-hypoxic groups of asthmatic patients

Parameters		Hypoxic groups (N=75)		P value
		Hypoxia(n=52)	No hypoxia(n=23)	
Blood urea (mmol/L)	before treatment	11.7±4.1	6.1±1.3	0.003
	after treatment	7±2.4	4.4±0.2	0.05
Serum creatinine (µmol/L)	before treatment	133.3±37	99.4±23	0. 1
	after treatment	77.5±24	51±11.8	0.2
Creatinine clearance (ml/min)	before treatment	58.4±12	74.9±18	0.008
	after treatment	101.6±30	141.3±48	0.001

Table (5) : The mean values ± SD and P- values for serum parameters of renal functions according to severity of asthma

Parameters		Groups of severity (N = 75)				P value
		Mild (n=6)	Moderate (n=26)	Severe (n=30)	V. Severe (n=13)	
Blood urea (mmol/L)	before treatment	5.5±1.1	12.2±0.7	10.4±3.3	11±3.5	0.12
	after treatment	4.3±0.5	6.1±0.4	6.3±2.1	6.7±2.6	0.3
Serum creatinine (µmol/L)	before treatment	72±2	133.6±31	132.4±47	130.6±35	0.27
	after treatment	46.7±9	76.2±19	73 ±31.4	79.7±21	0.12
Creatinine clearance(ml/min/1.73m2)	before treatment	73.7±14	66.9±20	55.9±12.7	55.3±19	0.3
	after treatment	118.1±8	120.9±33	99.3±34.8	97.5±28	0.3

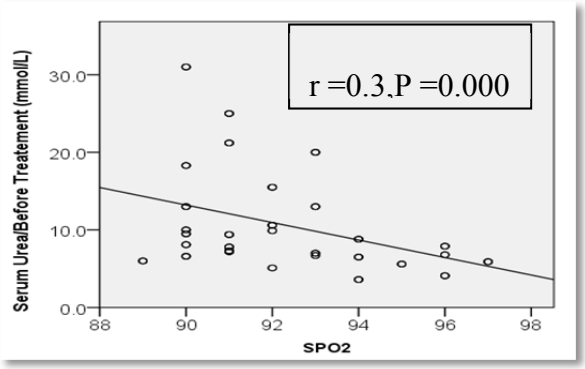

Figure (1): Correlation between blood urea and oxygen saturation ($SPO_{2)}$ (before treatment)

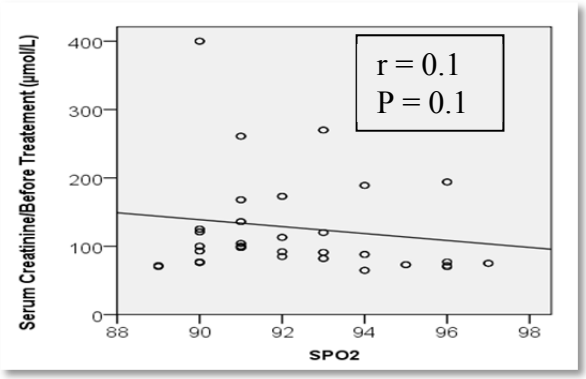

Figure (2): Correlation between serum creatinine and oxygen saturation ($SPO_{2)}$ (before treatment)

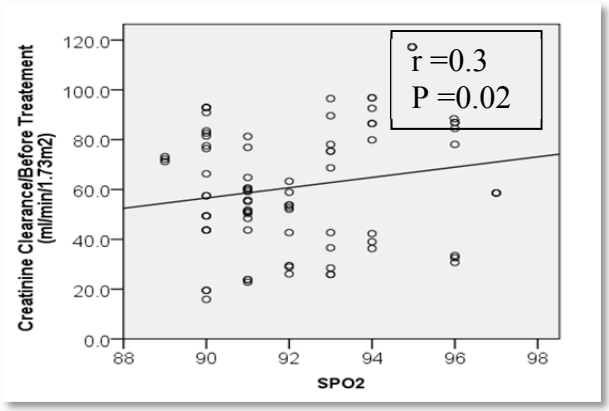

Figure (3): Correlation between creatinine clearance and oxygen saturation ($SPO_{2)}$ (before treatment)

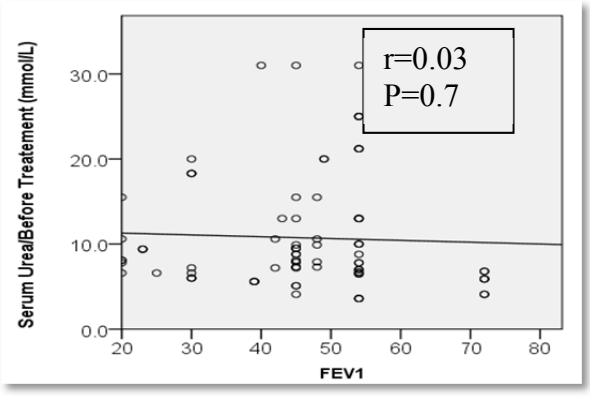

Figure (4): Correlation between serum urea and forced expiratory volume in one second (FEV1) (before treatment)

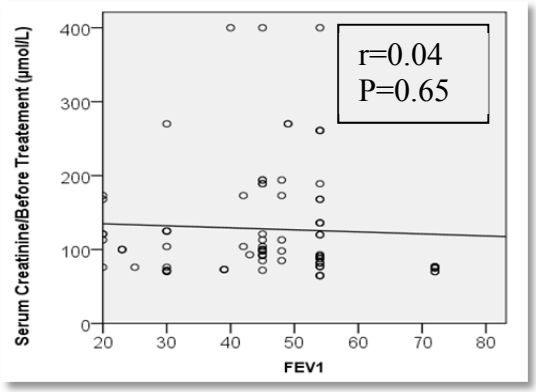

Figure (5): Correlation between serum creatinine and forced expiratory volume in one second (FEV1) (before treatment)

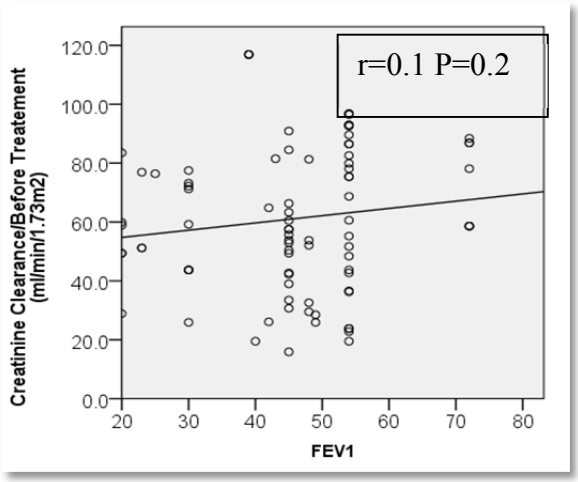

Figure (6): Correlation between creatinine clearance and forced expiratory volume in one second (FEV1) (before treatment)

DISCUSSION

Asthma is a chronic inflammatory disease of airways that is characterized by increased responsiveness of the tracheobronchial tree to a multiplicity of stimuli and it is a very common disease with immense social impact (9).

This study was performed to find the relation between asthma and changes in renal function as was assessed by measurement of blood urea and serum creatinine.

Recently, one study of 2354 asthma patients from a retrospective cohort in China indicates that there is 9.6% incidence of CKD in a period of six-year follow-up, in which the group of persistent asthma has independent, higher risk of CKD than the non-persistent group. Moreover, patients with hypertension, heart disease, diabetes, hyperlipidemia and obesity also have high risk of CKD. However, after adjusting for sex, age, and these co-morbidities, subjects with asthma still have significant and independent high risk of CKD (2).

In our study, we found a clinically and statistically significant reduction in kidney function with worsening hypoxia.

Asthma can produce right ventricular volume overload by increasing pulmonary vascular resistance leading to reduced cardiac output and kidney perfusion with resulting reductions in GFR (10). Another explanation could be a cellular or immune complex mediated systemic inflammatory response similar to other chronic inflammatory conditions such as rheumatoid arthritis. Such an inflammatory response can lead to kidney dysfunction either directly or by induction of endothelial dysfunction (11).

Studies on normal subjects have generally shown an increase in renal blood flow (RBF) with moderate acute hypoxemia, probably because of increased catecholamine concentrations and cardiac output. Paradoxically, RBF is low in chronic hypoxemia as in patients with asthma despite of normal or even increased (12).

In this study, there was association between hypoxemia and disturbed renal function but this might be not the only cause because not all patients with hypoxemia had renal dysfunction, other factors may play a role like use of some nephrotoxic drugs in the treatment of asthma especially third generation cephalosporins given during acute attacks.

CONCLUSION:

The study showed changes in renal function tests (blood urea and serum creatinine) in asthmatic patients and these changes should be monitored and followed up to determine the risk for development of chronic kidney disease in the future.

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