Clinical characteristics and outcomes of COVID-19 infected diabetic patients admitted in ICUs of the southern region of Bangladesh

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ARTICLE INFO

ABSTRACT

Background and aims: Diabetes mellitus is highly prevalent among critical cases of coronavirus disease 2019 (COVID-19) with poor outcomes. This study aimed to describe the clinical characteristics and outcomes of COVID-19 patients with diabetes, admitted in the intensive care unit (ICU) of the southern region of Bangladesh.

Methods: Epidemiological, clinical, laboratory, treatments, complications, and clinical outcomes data were extracted from electronic medical records of 168 COVID-19 patients admitted into ICU of two COVID-19 dedicated hospitals of Chattogram, Bangladesh and compared between diabetes ($n = 88$) and non-diabetes ($n = 80$) groups.

Results: The prevalence of diabetes was high among 51–70 years old patients. All the diabetic patients had at least one other comorbidity, with a significantly higher incidence of hypertension (53.4% vs 27.5%, $P < 0.05$). Prevalence of male patients (74/88; 84.1%) was slightly higher among diabetic patients than the non-diabetic patients (60/80; 75%). Even though not significant, Kaplan-Meier survival curve showed that COVID-19 patients with diabetes had a shorter overall survival time than those without diabetes. In subgroup analysis, diabetic patients were classified into insulin-requiring and non-insulin-requiring groups based on their requirement of insulin during the stay in ICU. COVID-19 infected diabetic patients requiring insulin have high risk of disease progression and shorter survival time than the non-insulin required group.

Conclusions: Diabetes is an independent risk factor for the poor prognosis of COVID-19. More attention should be paid to the prevention and prompt treatment of diabetic patients, to maintain good glycaemic control especially those who require insulin therapy.

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1. Introduction

Among the major types of non-communicable diseases that cause global morbidity and mortality, Diabetes ranks fourth. In 2016, the theme of the World Health Day organized by the World Health Organization (WHO) was diabetes and according to them, to that day about 422 million people had diabetes globally of which 80% of the diabetic cases were found in the low and middle-income countries [1]. They also reported that in terms of diabetes related mortality more than 80% of the deaths occur in the developing countries. The prevalence of diabetes is considerably increasing in

both urban and rural areas of Bangladesh. In 2010–2011 tenure, Bangladesh was ranked 8th among the countries having the highest diabetic population. According to The International Diabetes Federation's report, there are 7.1 million diagnosed cases of diabetes in Bangladesh, the figure being exact in terms of undetected cases, of which 4.5%–35% people have type 2 diabetes [1,2].

Bangladesh is a developing country with a steady economic growth. In the past few years, given the economic growth, Bangladesh has also seen a rather rapidly increasing rate of urbanization. This rapid urbanization in a broader sense has compelled people to alter their living habits, in regards to physical movement as well as dietary intake. Complying with the urban norms, increased access to and popularity of processed foods, irregular meals and less physical exercise has made people sedentary, increasing the risk of them becoming diabetic [3]. According to WHO, the female cohort in Bangladesh have a higher risk of developing health issues than men due to comparatively less physical activity, the prevalence of which was observed in 25.1% of the population [4]. Carbohydrate-dependent diet, sedentary lifestyle and lack of knowledge on diabetes are some reasons behind the higher prevalence of diabetes among people in Bangladesh [5]. In a study conducted in 2014, it was found that 1 in 10 adults in Bangladesh is diabetic [6].

In light of the ongoing COVID-19 pandemic (caused by the novel Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2)), which emerged from Wuhan, China and spread globally in a swift wave the term "comorbidity" came into discussion quite a lot of times because of SARS-CoV-2's more severe outcomes in comorbid individuals [7,8]. Comorbid individuals, especially those with diabetes have also been at high mortality risks along with higher needs to be admitted to ICUs due to severe prognosis during previous epidemics like the SARS epidemic in 2002–2003, novel influenza A (H1N1) in 2009 and Middle East respiratory syndrome coronavirus (MERS-CoV) epidemic in 2012 [9–11].

Recent studies have established that COVID-19 cases, who are diabetic have more severe complications and are at higher risk in terms of mortality [12]. Among those who died of SARS-CoV-2 infection, most were found to have underlying hypertension, diabetes, coronary artery disease, and cerebrovascular diseases, which led to a more severe prognosis of COVID-19 in these cases [13,14]. In China, a more extensive study on 72,314 patients with COVID-19 reported that the mortality rate in patients with diabetes was threefold compared to the mortality rate of COVID-19 in patients overall [15]. A previous study conducted in Bangladeshi on patients with COVID-19 admitted in ICUs found that over 50% of the patients (52.4%) seeking care in the ICUs had diabetes [16].

For a developing country like Bangladesh, managing COVID-19 is somewhat an enormous challenge due to its large population against a poor health care system with very limited number of ICU accommodations for COVID-19 patients. Additionally, epidemiological evidence suggests that diabetes is associated with high risk of infectious diseases along with high risk for the bacteremic form of pneumococcal infection noted as a high risk of nosocomial bacteremia [17]. With a goal to investigate and scrutinize the clinical manifestations of COVID-19 in severe cases with diabetes, this study was conducted on the cohort who were admitted in the ICUs to comprehend the etiological association between COVID-19 and diabetes. We believe the insights of this study from an epidemiological aspect will contribute in the prevention and management of COVID-19 through a more cohort based approach by targeting groups and cases who are at higher risk of developing severe instances of COVID-19.

2. Methods

2.1. Patients and data collection

This study was based on a sample of 168 in-patients who were diagnosed with COVID-19 seeking care in Chittagong General Hospital and Chittagong Medical College Hospital between April 1, 2020 and August 24, 2020. During the ongoing COVID-19 pandemic, Chittagong General Hospital and Chittagong Medical College Hospital have been chosen to carry out the necessary steps of providing clinical aid and managing the majority of the COVID-19 cases in Chattogram city, the economic centre. We obtained necessary and relevant epidemiological and demographic data for this study from each of the in-patient's files which were collected by the coordinating physicians. Non-inclusion of the death certificate among the files indicated the patient was alive during the conduction of this study. The 2012 Berlin Definition was used to describe Acute Respiratory Distress Syndrome (ARDS) [18] while the Sepsis-3 criteria was used to define shock [19]. The study was approved by the IRB of the Chattogram General Hospital Ethics Committee on July 27, 2020.

2.2. Real-time RT-PCR assay for COVID-19 patients

To confirm the presence of COVID-19 in the individuals of the study sample, real-time reverse transcription-polymerase chain reaction (RT-PCR) assay of upper and lower respiratory tract swab was carried out. Viral transport medium was used for maintaining the collected swabs. The laboratory test assays for COVID-19 were conducted according to the World Health Organisation's (WHO) recommendations and protocols. SARS-CoV-2 RNA extraction was a key step followed by other conventional protocols maintained for RT-PCR [20].

2.3. Statistical analysis and plotting

For expressing categorical variables in terms of numbers and proportions, we performed descriptive statistical analyses of the datasets. Comparison of these were then carried out using a chi-square test or Fisher's exact test and P values < 0.05 (two-sided) were esteemed to be statistically significant. We used GraphPad Prism version 7.04 and R programming language to perform all of the statistical analyses and visualizations. Cases within the sample who had at least one other type of medical condition apart from COVID-19 were considered to be comorbid and those without any underlying medical conditions apart from COVID-19 were considered as non-comorbid individuals.

3. Result

3.1. Epidemiological characteristic

In this study, 168 patients with COVID-19 were included, and among of them 88 were diabetic, and 80 were non-diabetic (Table 1). The median aged (51–60 years) patients were 48 (28.6%), where the number of the diabetic patient was higher than the non-diabetic patient. The count for male diabetic patients (74/88; 84.1%) was significantly larger than female diabetic patients (14/88; 15.9%) with COVID-19. Demographically, most of the patients belonged to urban areas (63/88; 71.5%). During hospitalization, most of the diabetic patient faced some common morbidity, respiratory problems (71/88; 80.6%), fever (48/88; 54.5%), cough

Table 1
Baseline characteristics of diabetic patients with COVID-19 pneumonia admission to hospital.

Variable	Total number (N = 168)	Diabetic (N = 88)	Non-diabetic (N = 80)	Pearson's χ2	P- Value
Clinical outcome; N = 168					
Dead	95/168 (56.5%)	53/88 (60.2%)	42/80 (52.5%)	1.02	0.31
Alive	73/168 (43.5%)	35/88 (39.8%)	38/80 (47.5%)		
Age; N = 168					
0−10	0/168 (0.0%)	0/88 (0.0%)	0/80 (0.0%)	15.73	0.03
11−20	2/168 (1.2%)	0/88 (0.0%)	2/80 (2.5%)		
21−30	11/168 (6.5%)	1/88 (1.1%)	10/80 (12.5%)		
31−40	14/168 (8.3%)	5/88 (5.7%)	9/80 (11.2%)		
41−50	29/168 (17.3%)	16/88 (18.1%)	13/80 (16.2%)		
51−60	48/168 (28.6%)	29/88 (32.9%)	19/80 (23.7%)		
61−70	36/168 (21.4%)	22/88 (25.0%)	14/80 (17.5%)		
71−80	22/168 (13.1%)	13/88 (14.8%)	9/80 (11.2%)		
80+	6/168 (3.6%)	2/88 (2.3%)	4/80 (5.0%)		
Sex; N = 168					
Male	134/168 (79.8%)	74/88 (84.1%)	60/80 (75.0%)	2.14	0.14
Female	34/168 (20.2%)	14/88 (15.9%)	20/80 (25.0%)		
Dwelling place; N = 168					
Urban	110/168 (65.5%)	63/88 (71.5%)	47/80 (58.7%)	3.06	0.08
Rural	58/168 (34.5%)	25/88 (28.4%)	33/80 (41.3%)		
Newly admitted to ICU; N = 168					
Yes	156/168 (92.9%)	83/88 (94.3%)	73/80 (91.2%)	29.27	0.00
No	12/168 (7.1%)	5/88 (5.7%)	7/80 (8.8%)		
Comorbidities; N = 168					
Hypertension	69/168 (41.1%)	47/88 (53.4%)	22/80 (27.5%)	11.62	0.00
Heart disease	28/168 (16.7%)	15/88 (17.0%)	13/80 (16.3%)	0.02	0.89
Asthma	15/168 (8.9%)	7/88 (7.9%)	8/80 (10.0%)	0.21	0.64
Kidney disease	5/168 (3.0%)	3/88 (3.4%)	2/80 (2.5%)	0.12	0.73
Other chronic disease	16/168 (9.5%)	6/88 (6.8%)	10/80 (12.5%)	1.00	0.32
None	35/168 (20.8%)	0/88 (0.0%)	35/80 (43.8%)	45.19	0.00
Common complications during hospital admission; N = 168					
Respiratory problems	133/168 (79.2%)	71/88 (80.6%)	62/80 (77.5%)	0.26	0.61
Fever	91/168 (54.2%)	48/88 (54.5%)	43/80 (53.7%)	0.01	0.92
Cough	43/168 (25.6%)	29/88 (32.9%)	14/80 (17.5%)	5.26	0.22
Sore throat	10/168 (6.0%)	3/88 (3.4%)	7/80 (8.7%)	1.71	0.19
Hypertension	5/168 (3.0%)	5/88 (5.7%)	0/88 (0.0%)	2.39	0.12
Diarrhea	4/168 (2.4%)	1/88 (1.1%)	3/80 (3.7%)	1.23	0.27
Vomiting	4/168 (2.4%)	1/88 (1.1%)	3/80 (3.7%)	1.23	027
Others	43/168 (25.6%)	22/88 (25.0%)	21/80 (26.3%)	0.03	0.85
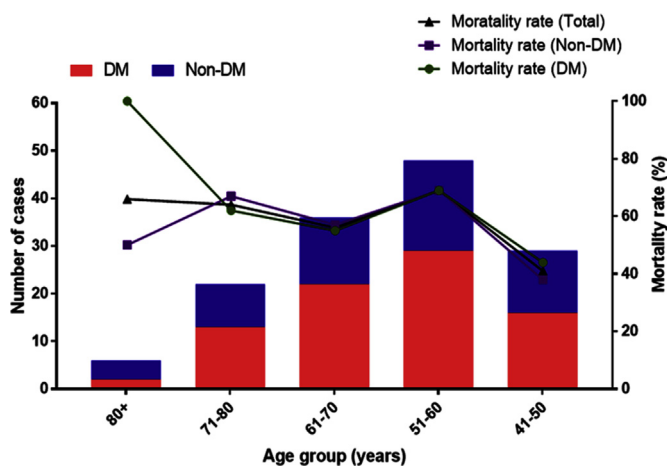
Fig. 1. Relation of age (over 40 years) with the number of COVID-19 case and mortality rate among the diabetic and non-diabetic patients. Left axis indicates number of COVID-19 case and right axis indicates mortality rate. Red and blue bar denotes number of diabetic and non-diabetic patients, respectively. Green, violate and black line indicate mortality rate of diabetic, non-diabetic and total patients. DM, Diabetes mellitus.

(29/88; 32.9%), hypertension (5/88; 5.7%), other (22/88; 25.0%) while sore throat (3/88; 3.4%), diarrhea (1/88; 1.1%), vomiting (1/88; 1.1%) were relatively low.

Among the ICU in-patients, the 51−60 years age group occupied the larger portion of the study population (48/168; 28.6%) in comparison with other age groups. (Table 1, Fig. 1, Supplementary Table 1). In the same age range (51−60 years), the combined mortality rate was also found to be the highest (69.0%). Among diabetic in-patients, the age group exceeding 80 years had a 100% mortality rate, although only two patients were admitted to ICU of that age. In general, mortality rate (95/168; 56.5%) was higher in the diabetic group (53/88; 60.2%) than patients without -diabetes (42/80; 52.5%) (Table 1). However, the mortality was almost identical between both with and without diabetic groups when compared in different age groups (Fig. 1).

The Kaplan-Meier method was also used in this study to examine the relation of diabetes with COVID-19 prognosis in critically ill Bangladeshi patients admitted in ICU. As presented in Fig. 2A, the results indicated that diabetic patients had a lower overall survival rate than non-diabetic patients (Fig. 2A). Kaplan-Meier survival curve also showed that the insulin-required diabetic patients had a shorter overall survival time than other diabetic patients. (Fig. 2B).

3.2. Vital signs and physical examination during ICU admission

On admission, the vital signs of all of the patients were observed. As compared to the non-diabetic in-patients, the diabetic in-patients had an elevated heart rate which was 47/88; 53.4% in diabetic cases and 38/80; 47.5% in non-diabetic cases (Table 2).
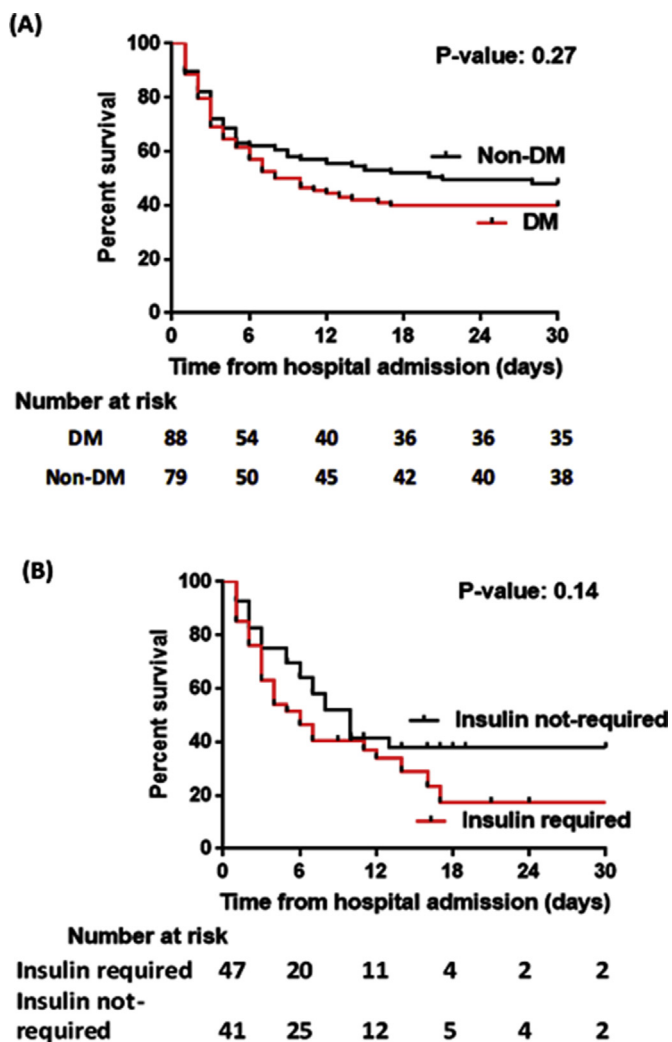
Fig. 2. Kaplan-Meier survival curve for Bangladeshi ICU patients with (A) severe COVID-19 with and without diabetes and (B) diabetic patients who required insulin and no-insulin. The Kaplan-Meier method was used in our study to investigate the relationship between diabetes and COVID-19 prognosis. The results showed that diabetic patients had lower overall survival rate than non-diabetic patients (P = 0.27). Moreover, Kaplan-Meier survival curve also showed that the insulin-required diabetic patients had a shorter overall survival time (P = 0.14) than other diabetic patients. DM, Diabetes mellitus.

Most of the ICU patients showed severe acute respiratory distress syndrome (ARDS) (133/168; 79.2%), where the diabetic patient had a higher proportion of ARDS (73/88; 83.0%) than the non-diabetic patient (60/80; 75.0%) (Table 2).

3.3. Laboratory findings of patients with COVID-19 in ICUs

Data retrieved through biochemical assays of both diabetic and non-diabetic COVID-19 patients in the ICU have been presented in Table 3. Most of the patients admitted in the ICU had a short stay in the hospital which limited the data available from biochemical diagnosis. Levels of capillary blood glucose significantly increased in diabetic patients than those without diabetes (54/63; 85.7% vs 7/17; 41.2%) (Table 3). Although it is not significant, a similar trend of increase in the total count of WBC (25/35; 71.4% vs 17/26; 65.4%), Neutrophils (28/37; 75.7% vs 16/29; 55.2%) and D-dimer (38/50;

76.0% vs 11/21; 52.4%) were also observed in diabetic patients than non-diabetic patients (Table 3).

3.4. Managements of diabetic patients with COVID-19 in ICUs

Among the 168 COVID-19 in-patients, 159 patients required oxygen support due to their low oxygen saturation. Among them, 84 patients had diabetes, and 75 were non-diabetic (Supplementary Table 2). Oxygen support was given by mask to 59.5% diabetic patients (n = 50) and by high flow nasal cannula to 31.0% (n = 26) (Supplementary Table 2). Most of the diabetic patients (74/88; 84.0%) were kept in the prone position as this position improves the oxygenation and lung recruitability. Among the eighty-eight diabetic COVID-19 patients, antiviral drug, anti–biotics, anti-allergic, vitamins and minerals supplementation and anti-inflammatory drugs have been given to 50 (56.8%), 86 (97.7%), 70 (79.5%), 81 (92.0%) and 74 (84.1%) patients, respectively. Antiviral drugs had a slightly better outcome (42% alive) in comparison with other types of drug (Fig. 3). Unfortunately, prone positioning or other drugs such as anti-ulcerents, anti-inflammatory drugs, vitamins and minerals, anti-allergic drugs, antibiotics and antiviral drugs could not significantly reduce the mortality rate of the diabetic patients.

4. Discussion

Among the comorbidities identified in severe cases of COVID-19, diabetes is commonly prevalent [21]. Noteworthy to mention, diabetes often develops with age and the geriatrics is one of the critical risk factors of severe prognosis of COVID-19 [21]. In this study, the proportion of elderly patients in the diabetes group was higher than that in those without -diabetes group. The highest number of diabetic COVID-19 patients (28.6%) belonged to the 51–60 years age range. This result is in no way deviant because in the study conducted in 2019, the mean age (±SD) of the Bangladeshi diabetic patients was found to be 55.1 ± 12.5 years [22]. In a study that included diabetic COVID-19 patients of Bangladesh, Akter et al. (2020) found that propensity of COVID-19 was significantly higher in diabetic patients aged over 40 years [23]. Consistent with the aforementioned study, this study also found that COVID-19 patients who required ICU support were older and were mostly have diabetes mellitus. Thus, age is an essential factor to influence clinical complications in diabetic COVID-19 patients.

In terms of clinical outcomes, the mortality rate in the diabetic group was slightly higher (60.2% vs 52.5%, P = 0.31) than that in the non-diabetic group. However, other studies have also shown that the presence of diabetes in COVID-19 patients has significantly increased disease severity and the mortality risk [21,24]. A recent study on Chinese patients reported that 14% of the COVID-19 patients who survived had diabetes as associated comorbidity, however 31% of those did not survive [21]. Likewise, the mortality rate was much higher among Korean COVID-19 patients with diabetes compared to those without (20.0% vs. 4.8%) [25]. Therefore, like other countries, Bangladeshi diabetic patients are more likely to have worse complications if they get infected with SARS-CoV-2.

Even though diabetes-associated pathophysiology of SARS-CoV-2 is a shaded area, several predictions have been proposed. Blood glucose level is a critical determinant in the pathogenesis of infectious diseases [26]. High blood glucose levels can alter the immune system of diabetic patients, resulting in immunocompromisation [26], which makes diabetic cases more susceptible to being easily infected by bacteria and viruses, including SARS-CoV-2 [8].

Table 2
Vital signs at ICU admission of COVID-19 diabetic patients.

Variable	Total number (N = 168)	Diabetic (N = 88)	Non-diabetic (N = 80)	Pearson's χ^2	P- Value
Temperature (°F); n = 168					
<98.0	5/168 (3.0%)	4/88 (4.5%)	1/80 (1.2%)	3.5	0.465
98 to 99	127/168 (75.6%)	64/88 (72.7%)	63/80 (78.7%)		
99.1 to 100	31/168 (18.4%)	19/88 (21.5%)	12/80 (15.0%)		
100.1 to 102	3/168 (1.8%)	1/88 (1.1%)	2/80 (2.5%)		
102+	2/168 (1.2%)	0/88 (0.0%)	2/80 (2.5%)		
Heart rate (Normal: 60 to 100 beats per minute); n = 168					
Increased	85/168 (50.6%)	47/88 (53.4%)	38/80 (47.5%)	7.46	0.02
Normal	68/168 (40.5%)	29/88 (32.9%)	39/80 (48.7%)		
Decreased	15/168 (8.9%)	12/88 (13.6%)	3/80 (3.8%)		
Respiratory rate (Normal: 12 to 20 breaths per minute); n* = 91					
Increased	51/91 (56.0%)	31/57 (54.3%)	20/34 (58.8%)	3.17	0.21
Normal	34/91 (37.4%)	14/57 (24.5%)	20/34 (58.8%)		
Decreased	6/91 (6.6%)	3/57 (5.3%)	3/34 (8.8%)		
Blood pressure (Systolic) (Normal range: 90 to 120 mmHg); n = 168					
Hypertensive crisis	7/168 (4.2%)	3/88 (3.4%)	4/80 (5.0%)	6.24	0.10
Increased	78/168 (46.4%)	43/88 (48.8%)	35/80 (43.7%)		
Normal	50/168 (29.7%)	25/88 (28.4%)	25/80 (31.2%)		
Decreased	33/168 (19.7%)	17/88 (19.3%)	16/80 (20.0%)		
Blood pressure (Diastolic) (Normal range: 60 to 80 mmHg); n = 168					
Hypertensive crisis	7/168 (4.2%)	3/88 (3.4%)	4/80 (5.0%)	1.86	0.60
Increased	40/168 (23.8%)	22/88 (25.0%)	18/80 (22.5%)		
Normal	100/168 (59.5%)	50/88 (56.8%)	50/80 (62.5%)		
Decreased	21/168 (12.5%)	13/88 (14.7%)	8/80 (10.0.%)		
Saturation of O2 (%) (Normal range: 95 to 100); n = 168					
95 to 100	33/168 (19.6%)	13/88 (14.7%)	20/80 (25.0%)	4.85	0.56
90 to 94	25/168 (14.8%)	12/88 (13.6%)	13/80 (16.2%)		
85 to 89	34/168 (20.2%)	20/88 (22.7%)	14/80 (17.5%)		
75 to 84	23/168 (13.8%)	13/88 (14.7%)	10/80 (12.5%)		
65 to 74	19/168 (11.3%)	12/88 (13.6%)	7/80 (8.7%)		
55 to 64	19/168 (11.3%)	10/88 (11.3%)	9/80 (11.2%)		
<55	15/168 (9.0%)	8/88 (9.1%)	7/80 (8.75%)		
Acute respiratory distress syndrome (ARDS); n = 168					
Severe	133/168 (79.2%)	73/88 (82.0%)	60/80 (75.0%)	1.15	0.77
Moderate	31/168 (18.5%)	15/88 (17.0%)	16/80 (20.0%)		
Mild	3/168 (1.7%)	1/88 (1.1%)	2/80 (2.5%)		
None	1/168 (0.6%)	0/88 (0.0%)	1/80 (1.2%)		

Moreover, the expression of angiotensin-converting enzyme 2 (ACE2) significantly increases in diabetic patients, which is important for SARS-CoV and SARS-CoV-2 binding and localization in target cells [27]. Consequently, the probability of a more severe prognosis of COVID-19 increases in the diabetic cohort.

Our study also found that the prevalence of hypertension is higher in diabetic patients (53.4%) than the non-diabetic (27.4%) cases. According to a recent meta-analysis, despite being one of the most prevalent comorbidities, there was no significant difference found in diabetes between severe and non-severe groups [28]. However, the presence of hypertension was positively correlated with death, ICU care and severity [12]. Worth mentioning, hypertension has not been found to make any significant difference in the mortality rate among the critical COVID-19 cases in Bangladesh [16]. Data obtained from a study in the U.K. suggest that mortality rate does not increase with hypertension, while the presence of uncontrolled and controlled diabetes along with hypertension increases the risk 2.36 and 1.50 fold respectively [29]. Elevated expression of ACE2 also occurs in hypertensive patients similar to diabetic cases due to imbalance in the renin-angiotensin system [30,31]. Given the facts, it can be assumed that coexistence of diabetes and hypertension may modulate the mortality rates of COVID-19 in patients in Bangladesh.

In terms of the clinical outcomes, the Kaplan-Meier survival curve illustrates that the survival rate of patients with severe COVID-19 with diabetes was lower than those without diabetes. Furthermore, diabetic patients relying upon insulin had an even worse prognosis of COVID-19 than the non-insulin requiring group. The high-risk of mortality among insulin-dependent diabetic patients may partly be explained by the expression of ACE2 receptor in the pancreas which makes the islet cells targets for SARS-CoV-2 and subsequently leads to insulin deficiency [30]. According to a study conducted on 1253 type 2 diabetes mellitus (T2DM) Bangladeshi patients, 65.5% were dependent on insulin [22]. This high dependency on insulin increases the risk of the poor outcome against COVID-19 in Bangladeshi diabetic patients.

To conclude, apart from diabetes, hypertension is an independent risk factor for the worst prognosis of COVID-19 in critical cases in Bangladesh. Because the studies have been conducted on smaller samples, to elucidate even more on the association of diabetes, hypertension and severe prognosis of COVID-19, extensive studies are necessary to fill the major gaps in understanding of the disease to establish risk stratification of the Bangladeshi cohort. For the comorbid individuals, because patients with diabetes are blatantly at a higher risk of infection as well as mortality, they call for more detailed observations to

Table 3
Laboratory finding of the diabetic patients with COVID-19 in ICU.

Variable	All patients (%)	Diabetic (%)	Non-diabetic (%)	Pearson's χ^2	P-value
Capillary blood glucose level; n* = 80; Diabetic* = 63; Non-diabetic* = 17					
Increased	61/80 (76.3%)	54/63 (85.7%)	7/17 (41.2%)	14.69	0.001
Normal	15/80 (18.8%)	7/63 (11.1%)	8/17 (47.1%)		
Decreased	4/80 (5.0%)	2/63 (3.2%)	2/17 (11.8%)		
White blood cell count ($\times 10^9$ per L; normal range 4–10); n* = 61; Diabetic* = 35; Non-diabetic* = 26					
Increased	42/61 (68.9%)	25/35 (71.4%)	17/26 (65.4%)	0.47	0.79
Normal	14/61 (23.0%)	7/35 (20.0%)	7/26 (26.9%)		
Decreased	5/61 (8.2%)	3/35 (8.6%)	2/26 (7.7%)		
Haemoglobin (g/L; normal range 130–175); n* = 57; Diabetic* = 28; Non-diabetic* = 29					
Increased	7/57 (12.3%)	3/28 (10.7%)	4/29 (13.8%)	0.93	0.63
Normal	33/57 (57.9%)	18/28 (64.3%)	15/29 (51.8%)		
Decreased	17/57 (29.8%)	7/28. (25.0%)	10/29 (34.5%)		
Neutrophils ($\times 10^9$ per L; normal range 1.8–6.3); n* = 66; Diabetic* = 37; Non-diabetic* = 29					
Increased	44/66 (66.7%)	28/37 (75.7%)	16/29 (55.2%)	5.04	0.08
Normal	16/66 (24.2%)	8/37 (21.6%)	8/29 (27.6%)		
Decreased	6/66 (9.1%)	1/37 (2.7%)	5/29 (17.2%)		
Lymphocytes ($\times 10^9$ per L; normal range 1.1–3.2); n* = 48; Diabetic* = 26; Non-diabetic* = 22					
Increased	16/48 (33.3%)	9/26 (34.6%)	7/22 (31.8%)	0.42	0.81
Normal	23/48 (47.9%)	13/26 (50.0%)	10/22 (45.5%)		
Decreased	9/48 (18.8%)	4/26 (15.4%)	5/22 (22.7%)		
Platelets ($\times 10^9$ per L; normal range 125–350); n* = 57; Diabetic* = 29; Non-diabetic* = 28					
Increased	18/57 (31.6%)	8/29 (27.6%)	10/28 (35.7%)	1.39	0.50
Normal	25/57 (43.9%)	12/29 (41.4%)	13/28 (46.4%)		
Decreased	14/57 (24.6%)	9/29 (31.0%)	5/28 (17.9%)		
Prothrombin time (s; normal range 9–13) n* = 53; Diabetic* = 28; Non-diabetic* = 25					
Increased	5/53 (9.4%)	4/28 (14.3%)	1/25 (4.0%)	1.99	0.37
Normal	45/53 (81.1%)	22/28 (78.6%)	23/25 (92.0%)		
Decreased	3/53 (5.7%)	2/28 (7.1%)	1/25 (4.0%)		
D-dimer (mg/L; normal range < 0.5); n* = 71; Diabetic* = 50; Non-diabetic* = 21					
Normal	22/71 (31.0%)	12/50 (24.0%)	10/21 (47.6%)	6.08	0.11
> 0.5 to ≤ 5	34/71 (47.9%)	25/50 (50.0%)	9/21 (42.9%)		
> 5 to ≤ 10	11/71 (15.5%)	9/50 (18.0%)	2/21 (9.5%)		
> 10	4/71 (5.6%)	4/50 (8.0%)	0/21 (0.0%)		
Ferritin concentration (μg/L; normal range < 500); n* = 67; Diabetic* = 41; Non-diabetic* = 26					
Normal	16/67 (23.8%)	7/41 (17.1%)	9/26 (34.6%)	4.34	0.36
≥ 500 to < 1000	23/67 (34.3%)	14/41 (34.1%)	9/26 (34.6%)		
≥ 1000 to < 1500	13/67 (19.4%)	8/41 (19.5%)	5/26 (19.2%)		
≥ 1500 to < 2000	11/67 (16.4%)	9/41 (22.0%)	2/26 (7.7%)		
≥ 2000	4/67 (5.9%)	3/41 (7.3%)	1/26 (3.8%)		
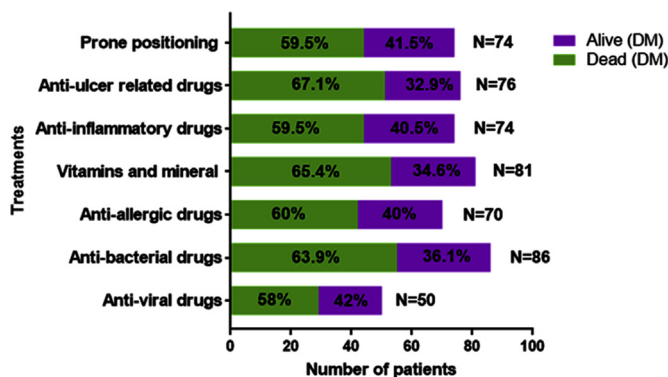
Fig. 3. Treatment and management of critical diabetic COVID-19 patients of Bangladesh. N = number of critical COVID-19 patients with diabetes included in the analysis. Bar chart of diabetic patient (dead and alive) shows the management of the patient with prone position, anti-ulcer related drugs, anti-inflammatory drugs, vitamins and minerals, anti-allergic drugs, anti-bacterial drugs and anti-viral drugs.

further elucidate proper prevention and management strategies in this cohort.

Declaration of competing interest

The authors declare that there is no conflict of interest.

Abbreviations

ARDS	Acute respiratory distress syndrome
COVID-19	Coronavirus disease 2019
DM	Diabetes mellitus
ICU	Intensive care unit
MERS-CoV	Middle East respiratory syndrome coronavirus
RT-PCR	Real-time reverse transcription polymerase chain reaction
SARS-CoV-2	Severe acute respiratory syndrome coronavirus 2
WHO	World Health Organization

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.dsx.2020.12.037.

Author contributions

AS, MMA, HMM, AP and TUQ: Study design. SN, AUC, HK, TR and AS Literature review, Data collection. FA, HMM and AS: Data analysis, Visualization. SN, HMM and AS: Manuscript writing, Editing. The final manuscript was reviewed and approved by all associated authors and they consented to be held accountable for the work.

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