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LETTER

Intensive care unit acquired muscle weakness in COVID-19 patients

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Dear Editor,

Infection with the SARS-CoV-2 virus may lead to hypoxemic respiratory failure and acute respiratory distress syndrome (ARDS). ARDS is frequently complicated by intensive care unit acquired weakness (ICUAW) [1], which is associated with poor outcomes [2]. Critically ill patients affected with coronavirus disease 2019 (COVID-19) may differ from typical ARDS-patients in baseline factors [3] and ICU exposures associated with ICUAW [4]. Of particular concern may be the need for deep sedation to avoid patient-ventilator dyssynchrony and ventilator-induced/self-inflicted lung-injury because of high respiratory drive [5]. We aimed to assess the incidence of ICUAW in critically ill COVID-19 patients, to identify factors associated with its occurrence, and to describe its short-term outcomes.

This single-center, retrospective, observational study involved adult critically ill COVID-19 patients admitted to the University Hospitals Leuven, from March 13th until June 8th 2020. After April 1st, physiotherapists were re-engaged in patient care and performed daily strength-assessment when appropriate. Records of eligible patients were searched for baseline characteristics, ICU exposures and outcomes. The primary outcome was the incidence of ICUAW, assessed with the MRC-sum score [2], at awakening, at ICU and hospital discharge in patients requiring invasive mechanical ventilation (IMV). In addition, we evaluated factors and short-term outcomes associated with weakness at ICU discharge. To assess bias, we compared characteristics and outcomes for patients with and without MRC-sum score, and studied patients without IMV.

Of 486 hospitalized COVID-19 patients, 114 required intensive care of whom 74 (64.9%) needed IMV (Supplemental Fig. 1). Admission and ICU characteristics are provided in the Online Supplement. Total hospital mortality was 60/486 (12.3%), ICU mortality was 11/114 (9.6%). All deaths occurred in IMV patients [11/74 (14.9%)]. In 50/74 (67.6%) assessed IMV patients, the incidences of ICUAW at awakening, ICU, and hospital discharge were 72%, 52% and 27% (Fig. 1). Those without MRC-sum-score were older as compared to those with MRC-sum-score [67 (60–76) versus 60 (53–67), $p=0.044$] and comprised nine patients who died before awakening, possibly introducing selection bias. Admission characteristics were similar between patients with and without ICUAW, but weak patients had prolonged ventilation (days) [24 (15–29) versus 12 (8–17), $p<0.001$], higher mean morning glycemia (mg/dl) [126 (119–134) versus 118 (110–129), $p=0.041$], and more frequently received dialysis [11/26 (42.3%) versus 4/24 (16.7%), $p=0.048$]. Exposure to corticosteroids, sedatives and analgesics, except for dexmedetomidine, and NMBAs was higher (see Online Supplement). Weak patients had longer ICU stays (days) [30 (19–42) versus 19 (12–25), $p=0.008$], lower mobility scores at ICU discharge [2 (2–2) versus 6 (4–6), $p<0.001$], but ICU readmission [0/26 (0%) versus 2/24 (8.3%), $p=0.225$] and mortality [2/26 (7.7%) versus 0/24 (0%), $p=0.491$] were not different. Handgrip-strength (%pred) [43% (28–59%) versus 64% (36–80%), $p=0.045$], and Barthel at hospital

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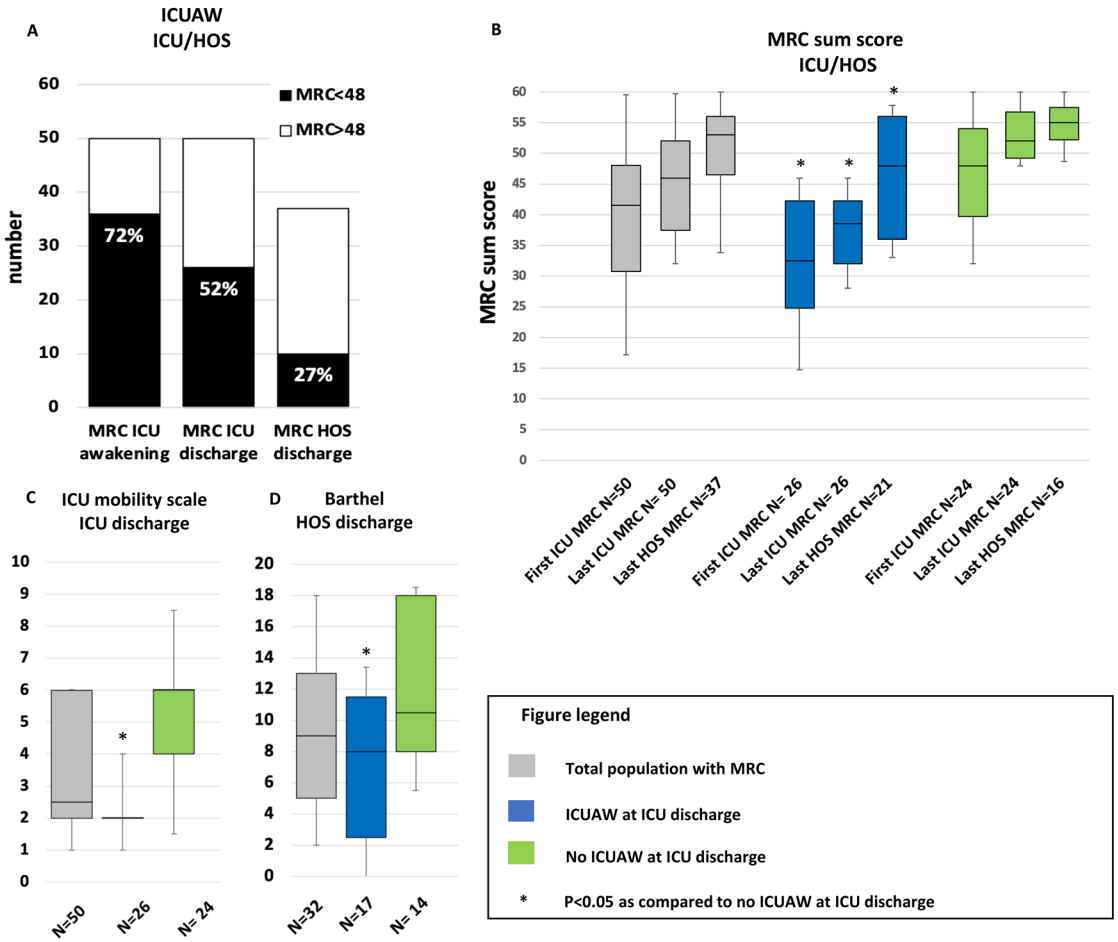

Fig. 1 Strength and functional outcomes in COVID-19 patients, requiring invasive mechanical ventilation, with and without weakness at ICU discharge. Panel **A** incidence of ICUAW at awakening, ICU discharge and hospital discharge. Panel **B** MRC-sum-score at awakening, ICU discharge and hospital discharge. Panel **C** ICU mobility score at ICU discharge. Panel **D** Barthel score at hospital discharge. *MRC* Medical Research Council, *ICUAW* intensive care unit acquired weakness, *ICU* intensive care unit, *HOS* hospitalization

discharge [8 (2.5–11.5) versus 10.5 (8–18), $p=0.040$], remained lower in weak patients (Fig. 1). 15/26 (57.7%) weak versus 6/24 (25%) not-weak patients were referred for in-patient rehabilitation. In 6/40 (15%) assessed non-IMV patients, one patient was weak at ICU discharge and none at hospital discharge (see Online Supplement).

In conclusion, in this cohort of critically ill COVID-19 patients, survival was high, but those needing prolonged sedation frequently presented with ICUAW. Although strength improved throughout hospitalization, impact on functional status remained substantial. These data indicate that there may be a price to pay for allowing rigorous lung-protective ventilation and underscore the need for follow-up of post-ICU COVID-19 patients, to offer tailored rehabilitation, hopefully reducing long-term impact.

Electronic supplementary material
The online version of this article (https://doi.org/10.1007/s00134-020-06244-7) contains supplementary material, which is available to authorized users.

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Compliance with ethical standards

Conflicts of interest

The authors declare that they have no conflict of interest.

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