

Original Research Article

Impact Of Hypoxemia In Patient With Chronic Obstructive Pulmonary Disease On Renal Function Tests

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Abstract

Chronic obstructive pulmonary disease (COPD) is one of the most common chronic diseases and is expected to be progressively increasing. There are many co-morbidities associated with it, but the relation between it and changes in renal function tests is still unclear. The aim of this work was to illustrate the extent of kidney dysfunction in patients who suffer from COPD. This study was performed in Merjan Medical City, the period of study was from November 2013 to June 2014, it included 86 patients with COPD and 70 control healthy subjects who completed medical questionnaires, pulmonary function tests and measurement of blood urea and serum creatinine. The data was statistically analyzed, the level of statistical significance that was depended for this study was P values ≤ 0.05 . The results of this study revealed 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 Ccr decreased significantly in hypoxic group in comparison with non hypoxic group ($P < 0.05$); while no significant changes in Scr ($P = 0.1$). 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 illustrated that the B_{ur} and S_{cr} increased; while C_{cr} decreased significantly in male group in comparison to female group ($P < 0.05$). Also there was no significant correlation between blood urea, serum creatinine, and creatinine clearance with forced expiratory volume in first second (FEV₁) (before treatment) ($P > 0.05$). From this study, we conclude that abnormalities of renal function tests are common in patients with COPD at the first days of admission to hospital.

Key Words: COPD, blood urea, serum creatinine, creatinine clearance.

الخلاصة

مرض الانسداد الرئوي المزمن هو من الامراض المزمنة الاكثر انتشارا وفي ازدياد مستمر وهناك الكثير من المشاكل الصحية الناتجة عن هذا المرض ولكن علاقته مع التغيرات الحاصلة في وظائف الكلى لاتزال غير واضحة. تهدف الدراسة لمعرفة مدى اضطراب وظائف الكلى في المرضى المصابين بمرض الانسداد الرئوي المزمن. تم اجراء الدراسة في مدينة مرجان الطبية للفترة من تشرين الاول 2013 الى حزيران 2014، وقد تضمنت 86 مريضا و 70 شخصا سليما والجميع اكمل الاستلثة الطبية، فحص وظائف الرئة وقياس مستوى يوريا الدم ومستوى الكرياتينين في مصل الدم. تم اجراء التحليل الاحصائي للنتائج، قيمة (p) اقل من او يساوي 0.05. تم اعتبارها قيمة معنوية سريريا. اثبتت النتائج ان هناك فرقا معنويا في معدل قيم يوريا الدم، كرياتينين في مصل الدم، وتصفية الكرياتينين قبل وبعد اعطاء العلاج لجميع المرضى، كانت هناك زيادة في يوريا الدم وانخفاض في تصفية الكرياتينين بشكل معنوي في مجموعة ناقصة الاوكسجين بالمقارنة مع المجموعة الغير ناقصة بالاوكسجين بينما لم يكن هناك تغيرات معنوية في مستوى الكرياتينين.بالاضافة الى ذلك، اظهرت الدراسة وجود علاقة معنوية بين مستوى يوريا الدم وتصفية الكرياتينين مع نسبة تشبع الاوكسجين قبل اعطاء العلاج للمرضى، بينما كانت هناك علاقة سلبية غير معنوية بين مستوى كرياتينين في مصل الدم ونسبة تشبع الاوكسجين قبل العلاج. بينت النتائج ازدياد مستوى يوريا الدم وكرياتينين مصل الدم بينما انخفض تصفية الكرياتينين بشكل معنوي في مجموعة الذكور بالمقارنة مع مجموعة الاناث.

كما اظهرت النتائج عدم وجود علاقة معنوية بين مستوى يوريا الدم، كرياتينين مصل الدم وتصفية الكرياتينين مع حجم الهواء الذي يخرج في اول ثانية من الزفير (قبل العلاج). نستنتج من هذه الدراسة ان الاضطرابات في اختبارات وظائف الكلى تكون شائعة في المرضى المصابين بمرض الانسداد الرئوي المزمن في الايام الاولى من دخول المستشفى.

الكلمات المفتاحية: التهاب القصبات المزمن، يوريا الدم، كرياتينين الدم، معدل تصفية الكرياتينين.

Introduction

The alterations in the blood oxygen (O₂) and carbon dioxide (CO₂) can affect kidneys hemodynamic and these are well-known in patients with chronic obstructive pulmonary disease (COPD), mostly in severe exacerbation [1,2]. Chronic obstructive pulmonary disease is a heterogeneous disease associated with multiple co-morbidities [3]. It has been reported that the prevalence of kidney dysfunction is increased in those with COPD, some of the smoking components like nicotine and selected heavy metals can be considered as risk factors for renal diseases [4]. serum creatinine was used to diagnose chronic renal failure and therefore there was underestimation for its prevalence [5]. Studying the relation between renal function and COPD is important because the disease is highly prevalent and there is significant morbidity, mortality, and cost associated with kidney failure and kidney replacement therapy [6]. COPD represents one of the sources of systemic inflammation which is not only restricted to the lungs and can extend systemically [7]. It is known to cause cardiovascular diseases. But there was little information regarding the relation between it and renal dysfunction [8].

This work aimed to determine the extent of changes in renal function in patients with COPD.

Materials and Methods

This study was performed in Medical City of Merjan in Babylon Province during the period from November 2013 to June 2014, the study involved 86 patients with history of COPD for more than six months who

were admitted in the ward due to acute exacerbations and they were compared with 70 control healthy subjects. Full history (age, gender, duration of disease, smoking and chronic diseases), with complete physical examination were done for all the patients and control subjects. The following investigations were done for patients and controls: electrocardiography, echocardiography, chest x-ray, random blood sugar, renal function tests, pulmonary function tests, and liver function tests. Pulmonary function testing was accomplished depending on the recommendations of the American Thoracic Society and measured values were compared with standard population-derived predicted values. Exclusion criteria were as follows: asthma, 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/m².

Statistical Analysis

The data was analyzed by using the Statistical Package for the Social Sciences (SPSS version 18). For the comparisons the mean between the two groups, we used Student's 't' test while for analyzing categorical data, Chi square test was used. For all tests $p \leq 0.05$ was taken as the level of statistical significance. Regarding the relation between some parameters, simple linear regression was used [9].

Results

The mean age of patients (active group) were 62.03±9.07 years, duration of symptoms ranged from six months to 10 years with mean 4.19±2.82 years. Patient

with increased blood urea and serum creatinine were older in age, male, and had lower BMI, lower PCV, and they smoke more than other patients. Patients with increased blood urea account for the largest

percentage of patients in reverse to the increased serum creatinine with significant difference between active and control groups as shown in table (1).

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

Type	Total no.	Increased blood urea	Increased serum creatinine	P value
Active group (patients)	86	48 (55%)	30 (35%)	0.000
Control healthy group	70	0 (0%)	0 (0%)	

Comparison the mean values of different parameters of renal function test before and after treatment in COPD patients

The mean values \pm SD for blood urea (B_{ur}), serum creatinine (S_{cr}), and creatinine clearance (C_{cr}); before and after treatment of all the involved patients in this study

were illustrated in table (2). Mean values of B_{ur} and S_{cr} , were significantly lower after treatment than that before treatment; while there was a significant increase in the mean of C_{cr} after treatment in comparison with the pretreatment values ($P < 0.05$).

Table 2: The mean \pm SD and P- Values for serum parameters of renal functions in COPD patients (before and after treatment)

Parameters		Mean \pm SD	P- value
Blood urea (mmol/L)	before treatment	10.7 \pm 4.5	0.0001
	after treatment	6.5 \pm 2.5	
Serum creatinine (μ mol/L)	before treatment	127.8 \pm 54.8	0.0001
	after treatment	73.2 \pm 29.1	
Creatinine clearance (ml/min/1.73m ²)	before treatment	61.1 \pm 20.6	0.0001
	after treatment	108.1 \pm 41.6	

Comparison of the mean values of different parameters of renal function test before and after treatment in male and female groups

The patients included in this study were divided according to their sex into two groups: male group (59 patients), and female

group (27 patients). The mean values \pm SD for B_{ur} , S_{cr} and 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 with females, ($P < 0.05$).

Table 3 : Mean \pm SD and P- values for serum parameters of renal functions in COPD patients according to sex groups

Parameters		Gender groups (N=86)		P values
		Females (n=27)	Males (n=59)	
Blood urea (mmol/L)	before treatment	7.4 \pm 2.5	12.3 \pm 4.1	0.001
	after treatment	5 \pm 1.4	7.2 \pm 2.7	0.001
Serum creatinine (μ mol/L)	before treatment	95.2 \pm 30	142.7 \pm 40.3	0.006
	after treatment	56.7 \pm 15.1	80.7 \pm 25.2	0.001
Creatinine clearance (ml/min/1.73m ²)	before treatment	68.2 \pm 19	57.9 \pm 16.3	0.03
	after treatment	115.4 \pm 34.5	100.7 \pm 34.3	0.05

Comparison the mean values of different parameters of renal function test before and after treatment in hypoxic and non hypoxic groups of COPD patients

We are used the oximeter to classify the patients for two groups according to hypoxia: hypoxic group (62 patients) and non hypoxic group (24 patients). The mean

values \pm SD for **B_{ur}**, **S_{cr}** and **C_{cr}** before and after treatment of both groups included in this study are 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}** ($P = 0.1$).

Table 4 : Mean values \pm SD and P- values for serum parameters of renal functions in hypoxia and non hypoxic groups of COPD patients

Parameters		Hypoxic groups (N=86)		P value
		Hypoxia(n=62)	No hypoxia(n=24)	
Blood urea (mmol/L)	before treatment	11.7 \pm 4.1	6.1 \pm 1.3	0.003
	after treatment	7 \pm 2.4	4.4 \pm 0.2	0.05
Serum creatinine (μ mol/L)	before treatment	133.3 \pm 37	99.4 \pm 23	0.1
	after treatment	77.5 \pm 24	51 \pm 11.8	0.2
Creatinine clearance (ml/min)	before treatment	58.4 \pm 12	74.9 \pm 18	0.008
	after treatment	101.6 \pm 30	141.3 \pm 48	0.001

Comparison the mean values of different parameters of renal function test before and after treatment according to severity of COPD

We used the spirometer to classify the patients for four groups according to severity of disease depending on FEV1;

these groups were: mild (7 patients), moderate (30 patients), severe (34 patients) and very severe group (15 patients). The mean values \pm 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 showed no significant differences among groups ($P > 0.05$).

Table 5 : Mean values ± SD and P- values for serum parameters of renal functions according to severity of COPD

Parameters		Groups of severity (N = 86)				P value
		Mild (n=7)	Moderate (n=30)	Severe (n=34)	V. Severe (n=15)	
Blood urea (mmol/L)	before treatment	5.6±1.1	12.2±0.7	10.4±3.3	11±3.5	0.12
	after treatment	4.4±0.5	7.1±0.4	6.3±2.1	6.7±2.6	0.3
Serum creatinine (µmol/L)	before treatment	74±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

Correlations between different variables of renal function tests and SPO

The study also revealed a significant negative relation between oxygen saturation

and blood urea (before treatment) ($r = 0.4, p < 0.05$) as shown in figure (1).

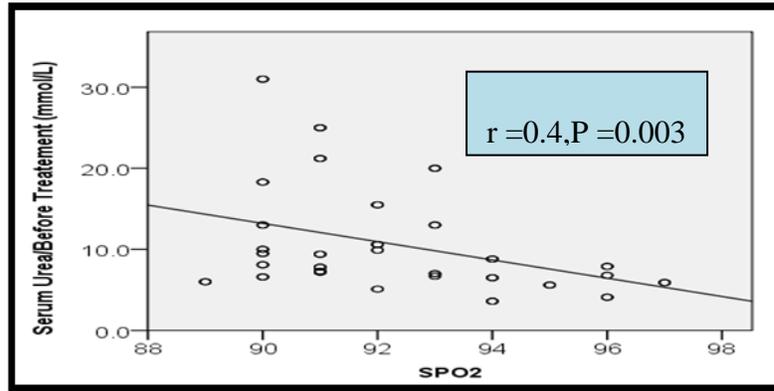


Figure 1: Relation between blood urea and oxygen saturation (SPO₂) (before treatment)

There was no significant negative correlation between serum creatinine and

oxygen saturation (SPO₂) (before treatment) ($r = 0.1, P > 0.05$) as shown in figure (2).

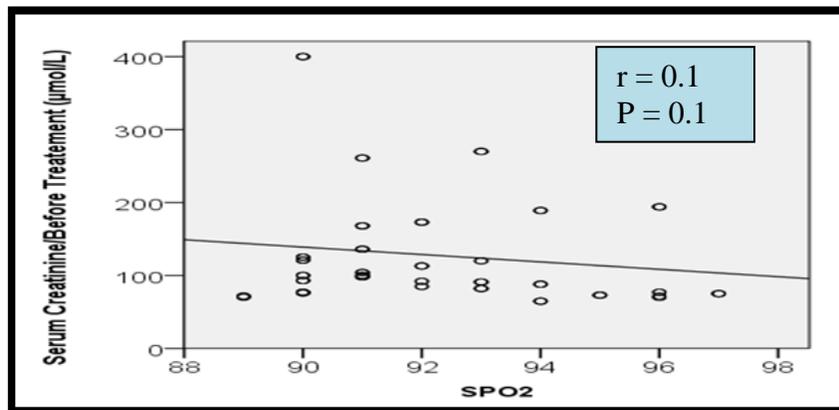


Figure 2: Relation between oxygen saturation (SPO₂) and serum creatinine (before treatment)

The study also showed a significant positive relation between creatinine clearance and

SPO₂ (before treatment) ($r = 0.2, p < 0.05$) as shown in figure (3).

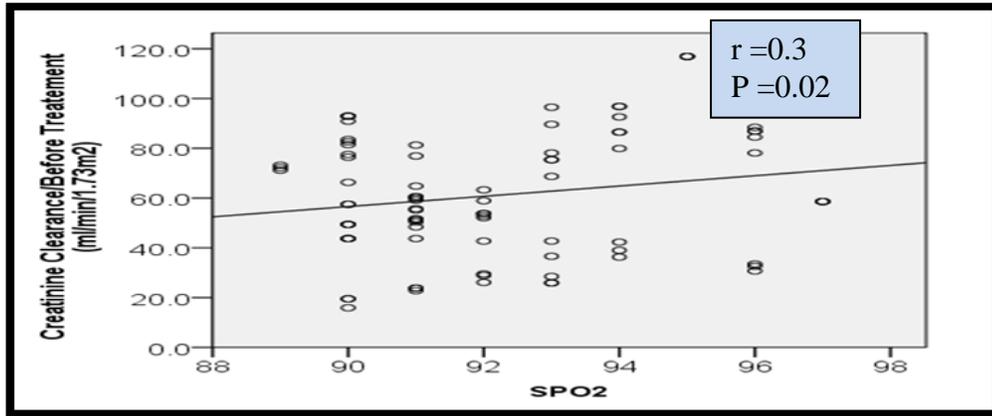


Figure 3: Relation between creatinine clearance and oxygen saturation (SPO₂) (before treatment)

Correlations between different variables of renal function tests and FEV1

treatment) ($r = 0.04, P > 0.05$) as shown in figure (4).

5.1. There was no significant relation between blood urea and FEV1 (before

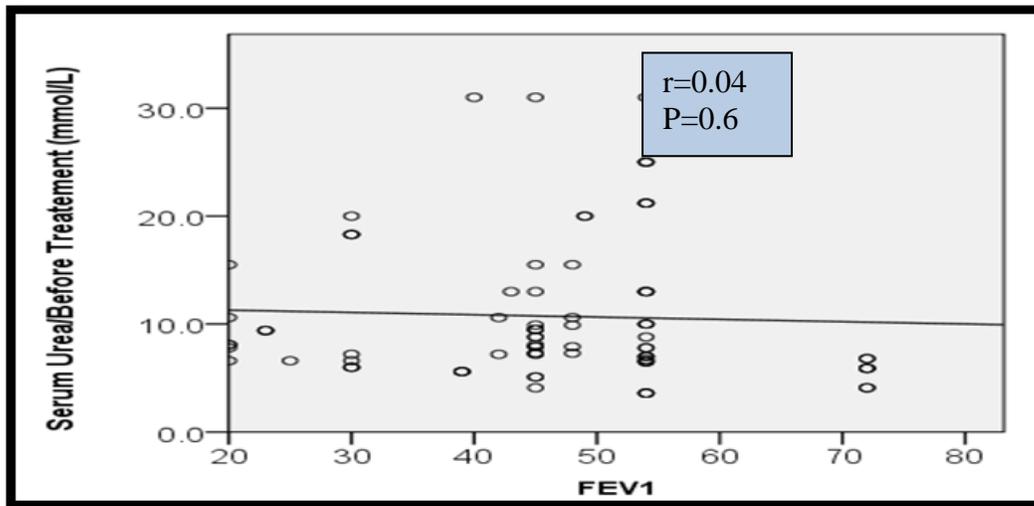


Figure 4: Relation between blood urea and FEV1 (before treatment)

The study also showed no significant relation between serum creatinine and FEV1

(before treatment) ($r = 0.04, P > 0.05$) as shown in figure (5).

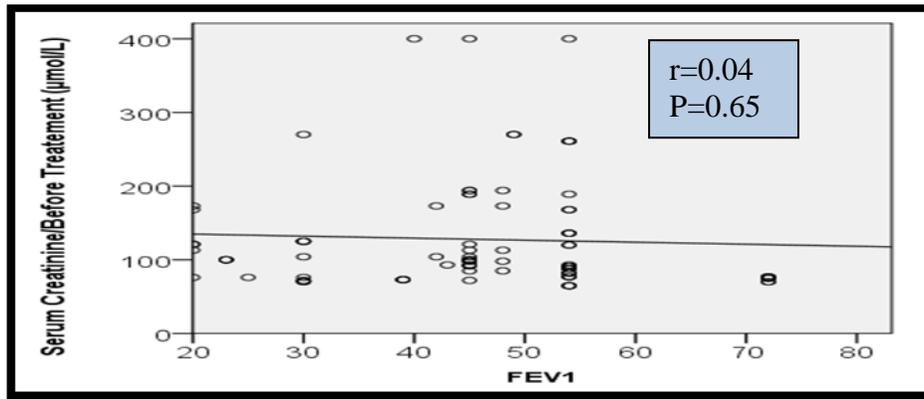


Figure 5: Relation between FEV1 and serum creatinine (before treatment)

There was no significant relation between creatinine clearance and FEV1 (before

treatment) ($r = 0.1$, $P > 0.05$) as shown in figure (6).

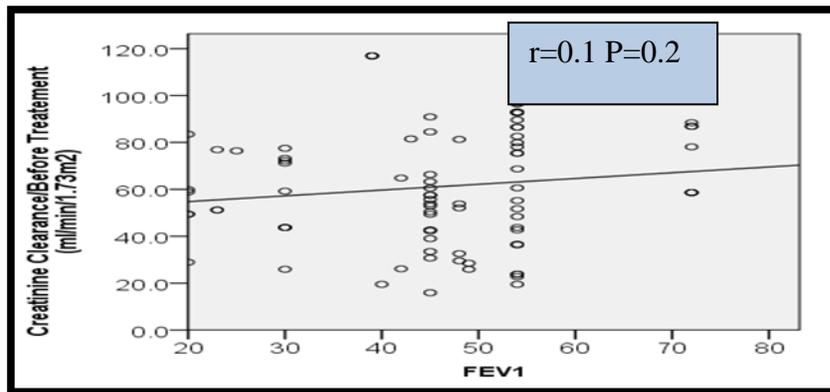


Figure 6: Relation between FEV1 and creatinine clearance (before treatment)

Discussion

In this study, there was clinical and statistical significant reduction in kidney function with worsening hypoxia. The mechanisms that link COPD and kidney function are at present speculative [10]. COPD can produce right ventricular volume overload by increasing pulmonary vascular resistance leading to reduced cardiac output and kidney perfusion with resulting reductions in GFR [11]. Another explanation could be a cellular or immune complex mediated systemic inflammatory response in patients with emphysema. Such an inflammatory response can lead to kidney dysfunction either directly or by induction of endothelial dysfunction [12,13]. 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 COPD despite of normal or even increased [14]. 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 some nephrotoxic drugs used in the treatment of COPD especially third generation cephalosporins given during acute exacerbations. The study showed that

creatinine clearance is better than serum creatinine in assessment of renal function in patients with COPD because serum creatinine can be affected by fat-free mass and muscle turnover and some of patients with this disease have a reduced muscular mass, so the serum creatinine may be falsely low because of reduced creatinine release [15].

Conclusion

Renal dysfunction should be taken in consideration in patients with COPD, even with normal serum creatinine, because its presence either have prognostic implications on the disease itself or affect clinical practice (eg, drug prescribing and dosing).

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