

A Descriptive Study, to Compare Electrolyte Profile with Severity of Coronavirus disease in Adult Patients, attending Tertiary Care Hospital, Telangana, India

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ABSTRACT

Introduction: Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people, with comorbidities are more likely to develop serious illness. In COVID-19 studies, evidence has been provided that electrolyte disorders may be present, and were related to severe disease. The current study aims to compare electrolyte profile with severity of COVID-19 disease in adult patients.

Material and methods: A descriptive analytical study done in adult COVID-19 patients in a tertiary care hospital during June 2020 to November 2020. Purposive sampling method was used and 235 study patients were categorised in to mild, moderate and severe COVID-19 disease. Serum electrolytes of the patients were compared with Severity of the disease. SPSS and Microsoft excel were used for data analysis. Chi-square test was done with $P < 0.05$ as statistically significant.

Results: Mean age and range of the study patients were 52.3 years and 23-72 years. Majority were males(169/71.9%). Fever (197/ 83.8%) was the most common complaint. Decreased serum ionised calcium, hypokalaemia, hyponatraemia, hypochloraemia and hyperkalaemia was found in, 63(23.9%), 35(14.9%), 26(11.1%), 12(5.1%) and 7(3%) COVID-19 patients respectively. Electrolyte disturbances were significantly seen most common in patients with severe COVID-19 disease.

Conclusion: Electrolyte disturbances was found significantly more in patients with severe COVID-19 disease, hence these should be measured earliest and corrected to improve the outcome.

Key words: CT Chest Severity Score (CT-SS), Hypokalaemia, Hypocalcaemia, Hyponatraemia, Hyperkalaemia, Hypochloraemia, Mild COVID-19 Disease, Moderate COVID-19 Disease, Severe COVID-19 Disease,

INTRODUCTION

In December, 2019, a local outbreak of pneumonia of initially unknown cause was detected in Wuhan (Hubei, China), and was quickly determined to be caused by a novel coronavirus, namely severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2).¹ Coronavirus disease (COVID-19) is an infectious disease caused by a newly discovered coronavirus. Most people infected with the COVID-19 virus will experience mild to moderate respiratory illness and recover without requiring special treatment. Older people and

those with underlying medical problems like cardiovascular disease, diabetes, chronic respiratory disease, and cancer are more likely to develop serious illness.²

Globally coronavirus has infected about 157,50,537 people. In India 21,892,676 were infected with 238,270 deaths with Case fatality rate 1.13% by 9th May 2021. India was ranked 2nd with respect to cases and deaths. In Telangana state, Case fatality rate was 0.55% as per dashboard to track COVID-19 in real time.³

Symptoms include fever and/or cough associated with difficulty breathing or shortness of breath, chest pain or pressure, or loss of speech or movement and should seek medical care immediately. Among those who develop symptoms, most (about 80%) recover from the disease without needing hospital treatment. About 15% become seriously ill and require oxygen and 5% become critically ill and need intensive care. Complications leading to death may include respiratory failure, acute respiratory distress syndrome (ARDS), sepsis and septic shock, thromboembolism, and/or multiorgan failure, including injury of the heart, liver or kidneys.⁴

Biochemical laboratory testing in COVID-19 patients aids in staging their disease, prognostication, and monitoring of therapeutic interventions.⁵ In early COVID-19 studies, some evidence has been provided that electrolyte disorders may also be present upon patient's presentation, including sodium, potassium, chloride and calcium abnormalities.⁶ In

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a meta-analysis, lower concentrations of sodium, potassium and calcium were related to severe disease. Such electrolyte disturbances have important implications not only for patient management but also for identifying potential pathophysiologic mechanisms underlying COVID-19, that could drive novel therapeutic opportunities. Electrolyte imbalance is known to exacerbate acute respiratory distress syndrome (ARDS) and acute cardiac injury, which are common complications in COVID-19, especially in patients with underlying lung or heart disease.⁷ Muscle spasms, twitching, convulsions, confusion, numbness and weakness etc can also be seen depending on the electrolyte affected. Hence the current study aims to compare electrolyte profile with severity of COVID-19 disease in adult patients.

MATERIAL AND METHODS

A descriptive analytical study was done in, adult COVID-19 patients in a tertiary care teaching hospital. COVID-19 patients were diagnosed by Reverse Transcription Polymerase Chain Reaction (RTPCR) and radiological imaging studies (CT chest). During study period (June 2020 to November 2020) 468 COVID-19 patients visited the hospital. Purposive sampling method was used and sample size was calculated using the formula for finite population. Where, $Z \alpha$ is the standard normal deviate, which is equal to 1.96 at 95% confidence interval.

p = Prevalence of electrolyte imbalance in the population under study, it is 50% when prevalence is unknown. Hence $p = 0.5$, $1-p = (1-0.5)$

d = precision (10% of prevalence) = 0.05

N = Population to be studied (patients with RTPCR positive, and radiological imaging suggesting COVID-19 disease during the study period) = 468

$$\text{Sample size}(n) = \frac{\frac{z^2 X p(1-p)}{d^2}}{1 + \frac{z^2 X p(1-p)}{d^2 N}}$$

$$\text{Sample size}(n) = \frac{\frac{(1.96)^2 X 0.5(1-0.5)}{(0.05)^2}}{1 + \frac{(1.96)^2 X 0.5(1-0.5)}{(0.05)^2 468}}$$

$\text{Sample size}(n) = 211$

Corrected sample size with non response rate as 10% was 235.

Inclusion criteria: Patients of both sex, more than 18 years, who gave informed consent to participate in the study with a) RTPCR positive for COVID-19 and b) CT chest imaging findings suggestive of COVID-19 disease.

Exclusion criteria: Patients with hepatic or renal dysfunction. Patients on long term treatment with drugs influencing serum electrolytes like diuretics, glucocorticoids, hormones etc. Patients previously diagnosed with cancer or any immunodeficiency status.

Data collection: After obtaining institutional ethical committee clearance and informed consent, data on socio

demographic factors, presenting symptoms, comorbidities, patients vitals like temperature, oxygen saturation (SpO_2) laboratory findings of serum electrolytes like Sodium, Potassium, Chloride and ionised calcium (Na^+ , K^+ , Cl^- , iCa^{2+}) radiological findings, severity category of COVID-19 disease of patients admitted were collected, in a pretested semi structured questionnaire.

Procedure

Patients vitals like temperature was recorded using infrared temperature detectors at a distance of 6 feet and oxygen saturation (SpO_2) (after 3 minute walk) using a standard protocol, for categorising the patients.

A semi quantitative scoring system was used to quantitatively estimate the pulmonary involvement based on the area involved. The CT chest severity score (CT-SS) was calculated based on the extent of lobar involvement. Each of the five lung lobes was visually scored on a scale of 0–5, with 0 indicating no involvement, 1 indicating less than 5% involvement, 2 indicating 5–25% involvement, 3 indicating 26–49% involvement, 4 indicating 50–75% involvement, and 5 indicating more than 75% involvement. The total CT score was the sum of the individual lobar scores and ranged from 0 (no involvement) to 25 (maximum involvement). ^{8,9} Lung involvement was graded as normal (CT-SS=0), mild (CT-SS <7), moderate (CT-SS = 8-17), and severe(CT-SS > 18).

Patients were categorized in to mild, moderate and severe COVID-19 infection following Clinical guidance for management of adult covid-19 patient by Ministry of health family welfare, by Government of India.

Mild disease: Upper respiratory tract symptoms (&/or fever) without shortness of breath or hypoxia

Moderate disease: Any one of: 1. Respiratory rate > 24/min, breathlessness 2. SpO_2 : 90% to < 93% on room air.

Severe disease: Any one of: 1. Respiratory rate >30/min, breathlessness 2. SpO_2 < 90% on room air. ¹⁰

Blood sample collected following Infection prevention and control practices during health care by WHO.¹¹ Serum electrolytes was analysed in Sensa Core ST 200 Pro/Plus/ CL (full auto analyzer) with auto calibration and External quality control. Normal range for sodium, potassium, chloride and ionised calcium was 135-145mmol/L, 3.5-5.0 mmol/L, 98-107 mmol/L and 1.15-1.35 mmol/L respectively. Hyponatraemia was serum sodium less than 135mmol/L, hypokalaemia and hyperkalaemia was serum potassium <3.5mmol/L and >5.0 mmol/L, hypochloraemia was serum chloride <98 mmol/L, decreased ionised calcium was <1.15 mmol/L.

STATISTICAL ANALYSIS

Data obtained was entered in Microsoft excel and analysed using SPSS 20. Analysis was done using frequency percentages. Chi-square test was used for statistical analysis. $P<0.05$ was considered statistically significant

RESULTS

After obtaining informed consent 235 patients with

COVID-19 disease participated in the study. Mean age and range of the study patients was 52.3 years and 23-72 years respectively. Majority of the study patients belong to age group 41-60 years (71.5%). Male and female patients were 169 (71.9%) and 66 (28.1%) respectively. Based on literacy status majority of the study patients were secondary school (112/47.7%), followed by primary school (79/33.6%), illiterate (23/9.8%), undergraduate (6.8%) and postgraduate (5/2.1%). Study patients belonging to urban and rural area were 88(37.4%) and 147(62.6%) respectively (shown in Table 1).

Fever (197/ 83.8%) was the most common presenting complaint followed by sore throat and cold (162/68.9%), body pains and headache (135/57.4%), cough 123(52.3%). Shortness of breath, Diarrhoea/ vomiting and Loss of smell

and taste was seen in 69(29.4%), 37(15.7%) and 14(6%) of study patients respectively. Other symptoms include chills, rigors, loss of appetite, abdominal pain and rash (shown in table 2). Comorbidities were present in 149(63.4%) of patients with diabetes mellitus (26.8%) being the most common.

CT chest was done in only 156(66.4%) patients. Majority had mild changes in CT scan. CT chest was normal in 12(5.1%) of patients, mild grade with CT-SS below 7 in 64(27.2%), moderate grade with CT-SS 8-17 in 56 (23.8%) and severe with CT-SS score 18 and more in 24 (10.3%) patients (shown in table 3).

Out of 235 study patients, mild COVID-19 disease, moderate COVID-19 disease and severe COVID-19 disease was found in 155(66%), 56(23.8%) and 24(10.2%) patients respectively,

Socio demographic variables	Groups	Frequency (n= 235)	Percentage (%)
Age	23- 40	37	15.7%
	41-60	168	71.5%
	60-72	30	12.8%
Sex	Male	169	71.9%
	Female	66	28.1%
Literacy status	Illiterate	23	9.8%
	Primary school	79	33.6%
	Secondary school	112	47.7%
	Undergraduate	16	6.8%
	Post graduate	5	2.1%
Residence	Urban	88	37.4%
	Rural	147	62.6%

Table-1: Distribution of study patients based on sociodemographic characteristics

Variables		Frequency(n=235)	Percentage
Presenting symptoms	Fever	197	83.8%
	Sore throat, Cold	162	68.9%
	Cough	123	52.3%
	Shortness of breath	69	29.4%
	Fatigue	108	45.9%
	Body pains and or headache	135	57.4%
	Diarrhoea, Vomiting	37	15.7%
	Loss of smell or taste	14	6%
	Other symptoms	29	12.3%
Comorbidities	Diabetes mellitus	63	26.8%
	Hypertension	51	21.7%
	Cardiovascular diseases	23	9.8%
	Thyroid disorders	15	6.4%
	Others	17	7.2%
	Absent	86	36.6%

Table-2: Distribution of study patients by Presenting symptoms and comorbidities

CT Chest Severity score (CT-SS)	Frequency (N=235)	Percentage %
Normal (0)	12	5.1%
Mild (7 or less)	64	27.2%
Moderate (8-17)	56	23.8%
Severe (18 and more)	24	10.3%
Not done	79	33.6%

Table-3: Distribution of patients by CT chest severity scores (CT-SS)

as per clinical guidelines by COVID-19 disease severity by Ministry of Health and Family Welfare, Government of India.¹⁰

Decreased serum ionised calcium was the most common electrolyte abnormality and it was found in, 63(23.9%) COVID-19 patients. Hypokalaemia, and hyponatraemia was found in 35(14.9%) and 26(11.1%) patients respectively. Only 12(5.1%), and 7(3%) COVID 19 patients have hypochloraemia and hyperkalaemia (shown in figure 2).

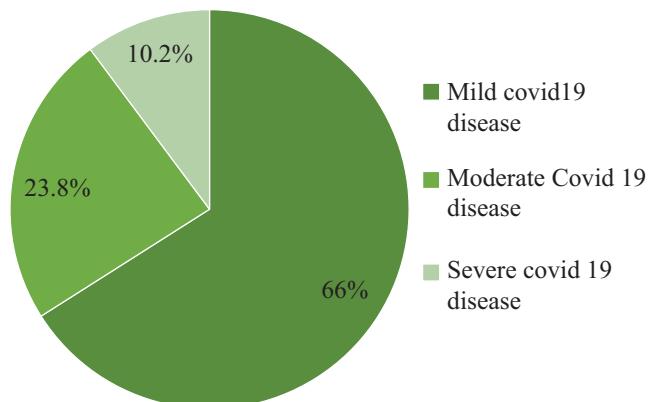


Figure-1: Distribution of patients by COVID-19 disease severity

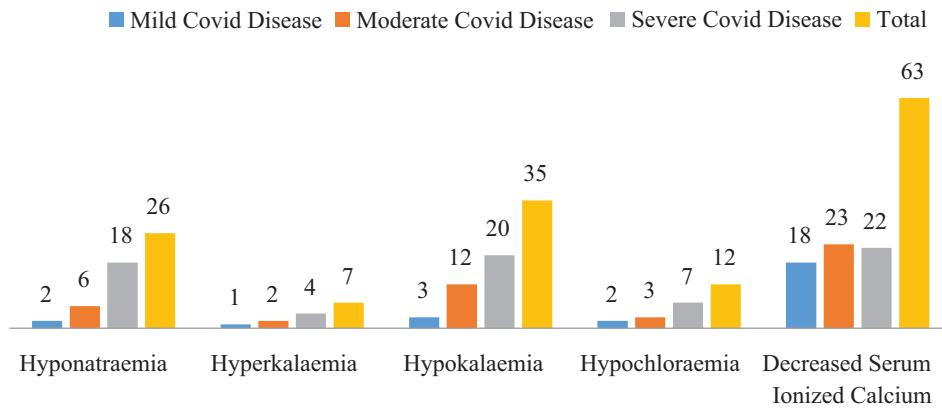


Figure-2: Frequency of patients with electrolyte disturbances with respect to COVID-19 disease severity

	Mild COVID-19 disease (155)	Moderate COVID-19 disease (56)	Severe COVID-19 disease (24)	Total (235)	χ^2 =chisquare statistic, P = p value
Hyponatraemia					
Present	2 (7.7%)	6 (23.1%)	18 (69.2%)	26	$\chi^2=114.7597$
Absent	153 (73.2%)	50 (23.9%)	6 (2.9%)	209	$P < 0.001$
Hypokalaemia					
Present	3 (8.6%)	12 (34.3%)	20 (57.1%)	35	$\chi^2= 111.1079$
Absent	152 (76%)	44 (22%)	4 (2%)	200	$P < 0.001$
Hyperkalaemia					
Present	1 (14.3%)	2 (28.6%)	4 (57.1%)	7	$\chi^2=18.548$.
Absent	154 (67.5%)	54 (23.7%)	20 (8.8%)	228	$P < 0.001$
Hypochloraemia					
Present	2 (16.7%)	3 (25%)	7 (58.3%)	12	$\chi^2=33.3377$.
Absent	153 (68.6%)	53 (23.8%)	17 (7.6%)	223	$P < 0.001$
Decreased serum Ionised Calcium					
Present	18 (28.6%)	23 (36.5%)	22 (34.9%)	63	$\chi^2=75.4989$.
Absent	137 (79.6%)	33 (19.2%)	2 (1.2%)	172	$P < 0.001$

Table-4: Distribution of patients by electrolyte profile versus COVID-19 disease severity

increasing several times when compared with the first wave, hence early identification of worse prognosis is essential to decrease the calamity.

Current study was done in 235 adult COVID-19 patients. Mean age and range of the study patients was 52.3 years and 23-72 years respectively which was slightly lower when compared with a study by Sultana et. al where mean age was 62.9 years.¹² In a study by Chen D et. al it was lower (mean [SD] age, 45 [14] years; age range, 15-85 years).¹³

Male and female patients in the present study were 169 (71.9%) and 66 (28.1%) respectively where as in study by Sultana et. al 58.57 % (n= 41) were male and 41.42% (n=29) were female.¹² In study by Wang D et al 73 (51.0%) were men and 70(49%) were women.¹⁴

In the present study Diabetes mellitus (63/26.8%) was the most common comorbidity, which was more when compared with study by Wang D et.al where diabetes was seen in only 13 (9.1%) of study patients. But hypertension (51/21.7%) and cardiovascular disease (23/9.8%) was slightly lower when compared to study by Wang D et.al, hypertension (36 [25.2%]), cardiovascular disease (16 [11.2%]).¹⁴

Fever (197/83.8%), fatigue (108/45.9%), cough (123/52.3%), shortness of breath (69/29.4%) of COVID 19 patients in present study were less when compared with study by Wang,D et al it was 137(95.8%), 93(65%), 78(54.5%) and 48(33.6%) respectively.¹⁴

CT chest was done in only 156(66.4%) COVID 19 patients, and abnormalities were detected in only 144(61.3%) in the current study which was low when compared with study by Wang D, et al (138/96.5%). In the current study patients with mild COVID-19 disease (155/66%) and moderate COVID-19 disease (56/23.8%) were more compared with severe COVID-19 disease (24/10.2%), where as in study by Wang D, et al mild/ moderate and severe/ critical COVID-19 illness it was 72(50.3%) and 71(49.7%) respectively.¹⁴

In present study hyponatraemia and hypokalaemia was seen in 26(11.1%) and 35(14.9%) study patients which was very low when compared with study by sultana, et al where it was 54(77.1%) and 35(50%) respectively. and in study by sarvazad, et al. it was 38% and 9.5% respectively.^{12,15}

Decreased serum ionised calcium was the most common electrolyte abnormality and it was found in, 63(23.9%) COVID-19 patients in the present study which was low when compared with study by Di Filippo L, et.al. where Decreased serum ionised calcium was found in 462 patients (82%). This study shows significant relation of hypocalcemia with level of COVID-19 disease severity which was similar to Di Filippo L et.al study which concluded that hypocalcemia is highly incident in COVID-19 patients and predicts the need for hospitalization and suggest that ionised calcium should always be assessed at initial hospital evaluation in order to identify more severe patients.¹⁶

In the current study out of 35 patients with hypokalaemia 20(57.1%) have severe COVID-19 disease which was significant, similar to study by Wang D et.al. where negative correlation was found between serum potassium and disease severity.¹⁴

Current study shows significant presence of dyselectrolytaemia in patients with severe COVID-19 disease when compared with mild and moderate COVID-19 disease. Which was similar to study by Chen D,et al , sarvazad, et al and Di Filippo L, et al.^{13,15,16}

Limitations: Present study was done in only one tertiary care hospital hence sample size though calculated was small. Study setting was not community based which has minimized the scope for including asymptomatic and could have missed some mild COVID-19 disease patients. But the strength of the study was improved by statistical analysis.

Recommendations: Community based study with sample size representing larger population for further research.

CONCLUSION

Mean age and range of the study patients was 52.3 years and 23-72 years with majority of the patients belonging to age group 41-60 years. COVID-19 disease was more common in male patients 169 (71.9%). Fever (197/ 83.8%) was the most common presenting complaint followed by sore throat and cold (162/68.9%), body pains and headache (135/57.4%), cough 123(52.3%). Only 24(10.2%) patients have severe COVID-19 disease. Decreased serum ionised calcium, hypokalaemia, hyponatraemia, hypochloraemia and hyperkalaemia was found in, 63(23.9%), 35(14.9%), 26(11.1%), 12(5.1%) and 7(3%) COVID-19 patients respectively. It shows that ionised calcium being the most deficient electrolyte. Electrolyte disturbances were seen most common in patients with severe COVID-19 disease which was significant. Hence serum electrolytes to be done at the time of disease onset and repeated further, when needed, will guide on prognosis and can alter disease outcome with appropriate interventions.

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