Original Article

Study of renal function during acute phase and recovery in patients with COVID - 19 in Baghdad/Iraq

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Abstract

This study aims to investigate traces of COVID – 19 on renal system during infection & after recovery in city of Baghdad from October 2021 till April 2022.

Method: Patients were consisted of 120 individuals with acute then to convalescent phase of COVID-19 and 60 healthy controls, all aged between 19 & 61 years.

They were consisted of equal halves of males & females, for both patients & controls.

Tests that were depended in this study are: Blood urea, serum creatinine & serum uric acid; all samples are of serum; that had been done using Roche – Integra 400 plus auto analyser at Al-Karkh Medical Laboratory in Baghdad.

Result: Renal impairment & problems were of several dilemmas that raised highly with proceeding of COVID – 19, made dysfunction of kidneys & other correlated parts of renal system parts a very significant criterion among patients suffering this problem; especially if there was a familiar history in these organs; like renal stone formation, uricemia & recurrent urinary tract infection; making consequences of this disease the worst among other problems that can take effect on renal system; rather than chemical toxification & cancers.

Blood urea had scored in males in acute & recovery phases of (38.08±15.36) & (43.27±18.13) respectively, while in females was (28.57±7.56) & (32.25±8.49) in same attribute, with high significance of ($p<0.01$ HS) in acute phase & ($p>0.05$ NS) for recovery phase.

Serum creatinine levels were lower in females than of males in both phases; where scores at (0.6517±0.19) in acute phase & (0.81±0.19) after recovery; which means that they stayed in normal ranges; while in males level of creatinine scored (0.94±0.370) & (1.19±0.45) in cue; hitting the highest normal ranges & made males in higher risk for any renal proper functioning, with high significance of ($p<0.01$ HS) for both.

Results of S. uric acid were slightly near the upper limits for females at (5.23±1.13) & (5.48±0.79) for acute & recovery phases in correspondence, while males crossed the borders of normal ranges in both phases; (6.31±1.17) & (7.07±1.09) respectively, ($p<0.01$ HS) for both.

Keywords: COVID – 19, renal impairment, blood urea, creatinine, uric acid.

Introduction

Many of patients were not under strict regime of diet that consists of healthy ingredients supposed to be eaten during or after infection with close period.

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For example, diets that consisted of heavy protein meals & of fatty ingredients had the highest negative effects on renal system.

Filtration takes place in "Glomerulus", where about (20 %) of blood total volume enters kidneys in order to be filtered in "Nephron"; where dysfunction of these units leads to renal impairment due to loss of reabsorption of essential amino acids, the basic units to build protein & defense system. (1)

One of the problems that lead human health dilemma around globe is "Chronic Kidney Disease"; (CKD); which consist about (15 %) of world population & patient numbers who suffer from or going to be renal failure people, rather than to say some of them might start to have permanent "Urinary – Tract – Infection"; (UTI); or getting filled with course crystals accumulated by low blood supply or low water intake, which make stones in future, leading to chronic "Renal – Tissue – Injury"; (RTI). (2)

When it comes to systemic infections, renal system will be under heavy burden in order to get rid of debris circulating the vascular system, which take an antagonism with elevated blood pressure came from renal dysfunction, like in case of COVID – 19, which take use of "Angiotensin" to bind with & getting intracellularly; hence; this hormone is "Inactive" in children & some people; these two either cannot be really infected with or miss the secondary sequences which causes most of mortality or destruction to body via "Cytokines – Storm", there is why many COVID – 19 patients suffer increasing blood pressure during infection, one of most important cause to make "Headache". (3)

Beside kidneys main role in carrying nitrogen waste, and by this action as transporter, passing through collecting tubules, it is can be reabsorbed according to need, in addition to water, sodium, potassium & other important minerals & compounds from passing blood in order to maintain body blood pressure & its (pH) under control of antidiuretic hormone to perform "Hyper – Osmotic" urine to prevent reabsorption of unwanted materials; hence; in case of impairment of kidneys this hyper – osmolality becomes less effect & leads to disturbance in maintaining balance for electrolytes & other minerals of body. (4)

High concentration of urea in blood stream can destroy or damage cells; or even tissues; and when it is generated from ingested amino acids; naturally or artificially; this substance can decompose & reacts with violent strength to oxidants, fatty acids, inorganic chloride, and can produce toxic compositions to cells; for thus; it can be irritant to skin, pulmonary tracts & eyes, where its elevation can appear like dandruff in hair or it may mistakenly diagnose as "Seborrhea – Dermatitis", like many of COVID – 19 suffered of it. (5)

Creatinine concentration in plasma & excreted urine are used usually for estimation "Glomerular – Filtration – Rate"; GFR; or to another correlation with calculation of "Creatinine – Clearance"; CrCl; and thus; importance of GFR measurement for kidneys function in cases of severe dysfunction, the rate of CrCl may overestimate GFR due to tubular creatinine hyper excretion, while in some cases of severe renal dysfunction, when absence of excretion of creatinine occurs; creatinine behave inulin – like compound, which leads furtherly to collaborate the dilemma of hyperuremia & hyperglycemia. (5)

Effect of COVID – 19 on creatinine is strictly related to reduction of oxygen concentration in blood stream (SpO_2) due to blockage of iron carriers; that hold "HAEM"; therefore; lacking of oxygen transporting is the main causative agent in "Hypoxia"; leading to continuous & consequential of pulmonary problems that may cause lung congestion, alveolar hypertension, haemorrhage, and finally (pH) alternation to alkaline to reduce concentration of "Carbonic acid"; H_2CO_3; which will cause systemic acidosis, which will lead to blood corpuscular destruction via increased concentration of carbonic acid in blood stream; then resulting in death. (6)

Method:

Patients were consisted of 120 patients with acute then to convalescent phase of COVID-19 and 60 healthy controls, all aged between 19 & 61 years.

They were consisted of equal halves of males & females, for both patients & controls, in order to keep in touch for getting tests during acute & recovery phases, and to prevent loss of patients; as could as possible; for a period last for about (1-3) weeks in acute phase & (4-6) weeks in recovery phase.

Study design was based upon manifestation of tests that can give an indication for an important signal towards decide the linage of infection with COVID-19, degree of incidence & intensity.

This is a novel study in Iraq via this linkage & comparison.

Samples were drawn & tested directly after getting serum from venous blood in a (6 ml.) gel tube using biochemistry auto analyser Roche – Integra 400 plus.

Results & discussion:

Study of patients:

Victims of COVID – 19 were of different age groups & both genders; therefore; by calculating collected data; the findings can be as: patients were 120 persons; divided by two halves of males & females; with 60 healthy individuals taken as controls which were taken after excluding their resent & previous infection with COVID – 19 by maintaining antibodies against it of both (IgM) & (IgG) respectively.

The age of study samples was normally distributed and ranged from (19 – 61) years; with a mean of (35.67 ± 9.137), and most of the sample at the age group of (20-29) years old with (36.7%) for females, while it was of (40 - >50) years old with (45%) for males.

The mean age of cases group was (36.92 ± 9.242) years old mostly at the age group of (30 – 39) & (40->50) years old (26.7%); which were equal in mean of infections; due to being the highest group in work field.

While that of controls was (33.17 ± 8.452) years old mostly at the age group of (20-29) years; (43.3%) for females, while males are of (30-39) years; (36.7%); with significant mean differences among them of (3.758); (t= -2.645, df: 178, P= 0.009); otherwise, no significant differences were identified regarding age groups of study samples (P> 0.05); as seen in table (1); matching with [7]

Table (1): Distribution of Studied groups according to Age groups (Years) by Gender

Studied groups	Gender		Age groups (Years)			Total
			(<20-29)	(30-39)	(40-≥50)	
COVID-19 Patients	Female	No.	22	21	17	60
		%	36.7%	35.0%	28.3%	100.0%
	Male	No.	10	23	27	60
		%	16.7%	38.3%	45.0%	100.0%
Control	Female	No.	13	11	6	30
		%	43.3%	36.7%	20.0%	100.0%
	Male	No.	10	11	9	30
		%	33.3%	36.7%	30.0%	100.0%

For renal profile tests, the comparison between males & females in acute stage; firstly, table (2) shows the statistical calculations for blood urea, S. Creatinine & S. uric acid in first (1-3) weeks of infection, which is called "The Acute Phase", where it scored highly significant elevation in levels of these test with those of controls, healthy people who do not have neither COVID – 19; nor any chronic diseases; hence; noticeably males are of higher scores than females; some linked these differences with hormones, body mass, type of diet, while others put an idea of having monthly menses that renew body tissues & re-stimulate further organs in this event, defending the creature who bears & raise babies in order to create a newer generation for humanity. [8]

Males are more affected by COVID – 19 than females in all tests of renal profile with remarkable difference, which gave the notice to accumulated problems in renal system; especially by elevation of S. Creatinine & S. Uric acid to the upper limits; compared to females. [9]

Table (2): Comparison the levels of renal level (B. urea, Creatinine & Uric acid) between male & female for acute phase during (1-3) weeks COVID – 19 patients

Renal profile	Gender	Mean ±Std.	t-test	P-Value
B. urea	Female	28.57±7.56	4.306	.000 (P<0.01 HS)
	Male	38.08±15.36		
S. Creatinine	Female	0.6517±0.19	5.418	.000 (P<0.01 HS)
	Male	0.94±0.370		
Uric acid	Female	5.23±1.13	5.176	.000 (P<0.01 HS)
	Male	6.31±1.17		

Table (3) showed the statistical criteria of the acute phase for significance of test; in addition to means of age & levels; getting highly significant scores of (P<0.01 HS) for all tests of profile with no consideration to gender.

This statistical table is special & owned for this study with no consideration to other studies or researches.

Table (3): Comparison between the levels of renal level (B. urea, S. Creatinine, S. Uric acid) & age (year) for acute phase during (1-3) weeks COVID – 19 patients

	Age (year)	B. Urea	S. Creatinine	S. Uric acid
Mean ±Std.	36.93±9.24	33.33±12.97	0.80±0.33	5.77±1.27
t-test		2.643	42.912	37.758
P-Value		.000 (P<0.01 HS)	.000 (P<0.01 HS)	.009 (P<0.01 HS)

Where as in table (4), the data can show an alternation in levels of blood urea towards decrement; mostly related to diet & assurance of females to get thinner after gaining some kilos due to staying quarantined or less movement behavior; but both S. Creatinine & S. Uric acid are still elevated even after recovery, due to the damage had occurred for renal system tissues caused by increased duties during acute phase of disease & persisted mechanical re-arrangement after recovery, which scored increased cases of tiredness after weeks of staying home or at hospitals; therefore; males were near or above the normal ranges which made them at higher risks for future renal expected problems. [10]

Table (4): Comparison the levels of renal level (B. Urea, Creatinine & Uric acid) between male & female for recovery phase after (4-6) weeks COVID – 19 patients

Renal profile	Gender	Mean ±Std.	t-test	P-Value
B. Urea	Female	32.25±8.49	4.263	.000 (P<0.01 HS)
	Male	43.27±18.13		
S. Creatinine	Female	0.81±0.19	6.001	.000 (P<0.01 HS)
	Male	1.19±0.45		
S. Uric acid	Female	5.48±0.79	9.201	.000 (P<0.01 HS)
	Male	7.07±1.09		

Table (5) declared the non – significant relationship alternation in level of blood urea; as mentioned before; while highly significant relationship stayed for S. Creatinine & S. Uric acid; as concerned with this study.

Table (5): Comparison between the levels of renal level (B. urea, S. Creatinine, S. Uric acid) & Age (year) for recovery phase after (4-6) weeks COVID – 19 patients

	Age (year)	B. urea	S. Creatinine	S. Uric acid
Mean ±Std.	36.93±9.24	37.76±15.14	1.00±0.40	6.27±1.24
t-test		0.546	42.695	37.303
P-Value		0.586 (P>0.05 NS)	.000 (P<0.01 HS)	.000 (P<0.01 HS)

The expectation curve of the above criteria & tests was of clear, expectable & compatible with signs & symptoms that scored by physicians during hospitalization or quarantine period that blow the planet intensively, as shown in table (6) & its figure (1) below.

Table (6): Receiver Operating Characteristic Curve analysis (ROC) of renal level (B. urea, S. Creatinine & Uric acid) for acute phase during (1-3) weeks COVID-19 patients

Variable(s)	Area	P-Value	Cut off	Sensitivity	Specificity
B. Urea (mg/dl)	.442	.168	>32.00	33.3%	41.8%
S. Creatinine (mg/dl)	.261	.000	>0.90	0.0%	26.7%
S. Uric acid (mg/dl)	.188	.000	>6.0	15.0%	42.7%

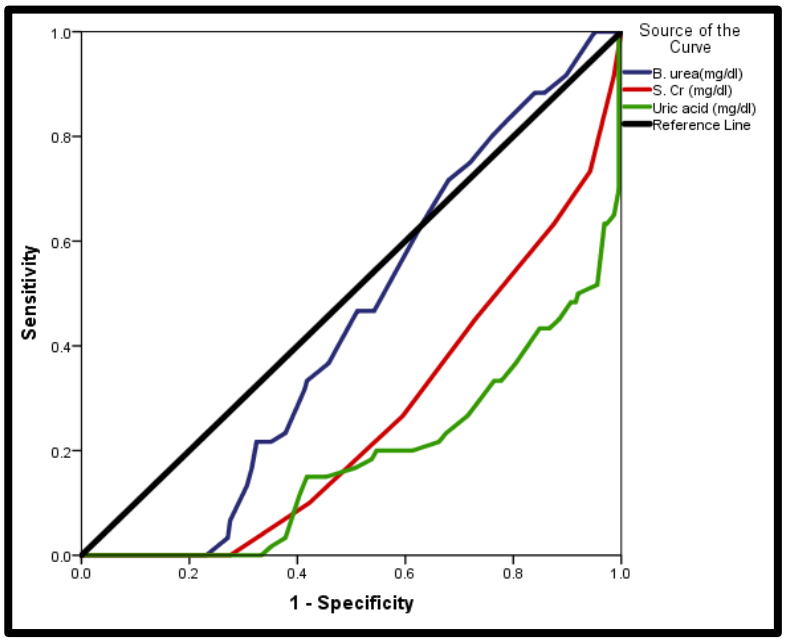

Figure (1): Receiver Operating Characteristic Curve analysis (ROC) of Renal level (B. urea, Creatinine & Uric acid) for Acute phase during (1-3) weeks COVID-19 patients.

The figure (1) of ROC shows the curves bias of tests towards area of specificity in accordance that can gives some previous expectations for prognosis of cases suffering COVID – 19 with taking in consideration all conditions that surrounds patients under estimation & examination by specialized physicians taking care of them; in addition to the supporting team(s); nurses, laboratories & radiology members. [11]

Table (7): Receiver Operating Characteristic Curve analysis (ROC) of renal level (B. urea, S. Creatinine & S. Uric acid) for recovery phase after (4-6) weeks COVID-19 patients.

Variable(s)	Area	P-Value	Cut off	Sensitivity	Specificity
B. Urea (mg/dl)	.368	.004	>29.00	46.7%	65.0%
S. Creatinine (mg/dl)	.168	.000	>0.70	45.0%	85.0%
S. Uric acid (mg/dl)	.148	.000	>5.75	18.3%	61.7%

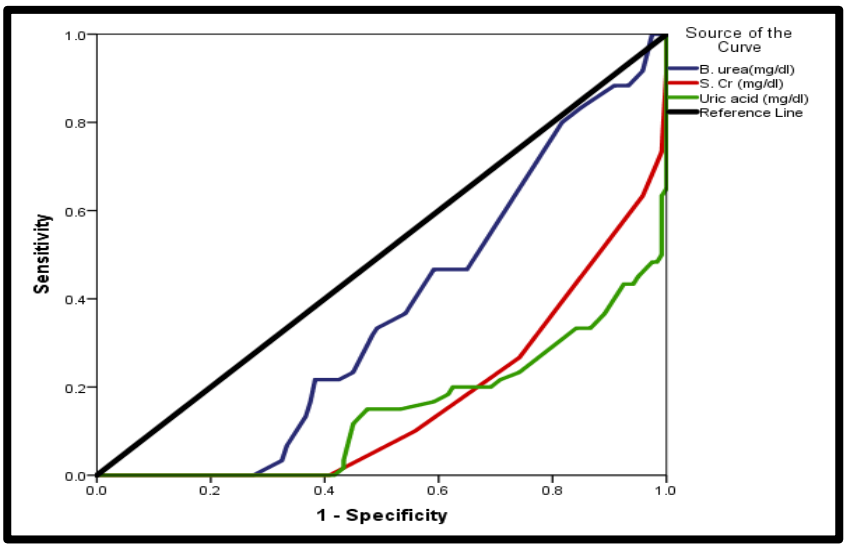

Figure (2): Receiver Operating Characteristic Curve analysis (ROC) of renal level (B. Urea, S. Creatinine & Uric acid) for recovery phase after (4-6) weeks COVID-19 patients.

While in table (7) which represents the same previous criteria; but after recovery; the noticeable alternations are in decrement in area, p-value, cut-off value & percentage sensitivity of test in comparison with table (6), but elevation in values of specificity in table (7) refers to increment of this criterion towards making these tests of more importance in diagnosis & follow up, making full agreement with [12].

Conclusions:

The effects of COVID – 19 on S. Creatinine & S. Uric acid are of very strong traces upon kidneys; which take further consequences to other organs; that may lead to get illness with chronic diseases due to accumulated effects on different tissues of body, for example; crystals of uric acid are water immiscible and can precipitate inside joints causing damages to cartilages and leading to secondary arthritis and more renal and/or cardiac congestion due to this accumulation; especially if it was accompanied with elevated S. Creatinine scores; which will lead for increment in interstitial fluids and will help in elevation of anaerobic pathway of Krebs cycle, in which increment of S. LDH and S. Creatinine will cause uprising for cardiac blood pressure due to increment in heart pulse rates to get rid of these molecules and particles via urination and diarrhea, meaning imbalance in glomerular functioning and in rates of electrolytes and other minerals; which those should be reabsorbed by kidneys.

Previous sequences and consequences will help in making the infected individual with COVID – 19 may suffer several problems after a short period of time; matter of months; according to records of laboratorial tests which are matched with signs and symptoms of renal, hypertension, arthritis and even cardiac dysfunctions or impairments.

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