Clinical research

Coronavirus disease 2019 (COVID-19) in older patients: outcomes and risks of mortality

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Abstract

Introduction: To understand how age and other factors impacted outcomes, we examined characteristics of patients aged 65 years and older hospitalized with COVID-19.

Material and methods: This was a retrospective cohort study that included all patients aged 65 years and older with laboratory-confirmed COVID-19, who were admitted to a suburban New York academic medical centre between 15 March and 13 May 2020, and discharged.

Results: Of 196 patients, the median age was 76 years, with 57% male, and 66% white. A greater proportion of "older" (77–105 years) compared to "old" (65–76 years) patients were admitted with a primary diagnosis other than COVID-19 (34% vs. 15%), were afebrile (80% vs. 67%), and had a clear initial chest X-ray (19% vs. 8%). Older patients had a higher prevalence of dementia (26% vs. 1.0%), cardiac (42% vs. 28%), and vascular disease (20% vs. 9%). Overall survival was lower among older compared to old patients (55% vs. 74%, p = 0.026) and when mechanical ventilation (20% vs. 46%, p = 0.29) or vasopressors (15% vs. 41%, p = 0.46) were required (20% vs. 46%, p = 0.029) and when new hepatic dysfunction (24% vs. 65%, p < 0.001) or new renal failure (29% vs. 56%, p = 0.015) developed. Factors at presentation that were associated with significantly lower survival included hypoxaemia, elevation of total white blood cell count, procalcitonin, and d-dimer.

Conclusions: Overall mortality was 34%. Survival was 2- to 3-fold higher for those aged 65–76 years compared to those aged 77 years and older who required advanced therapies such as mechanical ventilation. Improving clinical parameters were associated with significantly higher survival, regardless of age.

Key words: COVID-19, coronavirus, aging, pandemic.

Introduction

Patients of advanced age who are hospitalized with Coronavirus disease 2019 (COVID-19) have a higher risk of hospitalization, morbidity, greater need for a higher level of care, and higher mortality when compared to younger patients. Among 5700 patients hospitalized with COVID-19 in New York, early in the pandemic, mortality was around 43% for those aged 70 years [1]. A large, single-centre study from the western US showed a mortality rate of 37% among patients aged 80 years or older hospitalized with COVID-19 [2]. Previously published studies of COVID-19 in older patients (> 65 years) do not adequately explain the heterogeneity in outcomes related to age subgroups nor the association of age-related conditions such as immune senescence, frailty, and the prevalence of particular chronic comorbid conditions with unfavourable outcomes [1, 3, 4]. For that reason, we examined the clinical course and characteristics of patients aged 65 years and older who were hospitalized with COVID-19 at a suburban tertiary care centre during the early pandemic.

Material and methods

This is a retrospective cohort study conducted at Westchester Medical Centre, which serves a population of 2.5 million people in the Hudson Valley region of New York State. All hospitalized patients aged 65 years or older from 15 March to 15 May 2020, who tested positive for SARS-CoV-2 by polymerase chain reaction, and were discharged, were included in this study. Clinical characteristics, treatment, and hospital course were recorded, and variables were compared using Student's *t*-test, χ^2, and/or Fisher's exact test and binary logistic regression. The primary analysis focused on 2 age groups: "Old" (65–76 years) and "Older" (77–105 years). These age groups were selected because the 76-year median age corresponded to the age at which mortality has been shown to rise rapidly in other studies [1, 5]. Statistical significance was accepted at $p < 0.05$ and corrected using the Bonferroni method.

Results

The study included 196 patients, which comprised 32% of all COVID-19 patients hospitalized during the study period. The median age was 76 years (range: 65–105 years). The majority (70%) of patients arrived from home. The primary diagnosis at time of hospitalization was COVID-19 for 65% of patients and another diagnosis with COVID-19 for the remainder of the group. Atypical clinical presentations were common and included generalized weakness (36%), altered mental status (18%), myalgia (15%), and falls (7%), along with typical symptoms such as shortness of breath (63%) or fever (54%). The mean duration from symptom onset to arrival was 5.6 ±4.4 days. On admission, 70% of patients had bilateral infiltrates on chest X-ray, 27% were febrile, 33% had a respiratory rate over 24, and 53% had a lowest measured oxygen saturation level below 90%. Patients had multiple underlying chronic medical conditions, with a mean of 3.9 ±1.9 medical comorbidities. Common medical comorbidities were hypertension (63%), cardiac conditions (34%), diabetes mellitus (34%), and neurological disorders (inclusive of dementia) (19%). Mean body mass index (BMI) was 27.2 ±5.7 kg/m^2 (range: 14.5–44.1). Overall survival was 66.3% and did not differ significantly across various age groups 65–69 (30/40, 75%), 70–74 (37/52, 71%), 75–79 (24/31, 77%), but it was significantly lower in the age group 80 years and above (39/73, 53%, χ^2 = 9.0, p = 0.003) (Table I).

Comparison of age groups (65–76 "old" vs. 77–105 years "older")

Presentation

On admission, a greater proportion of older patients arrived from a location other than home (60% vs. 12%, p < 0.001) and had an admission diagnosis other than COVID-19 (34% vs. 15%, p = 0.001). More older patients had a history of dementia (25% vs. 1.0%, p < 0.001), chronic heart disease (42% vs. 28%, p = 0.038), a vascular disorder (20% vs. 9%, p = 0.023), or recurrent bacterial infections (7% vs. 1.0%, p = 0.022). Significant differences in the average number of comorbidities per patient and the proportions of other comorbid conditions were not observed between the 2 age groups. Antipsychotic (14% vs. 5%, p = 0.031) and antidepressant (20% vs. 9%, p = 0.023) drug use was reported more commonly in the older group. Mean body mass was significantly lower in the older group (26.0 ±5.3, vs. 28.4 ±5.8, p = 0.007). Clinical presentations varied significantly between the 2 groups, with a higher proportion of older patients being afebrile (33% vs. 21%, p = 0.047), having altered mentation (30% vs. 7%, p < 0.001), a need for oxygen by non-rebreather mask (27% vs. 8.0%, p = 0.001), having a clear initial chest X-ray (19% vs. 8%, p = 0.029), and reliance on surrogate decision-making (64% vs. 21%, p < 0.001).

Hospital course

The proportions of old versus older patients who had ever utilized intensive care, mechanical ventilation, vasopressors, or renal replacement therapy did not differ significantly during their hospitalization. However, survival was significantly lower for those in the older age group who required mechanical ventilation (20% vs. 46%, p = 0.029), vasopressors (15% vs. 41%, p = 0.046), had new renal failure (29% vs. 56%, p = 0.015), or new hepatic dysfunction (24% vs. 65%, p < 0.001). On admission, 94% of old patients and 70% of older patients placed no restrictions on potential resuscitative measures. During hospitalization, older patients were more likely than younger patients to change their wishes for cardiopulmonary resuscitation (18% vs. 12%). The average number of individual COVID-19-directed medication doses given to older patients was significantly lower than for old patients (7 ±9 vs. 16 ±15, p < 0.001) with fewer older patients receiving azi-

Table I. Baseline characteristics of patients hospitalized with COVID-19 aged 65 years and older

Parameter		*N*	%
Demographic information:		196	
Overall survival		130	66.3
Current age [years] (median, min./max.)		76 (65–105)	
Sex	F	85	43.4
	M	111	56.6
Race and ethnicity (*n* = 194)	Asian/Pacific Islander	8	4.1
	Black	21	10.8
	Hispanic	32	16.5
	Other/not identified	5	2.6
	White	127	65.5
	Native American	1	0.5
Advanced directives and presentation:		196	
Resuscitation wishes on admission	DNR/DNI	23	11.7
	Full measures	173	88.3
Decision-maker on admission	Not identified	2	1.0
	HCP/Surrogate	76	38.8
	Patient	117	59.7
	Physician on patient's behalf	1	0.5
Change in resuscitation wishes during hospital course		29	14.8
Primary diagnosis (*n* = 195)	COVID-19	128	65.6
	COVID-19 and other	20	10.3
	Other condition and COVID-19	47	24.1
Arrived from (*n* = 196)	Home	128	65.3
	NH, Rehab, other	68	34.7
Initial disposition (*n* = 196)	Not known	9	4.6
	Discharged from Emergency Dept.	9	4.6
	General Medical Ward	134	68.4
	Intensive Care	44	22.4
Symptoms (*n* = 196):			
Mean duration between symptom onset and admission [days] (SD)		5.6 (4.4)	
Shortness of breath		124	63.3
Fever		105	53.6
Cough		103	52.6
Generalized weakness		71	36.2
Decreased appetite (anorexia)		37	18.9
Altered mental status (delirium)		35	17.9
Diarrhoea		32	16.3
Myalgia		29	14.8
Fatigue		28	14.3
Fall		13	6.6
Medical comorbidities:		196	
Total comorbidities per patient (mean (SD))		3.9 (1.9)	
Hypertension		124	63.3
Diabetes Mellitus		66	33.7
Obesity		42	21.4
Chronic heart disease (CHF, CAD, arrhythmia, implantable defibrillator, pacer)		67	34.2

Table I. Cont.

Parameter	*N*	%
Neurological disorders: any	37	18.9
Chronic lung disease	30	15.3
Vascular disease: ischaemic stroke, PAD, PVD	28	14.3
Hypothyroidism	28	14.3
Dementia	25	12.8
Smoker (ever)	23	11.7
Chronic kidney disease	18	9.2
Malignancy (any)	17	8.7
Depression	16	8.2
Immunosuppression	13	6.6
Recurrent serious bacterial infections	8	4.1
Haemodialysis	6	3.1
Chronic liver disease	5	2.6

CHF – congestive heart failure, CAD – coronary artery disease, pacer – cardiac pacemaker, NH – skilled nursing facility, PAD – peripheral arterial disease, PVD – peripheral vascular disease, SD – standard deviation from mean, race and ethnicity reported in categories based on those of the Agency for Health Care Research and Quality

thromycin (54% vs. 78%, $p < 0.001$), hydroxychloroquine (56% vs. 82%, $p < 0.001$), non-pulse dose steroids (25% vs. 43%, $p = 0.006$), or tocilizumab (2% vs. 14%, $p = 0.003$). However, the proportion of old vs. older patients who had ever received at least 1 dose of a COVID-19-directed medication was not significantly different (Table II).

Outcomes

Overall survival for the cohort was 66%, but it was significantly lower (59% vs. 74%, $p = 0.026$) for the older group (77–105 years) compared to the old group (65–76 years). The mean duration of hospitalization (14.1 vs. 13.5, $p = 0.754$), mean BMI (27.21 vs. 27.23 kg/m^2, $p = 0.984$), proportions of survivors versus non-survivors with a primary diagnosis of COVID-19 on admission (67% vs. 33%, $p = 0.975$), male sex (67% v 33%, $p = 0.908$), or of different racial/ethnic groups did not differ significantly between the older/old groups. However, survival was significantly higher among older compared to old patients with BMI less than 23 (63% vs. 38%, $p = 0.033$). Survival was higher among those with no initial restrictions on resuscitation (69% vs. 31%, $p = 0.014$) and for those whose resuscitation wishes did not change during hospitalization (73% vs. 27%, $p < 0.001$). We did not observe significant differences in survival between patients treated versus not treated with azithromycin (64% vs. 36%, $p = 0.102$), hydroxychloroquine (68 vs. 32%, $p = 0.482$), tocilizumab (63% vs. 38%, $p = 0.605$), or convalescent plasma (64% vs. 36%, $p = 0.761$). However, survival was lower among those treated with steroids (non-pulse dose, 55% vs. 45%, $p = 0.018$) or pulse dose (38% vs. 62%, $p < 0.001$).

Factors associated with significantly higher mortality in a univariate analysis included older age group (59% vs. 41%, $p = 0.026$), pre-admission use of antidepressants, or presence of delirium or dementia on admission and the following admission parameters: oxygen saturation < 90% (68% vs. 46%, $p = 0.004$), elevated procalcitonin (64% vs. 16%, $p < 0.001$), elevated aspartate transaminase (AST) ≥ 2× upper limit of normal (39% vs. 17%, $p = 0.001$), elevated total white blood count (46% vs. 13%, $p < 0.001$), and elevated D-dimer ≥ 5× upper normal (54% vs. 20%, $p < 0.001$). The prevalence of these factors by incremental 5-year age subgroups and by age group 80 years and older is displayed in Figure 1. In a multivariable regression model that included each of these factors, elevated procalcitonin (odds ratio = 9.8, 95% CI: 2.4–40), D-dimer (odds ratio = 4.2, 95% CI: 1.1–16), and total white cell count (odds ratio = 5.3, 95% CI: 1.3–21) were significantly associated with mortality (Table III). During hospitalisation, the proportion of patients who survived versus died was significantly higher among those with improving organ function: oxygenation (98% vs. 3%, $p < 0.001$), renal function (89% vs. 11%, $p < 0.001$), hepatic function (84% vs. 16%, $p < 0.001$), or delirium (95% vs. 5%, $p < 0.001$) (Supplementary Table I).

Discussion

In this report, we provide a detailed description of characteristics and clinical outcomes in patients aged 65 years and older hospitalized with COVID-19, with further sub-group analysis among 2 different chronological age groups. In this early-pandemic cohort, overall survival was 66%

Table II. Presenting findings, vitals, and advance directives, treatments, and outcomes (total *N* = 196)

Parameter		*N*	Age 65 to 76 years		Age 77 years and older		
			N = 102	%	*N* = 94	%	*P*-value
Survival (overall)	Lived		75	73.5	55	58.5	0.026
Primary admitting diagnosis	COVID	195	75	73.5	53	57.0	0.015
	COVID and other		12	11.8	8	8.6	–
	Other and COVID		15	14.7	32	34.4	0.001
Goals of care (on admission)	Comfort only		0	0.0	4	4.3	
	Full care		96	94.1	66	70.2	< 0.001
	Some limits		3	2.9	16	17.0	0.001
	Some limits then comfort only		1	1.0	8	8.5	0.012
Change of resuscitation status and goals of care		191	12	12.2	17	18.3	–
Duration since first symptom/onset (mean days (SD))			6 (4)		5 (5)		–
Residence preceding admission	AL/Rehab/OSH/NH		12	11.8	56	59.6	< 0.001
	Home		90	88.2	38	40.4	< 0.001
Total comorbidities for patient, mean (SD)			4.0 (2.0)		3.8 (1.8)		–
Dementia			1	1.0	24	25.5	< 0.001
Chronic cardiac disease			28	27.5	39	41.5	0.038
Chronic vascular disease			9	8.8	19	20.2	0.023
Recurrent serious bacterial infection			1	1.0	7	7.4	0.022
Pre-admission medications	Antidepressants		9	8.8	19	20.2	0.023
	Antipsychotics		5	4.9	13	13.8	0.031
Has medical decision-making capacity			81	79.4	34	36.2	< 0.001
Altered mental status			7	6.9	28	29.8	< 0.001
Fall			2	2.0	11	11.7	0.016
Body mass index, mean (SD)		177	28.4 (5.8)		26.0 (5.3)		0.007
Survived	(BMI < 23)	37	9	37.5	15	62.5	0.033
	(BMI 23–30)	93	36	60.0	24	40.0	–
	(BMI > 30)	47	19	56.6	49	43.4	–
Lowest oxygen saturation	< 90%	193	57	55.9	46	50.5	–
Fever	Temp > 100.4		34	33.3	18	20.5	0.047
oxygen type on admission	Room air	190	20	20.0	24	26.7	–
	Nasal cannula or venturi-mask		55	55.0	30	33.3	0.003
	Non-rebreather		8	8.0	24	26.7	0.001
	Mechanical ventilation		17	17.0	12	13.3	–
initial admission location	Discharged from Emergency Room		4	3.9	5	5.3	–
	General ward		70	68.6	64	68.1	–
	Intensive care		22	21.6	22	23.4	–
Initial chest X ray	Clear lung fields		8	8.0	15	19.0	0.029
	Unilateral infiltrates		9	9.0	10	12.7	–
	Bilateral infiltrates		83	83.0	54	68.4	0.022
Medical treatments	Azithromycin		80	78.4	51	54.3	< 0.001
	Hydroxychloroquine		84	82.4	53	56.4	< 0.001
	Steroids (non-pulse)		44	43.1	23	24.5	0.006
	Pulse dose steroids		23	22.5	14	14.9	–

Table I. Cont.

Parameter		*N*	Age 65 to 76 years		Age 77 years and older		
			N = 102	%	*N* = 94	%	*P*-value
Medical treatments	Ritonavir		6	5.9	4	4.3	–
	Saquinavir		3	2.9	0	0.0	–
	Tocilizumab		14	13.7	2	2.1	0.003
	Plasma		28	27.5	17	18.1	–
Any COVID-19-directed medication			87	85.3	71	75.5	–
Total Doses of COVID-19-directed medications (SD)			15.6 (15.3)		7.4 (7.9)		< 0.001
Disposition	Death		27	26.5	39	41.5	0.026
	Home		56	54.9	28	29.8	< 0.001
	Other		10	9.8	7	7.4	–
	Rehab		0	0.0	4	4.3	–
	SNF		9	8.8	16	17.0	–
Length of hospital stay [days] mean (SD)			16.4 (18.6)		11.2 (12.0)		0.021
Required intensive care		80	45	44.1	35	37.2	–
Intensive care, survived (LR = 1.9) χ^2 = 1.9			21/45	47	11/35	31	0.168
Required mechanical ventilation		65	35	34.3	30	31.9	0.722
Survived (LR = 3.0) χ^2 = 3.0			16/35	46	6/30	20	0.029
Respiratory status and course	Oxygen requirements decreased		58	63.0	23	45.1	0.038
	Oxygen requirements increased		20	21.7	15	29.4	–
	Oxygen requirements unchanged		14	15.2	13	25.5	–
Required vasopressors	Total	58	32	31.4	26	27.7	0.569
Vasopressors and course	No longer needed		14/32	43.8	8/26	30.8	–
	Needed to death/DC		18/32	56.3	18/26	69.2	–
Vasopressors, survived (LR = 4.6) χ^2 = 4.4			13/32	41	4/26	15	0.046
Delirium and course	Total	82	32	31.4	50	53.2	0.002
	Delirium resolved		14/32	43.8	7/50	14.0	0.003
	Delirium remained or worsened		18/32	56.3	43/50	86.0	
Delirium survived (LR = 268) χ^2 = 0.268			14/32	43.8	19/50	38.0	0.604
Hepatic dysfunction and course	Total	83	54	52.9	29	30.9	0.002
	Hepatic function improved		23	42.6	8	27.6	–
	Hepatic function remained abnormal		12	22.2	14	48.3	0.015
	hepatic functioned worsened until death or DC		19	35.2	7	24.1	–
Hepatic dysfunction, survived (LR = 12.9) χ^2 = 12.5			35/54	65	7/29	24	< 0.001
Renal failure	Total	81	43	42.2	38	40.4	0.806
	Renal function remained abnormal, No RRT needed		4	9.3	16	42.1	0.001
	Worsened, RRT needed		19	44.2	15	39.5	–
	Improved, no RRT needed		20	46.5	7	18.4	0.007
Renal failure, survived (LR = 6.03) χ^2 = 5.9			24	56	11	29	0.015
Required renal replacement therapy		34	19	100	15	100	–
RRT, survived LR = 1.49 χ^2 = 1.38			4/19	21	1/15	6.7	0.355*

AL – Assisted Living Facility, DC – discharge, NH – long-term nursing care facility, OSH – Outside Hospital, Rehab – Rehabilitation Facility, SD – standard deviation, RRT – renal replacement therapy, LR – likelihood ratio.

Table III. Presenting factors associated with survival to discharge

Parameter	Univariate								Regression		
	Lived			Died							
	Count	%	95% CI	Count	%	95% CI	χ^2	*P*-value	Odds Ratio	95% CI	*P*-value
Age 65 to 76	75/130	58	(49–66)	27/66	41	(30–53)	4.9	0.026	2.1	(0.42–10)	0.370
Age 77 and older [years]	55/130	42	(34–51)	39/66	59	(47–70)					
Myalgia	27/130	21	(15–28)	2/66	3	(0.6–9)	10.9	0.001	11.6	(1.1–127)	0.044
Has medical decision-making capacity	88/130	68	(59–75)	27/66	41	(30–53)	15.1	< 0.001	5.5	(1.0–30)	0.051
Procalcitonin elevated	13/84	16	(9–24)	25/39	64	(49–78)	29.5	< 0.001	9.8	(2.4–40)	0.002
Lowest O_2 < 90%	59/128	46	(38–55)	44/65	68	(56–78)	8.1	0.004	3.4	(0.78–14)	0.104
AST ≥ 2× upper normal	20/120	17	(11–24)	26/66	39	(28–51)	11.8	0.001	1.3	(0.32–5)	0.734
White blood count elevated	16/122	13	(8–20)	30/66	46	(34–57)	24.2	< 0.001	5.3	(1.3–21)	0.018
D-dimer ≥ 5× upper normal	20/99	20	(13–29)	32/59	54	(42–67)	19.4	< 0.001	4.2	(1.1–16)	0.034
SSRI/antide-pressant	12/130	9	(5–15)	16/66	24	(15–36)	8.1	0.005	5.6	(0.89–35)	0.066
Altered mental status	18/130	14	(9–21)	17/66	26	(16–37)	4.2	0.040	8.1	(0.97–67)	0.054
Dementia	10/130	8	(4–13)	15/66	23	(14–34)	8.9	0.003	1.7	(0.08–41)	0.728

SSRI – selective serotonin reuptake inhibitor, CI – confidence interval, Univariate – univariate analysis using χ^2 test, Regression – binary logistic regression analysis, 2× – 2 times, 5× – 5 times, Lowest O_2 – oxygen saturation recorded on room air and lower than 90%.

but was significantly lower for those 77 years of age and above. Our findings are consistent with earlier studies which have shown that patients in the higher age groups, particularly those over age 80 years, had a significantly greater risk of death compared to younger patients [1, 2, 6–10]. We did not observe differences in survival related to hypertension, diabetes, cardiovascular disease, or total number of medical comorbidities, which have been described in prior reports [11–13]. Body mass index was not associated with differences in survival except that survival was higher among older compared to old patients with low BMI (< 23 kg/m^2). The proportions of patients who received advanced therapies (e.g. haemodialysis, mechanical ventilation) did not differ significantly by age group. However, the total number of per-patient doses of COVID-19-directed medications was lower among older patients. Survival was similar for patients receiving most medications, except that those who received corticosteroids had lower survival. This was probably due to greater use of steroids among the sickest patients, a pattern that shifted to general use in the later pandemic following publication of the Randomised Evaluation of COVID-19 Therapy (RECOVERY) trial [14]. Overall lower medication use in the older group may have been due to factors such as patient/family preferences or higher potential for medication side effects in the older age group.

Of note, survival was lower for older versus old patients who received mechanical ventilation (66% vs. 34%). In prior studies, mortality was 97% for those older than 65 years who received mechanical ventilation, and in a meta-analysis that included over 50,000 patients mortality was 84% for those age > 80 years [1, 15]. These differences may have been related to factors such as inclusion of patients who remained hospitalized, differences in steroid use, or intubation strategies.

Identification of prognostic, clinical, and laboratory indicators on admission and throughout the course of hospitalisation can assist provider discussions with COVID-19 patients and their families. We found a number of presenting factors including dementia [16], new loss of decision-making capacity, depression, myalgia, and hypoxia [17], and elevations in inflammatory markers, total white blood cell count, and procalcitonin to be associated with reduced survival in univariate analysis. In a prior meta-analysis, liver function-related tests and inflammatory markers were among the most important mortality predictors [13]. After adjusting for age and other factors, we found that even modest elevations of AST and D-dimer levels or total white blood cell count were independent predictors of mortality. Elevations in total white blood cell count in COVID-19 were found to be predictive of mortality in another recent study [18]. Worsening clinical status, such as the need for mechanical ventilation or pressor support or the development of acute kidney injury or new hepatic dysfunction, increased mortality 2–3-fold in older versus old patients in this study. Conversely, in both older and old patients, improving mentation, oxygenation, as well as hepatic and renal function were highly significant and favourable prognostic indicators. In our cohort, around 90% of patients for whom these clinical indicators were improving during hospitalization survived to discharge.

The prevalence of atypical symptoms among patients aged 65 years and over reaffirms the need for physicians to have a high index of suspicion for COVID-19 diagnosis. Almost half of all patients had no fever or cough, and over one-third did not complain of shortness of breath. Atypical symptoms such as anorexia, altered mental status, and generalized weakness were common. In addition, older patients were less likely to be diagnosed with COVID-19 as the primary diagnosis on admission. They also presented with more subtle symptoms initially than their younger counterparts, including lack of fever and normal CXR. In addition, the older patients were more likely to have comorbidities such as dementia, and chronic cardiac and vascular disease, which can obscure COVID 19 symptoms.

In a large meta-analysis, the only symptom that was associated with decreased survival in hospitalized COVID-19 patients was dyspnoea [13]. Consistent with a recent report, we found that that hypoxaemia on admission (rather than respiratory symptoms) predicted poor outcome [17]. We also found that although myalgia was uncommon among the oldest patients, its presence was significantly associated with mortality – even after adjusting for other factors. It is plausible that muscle pain may represent a previously unrecognized, early marker of severe disease.

Consistent with earlier reports, we found that dementia was associated with higher mortality in a univariate analysis [16, 19–21]. This association, however, was less clear when other factors were considered as well. Patients with dementia appear to be more easily infected and harmed by SARS-CoV-2 than those with normal mental function [16]. It has been speculated that pre-existing brain damage may permit greater viral entry into the nervous system, which is worsened by hypoxia and other organ failure. On admission, over one-third of older patients in this study lacked decision-making capacity due to underlying dementia and/or delirium. Older patients were also more likely to change their advance care directives/resuscitation wishes during their hospitalization. The potential for rapid mental decline in the setting of COVID-19 underscores the need for patients and their families to proactively anticipate circumstances in which surrogate decision-making could be necessary, and to timely craft suitable advanced directives [22, 23].

An important concern during the pandemic has been the possibility that members of racial and ethnic minority groups have been disproportionately impacted. Racial disparities in terms of hospitalizations and death due to COVID-19 have been reported [24, 25]. In the present study, the highest number of COVID-19 admissions were among white (66%) patients followed by Hispanic (17%), black (11%), and Asian/Pacific Islander (4%). We did not observe significant differences in survival across racial and ethnic groups (black 29%, Hispanic 28%, white 35%, Asian 36%).

This study had several limitations. First, this was a single-centre, retrospective cohort study with a relatively small sample size, which could influence the generalizability of results. Secondly, practice guidelines and patterns during the COVID-19 pandemic have continued to evolve. Such changes could render certain results less applicable to patients currently hospitalized with COVID-19. While the factor of age over or under 77 years was associated with higher mortality in a univariate analysis, after adjustment for other laboratory and clinical factors it was no longer significantly related to mortality. These findings suggest that other factors must be taken into account with age in order to more accurately predict mortality. Given the modest sample size, these results will require confirmation in larger studies.

In conclusion, among patients aged 65 years and older, age and other factors should be considered together to estimate the risk of mortality.

Conflict of interest

The authors declare no conflict of interest.

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