

ORIGINAL ARTICLE

Analysis of Patients Admitted to the Emergency Department With High Blood Glucose Level in the COVID-19 Pandemic Era

COVID-19 Pandemisi Döneminde Yüksek Kan Şekeri ile Acil Servise Başvuran Hastaların Analizi

¹Zikret KOSEOĞLU , ²Deniz GEZER , ³Seval Müzeyyen ECİN 

¹Department of Emergency Medicine, University of Health Sciences, Mersin City Education and Research Hospital, Mersin

²Department of Internal Medicine, University of Health Sciences - Mersin City Education and Research Hospital, Mersin

³Department of Occupational Diseases Clinic, University of Health Sciences - Mersin City Education and

Research Hospital, Mersin

Correspondence

Zikret Koseoglu, Korukent Mah. 96015 Sok. Mersin Entegre Sağlık Kampüsü, Toroslar, Zip Code:33240, Mersin

E-Mail: drzikret@yahoo.com

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ABSTRACT

Introduction: This study aims to analyze the relationship and effects of sociodemographic characteristic data and clinical, laboratory and other findings of cases who are admitted to the emergency department (ED) with high blood glucose levels during the COVID-19 pandemic period.

Method: This is a cross-sectional study in which the demographic data, blood gases, blood count and biochemical variables of adult patients admitted to the ED between 01.01.2020 and 31.05.2021 in a 17-month period were retrospectively screened and analyzed.

Results: Infection was detected in 67 (10.5%) of 638 patients with blood glucose level of 300 mg/dl and above. Pneumonia was detected in 56 (8.7%) patients and 203 (31.8%) were hospitalized and 34 (5.3%) died during follow-up. SpO₂ was lower (p<0.01), heart rate was higher (p<0.01), systolic blood pressure was lower (p<0.01); in blood gases, pH, HCO₃ and CO₂ are lower (p<0.01) in the inpatients than outpatients. SpO₂ (p<0.01), systolic blood pressure (p<0.01) and diastolic blood pressure (p=0.02) pH (p<0.01) and HCO₃ (p<0.01) were lower; WBC (p<0.01), neutrophil (p<0.01) were higher, hemoglobin was lower (p=0.01), platelet (p=0.02) and CRP levels were higher (p<0.01) in patients who died within the follow-up period than the survivors.

Conclusion: Hyperglycemia is a poor prognostic factor in patients hospitalized during the COVID-19 pandemic period. An increase in LDH values, WBC, neutrophils, and a decrease in lymphocyte, hemoglobin and hematocrit values have a negative impact on the outcomes, and clinicians should follow these variables closely.

Keywords: Blood glucose, COVID-19, Emergency room, Hospitalization, Hyperglycemia, Mortality

ÖZ

Giriş: Bu çalışmanın amacı, COVID-19 pandemisi döneminde acil servise kan şekeri yüksekliği ile başvuran olguların sosyodemografik özellikleri ile klinik, laboratuvar ve diğer bulgularının ilişkisini ve etkilerini analiz etmektir.

Yöntem: Bu çalışma, 01.01.2020 ile 31.05.2021 tarihleri arasındaki 17 aylık dönemde acil servise başvuran yetişkin hastaların demografik verileri, kan gazları, kan sayımı ve biyokimyasal değişkenlerinin retrospektif olarak tarandığı ve analiz edildiği kesitsel bir çalışmadır.

Bulgular: Kan glukoz düzeyi 300 mg/dl ve üzerinde olan 638 hastanın 67'sinde (%10,5) enfeksiyon tespit edildi. Hastaların 56'sında (%8,7) pnömoni saptandı ve 203'ü (%31,8) hastaneye yatırıldı ve 34'ü (%5,3) takip sırasında öldü. Takip süresi içinde ölen hastalarda hayatta kalanlara kıyasla; SpO₂ (p<0.01), sistolik kan basıncı (p<0.01) ve diastolik kan basıncı (p=0.02), pH (p<0.01) ve HCO₃ (p<0.01) daha düşük; WBC (p<0.01), nötrofil (p<0.01) daha yüksek hemoglobin daha düşük (p=0.01), platelet (p=0.02) and CRP seviyesi (p<0.01) daha yüksek saptandı.

Sonuç: Hiperglisemi, COVID-19 pandemisi döneminde hastaneye yatırılan hastalarda kötü prognostik bir faktördür. LDH, WBC, nötrofil değerlerinde artış ve lenfosit, hemoglobin ve hematokrit değerlerinde azalma sonuçları olumsuz etkilemektedir ve klinisyenler bu değişkenleri yakından takip etmelidir.

Anahtar Kelimeler: Kan şekeri, COVID-19, Acil Servis, Hastaneye yatış, Hiperglisemi, Ölüm

Introduction:

Diabetes mellitus (DM) is one of the leading chronic diseases worldwide in the last decade. Factors contributing to the increased incidence of DM include a sedentary lifestyle, obesity, and aging of the population. Complications due to DM boost morbidity and mortality, and as a result, people's health-related quality of life diminishes (1).

Although the clinical course of the cases presenting with hyperglycemic conditions is mostly benign, metabolic acidosis, electrolyte disorders and fluid loss-related complications can be observed in severe cases and in patients whose treatment is delayed

for some reason (2,3). For this reason, revealing the characteristics of the cases presenting to the emergency department (ED) with hyperglycemia, clinicians providing timely and effective treatment to prevent complications, knowing how and when to activate the team approach and consultations strengthen awareness about contemporary approaches. The role of hyperglycemia in the risk of serious infections in patients with diabetes has not been fully investigated. Poorly controlled diabetes is a risk factor for infection in general. Because COVID-19 can trigger an intense inflammatory response, it has been difficult to distinguish whether hyperglycemia in COVID-19 is a cause or, as

seems more likely, a consequence of severe disease.

A systematic review evaluating COVID-19 and diabetes showed an increased risk of disease severity, intensive care hospitalization and mortality in people with diabetes (4).

In this study, the sociodemographic characteristics of the patients admitted to the ED with high blood glucose levels during the Coronavirus disease (COVID-19) 2019 pandemic period, and the relationship and effects of clinical, laboratory and other findings were analyzed. In patients who died; SpO₂, systolic blood pressure, diastolic blood pressure, pH, HCO₃ were significantly lower; pulse rate, WBC, neutrophil creatinine, AST, ALT, LDH CRP values were significantly higher than those who survived.

Materials and Methods

Among the adult patients aged 18 years and older, who have been admitted to the ED in the Mersin City Training and Research Hospital's between 01.01.2020 and 31.05.2021, patients with a blood glucose level of 300 mg/dL and above and a decision to start blood glucose-lowering treatment were included in the study. In the hyperosmolar hyperglycemic state, a hyperglycemic crisis, the glucose value was taken as 300mg/dl (5). We took this value as the lower limit in our study.

Patients under the age of 18, those with cardiac or respiratory arrest, conditions requiring emergency interventions and resuscitation (such as surgery, catheter) were excluded from the study. The data of 638 patients were retrospectively abstracted. Patients' age, gender, DM, comorbid diseases (some patients have more than one comorbid disease), which were detected during the ED management, mode of disposition during 1-month patient follow-up, COVID-19 diagnosis, vital signs, blood gases, blood count, glucose, creatinine, glomerular filtration rate (GFR), aspartate transaminase (AST), alanine aminotransferase (ALT), lactate dehydrogenase (LDH), sodium, potassium, calcium, C-reactive protein (CRP), d-dimer, International Normalized Ratio (INR) and complete urinalysis were screened and analyzed retrospectively.

Data were calculated using the statistical program SPSS 21.0 (IBM Corp., Armonk, NY, USA). The conformity of the variables in the study to the normal distribution was examined with the Kolmogorov-Smirnov test. For the definition of numerical variables, those with normal distribution were mean ± SD (standard deviation), those without normal distribution were median (min-max), categorical variables were numbers and percentages, t test and Mann-Whitney U test for comparisons made between two groups in terms of numerical variables; Chi-square or Fisher's exact tests were performed for categorical variables. The relationship between variables such as being infected with COVID-19, hospitalization or death, and vital signs, hematological-biochemical parameters, and blood gas were analyzed by univariable logistic

regression method. Ethical approval was obtained from the non-interventional clinical ethics committee of Mersin University with the decision of the board dated 31.08.2022 and numbered 2022/606.

Results

Of the 46,309 patients who were admitted to the ED of the Mersin City Education and Research Hospital between 01.01.2020 and 31.05.2021, 638 (1.4%) patients aged 18 years and above and blood glucose ≥ 300 mg/dL were included in the study. The mean age of the patients was 59±16.3, and 376 (58.9%) of them were women. 546 (85.5%) of the patients had Type 2 DM and hypertension (279 patients, 43.7%) was the most common comorbid disease. In the present study, infection was detected in 67 (10.5%) of 638 patients, pneumonia was detected in 56 (8.7%) patients, COVID-19 pneumonia was detected in 51 (8.0%) and bacterial pneumonia was detected in 5 (0.8%) patients. 203 (31.8%) were hospitalized and 34 (5.3%) died during follow-up. Demographic and laboratory data of the patients were given Table 1.

Table 1. Demographic and laboratory data of the patients

Features	n=638
Gender	n (%)
Female	376 (58,9)
Male	262 (41)
Age, years mean ± SD	59±16.3
Diabetes Mellitus	n (%)
Type 1	73 (11.4)
Type 2	546 (85.5)
Gestational diabetes	4 (0,6)
Blood glucose >300 not Type 1 or Type 2	15 (2,3)
Comorbidity (each patient may have more than one)	n (%)
Hypertension	279 (43,7)
Coronary disease	75 (11,7)
Congestive heart failure	42 (6,5)
Cerebrovascular disease	27 (4,2)
Chronic renal failure	17 (2,6)
Chronic obstructive pulmonary disease	21 (3,2)
Cancer	14 (2,1)
Epilepsy	5 (0,7)
Others	14 (2,1)
No Comorbidity	198 (31)
Total	692
Status	n (%)
Hospitalization	203 (31,8)
Ward	52 (8,2)
Intensive care	151 (23,7)
Discharged	427 (66,9)
Referral to another hospital	8 (1,3)
Total	638 (100)
Died	34 (5,3)
COVID-19	51 (8,0)
Vital signs	mean ± SD

SpO2, (%)	95.3±6.4
Heart rate, beats per minute	88±19.3
BT, °C	37.0±11.9
Systolic blood pressure, mmHg	131.3±27.5
Diastolic blood pressure, mmHg	74.7±13.7
Arterial Blood Gases	Mean±SD
pH	7.38±0.1
HCO3, mmol/L	22.5±24.1
CO2, mmol/L	41.8±11.4
WBC, x103/uL	10.8±5.1
Neutrophil, x103/uL	7.9±4.8
Lymphocyte, x103/uL	2.0±1.4
Monocyte, x103/UI	0.5±0.3
LUC, % Large unstained cells	1.4±0.9
Hb, g/dl	12.7±2.4
Hematocrit, %	39.1±6.6
MCV, fl	86.8±7.5
MCHC, g/dL	32.5±1.7
RDW, %	14.5±1.8
Thrombocyte, x103/uL	273±109
MPV, fl	9.2±1.2
Glucose, mg/dl	453.5±127.3
Creatinine, mg/dl	1.0 ±0.9
GFR, ml/dk/1.73 m2	67.9±31.5
AST, U/L	24.0(0-1531)
ALT, U/L	21.0 (0.0-1186)
LDH, U/L	320.1±199.4
Sodium, mmol/L	133.1±6.2
Potassium, mmol/L	4.7±0.7
Calcium, mg/dl	9.2 ±0.9
CRP, mg/dl	3.9 (0.0-47)
D-dimer, mg/L	2.6 (0-62.8)
INR,	1.0 ±0.2
Urine density,	1030±10.7

WBC: White blood cell, LUC: Large unstained cells, Hb: Hemoglobin, MCV: Mean corpuscular volume, MCHC: Mean corpuscular hemoglobin concentration,

RDW: Red cell distribution width, MPV: Mean Platelet volume, MPV: Mean Platelet Volume, AST: Aspartate transaminase,

GFR: Glomerular Filtration Rate, ALT: Alanine aminotransferase, LDH: lactate dehydrogenase, CRP: C-reactive protein INR: International normalized ratio.

SpO2 was lower (p<0.01), heart rate was higher (p<0.01), and systolic blood pressure was lower (p<0.01) in patients who were decided to be hospitalized, when compared to the others. When blood gas was examined, pH, HCO3 and CO2 were lower (p<0.01); White blood cell (WBC) (p<0.01) and neutrophil count (p<0.01) were higher and lymphocyte count lower (p<0.01) in hematological parameters. Statistically significant differences in biochemical parameters are as follows; CRP (p<0.01)/ creatinine (p<0.01)/ AST and ALT (p<0.01) were higher and GFR was lower (p<0.01) in hospitalized patients than the others. Considering the patients who died during the follow-ups, it was found that SpO2 (p<0.01), systolic blood pressure (p<0.01) and diastolic blood pressure (p=0.02) were lower than the others. As far as the blood gases, pH (p<0.01) and HCO3 (p<0.01) values and hemoglobin (p=0.01), were lower; WBC (p<0.01), neutrophil (p<0.01), platelet count (p=0.02), and CRP were higher (p<0.01) than the remaining in hematological parameters. When biochemical variables were examined, it was noted that creatinine (p<0.01), AST and ALT values were higher (p<0.01, p<0.01) whereas GFR was lower than the others (p<0.01), it was determined that the blood glucose level was higher, although not significant, in hospitalized and deceased patients when compared to the others. The comparison between patients with or without ketoacidosis, died or survived, COVID-19 or not, hospitalized or discharged were given Table 2.

Data mean ± SD, median (min-max), number (%) as appropriate., SpO2: Oxygen saturation, BT: body temperature,

Table 2. The comparison between patients with or without ketoacidosis, died or survived, COVID-19 or not, hospitalization or discharged

	Ketoacidosis		P value	COVID-19		P value
	Yes (N:73, %11.1)	No (N:565, %88.8)		Yes (N:51, %7.99)	No (N:587, %92)	
Gender	n (%)	n (%)	p	n (%)	n (%)	p
Male	21 (29,5)	63 (11.1)	<0.01	6(11.8)	78(13.3)	0.8
Female	52 (70,5)	502 (88.8)		45(88.2)	509(86.7)	
Age, years mean ± SD	53.2±18.3	58.9±15.9	0.02	55.7±16.8	58.4±16.2	0.2
Vital signs	mean ± SD	mean ± SD	p	mean ± SD	mean ± SD	p
SpO2, (%)	93.5±12.1	95.5±5.2	0.2	92.5±13.1	95.6±5.4	<0.01
Heart rate, bpm	98.5±22.8	91.5±18.7	0.02	96.5±20.5	91.9±10.2	0.2
Fever, °C	36.6±0.4	37.1±12.6	0.8	42.6±41.9	36.6±0.4	<0.01
Systolic blood pressure, mmHg	123.5±32.3	132.2±26.4	<0.01	136.8±28.3	130.8±27.4	0.1
Diastolic blood pressure, mmHg	71.3±12.5	75.1±13.7	<0.01	76.2±13.6	74.5±13.7	0.2
Blood gas	mean ± SD	mean ± SD	p	mean ± SD	mean ± SD	p

pH	7.2±0.1	7.4±0.1	<0.01	7.3±0.1	7.4±0.1	0.5
HCO ₃ mmol/L	12.8±5.4	23.9±6.0	<0.01	21.7±7.2	22.6±6.9	0.4
PCO ₂ mmHg	32.1±12.7	43.0±10.4	<0.01	41.5±16.8	41.9±10.9	0.5
WBC, x10 ³ /uL	13.7±7.5	10.4±4.5	<0.01	10.5±5.0	10.8±5.1	0.6
Neutrophil, x10 ³ /uL	10.9±6.7	7.5±4.4	<0.01	7.6±4.1	7.9±4.8	0.8
Lymphocytes, 10 ³ /uL	1.9±1.8	1.9±1.3	0.01	2.1±2.1	1.9±1.2	0.3
Monocyte, x10 ³ /UI	0.5±0.5	0.5±0.2	0.5	0.5±0.3	0.5±0.3	0.9
LUC, %	1.5±1.5	1.5±0.7	0.08	1.6±0.9	1.5±0.8	0.7
Hb, g/dl	12.7±2.9	12.7±2.4	0.9	11.8±2.4	12.8±2.4	0.05
Hematocrit, %	39.9±8.1	38.9±6.4	0.1	36.6±7.1	39.3±6.5	0.04
MCV fl	92.4±9.9	86.0±6.8	<0.01	86.3±7.7	86.8±7.4	0.4
MCHC, g/dL	31.5±2.0	32.7±1.6	<0.01	32.3±1.6	32.5±1.7	0.3
RDW, %	14.9±2.1	14.5±1.8	0.1	14.8±2.1	14.5±1.8	0.3
Thrombocyte, x10 ³ /uL	317.6±130.3	268.2±105.3	<0.01	294.2±116.8	271.9±108.7	0.1
MPV, fl	9.7±1.4	9.2±1.2	<0.01	9.4±1.2	9.2±1.2	0.3
Glucose, mg/dl	537.1±194.3	442.8±111.6	<0.01	450.7±116.0	453.7±128.3	0.9
Creatinine, mg/dl	1.8±1.5	1.3±0.9	<0.01	1.5±1.3	1.3±0.9	0.9
GFR, ml/dk/1.73 m ²	56.9±32.9	69.4±31.3	<0.01	63.2±33.6	68.3±31.4	0.4
AST, U/L	29.0(0.0-339)	24.0(0-1531)	0.09	27(0-1531)	24(0-644)	0.3
ALT, U/L	23.0(0.0-334)	21.0(0-1186)	0.2	22(0-1186)	21(0-690)	0.9
LDH, U/L	443(211-1584)	275(103-551)	0.3	505(186-661)	271(103-1584)	0.1
Sodium, mmol/L	132.5±10.5	133.1±5.4	0.4	132.1±5.9	133.2±6.2	0.4
Potassium, mmol/L	4.9±0.9	4.7±0.6	0.5	4.6±0.7	4.7±0.7	0.6
Calcium, mg/dl	8.9±0.8	9.0±0.9	0.6	8.5±1.9	9.1±0.8	0.03
CRP, mg/dl	1.4 (0.0-36)	0.5(0-47)	0.02	1.1(0-24)	0.6(0-479)	0.06
D-dimer, mg/L	2.2(2.2-2.2)	2.8(0-62.3)	0.9	5.1(0.2-31)	2.4(0-62)	0.7
INR	1.1±0.2	1.0±0.2	0.02	1.1±0.3	1.0±0.1	0.8
Urine density	1025±10.5	1026±10.7	0.2	1023±10.7	1026±10.6	0.02

	Hospitalized			Death		
	Yes (N:211, %33)	No (N:427, %66.9)	P value	Yes (N:34, %5.32)	No (N:604, %94.3)	P value
Gender	n (%)	n (%)	p	n (%)	n (%)	p
Male	31(14.7)	53(12.4)	0.4	2(5.9)	82(13.6)	0.3
Female	180(85.3)	374(87.6)		32(94.1)	522(86.4)	
Age, years mean ± SD	59.3±16.4	57.7±16.2	0.2	59.9±17.1	58.1±16.2	0.5
Vital signs	mean ± SD	mean ± SD				
SpO ₂ (%)	92.8±9.8	96.6±3.1	<0.01	90.5±10.5	95.6±5.9	<0.01
Heart rate, bpm	98.7±23.4	89.2±16.1	<0.01	102.1±30.3	91.8±18.4	0.05
Fever, °C	38.1±20.7	36.5±0.3	0.5	36.6±0.4	37.0±12.2	0.9
Systolic blood pressure, mmHg	126.7±32.8	133.6±24.2	<0.01	118.0±44.6	132.1±26.1	0.01
Diastolic blood pressure, mmHg	72.5±14.9	75.8±12.9	0.07	68.3±15.8	75.1±13.4	0.02
Blood gas	mean ± SD	mean ± SD	P			
pH	7.3±0.1	7.4±0.1	<0.01	7.3±0.1	7.4±0.1	<0.01
HCO ₃ mmol/L	18.9±7.7	24.4±5.7	<0.01	17.9±7.7	22.9±6.8	<0.01
PCO ₂ mmHg	38.6±14.4	43.4±9.2	<0.01			0.4
WBC, x10 ³ /uL	12.7±6.2	9.8±4.1	<0.01	13.9±7.1	10.5±4.9	<0.01
Neutrophil, x10 ³ /uL	9.8±5.7	6.9±3.9	<0.01	11.1±6.9	7.8±4.6	<0.01
Lymphocytes, 10 ³ /uL	1.9±1.8	2.0±1.1	<0.01	2.1±2.2	1.9±1.3	0.1
Monocyte, x10 ³ /UI	0.5±0.4	0.5±0.2	0.3	0.5±0.3	0.5±0.3	0.2
LUC, %	1.5±1.1	1.5±0.7	0.1	1.6±1.3	1.5±0.8	0.4
Hb, g/dl	12.4±2.8	12.9±2.2	0.1	11.6±2.6	12.8±2.4	0.01

Hematocrit, %	38.5±8.0	39.4±5.8	0.2	37.5±7.9	39.2±6.6	0.2
MCV fl	88.6±8.8	85.8±6.5	<0.01	90.7±10.0	86.5±7.2	0.3
MCHC, g/dL	31.9±2.1	32.8±1.4	<0.01	30.9±1.8	32.6±1.6	<0.01
RDW, %	15.1±2.2	14.2±1.5	<0.01	15.9±2.2	14.4±1.8	<0.01
Thrombocyte, x10 ³ /uL	286.9±128.9	267.2±97.9	0.1	238.6±137.3	275.7±107.4	0.02
MPV, fl	9.7±1.4	9.0±1.0	<0.01	10.2±1.8	9.2±1.1	<0.01
Glucose, mg/dl	472.7±155.5	444.0±109.7	0.3	471.3±183.8	452.5±123.5	0.9
Creatinine, mg/dl	1.7±1.3	1.1±0.8	<0.01	2.0±1.2	1.3±0.9	<0.01
GFR, ml/dk/1.73 m ²	55.6±31.1	74.1±29.9	<0.01	37.7±21.3	69.7±31.2	<0.01
AST, U/L	29(0-1531)	23(0-397)	<0.01	43.5(0-1531)	24(0-644)	<0.01
ALT, U/L	23(0-1186)	20(0-323)	<0.01	28(0-1186)	21(0-504)	<0.01
LDH, U/L	418.2±315.6	275.7±89.2	0.1	477(308-1584)	262(103-551)	0.02
Sodium, mmol/L	133.1±8.9	133.1±4.2	0.2	133.9±12.8	133.0±5.6	0.7
Potassium, mmol/L	4.7±0.8	4.6±0.6	0.2	4.8±0.9	4.7±0.7	0.7
Calcium, mg/dl	8.9±1.1	9.1±0.8	<0.01	8.5±0.9	9.1±0.9	<0.01
CRP, mg/dl	1.6(0-47.1)	0.4(0-40.9)	<0.01	7.1(0-47.1)	0.6(0-40.9)	<0.01
D-dimer, mg/L	3.7(0.4-62.3)	2.2(0-33.5)	0.3	5.9(3.7-31.4)	1.9(0-62.2)	0.04
INR	1.8±0.2	1.0±0.2	0.002	1.1±0.3	1.1±0.2	0.5
Urine density	1024±10.8	1027±10.5	<0.01	1022±10.9	1026±10.6	0.09

Data mean ± SD, median (min-max), number (%) as appropriate. Significant P values are indicated in bold. HB: Hemoglobin, WBC: White blood cell, LUC: Large unstained cells, MCV: Mean corpuscular volume, MCHC: Mean corpuscular hemoglobin concentration, RDW: Red cell distribution width, MPV: Mean Platelet volume, GFR: Glomerular Filtration Rate, AST: Aspartate transaminase, ALT: Alanine aminotransferase, LDH: lactate dehydrogenase, CRP: C-reactive protein, INR: International Normalized Ratio.

In the univariable logistic regression analysis; levels of SpO2 (OR: 1.1, 95% CI: 0.9-1.1, p=0.03), lymphocyte (OR: 1.2, 95% CI: 1.0-1.4, p=0.01), hematocrit (OR:0.9, 95% CI: 0.9-1.0, p:0.03) were lower in those with COVID-19 than in those without.

Considering inpatients, SpO2 (OR: 0.8, 95% CI: 0.8-0.9, p<0.01), systolic blood pressure (OR:1.0, 95% CI: 0.9-1.0, p= 0.03), pH (OR:0.1) , 95% CI:0-0.05, p<0.01), HCO3 (OR:0.9, 95% CI: 0.8-0.9, p <0.01) significantly lower, PCO2 (OR:1.0, 95% CI:0.9-1.0, p <0.01), pulse (OR:1.0, 95% CI: 1.0-1.1, p <0.01), fever (OR:1.7, 95% CI: 1.1-2.6, p: 0.01), hemoglobin (OR:0.9, 95% CI:0.8-1.0, p=0.04), MCV 1.1 (OR:1.0, 95% CI: 1.0-1.1, p<0.01), platelet (OR:1.0, 95% CI: 1.0-1.0, p=0.03) , MPV (OR:1.6, 95% CI:

1.4-1.8, p <0.01), GFR (OR:1.0, 95% CI: 0.9-1.0, p <0.01) significantly lower, creatinine (OR:1.8, 95% CI: 1.5-2.2, p<0.01) AST (OR:1.0, 95% CI: 1.0-1.0, p <0.01), ALT (OR:1.0, 95% CI: 1.0-1.0, p=0.01), LDH (OR:1.0, 95% CI: 1.0-1.0, p=0.02), CRP (OR:1.0, 95% CI: 1.0-1.1, p <0.01) were found to be significantly higher than the others.

In the univariate logistic regression analysis performed in deceased patients; SpO2 (OR: 1.0 95% CI: 0.9-1.0, p<0.01), systolic blood pressure (OR: 1.0, 95% CI: 0.9-1.0, p= 0.02), diastolic blood pressure (OR: 1.0, 95% CI : 0.9-1.0, p= 0.04), pH (OR:0.01, 95% CI:0-0.07, p<0.01), HCO3 (OR:0.9, 95% CI: 0.9-1.0, p <0.01) significantly lower, pulse (OR:1.0, 95% CI: 1.0-1.0, p=0.02), WBC (OR:1.1, 95% CI:1.0-1.1, p <0.01), neutrophil (OR:1.1, 95% CI:1.1- 1.2, p <0.01) significantly higher, hemoglobin (OR:0.8, 95% CI:0.7-0.9, p=0.02), MCV (OR:1.1, 95% CI: 1.0-1.1, p=0.01), MPV (OR :1.6, 95% CI: 1.3-1.9, p <0.01), GFR (OR:1.0, 95% CI: 1.0-1.0, p <0.01) significantly lower, creatinine (OR:1.5, 95% CI: 1.2-1.8) , p<0.01), AST (OR:1.0, 95% CI: 1.0-1.0, p <0.01), ALT (OR:1.0, 95% CI: 1.0-1.0, p=0.01), LDH (OR:1.0, 95% CI: 1.0-1.0, p=0.02), CRP (OR:1.0, 95% CI: 1.0-1.1, p <0.01) were found to be significantly higher than the survivors. The adjusted univariable logistic regression analysis between patients with died or not died, COVID-19 or

Table 3.The adjusted univariable logistic regression analysis between patients with died or not died, COVID-19 or not, hospitalized or discharge COVID-19 or not, hospitalized or discharge

Features	COVID-19		Hospitalization		Death	
	OR (95% CI)	P-value	OR (95% CI)	P-value	OR (95% CI)	P-value
Age, years	1.0(0.9-1.0)	0.2	1.0(0.9-1.0)	0.1	1.0(0.9-1.0)	0.8
Female Gender	1.4 (0.5-3.4)	0.5	0.7(0.4-1.2)	0.2	2.4(0.5-10.1)	0.2
Vital signs						
SpO2, (%)	1.1(0.9-1.0)	0.04	0.8(0.8-0.9)	<0.01	1.0(0.9-1.0)	<0.01
Heart rate, beats per minute	1.0(1.0-1.0)	0.1	1.0(1.0-1.0)	<0.01	1.0(1.0-1.0)	0.02
Fever, °C	2.4(1.5-4.2)	0.01	1.7(1.1-2.6)	0.01	0.9(0.9-1.1)	0.9
Systolic blood pressure, mmHg	0.9(0.9-1.0)	0.1	1.0(0.9-1.0)	0.03	1.0(0.9-1.0)	0.02

Diastolic blood pressure, mmHg	1.0(0.9-1.0)	0.5	0.9(0.9-1.0)	0.07	1.0(0.9-1.0)	0.04
Blood gas						
pH	0.02(0.02-1.9)	0.2	0.1(0-0.05)	<0.01	0.01(0-0.07)	<0.01
HCO ₃ , mEq/L	0.9(0.9-1.0)	0.4	0.9(0.8-0.9)	<0.01	0.9(0.9-1.0)	<0.01
PCO ₂ , mmHg	1.0(0.9-1.0)	0.9	1.0(0.9-1.0)	<0.01	1.0(0.9-1.0)	0.05
WBC, x10 ³ /uL	0.9(0.9-1.0)	0.7	1.1(1.1-1.2)	<0.01	1.1(1.0-1.1)	<0.01
Neutrophil, x10 ³ /uL	0.9(0.9-1.0)	0.7	1.1(1.1-1.2)	<0.01	1.1(1.1-1.2)	<0.01
Lymphocytes, x10 ³ /uL	1.2(1.0-1.4)	0.01	0.9(0.9-1.1)	0.8	1.1(0.9-1.3)	0.5
Hb, g/dl	0.8(0.8-0.9)	0.06	0.9(0.8-1.0)	0.04	0.8(0.7-0.9)	0.02
Hematocrit, %	0.9(0.9-1.0)	0.03	1.0(0.9-1.0)	0.09	1.0(0.9-1.0)	0.3
MCV, fl	1.3(0.9-1.4)	0.3	1.1(1.0-1.1)	<0.01	1.1(1.0-1.1)	0.01
Thrombocyte, x10 ³ /uL	1.0(0.8-1.3)	0.7	1.6(1.4-1.8)	<0.01	1.6(1.3-1.9)	<0.01
MPV, fl	1.0(0.9-1.0)	0.8	1.0(1.0-1.0)	0.06	1.0(0.9-1.0)	0.4
Glucose, mg/dl	1.1(0.9-1.5)	0.2	1.8(1.5-2.2)	<0.01	1.5(1.2-1.8)	<0.01
Creatinine, mg/dl	0.9(0.9-1.0)	0.3	1.0(0.9-1.0)	<0.01	1.0(0.9-1.0)	<0.01
GFR, ml/dk/1.73 m ²	1.0(1.0-1.0)	0.08	1.0(1.0-1.0)	<0.01	1.0(1.0-1.0)	<0.01
AST, U/L	1.0(0.9-1.0)	0.2	1.0(1.0-1.0)	0.01	1.0(1.0-1.0)	0.01
ALT, U/L	1.0(0.9-1.0)	0.3	1.0(1.0-1.0)	0.02	1.0(1.0-1.0)	0.02
CRP, mg/dl	1.0(0.9-1.0)	0.1	1.1(1.0-1.1)	<0.01	1.1(1.0-1.1)	<0.01

not, hospitalized or discharged was given Table 3.

Significant P values are indicated in bold.

HB: Hemoglobin, WBC: White blood cell, MCV: Mean corpuscular volume, MCHC: Mean corpuscular hemoglobin concentration, RDW: Red cell distribution width, MPV: Mean Platelet volume, AST: Aspartate transaminase, ALT: Alanine aminotransferase, LDH: lactate dehydrogenase, CRP: C-reactive protein, GFR: Glomerular Filtration Rate

Discussion

It has been shown in studies that severe hyperglycemia increases mortality and morbidity in many patient groups (6,7). In addition, many factors such as infection cause exacerbation of hyperglycemia (8). COVID-19 disease, which first appeared in China, still emerges as an important infection factor all over the world (9). Infectious and parasitic diseases accounted for 12.2% of all admissions to the United States emergency department in 2018 (10). In a single-center study conducted in Turkey in 2020, 9.4% of the admissions to the ED were COVID-19 infections and 5.7% of them were found to have COVID-19 pneumonia (11). COVID-19 pneumonia was detected in 275 (5.9%) of 4620 patients (12). Pneumonia was diagnosed in 8.7% of the patients in our study and COVID-19 pneumonia was detected in 8.0% of the patients. The present study was consistent with the frequency of infection before the pandemic. Since this study included a hyperglycemic population and the risk of conversion to pneumonia was higher in this patient group, the frequency of COVID-19 pneumonia is found higher in this study.

Kim et al. examined admissions to the ED in Korea between 2016 and 2018, and reported the rate of hospitalization as 20.3% and emphasized that the vital signs of patients who were admitted to hospital were worse than the outpatients (13). In a single-

center study in Turkey, they reported the rate of hospitalization as 4.5% (14). The rate of hospitalization in our ED is as high as 31.8%. Considering the vital signs of the patients, we found that sPO2 was lower, pulse and fever were higher, and systolic blood pressure was lower in hospitalized patients than outpatients. We think that the reason for the higher hospitalization rates compared to the literature is due to the higher morbidity rate due to the hyperglycemic nature of patient population enrolled in the present study. When we investigated the blood gases, hematological and biochemical variables as well as vital signs; blood gases (pH low, HCO3 low, CO2 high) worse, hemoglobin, platelets, GFR are lower in hospitalized patients. We found that creatinine, AST, ALT, LDH and CRP were higher in hospitalized patients and worsened in hematological and biochemical parameters as well as vital signs.

In a study on hyperglycemic emergencies, Peper et al. reported the mortality rate as 7.5% (15), Mbugua et al. 8.4% (16), Anthanont et al. 8.4% (5), Desse et al. 9.8% (17), Guo et al. 14.6% (3), Ogbera et al 20% (18). They found it to be 20% and these results are above our mortality rate. Andrew found the mortality rate in hyperglycemic emergencies to be 3.6% (19), Basu et al. 3.9% (20), Macisaac et al. 4.8% (21), Cheung et al. 4.8% (22), Hong et al. 4.9% (13). These results are below our mortality rate. In this study, the overall mortality rate was 5.3% and the blood glucose level was 453.5±127 mg/dl. The mortality rate was found to be higher than the general mortality rates in patients admitted to the ED, but lower than patients with severe hyperglycemia. The mortality rate found in the present study falls between the range cited in the literature.

In addition, Guo et al. found that low blood pressure, low hemoglobin, respiratory rate, WBC, neutrophil count, CRP, urea, and creatinine levels were associated with an increase in mortality rates and more prone to

sepsis.³ In the present study, similar results to those of the study by Guo et al. were obtained. However, in this study, in addition to the variables mentioned above, we found that low pH and HCO₃, high AST, ALT, LDH were associated with an increase in mortality rates.

This study is important in terms of evaluating prognostic factors in hyperglycemic patients admitted to the ED during the COVID-19 pandemic. One of the strengths of this study is the fact that vital signs and hematological variables as well as blood gases and biochemical markers were examined in moderately hyperglycemic patients during the COVID-19 period. The limitations of the present study are that it is a single-center, retrospective study and short-term results are monitored. Therefore, it is difficult to extrapolate its conclusions to the general population.

In addition to the fact that hyperglycemia is a risk factor in moderately severe hyperglycemic patients during the COVID-19 pandemic period, especially in patients who were hospitalized or died during their follow-up, worsening of vital signs and blood gas values, low GFR, high creatinine and AST. We should emphasize that an increase in LDH values, an increase in WBC, an increase in neutrophils, and a decrease in lymphocyte, hemoglobin and hematocrit values negatively affect the prognosis, and clinicians should follow these parameters closely while following up the patients. However, long-term follow-up studies are needed due to the evaluation of short-term results.

Conflict of Interest

No conflict of interest was declared by the authors.

Authorship Contribution

Idea/Hypothesis: ZK, DG, SME Design: : ZK, DG, SME Data collection/Data processing: ZK, DG, SME Data Analysis: : ZK, DG, SME Preparation of the article: ZK, DG, SME

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