

Clinical Predictors of Mortality and Critical Illness in Patients



with COVID-19 Pneumonia

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Abstract: Early identification of patients with COVID-19 who will develop severe or critical disease symptoms is important for delivering proper and early treatment. We analyzed demographic, clinical, immunological, hematological, biochemical and radiographic findings that may be of utility to clinicians in predicting COVID-19 severity and mortality.

Methods: Electronic medical record data from patients diagnosed with COVID-19 from November, 2020 to June, 2021 in the COVID-19 Department in the Galilee Medical Center, Nahariya, Israel, were collected. Epidemiologic, clinical, laboratory and imaging variables were analyzed. Multivariate stepwise regression analyses and discriminant analyses were used to identify and validate powerful predictors. The main outcome measure was invasive ventilation, or death.

Results: The study population included 390 patients, mean age 61 ± 18 , 51% male. The non-survivors were mostly male, elderly and overweight and significantly suffered from hypertension, diabetes mellitus type 2, lung disease, hemodialysis and past use of aspirin. Four predictive factors were found that associated with increased disease severity and/or mortality: age, NLR, BUN, and use of high flow oxygen therapy (HFNC).

Conclusions: Predictive factors associated with increased mortality include age, NLR, BUN, and use of HFNC upon admission.

Variable	Survivors Non-Survivors		<i>p</i> -Value
Total	<i>N</i> = 318	N = 74	•
Age	58 ± 18	78 ± 12	0.001
Male (%)	47%	60%	0.60
BMI	29 ± 6	32 ± 11	0.008
Comorbidities %			
Diabetes (%)	30	57	0.001
Hypertension (%)	48	84	0.001
Lung disease (%)	9	18	0.03
Hemodialysis (%)	5	15	0.003
Aspirin use (%)	30	61	0.001
Symptom's duration			
before admission to	6 ± 5	9 ± 12	0.19
hospitals (days)			
Symptoms before			
admission			
(% of total)			
Fever %	57	56	0.77
Diarrhea %	6	2	0.26
Dyspnea %	59	59	0.74
Clinical severity on	30	54	0 001
admission %	00		0.001
Lab Findings upon			
admission			
Hemoglobin (mg/dl)	13 ± 3	12 ± 1.2	0.06
Absolute neutrophil count (×10 ³ /µL)	13 ± 9	13 ± 6	0.9
Absolute lymphocyte	2.06 ± 11	1.4 ± 4	0.001
Neutrophil to lymphocyte			
ratio (NLR)	7.01 ± 3	9.1 ± 0.8	0.001
Platelet (×10 ³ /µL)	220 ± 86	220 ± 90	0.79
BUN (mg/dl)	19 ± 14	40 ± 27	0.001
Creatinine (mg/dl)	2 ± 8	2.2 ± 2	0.7
Triglycerides (mg/dl)	145 ± 148	157 ± 48	0.08
HDL (mg/dl)	33 ± 12	30 ± 13	0.09
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A.					
	Coefficient	95%Conf. (±)	Std. Error	Т	<i>P</i> -value.
Constant					
Age	0.01	0.002	0.001	5.4	0.00001
Gender	-0.04	0.07	0.036	-1.36	0.17
Ethnicity	-0.04	0.07	0.03	-1.23	0.21
BMI	0.001	0.005	0.002	2.23	0.02
DM	0.04	0.088	0.044	1.05	0.2
HTN	-0.02	0.048	0.048	0.5	0.6
Hemodialysis	0.1	0.07	0.07	2.2	0.02
Lung disease 0.05		0.1	0.05	0.86	0.8
В.					
	Coefficient	95%Conf. (±)	Std. Error	Т	<i>P</i> -value.
Constant					
Past Aspirin use	0.14	0.08	0.04	3.6	0.0003
O ₂ supplement before admission	0.25	0.08	0.04	6.2	0.00001
orrelations bet A): Univariate rediction. (B): ortality risks.	ween risk fa analysis of Analysis of	ctors and more the strength past medical	rtality in CO of risk fac history of	OVID-19 tors in the pat	patients mortality ients and

Coefficient 95%Conf. (±)

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P-value

0.21	47 4	43
0.02	В	
0.2	Specificity	59.7
0.6	Sensitivity	97.9
0.02	Positive predictive value	86.7
0.0	Negative predictive value	91.5
value.	The validity (predictive pow NLR, BUN, and use of H	er) of age, FNC, and
.0003	mortality in COVID-19 pat	tients. The
00001	accuracy of the calculations is The number of samples:	s 87%. (A): Predicted
tients. rtality s and	condition—218, survival; 47, true condition, 0 for disease and disease. (B): the sensitivity,	death; and nd 1 for no specificity,
	positive predictive value all	u negative

predictive value.

Actual count

218

0

189

29

Survival analysis according to Cox regression

A

Clinical characteristics of the surviving and non-surviving patients with COVID-19 infection. NS: not significant (*p*)

Constant					
Age	0.01	0.01	0.008	1.35	0.18
BMI	0.008	0.024	0.01	0.89	0.38
SO2 upon admission	-0.004	0.044	0.02	-0.26	0.79
% Pneumonia	0.0003	0.007	0.003	0.104	0.9
PAO ₂ /FIO ₂	0.0002	0.001	0.0004	0.42	0.67
ARDS class	0.187	0.37	0.18	1.043	0.30
D-Dimer	-0.0001	8.60	0.001	-0.50	0.62
Fibrinogen	-0.000	0.0007	0.001	-1.26	0.21
NLR	0.00125	0.0014	0.001	1.84	0.076
Ferritin	0.001	0.0001	0.001	0.75	0.45
IL-6	0.0007	0.002	0.001	0.54	0.58
ALT	-0.001	0.007	0.001	-0.51	0.61
BUN	0.004	0.014	0.007	0.56	0.56
BUN Class	0.096	0.36	0.175	0.557	0.58
Cytokine storme	-0.068	0.33	0.16	-0.427	0.67
CRP	0.0001	0.002	0.001	0.10	0.92
HDL	-0.006	0.016	0.008	-0.81	0.42
HDL Class	0.003	0.34	0.169	0.01	0.98
TG	-0.0004	0.002	0.0014	-0.29	0.76
TG/HDL	-0.0004	0.055	0.026	-0.017	0.98
4C-score	-0.012	0.07	0.03	-0.36	0.71
High flow use	0.18	0.38	0.18	0.96	0.34
B					
	Coefficie	95%Conf.	Std.	т	D waluo
	nt	(±)	Error	1	I -value
Constant					
Age	0.009	0.005	0.002	3.1	0.003
NLR	0.001	0.001	0.0005	2.3	0.022
BUN	0.006	0.004	0.002	2.9	0.004
High flow use	0.258	0.183	0.091	2.8	0.006



Survival analysis versus hospitalization length using Cox regression.



Particités		1/		Significante
value < 0	.05).			

Conclusions:

1. Predictive with associated factors increased mortality include age, NLR, BUN, and use of HFNC upon admission. 2. Identifying those with higher risks of mortality could help in early interventions to reduce the risk of death.

Univariate analyses of the strength of clinical and laboratory tests in predicting mortality in COVID-19 patients. (B): Multiregression analyses of the clinical parameters, blood tests and their correlation to mortality in COVID-19 patients.

Cytokines levels in COVID-19 patients: The cytokines measured are CCL-2, CCL-3, CXCL-10, GCSF, IFN-gamma, IL-10, IL-2, IL-4, IL-6, IL-7 and TNF α . Cytokine levels were measured upon admission and upon discharge, in severely ill and mildly ill patients, and also between survivors and those not surviving. (A): Cytokine levels upon admission vs. upon discharge. (**B**) survivors vs. non-survivors. * *p* < 0.05, ** *p* < 0.001.