Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Original Article

Clinical characteristics and outcomes of the first 63 adult patients hospitalized with COVID-19: An experience from Oman

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ABSTRACT

Introduction: To identify the clinical characteristics and outcomes of hospitalized patients with COVID-19 in Oman.
Methods: A case series of hospitalized COVID-19 laboratory-confirmed patients between February 24th through April 24th, 2020, from two hospitals in Oman. Analyses were performed using univariate statistics.
Results: The cohort included 63 patients with an overall mean age of 48 ± 16 years and 84% ($n = 53$) were males. A total of 38% ($n = 24$) of the hospitalized patients were admitted to intensive care unit (ICU). Fifty one percent ($n = 32$) of patients had at least one co-morbidity with diabetes mellitus (DM) (32%; $n = 20$) and hypertension (32%; $n = 20$) as the most common co-morbidities followed by chronic heart and renal diseases (12.8%; $n = 8$). The most common presenting symptoms at onset of illness were fever (84%; $n = 53$), cough (75%; $n = 47$) and shortness of breaths (59%; $n = 37$). All except two patients (97%; $n = 61$) were treated with either chloroquine or hydroxychloroquine, while the three most prescribed antibiotics were ceftriaxone (79%; $n = 50$), azithromycin (71%; $n = 45$), and the piperacillin/tazobactam combination (49%; $n = 31$). A total of 59% ($n = 37$), 49% ($n = 31$) and 24% ($n = 15$) of the patients were on lopinavir/ritonavir, interferons, or steroids, respectively. Mortality was documented in (8%; $n = 5$) of the patients while 68% ($n = 43$) of the study cohort recovered. Mortality was associated with those that were admitted to ICU (19% *vs* 0; $p = 0.009$), mechanically ventilated (31% *vs* 0; $p = 0.001$), had DM (20% *vs* 2.3%; $p = 0.032$), older (62 *vs* 47 years; $p = 0.045$), had high total bilirubin (43% *vs* 2.3%; $p = 0.007$) and those with high C-reactive protein (186 *vs* 90 mg/dL; $p = 0.009$) and low corrected calcium (15% *vs* 0%; $p = 0.047$).
Conclusions: ICU admission, those on mechanical ventilation, the elderly, those with high total bilirubin and low corrected calcium were associated with high mortality in hospitalized COVID-19 patients.

Introduction

In December 2019, multiple patients were admitted with pneumonia caused by an unknown aetiology in Wuhan, the capital city of Hubei Province in the Republic of China [1]. Subsequently, in January 2020, the organism was identified as a novel corona virus (2019-nCoV) [2–4]. Due to phylogenetic similarities to SARS-CoV, it has been currently termed as Severe Acute Respiratory Distress Syndrome Coronavirus 2 (SARS-CoV-2) [5]. On 11th of March, 2020, the World Health Organization (WHO) declared the corona virus disease 2019 (COVID-19) as a pandemic due to an increasing number of cases and mortalities in many countries worldwide [6]. Globally, up to 7th May, 2020, there has been nearly 3 and a half million of confirmed cases, causing nearly 250,000 deaths with the fatality rate of almost 7% [7].

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In Oman, the first two cases of COVID-19 infection were detected on 24th February, 2020, and were linked to travel to the Islamic Republic of Iran. Since then,the number of laboratory-confirmed cases have been increasing and up to 7th May, a total of 2958 laboratory confirmed COVID-19 cases with 980 cases being cured and mortality rate 0.5%. The cases are being reported across the country [8,9]. In Oman, cases presenting with mild upper respiratory tract infection and mild pneumonias are managed as outpatients with supportive therapy which is a different approach than the other Gulf Cooperation Council (GCC) countries. In contrary to global reports, the number of hospitalized sick patients in Oman is rather small; a reflection of the appropriate and timely implementation of government policies.

Various risk factors, either clinical or biochemical, have been described to predict outcomes in COVID-19 infected patients. In the Republic of China, a study involving 323 hospitalized patients in Wuhan has found out that body mass index (BMI) > 30 kg/m^2, diabetes mellitus (DM), cardiovascular diseases and high troponin I levels were associated with poor outcomes, whereas the use of hypnotics was associated with a significant favourable outcome [10]. Another study from China [11] involving 344 patients required intensive care unit (ICU) admission, reported that 70% of non-survivors presented with lymphopenia, dyspnoea and higher respiratory rates compared to survivors. In notable addition, 52% of those who died suffered from hypertension compared to 34% of survivors. Similar findings were observed in a study from Italy that involved more than 1500 patients, all admitted in the ICU, where hypertension was more common among those who died (63%) compared to those that were discharged (40%) [12].

Due to the wide scale clinical presentation; research on clinical and epidemiological factors which can predict prognosis is essential. This report is a case series from two hospitals in Oman that describes the epidemiological characteristics, clinical and laboratories features as well as outcomes of moderate and severe hospitalized COVID-19 patients. This report, the first from the GCC countries, might enable early recognition of patients that require intervention to halt progression of the disease and would provide an insight of the first COVID-19 experience in the region. Countries and the region need to share their experiences so these global variations could be better understood.

Methods

Study design and data collection

A case series study conducted from 24th February to 24th April, 2020 that included patients with laboratory confirmed COVID-19 infection who were admitted to two hospitals in Oman, the Royal Hospital and Al Nahdha Hospital. The cases were diagnosed based on the national case definitions of suspected and confirmed COVID-19 interim guidance [13]. All admitted patients had radiological findings suggestive of pneumonia and/or acute respiratory distress syndrome (ARDS). Sixty-three non pregnant adults above 18 years of age were identified.

The patients' data was obtained from the hospital medical records and was recorded onto standardized report forms. The clinical data was transferred into an electronic questionnaire, that included the baseline demographic characteristics (gender, age, occupation, place of residency and nationality), information on the name of the hospital, date of onset of illness, date of COVID-19 confirmation, travel history, contact history, symptoms on presentation, risk factors and underlying co-morbidities, clinical symptoms and signs on presentation, need for respiratory support, laboratory parameters, radiological features, drug therapy, duration of hospitalization and patients' outcomes. Patients were stratified based on ICU admission status. Data was censored at the time of data cutoff, which occurred on April 24th, 2020.

Study definitions

ARDS was defined as acute-onset hypoxaemia (the ratio of the partial pressure of arterial oxygen to the fraction of inspired oxygen [Pao2:Fio2], <300) with bilateral pulmonary opacities on chest imaging that were not fully explained by congestive heart failure. Severe pneumonia in adults defined as fever or suspected respiratory infection plus one of the following: respiratory rate of >30 breaths/min, severe respiratory distress and SpO2 of <90% on room air [14].

Laboratory procedures

Samples were tested using the WHO recommendations and national guidelines [15]. All the testing was held out in one Public Health Laboratory in Oman, dedicated to RT-PCR assay testing. The national laboratory participated in the internal quality assurance programme conducted by the WHO National External Quality Assessment services.

The throat and nasopharyngeal swabs were placed into a collection tube with 150 μL of virus preservation solution, and total RNA was extracted within 2 h by Liferiver Novel Coronavirus (2019-nCoV) Real Time Multiplex RT-PCR Kit [Shanghai Zhijiang Biotechnology Co., Ltd (ZJ Bio-Tech)]. This was the same kit that was used for the qualitative detection of a novel coronavirus, which was identified in 2019 at Wuhan City, China, by real time PCR systems. The assays included a positive and an internal control. The probes specific for SARS-CoV-2 RNA were labelled with the fluorophore FAM (ORF1ab), HEX/VIC/JOE (gene N), and Cal Red 610/ROX/TEXAS RED (gene E).

Ethical approval

The study was approved by the Royal and Al Nahdha hospital ethical committees. The written informed consent was waived as the researchers analyzed the data anonymously and no potential risk to the patients was anticipated.

Statistical analysis

Descriptive statistics were used to describe the data. For categorical variables, frequencies and percentages were reported. Differences between groups were analyzed using Pearson's χ^2 tests (or Fisher's exact tests for expected cell count <5 in more than 20% of the cells). For continuous variables, mean and standard deviation were used to summarize the data and analyses were performed using Student's *t*-tests. An a *priori* two-tailed level of significance was set at 0.05. Statistical analyses were conducted using STATA version 13.1 (STATA Corporation, College Station, TX, USA).

Results

Demographic and clinical characteristics

The study population included 63 hospitalized patients with confirmed COVID-19. Fifty four percent ($n = 34$) and 46% ($n = 29$) were admitted to Royal and Al Nahdha hospitals, respectively. The overall mean age of the hospitalized COVID-19 cohort was 48 ± 16 years, ranging from 22 to 87 years. A total of 84% ($n = 53$) of the patients were males and 46% ($n = 29$) were Omani citizens. Nearly 78% ($n = 49$) of the patients were employed, whether full-, part-time, or self-employed. Thirteen percent ($n = 8$) of the patients

Table 1
Demographic and clinical characteristics of Oman's hospitalized COVID-19 patients stratified by intensive care unit (ICU) admission.

Characteristic,*n (%) unless specified otherwise*	All(N = 63)	Non-ICU(n = 39)	ICU(n = 24)	*p*-value
Demographics				
Age, mean ± SD, years	48 ± 16	47 ± 16	50 ± 17	0.552
Male gender	53 (85%)	32 (82%)	21 (88%)	0.729
Omani	29 (46%)	21 (54%)	8 (33%)	0.113
Active smoker	4 (6.4%)	3 (7.7%)	1 (4.2%)	1.000
Alcohol consumer	4 (6.4%)	3 (7.7%)	1 (4.2%)	1.000
Hospital				
Royal Hospital	34 (54%)	10 (26%)	24 (100%)	<0.001
Al-Nahdha Hospital	29 (46%)	29 (74%)	0	
Employed (full/part/self)	49 (78%)	26 (67%)	23 (96%)	0.011
Exposure history				
History of travel	8 (13%)	7 (18%)	1 (4.2%)	0.141
Contact with COVID-19 patient	14 (22%)	10 (26%)	4 (17%)	0.538
Spouse/partner	2 (3.2%)	2 (5.1%)	0	
Household	9 (14%)	6 (15%)	3 (13%)	
Workplace	3 (4.8%)	2 (5.1%)	1 (4.2%)	
Co-morbidities				
Hypertension	20 (32%)	13 (33%)	7 (29%)	0.730
Diabetes mellitus	20 (32%)	9 (23%)	11 (46%)	0.060
Chronic heart disease	4 (6.4%)	2 (5.1%)	2 (8.3%)	0.632
Chronic renal disease	4 (6.4%)	3 (7.7%)	1 (4.2%)	1.000
Admission diagnosis				
Uncomplicated illness	1 (1.6%)	1 (2.6%)	0	
Pneumonia	37 (59%)	35 (90%)	2 (8.3%)	<0.001
Severe pneumonia	12 (19%)	2 (5.1%)	10 (42%)	
Acute respiratory distress syndrome	13 (21%)	1 (2.6%)	12 (50%)	
Disease severity				
Mechanical ventilation	16 (25%)	0	146 (62%)	<0.001
CVVHD/HD	7 (11%)	1 (2.6%)	6 (25%)	0.010
On oxygen therapy	31 (49%)	7 (18%)	24 (100%)	<0.001
Shortness of breath	23 (37%)	8 (21%)	15 (63%)	0.001
Length of stay, median (IQR), days	4 (6–10)	4 (5–9)	8 (5.5–13)	0.013

SD, standard deviation; CVVHD, continuous veno-venous hemodialysis; HD, hemodialysis; IQR, interquartile range.
Non-Omanis included 22% (*n* = 14) from India, 16% (*n* = 10) from Bangladesh, 7.9% (*n* = 5) from Pakistan, 3.2% (*n* = 2) from Lebanon and one (1.6%) each from Ireland, Sudan and the United Kingdom. The countries travelled (*n* = 8) were Indonesia (*n* = 1), Pakistan (*n* = 1), Saudi Arabia (*n* = 1), Turkey (*n* = 1), United Arab Emirates (*n* = 1), United Kingdom (*n* = 2) and United States (*n* = 1).
Column percentages might not add up to 100% due rounding off.

had a history of travel to a country with local where COVID-19 transmission and (22%; *n* = 14) had a contact with a known COVID-19 patient, mostly through household contact (14%; *n* = 9). The remaining almost two thirds of the patients had unknown mode of infection. Fifty one percent (*n* = 32) of patients had at least one co-morbidity with DM (32%; *n* = 20) and hypertension (32%; *n* = 20) as the most common co-morbidities followed by chronic heart and renal diseases (12.8%; *n* = 8) [Table 1]. As shown in Fig. 1, the most prevalent symptoms at onset of illness were fever (84%; *n* = 53), cough (75%; *n* = 47) and shortness of breaths (59%; *n* = 37).

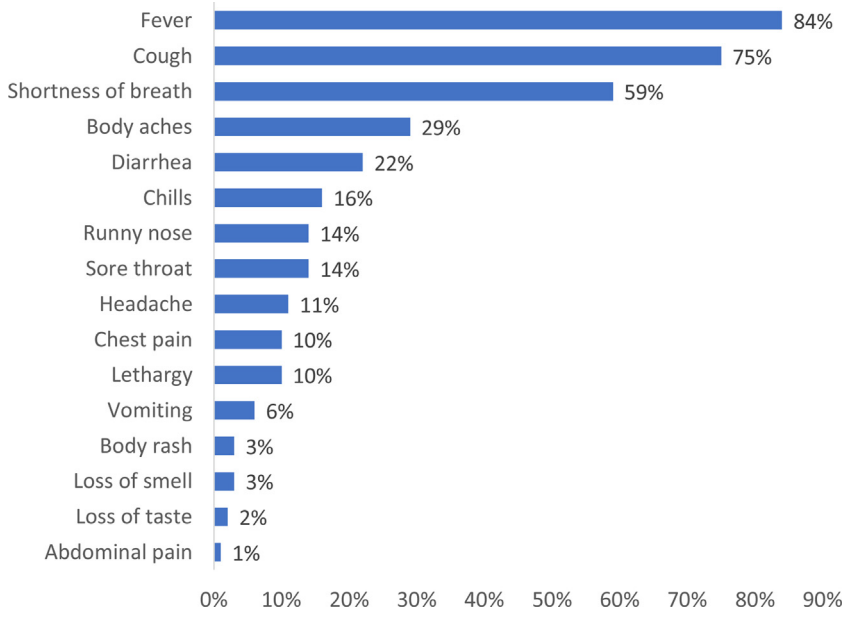

Fig. 1. Symptoms of Oman's COVID-19 hospitalized patients (*N* = 63).

A total of 38% ($n = 24$) of the hospitalized patients were admitted to ICU. As outlined in Table 1, those admitted to the ICU were more likely to have been employed (96% *vs* 67%; $p = 0.011$), had shortness of breath (63% *vs* 21%; $p = 0.001$), crepitation's on chest examination (100% *vs* 56%; $p < 0.001$) and required oxygen therapy (100% *vs* 18%; $p < 0.001$) on initial presentation. ICU admission was associated with severe pneumonia (42% *vs* 5.1%; $p = 0.001$), ARDS (50% *vs* 2.6%; $p < 0.001$), mechanical ventilation (62% *vs* 0%; $p < 0.001$), continuous veno-venous hemodialysis (CVVHD)/intermittent hemodialysis (ID) (25% *vs* 2.6%; $p = 0.010$) and longer hospital stays (8 *vs* 4 median days; $p = 0.013$).

Laboratory and radiological findings

Patients admitted to the ICU were more likely to be presented with increased levels of high D-dimer (83% *vs* 42%; $p = 0.005$), lactate dehydrogenase (96% *vs* 63%; $p = 0.006$), total bilirubin (32% *vs* 0%; $p = 0.002$), *p*CO2 (33% *vs* 0; $p = 0.042$) and major bilateral abnormalities on chest x-ray (50% *vs* 7.9%; $p < 0.001$). Other investigations of the cohort are outlined in Table 2.

Therapeutic agents

As shown in Table 3, all except two (97%; $n = 61$) patients were treated with either chloroquine or hydroxychloroquine, while the three most prescribed antibiotics were ceftriaxone (79%; $n = 50$), azithromycin (71%; $n = 45$), and the piperacillin/tazobactam combination (49%; $n = 31$). A total of 59% ($n = 37$) and 49% ($n = 31$) of the patients were on lopinavir/ritonavir and interferons (either interferon beta or peginterferon alfa 2a), respectively (Table 2). Those admitted to the ICU were more likely to have been prescribed the piperacillin/tazobactam combination (79% *vs* 31%; $p < 0.001$), meropenem (29% *vs* 2.6%; $p = 0.004$), lopinavir/ritonavir (100% *vs* 33%; $p < 0.001$), intravenous (IV) steroids (50% *vs* 5.4% $p < 0.001$) (either hydrocortisone or methylprednisolone) and interferons (88% *vs* 22% $p < 0.001$). Medication side effects observed included *QTc* prolongation in those that had azithromycin either alone or in combination with hydroychlroquine (13%; 6/45) and diarrhoea in those that had lopinavir/ritonavir (8.1%; 3/37). Of interest, IV steroids (50% *vs* 5.4% $p < 0.001$) and interferons (88% *vs* 22% $p < 0.001$) were more likely to be prescribed to COVID-19 patients on mechanical ventilation than those not on mechanical ventilation.

Clinical outcomes

Fig. 2 outlines clinical outcomes of the cohort with mortality documented in (8%; $n = 5$) of the patients while 68% ($n = 43$) of the study cohort recovered. Mortality was associated with those that were admitted to an ICU (19% *vs* 0; $p = 0.009$), mechanically ventilated (31% *vs* 0; $p = 0.001$), had DM (20% *vs* 2.3%; $p = 0.032$), older (62 *vs* 47 years; $p = 0.045$), had high total bilirubin (43% *vs* 2.3%; $p = 0.007$), high C-reactive protein (186 *vs* 90; $p = 0.009$) and those with low corrected calcium (15% *vs* 0%; $p = 0.047$).

Discussion

In this study, we describe the clinical characteristics, laboratory parameters, and outcomes of laboratory-confirmed COVID-19 patients admitted to two different hospitals in Oman, with a focus on critically ill patients. The majority of our patients were middle aged men with no history of travel or contact with COVID-19 patients. The male predominance has been consistent with a number of studies [12,16], as it is hypothesized that the X chromosome contains a high density of immune-related genes and regulatory elements that are extensively involved in both the innate and adaptive immunity [17].

However, in our study this is probably related to different lifestyles between men and women, especially among men who were mostly foreign-born labourers. In comparison to other published studies, this work illustrated that foreign-born population constitutes of a disproportionately greater number of reported COVID-19 cases. No such disparities are evident in other countries outside the GCC. Several factors increase the likelihood of exposure to COVID-19 among this population that include: poor standards of living, crowdedness as mostly live in big cities (urban), unawareness of the COVID-19 signs and symptoms and the general preventive measures due to language barriers, late presentation to health facilities that allows a higher chance of acquisition of the disease and transmission to others especially during asymptomatic stage. Effective strategies need to be in place to manage foreign-born population.

The mean age for ICU patients was 50 ± 17 years; lower than reports from large cohorts in other countries [12,16–18]. There were no statistical significant differences in age between ICU and non- ICU patients in our cohort. This indicates that age alone is not a risk factor for ICU admission, similar to findings from Italian and a number of other studies from China [16–18]. However, the total population in Oman is young with a median age of 30.6 years and 54% of the patients in this cohort were young foreign-born workers.

In our study, the percentage of smokers in all groups was very low. Smoking has been indicated as a risk factor in some reports. However, others reported low percentage of smokers within a group of severe COVID-19 infection [17]. Most of our patients had no history of cigarette smoking or hookah use (shisha), however, as a good number of our cohort were non-nationals, the possibility exists of other forms of smoking such as tobacco chewing which is a very common habit in other nationalities.

Most of the patients admitted with radiological confirmed pneumonia and/or ARDS had fever, cough and shortness of breath. These symptoms have been described as the most common symptoms in COVID-19 patients indicating similar host immune response to SARS COV-2 [18]. Fever predominated with or without symptoms of acute respiratory infection. However, it is difficult based on symptoms alone to distinguish COVID-19 from other viral or bacterial infections [16].

In our cohort, co-morbidities were seen less frequently than previous reports from other large cohorts [12,19]. DM and hypertension were the most common co-morbidities followed by cardiovascular disorders and chronic renal diseases. DM was associated with a higher mortality rate in our cohort. A meta-analysis by Huang et al. [20] showed that DM was associated with increased mortality (relative rate (RR) of 2.12), severe COVID-19 (RR of 2.45), ARDS (RR of 4.64), and disease progression (RR of 3.31). Long standing high blood glucose has been linked to low ability to defend microorganisms; increasing the risk of rapid progression of infections.

In this study, the ICU admission rate was 38%. The majority of patients were admitted to the ICU because of severe pneumonia and ARDS that required respiratory support and invasive mechanical ventilation in 62% (16/26) of the patients. Conversely, noninvasive ventilation and high flow nasal cannula were not used. The need for invasive mechanical ventilation in our study was similar to reports from ICU's in other countries which ranged between 30% to 88% [1,12,19,21,22]. Our ICU cohort had major bilateral lung infiltrates on chest x-ray, highlighting the importance of early screening with chest imaging. Chest Computed Tomography (CT) scan were done in four patients for suspicious of pulmonary embolism (PE), two of them were confirmed to have PE.

Laboratory abnormalities that have been described in severe COVID-19 disease and had been associated with worse outcomes

Table 2
Investigations of Oman's hospitalized COVID-19 patients stratified by intensive care unit (ICU) admission.

Characteristic, *n (%) unless specified otherwise*	All (*N* = 63)	Non-ICU(*n* = 39)	ICU (*n* = 24)	*p*-value
WBC count, median (IQR), $\times 10^9$/L	2 (2–2)	2 (2–2)	2 (2–2.5)	0.161
<3.5	7 (11%)	5 (13%)	2 (8.3%)	
3.5–9.5	46 (73%)	30 (77%)	16 (67%)	0.254
>9.5	10 (16%)	4 (10%)	6 (25%)	
ALC, median (IQR), $\times 10^9$/L (*n* = 62)	1.1 (0.8–1.5)	1.3 (1–1.6)	0.8 (0.6–1.1)	0.003
<1.1	29 (47%)	15 (39%)	15 (58%)	
1.1–3.2	31 (50%)	22 (58%)	9 (38%)	0.308
>3.2	2 (3.2%)	1 (2.6%)	1 (4.2%)	
Platelet count, median (IQR), $\times 10^9$/L (*n* = 62)	225 (177–299)	215 (169–264)	253 (213–322)	0.049
<125	1 (1.6%)	1 (2.6%)	0	
125–400	57 (92%)	35 (92%)	22 (92%)	0.781
>400	4 (65%)	2 (5.3%)	2 (8.3%)	
Hb, median (IQR), g/dL	13 (12–14)	13 (12–15)	13 (12–14)	0.090
≤11.5	10 (16%)	5 (13%)	5 (21%)	0.485
>11.5	53 (84%)	34 (87%)	19 (79%)	
D-Dimer, median (IQR), μg/mL (*n* = 54)	0.6 (0.3–2.4)	0.4 (0.2–0.7)	2.3 (0.7–4.3)	<0.001
≤0.55	22 (41%)	18 (58%)	4 (17%)	0.005
>0.55	32 (59%)	13 (42%)	19 (83%)	
CRP, median (IQR), mg/dL (*n* = 62)	82 (32–144)	37 (17–94)	148 (101–208)	<0.001
≤6	5 (8.1%)	5 (13%)	0	0.147
>6	57 (92%)	33 (87%)	24 (100%)	
Serum lactate, median (IQR), mmol/L (*n* = 39)	1.3 (1–1.9)	1.5 (1.1–2)	1.3 (0.9–1.7)	0.247
≤2	34 (87%)	12 (75%)	22 (96%)	0.139
>2	5 (13%)	4 (25%)	1 (4.4%)	
Lactate dehydrogenase, median (IQR), U/L (*n* = 51)	350 (283–477)	293 (221–345)	444 (367–643)	<0.001
≤250	11 (22%)	10 (37%)	1 (4.2%)	0.006
>250	40 (78%)	17 (63%)	23 (96%)	
Ferritin, median (IQR), μg/L (*n* = 33)	841 (504–1240)	632 (394–1045)	965 (573–1364)	0.069
≤600	13 (39%)	8 (50%)	5 (29%)	0.296
>600	20 (61%)	8 (50%)	12 (71%)	
Bilirubin, median (IQR), mmol/L (*n* = 50)	10 (6–14)	8 (5.5–11)	13 (8–25)	0.007
≤21	43 (86%)	28 (100%)	15 (68%)	0.002
>21	7 (14%)	0	7 (32%)	
Creatinine, median (IQR), μg/L (*n* = 62)	81 (68–90)	82 (68–90)	74 (60–91)	0.462
35–115	58 (94%)	35 (92%)	23 (96%)	1.000
>115	4 (6.5%)	3 (7.9%)	1 (4.2%)	
Corrected calcium, median (IQR), mmol/L (*n* = 54)	2.2 (2.0–2.3)	2.3 (2.2–2.3)	2.0 (2.0–2.1)	<0.001
≤2.15	26 (48%)	5 (17%)	21 (88%)	<0.001
>2.15	28 (52%)	25 (83%)	3 (13%)	
G6PD deficiency (n = 62)				
Normal	56 (90%)	37 (97%)	19 (79%)	
Partial deficiency	4 (6.5%)	0	4 (17%)	0.019
Complete deficiency	2 (3.2%)	1 (2.6%)	1 (4.2%)	
pH, median (IQR) (*n* = 38)	74 (7.3–7.5)	74 (7.4–7.5)	74 (7.3–7.5)	0.544
≤7.3	8 (21%)	1 (7.1%)	7 (29%)	0.216
>7.3	30 (79%)	13 (93%)	17 (71%)	
pCO2, median (IQR) (*n* = 38)	36 (32–42)	34 (32–39)	37 (33–51)	0.107
<35	16 (42%)	8 (57%)	8 (33%)	
35–45	14 (37%)	6 (43%)	8 (33%)	0.042
>45	8 (21%)	0	8 (33%)	
pO2, median (IQR) (*n* = 37)	62 (54–78)	60 (49–65)	66 (54–101)	0.109
≤75	27 (73%)	12 (86%)	15 (65%)	0.260
>75	10 (27%)	2 (14%)	8 (35%)	
PaO2/FiO2, median (IQR) (*n* = 33)	233 (155–280)	269 (237–295)	195 (145–247)	0.019
Severe	3 (9.1%)	1 (8.3%)	2 (9.5%)	
Moderate	10 (30%)	0	10 (48%)	0.005
Mild	20 (61%)	11 (92%)	9 (43%)	
RR, median (IQR), breaths/min (*n* = 58)	22 (20–26)	22 (20–26)	22 (20–32)	0.800
≤22	32 (55%)	22 (56%)	10 (53%)	1.000
>22	26 (45%)	17 (44%)	9 (47%)	
PR, median (IQR), breaths/min	89 (80–100)	89 (80–104)	87 (78–100)	0.515
≤90	36 (57%)	22 (56%)	14 (58%)	1.000
>90	27 (43%)	17 (44%)	10 (42%)	
SBP, median (IQR), mmHg (*n* = 61)	129 (117–142)	130 (120–143)	124 (112–142)	0.224
≤100	1 (1.6%)	0	1 (4.6%)	0.361
>100	60 (98%)	39 (100%)	21 (95%)	
SpO2, median (IQR), %	95 (80–97)	96 (95–98)	80 (80–86)	<0.001
≤93	30 (48%)	6 (15%)	24 (100%)	<0.001
>93	33 (52%)	33 (85%)	0	
Baseline QTc interval, median (IQR), ms (*n* = 42)	2 (1–3)	2 (1–3)	1 (1–3)	0.842
<430	20 (48%)	13 (45%)	7 (54%)	
431–450	10 (24%)	8 (28%)	2 (15%)	0.759
>450	12 (29%)	8 (28%)	4 (31%)	
Chest examination				
Normal	17 (27%)	17 (44%)	0	<0.001
Crepitation	46 (73%)	22 (56%)	24 (100%)	
Chest X-ray				
Normal	2 (3.2%)	2 (5.3%)	0	
Major bilateral abnormality	15 (24%)	3 (7.9%)	12 (50%)	<0.001
Infiltrations/patchy shadowing	45 (73%)	33 (87%)	12 (50%)	

WBC, white blood cell; IQR, interquartile range; ALC, absolute lymphocyte count; Hb, haemoglobin; CRP, C-reactive protein; GCS, Glasgow coma scale; *p*CO2, partial pressure of carbon dioxide; *p*O2, partial pressure of oxygen; *PaO2/FiO2*, ratio of arterial oxygen partial pressure to fractional inspired oxygen; RR, respiratory rate; PR, pulse rate; *SpO2*, peripheral capillary oxygen saturation.
Column percentages might not add up to 100% due rounding off.

Table 3
Medication characteristics of Oman's hospitalized COVID-19 patients stratified by intensive care unit (ICU) admission.

Characteristic,*n (%) unless specified otherwise*	All($N=63$)	Non-ICU($n=39$)	ICU($n=24$)	*p*-value
Antibiotics				
Ceftriaxone	50 (79%)	34 (87%)	16 (67%)	0.062
Piperacillin/tazobactam	31 (49%)	12 (31%)	19 (79%)	<0.001
Azithromycin	45 (71%)	32 (82%)	13 (54%)	0.023
Meropenem	8 (13%)	1 (2.6%)	7 (29%)	0.004
Antiviral [lopinavir/ritonavir]	37 (59%)	13 (33%)	24 (100%)	<0.001
Anti-malarials	61 (97%)	36 (97%)	25 (96%)	0.799
Anti-interleukin-6 [tocilizumab]	2 (3.2%)	1 (2.6%)	1 (4.2%)	1.000
Intravenous steroids	15 (24%)	2 (5.4%)	13 (50%)	<0.001
Interferons	31 (49%)	8 (22%)	23 (88%)	<0.001
Convalescent plasma exchange	2 (3.2%)	0	2 (8.3%)	0.141

The anti-malarials included hydroxyxhloroquine and chloroquine, the intravenous steroids included hydrocortisone and methylprednisolone while the interferons included peginterferon alfa 2a and interferon beta 1b.
The side effects observed included *QTc prolongation* in those that had azithromycin either alone or in combination (13%; 6/45) and diarrhoea in those that had the antiviral, lopinavir/ritonavir (8.1%; 3/37).
Percentages might not add up to 100% due to rounding off.

include:lymphocytopenia, hypoalbuminemia, elevated levels of aspartate aminotransferase (AST), alanine aminotransferase (ALT), total bilirubin (T.BIL), lactate dehydrogenase (LDH), creatine kinase and high D-dimer [16,17].

Elevated levels of D-dimer, LDH, T. BIL were seen in our ICU patients. Additionally, one quarter of them developed acute renal impairment requiring either CVVHD or HD. It is postulated that SARS-CoV-2 can infect respiratory epithelial cells through the angiotensin-converting enzyme 2 (ACE2) receptors on human cells [23]. Recent data on RNA-sequencing in human tissue indicated that the expression of ACE2 in genitourinary system was100-fold higher than the respiratory system [16,23]. In addition, the cytokines and immune-mediators released by the viral particles might induce tissue hypoxia, shock, and rhabdomyolysis [24]. This might explain the reason why multi-organ dysfunction occurs in severely infected COVID-19 patients.

Low corrected calcium was observed in 21 (88%) of our ICU patients. In a retrospective study by Sun et al. [25] that enrolled 241 patients, low serum calcium incidence was 74.4% and was a predictor of clinical severity and prognosis. Hypocalcemia can be multifactorial due to over excretion of parathyroid hormone, low vitamin D, low dietary intake and hypoproteinemia. Similar to our findings, the authors found that serum value of <2 was an indicator of mortality.

In our study, lymphopenia and elevated (CRP) were seen in the majority of our ICU admitted patients and were predictive of severity of illness and mortality. This is in line with other studies, where the median of lymphocyte count was lower in severe COVID-19 patients; as targeted invasion by SARS-CoV viral particles can damages the cytoplasmic component of the lymphocyte and cause its necrosis or apoptosis [26]. Furthermore, CRP is a biomarker reflecting inflammation and high values have been associated with poor prognosis [27,28].

Currently, there is no specific treatment to COVID-19 infection and treatment remains mostly supportive. Several therapies have been used with limited or no effects. Many experts' advice the use of these agents within the setting of clinical trials and close monitoring of safety. In our patients, treatment with investigational therapeutics was given based on the interim "National clinical management pathways for hospitalized patients with COVID-19", thus, all patients except one (99%; $n=62$) received chloroquine or hydroxychloroquine. This was not associated with significant *QTc*

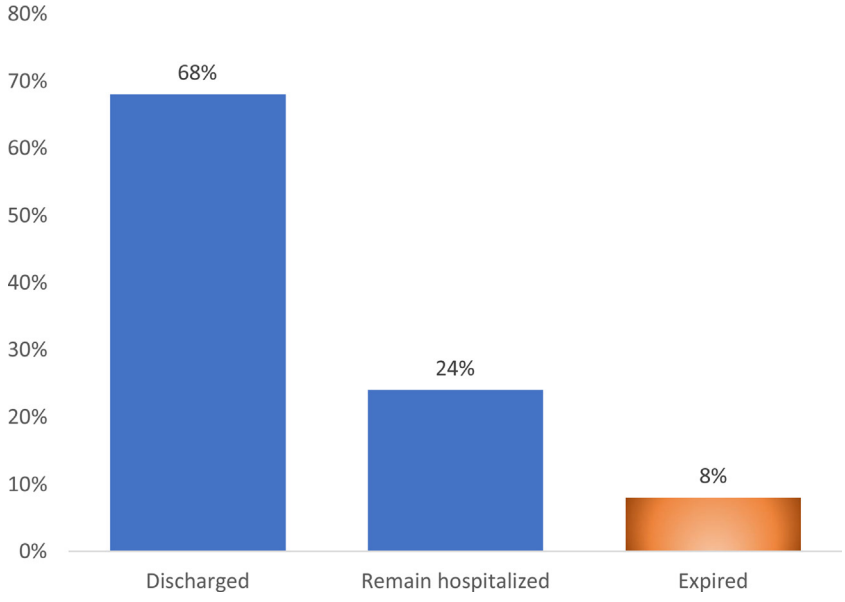

Fig. 2. Clinical outcome of Oman's COVID-19 hospitalized patients.

prolongation or death. Azithromycin on the other hand, was associated with *QTc prolongation* whether used alone or in combination with hydroxychloroquine (13%). Several studies have shown similar findings [12,15,16,26].

Lopinavir/ritonavir combination was used in 59% of our patients, including all the 24 ICU admitted patients (100% *vs* 33%; $p < 0.001$). Diarrhoea developed in 8% of those that had lopinavir/ritonavir. Lopinavir/ritonavir was found to reduce viral loads and improve clinical symptoms during the treatment for corona viruses [28,29]. However, it failed to show effectiveness in a recent randomized controlled clinical trial on 199 patients infected with COVID-19 [30]. A large proportion of mechanically ventilated patients received intravenous steroids as part of the "Surviving Sepsis Campaign" recommendation for intubated patients with COVID-19 and ARDS [31]. The role of steroids in the management of COVID-19 patients remains controversial and the use is considered to be on case by case basis. Neither the use of steroids nor Lopinavir/ritonavir was associated with improved or worsening survival. In this cohort, more than 70% of admitted patients received empirical antibiotics for treatment of community acquired pneumonia based on the National clinical management pathways for hospitalized COVID-19 patients. Antibiotics were started upon admission and lasted up to five days. However, antibiotics were escalated to piperacillin/tazobactam in a number of patients due to persistence of fever.

There is a great difference in the mortality rates of COVID-19 in patients requiring ICU care worldwide; reports range from 16% in Wuhan China to 88% in USA [12,24]. Apart from crowdedness, determinants such as co-morbid diseases, occupational exposures, socioeconomic factors, racial injustice may explain the differences in outcomes among populations in different countries [32]. Our fatality rate was 8% among admitted patients, which is way lower than reports from elsewhere [12,16–23,26,28]. This should be interpreted with caution since 24% of our patients were still hospitalized but in a stable condition at the time of writing the manuscript. Our mortality rates were high in patients who were older, diabetic, had high CRP and total bilirubin and in patients with low serum calcium.

This study has several limitations. First, the retrospective data collection design that did not allow the capture of more detailed information. Second, the follow-up was limited through April 24th, 2020, hindering the possibility of including all outcomes as some patients still remained hospitalized during the manuscript preparation. Third, some data were missing particularly in the non-ICU patients. Finally, the small sample size could have affected the statistical significance of important risk factors and clinical parameters.

Conclusion

To our knowledge this is the first report describing the clinical characteristics, laboratory parameters and outcomes of COVID-19 infected patients from Oman and the region. Old age, DM, high CRP, LDH and total bilirubin and low calcium on admission were risk factors for poor prognosis. Elevated D-dimer, LDH, total bilirubin and high pCO2 were associated with ICU admission. There is a paucity of data on the clinical characteristics of COVID-19 pandemic in the Arab world and the GCC region This manuscript shades light on the risk factors and outcomes of hospitalized COVID-19 patients in Oman; information much needed particularly for policy makers and authorities in the region and physicians alike caring for high risk populations.

Additionally, larger scale studies are necessary to determine the best discriminatory prognostic factors and therapeutic modalities for COVID-19 infections.

Data availability statement

The data sets used and/or analyzed during the current study are available from the corresponding author upon reasonable request.

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Competing interests

The authors declare no conflict of interest.

Ethical approval

Not required.

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