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Comparative Analysis of Laboratory Profiles and Clinical Outcomes in COVID-19 Patients with and without Diabetes: A Single Center Study

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ABSTRACT

Background: The present study aimed to compare the clinical outcome as well as laboratory and clinical profiles of Coronavirus disease 2019 (COVID-19) patients with and without diabetes. **Materials & Methods:** The present study is a retrospective study that included 266 non-diabetic and 259 diabetic patients who were admitted to a tertiary healthcare center in South India between March 2021 to April 2021.The objective of the study was to compare the clinical outcome and laboratory profiles of COVID-19 patients with and without diabetes. Patients aged 18 years or above, diagnosed with COVID-19 by either RT-PCR and/or HRCT chest as well as diagnosed to be diabetic or non-diabetic were included in the study. After observing inclusion and exclusion criteria, the study included patients whose medical records were scrutinized, and data was analyzed using SPSS v 28.0 and the continuous variables were expressed in mean, standard deviation, minimum and maximum value. The categorical variables are expressed in frequency and percentage. Comparison was done using binomial test and Mann-Whitney U test while association was tested using Fischer exact test. **Findings.** Primary outcomes show that higher number of patients with diabetes (84.94%) presented with abnormal Interleukin-6 (IL-6) levels and this difference was found to a statistically significant (p<0.001). Hypertension was the most common comorbidity among both diabetic (46.72%) and non-diabetic (33.52%) patients and it was shown to be associated with clinical outcome and oxygen requirement (p<0.001). A significant difference was observed in the mean score of age, total count, IL-6 and number of days admitted between COVID-19 subjects of both groups with the mean being higher in the group of patients with diabetes (p<0.001). **Conclusion**: The results of the present study reinforce available evidence that IL-6 levels can be used to ascertain progression, morbidity, and mortality to ensure proper management of COVID-19 patients and that diabetes state results in higher total count, IL-6 and number of days admitted.

Keywords: COVID-19, SARS-CoV-2, Infections, Mortality, Europe

CITATION LINKS

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Introduction

In December 2019, cases of "pneumonia of unknown origin" were reported in Wuhan, the capital of Hubei province in China and later isolated to be caused by a strain of coronavirus[1].This virus then rapidly spread across many countries in Asia and then Europe, North America, Australia, and others thus leading to the World Health Organization (WHO) declaring the Coronavirus disease 2019(COVID-19) as a pandemic.[2] Thispandemic was caused by the novel coronavirus (CoV), SARS-CoV-2 which resulted in a systemic infection increasing morbidity and mortality. The infection was found to spread predominantly via the inhalational route and affected individuals of all age groups, but older individuals or people suffering from diabetes mellitus (DM), hypertension or obesity were found to have a significantly increased risk for hospitalization and death after COVID-19 infection.[3]

The complications associated with COVID-19 infection included conditions like acute respiratory distress syndrome, acute respiratory failure, sepsis, disseminated intravascular coagulation, acute liver and kidney injury and pulmonary embolism. [4] These complications can be exacerbated when patients suffer from existing systemic conditions like DM with the estimated global population with DM being 463 million in 2019and 700 million by 2045.[5]Potential factors that may increase susceptibility for COVID-19 infection and increased morbidity in patients with DM include: a) efficient virus entry and higher affinity cellular binding, b) reduced T cell function, c)decreased viral clearance, d) presence of CVD, and e) higher propensity for cytokine storm syndrome and hyperinflammation.[3]

Patients can have various adverse outcomes including prolongation of duration of hospital stay, oxygen requirement, risk of thromboembolic complications like pulmonary thromboembolism, deep vein thrombosis, acute coronary syndrome and ultimately, increased mortality. Individuals with diabetes, hypertension and severe obesity are at a higher risk for the complications mentioned above.[1-3,6]

However, there is some overlap of these comorbidities because of the high prevalence of cardiovascular disease (CVD), obesity, and hypertension in patients with DM. It is unknown whether DM independently contributes to this increased risk. Plasma glucose levels and DM are independent predictors of mortality and morbidity in patients with SARS infection.[7]Increased D-dimer levels are associated with increased coagulation activity in the body and multiple studies have reported that cases of COVID-19 resulted in increased D-dimer levels in people with diabetes compared to people without diabetes.[8]Previously conducted meta-analyses have reported a significant (two- to threefold) increase in mortality in people with diabetes and COVID-19.[9-12] However, these studies have the same limitation of overlapping data, and they lack comparison to COVID-19patients without DM.[9]

Objectives: The aim of this study was to describe the clinical outcome and hematological data of COVID-19-positive DM patients versus non-diabetic COVID-19-positive patients, and to compare their outcomes including duration of hospitalization and need for O_2 supplementation. The primary objective was to assess the relationship between laboratory markers and clinical outcomes in diabetic COVID-19 and non-diabetic COVID-19 patients while the secondary objective was to assess the difference in duration of hospital stay as well as oxygen requirement between diabetic and non-diabetic COVID-19 patients.

Materials and Methods

The present study was a retrospective study conducted in a tertiary healthcare center located in South India. 550 COVID-19-positive patients with and without diabetes who had been admitted to the hospital between March 2021 to May 2021 were part of the research. The study was conducted after obtaining clearance from the Institutional Human Ethics Committee (PSG/IHEC/2023/Appr/Exp/007).

A sample size of 275 participants for both groups was calculated based on the findings of a previously conducted study by Alkundi A in 2020.[13]

The sample size for the various primary objectives, with 80% power and 5% level of significance to assess the following objectives: Number of days in the hospital between COVID-19 patients with DM and without DM and to assess the proportion of subjects who require oxygen among COVID-19 patients with DM and without DM. The higher sample size that was calculated was selected (275).

Patient who were of the age 18 and above with known diabetes and admitted between March 2021 and April 2021 with COVID-19 diagnosed either by RT-PCR and/or HRCT chest were included in the diabetic group and patients without diabetes mellitus with COVID-19 were included in the non-diabetic group. Patients were excluded from the study if they were discharged against medical advice or had inadequate medical records. The study involved 275 consecutive diabetic and 275 consecutive non-diabetic patients whose medical records were scrutinized. After applying the inclusion and exclusion criteria, 266 non-diabetic and 259 diabetic patients were included in the study and further analysis.

The following data was collected from the electronic medical records: demographics, comorbidities, total count, platelet count, IL-6, D-Dimer, HbA1C (for diabetic patients), number of days in hospital, oxygen requirements and outcome (death or discharge).

The name of the measurement kit used for D dimer levels was Innovance D dimer (by Siemens), the name of the measurement kit used for CBC levels was the Beckman colter hematology analyzer. Interleukin-6 (IL-6) was assessed by Chemiluminescent Immunoassay (Elecsys IL-6 by Roche Diagnostics). Quality control was performed using Precicontrol Multimarker (done daily). D-dimer assessment was done using immunoturbidimetric assay. Innovance D dimer controls were used for the assessment of precision and analytical bias in the normal and pathological range. (done daily)

Statistical analysis: The analysis was conducted using SPSS v 28.0 using spreadsheets from Microsoft Excel 2021 (Office 365, Microsoft Corporation). The continuous variables were expressed in mean, standard deviation, minimum and maximum value. The categorical variables are expressed in frequency and percentage. Fisher exact test was conducted to assess association of patient's characteristics and clinical outcome. Binomial test was conducted to compare RTPCR positive and negative patients. Mann-Whitney U test was used to compare the means of patient's characteristics and laboratory profiles.

Findings

Patient characteristics, laboratory profile, and clinical outcomes of participants:

The results of the present study showed that the mean age of the COVID-19 participants with DM was higher (60.74±11.84 years) when compared to participants without DM (50.38±16.41) and COVID-19 patients with diabetes were shown to have higher mean values with regard to total count, platelet count, IL-6 and number of days hospitalized

but showed a lower mean D-dimer count(1.63±3.53mg/L) when compared to COVID-19 patients without diabetes (1.92±4.75mg/L). (Table 1)

Comparison of laboratory profile and clinical outcomes between COVID-19 patients with and without DM:

Most of the participants included in the present study were screened for COVID-19 by means of RT-PCR which included participants who had DM (83.01%) and those who did not suffer from DM (90.98%). Most of the participants in both groups had a total WBC count between 4000-11000/mL with 69.88% participants with DM and 76.32% without DM. When platelet count was assessed, 79.54% of participants with DM reported a total platelet count between 150000-450000/mL, and 80.45% of participants without DM reported a similar platelet count. A major portion of both groups of participants did not have a requirement for oxygen (COVID-19 with DM:67.18% and COVID-19 without DM: 80.45%). The D-Dimer levels of the participants showed that most participants with DM (61.78%) had abnormal levels (>0.5g/L) and in participants without DM, 46.24% participants reported normal levels (<0.5g/L) and 53.76% showed abnormal D-Dimer levels. Regarding IL-6 levels, most participants in both groups (75.81%) showed abnormal levels (greater than 7 pg/ml). The comorbidity status of the patients showed that most participants in both groups (with DM: 46.72% and without DM: 33.52%) suffered from systemic hypertension. When the duration of hospital stay was assessed, most of the participants involved (68.19%) stayed at the hospital for less than or equal to a week, and 91.24% of all participants were discharged by the hospital. (Table 2)

Association of patient's characteristics and clinical outcome among participants:

Table 3 depicted the results of chi-square test which was performed to assess the association of patient's characteristics and clinical outcome between the comparison groups. When the expected cell count is less than 5, Fisher Exact test was performed and corresponding p-values were reported. For those variables having single category,

Table 1) Patient characteristics, laboratory profile, and clinical outcomes of COVID-19 patients with or without diabetes

Variable	Mean	
	COVID with DM	COVID without DM
Age (in years)	60.74±11.84	50.38±16.41
Total WBC count(/mL)	8156.226731.15±	6975.195475.41±
Platelet count (/mL)	231952.9±98731.29	227270.5±92389.16
IL-6(pg/mL)	74.93±187.20	59.01±312.84
D-Dimer(g/L)	1.63±3.53	1.92±4.75
Duration of hospital stay (in days)	8.98±7.94	7.12±4.99
HbA1C	8.87±1.82	0±0

Note: DM-diabetes mellitus, IL-6=Interleukin 6.

Table 2) Laboratory profile and clinical outcomes of COVID-19 patients with or without diabetes mellitus (DM)

Variable	Sub-category	COVID with DM		COVID without DM		Overall	
		n	%	n	%	n	%
Screening for COVID	RTPCR	215	83.01	242	90.98	457	87.05
	Radiological COVID	43	16.60	24	9.02	67	12.76
HbA1c#	Diabetic	170	65.64	0	0	170	32.38
	NA	89	34.36	266	100	355	67.62
Total WBC count (/mL)	Below 4000	31	11.97	39	14.66	70	13.33
	4000-11000	181	69.88	203	76.32	384	73.14
	Above 11000	47	18.15	24	9.02	71	13.52
Platelet count(/mL)	Below 150000	40	15.44	43	16.17	83	15.81
	150000-450000	206	79.54	214	80.45	420	80
	Above 450000	13	5.02	9	3.38	22	4.19
Oxygen requirement	Yes	85	32.82	52	19.55	137	26.10
	No	174	67.18	214	80.45	388	73.90
D-Dimerg/L	Normal	99	38.22	123	46.24	222	42.29
	Abnormal	160	61.78	143	53.76	303	57.71
IL-6pg/mL	Normal	39	15.06	88	33.08	127	24.19
	Abnormal	220	84.94	178	66.92	398	75.81
Comorbidity status *	Cerebrovascular Accident (CVA)	4	1.54	2	0.75	6	1.14
	Chronic Obstructive Pulmonary Disease (COPD)/Asthma	9	3.47	7	2.63	16	3.05
	SystemicHypertension (SHT)	121	46.72	55	20.68	176	33.52
	Coronary Artery Disease (CAD)	33	12.74	11	4.14	44	8.38
	Chronic Kidney Disease (CKD)	3	1.16	6	2.26	9	1.71
	Dyslipidemia (DLP)	8	3.09	3	1.13	11	2.10
	Hypothyroidism	11	4.25	10	3.76	21	4
Duration of hospital stay	Less than or equal to1 week	164	63.32	194	72.93	358	68.19
	More than 1 week	95	36.68	72	27.07	167	31.81
Treatment outcome*	Discharged	238	91.89	241	90.60	479	91.24
	Died	20	7.72	25	9.40	45	8.57

Note: n-number of patients, %-the percentage of patients, RTPCR-Reverse transcription polymerase chain reaction, DM-diabetes mellitus, IL-6=Interleukin 6, NA-Not Applicable, CVA-Cerebrovascular accidents, COPD-Chronic obstructive pulmonary disease, SHT-Systemic Hypertension, CAD-Coronary artery disease, CKD-Chronic kidney disease, DLP-Dyslipidemia, *the total may not tally 100 as there is the presence of missing data. D-Dimer-normal = less than 0.5g/L, IL-6 -Normal =up to 7 pg/mL, # - diabetic when HbA1c more than 5.5%.

Table 3) Association of patient's characteristics and clinical outcome among COVID19- subjects with diabetes and non-diabetes

Variable	COVID-19			p-value
	Category	Diabetic (n = 259)	Non-Diabetic (n =266)	
Gender	F	90 (17.14%)	104 (19.81%)	0.302
	M	169 (32.19%)	162 (30.86%)	
Oxygen Requirement	No	174 (33.33%)	213 (40.8%)	<0.001*
	Yes	85 (16.28%)	50 (9.58%)	
Hypertension	No	139 (26.63%)	211 (40.42%)	<0.001*
	Yes	117 (22.41%)	55 (10.54%)	
Chronic obstructive pulmonary disease(COPD)/Asthma	No	253 (48.19%)	259 (49.33%)	0.816
	Yes	6 (1.14%)	7 (1.33%)	
Coronary artery disease(CAD)	No	229 (43.62%)	255 (48.57%)	0.002*
	Yes	30 (5.71%)	11 (2.1%)	
Cerebrovascular accidents(CVA)	No	258 (49.24%)	264 (50.38%)	>0.99*
	Yes	1 (0.19%)	1 (0.19%)	
Dyslipidemia (DLP)	No	251 (47.81%)	263 (50.1%)	0.117
	Yes	8 (1.52%)	3 (0.57%)	
Hypothyroid	No	248 (47.24%)	256 (48.76%)	0.776
	Yes	11 (2.1%)	10 (1.9%)	
Chronic kidney disease(CKD)	No	256 (48.76%)	260 (49.52%)	0.504
	Yes	3 (0.57%)	6 (1.14%)	
Clinical Outcome	Death	20 (3.82%)	25 (4.77%)	0.501
	Discharged	238 (45.42%)	241 (45.99%)	
RTPCR	No	43 (8.21%)	24 (4.58%)	0.009*
	Yes	215 (41.03%)	242 (46.18%)	
Radiological Covid	Yes	46 (65.71%)	24 (34.29%)	-

Note: n-number of patients, %-the percentage of patients, RTPCR-Reverse transcription polymerase chain reaction, CVA-Cerebrovascular accidents, COPD-Chronic obstructive pulmonary disease, CAD-Coronary artery disease, CKD-Chronic kidney disease, DLP-Dyslipidemia,* p-values from Fisher exact test

p-values cannot be estimable from the chi-square test. The results show that a significant association was identified *between clinical outc*ome and Oxygen Requirement (p<0.001), variables such as hypertension (p<0.001) and CAD (p=0.002) were also found to be associated but more with diabetic patients than non-diabetic patients as a comorbidity status as well as screening by RTPCR (p=0.009) among COVID-19 subjects with diabetes and non-diabetes.

Comparison of RTPCR positive and RTPCR negative using Binomial Test:

In table 4, the proportion of RTPCR positive was compared with the RTPCR negative using binomial test. The test was performed with an assumption of equal proportion of

Table 4) Comparison of RTPCR positive and RTPCR negative using Binomial Test

RTPCR positive	COVID with Diabetes (N = 259)	COVID without diabetes (N=266)	Risk estimate with 95%CI among COVID-19 subjects	*p*-value
Yes	242 (46.18%)	215 (41.03%)	0.47 (0.425, 0.516)	<0.001*
No	24 (4.58%)	43 (8.21%)	0.64 (0.527, 0.757)	
Risk of RTPCR positive - Risk of RTPCR negative			-0.17 (-0.295, -0.048)	

Note: RTPCR-Reverse transcription polymerase chain reaction, * p-values<0.05 is statistically significant

Table 5) Comparison of means of patient's characteristics and laboratory profiles among COVID-19 subjects with diabetes and non-diabetes

Variable	Diabetes (N=259)	Non-Diabetes (N=266)	*p*-value
Age	60.74 ± 11.84	50.38 ± 16.41	<0.001*
Total count	8156.22 ± 6731.15	6975.19 ± 5475.41	<0.001*
Platelet	231952.9 ± 98731.29	227270.45 ± 92389.16	0.92
IL-6	74.93 ± 187.2	59.01 ± 312.84	<0.001*
D-Dimer	1.63 ± 3.53	1.92 ± 4.75	0.09
No# days	8.98 ± 7.94	7.12 ± 4.99	<0.001*

Note: n-number of patients, IL-6=Interleukin 6. *- p-values<0.05 is statistically significant

RTPCR positive and RTPCR negative. Based on the result, there is a significant difference in risk among RTPCR positive patients when compared to risk among RTPCR negative patients (-0.17 (-0.295, -0.048); p value <0.001) among COVID-19 subjects.

Comparison of means of patient's characteristics and laboratory profiles among participants:

The continuous variables of patient's characteristics and laboratory profiles were compared between the two groups and the normality of data was assessed using Kolmogorov-Smirnov test when the sample size was more than 50. Shapiro-Wilk test was performed when the sample size is less than 50. The results showed that all the variables did not follow normal distribution. Therefore, Mann-Whitney U test was performed to compare the mean values between groups and results are depicted in table 5 and it was found that there is a significant difference in the mean score of age (p<0.001), total count (p<0.001), IL-6 (p<0.001) and number of days admitted (p<0.001) between COVID-19 subjects of both groups. (Table 5)

Discussion

Diabetes and infections have had a relationship that has always been an important concern for clinicians. Infectious diseases like influenza and pneumonia, are very common among elderly diabetic patients. Additionally, previously conducted research had reported that diabetes was a risk factor for the morbidity and mortality of multiple viral infections, including MERS-CoV, SARSCoV, and 2009 influenza A

(H1N1).[14]The present study studied the clinical outcomes and hematological data of COVID-19-positive T2DM patients when compared to non-diabetic COVID-19-positive patients.

The mean age of the COVID-19 participants with DM (60.74±11.84 years) was higher when compared to participants without DM (50.38±16.41 years). This result was in agreement with results of previous studies that aimed to understand the relationship between DM and the prognosis of COVID-19 and involved a majority of participants belonging to the same age groups.[14,15]

When platelet count was assessed, 79.54% of participants with DM reported a total WBC count between 150000-450000/mL, and 80.45% of participants without DM reported the same platelet count. These results are in contrast with the results of a study conducted by Moin ASM et al., in 2021which stated that diabetes patients presented with platelet hyperactivation and increased levels when compared to control (non-diabetic patients), this difference could be explained by the participants not being COVID-19 patients. They also stated that higher platelet activation could result in a higher risk of death if diabetic patients suffered from COVID-19 disease.[16] However, a review of the CORONADO (CORONA virus and Diabetes Outcomes) study conducted by Smati S et al., in 2022 stated that low platelet levels were associated with an increased risk of death among COVID-19 patients.[17]Platelet-relatedpathologies were also associated with Long COVID/PASC symptoms that persisted after the recovery from acute COVID-19.[18]

D-dimer is a fibrin degradation product and is one of the main markers of coagulation activity. The high concentration of serum D-dimer is closely related to a variety of thrombotic diseases, including myocardial infarction, cerebral infarction, pulmonary embolism, and venous thrombosis.[14]The D-Dimer levels of the participants in the present study showed that most participants with DM (61.78%) had abnormal levels and in participants without DM, 53.76% showed abnormal D-Dimer levels. This was in accordance with the results of a previous study that reported that COVID-19 patients with diabetes had higher mean D-dimer levels (0.31) when compared to non-diabetic COVID-19 patients (0.19) and this difference was statistically significant (p=0.03).[14] Higher D-dimer levels were found to increase the risk factor in patients according to the results of another study conducted by Zhou F et al in 2020.[7] Another study conducted by Mishra Y et al in 2020 also reported that the mean peak D-dimer level of the diabetic group of COVID-19 patients was higher (1509±2420 ng/mL) than that of non-diabetic COVID-19 patients (515±624 ng/mL) and this difference was statistically significant (p=0.002).[19] D-dimer levels in diabetic COVID-19 patients were significantly higher when compared to nondiabetic patients in a study conducted by Miri C et al in 2021suggesting that diabetic patients were more likely to suffer from a hypercoagulable state which increases morbidity and mortality.[15]A systematic review conducted by Rostami M et al in 2020 has recommended monitoring of D-dimer levels as a crucial approach in the clinical management of COVID-19 infection.[20]This was reinforced by the results of a meta-analysis that highlighted increased D-dimer levels to be associated with fatal outcomes with regard to coronavirus infection.[21]

Regarding IL-6 levels, most participants in both groups (75.81%) showed abnormal levels.

A study conducted by Han H et al in 2020 that profiled serum cytokines in COVID-19 patients revealed that IL-6 and IL-10 are disease severity predictors in

patients suffering from COVID-19.[22] This was reinforced by a cross-sectional study conducted by Nugroho GMS et al in 2022 that analyzed IL-6 expression of lung tissue in COVID-19 patient and disease severity and concluded that an increase in IL-6 expression on lung tissue helped report level of severity of COVID-19 infection.[23] The association between IL-6 levels and COVID-19 disease progression had led to the proposed utilization of IL-6 blockade to manage COVID-19-induced cytokine release syndrome (CRS).[24] The abnormal level of IL-6 in the present study can be attributed to the COVID-19 disease and not associated with the diabetic state of the patient and this can be researched further.

The comorbidity status of the patients showed that most participants in both groups (with DM: 46.72% and without DM: 20.68%) suffered from systemic hypertension. Systemic hypertension is a common occurrence among individuals with white collar occupations and is diagnosed when Workplace clinic Blood Pressure (CBP)≥140/90 mmHg and Anytime Blood Pressure (ABP)≥135/85 mmHg.[25]This result was consistent with the results of a study conducted by Shang J in 2020 which reported that COVID-19 patients with and without diabetes reported hypertension to be the most commonly seen comorbidity.[14] Similar findings were observed in a study by Mishra Y et al., in 2020 and Miri C et al., in 2021 also reported that hypertension was the most common comorbidity among COVID-19 patients with and without diabetes.[15,19]

When the duration of hospital stay was assessed, most of the participants involved (68.19%) stayed at the hospital for less than or equal to a week, and 91.24% of all participants were discharged by the hospital. The results of the present study were in close agreement with the results of a study conducted by Al-Salameh A et al in 2020 which reported that COVID-19 patients with diabetes stayed at hospitals longer than patients without diabetes and this difference was statistically significant (p=0.007) and diabetic patients were more prone to be admitted to the ICU than non-diabetic patients (p=0.015). This result can be expected in diabetic COVID-9 patients with an increased level of mortality and morbidity.[26]This result was in agreement with a previous study where the majority of participants from diabetic and non-diabetic COVID-19 patient groups (90.2%) were alive and discharged from the hospital.[14]

The results show that a significant association was identified between clinical outcome andOxygen Requirement, hypertension, and CAD as comorbidity status as well as screening by RTPCR among both groups of patients. A study conducted by Choi K et al assessed the association between mortality and oxygen requirement among COVID-19 patients, the results showed that SF ratio (ratio of oxygen saturation to fraction of inspired oxygen) were strong predictors of the occurrence of ARDS which is one of the main clinical outcomes in COVID-19 patients.[27] Another study showed that patients with more than three comorbidities were at significant risk of CCU admissions, delayed recovery, and death (clinical outcomes).[28] Based on the result, there is a significant difference in risk between RTPCR positive and RTPCR negative patients among COVID-19 subjects. This can be explained by the results of a study conducted by Parmar H et al which stated that a cohort of patients presenting with signs and symptoms of COVID-19 were RTPCR negative even after repeated testing and these patients were half as likely to receive the necessary treatment as COVID-19 patients who tested positive on RTPCR test, the delay that this can cause toward necessary treatment can result in a

huge difference in risk among the two sets of patients.[29]

A significant difference was observed in the mean score of age, total count, IL-6and number of days admitted between COVID-19 subjects of both groups with the mean being higher in the group of patients with diabetes. Diabetes is a debilitating disease that makes an individual prone to all sorts of infections. The proportion of diabetics among COVID-19positive patients has also been assessed and it shows that in Italy as many as 36% of those who were extremely sick and tested positive for a COVID-19 test, were burdened with diabetes, and in the United States, the same was observed in as many as 58% of patients.[30] The increased total WBC count is in keeping with the results of a study conducted by Ebrahim H et al which reported that total WBC count was positively correlated with fasting blood sugar levels.[31] However, IL-6 levels has been shown to be a marker for severity of COVID-19 disease and this can help reinforce the point that diabetic patients will have suffered a more severe form of COVID-19 when compared to non-diabetics which in turn results in an increased number of days hospitalized as found in the present study.[32]

The limitations of the present study include the retrospective nature of the investigations and the involvement of only one center in the study. The advantages of the study are the low amounts of missing data and an equal number of samples in both diabetic and non-diabetic groups of patients. There lies a possibility of confounding factors due to the inclusion of hospital patients afflicted by multiple conditions as well as biases such as selection or confirmation bias. However, the present study holds an advantage over previously conducted studies which lacked comparison with COVID-19 patients without DM as well as overlapping data.[9] Clinical implications of the present study includes reinforcement of evidence from previously conducted meta-analyses which reported a significant increase in mortality in people with diabetes and COVID-19.[9-12] Other implications include proof necessary to propose the use of D-dimer and IL-6 levels to assess the severity of COVID-19 disease among both sets of patients and the management of diabetes among all populations to provide better chances of survival in case of COVID-19 infection. Diabetes should be considered as a risk factor for a rapid progression and bad prognosis of COVID-19.[33] The use of IL-6 blockade for the management of COVID-19 can also be further studied to reduce associated mortality rate and reduce days of hospital stay.

Conclusion

The results of the present study help us conclude that COVID-19 patients suffering from diabetes are at risk for the severe form of the disease and an associated increase in mortality. Factors such as IL-6 can be used to ascertain the extent of the disease and its progression to aid in the management of the disease. Patients with diabetes will additionally suffer from hematological as well as clinical states which increase severity of COVID-19 disease which in-turn results in increased duration of hospitalization of these patients.

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