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Research Article

Clinical Characteristics and Outcomes of ICU Admitted Patients with COVID-19: Analysis of University Hospital Data

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Abstract

Background: Clinical findings of Covid-19 patients admitted to Intensive Care Unit (ICU) and risk factors predicting this admission are similar, however, short-term outcomes for such patients may be different and depend on treatment options and ventilator support approaches of the local ICU. We aimed to evaluate the risk factors for intensive care unit admission, clinical features, treatment and outcomes of patients with Covid-19 admitted to ICU in University Hospital of Baku.

Methods: In this mono center, retrospective, observational study, we enrolled consecutive patients with Covid-19 who were admitted to ICU of University Hospital of Baku from 01st July to 30th December 2020. All data were undertaken from patients records and were compared between patients with and without acute respiratory distress syndrome (ARDS), with and without intubation, and although between survived and non-survived.

Results: A total of 289 Covid-19 patients required ICU admission in the study hospital (mean age 64.8 ± 15.4 years, 192 males [66.4%]). The most common risk factors for ICU admission were: older age ($p < 0.0001$), followed by male gender predominance ($p < 0.001$), Diabetes Mellitus (DM) (OR 5.58 [0.98 - 12.45] 95 CI; $p < 0.002$), cardiac diseases (OR 2.89 [0.88 - 7.35] 95% CI; $p < 0.004$), hypertension (OR 1.89 [0.92-4.26] 95% CI; $p < 0.01$). Among ICU admitted patients comorbidities such as active cancer and obesity were common findings compared to non-ICU admitted ($p < 0.001$). Chronic respiratory conditions such as COPD, asthma, and interstitial lung diseases (ILD) were not associated with increased risk for ICU admission. Acute respiratory distress syndrome (ARDS) was developed in 130 of 289 patients (44.0%). Most common risk factors associated with ARDS were: obesity (OR 3.21 [0.89 - 7.32] 95% CI; $p < 0.001$); lack of use of prone position ventilation (OR 2.65 [0.82 - 6.43] 95% CI; $p < 0.004$); lack of use the HFNC and NIPPV support (OR 2.28 [0.79 - 5.72] 95% CI; $p < 0.01$); older age ($p < 0.001$) and lack of use of dexamethasone at the onset of respiratory failure (OR 2.94 [0.72 - 8.36] 95%CI; $p < 0.002$). Severe sepsis and septic shock (OR 4.87 [1.65 - 10.45) 95% CI; $p < 0.0001$), kidney failure required renal replacement therapy (OR 3.49 [1.12 - 9.37) 95% CI; $p < 0.001$), lymphocytopenia (OR 2.96 [0.92 - 6.45]) 95% CI; $p < 0.004$), and level of serum IL-6 (OR 2.57 [0.84 - 6.21] 95% CI; $p < 0.006$) were associated with severe ARDS ($p < 0.001$). Secondary multi-drug resistant (MDR) bacterial infection was associated with more frequent septic shock and severe ARDS ($p < 0.001$). Risk factors predicting intubation were: older age ($p < 0.001$); severe ARDS ($p < 0.0001$); and lack of use HFNC and NIPPV before intubation ($p < 0.004$). Overall mortality rate among ICU admitted patients was 30.4% and common risk factors predicting mortality were: high mean SOFA score (OR 3.02 [2.16 - 3.98] 95% CI; $p < 0.001$); lymphocytopenia ($p < 0.004$); lack of use prone position (OR 2.24 [0.94 - 5.14] 95% CI; $p < 0.005$); and MDR pathogens associated VAP (OR 3.44 [1.24 - 7.21] 95% CI; $p < 0.001$).

Conclusion: Several risk factors were associated with increased risk of development of ARDS. The risk of the death of patients with COVID-19 depends on severity of ARDS. Among most important risk factors predicting severe ARDS are: septic shock, renal replacement therapy, lymphocytopenia, high serum level of IL-6, lack of use of prone position ventilation, lack of use HFNC and NIPPV before intubation, and lack of use dexamethasone at the onset of the respiratory failure.

Keywords: *COVID-19; ICU Admission; Intubation; ARDS; Mortality Risk*

Introduction

Outcomes of critically ill patients such as those admitted to intensive care unit (ICU) with COVID-19 are determined by several factors (included resources and devices at ICU). These rick factors are very important in predicting of development of acute respiratory distress syndrome (ARDS), need for mechanical ventilation (MV) and even death [1]. Severe patients with COVID-19 usually present respiratory rates ≥ 30 breaths per minute, oxygen saturation ≤ 93% and lung infiltration > 50% [2] and are in high risk of clinical impairment and developing of critical illness and ARDS [3]. Most centers report that approximately 25% of hospitalized patients require ICU admission [2,4]. Related to high number of patients with rapidly progression from mild-to-moderate to severe ARDS, it is urgently needed to closely monitor above those. Admission criteria include oxygen requirement equal or superior to 6 - 8 l/min to reach a peripheral oxygen saturation ≥ 90 - 92%, respiratory failure, shock, acute organ dysfunction and patients at high risk for clinical deterioration [5,6]. More importantly, when reviewing the literature and analyzing our data, we found that there was big difference in ARDS incidence intubation rates, mortality rates and intensive care admission rates among patients depending on several risk factors predicting those.

Aim of the Study

The aim of our retrospective study was to assess the risk factors for ICU admission, clinical features, treatment options and outcomes of critically ill patients with COVID-19 admitted to ICU in University Hospital of Baku.

Materials and Methods

Study design

The first objective of our retrospective study was to identify the risk factors for ICU admission and ARDS in COVID-19 patients; the second objective was to compare the differences for intubation and mortality rate between intubated and non-intubated, survivors and non-survivors. Patients were enrolled from one medical center: ICU of Therapeutic and Education Clinic of Medical University of Azerbaijan. The inclusion criteria were as follows: hospitalized patients to ICU with laboratory-confirmed COVID-19; available data regarding epidemiological, clinical, laboratory findings; although available data on the incidence of ARDS, and/or mortality rate, sequential organ failure assessment (SOFA) [7], comorbidities and dates of the ICU admission. All data have been collected retrospectively including respiratory support devices (oxygen mask, High Flow nasal cannula, non-invasive positive pressure ventilation), mechanical ventilation settings (positive end expiratory pressure, PEEP), the fraction of inspired oxygen (FiO_2), respiratory rate, tidal volume, plateau pressure, arterial blood gas standard laboratory parameters and adjuvant therapies for ARDS such as the use of continuous neuromuscular blockers, nitric oxide, prone position, corticosteroids, antiviral and immune-modulators.

ARDS severity, complications and outcomes

ARDS was classified based on Berlin definition criteria for patients undergoing mechanical ventilation (invasive or non-invasive) on ICU stay [8]. ICU complications and organ dysfunction included acute kidney failure requiring renal replacement therapy, thromboembolic complications (distal venous thrombosis or proven pulmonary embolism by either pulmonary CT angiography or cardiac angiography) and ventilator-associated pneumonia. Clinical suspicion of ventilator associated pneumonia was confirmed before antibiotics either by endotracheal aspirates growing ≥ 10^6 cfu/ml or by quantitative distal bronchoalveolar lavage cultures growing ≥ 10^4 cfv/ml. Patient outcomes included the date of liberation from mechanical ventilation, dates of ICU discharge, vital status at ICU and death at ICU.

Statistical analysis

Categorical variables were compared by Chi-square or Fisher's exact test, and continuous variables were compared by Student's test or Wilcoxon rank-sum test. Kaplan-Meier overall survival curves until day 30 were computed and were compared using log-rank tests.

The median length of stay in ICU was also estimated using a Kaplan-Meier estimator to take into account patients that may be still in ICU at the time of the analysis.

Baseline risk factors of death at ICU stay were assessed within the whole cohort using univariate and multivariate Cox regression. Proportional hazard assumption was assessed by inspecting the scaled Schoenfield residuals and Harrel's test [8]. Lastly, a sensitivity analysis using a Cox model stratified on the center variable was also performed. Hazard ratios and their 95% confidence interval were estimated. A p valve < 0.05 was considered statistically significant. Statistical analysis were conducted with R v 3.5.1.

Results

A total of 289 patients requiring ICU admission were enrolled to this study from ICU of University Hospital from 01st of July to 30th of December 2020. The number of ICU beds in this center were 35.

There were 192/289 (66.0%) male patients (Table 1). At ICU admission, their median age were 65 (52 - 81) years and 5 (3 - 8), respectively. The rate of obese (BMI ≥ 30 kg/m^2) patients was 131 (45.0%). The most common comorbidities were hypertension 147 (50.8%), DM 123 (42.6%) and cardiac diseases 102 (35.0%). Immuno-compromised status leads to ICU admission just in 13 of 289 cases (4.0%). Median (IQR) time between first symptoms and ICU admission was 9 (6 - 13) days and only 6/289 (2.0%) had concomitant bacterial pneumonia at ICU admission. However, bacterial infection was common among intubated patients 41/109 (37.0%) and these pathogens were responsible for developing of VAP in intubated patients.

Parameters	All patients (n = 289)	ARDS (n = 130)	non-ARDS (n = 159)	P value
Age, years	65 (52 - 81)	71 (58 - 81)	60 (51 - 70)	< 0,01
> 65 years No (%)	146 (50,0%)	104 (80,0%)	47 (26,0%)	< 0,0001
Male sex - No (%)	192 (66,4%)	105 (80,0%)	87 (54,0%)	< 0,01
BMI median range, kg/m^2	28,44 (23,40 - 32,61)	32,01(26,15 - 36,12)	25,39 (22,14 - 30,19)	< 0,001
Comorbidities				
Any	238 (82,0)	126 (96,0)	112 (70,0)	< 0,05
Hypertension	147 (50,8)	71 (54,0)	77 (48,0)	0,264
Diabetes Mellitus	111 (38,0)	58 (44,0)	53 (33,0)	0,122
Cardiac diseases	78 (26,0)	36 (27,0)	42 (26,0)	0,746
COPD	26 (8,0)	12 (9,0)	14 (8,0)	0,814
ILD	14 (4,0)	6 (4,0)	8 (5,0)	0,612
Asthma	19 (6,0)	8 (6,0)	11 (6,0)	0,947
Other	26 (8,0)	15 (11,0)	11 (6,0)	0,215
Clinical manifestation				
Dyspnea	126 (43,0)	91 (70,0)	35 (22,0)	< 0,001
Dry/moist rales	34 (11,0)	31 (24,0)	3 (1,0)	0,02
Total complications	48 (16,0)	40 (30,0)	8 (5,0)	<0,001
CT images				
Single lung involvement	31 (10,0)	0 (0)	31 (19)	—
Ground glass opacities	237 (82,0)	78 (60,0)	159 (100,0)	0,01
Consolidative/mixed opacities	89 (30,0)	86 (66,0)	3 (1,0)	< 0,001

Laboratory findings				u
Lymphocyte (x10^9/l)	1,12 (0,78 - 1,70)	0,65 (0,55 - 0,92)	1,14 (0,89 - 1,70)	< 0,001
< 0,6	68 (23,0%)	61 (46,0%)	7 (4,0%)	< 0,001
Creatinine (mmol/l)	64,10 (41,68 - 92,82)	52,4 (41,29 - 72,14)	47,12 (37,71 - 102,51)	0,714
LDH (U/L)	171,25 (125,8 - 218,82)	374,64 (192,55 - 401,54)	169,21 (132,21 - 215,96)	< 0,001
Blood Glucose (mmol/l)	289 (100,0%)	6,24 (5,14 - 12,26)	5,78 (5,01 - 9,26)	0,274
CRP (mg/l)	22,79 (6,55 - 38,49)	59,70 (23,30 - 102,26)	21,16 (6,49 - 45,21)	0,002
Procalcitonin (mcmol/l)	0,12 (0,04 - 0,28)	0,84 (0,60 - 82,83)	0,74 (0,09 - 0,48)	0,118
< 0,5	48 (16,0)	42 (32,0)	6 (3,0)	< 0,01
D-dimer (mg/l)	0,36 (0,09 - 0,78)	1,26 (0,39 - 9,12)	0,31 (0,12 - 1,12)	0,001
Albumin (g/l)	34,64 (30,26 - 37,18)	26,16 (24,86 - 32,25)	35,31 (31,24 - 38,26)	< 0,001
Prone position ventilation, n/%	156 (53,0)	46 (35,0)	110 (69,0)	< 0,01
HFNC, n%	178 (61,0)	39 (30,0)	139 (87,0)	< 0,001
NIPPV, n%	24 (8,0)	3 (2,0)	21 (13,0)	< 0,05
Intubation	109 (37,0)	109 (83,0)	0(0)	< 0,001
Antiviral therapy	280 (96,0)	130 (100,0)	150 (94,0)	1,000
Antibiotic therapy	211 (73,0)	130 (100,0)	81 (50,0)	< 0,001
Dexamethasone	205 (70,0)	126 (96,0)	79 (49,9)	< 0,001

Table 1: *Demographic clinical, and ventilator support characteristics of 289 ICU admitted patients.*

One hundred thirty patients (44,0) developed ARDS.

The use of HFNC and prone position ventilation in patients significantly reduces the risk of ARDS and related to intubation ($p < 0,001$ and $p < 0,01$ respectively). Among risk factors leading to development of ARDS were: age ($p < 0,01$), male gender ($p < 0,01$) and obesity with BMI more than 32 kg/m^2, $p < 0,001$. Comorbidities have been associated with increased risk for ARDS in severe COVID-19 patients ($p < 0,05$). Among symptoms most common presenting in ARDS group of patients was dyspnea ($p < 0,001$). Dry and moist rales as auscultating findings most common was noticed in ARDS patients (24% v s 1.0%; $p = 0,02$). Complications were most commonly in ARDS patients (40 [30%] v s 8 [5,0%]; $p < 0,001$). In patients with ARDS CT findings were most demonstrative and consolidate/mixed opacities with bilateral lung involvement has been found in 86 (66,0%) of 130 patients with ARDS and it was significantly higher compared to non-ARDS ICU admitted patients ($p < 0,001$).

Among laboratory findings the lymphocyte count level less than < 0,6 x 10^9/l significantly associated with developed ARDS ($p < 0,001$).

Compared to the non-ARDS group, patients in the ARDS group were significantly higher inflammation related indicators such as CRP (median 59,70 mg/l v s 21,16 mg/l; $p = 0,002$), PCT (32.0% v s 3,0%; $p < 0,01$), LDH (median 374,64 U/L v s 169,21 U/L; $p < 0,001$); higher coagulation function levels including D-dimer (1,26 mg/l vs 0,3 mg/l; $p < 0,001$); albumin (median 26,16 g/l vs 35,31 g/l; $p < 0,001$). The rick factors predicting development of ARDS are presented in table 1.

Univariate logistic regression analysis has been showed that older age [odds ratio (OR) = 1.14], obesity (OR = 3,21), dyspnea (OR = 3,45), dry/moist rales (OR = 6,64), lymphocytes (OR = 2,04), D-dimer (OR = 4,12), albumin (OR = 0,89 for high albumin compared to low albumin) and PCT (OR = 11,01) were all risk factors of ARDS.

Lack of use prone position ventilation in the patients with respiratory failure and lack of administration of HFNC and non-invasive ventilation despite indications for their use at the time of patients ICU admission were associated with worse outcomes and developed ARDS (OR = 2,01 for prone position ventilation and OR = 2,75 for High Flow nasal cannula). Lack of use dexamethasone at the onset of respiratory failure was significantly associated with increased risk of ARDS (OR = 2,12).

Severe sepsis and septic shock (OR = 4,87), kidney failure required renal replacement therapy (OR = 3,49) and high serum level of IL-6 (OR = 2,57) were associated with severe ARDS (p < 0,001). In intubated patients secondary multi-drug resistance (MDR) bacterial infection most frequently was associated with septic shock and severe ARDS (p < 0,001).

Multivariate logistic regression analysis showed only four significant independent risk factors: dyspnea (OR = 10,45), dry/moist rales (OR = 34,14), consolidative/mixed opacities (OR = 11,52) and PCT (adjusted OR = 17,24). The logistic regression analysis results are demonstrated in table 2.

Variables	OR (95% CI)	P value
Ages	1,14 (1,01 - 1,18)	< 0,01
Obesity	3,21 (1,28 - 8,42)	< 0,005
Dyspnea	3,45 (1,24 - 8,92)	< 0,004
Dry/moist rales	24,01 (3,94 - 52,09)	< 0,001
Consolidative/mixed opacities	6,64 (2,96 - 12,41)	0,002
Lymphocytes	2,04 (0,04 - 2,10)	< 0,001
D-dimer	4,12 (1,18 - 8,26)	0,001
Albumin	0,89 (0,71 - 0,97)	< 0,001
LDH	2,12 (1,64 - 2,89)	< 0,09
PCT	11,01 (2,01 - 68,4)	0,009
Lack of use prone position ventilation	2,01 (0,91 - 2,84)	< 0,01
Lack of use HFNC	2,75 (1,12 - 4,26)	< 0,008
Lack of use Dexamethasone	2,12 (0,92 - 4,41)	< 0,009

Logistic multivariate regression

Variables	OR (95% CI)	P value
Dyspnea	10,45	< 0,05
Dry/moist rales	34,45	< 0,01
Consolidative/mixed opacities	11,52	< 0,03
PCT	17,24	0,02

Table 2: *Logistic regression analysis for risk odds of acute respiratory distress syndrome.*

One hundred nine patients (37,0%) were intubated related to refractory respiratory failure and poor response to the HFNC and NIPPV and risk factors for intubation were: older age (p < 0,001), lack of use HFNC and NIPPV before intubation (p = 0,002), PaO_2/FiO_2 ratio (p = 0,002), lymphocyte count (p < 0,001), D-dimer (p = 0,002), LDH (p = 0,001) and IL-6 (p < 0,001). Risk factors predicting intubation in patients were presented in table 3.

Variables	All patients (n = 289)	Intubated (n = 109)	Non-intubated (n = 180)	P
Age	65,4 ± 12,24	71,8 ± 13,20	60,8 ± 14,25	< 0,001
Lack of use HFNC and NIPPV	111 (38,0)	70 (64,0)	41 (22,0)	0,009
PaO_2/FiO_2 (mm Hg)	168,0 (114,1-220,4)	128,8 (100,6-192,5)	199,2 (150,4-281,1)	0,002
$PaCO_2$ (mm Hg)	36,5 (32,4-40,6)	41,2 (35,2-48,1)	36,1 (31,7-41,3)	0,0721
Fibrinogen (g/l)	4,61 (3,61-5,62)	4,92 (3,61-6,22)	4,12 (3,7-5,1)	0,0841
D-dimer (mg/l)	0,36 (0,09-0,78)	1,29 (0,41-9,29)	0,32 (0,13-1,24)	0,002
Lymphocyte count (x 10^9/l)	1,12 (0,78-1,70)	0,59 (0,51-0,90)	1,15 (0,88-1,78)	< 0,001
Albumin (g/l)	34,64 (30,26-37,18)	25,36 (23,12-31,40)	35,17 (31,44-37,16)	< 0,001
Lactate dehydrogenase (U/L)	171,25 (125,8-218,82)	389,62 (201,44-426,52)	170,18 (130,16-224,91)	< 0,001
IL-6 (ng/ml)	246,14 (48,21-416,35)	489,19 (116,15-900,26)	180,81 (40,51-398,41)	< 0,001
Procalcitonin, mcmol/l	0,12 (0,04-0,28)	1,02 (0,62-86,12)	0,61 (0,08-0,96)	0,001

Table 3: *The assessment of risk factors predicting intubation in patients with COVID-19 admitted to the ICU.*

Overall in-hospital mortality rate among ICU admitted patients was 30,4% (80 of 289 patients) at the time of ICU admission their median (interquartile) age and median SOFA score were 65 (52 - 81) and 4 (3,0 - 7,0) respectively and there were significantly differences between age and median SOFA scores in survivors and non-survivors ICU admitted patients (p < 0,001).

Among comorbidities most important risk factor which associated with increased mortality rate was obesity and among non-survivors the BMI was significantly higher compared to survivors (p < 0,001). Median time between first symptoms and ICU admission was significantly differed in survivors and non-survivors (p < 0,001) and early administration of patients to ICU was associated with higher mortality rate and once again suggested for severity of the COVID-19 infection in non-survivors. Prone position ventilation in patients was lifesaving and was associated with improved survival of ICU admitted patients (p < 0,001).

HFNC was associated with good outcomes in patients and improved survival (p < 0,001), however, invasive mechanical ventilation was associated with increased mortality in patients (p < 0,001). There were low PaO_2/FiO_2, pH, HCO_3 and high $PaCO_2$ in blood gas analysis which associated with increased risk of mortality (p < 0,001). High level of serum creatinine and high D-dimer although were common in non-survivors (p < 0,001) and these findings suggested about the high prevalence of acute kidney failure and thromboembolic among non-survivors and similar to reference findings.

Overall in-hospital mortality rate among ICU admitted patients was 30,4% (Table 4) and risk factors predicting in-hospital mortality were: older age (p < 0,001), high mean SOFA score (p < 0,001), lymphopenia (p < 0,002), lack of use prone position ventilation (p < 0,04), high D-dimer level (p < 0,004) and MDR pathogens associated pneumonia in intubated patients (p < 0,001).

The univariate logistic regression analysis for in-hospital mortality is presented in table 5.

Characteristics	All patients, (n = 289)	Survivors (n = 201)	Non-survivors (n = 88)	P valve
Median SOFA score	4,0 (3,0-7,0)	3,0 (2,0-4,0)	8,0 (5,0-13.0)	< 0,001
Age	65,4 ± 12,24	59,2 ± 14,26	72,9 ± 12,21	< 0,001
Body mass index, kg/m^2	28,44 (23,40-32,61)	26,40 (21,36-31,43)	33,04 (27,19-36,81)	< 0,001
First symptoms to ICU admission, days	9 (6-13)	10 (7-13)	8 (5-12)	< 0,001
Prone position ventilation, n%	156 (53,0)	106 (68,0)	50 (32,0)	< 0,001
HFNC, n%	178 (61,0)	124 (69,0)	54 (31,0)	< 0,001
Invasive mechanical ventilation, n%	109 (37,0)	21 (19.0)	88 (81,0)	< 0,001
PaO_2/FiO_2	159 (109-231)	171 (120-254)	132 (89-194)	< 0,001
Blood gases, pH	7,40 (7,32-7,45)	7,42 (7,34-7,48)	7,37 (7,29-7,41)	< 0,001
PaCO2 (mm Hg)	39 (34-47)	38 (33-46)	42 (36-50)	< 0,001
HCO2, mmol/l	25 (21-28)	26 (23-29)	23 (20-26)	< 0,001
Lactate, mmol/l	1,3 (0,9-1,7)	1,2 (0,8-1,5)	1,4 (1,1-1,9)	< 0,001
Serum creatinine, mcmol/l	79 (60-110)	72 (58-109)	96 (71-158)	< 0,001
D-dimer, mg/l	0,36 (0,09-0,78)	0,30 (0,11-1,13)	1,29 (0,41-9,89)	0,001

Table 4: *Assessment of risk factors predicting in-hospital mortality in ICU admitted patients.*

Logistic univariate regression

Variables	OR (95% CI)	P valve
Ages	1,24 (1,11 - 1,46)	< 0,001
Lack of use prone position	1,18 (0,91 - 1,24)	< 0,04
D-dimer	2,46 (1,41 - 5,21)	< 0,004
Lymphocytopenia	2,87 (1,14 - 6,24)	< 0,002
MDR pathogens associated VAP	4,21 (1,12 - 9,26)	< 0,001
SOFA score	2,14 (1,86 - 12,41)	< 0,005

Table 5: *Logistic regression analysis for risk odds of in-hospital mortality in ICU admitted patients.*

A total of 201 patients (69.0%) had been discharged from ICU.

Discussion

The study presents a mono center retrospective observational study of 289 patients admitted to ICU for COVID-19 at University Hospital of Baku. Of all included patients, 130 (44,0%) developed ARDS at ICU admission, 109 (37,0%) required invasive mechanical ventilation, and 88 (30,0%) were died in ICU, demonstrating that COVID-19 infection can cause severe illness.

Our retrospective analysis has been shown that by assessing of some clinical manifestations of the disease such as dyspnea, dry/moist rales in auscultation the clinicians may predict the development of acute respiratory distress syndrome in ICU admitted patients with severe COVID-19. In such patients common CT finding was consolidative/mixed opacities which may explain more severe impairment of

gas exchange at the capillary-alveolar membrane permeability and development of severe respiratory failure refractory to oxygen therapy and required invasive mechanical ventilation. Lymphocytopenia occurred in more than 90% of COVID-19 patients admitted to ICU, which was similar to our university study [9,10]. We found that patients with ARDS had significantly lower lymphocyte counts than non-ARDS patients. We found that patients with lower lymphocyte count s were at higher risk for intubation and that lymphocytes costs ware significantly negatively correlated with SOFA score at ICU admission. We also found that lower lymphocyte counts were associated with higher mortality rate at ICU admission. In our study a lymphocyte count < 0,6 x 10^9/l was an independent risk factor for in-hospital mortality at ICU admission. Therefore, lymphocytopenia may predict the severity of COVID-19, need to intubation and also in-hospital mortality of patients admitted to ICU. Monitoring of lymphocytes counts might be useful in terms of predicting the intensive care phase of the clinical illness and mortality risk of patients admitted to ICU.

Ventilator support of clinically ill patients is important and guidelines based administration of ventilation supply with subsequently use of low oxygen flow high oxygen flow nasal cannula NIPPV mechanical ventilation ECMO might be lifesaving for such patients. In our study it has been suggested in significantly decreasing the number of ARDS and intubated patients in whom HFNC and NIPPV have been used (p < 0,001). In contrast to, the mortality risk was higher in whom HFNC and NIPPV were not applied (p < 0,001). Our findings suggested that early administration of prone position ventilation, nasal cannula and non-invasive ventilation may be preventable for invasive mechanical ventilation in patients at the time of respiratory failure.

Although our new finding in this study was the beneficial effect of use dexamethasone in low dose (6 mg/day) at the time of respiratory failure development and the use of this anti-inflammatory drug was associated with lower intubation rates and low incidence of ARDS development (p < 0,001).

The in-hospital mortality rate of ICU patients with COVID-19 was 30,4% in our retrospective study, which was higher as compared to reported mortality of ICU patients around the world [10-12]. There were a lot of factors associated with higher mortality. First, the age of non-survivors was higher compared to survivors ICU admitted patients (p < 0,001). In non-survivors the median SOFA score was higher compared to survivors (p < 0,001) and it is appropriate to other study findings [13,14]. The high median SOFA score once again suggested for common complication in ICU admitted patients as severe sepsis and septic shock. Serum creatinine level was higher in non-survivors and it also suggested for another common complication as acute kidney failure which associated with increased risk of mortality rate in ICU admitted COVID-19 patients.

Limitations of the Study

Our study has some limitations. First, the study was a retrospective assessment of 289 ICU admitted patients records and we could not assess patients all aspects of patients outcomes in ICU admitted COVID-19 patients. Second, despite that the study included high number (289) COVID-19 patients admitted to ICU of University Hospital, this study was one center based assessment of critically ill patients outcomes with COVID-19 admitted to ICU. Third, in our study we did not assess the administration of ECMO in our patients for that our department was not supply by ECMO machine, and the use of this device might impact to the result of patients outcomes accordingly death [14,15].

Conclusions

The patients with COVID-19 from ICU of Azerbaijan Medical University Hospital in our study had a higher ARDS incidence, intubated rate and ICU mortality (30,0%). There were several risk factors which associated with higher ARDS incidence, higher intubation rate and higher mortality rate. Larger cohort is still needed in future studies. Data availability statement and all datasets generated for this study are included in the article.

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Volume 10 Issue 6 June 2021