SHORT ARTICLE

Clinical and Laboratory Characteristics of Diabetic COVID-19 Patients with High Risk of Mortality: A Single-Center Study from Central India

Nidhi Tripathy[1], Ashutosh Jain[2], Jaya Jain[3]

[1,3]Department of Biochemistry, Index Medical College, Hospital & Research Centre (IMCHRC), Malwanchal University, Indore-452016, Madhya Pradesh

[2]Department of Physiology, Index Medical College, Hospital & Research Centre (IMCHRC), Malwanchal University, Indore-452016, Madhya Pradesh

CORRESPONDING AUTHOR

Jaya Jain, Associate Professor, Department of Biochemistry, Index Medical College, Hospital & Research Centre (IMCHRC), Malwanchal University, Indore-452016, Madhya Pradesh

Email: jayajain.imc@gmail.com ; jain02jaya@gmail.com

CITATION

Tripathy N, Jain A, Jain J. Clinical and Laboratory Characteristics of Diabetic COVID-19 Patients with High Risk of Mortality: A Single-Center Study from Central India. Indian J Comm Health. 2024;36(6):879-885.

https://doi.org/10.47203/IJCH.2024.v36i06.023

ARTICLE CYCLE

Received: 27/09/2024; Accepted: 11/12/2024; Published: 31/12/2024

ABSTRACT

Background: Diabetes is a common comorbidity and risk factor of mortality in COVID-19 in India but data on characteristics of diabetic COVID-19 is scarce. **Objectives:** We aimed to study clinical and laboratory characteristics, and mortality of diabetic COVID-19 patients. **Methods:** This study included 235 COVID-19 patients presenting to our Center, from February, 2021 to May 2022. The demographics, clinical features, laboratory results were collected from the hospital records. **Results:** Out of 235 eligible COVID-19 patients, 107 (45.5%) were diabetic and 128 (54.5%) were non-diabetic. The diabetics compared to non-diabetics had higher frequency of hypertension (62.6% vs 34.4%; p<0.001), cardiovascular disease (8.4% vs 1.5%; p<0.05) and mortality (27.1% vs 13%; p<0.001). D-dimer (8.9±3.1 vs 1.2± 5.1; p<0.01), CRP (269.2±136.0 vs 49.8 ± 63.4; p<0.001), neutrophils (10.6 vs 7.2; <0.001], HbA1c (8.3 ± 1.6 vs 5.2± 0.5%; p<0.05) and Troponin-T (1.8±17.6 vs 0.02 ±1.2; <0.05) were higher while AST (48.9±79.6 vs 77.0±88.4; p<0.01) and lymphocytes (0.9 vs 1.3); <0.01) were lower in diabetics than non-diabetics. Mortlaity in diabetics was associated with hypertension (p<0.01), cardiovascular disease (p<0.001) and elevated D-dimer (p<0.0001) and neutrophils (p<0.05) but lower lymphocyte counts (p<0.001). **Conclusion:** The diabetic COVID-19 patients had higher mortality associated with hypertension, cardiovascular disease, elevated D-dimer, neutrophilic leukocytosis and lymphocytopenia.

KEYWORDS

Diabetes Mellitus; COVID-19, Clinical Characteristics, Laboratory characteristics, Mortality.

INTRODUCTION

Coronavirus disease 2019 (COVID-19), a fatal respiratory infection caused by the severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2), has been the most devastating pandemic in the modern history (1,2). Since its declaration as pandemic on March 11, 2020 by the World Health Organization (WHO) (3) till writing of this article, COVID-19 has been documented to claim around 7.0 millions of deaths worldwide and the actual death toll may be double or even quadruple of this official count i.e. at least 20 million (4, 5). So, the need of time is to decipher the potential causes of high mortality of COVID-19 for improving the outcome of COVID-19 or other similar pandemics that we may face in near future.

Diabetes mellitus (DM) or hyperglycaemia is one of the commonest comorbidities in COVID-19 in India and it may be an important risk factor for the disease severity and mortality in COVID-19 (6-9). However, there is paucity of data on clinical and

laboratory factors associated with diabetic COVID-19 from India.

Aim: Evaluation of clinical symptoms and laboratory findings of diabetic COVID-19 patients.

Objective(s):

- To study clinical and laboratory characteristics of diabetic COVID-19 patients.
- To identify the risk factors associated with high mortality of diabetic COVID-19.

MATERIAL & METHODS

Study Type & Study Design: Retrospective observational study.

Study Setting: Single-center study conducted at Index Medical College, Hospital & Research Centre (IMCHRC), Indore, Madhya Pradesh, India.

Study Population: Laboratory confirmed adult COVID-19 patients hospitalized at our center.

Study duration: One year and Three months (from February, 2021 to May 2022).

Sample size calculation: The sample size calculated was 235 as per details from previous studies using following formula. n= (Zα2 * p*q)/ d2, where Zα=1.96 at 95% confidence level. Where, P=0.13, q=0.87, d=0.06

Inclusion and Exclusion Criteria: The adult patients with age >18 years having a confirmed diagnosis of either COVID-19 or COVID-19 and DM were included in the study. The patients having uncertain diagnosis of either COVID-19 or DM, an acute lethal organ injury, end-stage chronic organ failure, solid cancer, hematologic malignancy, pregnancy or lack of relevant clinical and laboratory data were excluded from the study.

Strategy for data collection: A format of Microsoft Excel file was designed to systematically record the clinical and laboratory data of the patients. After assigning a specific code to each patient, the basic clinical and laboratory information was extracted from the case reports of the patients at presentation to hospital. The data extracted included demographics, existing comorbidities, clinical symptoms, routine biochemical, hematological and endocrinological laboratory results and outcome of the patients. The biochemistry laboratory data included routine Biochemistry blood tests comprising of albumin, total protein, alkaline phosphatase (ALP), alanine aminotransferase (ALT), aspartate aminotransferase (AST), serum creatinine, total-bilirubin, direct/conjugated-bilirubin, lactate dehydrogenase (LDH), D-Dimer, C-reactive protein (CRP). The hematology laboratory data included hemoglobin, total leukocyte count (TLC), absolute neutrophil count (ANC), absolute lymphocyte count (ALC) and platelet count. The endocrinology data included glycosylated hemoglobin (HbA1c), thyroid stimulating hormone (TSH), tri-iodothyronine (T3), free-thyroxine (FT4), pro-B-type natriuretic peptide (Pro-BNP), troponin-T (Trop-T) and vitamin-D. A comparative analysis of these clinical and laboratory characteristics of diabetic and non-diabetic COVID-19 patients was carried out.

Working Definitions: ***COVID-19:*** The COVID-19 was defined by clinical symptoms including fever, cough, dyspnea, anosmia etc and positivity for SARS-CoV-2 RNA in nasal or throat swab samples by reverse-transcription polymerase chain reaction (RT-PCR) testing as per guidelines of Indian Council of Medical Research (ICMR, Government of India, www.icmr.gov.in).

Diabetes: Diabetes status of the patient was defined according to the patient's medical history of taking anti-diabetic drugs or fasting blood glucose ≥ 126 mg/dL or random blood glucose level ≥ 200 mg/dL at presentation to the hospital (10)

Ethical Issues & informed Consent:

The Ethics Committee of IMCHRC, Indore reviewed and approved the study. A waiver of informed consent of the subjects was granted by the Ethics Committee due to retrospective nature of the study and nature of data as part of routine clinical patient care service.

Data Analysis: All data were computed and analyzed using SPSS Version 22.0 (IBM Corp., Armonk, NY, USA). Continuous variables were expressed as the mean ± SD for data of normal distribution, and as the median and range for data of non-normal distribution. Depending on whether the data were parametric or non-parametric, appropriate statistical tests of significance including Student's t test, Mann Whitney U test, or chi-square test were applied. A p-value of <0.05 was considered to be statistically significant.

RESULTS

After screening the enrolled patients based on inclusion and exclusion criteria, a total of 235 COVID-19 patients qualified for this study. Of these 107 were diabetic while 128 were non-diabetic COVID-19 patients. The clinical features, outcome and laboratory findings of diabetic COVID-19 patients (n=107) in comparison non-diabetic COVID-19 i.e control patients (n=128) are presented below.

Clinical Characteristics of Diabetic COVID-19 Patients: The mean age of diabetic COVID-19 patients was comparable to that of non-diabetic COVID-19 patients (mean ± SD: 57.8 ± 12.2 vs 50.4 ± 15.3 years; p>0.05). Similarly, the percentage of male sex in both the groups was also comparable [85/107 (79.4%) vs 87/128 (68.0%); p>0.05). The diabetic COVID-19 patients as compared to non-

diabetic controls had higher frequency of hypertension (62.6% vs 34.4%; p<0.001), cardiovascular disease (8.4% vs 1.5%; p<0.05) and mortality (27.1% vs 13%; p<0.001). However clinical symptoms and other comorbid conditions present in the groups had no difference (Table-1).

Table 1 Clinical Characteristics of Diabetic and Non-diabetic COVID-19 Patients

Clinical Characteristics	Total (N=235)	Diabetic COVID-19 (n=107)	Non-diabetic COVID-19 (n=128)	p-value
Demographics				
Age (Mean+ SD, Years)	53.4 +14.6	57.8 + 12.2	50.4 + 15.3	ns
Males, n (%)	172(73.2)	85 (79.4)	87 (68.0)	ns
Symptoms, n (%)				
Fever	161(68.5)	78 (72.8)	83 (65.6)	ns
Cough	105(44.6)	52 (47.6)	53(41.4)	ns
Diarrhoe**a**	11(4.6)	2 (1.8)	9 (7.1)	ns
Dyspnea	71(30.2)	37 (34.5)	34(26.5)	ns
Anosmia	35(15.0)	19 (17.7)	16 (12.5)	ns
Headache	37(15.7)	22(20.5)	15(11.7)	ns
Fatigue	37 (15.7)	22(20.5)	15(11.7)	ns
Comorbidities, n (%)				
Hypertension	111(47.2)	67 (62.6)	44 (34.3)	<0.01
COPD	13(5.5)	7 (6.5)	6 (4.6)	ns
Asthma	13(5.5)	7(6.5)	6 (4.6)	ns
CVD	11(4.7)	9 (8.4)	2(1.5)	<.0.05
CKD	32(13.6)	15 (14.0)	17 (13.2)	ns
CLD	05(2.1)	03(2.8)	02(1.5)	ns
Hypothyroidism	16(6.8)	9(8.4)	7(5.4)	ns
None	34 (14.4)	15 (14.0)	19 (14.8)	ns
Outcome, n (%)				
Died	42 (17.9)	29 (27.1)	13 (10.1)	<0.001

COVID-19: Coronavirusdisease-2019, COPD: Chronic Obstructive Pulmonary disease , CAD: Coronary Artery Disease CVD: Coronary Vascular Disease CKD: Chronic Kidney Disease , CLD: Chromic Liver Disease, SD: Standard Deviation; ns: Not Significant

Laboratory Characteristics of Diabetic COVID-19 Patients: The diabetic COVID-19 patients as compared to non-diabetic COVID-19 had higher levels of D-dimer (8.9±3.1 vs 1.2± 5.1; p<0.01), CRP (269.2±136.0 vs 49.8 ± 63.4; p<0.001), neutrophils (10.6 vs 7.2; <0.001], HbA1c (8.3 ± 1.6 vs 5.2± 0.5%; p<0.05) and Troponin-T (1.8±17.6 vs 0.02 ±1.2; <0.05) while lower levels of AST (48.9±79.6 vs 77.0±88.4; p<0.01) and lymphocytes (0.9 vs 1.3); <0.01). The two groups had no difference in other studied laboratory characteristics (Table-2).

Table 2 Laboratory Characteristics of Diabetic and Non-diabetic COVID-19 patients

Laboratory Characteristics	Reference Range	Total (N: 235)	Diabetic COVID-19 (n= 107)	Non-diabetic COVID-19 (n= 128)	P-value
Biochemical					
Albumin, g/dL	3.5-5.5	3.6+2.1	3.9 + 0.6	4.0 + 0.5	ns
Total Protein, g/dL	6.6-8.7	6.1+10.3	8.9 + 14.53	6.7 + 1.2	ns
ALP, U/L	80-305	233.6+220.3	293.2 + 250.6	297.1 + 220.4	ns
ALT, U/L	<35	42.5 + 14.1	44.3+ 21.3	52.9 + 33.2	ns
AST, U/L	<35 U/L	65.4+33.7	48.9 + 79.6	77.0 + 88.4	<0.01
Creatinine, mg/dL	0.7-1.3	1.9+2.2	1.1 + 2.2	1.4 + 3.5	ns
T-Bilirubin, mg/dL	≤ 0.3	1.2.2+7.1	1.5 + 4.8	1.1 + 1.2	ns
D-Bilirubin, mg/dL	≤ 0.3	0.7+6.3	0.9 + 2.9	0.4 + 0.5	ns
LDH, U/L	135-214	279.3+422.1	588.2 + 440.4	530.5 + 416.4	ns
D-Dimer, µg/mL	<0.5	4.6+3081.0	8.9 + 3.1	1.2+ 5.1	<0.01
CRP, mg/L	< 5.0	151.7+934.9	269.2+ 36.0	19.8 + 3.4	<0.001
Hematological					
Hemoglobin, g/dL	Dec-16	11.8 + 1.9	11.1+ 2.6	12.2 + 2.7	ns
TLC x103/µl	4.0-10.0	8.6 (6.2–12.1)	13.7 (7.8–18.2)	8.5 (6.2–11.4)	<0.05
ANC x103/µl	1.8-6.5	6.9 (4.0-9.6)	10.6 (6.5-16.9)	7.2 (4.0-10.2)	<0.001
ALC x103/µl)	1.1-3.2	1.4 (0.9–1.9)	0.9 (0.6-1.2)	1.3 (0.9-2.8)	<0.01
Platelets x103/µl)	150-350	189.3 (107–265)	339.5 (175-459)	280.6 (107-347)	ns
Endocrinological					

Laboratory Characteristics	Reference Range	Total (N: 235)	Diabetic COVID-19 (n= 107)	Non-diabetic COVID-19 (n= 128)	P-value
HbA1c, %	4.0-5.6	7.1+1.7	8.3 + 1.6	5.2± 0.5	<0.05
TSH, IU/L	0.8-5.0	2.4+2.8	2.6 ± 3.6	2.3 ± 2.0	ns
T3, IU/L	1.4-3.3	2.8+12.9	4.2 ± 19.1	3.6 ± 0.7	ns
FT4, IU/L	14-25	17.7+8.1	18.2 ± 4.0	17.4 ± 10.3	ns
Pro-BNP, pg/mL	<125	81.7 +30.2	78.1±13.1	64.0 ± 27.1	ns
Trop-T, IU/L	<0.04	0.84+11.7	1.8+ 17.6	0.02 + 1.2	<0.05
Vitamin-D, IU/L	30-50	69.4+52.5	76.5+ 49.9	73.3+ 54.6	ns

ALP: Alkaline Phosphatase, ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, T-Bilirubin: Total Bilirubin, D-Bilirubin: Direct-Bilirubin, LDH: Lactate Dehydrogenase, CRP: C reactive protein, HbA1c: Glycated Hemoglobin, TSH: Thyroid Stimulating Hormone, FT4: Free Thyroxine , T3: Tri-iodothyronine, Pro-BNP: Pro B-Type Natriuretic Peptide , Trop-T: Troponin-T, TLC: Total Leukocyte Count , ANC: Absolute Neutrophil Count, ALC: Absolute Lymphocyte Count; ns: Not Significant

Clinical Outcome of Diabetic COVID-19 Patients: There were a total of 42 deaths in patients with COVID-19. Out of these 29 deaths were in diabetic COVID-19 and 13 were among non-diabetic COVID-19 patients. The rate mortality in diabetic COVID-19 was significantly higher than that of non-diabetic COVID-19 patients [29/107 (27.1%) vs 13/128 (10.1%); p<0.001)] (Table-1). Among patient with diabetic COVID-19, died as compared to survived patients had higher frequency hypertension [22/29 (75.9%) vs 45/78 (57.7%); p<0.01] and CVD [05/29 (17.2%) vs 04/78 (5.1); p<0.001]. The remaining clinical characteristics including age and sex had no correlation with mortality in diabetic COVID-19 patients. In the laboratory characteristics higher D-dimer (10.2±4.2 vs 1.1±1.8; p<0.0001) and neutrophil counts (12.3 vs 8.5); p<0.05) but lower lymphocyte counts (0.7 vs 1.1; p<0.001) were associated with mortality in patients with diabetic COVID-19. No other studied laboratory characteristics had relation with mortality in diabetic COVID-19 (Table-3).

Table 3 Relationship of Clinical and Laboratory Characteristics with Mortality in Diabetic COVID-19 Patients

Characteristics	Total (N=107)	Died (n=29)	Survived (n=78)	p-value
Clinical, n(%)				
Age (Mean+ SD)	57.8 + 12.2	58.9+12.4	52.2+ 9.9	ns
Males, n (%)	85 (79.4)	16(84.2)	69(78.4)	ns
Fever, n (%)	78 (72.8)	19 (65.5)	59 (75.6)	ns
Cough, n (%)	52 (47.6)	13 (44.9)	39 (50)	ns
Diarrhea, n (%)	2 (1.8)	0 (0)	2 (2.7)	ns
Dyspnea, n (%)	37 (34.5)	11 (37.9)	26 (33.3)	ns
Anosmia, n (%)	19 (17.7)	6 (20.7)	13 (16.7)	ns
Headache, n (%)	22(20.5)	5 (17.2)	17 (21.8)	ns
Fatigue, n (%)	22(20.5)	7 (24.1)	15 (19.2)	ns
Hypertension, n (%)	67 (62.6)	22(75.9)	45 (57.7)	<0.01
COPD, n (%)	7 (6.5)	2 (6.9)	5 (6.4)	ns
Asthma, n (%)	7(6.5)	2 (6.9)	5 (6.4)	ns
CVD, n (%)	9 (8.4)	5 (17.2)	4 (5.1)	<0.001
CKD, n (%)	15 (14.0)	4 (13.8)	11 (14.1)	ns
CLD, n (%)	03(2.8)	1 (3.4)	2 (2.7)	ns
Hypothyroidism, n (%)	9(8.4)	2 (6.9)	9 (9.0)	ns
Hyperthyroidism, n (%)	15 (14.0)	5 (17.2)	10 (12.8)	ns
None, n (%)	15 (14.0)	4 (13.8)	11 (14.1)	ns
Laboratory				
Albumin,	3.9 + 0.6	3.5 + 0.6	4.0 + 0.5	ns
Total Protein	8.9 + 14.5	7.8 + 1.4	6.7 + 1.2	ns
ALP	293.2 + 250.6	288.2 + 212.1	297.1 + 220.4	ns
ALT	44.3+ 21.3	41.7 + 23.4	52.9 + 33.2	ns
AST	48.9 + 79.6	57.2 + 66.1	77.0 + 88.4	ns
Creatinine	1.1 + 2.2	1.2 + 2.6	1.4 + 3.5	ns
T-Bilirubin	1.5 + 4.8	1.7 + 0.8	1.1 + 1.2	ns
D-Bilirubin	0.9 + 2.9	0.7 + 0.4	0.4 + 0.5	ns
LDH	588.2 + 440.4	590.2 + 386.1	530.5 + 416.4	ns
D-Dimer, µg/mL	8.9 + 3.1	10.2 + 4.2	1.1+1.8	<0.0001
CRP	269.2+ 36.0	288.2+ 33.2	6.8 + 3.7	ns
Hemoglobin	11.1+ 2.6	10 + 3.8	12.2 + 2.7	ns
TLC (x103/µl)	13.7 (7.8–18.2)	11.2 (8.9–18.2)	8.5 (7.8–11.4)	ns

Characteristics	Total (N=107)	Died (n=29)	Survived (n=78)	p-value
ANC (x103/µl)	10.6 (6.5-16.9)	12.3 (8.5-16.9)	8.5 (6.5-10.2)	<0.05
ALC (x103/µl)	0.9 (0.6-1.2)	0.7 (0.6-1.0)	1.1 (0.9-1.2)	<0.001
Platelet Count (x103/µl)	339.5 (175-459)	325 (250-459)	280.6 (107-347)	ns
HbA1c	8.3 + 1.6	8.8 + 1.2	6.9± 1.5	ns
TSH	2.6 ± 3.6	2.8 ± 1.4	2.1 ± 1.1	ns
T3	4.2 ± 19.1	3.9 ± 12.1	3.2 ± 11.7	ns
FT4	18.2 ± 4.0	19.1 ± 3.2	16.9 ± 9.8	ns
Pro-BNP	78.1±13.1	79.3±12.7	63.2 ± 19.5	ns
Trop-T	1.8+ 17.6	1.9 + 17.6	`1.4 + 8.4	ns
Vitamin-D	76.5+ 49.9	74.1+ 61.3	73.3+ 54.6	ns

COVID-19: Soronavirusdisease-2019, COPD: Chronic Obstructive Pulmonary disease , CAD: Coronary Artery Disease, CVD: Coronary Vascular Disease, CKD: Chronic Kidney Disease , CLD: Chromic Liver Disease, SD: Standard Deviation, ALP: Alkaline Phosphatase, ALT: Alanine Aminotransferase, AST: Aspartate Aminotransferase, T-Bilirubin: Total Bilirubin, D-Bilirubin: Direct-Bilirubin, LDH: Lactate Dehydrogenase, CRP: C reactive protein, HbA1c: Glycated Hemoglobin, TSH: Thyroid Stimulating Hormone, FT4: Free Thyroxine , T3: Tri-iodothyronine, Pro-BNP: Pro B-Type Natriuretic Peptide , Trop-T: Troponin-T; TLC: Total Leukocyte Count , ANC: Absolute Neutrophil Count, ALC: Absolute Lymphocyte Count; ns: Not Significant

DISCUSSION

In the present study, we divided 235 COVID-19 patients into the diabetic (n=107) and non-diabetic (n=128) groups and compared their clinical features, laboratory findings, and clinical outcome. Our main findings of this study include that diabetic COVID-19 have (i) higher rate of mortality, (ii) high frequency of HTN and CVD as clinical characteristics, (ii) elevated levels of D-dimer, CRP, HbA1c, Troponin-T, and neutrophil counts but decreased AST levels and lymphocyte counts as laboratory characteristics, (iii) association of HTN, CVD, elevated D-dimer, and increased neutrophil counts (neutrophilic leukocytosis) and decreased lymphocyte counts (lymphocytopenia) with increased risk of mortality. To the best of our knowledge this is the first study in literature reporting clinical and laboratory characteristics of diabetic COVID-19 patients from India and their relationship with mortality in the patients.

Although there is limited data on diabetic COVID-19 from India, a meta-analysis of 34 Indian studies has reported HTN, diabetes and CVD as major comorbidities present in COVID-19 patients lending support to our observation of the present study (11). The presence of raised levels of Troponin-T in diabetic COVID-19 patients may be associated with events of CVD in these patients. A recent prospective observational Indian study has reported higher frequency of HTN and its association with increased risk of mortality in diabetic COVID-19 patients as compared to non-diabetic COVID-19 corroborating to our observation of the present study (12). Similarly, a study from outside India has reported high prevalence of HTN among diabetic COVID-19 patients and an increased risk of mortality in diabetic COVID-19 patients with HTN (13). We have reported more than two-fold higher mortality in diabetic than non-diabetic COVID-19 patients suggesting that diabetic COVID-19 are more likely to develop severe or even fatal course of disease than non-diabetic COVID-19 patients. Similar to our observation a recent meta-analysis of 43 global studies have reported a significantly higher rate of mortality in diabetic COVID-19 patients as compared to non-diabetic COVID-19 (14). Another report from India has shown that co-existence of diabetes and HTN in COVID-19 patients constitute a high risk for COVID-19 related mortality further supporting our study (15). A report of 72,314 cases of COVID-19 published by Chinese Centre for Disease Control and Prevention showed increased mortality in people with diabetes (2.3%, overall and 7.3%, patients with diabetes) (16).

In laboratory characteristics of our cohort, we have reported elevated levels of D-dimer in diabetic patients and their association with mortality of the patients. Corroborating to our observation, an Indian study has also shown association of raised levels of D-dimer with mortality in diabetic COVID-19 (17). Some more studies have also observed elevated levels of D-dimer in died than survived COVID-19 patients further supporting D-dimer as a potential risk factor of mortality in the patients (18). There are reports showing lower AST levels in diabetic COVID-19 patients as observed in the present study indicating that altered liver functions may also be involved in these patients (19). In our cohort, we have observed neutrophilic leukocytosis and lymphocytopenia in diabetic COVID-19 than those without diabetes and their association with the mortality in diabetic COVID-19 patients suggesting that these cellular anomalies in the patients are robust predictor of severity and mortality of the disease. Similar to our findings diabetic COVID-19 patients have been reported to have neutrophilic leukocytosis and lymphocytopenia and their association with mortality in the patients (20, 21). Some other studies in diabetic COVID-19 have also reported elevated CRP levels and lymphocytopenia as

observed by us (22). Lymphocytes are the most important immune cells regulating cellular immunity and lymphocytopenia in patients with diabetic COVID-19 point towards existence of a dysregulated immune response leading to hyper-inflammation evidenced by presence of neutrophilic leukocytosis and a higher rate of mortality in the patients.

Diabetes is one of the most common underlying comorbidities in patients with COVID-19 and is associated with severity and mortality in these patients (23). However, very few studies have shown the underlying cause of high mortality in diabetic COVID-19 patients. Diabetic patients have been identified at a high risk of respiratory infections. Many changes occur in the immune system of diabetic patients particularly those cell-mediated immune function may be associated with severity and mortality in the disease (24). Consistently, the data of the present study showed altered cellular elements including neutrophilic leukocytosis and lymphopenia as important risk factors for disease severity and mortality in the diabetic COVID-19 patients.

Conclusion

In conclusion, this study shows that diabetic COVID-19 patients have significantly higher mortality than those without diabetes and HTN, CVD, and laboratory findings of elevated levels D-dimer, neutrophilic leukocytosis and lymphocytopenia are associated with high mortality in the patients. The findings of this study will be useful to identify the diabetic COVID-19 patients at higher risk of mortality for early initiation of anti-diabetic treatments along with clinical management of COVID-19 to improve the prognosis of the disease. Additional large cohort and prospective studies are warranted to further elucidate the impact of diabetes on the outcome of COVID-19 and validate our conclusions of this study.

Recommendation

Although pandemicity of COVID-19 is over but the disease is still persisting in several countries including India as significant threat to public health. The clinical and laboratory characteristic based identification diabetic COVID-19 at high risk of mortality will be useful to improve outcome of the COVID-19 and other similar pandemic that we may face in near future.

Limitation of the Study

Although our study provides useful clinical and laboratory clues to distinguish diabetic from non-diabetic COVID-19 patients and risk factors associated with increased mortality in diabetic COVID-19 patients but it has certain limitations. These mainly include single-cantered retrospective nature of study, small sample size, and non-availability of data on lymphocyte subsets and cytokine profile to explain the mechanisms underlying our observations of this study.

Relevance of the Study

There is no clear documentation in literature on clinical and laboratory characteristics of diabetic COVID-19 at high risk of mortality. Our study adds that diabetic patients having clinical features of HTN and CVD and laboratory finding of elevated D-dimer, neutrophilic leukocytosis and lymphopenia are at high risk of mortality.

Authors Contribution

All authors have contributed equally.

Financial Support and Sponsorship

Nil

Conflict of Interest

There are no conflicts of interest.

Acknowledgement

We are grateful to all the patients who participated in this study. We would like to express our highest esteem and sincere respect to those medical staff, who helped in collection of the data for this study during the difficult pandemic time. We would like thank Dr Sudha Tawar, Post-doctoral fellow, Tulane University, New Orleans, USA for her linguistic and statistical assistance during the preparation of this manuscript.

Declaration of Generative AI and AI Assisted Technologies in the Writing Process

During the preparation of this work, the authors used Grammarly for grammar correction. After using this tool, the authors reviewed and edited the content as needed and take full responsibility for the content of the publication.

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