Intensive Care Med (2020) 46:1634–1636
https://doi.org/10.1007/s00134-020-06087-2

LETTER

Frailty index predicts poor outcome in COVID-19 patients

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Frailty is a condition of increased vulnerability to endogenous and exogenous stressors, resulting from the interaction of progressive age-related decline in physiologic systems with chronic diseases, leading to decreased functional reserve capacities [1]. The effect of frailty on patient's clinical outcomes has been examined in several settings of care, including intensive care units (ICU) and acute hospital wards [1, 2], showing to be a reliable predictor of clinical and health care related outcomes. Based on these and other evidences, some scientific societies (https://www.nice.org.uk/guidance/ng159/resources/critical-care-admission-algorithm-pdf-8708948893; https://www.brc-rea.be/wp-content/uploads/2020/03/Ethical-decision-making-in-emergencies_COVID19_22032020_final.pdf) are recommending to assess frailty in patients with coronavirus disease 19 (COVID-19) infection to guide their triage. However, not all international scientific associations have similar positions (https://smw.ch/article/doi/smw.2020.20229; http://www.siaarti.it/SiteAssets/News/COVID19%20-%20documenti%20SIAARTI/SIAARTI%20-%20Covid19%20-%20Raccomandazioni%20di%20etica%20clinica.pdf).

Therefore, we decided to evaluate the role of frailty assessment in patients with COVID-19. Here, we analyzed the data of a cohort of consecutive COVID-19 patients admitted to 8th floor of San Gerardo hospital between February 27th and April 7th, 2020. Inclusion criteria were age > 18 years, informed consent and hospitalization due to COVID-19 infection. There were no exclusion criteria. Frailty was assessed with the Frailty Index (FI), a commonly used tool which is based on the concept that frailty is the result of an accumulation of deficits during lifetime [3]. The FI evaluated coexisting diseases, cognitive and physical impairments and laboratory abnormalities. For each variable, we assigned a score 0 in the absence and 1 in the presence of a deficit. The score was calculated for each participant by dividing the sum of the deficits by the total number of variables measured. Overall, we assessed 43 variables, which provided our index with a sufficient amount of robustness [3]. Importantly, one study has shown that a FI constructed with a similar number of variables was superior to other frailty tools in predicting mortality [4]. The variables included in the 43-item FI are listed in the Electronic Supplementary Material along with the graphical distribution of the scores.

Among 105 patients included in our study, 40 had a "do not intubate" indication, 58 had an "intubate if needed" indication and 7 had neither. The FI median score was 0.17 [interquartile ranges, IQR 0.12, 0.26] among the 42 patients died or transferred to ICU and 0.07 [IQR 0.05, 0.14] among the 63 patients who recovered ($p < 0.001$) (Table 1). According to a previous study, participants with a FI score ≥ 0.25 were considered frails [5]. In a multivariable logistic model (see Electronic Supplementary Material), including age, sex and FI, age and the dichotomized FI were independent predictors of inhospital mortality or ICU admission (odds ratio in patients with FI ≥ 0.25 vs < 0.25 1.32, 95% confidence intervals: 1.03; 1.70).

We suggest integrating the frailty assessment in all the COVID-19 patients at hospital admission. With electronic medical records progressively more available in the hospitals, the assessment of frailty with an electronic FI can help clinicians in their decision-making

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Table 1 Baseline characteristics of patients by outcome (recovered or death/transferred to ICU)

	Patients who recovered ($n=63$)	Patients who died or were transferred to ICU ($n=42$)	p value*
Males, *n* (%)	41 (65)	31 (74)	0.466
Age, years	58.74 [51.78, 68.54]	77.25 [68.42, 83.59]	< 0.001
Diseases			
Hypertension, *n* (%)	33 (52)	31 (74)	0.045
Coronary heart disease, *n* (%)	5 (8)	20 (48)	< 0.001
Atrial fibrillation, *n* (%)	2 (3)	9 (21)	0.008
Peripheral vascular, *n* (%)	2 (3)	14 (33)	< 0.001
Congestive heart failure, *n* (%)	1 (2)	3 (7)	0.349
Previous stroke, *n* (%)	1 (2)	3 (7)	0.349
Diabetes, *n* (%)	7 (11)	14 (33)	0.011
Chronic respiratory, *n* (%)	2 (3)	4 (10)	0.345
Chronic renal failure, *n* (%)	5 (8)	2 (5)	0.811
Liver, *n* (%)	4 (6)	1 (2)	0.64
Altered thyroid function, *n* (%)	6 (9.5)	2 (4.8)	0.599
Osteoarthritis, *n* (%)	1 (2)	1 (2)	1
Osteoporosis, *n* (%)	0 (0)	3 (7)	0.12
Solid neoplasm, *n* (%)	7 (11)	4 (10)	1
Lymphoma/leukemia, *n* (%)	0 (0)	2 (5)	0.308
Peptic ulcer, *n* (%)	1 (2)	1 (2)	1
Rheumatic, *n* (%)	4 (6)	4 (10)	0.822
Anemia, *n* (%)	2 (3)	1 (2)	1
Hearing impairment, *n* (%)	1 (2)	2 (5)	0.72
Visual impairment, *n* (%)	4 (6)	3 (7)	1
Depressed mood, *n* (%)	3 (5)	1 (2)	0.917
Dementia, *n* (%)	3 (5)	2 (5)	1
Parkinson/parkinsonism, *n* (%)	0 (0)	2 (5)	0.308
Nutritional status			0.018
Undernourished, *n* (%)	0 (0)	2 (7)	
Normal, *n* (%)	48 (89)	19 (66)	
Obese, *n* (%)	6 (11)	8 (28)	
Number of drugs	2 [1, 3.75]	8 [2, 10]	< 0.001
Disability			
Self-doing in bathing, *n* (%)	4 (7)	9 (27)	0.014
Self-dressing, *n* (%)	3 (5)	6 (20)	0.062
Walking at home, *n* (%)	3 (5)	5 (17)	0.135
Walking out of home, *n* (%)	4 (6)	7 (23)	0.046
Shopping, *n* (%)	5 (8)	10 (32)	0.009
Unable to drive a car, *n* (%)	8 (13)	13 (43)	0.004
Unable to handle money, *n* (%)	6 (10)	7 (23)	0.168
Unable to handle drugs, *n* (%)	6 (10)	9 (30)	0.036
Nursing home resident/caregiver, *n* (%)	2 (3)	4 (12)	0.234
Laboratory findings (serum levels)			
Hemoglobin g/dl	13.50 [12.1, 15]	13.65 [11.62, 15.05]	0.554
White blood cell count, $\times 10^9$	5.78 [4.37, 7.32]	6.74 [5.1, 9.45]	0.065
Lymphocites count, $\times 10^9$	1.13 [0.89, 1.47]	0.88 [0.6, 1.16]	0.024
Platelet count, $\times 10^9$	182 [160, 219]	176.5 [146.25, 252.75]	0.702
Lactate dehydrogenase, U/L	292 [247, 365]	367 [290.25, 468.25]	0.008
C-reactive protein, mg/dL	5.64 [3.07, 10.9]	9.66 [5.46, 17.72]	0.003
International normalized ratio	1.09 [1.03, 1.16]	1.15 [1.06, 1.27]	0.071

Table 1 (continued)

	Patients who recovered ($n=63$)	Patients who died or were transferred to ICU ($n=42$)	p value*
Creatine kinase, U/L	98 [68.75, 209]	124.5 [66, 241.25]	0.447
Albumin, g/dL	3.11 [2.96, 3.4]	3.2 [3, 3.54]	0.685
Total bilirubin, mmol/L	0.6 [0.3, 0.7]	0.5 [0.4, 0.8]	0.212
Creatinine, mmol/L	1 [0.8, 1.1]	1.1 [1, 1.4]	0.001
Frailty Index	0.07 [0.05, 0.14]	0.19 [0.14, 0.26]	< 0.001

Data are presented as median [Interquantiles range] unless otherwise specified

The score of the Frailty Index was based on the assessment of 43 health deficits. For each variable, we assigned a score 0 in the absence and 1 in the presence of a deficit. The score was calculated for each participant by dividing the sum of the deficits by the total number of variables measured

*Significance on Fisher exact test or Mann–Whitney test as appropriate

processes, identifying patients most likely to require ICU admission and those with poor outcomes. Future studies are needed to determine if FI is superior to other tools in predicting the outcomes of COVID-19 patients.

Electronic supplementary material
The online version of this article (https://doi.org/10.1007/s00134-020-06087-2) contains supplementary material, which is available to authorized users.

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Authors contribution
All authors designed the study. GB and PM collected the clinical data. MGV and PR performed the statistical analyses. All authors reviewed and approved the manuscript.

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Funding
None.

Compliance with ethical standards

Conflicts of interest
None.

Ethical approval
The study was approved by the institutional Ethical committee Brianza and was performed in adherence to the tenets of the Declaration of Helsinki.

Consent to participate
Informed consent was verbally obtained from all individuals participating in the study. Written consent was waived by Ethical Committee due to the context of emergency, which made hard circulating papers in the recruiting wards.

Publisher's Note

Accepted: 4 May 2020
Published online: 25 May 2020

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