Characteristics and outcomes of 974 COVID-19 patients in intensive care units in Turkey

Hülya Sungurtekin, a Cansu Özgen, a Ulku Arslan, a Kemal Tolga Saracoglu, b Volkan Yarar, c Ahmet Sarı, d Ayse Turan Çivraz, a Ali Aydin Altunkan, f Hilal Ayoglu, b Nilgün Kavrut Ozturk, b Nihal Bulut Yüksel, j Birgul Yelken, i Elif Bombaci, b Gokhan Kilinc, c Damla Akman, d Pınar Demir, f Ferruh Ayoglu, b Fulya Ciyiltepe, a Ahmet Calsikan, f Simay Karaduman

BACKGROUND: In our previous report on Turkish COVID-19 patients requiring intensive care, the 24 patients in a single ICU were elderly and mortality was high. We extended our analysis to include patients admitted to ten ICUs.

OBJECTIVES: Report the demographics, clinical features, imaging findings, comorbidities, and outcomes in COVID-19 patients.

DESIGN: Retrospective.

SETTING: Intensive care unit.

PATIENTS AND METHODS: The study includes patients with clinical and radiological confirmed or laboratory-confirmed COVID-19 infection who were admitted to ten ICUs between 15 March and 30 June 2020.

MAIN OUTCOME MEASURES: Clinical outcomes, therapies, and death during hospitalization

SAMPLE SIZE: 974, including 571 males (58%).

RESULTS: The median age (range) was 72 (21-101) years for patients who died (n=632, 64.9%) and 70 (16-99) years for patients who lived (n=342, 35.2%) (\(P<.001\)). APACHE scores, and SOFA scores were higher in patients who died than in those who survived (\(P<.001\), both comparisons). Respiratory failure was the most common cause of hospitalization (82.5%), and respiratory failure on admission was associated with death (\(P=.013\)). Most (n=719, 73.8%) underwent invasive mechanical ventilation therapy.

CONCLUSIONS: The majority of patients admitted to the ICU with a diagnosis of COVID-19 require respiratory support.

LIMITATIONS: Although the Turkish Ministry of Health made recommendations for the treatment of COVID-19 patients, patient management may not have been identical in all ten units.

CONFLICT OF INTEREST: None.
Severe acute respiratory syndrome coronavirus 2 (SARS-CoV-2) emerged in Wuhan, China, and has spread worldwide, infecting millions of people since December 2019. Coronavirus disease 2019 (COVID-19), has various clinical manifestations, ranging from no symptoms to severe acute respiratory failure.1,2 To combat the disease in Turkey, the COVID-19 Science Board was created on 10 January 2020 by the Ministry of Health. On 3 February, it was announced that it would stop all flights from China to Turkey. The first COVID-19 case in Turkey was detected on 11 March 2020, and the diagnosis was made by investigating the cause of symptoms of high fever and cough. The first death due to coronavirus disease in the country occurred on 17 March 2020.3

Collaboration at the local, national, and international levels with a focus on high-quality research, sharing of data and resources, and clinical practice will be crucial to the success of the management of COVID-19.4 Little information is available on the characteristics and outcomes of Turkish patients with COVID-19 requiring intensive care. We previously published COVID-19 patients hospitalized in the intensive care units of our hospital in a small group of patients. In that article, we showed that in a few patients, COVID-19 is seen mostly in the elderly and those with comorbidities, and the mortality rate is high.5 The aim of this study was to report the demographics, clinical features, imaging findings, comorbidities, and outcomes in COVID-19 patients in the ICUs of ten different hospitals in Turkey.

PATIENTS AND METHODS

In this retrospective cohort study of patients in ten ICUs in Turkey, we selected all sequential patients older than 18 years of age with laboratory-confirmed COVID-19 infection or clinical-radiological confirmed COVID-19 infection admitted to the participating ICUs between 15 March 2020 and 30 June 2020. Criteria for admission to the ICU included at least one pneumonia symptom with a breath rate >30/mins, severe respiratory distress with oxygen saturation (SpO₂) in room air below 90%, presence of sepsis, septic shock, acute respiratory distress syndrome (ARDS), and severe viral pneumonia with life-threatening conditions such as acute thrombosis. Laboratory confirmation of SARS-Cov-2 was defined as a positive result by real-time reverse transcriptase-polymerase chain reaction (RT-qPCR) assay from a specimen collected on a nasopharyngeal swab or endotracheal aspirate.3 Patient data were obtained from electronic data on hospital computers. An intensivist recorded the data on a daily basis. The study was approved by the local ethics committee of Pamukkale University, Medical School, and the ethics committee of the Turkish Ministry of Health (#60116787-020/28387). Informed consent was waived because of the retrospective design of the study, and the researchers analyzed the anonymized data.

Data collection

Patient information collected at ICU admission included age, sex, smoking history, Acute Physiology and Chronic Health Evaluation II (APACHE II) score, Sequential Organ Failure Assessment (SOFA) score, recent exposure and travel history, date of the first symptom, clinical symptoms or signs, laboratory findings and comorbidities, ventilator therapy and parameters, and dates of the hospital and ICU admission. Laboratory findings included a complete blood count, coagulation testing, D-dimer, blood chemical analysis, C-reactive protein, procalcitonin, and assessment of liver and renal function. Invasive mechanical ventilation parameters, such as the level of positive end-expiratory pressure (PEEP), fraction of inspired oxygen (FiO₂), plateau pressure, compliance, and noninvasive mechanical ventilation parameters, were also recorded during ICU hospitalization. Radiologic imaging such as chest radiography and/or CT was performed on day 1 as needed. Arterial blood gas analysis was performed depending on the patient’s clinical condition. ARDS, sepsis, and septic shock were defined according to the guidelines.4,5 The Turkish Ministry of Health made recommendations for the treatment of COVID-19 patients, and the evaluation of all available evidence and ongoing clinical trial protocols have been developed. This recommendation was prepared by the scientific committee of the Turkey Ministry of Health. Patients were treated according to these recommendations and available literature.9 Therapies of the patients (drug, renal replacement therapy, mesenchymal stem cell, prone positioning, etc.) were documented daily. Informed consent forms were obtained from the patients’ relatives for the use of drugs without a labeled indication drugs and methods, and permission was obtained from the Ministry of Health. Microbial cultures from tracheal aspirate, blood, and urine were collected at admission and as needed. For SARS-CoV-2, samples were evaluated in the General Office of Public Health Microbiology Reference Laboratory and laboratories in the specified provinces. RT-qPCR assays (COVID-19 RT-qPCR, Bio-Speedy) were performed according to the protocol approved by the WHO in this laboratory.9

Patient discharge status (dead or alive) and length of stay in the ICU were entered into the data form.
Statistical analysis
Data were compared between survivors and non-survivors. Statistical evaluations were performed using the IBM SPSS for Windows 19 software IBM SPSS (Armonk, New York, United States: IBM Corp) version. Descriptive statistics are summarized as counts, percentages and mean and standard deviation (SD). The chi-square test and independent samples t-test were used for compar-

Table 1. Ten intensive care unit patients admitted from 15 March and 30 June 2020.

| Hospital                                      | Number of patients | ICU beds | Attending physicians | Residents | Nurses |
|-----------------------------------------------|--------------------|----------|-----------------------|-----------|--------|
| Lutfu Kırdar Training and Research Hospital, İstanbul | 301 (30.9)        | 70       | 12                    | 12        | 32     |
| Balıkesir Atatürk City Hospital, Balıkesir     | 200 (20.5)        | 51       | 2                     | 0         | 74     |
| Haydarpaşa Numune Training and Research Hospital, İstanbul | 110 (11.3)     | 21       | 7                     | 5         | 42     |
| Health and Science University Derince Training and Research Hospital, Kocaeli | 96 (9.9)        | 24       | 4                     | 4         | 22     |
| Pamukkale University Medical Faculty, Denizli,   | 83 (8.5)         | 50       | 4                     | 6         | 28     |
| Mersin University Medical Faculty, Mersin       | 76 (7.8)         | 44       | 2                     | 10        | 72     |
| Zonguldak Bülent Ecevit University, Faculty of Medicine, Zonguldak | 36 (3.7)     | 10       | 2                     | 3         | 15     |
| University of Health Sciences Antalya Training and Research Hospital, Antalya | 34 (3.5)        | 117      | 3                     | 1         | 16     |
| Medical Faculty, Hacettepe University, Ankara   | 23 (2.4)         | 16       | 10                    | 3         | 34     |
| Osmangazi University, Faculty of Medicine, Zonguldak | 15 (1.5)     | 44       | 2                     | 10        | 72     |

Data in second column are number (%) of patients.

Figure 1. Age distribution of the study population by survival (n=974) (died vs survived, P=.01515, Wilcox on rank sum test with continuity correction).
isons between survivors and non-survivors. Results of the analysis were evaluated with 95% confidence interval, and \( P < 0.05 \) was accepted as a statistically significant difference.

**RESULTS**

During the study period, 974 patients were admitted to the ten ICUs (Table 1). Fifty-eight percent (n=571) were men. The median age and range was 75 (16-101) years for men and 69.5 (21-99) years for women (\( P < 0.001 \)). The median and range age was 72 (21-101) years for patients who died (n=632, 64.9%) and 70 (16-99) years for patients who lived (Figure 1, \( P < 0.001 \)). The mean APACHE and SOFA scores were higher in patients who died than in surviving patients (\( P < 0.001 \), both comparisons). There was a travel history in 19 patients. The most common symptom was dyspnea followed by fever, cough, and headache (Table 2). Most patients were admitted to the emergency department (54.9%). The majority of patients admitted from the chest disease ward died (80.9%). Respiratory failure was the most common cause of hospitalization (82.5 %). Respiratory failure on admission was associated with death (\( P = 0.013 \)).

The mean arterial pressure was higher in surviving patients (\( P = 0.004 \)) (Table 3). Of laboratory values taken during admission, ferritin AST, ALT, and C reactive protein levels were significantly higher in patients who died. Most patients (n=719, 73.8%) underwent invasive mechanical ventilation therapy; 158 (22%) survived. Of the 211 patients who received noninvasive ventilation, 104 died (49.3%). Forty-six patients received oxygen with only a mask. Tidal volume and driving pressure were higher in patients who died (\( P = 0.010 \) and \( P = 0.008 \) respectively). Regarding the PaO\(_2\)/FiO\(_2\) values during the ICU, most patients were classified with moderate to severe ARDS. Arterial blood gas values were signifi-

| Table 2 | Demographic and clinical characteristics (categorical variables). |
|---------|---------------------------------------------------------------|
| **Gender** | Survived (n=342) | Died (n=632) | \( P \) |
| Female | 150 (37.2) | 253 (62.8) | .247 |
| Male | 192 (33.6) | 379 (66.4) | |
| **Symptoms** | Survived (n=342) | Died (n=632) | \( P \) |
| Fever | 126 (33.8) | 247 (66.2) | .492 |
| Dyspnea | 277 (33.9) | 541 (66.1) | .061 |
| Coughing | 151 (38.0) | 246 (62.0) | .113 |
| Headache | 33 (28.7) | 33 (28.7) | .125 |
| **Admission service** | Survived (n=342) | Died (n=632) | \( P \) |
| Chest disease | 9 (19.1) | 38 (80.9) | |
| Infection | 67 (26.6) | 185 (73.4) | |
| Medical | 13 (40.6) | 19 (59.4) | .001 |
| Emergency | 215 (40.2) | 320 (59.8) | |
| Other | 38 (35.2) | 70 (64.8) | |
| **Reason for admission** | Survived (n=342) | Died (n=632) | \( P \) |
| Respiratory failure | 276 (34.3) | 528 (65.7) | .040 |
| Sepsis | 8 (38.1) | 13 (61.9) | |

| Table 2 (cont.) | Demographic and clinical characteristics (categorical variables). |
|-----------------|---------------------------------------------------------------|
| **Other** | Survived (n=342) | Died (n=632) | \( P \) |
| Multiple reason | 40 (48.2) | 43 (51.8) | .040 |
| Admission respiratory failure | 294 (33.8) | 576 (66.2) | .013 |
| Admission sepsis | 23 (31.1) | 51 (68.9) | .450 |
| Admission other | 43 (42.6) | 58 (57.4) | .097 |
| Diagnosis with PCR | | | |
| Negative | 285 (38.6) | 453 (61.4) | <.001 |
| Positive | 57 (24.2) | 179 (75.8) | .627 |
| Comorbidity | 295 (33.4) | 588 (66.6) | .001 |
| Hypertension | 173 (34.4) | 330 (65.6) | .381 |
| Diabetes | 90 (33.0) | 183 (67.0) | .722 |
| Cardiac disease | 127 (34.4) | 242 (65.6) | |
| Pulmonary disease | 107 (37.9) | 175 (62.1) | |
| Malignity | 53 (24.5) | 163 (75.5) | <.001 |
| Chronic renal failure | 40 (33.6) | 79 (66.4) | .715 |
| Immune deficiency | 22 (22.9) | 74 (77.1) | .008 |

Data are number of patients (%).
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Table 3. Clinical characteristics (continuous variables) by survival.

|                          | Survived (n=342) | Died (n=632) | P     |
|--------------------------|------------------|--------------|-------|
| Age (years), median (range) | 70 (16-99)       | 72 (21-101)  | <.001 |
| Body mass index (kg/m²)   | 26.6 (17.3)      | 25.9 (13.5)  | .507  |
| Duration of symptoms before ICU (days) | 3 (0-30)        | 2 (0-30)     | .596  |
| Apache II scores          | 23.5 (14.6)      | 29.7 (16.7)  | <.001 |
| SOFA scores               | 5.1 (2.6)        | 7.1 (3.3)    | <.001 |
| Length of ICU (days)      | 8 (1-96)         | 6 (1-78)     | <.001 |
| Length of invasive mechanical ventilation (days) | 7 (1-66)        | 4 (1-170)    | .001  |
| Length of noninvasive mechanical ventilation (days) | 3 (1-29)        | 3 (1-25)     | .314  |
| Fever (°C)                | 36.9 (0.8)       | 36.9 (0.8)   | .844  |
| Respiratory rate (/min)   | 24.6 (7.6)       | 25.3 (8.1)   | .171  |
| Heart rate (/min)         | 99.9 (20.9)      | 100.9 (21.9) | .490  |
| Mean arterial pressure (mm Hg) | 78.7 (21.0)     | 74.5 (22.1)  | .004  |
| SpO₂ (%)                  | 91.3 (7.2)       | 89.7 (7.9)   | .002  |
| White blood cell (per mm³) | 9860 (960-108000) | 9820 (60-860000) | .348  |
| Lymphocyte (per mm³)      | 1180 (100-25300) | 1000 (100-830000) | .467  |
| Platelet (per mm³)        | 229000 (203-433000) | 219000 (300-3310000) | .173  |
| Neutrophil to lymphocyte ratio | 7.3 (0.3-94)   | 10.3 (0.1-92.9) | .004  |
| International normalized ratio | 1.2 (0.8-13) | 1.3 (0.9-138) | .314  |
| Aspartate aminotransferase (U/L) | 35 (6-1050) | 45 (6-10474) | <.001 |
| Alanine aminotransferase (U/L) | 24 (3-931) | 29 (1-6428) | .001  |
| D-dimer (ng/mL)           | 986 (0-36146)    | 1848 (0.1-41666) | .198  |
| Creatinine (mg/dL)        | 1.1 (0.3-761)    | 1.5 (0.1-4223) | .337  |
| Lactate (µg/L)            | 2 (0.1-797)      | 2.5 (0.1-4078) | .290  |
| Ferritin (µg/L)           | 327 (9-4399)     | 553.7 (2-39894) | .002  |
| Fibrinogen (mg/dL)        | 524.8 (195.3)    | 549.8 (220.2) | .183  |
| C-reactive protein (mg/L) | 36.4 (0.1-450)   | 48 (0.1-498)  | .010  |
| Procalcitonin (ng/mL)     | 0.5 (0.1-12680)  | 1.2 (0.1-21100) | .435  |
| Echocardiography ejection fraction (%) | 51.0 (13.4) | 51.6 (12.2) | .806  |

cantly lower in the patients who lived than died (Table 3). The neutrophil-to-lymphocyte ratio was higher than normal in all patients at admission, but was higher in patients who died than in those who survived (P=.004).

All 974 patients were tested by RT-PCR; 236 (22.4%) were positive; 236 patients were diagnosed by RT-PCR, 138 were patients diagnosed as COVID-19 positive by clinical-radiology had negative RT-PCR results. Chest radiography was not available in 259 patients during hospitalization. Chest radiography revealed pathology in 539/715 patients at the time of admission. Bilateral infiltrates were detected on radiography in 556/715 patients. Chest radiography results were significantly higher in patients who died than in those who survived.

At admission, 884 patients underwent computed tomography (CT). Eighty-six percent (767/884) of these patients had bilateral ground-glass opacification on CT scan. There were no significant differences in CT imaging between the patients who lived and died (Table 4).

One or more comorbidities were detected in 883/974 of the patients. Hypertension, cardiac disease, diabetes mellitus, chronic kidney disease, chronic lung disease, malignancy, and immune deficiency were the most common comorbidities. The presence of malignancy and immunodeficiency was statistically higher in patients who died (P<.001 and P=.008, respectively) (Table 2). Ventricular fibrillation/tachycardia (VF/VT) occurred in 7.9% in all the patients, while the mortality rate was 81.8% in patients with VF/VT, it was 63.4% in those who did not (P=.001).

The prone position was applied to 19% of patients. While 55.7% of the patients who were in the prone position died, the mortality rate was 67% in the patients not applied (P=.004). Hydroxychloroquine sulfate (Plaquenil/generic) was given to 809 patients, 816 patients received antivirals Enfluvir (oseltamivir), Kaletra (50 mg ritonavir and 200 mg lopinavir), Favipiravir (favipiravir), and 918 received antibiotic therapy. Cytokine removal was performed in 17 patients undergoing renal replacement therapy. Tocilizumab, a humanized monoclonal antibody against the interleukin-6 receptor (IL-6R) was administered to 71 patients. More patients who underwent renal replacement therapy, or used hydroxychloroquine, antivirals, and vasopressors died than lived (P<.001) (Table 4). The rate of steroid use in all the patients was 15%. Organ failure was not present in 33.5% (326/974) of patients. In terms of organ failure, ARDS, renal failure, and sepsis were significantly higher in patients who died than in those who survived (P<.001) (Table 5). The duration of invasive mechanical ventilation and ICU stay was significantly longer in those who survived (P<.001) (Table 5).
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DISCUSSION

Data on Turkish COVID-19 patients in intensive care has been limited to small groups of patients, including our previous study. In this report, we summarize data on patients diagnosed with COVID-19 in ten ICUs in Turkey from 15 March to 30 June 2020. Of 974 patients, 632 died (64.9%). By comparison, in a study of 2215 patients admitted to ICUs at 65 hospitals from March 4 to April 4, 2020 in the United States, 35.4% died within 28 days. In a cohort of 1500 critically ill ICU patients with COVID-19 in Lombardy, Italy, the ICU mortality was 26%. In a study in Wuhan, China in January 2020, the mortality rate was 4.3% in 36 of 138 patients with COVID-19 admitted to the ICU. The median age of the ICU patients was older than non-ICU patients in the Wuhan study (66 years vs 51 years) and the ICU patients had more comorbidities. In our study, most of the patients were admitted to the ICU because of respiratory failure. The majority of patients were hospitalized directly from the emergency room to the ICU. The median age in our study was 72 years.

In the US study, the most common symptoms before ICU admission were cough (77.1%), dyspnea (74.9%), and fever (70.7%). A total of 1738 patients had at least one comorbidity, such as hypertension, diabetes, and chronic lung disease. 1738 patients (78.5%) had at least one comorbidity, including hypertension (59.7%), diabetes (38.9%), and chronic lung disease (24.0%). As in our study, the most common symptoms were cough and dyspnea in the US and Italy studies as in our study. In our study, the most common comorbidities were cardiovascular disease and hypertension and high APACHE II and SOFA scores, which is consistent with other studies.

In a European multicenter study of 4244 critically ill adults with COVID-19, high-flow oxygen, standard oxygen therapy, and non-invasive ventilation were applied to patients at the time of ICU admission, from February 25 to May 4, 2020. Sixty-three percent of the patients were intubated during the first 24 hours while 3376 (80%) established invasive mechanical ventilation during their ICU stay. The median plateau pressures and PEEP were 24 cmH2O and 12 cmH2O, respectively. The median PaO2:FiO2 ratio was 154 mm Hg during the first 24 hours. Gupta et al10 reported that 1494 patients (67.4%) received invasive mechanical ventilator support, and 958 (48.3%) received vasopressors on the day of ICU admission in their study. The median PaO2:FiO2 ratio was 124 mmHg (IQR, 86-188 mmHg). In another Italian study, 1300 patients received ventilator support, 11% of whom received noninvasive ventilation and 88% of whom received invasive mechanical ventilation.11

The median PEEP, maximum PEEP, and PaO2:FiO2 were 14 cmH2O, 22 cmH2O, and 160, respectively. In our study invasive mechanical ventilation was required in 74% and 21% of the patients, respectively. The median PEEP, maximum PEEP, and PaO2:FiO2 values, which is consistent with other studies.

Clinical findings should be evaluated using laboratory and radiological findings for the diagnosis of COVID-19. Fang et al14 reported that the sensitivity of chest CT was greater than that of RT-PCR (98% vs. 71%, respectively, P<.001) for the diagnosis of COVID 19.

| Table 3 (cont.) Clinical characteristics (continuous variables) |
|---------------------------------------------------------------|
| Survived (n=342) | Died (n=632) | P |
|------------------|--------------|---|
| FiO2             | 42.1 (27.3)  | 40.8 (31.8) | .529 |
| PEEP (cmH2O)     | 7.5 (2.2)   | 7.7 (2.1)   | .145 |
| Tidal volume (mL)| 460.9 (66.8)| 475.8 (64.1)| .010 |
| Ppeak            | 24.2 (4.9)  | 25.9 (23.1) | .352 |
| Compliance (mL cm H2O) | 19.5 (5.3) | 20.4 (4.8) | .071 |
| Driving pressure | 36.3 (13.6) | 34.8 (10.9) | .293 |
| Pao2:Fio2 ratio  | 198.4 (104.8)| 165.7 (93.5)| <.001 |
| Highest PEEP (cmH2O) | 8.8 (3.5) | 9.6 (4.0) | .035 |
| Lowest PEEP (cmH2O) | 6.7 (6.2) | 6.7 (2.7) | .971 |
| Max Pao2:Fio2 ratio | 297.3 (199.7)| 225.9 (146.5) | <.001 |
| Min Pao2:Fio2 ratio | 158.6 (79.0) | 130.3 (69.0) | <.001 |
| Max Pao2         | 105.6 (68.8)| 92.4 (68.2)| .005 |
| Min Pao2         | 59.7 (58.9) | 51.5 (35.8)| .009 |
| Max Ppeak        | 27.4 (11.3) | 28.4 (7.7) | .154 |
| Min Ppeak        | 21.2 (4.6)  | 22.0 (5.1) | .069 |
| Compliance (max) | 40.2 (13.6) | 37.9 (11.5) | .067 |
| Compliance (min) | 30.9 (11.3) | 29.2 (10.2) | .113 |

Values are mean (standard deviation) unless noted otherwise. PEEP: positive end-expiratory pressure.
Table 4. Radiologic findings and therapies.

|                               | Survived (n=342) | Died (n=632) | P     |
|-------------------------------|------------------|--------------|-------|
| Radiography                   | 258/715 (36.1)   | 457 (63.9)   | .292  |
| Pathology                     | 329 (61.5)       | 206 (38.5)   | .020  |
| Bilateral infiltrates         | 197 (35.5)       | 358 (64.5)   | .542  |
| Pleural effusion              | 75 (41.0)        | 108 (59.0)   | .110  |
| Irregular opacities           | 117 (35.9)       | 209 (64.1)   | .921  |
| Computerized tomography       | 311 (35.2)       | 573 (64.8)   | .889  |
| CT bilateral ground-glass opacification | 262 (34.4) | 499 (65.6)   | .244  |
| CT pleural effusion           | 133 (35.6)       | 241 (64.4)   | .839  |
| CT nodules                    | 77 (33.6)        | 152 (66.4)   | .567  |
| Cardiac arrest                | 22 (16.3)        | 113 (83.7)   | <.001 |
| VT/VF                         | 14 (18.2)        | 63 (81.8)    | .001  |
| Recruitment                   | 51 (29.1)        | 124 (70.9)   | .068  |
| Prone position                | 82 (44.3)        | 103 (55.7)   | .004  |
| Renal replacement             | 55 (24.2)        | 172 (75.8)   | <.001 |
| Convalescent plasma           | 13 (23.2)        | 43 (76.8)    | .055  |
| Hydroxychloroquine            | 269 (33.3)       | 540 (66.7)   | .007  |
| Antibiotic                    | 316 (34.4)       | 602 (65.6)   | .068  |
| Antiviral                     | 264 (32.4)       | 552 (67.6)   | <.001 |
| Vasopressor                   | 87 (15.2)        | 488 (84.9)   | <.001 |
| Tocilizumab                   | 20 (28.2)        | 51 (71.8)    | .003  |
| Cytokine removal              | 6 (35.3)         | 11 (64.7)    | .987  |

Data are number of patients (%).

Table 5. Organ failure and antibiotic culture results.

|                               | Survived (n=342) | Died (n=632) | P  |
|-------------------------------|------------------|--------------|----|
| Organ failure (single)        |                  |              |    |
| No                            | 190 (58.3)       | 136 (41.7)   |    |
| ARDS                          | 73 (27.9)        | 189 (72.1)   |    |
| Renal failure                 | 13 (35.1)        | 24 (64.9)    |    |
| Sepsis                        | 24 (22.9)        | 81 (77.1)    | <.001|
| Liver failure                 | 2 (66.7)         | 1 (33.3)     |    |
| DIC                           | 0 (-)            | 1 (100.0)    |    |
| Multiple organ failure        | 40 (16.7)        | 200 (83.3)   |    |
| Adult respiratory distress syndrome | 109 (24.5) | 336 (75.5)   | <.001|
| Renal failure                 | 25 (16.9)        | 123 (83.1)   | <.001|
| Sepsis                        | 59 (18.4)        | 262 (81.6)   | <.001|
| Liver failure                 | 3 (17.6)         | 14 (82.4)    | .128 |
| Disseminated intravascular coagulation | 0 (-) | 3 (100.0)    |    |
| Culture positive              | 57 (30.8)        | 128 (69.2)   | .173 |

Data are n (%).
in the trial: seven repurposed drugs, one newly created drug, and convalescent plasma. Dexamethasone improved the survival of patients receiving invasive mechanical ventilation or oxygen at randomization. In the dexamethasone group, the incidence of death was lower than that in the usual care group among patients receiving invasive mechanical ventilation (29.3% vs. 41.4%). Since there was not enough evidence to support the use of steroids at the beginning of the pandemic, we did not routinely use steroids in our patients. Recommendations on this subject began to be published in early 2021. We found that the rate of steroid use in all patients was 15%. This may help explain the higher mortality rate in our study.

Fifty-two critically ill adult patients with COVID-19 pneumonia were admitted to the ICU in the study by Yang et al. The mean age of the patients was 59.7 years, 35 (67%) were men, 21 (40%) had chronic illness, and 98% of the patients had fever. Thirty-two (61.5%) died after twenty-eight days. APACHE and SOFA scores were higher in patients who died than in surviving patients. Patients who died were older than survivors (64.6 years vs 51.9 years). Seventy-one percent of patients required mechanical ventilation. Most patients had organ function damage, including ARDS (67%), acute kidney injury (29%), cardiac injury (23%), and hepatic dysfunction (29%). In our study, the rate of male patients was higher than that reported by Yang et al. Our patients were older than their patients and had a very high rate of comorbidities. The APACHE and SOFA scores in our study patients were much higher than those in the study by Yang et al. Therefore, the mortality rate in our study may have been higher than that in that study.

To maximize the use of ICU treatment and other hospital services, it is important to recognize the determinants of the outcomes of critically ill patients with extreme COVID-19. In a European multicenter study, the 90-day mortality was 63% (57-71) years and 63%, 48%, and 7%, respectively. The SOFA score was 5 for all patients. Our patients were older than the patients in the European multicenter study. In addition, the rates of comorbidities such as hypertension and immunocompromised patients were higher. The invasive ventilation management rate was also higher in our study (74% vs. 63%). We found a SOFA score of 6.4 (3.2) in all patients. The mortality rate was 64.9% in our study and in older patients, and the presence of malignancy and immunodeficiency was statistically higher in patients who died.

Recently, in a systematic review and meta-analysis of 52 studies involving 43,128 patients, the ICU mortality rate was 35.5% (95% CI 31.3%-39.9%), and varied from 0 to 84.6%. Hospital mortality rates significantly and progressively declined in the UK during the first wave of the pandemic between March and August, 2020 in patients with COVID-19. Hospital mortality was higher in the period from March 9 to April 26, 2020, than in the period from June 15 to August 2, 2020. They reported that most patients in the first wave were older (i.e., median age 70 years), had two or more comorbidities, and were of white ethnicity, and hospital mortality was highest in these groups. Mortality reduction may be explained by changes in breathing and lung-related support and steroid treatment, together with changes in other organ support management. In addition, this wide range of mortality rates may be related to the mean age of patients hospitalized in the ICU, comorbidity, critical care capacity strain, and the reliability of reported research.

Our study has several limitations. First, it was a retrospective study based on data mainly recorded from hospital database systems. Although the Turkish Ministry of Health made recommendations for the treatment of COVID-19 patients, ICU admission policies and patient management may not have been identical in all centers. COVID-19 is a challenge for ICUs and healthcare systems worldwide. In 974 critically ill patients with COVID-19 admitted to ICUs, the mortality rate was high (64.9%) in this multicenter study. The majority of patients needed respiratory support after diagnosis of COVID-19.

**Author contributions**

HS writing the original draft, review and editing, UA, CÔ, conceptualization, data collection, formal analysis, investigation, methodology. KTS, VY, AS, AZT, AAA, HA, NKO, NDB, BY, EB, GK, DA, PD, FC, AC, SK data collection.
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