

Biomedical Communication

Significance of Addressal of Clinical Investigations of Kidney Functions in Recovery/Mortality of Certain COVID-19 Patients

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ABSTRACT

Clinical management of COVID-19 patients through a robust protocol is key to the good recovery and reduced mortality of patients. Efficient kidney functions during treatment period can contribute for improvised recovery and reduced mortality of patients. Analysis of the kidney function among Recovered and Dead cases of COVID-19 was made to reveal the degree of association of kidney functions with the two categories of patients. 83.4% of recovered patients did not show hyper values of blood urea whereas 72.5% of dead patients showed hyper-urea level in blood. 88.8% of survivors showed non-hyper creatinine level of blood whereas only 40% of dead cases showed hyper creatine level. Strong degree of association of blood urea with recovery/mortality was observed. Sodium levels were seen to be low while potassium and chloride ions were seen to be high in COVID-19 individuals. Our preliminary study suggests that kidney functions especially the value of blood urea and creatinine need to be addressed during COVID-19 patients to ensure the best recovery and reduced mortality. After more number of case studies, the present observation could sensitize consideration for inclusion of addressal and treatment of kidney functions into treatment protocol against COVID-19. It was also interesting to observe that levels of sodium and potassium ions among Survivors and Dead cases have impacted function of the essential ion channels in patient's physiology.

KEY WORDS: COVID-19, ELECTROLYTES, KIDNEY, SARS-COV2, UREA.

INTRODUCTION

Severe Acute Respiratory Syndrome-CoronaVirus-2 (SARS-COV2) has now taken the shape of one of the most rampant human pandemics the world has ever faced. In India, there prevails the second wave of pandemic starting from 11th February 2021 with a total of 178360849 cases and 3869384

as of today as updated on W.H.O's Coronavirus (COVID-19) dashboard (<https://covid19.who.int/>), (Ranjan et al. 2021).

Due to huge number of cases being reported to hospitals every day, the treating clinicians are compelled to focus aggressively only on the anti-viral/anti-bacterial treatments to the patients with parallel attention on normalcy in vital levels of pulmonary oxygen saturation level, cardiac parameters and Blood Pressure levels. However, although many other parameters such as Liver Function Tests, Hematological parameters and Kidney Function Tests etc.

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are being measured and recorded essentially among all the admitted patients, yet kidney function parameters are not paid attention to address them in the corresponding treatment protocols. It is well known that the human cell receptor of SARS-COV2 is Angiotensin-Converting Enzyme-2 (ACE-2) and it is very important enzyme of the RAS pathway (Renin-Angiotensin System) i.e. in regulating the blood pressure homeostasis of the body as well as in maintaining the fluid and salt balance in the body (<https://www.rndsystems.com/resources/articles/ace-2-sars-receptor-identified>), Acc Apr 2021)

This ACE receptor is expressed specifically on the lungs and also on the kidney, gastrointestinal cells, vascular epithelial cells, kidney and Leydig cells. The IFFC (International Federation of Clinical chemistry and Laboratory Medicine) Guidelines on COVID-19 highlights the need of monitoring creatinine levels in critical COVID-19 patients so as to diagnose any injury to kidney at an early stage (IFCC guide on COVID-19, 2020).. The observations reported in the present study are in concurrence with the IFFC guidelines. Previous studies have reported that in the SARS-COV 1, 2003 strain and the Middle East respiratory syndrome (MERS) infection, there were cases with Acute kidney injury (AKI) and subsequent mortality of cases (Elias & Benito, 2018, Cheng et al. 2020; Naicker et al. 2020).

The present study highlights the association between the recovery/mortality of Covid-19 patients with their Kidney Function parameters and reports that surviving patients showed normal and not surviving patients showed abnormal kidney function parameters. Crucial kidney function parameters viz; Blood urea and creatinine level needs addressal and after more number of studies their treatment could be included in treatment protocols of COVID-19 patients. Similarly, the observations reported of Sodium and potassium levels among “survivors” and “dead” sensitized further clinic-basic studies on roles of SARS-COV2 in blocking essential ion channels of human physiological system.

MATERIAL AND METHODS

A study of association between Kidney Function Tests and survival/mortality of COVID-19 patients was undertaken among patients reporting in Noida and Greater Noida, UP, India. Surviving and Dead cases were chosen at random for the study. Few investigations were done in the residential society as per the information of COVID-19 patients obtained from the society notifications/news board. Few samples were also studied among students, staff and faculties in Sharda University who had either been a patient of COVID-19 or had any family members infected with COVID-19 in the past. Some information was collected from the patients records of Sharda hospital, Greater Noida, UP, India after obtaining appropriate permission from the Hospital administration. The contact details of the COVID-19 patients obtained from the above survey was tabulated and patients were contacted telephonically. The aims and objectives of this study were telephonically conveyed to the patients or their family members (who so ever were available on phone for the conversation). After taking their

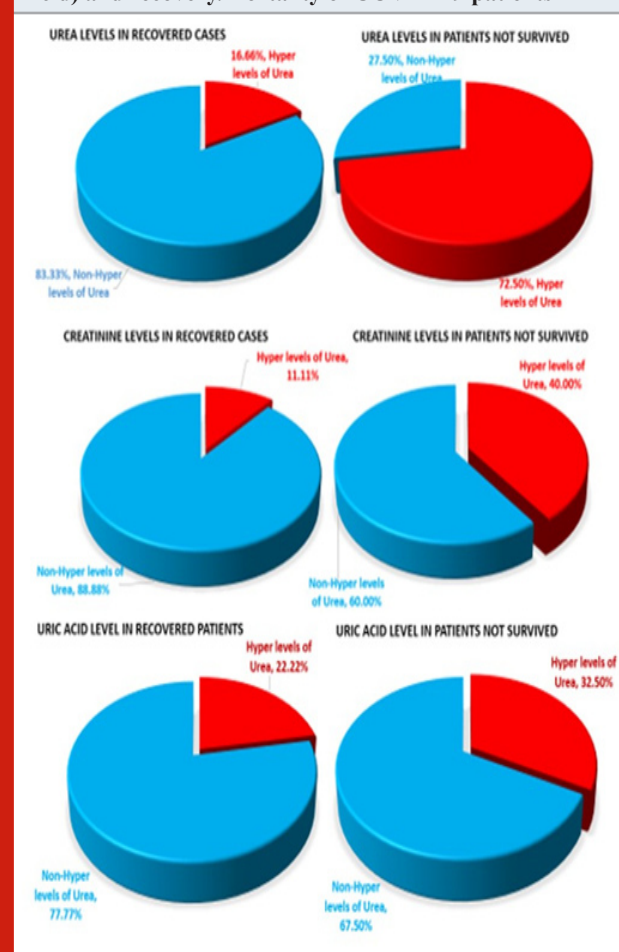
verbal consent for participation in the study, their Kidney function tests parameters were noted down along with other clinical parameters.

RESULTS AND DISCUSSION

A total of 76 patients were included in the study which comprised of 36 “Recovered” patients and 40 “Dead” cases (Table 1 &2). Association of Kidney Function parameter with the Recovery from COVID-19 infection: Of the 36 study patients, 5.5% (2 patients; 1 Male, 1 Female) were in the age group of 0-20 years; 33.3% (12 patients; 7 Males, 5 Female) were of the age 21-40 years; 27.7 % (10 patients; 5 Males, 5 Females) were of the age 41-60 years and 30.55 % (11 males & 2 Females) were above 61years of age. (Table 1).

Association between Recovery of patients and Blood Urea level: It was observed that of the total 36 “Recovered” patients, 30 patients (83.3%) did not have hyper levels of urea (non-hyper level) in their blood establishing the optimum functioning of kidney with respect to Urea extraction from blood. Only 6 patients (16.6%) who recovered had hyper/higher levels of blood urea. (Fig. 1).

Figure 1: Schematic presentation of degree of association between kidney function values (Urea, Creatinine and Uric Acid) and recovery/mortality of COVID-19 patients

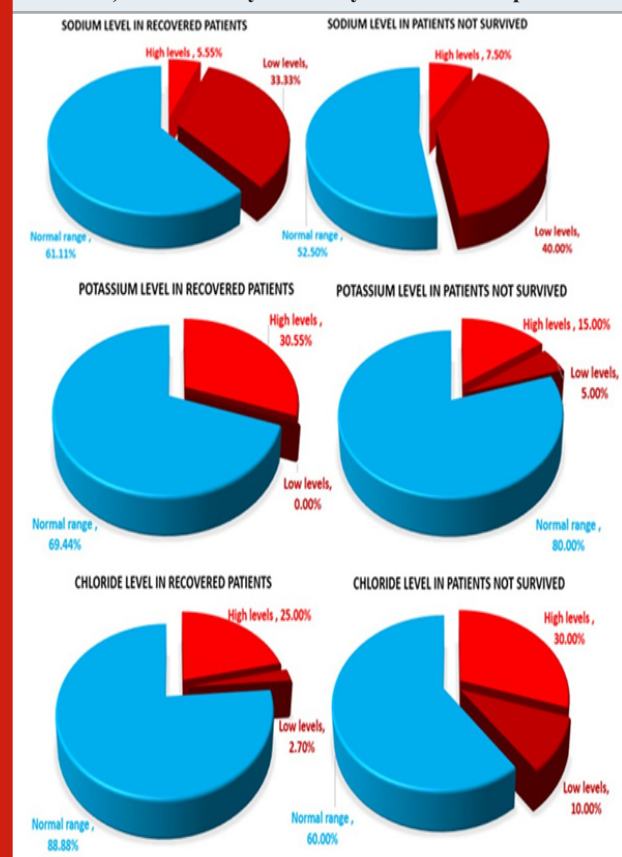


Association between Recovery of patients and Blood Creatinine level: Of the total 36 patients studied who recovered from infection, 32 patients (88.8%) had non-hyper levels of Creatinine in their blood establishing the optimum functioning of kidney with respect to Creatinine extraction from blood. Only 4 patients (11.11%) who recovered had higher levels of blood creatinine. This comprised of 2 females (56& 65years respectively) and 2 males (65& 78 years respectively). (Fig.1).

Association between Recovery of patients and Blood Uric acid level: Out of 36 patients who recovered from COVID-19, 8 (22.2%) patients had hyper levels of Uric acid whereas 28 patients (77.8%) showed non-hyper levels of Uric acid in the blood. The 8 patients included 4 males (between 46-65 years) and 4 females (between 56-75 years) (Fig. 1).

Association between Recovery of patients and Blood Sodium level: The values observed in the recovered patients indicated that 12 (33.3%) patients (8 males and 4 female patients of age 41 to 78 years) had low levels i.e. between 130 to 136mg/Eq/L. Higher values were observed in 2 (5.55%) patients (1 male patient of 46 years and 1 female of age 75years) the value being 148 and 150 mgEq/L respectively i.e. 18 patients (61.11%) had normal sodium levels (Fig. 2).

Figure 2: Schematic presentation of degree of association between Electrolyte values (Sodium, Potassium and Chloride) and recovery/mortality of COVID-19 patients



Association between Recovery of patients and Blood Potassium level: Higher values of Potassium were observed in 11 (30.55%) patients (six female of 23-59 years; 5 males of 23-65 years), the value was found to be between 5.3 to 10.0 mgEq/L. No low values were observed in the recovered patients, the remaining 25 patients had normal levels of potassium account to 69.44%. (Fig. 2).

Association between Recovery of patients and Blood Chloride level: The values observed in the recovered patients indicated that one male patient (2.7%) had low level (age 78 years) of Chloride while Higher values were observed in 9 (25%) patients; six females (age 23-75 years), 3 male patients (age 46-65 years). The remaining 26 (88.88%) had normal chloride levels (Fig. 2).

Association of Kidney Function parameters with the Mortality of patients from COVID-19 infection: Of the total 40 patients who did not survive, their age ranged from 23 to 99 years. 7.5% were of age between 21-40 years (one female & 2 male), 30% were of the age 41-50 years (5 females & 7 males) and 55 % were above 61 years of age (7 females; 15 males) (Table 2).

Association between Mortality of patients and Blood Urea level: Referring to the level of urea to be 20.0-43.0 mg/dl in a healthy person, the values were analyzed among 40 "Dead" patients. It was found that hyper values of blood urea were observed in 29 patients (72.5%) out of the 40 patients (8 females of age 24 to 99 years and 19 males of age 46 to 82 years). The values ranged from 43.2. to as high as 221.8mg/dl. Only 11 (27.5%) "Dead" patients had non-hyper levels of urea (Fig. 1).

Association between Mortality of patients and Blood Creatinine: The values observed for blood creatinine in the "Dead" cases indicated that 16 patients (40%) (3 females and 13 males) had hyper values of creatinine ranging from 1.1 to 7.0mg/dl while 24 patients (60%) had non-hyper levels of creatinine (Fig. 1).

Association between Mortality of patients and Blood Uric acid: The values observed in the dead patients indicated that 13 patients (32.5%) (2 females, 10 males and 1 UnK case) had hyper values. The age group was 24 -63 years in female patients, while in male patients it ranged from 57 to 82 years (within 6.2 to 13.9mg/dl range). However, there were 27 (67.5%) of "Dead" patients who had non-hyper levels of uric acid (Fig. 1).

Association between Mortality of patients and Blood Sodium: The values of blood sodium observed in the patients who did not survive indicated 16 (40%) patients with low Sodium values (5 females, 11males; age group 24-66 years and 53 to 82 years respectively). The values were found to be between 115-136mgEq/L. Higher values were observed in three (7.5%) male patients, of 40, 65 and 67 years with values between 149-153mgEq/L. Remaining 21 (52.5%) had normal levels of sodium (Fig. 2).

Association between Mortality of patients and Blood Potassium: The Potassium levels observed in the patients

who did not survive, indicated that two (5%) male patients of age 71 & 80 years had low levels of potassium (2.6 & 2.8mgEq/L respectively). Higher values were observed

in six (15%) patients; 5 males & 1 UnK of age between 58-82years, the values were between 5.1-6.5 mgEq/L. Remaining 32 (80%) patients showed normal levels (Fig. 2).

Table 1. Values of Kidney function parameters obtained from patients recovered from COVID-19 infection.

S.No	Patient code	Age	Sex	Day of recovery/ discharge after hospitalization	Kidney Function Test			Electrolytes		
					Urea (mg/dl) Ref level: 20.0-43.0 mg/dl	Creatinine (mg/dl) Ref level: 0.52-1.04 mg/dl	Uric acid (mg/dl) Ref level: 2.50-6.20 mg/dl	Sodium (mEq/L) Ref Level: 137.0-145.0 mgEq/L	Potassium (mgEq/L) Ref Level: 3.50-5.10 mgEq/L	Chloride (mgEq/L) Ref level: 98.0-107.0 mgEq/L
1.	SCR 5	41	M	8 th	38.5	0.5	2.2	136	3.7	98
2.	SCR 7	56	F	9 th	99.7	1.1	7.1	138	4.6	103
3.	SCR 9	35	M	10 th	19.2	0.8	5.6	142	4.2	105
4.	SCR 13	62	M	10 th	30.90	0.70	4.0	139	4.4	103
5.	SCR 15	23	F	11 th	19.20	0.4	3.5	140	4.4	105
6.	SCR 16	31	F	10 th	16.2	0.5	1.7	139	4.4	108
7.	SCR 17	25	F	11 th	14.8	0.6	2.9	140	3.8	104
8.	SCR 18	35	F	9 th	22.0	0.5	2.3	139	4.1	104
9.	SCR 19	5	F	6 th	20.5	0.2	3.0	140	4.1	105
10.	SCR 20	65	M	8 th	20.8	0.9	5.2	141	4.2	109
11.	SCR 21	29	M	10 th	25.1	0.7	5.2	145	5.0	107
12.	SCR 22	37	M	3 rd	23.1	0.5	4.4	138	4.8	102
13.	SCR 25	46	M	8 th	24.7	0.9	6.7	148	4.9	109
14.	SCR 26	48	F	5 th	29.7	0.5	1.9	136	5.3	109
15.	SCR 27	65	M	14 th	125.3	3.7	9.6	132	7.7	109
16.	SCR 28	51	M	7 th	23.4	0.8	7.1	141	5.1	110
17.	SCR 31	78	M	13 th	61.4	1.1	5.2	135	4.1	97
18.	SCR 32	58	F	11 th	30.4	0.6	7.3	135	4.0	101
19.	SCR 35	62	M	8 th	25.6	0.9	5.8	140	5.0	102
20.	SCR 37	65	M	11 th	26.5	1.0	7.0	133	5.4	102
21.	SCR 41	23	M	7 th	20.9	0.8	3.9	139	5.8	104
22.	SCR 44	23	F	13 th	17.5	0.6	3.9	145	5.9	110
23.	SCR 45	21	M	13 th	17.9	0.6	5.2	139	10.0	105
24.	SCR 53	59	F	18 th	35.0	0.7	10.0	133	5.8	98
25.	SCR 54	62	M	3 rd	24.3	0.6	5.1	135	5.4	101
26.	SCR 55	74	M	9 th	40.0	0.9	5.1	134	4.3	98
27.	SCR 56	75	F	9 th	41.4	3.0	10.0	150	5.3	112
28.	SCR 60	52	M	7 th	82.8	0.9	5.0	137	4.3	104
29.	SCR 61	-	F	2 nd	21.3	0.6	5.9	139	5.9	106
30.	SCR 62	41	F	8 th	40.1	0.4	5.8	144	5.2	108
31.	SCR 64	35	M	30 th	53.1	0.8	4.5	131	5.1	100
32.	SCR 65	62	M	4 th	34.2	0.7	3.9	133	4.1	100
33.	SCR 67	72	F	4 th	24.5	0.5	5.5	130	3.5	99
34.	SCR 72	14	M	10 th	25.9	0.3	3.6	138	4.4	105
35.	SCR 73	40	M	8 th	22.9	0.7	5.2	139	5.0	103
36.	SCR 74	49	M	12 th	59.4	1.0	5.4	138	4.3	105

Table 2. Values of Kidney function parameters obtained from patients who did not survive the COVID-19 infection.

S.No	Patient code	Age	Sex	Day Till hospitalized	Kidney Function Test			Electrolytes		
					Urea (mg/dl) Ref level: 20.0-43.0 mg/dl	Creatinine (mg/dl) Ref level: 0.52-1.04 mg/dl	Uric acid (mg/dl) Ref level: 2.50-6.20 mg/dl	Sodium (mEq/L) Ref Level: 137.0-145.0 mgEq/L	Potassium (mgEq/L) Ref Level: 3.50-5.10 mgEq/L	Chloride (mgEq/L) Ref level: 98.0-107.0 mgEq/L
1.	SCD 1	60	M	5 th	234.9	7.0	13.3	124	5.6	98
2.	SCD 2	63	F	6 th	52.6	0.8	13.7	142	5.0	99
3.	SCD 3	80	M	5 th	86.6	0.8	4.3	136	3.8	104
4.	SCD 4	70	M	4 th	221.8	4.4	10.0	137	6.2	105
5.	SCD 5	51	F	3 rd	39	0.8	3.5	140	3.6	107
6.	SCD 7	52	F	9 th	114.8	3.4	2.5	141	4.1	106
7.	SCD 8	24	F	4 th	63.5	0.6	6.4	134	3.9	110
8.	SCD 9	80	F	4 th	52.4	0.6	4.8	145	2.8	107
9.	SCD 10	46	M	6 th	123.4	3.3	3.2	143	5.1	116
10.	SCD 11	63	M	5 th	116.3	1.0	3.9	144	4.8	117
11.	SCD 19	23	M	9 th	36.1	0.7	5.5	140	5.0	113
12.	SCD 22	67	M	8 th	29.7	0.8	5.9	137	4.2	103
13.	SCD 23	57	F	7 th	36.3	1.1	5.0	135	4.3	96
14.	SCD 24	68	F	2 nd	47.8	0.5	5.1	140	3.5	98
15.	SCD 26	67	M	5 th	70.3	0.9	6.3	135	3.5	99
16.	SCD 27	70	M	8 th	112.7	10.6	4.8	123	4.1	94
17.	SCD 28	67	M	6 th	87.0	3.0	5.8	149	3.6	115
18.	SCD 29	53	M	3 rd	23.5	0.8	4.5	135	5.0	106
19.	SCD 30	71	M	6 th	55.2	1.5	7.8	141	2.6	97
20.	SCD 31	65	M	10 th	74.1	0.9	3.8	147	3.5	102
21.	SCD 32	58	M	4 th	85.1	0.8	7.2	138	5.7	99
22.	SCD 33	67	M	5 th	35.5	1.1	6.6	133	5.6	97
23.	SCD 34	54	M	5 th	23.2	0.6	3.1	128	4.5	98
24.	SCD 38	57	M	2 nd	43.2	1.5	6.6	137	4.4	95
25.	SCD 42	60	F	3 rd	67	2.2	5.1	134	4.7	110
26.	SCD 45	-	-	5 th	112	1.0	13.9	145	6.5	108
27.	SCD 46	54	M	4 th	36	1.5	4.2	133	4.6	105
28.	SCD 49	61	M	1 st	55.7	0.82	-	133	4.5	101
29.	SCD 52	66	F	8 th	45.2	0.9	5.4	127	3.6	94
30.	SCD 53	66	M	3 rd	75.7	1.5	6.9	139	4.4	104
31.	SCD 55	40	M	6 th	42.3	0.7	2.8	153	4.2	116
32.	SCD 57	78	M	2 nd	91.8	5.7	5.3	139	4.3	104
33.	SCD 58	59	F	2 nd	25.6	0.6	5.1	136	5.0	105
34.	SCD 60	74	F	6 th	86.4	0.8	4.8	145	3.3	114
35.	SCD 61	80	M	5 th	47.7	0.7	3.3	139	3.1	115
36.	SCD 62		M	9 th	44.8	0.7	2.4	137	4.2	98
37.	SCD 64	99	F	3 rd	70.7	0.9	4.8	144	3.9	107
38.	SCD 67	82	M	2 nd	207.7	1.6	7.3	115	5.6	111
39.	SCD 68		M	4 th	54.3	0.6	4.3	133	4.7	99
40.	SCD 69	82	M	4 th	133.9	3.0	7.8	145	4.2	112

Association between Mortality of patients and Blood Chloride: The Chloride values observed in the patients who did not survive indicated low values (94-96mEq/L) in 4 (10%) patients i.e. two females and two male patients (age between 57-66years). Higher values were observed in 12 (30%) patients; one UnK with 108mEq/L; three females (age 24-74 years), had values between 110-114mgEq/l. The 6 male patients (age 23-80 years) had values between 114-117mgEq/l. Normal values were seen on 24 (60%) patients (Fig. 2).

Relative association of Blood Urea, Creatinine and Uric acid with survival/mortality of patients: Blood Urea: It was observed that average percentage of the association between hyper blood urea and recovery/mortality of the cases was 77.9%. As 83.4% of "Recovered" patients did not show hyper urea level whereas 72.5% of "Dead" patient showed hyper urea levels.

Blood Creatinine: It was observed that average percentage of the association between hyper blood creatinine and recovery/mortality of the cases was 64.4%. 88.8% of "Recovered" patients did not show hyper creatinine level whereas 40.0% of "Dead" patient showed hyper creatinine levels.

Uric Acid: It was observed that average percentage of the association between hyper blood uric acid and recovery/mortality of the cases was observed to be 55.1%. 77.7% of "Recovered" patients did not show hyper uric acid levels whereas 32.5% of "Dead" patient showed hyper creatinine levels.

Association of Electrolyte levels in survival/mortality in COVID-19 patients: Sodium & Potassium level: An inverse association of Sodium and Potassium levels were observed in study subjects. Of the total number of 36 patients who recovered, it was observed that maximum patients were having Low levels of sodium and high levels of potassium (33.33% and 30.55% respectively) when compared to the high and normal values. Similarly, of the total number of 40 patients who died, maximum patients were reported with Low levels of sodium and high levels of potassium (40% and 15% respectively) when compared with their high and normal values. Chloride level: Chloride levels also had trend like that of potassium levels. Maximum number of patients who survived and who died were comparatively more (25% and 30% respectively).

Present work has been undertaken to study association of kidney function parameters with the survival/mortality of COVID-19 patients. After careful observations and analysis of Kidney Function parameters among the categories of "Recovered" and "Dead" cases, we observed that most crucial of these KFT parameters is the level of Blood Urea followed closely by Blood Creatinine level among the two categories of COVID-19 patients. The degree of association observed between blood urea level versus survival/mortality of patients emerged to be the most significant observation.

Our preliminary study reveals that need for addressal

and/or correction of blood urea level among patients may be considered for possible inclusion into the COVID-19 TREATMENT protocol through appropriate clinical interventions. Fundamentally, when protein is broken down in the body, then urea is made in the liver and is then passed out of the body in the form of urine, which indirectly amounts to the level of nitrogen in the body. So if there is elevated levels of Urea in the blood it is as indication of inefficient kidney functions, which may impact the blood chemistry to lead to cardiac and/or pulmonary problems enhancing mortality of COVID-19 patients.

The second important observation emerged out of present study is a high degree of association of Serum Creatine level with the survival and mortality of patients. The degree of association between creatinine and survival/mortality of patients was computed to be 64.4 which reveals that treatment to keep normal creatinine after studying the observed value of this parameter among patients has to be the part of COVID-19 treatment protocol. Creatine is yet another amino acid which we get through dietary intake. This is also made in the liver and provides energy to the body. It is also present in muscles and when the body utilizes creatine as an energy source, then creatinine is expelled out of the body as waste material (<https://www.medicalnewstoday.com/articles/322380>) (Acc May 2021).

Elevated levels of creatinine in blood may be correlated with decreased excretion and besides this Creatinine is also measured to correlate the Glomerular filtration rate (GFR) in our body (Thomas 2005). The IFCC (International Federation of Clinical chemistry and Laboratory Medicine) Guidelines on COVID-19 highlights the need of monitoring creatinine levels in critical COVID-19 patients so as to diagnose any injury to kidney at an early stage (IFCC guide on COVID-19, 2020).. The observations reported in the present study are in concurrence with the IFCC guidelines. Previous studies have reported that in the SARS-COV 1, 2003 strain and the Middle East respiratory syndrome (MERS) infection, there were cases with Acute kidney injury (AKI) and subsequent mortality of cases (Cheng et al. 2020; Naicker et al. 2020).

Many viruses including SARS-COV2 have been reported to show 'viroporin' activity for which it depends on the ion channels present on the host cells (Charlton et al. 2020; Neiva et al. 2012; Neiva et al. 2015; Royle et al. 2015) as it does for its replication and dissemination activities. As it causes infection and complication when it enters specific cell or tissue, similarly it may also cause impaired ion-channels and may contribute to internal imbalance or disturbances. Of the whole array of 300 ions channels known in humans (Yu et al. 2005), there are many channels which have been studied for their involvement either in viral entry or in replication or in dissemination and also in the involvement in dysfunctions generalized as 'Channelopathies' and hence causing chaos in the ion channels associated with the nervous, musculoskeletal, cardiovascular, immune systems, (Kim, 2014; Elias & Benito, 2018; Vaeth & Feske, 2018, Charlton et al. 2020).

It has also been known that the E protein of the SARS-COV2 virus has more affinity for sodium ions than potassium ions (Kai et al. 2016; Melton et al. 2002), while the 3a protein have a tendency to form ion channel and thus aid in virus dissemination (Lu et al. 2006). The low levels of sodium as seen in the patients who did not survive may indicate utility of ion channels by the virus and thus leading to decrease in the sodium channels availability for the human system to perform its normal functioning such as disturbance in the RAS/homeostasis pathway.

The fact that low levels of sodium had been observed in recovered patients also can be supported by the fact that may be use of ion channel blockers are hypertensive medication may have contributed as a modulator of this viral activity. This necessitate further studies of adding ion channel modulators in the treatment protocol (only after careful analysis of KFT test reports) in complicated cases. The Dysregulation of sodium channels specifically of the respiratory tract has been observed in Human Respiratory Syncytial virus (Chen et al. 2009). This observation also focuses studies to be extended on understanding role of SARS-COV2 with chloride and potassium levels too.

CONCLUSION

All the parameters i.e. urea, creatinine, uric acid and electrolytes are very important and speak for their individual existence and persistence within the human body, but the fact needs to be considered whether these are symptoms prior to viral infection or whether these are the post effects of COVID-19 infection. The findings of the present study thus highlight an important observation which needs to be considered to improvise renal treatment regime of the COVID-19 patients. Preliminary observations reported in the present paper sensitizes to further understand and confirm the reported association of kidney function and recovery/mortality of patients and if proved the treatment protocol of COVID-19 may be considered for possible modification.

Disclosure: The authors declare that there are no conflicts of interest in this work.

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