MÆDICA - a Journal of Clinical Medicine

ORIGINAL PAPER

MAEDICA – a Journal of Clinical Medicine
2022; 17(3): 672-679
https://doi.org/10.26574/maedica.2022.17.3.672

Risk Assessment of COVID-19 Infection among the Elderly Population

Varatharajan SAKTHIVADIVEL[a], Jeganathan GEETHA[b], Devarajan RADHA[c], Archana GAUR[d], Ariyanachi KALIAPPAN[e], Bobby ABRAHAM[c], Yuvaraj BALAN[f], Kalpana MEDALA[d], Lakshmi Jyothi TADI[g]

[a]Department of General Medicine, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India

[b]Department of General Medicine, Karpaga Vinayaga Institute of Medical Sciences and Research, Maduranthgam, Tamilnadu, India

[c]Department of General Medicine, Government Villupuram Medical College, Mundiyambakkam, Tamilnadu, India

[d]Department of Physiology, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India

[e]Department of Anatomy, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India

[f]Department of Biochemistry, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India

[g]Department of Microbiology, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India

ABSTRACT

Introduction: *Elderly patients are susceptible to COVID-19 infection. They usually present with atypical symptoms and multiple organ dysfunction. The poor outcome in elderly patients is due to multiple co-morbidities, declining functional status, and frailty. This study aimed to assess the risk profile of COVID-19 infection in the elderly population.*

Materials and methods: *Patients aged 60 years and above with COVID-19 positive by RT-PCR were included in the study. Patients' demographic data, co-morbidities and severity of illness, complete hemogram, blood sugar, renal, liver function test, lactate dehydrogenase, interleukin-6, ferritin, D-dimer were noted. Patients' outcome in terms of survival was observed.*

Results: *The total count, neutrophil lymphocyte ratio, ESR, urea, creatinine, interleukin 6, D-dimer, and blood sugar value were significantly associated with non-survival even after adjustment for age and*

Address for correspondence:
Dr Varatharajan SAKTHIVADIVEL, MD, Associate Professor
Department of General Medicine, All India Institute of Medical Sciences, Bibinagar, Hyderabad, Telangana, India, Pin-508126
Mobile tel.: 91-9962528811; email: vsakthivadivel28@gmail.com

Article received on the the 29th of June 2022 and accepted for publication on the 29th of September 2022

gender. Complications such as acute kidney injury (AKI), renal failure, acute respiratory distress syndrome, multiorgan dysfunction syndrome (MODS), and World Health Organization (WHO) severity were also associated with non-survival before and after adjustment for age and gender. On Cox regression survival analysis, ≥ three co-morbidities had hazard ratio (HR) of 54.36 [95% CI 3.66 to 807.01], WHO severity had HR of 31.09 [95% CI 1.31 to 738.22], MODS had HR of 16.97 [95% CI 2.86 to 100.39], creatinine had HR of 8.44 [95% CI 1.99 to 35.77], AKI had HR of 6.71 [95% CI 1.11 to 40.56].

Conclusion: *In elderly patients with COVID-19 infection, the presence of at least three co-morbidities, severity of infection by WHO criteria and presence of complications such as MODS, elevated creatinine and AKI were predictors of the survival rate and mortality.*

Keywords: elderly, COVID-19, co-morbidities, MODS, WHO severity.

INTRODUCTION

Coronavirus disease (COVID-19) is an infectious disease caused by SARS-CoV-2, a novel type of Coronavirus, which belongs to the *Coronaviridae* family of the *Nidovirales* order. It is highly pathogenic to humans and highly transmissible. The most common clinical manifestations of COVID-19 infection include fever, dyspnea, cough, myalgia, and fatigue. Some patients develop severe pneumonia and may present as acute respiratory distress syndrome (ARDS). Few patients present with extrapulmonary organ dysfunction or even death (1). Older age has been identified as an important risk factor for the severity of disease, with increasing death rates across every decade of life. Elderly patients are susceptible to COVID-19 infection and have a poor outcome. They usually present with atypical symptoms and multiple organ dysfunction. Elderly patients with COVID-19 may present with only fatigue, myalgia, headache, or gastrointestinal symptoms. Old age is one of the main risk factors for poor outcomes. This poor outcome in the elderly is due to multiple co-morbidities, declining functional status, declining cognitive status, and frailty (2).

Aging causes many biological changes in the immune system making elderly patients more susceptible to infectious diseases. Age-related immune-mediated inflammation and associated inflammatory diseases increase with aging (3). Immunosenescence and inflammaging are key factors of the aging immune system, in which accumulation of senescent immune cells leads to its decline and simultaneous increase in inflammatory phenotype leads to immune dysfunction. Age-related changes in the immune system affect cells and soluble mediators of immune responses, which determine susceptibility to infection, disease progression, and clinical outcomes. These changes also influence the response to medications and immune response to vaccines (4). Thus, age-related changes in the immune system along with co-morbidities in elderly patients render them more vulnerable to latent or novel infection and hence increase in morbidity and mortality of COVID-19 infection. This study was aimed at assessing the clinical and biochemical profile of elderly patients with COVID-19 infection. ❑

MATERIAL AND METHODS

This retrospective observational study was done in a tertiary care center from South India after obtaining the ethics approval from the Institute Ethics Committee (GVMC/IEC/2020/28). Data was obtained from the previous records of the hospital from March 2020 to July 2020. All patients aged 60 years and above who were admitted in specified wards/intensive care for COVID-19 were enrolled in the present study. The total number of patients in the study was 137 after nCoV-19 (novel coronavirus 2019) positive test confirmed by an RT-PCR. Variables assessed at baseline, including the socio-demographic profile and co-morbidities such as diabetes, hypertension, ischemic heart disease, bronchial asthma, chronic kidney disease, hypothyroidism, stroke, etc were collected. Patients

were categorized according to the Ministry of Health and Family Welfare (MoHFW) and World Health Organization (WHO) criteria (5, 6). Worsening signs of COVID-19 in the form of hypotension, sepsis, multiorgan dysfunction syndrome (MODS), pneumonia, ARDS, respiratory failure, myocarditis, coronary artery disease (CAD), heart failure, acute kidney injury (AKI), deep vein thrombosis, pulmonary thrombo-embolism, and stroke were noted. Complete hemogram, blood sugar, renal and liver function tests, C-reactive protein (CRP), interleukin 6 (IL-6), ferritin, d-dimer, lactate dehydrogenase (LDH), creatine kinase N-acetyl cysteine (CK-NAC), prothrombin time (PT), international normalized ratio (INR) and activated partial thromboplastin time (APTT) were outlined. Patients' outcome in terms of recovery and mortality was noted.

Statistical analysis

Data was analyzed using SPSS 22.0. Quantitative variables were represented as mean±SD (standard deviation) or median. Qualitative data were presented as numbers and percentages. The Chi-square test was used to find the difference among the qualitative data. Unpaired t-test was used to analyze the difference among quantitative variables. Overall survival was assessed by Cox proportional hazards regression models. The P value of less than 0.05 was considered statistically significant. ❑

RESULTS

The mean age of the study subjects did not differ among survivors and non-survivors. The proportion of males was higher (70%) in both groups; 90% of both groups had hypertension and 50% diabetes. The number of subjects with at least three co-morbidities was significantly greater in the non-survivor group (Table 1).

The most common presenting symptom in both groups was fever, but respiratory distress was greater (52.6%) in the non-survivor group. Everyone in the non-survivor group developed complications. In both groups, the most commonly seen complication was ARDS, followed by renal failure and AKI, and thereafter MODS, sepsis, arrhythmia, and pneumonia in sporadic cases. According to MOHFW classification, all non-survivors had a grade 3 severity, while survivors were strewn in all grades, mostly grade 1. Similarly, according to WHO severity, non-survivors had grade 4 or 3 and survivors mostly grade 1 (Table 2).

Among non-survivors, the total count, neutrophil count, lymphocyte count, neutrophil lymphocyte ratio (N/L ratio), creatinine, IL-6, D-dimer, RBS, and APTT were significantly greater and lymphocyte count significantly lesser (Table 3).

On logistic regression, the presence of at least three co-morbidities before and after adjustment for age and gender was significantly associated

Parameter	Survivors n=118 (percentage)	Non-survivors n=19 (percentage)	*P* value
Mean age in years (SD)	68.72 (6.55)	68.79 (6.7)	0.967
Gender			0.772
Male	91 (77.1)	14 (73.7)	
Female	27 (22.9)	5 (26.3)	
Smoking	4 (3.4)	-	1.000
Co-morbidities			
Hypertension	107 (90.7)	18 (94.7)	1.000
Diabetes mellitus	60 (50.8)	11 (57.9)	0.627
Ischemic heart disease	17 (14.4)	6 (31.6)	0.092
Hypothyroidism	-	5 (26.3)*	0.000
Stroke	-	3 (15.8)*	0.002
Chronic kidney disease	-	2 (10.5)*	0.018
Asthma	-	1 (5.3)	0.139
Pulmonary tuberculosis	1 (0.8)	-	1.000
Interstitial lung disease	1 (0.8)	-	1.000
Rheumatoid arthritis	1 (0.8)	-	1.000
Brain tumor	-	1 (5.3)	0.139
At least three co-morbidities	12 (10.2)	10 (52.6)*	0.000

TABLE 1. General characteristic of the study population

Parameter	Survivors n=118 (percentage)	Non-survivors n=19 (percentage)	*P* value
Fever	71 (60.2)	14 (73.7)	0.316
Cough	56 (47.5)	12 (63.2)	0.226
Respiratory distress	45 (38.1)	10 (52.6)	0.313
Headache	3 (2.5)	-	1.000
Complications	18 (15.3)	19 (100)*	0.000
Acute kidney injury	5 (4.2)	7 (36.8)*	0.000
Renal failure	2 (1.7)	10 (52.6) *	0.000
ARDS	8 (6.8)	16 (84.2) *	0.000
MODS	1 (0.8)	3 (15.8) *	0.008
Sepsis	1 (0.8)	1 (5.3)	0.259
Arrhythmia	0	1 (5.3)	0.139
Pneumonia	6 (5.1)	1 (5.3)	1.000
MOHFW severity			0.000
Grade 0	7 (5.9)	0	
Grade 1	53 (44.9)	0	
Grade 2	22 (18.6)	0	
Grade 3	36 (30.5)	19 (100) *	
WHO severity			0.000
Grade 0	7 (5.9)	0	
Grade 1	53 (44.9)	0	
Grade 2	22 (18.6)	0	
Grade 3	24 (20.3)	1 (5.3)	
Grade 4	12 (10.2)	18 (94.7) *	
Duration of hospitalization in days	8.42 (4.45)	12.26 (5.1)*	0.005

ARDS=acute respiratory distress syndrome, MODS=multiorgan dysfunction syndrome, MOHFW=Ministry of Health and Family Welfare, WHO=World Health Organization

TABLE 2. Clinical features of the study population

Parameters	Survivors n=118 Mean (SD)	Non-survivors n=19 Mean (SD)	*P* value
Hemoglobin (gms)	12.97 (1.9)	12.53 (1.93)	0.368
Total count (cells/mm^3)	8204.07 (4168.46)	11510.53(4643.42)*	0.008
Neutrophil count (cells/mm^3)	6298.86 (4136.18)	10127 (4742.64)*	0.003
Lymphocyte count (cells/mm^3)	1135.5 (544.79)	887.84 (392.85)*	0.000
N/L ratio	5.07 (3.37)	11.47 (3.17)*	0.000
Platelet (cells/mm^3)	256025.42 (93160.64)	256789.47 (82156.74)	0.971
ESR (mm/hour)	31.64 (15.97)	40.79 (19.84)*	0.027
C-Reactive Protein (mg/dL)	61.83 (47.13)	65.89 (29.28)	0.614
Procalcitonin (ng/mL)	0.25 (0.32)	0.27 (0.22)	0.631
Ferritin (ng/mL)	329.62 (198.29)	400.79 (198.23)	0.159
AST (U/L)	44.44 (22.65)	47.42 (19.52)	0.551
ALT (U/L)	41.88 (27.11)	42.68 (17.96)	0.869
Albumin (gm/dL)	3.58 (0.59)	3.58 (0.61)	0.969
Urea (mg/dL)	33.32 (12.90)	39.95 (14.83)*	0.044
Creatinine (mg/dL)	1.08 (0.64)	1.53 (0.77)*	0.027
Interleukin 6 (pg/mL)	51.65 (25.83)	86.11 (34.73)*	0.000
D-dimer (µg/mL)	2.13 (1.42)	5.42 (2.17)*	0.000
Lactate Dehydrogenase (U/L)	288.77 (146.74)	303.05 (90.09)	0.567
CK-NAC (U/L)	68.52 (32.69)	73.89 (33.25)	0.518
Random blood sugar (mg/dL)	142.65 (61.45)	190.16 (76.63)*	0.017
Prothrombin time (seconds)	13.88 (1.74)	14.58 (2.43)	0.129
INR	1.03 (0.16)	1.0 (0.18)	0.458
APTT (seconds)	30.31 (9.79)	34.53 (5.92)*	0.014

N/L ratio=neutrophil lymphocyte ratio, ESR=erythrocyte sedimentation rate, AST-aspartate transaminase, ALT-alanine transaminase, CK-NAC=creatine kinase N-acetyl cysteine, INR=international normalized ratio, APTT=activated partial thromboplastin time.

TABLE 3. Laboratory parameters of the study population

TABLE 4. Logistic regression analysis of risk factors for outcome in the elderly population

	Univariate analysis		Age, sex adjusted analysis	
Parameter	**OR (95% CI)**	***P* value**	**Adjusted OR (95% CI)**	***P* value**
≥ three co-morbidities	9.82 (3.33-28.91)	0.000	10.83 (3.48-33.64)*	0.000
Hypothyroidism	-	0.999	-	-
Stroke	-	0.999	-	-
Chronic kidney disease	-	0.999	-	-
Duration of hospitalization	0.85 (0.77-0.94)	0.002	0.84 (0.76-0.94)*	0.001
Total count	1.0 (1.0-1.0)	0.004	1.00 (1.00-1.00)*	0.003
N/L ratio	0.63 (0.52-0.76)	0.000	0.63 (0.52-0.76)*	0.000
ESR (mm/hour)	0.96 (0.94-0.99)	0.031	0.96 (0.94-0.99)*	0.031
Urea (mg/dL)	0.96 (0.93-1.00)	0.054	0.96 (0.93-1.00)*	0.049
Creatinine (mg/dL)	0.52 (0.27-0.99)	0.049	0.51 (0.26-0.97)*	0.041
Interleukin 6 (pg/mL)	0.97 (0.95-0.98)	0.000	0.97 (0.95-0.98)*	0.000
D-dimer (µg/mL)	0.39 (0.27-0.57)	0.000	0.38 (0.26-0.56)*	0.000
RBS (mg/dL)	0.99 (0.98-0.99)	0.006	0.99 (0.98-0.99)*	0.006
APTT (seconds)	-	0.149	-	0.155
Complications	-	0.996	-	0.996
AKI	13.18 (3.62-48.02)	0.000	15.47 (3.94-60.7)*	0.000
Renal failure	64.44 (12.22-339.88)	0.000	65.49 (12.33-347.99)*	0.000
ARDS	73.33 (17.61-305.45)	0.000	83.09 (18.86-366.16)*	0.000
MODS	21.93 (2.15-223.83)	0.009	22.91 (2.21-237.26)*	0.009
MOHFW severity	-	0.995	-	-
WHO severity	0.026 (0.003-0.206)	0.001	0.024 (0.003-0.199)*	0.001

N/L ratio=neutrophil lymphocyte ratio, ESR=erythrocyte sedimentation rate, RBS=random blood sugar, APTT=activated partial thromboplastin time, AKI=acute kidney injury, ARDS=acute respiratory distress syndrome, MODS=multiorgan dysfunction syndrome, MOHFW=Ministry of Health and Family Welfare, WHO=World Health Organization

TABLE 5. Cox regression survival analysis of risk factors in the elderly population

Parameter	Hazard ratio (95% CI)	*P* value
≥ three co-morbidities	54.36 (3.66-807.01)	0.004
NL ratio	1.53 (1.17-2.01)	0.002
ESR	1.05 (1.01-1.10)	0.015
Urea	0.88 (0.81-0.96)	0.006
Creatinine	8.44 (1.99-35.77)	0.004
IL 6	1.05 (1.01-1.08)	0.002
D-dimer	1.63 (1.08-2.46)	0.020
AKI	6.71 (1.11-40.56)	0.038
MODS	16.97 (2.86-100.39)	0.005
WHO severity	31.09 (1.31-738.22)	0.033

N/L ratio=neutrophil lymphocyte ratio, ESR=erythrocyte sedimentation rate, IL 6=interleukin 6, RBS=random blood sugar, AKI=acute kidney injury, MODS=multiorgan dysfunction syndrome, WHO=World Health Organization

with poorer survival outcomes [OR-10.83 (CI-3.48-33.64)]. Duration of stay was associated with poor outcomes in univariate analysis, but on adjustment with age and gender, this association was lost. The total count, N/L ratio, ESR, urea, creatinine, IL 6, D-dimer, and blood sugar value were significantly associated with non-survival before and after adjustment. Complications such as AKI, renal failure, acute respiratory distress syndrome and MODS were significantly associated with non-survival. The WHO severity was also associated with non-survival before and after adjustment for age and gender (Table 4).

In Cox regression analysis for survival, HR was 54.36 (95% CI 3.66 to 807.01) for the presence of ≥three co-morbidities, 8.44 (95% CI 1.99 to 35.77) for creatinine, 6.71 (95% CI 1.11 to 40.56) for AKI, 16.97 (95% CI 2.86 to 100.39) for MODS, and 31.09 (95% CI 1.31 to 738.22) for WHO severity (Table 5). ❑

DISCUSSION

Age is thought to be a crucial factor for the clinical outcomes, course, severity and prognosis of the disease. In the current study, the mean age did not differ among survivors and non-survivors. In our study, on logistic regression the presence of at least three co-morbidities before and after adjustment for age and gender was

significantly associated with poorer survival outcomes [OR 10.83 (CI 3.48 to 33.64)]. Diabetes and hypertension were shown to be the prevalent underlying illnesses in COVID-19 patients from previous studies (7). Among the non-survivors of the present study, the prevalence of hypertension was 94.7% and that of diabetes 57.9%. Though there was no statistically significant difference in the prevalence of hypertension or diabetes between survivors and non-survivors, more than half of the non-survivors had at least three pre-existing co-morbidities in addition to diabetes and hypertension, mostly being ischemic heart disease, hypothyroidism, and chronic kidney disease. In our study, Cox regression analysis found that the presence of ≥ three pre-existing co-morbidities was also associated with in-hospital mortality [HR 54.36 (3.66 to 807.01)]. These findings are in accordance with those of previous studies which showed that patients with chronic renal disease and heart failure were more vulnerable than those without these problems to die from COVID-19. It has been documented that COVID-19 patients with diabetes, hypertension, and cardiorespiratory illness had a significantly higher risk of severe disease and increased risk of mortality (8).

Among the common symptoms, our study showed that the presence of respiratory distress at the time of admission was an indicator of poor prognosis and survival in geriatric patients. This is consistent with the previous findings, which have also shown that in geriatric patients with COVID-19, early dyspnea at admission and fever throughout hospitalisation were both major risk factors for a bad prognosis and increased mortality (9). According to MOHFW classification, all non-survivors had grade 3 severity, while survivors were scattered in all grades, mostly in grade 1. Similarly, according to WHO severity, non-survivors had grade 4 or 3 and survivors mostly grade 1. This implies that patients presenting with, or developing, severe pneumonia, ARDS, sepsis or septic shock have a higher risk of mortality and a poor survival rate. In our study, Cox regression analysis found WHO severity was associated with in-hospital mortality, with HR 31.09 (1.31-738.22). A similar study documented that in the first 24 hours, respiratory symptoms, hypoxia and hypotension predicted the progression to severe disease, while tachypnea and hypotension were associated with increased in-hospital mortality (10). This highlights the necessity of early and regular vital sign monitoring, which may reveal early symptoms of imminent worsening or mortality.

In this study, during hospitalization, AKI, renal failure, ARDS and MODS were significantly associated with non-survival after adjustment for age and sex. Also in our study, Cox regression analysis found a HR of 6.71 (1.11-40.56) for AKI. A similar study was done to evaluate the clinical characteristics of elderly patients, of which about 40% developed ARDS and required invasive mechanical ventilation (2). Another study reported that secondary infection (34%) was the most commonly seen complication in elderly patients, followed by AKI (22%) and ARDS (20%). The weighted pooled prevalence of AKI and ARDS in others studies vary from 2.7% to 25.5% and 15.7 to 19.5%, respectively, with a considerable proportion of patients (21%) needing invasive mechanical breathing (11). Studies have also shown that as COVID pneumonia progressed, the incidence of AKI was significantly increasing as well as in-patient mortality once the AKI set in. The mechanism behind kidney impairment in COVID-19 patients is now thought to entail SARS-CoV-2 targeting intrinsic renal cells directly. SARS-CoV-2 is a cytopathic virus that enters host cells bypassing *via* the membrane protein ACE2. Renal cells had the fourth-highest level of ACE2 expression among the six blood cell types and 55 tissue types. Also, AKI is frequently a sign of a more serious illness and multiorgan failure, hence kidney function restoration should be a key aspect of management (12).

In our study, Cox regression analysis found a HR of 16.97 (2.86 to 100.39) for MODS. In a similar study, it was documented that after a 58-day hospitalisation, the MODS group had a 44% death rate, while the non-MODS group had only 1% mortality rate (13). Another study also reported that MODS was the major cause of death (37%) in hospitalized elderly patients (14). Coronavirus is thought to decrease the immunological response, weaken the body's defensive mechanism, and finally cause an uncontrolled inflammatory storm. The alveolar-capillary barrier is disrupted by this uncontrolled inflammatory process, and virus particles, along with the resultant cytokine storm, can subsequently move to other organs, resulting in MODS. Multiorgan organ dysfunction syndrome is

frequently associated with a worse prognosis and increased mortality. Hence, vigilant monitoring and prompt supportive medications are advocated halting the disease progression before it is too late.

Immunological senescence, or age-related reduction in immune function, affects both the innate and adaptive immune systems in the elderly population. Furthermore, having multiple comorbidities increases the risk of exacerbated immune responses and even chronic inflammation in the elderly. However, those immune responses are frequently abnormal, creating an ideal situation for SARS-CoV-2 to infect this vulnerable group. In this study, the vast majority of patients among non-survivors had neutrophilia and lymphopenia. The laboratory results of our patients were consistent with those reported by previous studies. Lymphopenia was a prevalent anomaly in SARS-CoV-2 infected patients, with 32.5–75.4% of COVID-19 patients experiencing it (15). The number of circulating naive CD4+ and CD8+ T cells decreased with age in large research involving 1,068 healthy people, indicating immunosenescence of the immune system (3). According to a recent study, individuals with severe COVID-19 had fewer CD4+ and CD8+ T cells than non-severe ones (16). The findings of the two investigations might explain why aged people had a greater prevalence of severe COVID-19, which could be attributed to a lack of T cells. Also, the N/L ratio was significantly greater among the non-survivors of this study. Similar studies have shown that the N/L ratio tended to decrease from the time of diagnosis in elderly non-survivors, whereas neutrophilia and lymphopenia improved in survivors and worsened in non-survivors (17). A study documented that a N/L ratio ≥ 3.13 had a high risk of critical illness, intensive care therapy, and mortality (18). These cells may have aided healing by reducing inflammatory responses in survivors, and death by increasing inflammatory responses in COVID-19 non-survivors.

Levels of IL-6, the most prevalent kind of cytokine generated by activated macrophages, have been found to dramatically rise in patients with severe COVID-19 symptoms, according to studies. Our study is also consistent with this finding, with the IL-6 level being significantly greater among non-survivors, indicating a poor prognosis in elderly patients (15, 19). Multiple organ damage and septic shock have been linked to elevated levels of interleukin-6, which might lead to cardiac and circulatory failure. The specific cause of this dysregulated immunological response in the elderly is unknown; nevertheless, age-related changes in lung microstructure that modify the physiological function of dendritic cells, particularly their migration to lymph nodes, might be a factor, resulting in faulty T-lymphocyte activation (20). D-dimer is produced by the lysis of cross-linked fibrin, with increased levels suggesting coagulation and fibrinolysis activation. COVID-19 has been linked to haemostatic disorders in the past, with one research finding higher levels of D-dimer, a coagulation marker, among non-survivors compared to survivors (21). Our study is also consistent with this finding, with the higher levels of D-dimer among non-survivors paving a way for poor prognosis. Researchers discovered that ICU patients had higher median D-dimer levels than non-ICU patients. This implies that D-dimer levels can be used as a biomarker for prognosis, allowing physicians to keep track of patients whose health status is more likely to worsen (22).

In this study, the levels of urea and creatinine were considerably greater among non-survivors. An elevated creatinine level was also significantly associated with in-hospital mortality in our study, as revealed by Cox regression analysis. Studies have shown considerably elevated levels of renal biomarkers such as serum urea and creatinine in severe COVID cases (23). In another similar study, COVID-19 patients with advanced age exhibited greater levels of creatinine and blood urea nitrogen, which might be explained by the loss of renal function that comes with ageing (24). However, it emphasizes the significance of monitoring renal function in elderly people and using therapies that have fewer renal adverse effects. Another study of 701 individuals found that high blood creatinine levels on admission were associated with severity due to substantial coagulation system abnormalities (25). Therefore, renal anomalies at the time of admission may signal a poor prognosis and higher risk of mortality, necessitating proper triaging.

Limitations

Our research was done in a single tertiary centre and, being a retrospective study, it had limitations due to inter-observer variability. ❑

CONCLUSIONS

In hospitalized elderly patients with COVID-19 infection, the presence of ≥ three co-morbidities, severity of the infection by WHO criteria and presence of complications such as MODS, elevated creatinine and AKI were predictors of survival rate and mortality. In the geriatric population, these typical parameters, and not disparities in age, should be utilised to assess prognosis and management. ❑

Acknowledgments: We would like to thank the institute for providing support and facilities for the present study as well as the faculties, students and staffs involved in COVID care management.

Conflicts of interest: none declared.

Financial support: none declared.

References

1. **Gao Z, Xu Y, Sun C, et al.** A systematic review of asymptomatic infections with COVID-19. *J Microbiol Immunol Infect Wei Mian Yu Gan Ran Za Zhi* 2021;54:12-16.
2. **Guo T, Shen Q, Guo W, et al.** Clinical Characteristics of Elderly Patients with COVID-19 in Hunan Province, China: A Multicenter, Retrospective Study. *Gerontology* 2020;66:467-475.
3. Aging of immune system: Immune signature from peripheral blood lymphocyte subsets in 1068 healthy adults - PubMed (Internet). (cited 2022 Feb 10). Available from: https://pubmed.ncbi.nlm.nih.gov/26886066/.
4. **Felsenstein S, Herbert JA, McNamara PS, Hedrich CM.** COVID-19: Immunology and treatment options. *Clin Immunol Orlando Fla* 2020;215:108448.
5. Living guidance for clinical management of COVID-19 (Internet). (cited 2022 Feb 14). Available from: https://www.who.int/publications-detail-redirect/WHO-2019-nCoV-clinical-2021-2.
6. Guidelines on Clinical Management of COVID-19:15.
7. **Guan W-J, Ni Z-Y, Hu Y, et al.** Clinical Characteristics of Coronavirus Disease 2019 in China. *N Engl J Med* 2020;382:1708-1720.
8. **Guan W, Liang W, Zhao Y, et al.** Comorbidity and its impact on 1590 patients with COVID-19 in China: a nationwide analysis. *Eur Respir J* (Internet). 2020 May (cited 2022 Feb 10);55(5). Available from: https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC7098485/.
9. **Du R-H, Liang L-R, Yang C-Q, et al.** Predictors of mortality for patients with COVID-19 pneumonia caused by SARS-CoV-2: a prospective cohort study. *Eur Respir J* 2020;55:2000524.
10. **Pandita A, Gillani FS, Shi Y, et al.** Predictors of severity and mortality among patients hospitalized with COVID-19 in Rhode Island. *PLoS One* 2021;16:e0252411.
11. **Zhu J, Ji P, Pang J, et al.** Clinical characteristics of 3062 COVID-19 patients: A meta-analysis. *J Med Virol* 2020;92:1902-1914.
12. **Li Q, Zhang T, Li F, et al.** Acute Kidney Injury Can Predict In-Hospital Mortality in Elderly Patients with COVID-19 in the ICU: A Single-Center Study. *Clin Interv Aging* 2020;15:2095.
13. **Cui J, Yuan B, Li Y, et al.** The clinical characters and prognosis of COVID-19 patients with multiple organ dysfunction. *Medicine* (Baltimore) (Internet). 2021 Oct 15 (cited 2022 Feb 12);100(41). Available from: https://www.ncbi.nlm.nih.gov/labs/pmc/articles/PMC8519259/.
14. **de Roquetaillade C, Bredin S, Lascarrou J-B, et al.** Timing and causes of death in severe COVID-19 patients. *Crit Care* 2021;25:224.
15. **Chen N, Zhou M, Dong X, et al.** Epidemiological and clinical characteristics of 99 cases of 2019 novel coronavirus pneumonia in Wuhan, China: a descriptive study. *Lancet Lond Engl* 2020;395:507-513.
16. Characteristics of lymphocyte subsets and cytokines in peripheral blood of 123 hospitalized patients with 2019 novel coronavirus pneumonia (NCP) | medRxiv (Internet). (cited 2022 Feb 10). Available from: https://www.medrxiv.org/content/10.1101/2020.02.10.20021832v1.
17. **Alagbe AE, Pedroso GA, Oliveira BB de, et al.** Lymphocyte Ratios Progressively Worsen in Non-Survivors of COVID-19. *Blood* 2021;138:4196.
18. **Liu J, Liu Y, Xiang P, et al.** Neutrophil-to-lymphocyte ratio predicts critical illness patients with 2019 coronavirus disease in the early stage. *J Transl Med* 2020;18:206.
19. **Sakthivadivel V, Bohra GK, Maithilikarpagaselvi N, et al.** Association of Inflammatory Markers with COVID-19 Outcome among Hospitalized Patients: Experience from a Tertiary Healthcare Center in Western India. *Maedica A Journal of Clinical Medicine* 2021;16;620-627.
20. **Zhang C, Wu Z, Li J-W, et al.** Cytokine release syndrome in severe COVID-19: interleukin-6 receptor antagonist tocilizumab may be the key to reduce mortality. *Int J Antimicrob Agents* 2020;55:105954.
21. **Tang N, Li D, Wang X, Sun Z.** Abnormal coagulation parameters are associated with poor prognosis in patients with novel coronavirus pneumonia. *J Thromb Haemost* 2020;18:844-847.
22. **Kermali M, Khalsa RK, Pillai K, et al.** The role of biomarkers in diagnosis of COVID-19 – A systematic review. *Life Sci* 2020;254:117788.
23. Potential biochemical markers to identify severe cases among COVID-19 patients | medRxiv (Internet). (cited 2022 Feb 10). Available from: https://www.medrxiv.org/content/10.1101/2020.03.19.20034447v1.
24. The aging kidney: physiological changes - PubMed (Internet). (cited 2022 Feb 10). Available from: https://pubmed.ncbi.nlm.nih.gov/20610357/.
25. **Cheng Y, Luo R, Wang K, et al.** Kidney disease is associated with in-hospital death of patients with COVID-19. *Kidney Int* 2020;97:829-838.