Since January 2020 Elsevier has created a COVID-19 resource centre with free information in English and Mandarin on the novel coronavirus COVID-19. The COVID-19 resource centre is hosted on Elsevier Connect, the company's public news and information website.

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Letter to the Editor

Nutrition in critically ill patients with COVID-19: Challenges and special considerations

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The impact of inadequate nutrition on critically ill patients is well documented, having been linked to increased mortality and associated with longer lengths of Intensive Care Unit (ICU) stay, disability, and overall morbidity following hospital discharge [1]. The European society for clinical nutrition and metabolism (ESPEN) recently published guidelines for nutritional management of individuals with SARS-CoV-2 infection, which include recommendations for patients hospitalized in the ICU [2]. These recommendations center on providing early enteral nutrition (EN), when possible, use of promotility agents to encourage gastric emptying, initiating peripheral nutrition (PN) if EN is not tolerated, and using EN post-extubation if oral nutrition is not tolerated. While these recommendations provide general guidance for providing nutrition in critically ill patients with COVID-19, we have encountered unprecedented challenges in providing adequate nutrition in this patient population. These challenges appear to result from the direct effects of the SARS-CoV-2 virus on the on the gastrointestinal tract and are compounded by the elevated sedation required for this patient population. We would like to briefly outline some of the unique considerations and challenges in providing nutrition to the critically ill COVID-19 population which have not been addressed in the recent guidelines:

- Nearly half of critically ill patients with COVID-19 develop gastrointestinal hypomotility which results in enteral feeding intolerance for at least 24 h. Over half of those patients have either clinical or radiographic evidence of an ileus/pseudo obstruction. Almost 4% of critically ill COVID-19 patients with intestinal dysmotility have evidence of small and/or large bowel ischemia after exploratory laparotomy [3]. These findings cannot be solely explained by the effects of vasoconstriction from vasopressor use given the relatively low vasopressor doses required compared with other populations of critically ill patients (e.g., septic shock patients). Also, while the elevated doses of sedatives and opioids required to facilitate mechanical ventilation in patients with COVID-19 can contribute to intestinal dysmotility, and its related complications, the extent of feeding intolerance is out of proportion to other patient populations that require high doses of sedation (e.g., burn-injured patients). It therefore appears that the intolerance to enteral feeding may be exacerbated by significant gastrointestinal involvement specific to SARS-CoV-2 infection [3,4]. Serial abdominal exams along with careful monitoring of feeding intolerance, bowel function, and signs of abdominal hypertension may be helpful for the diagnosis of serious acute abdominal pathologies.
- Many critically ill patients with COVID-19 receive multiple pharmacologic agents (e.g., promotility agent, osmotic agent, stimulant laxative, mu-opioid antagonist, enema) to preserve and promote gastrointestinal motility. We have observed that despite the use of such multimodal regimens initiated at the time of ICU admission, impaired intestinal motility remains a problem. Furthermore, even when gastrointestinal motility appears to be present with low gastric residuals and regular stool output, we have observed inadequate absorption as measured by the use of oral acetaminophen [5] absorption testing. Consequently, while routine monitoring of gastric residuals (using the cut-off above 500 mL as recommended by the ESPEN guidelines) may indicate appropriate gastric emptying, it is insufficient to ensure adequate intestinal absorption in this population.
- For patients with gastric residuals above 500 mL, the ESPEN guidelines recommend placement of a post-pyloric feeding tube as soon as possible [2]. However, post-pyloric feeding tube placement is not trivial in critically ill patients with COVID-19. Placement of a post-pyloric feeding tube is often more technically challenging than a gastric feeding tube and may require multiple attempts by the provider along with multiple abdominal X-rays, thus posing an increased risk of viral exposure to staff. Electromagnetic confirmation of gastric and post-pyloric feeding tubes may be favored to minimize the need for x-ray confirmation. Post-pyloric feeding tubes have not been shown to significantly decrease the risk of aspiration and may be dislodged from their position, especially during proning [6].
- Critically ill patients with COVID-19 often have severe lung injury and do not tolerate the setbacks imposed by even small aspiration events. We have witnessed episodes of emesis and aspiration particularly when transitioning from the supine to prone position and back. To reduce the risk of aspiration, we suggest holding tube feeding 1 h prior to proning and using a lower threshold for gastric residuals. Furthermore, we recommend holding or decreasing tube feeds in the proned patient if signs of intolerance are present. Due to the challenges related to aspiration in the prone patient, we have opted for continuous tube

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feeding despite the potential benefits of bolus tube feeding in critically ill patients [7–9]. Whether a gastric residual threshold of 500 ml is safe in this population is unknown. The potential benefits of bolus tube feeding in critically ill patients with COVID-19 and its associated risk of aspiration warrant further investigation [7–9].

- The ESPEN guidelines recommend that hypocaloric nutrition (below 70% estimated needs) should be preferred over isocaloric nutrition for the first week of an ICU stay. However, patients with COVID-19 are often sick at home for days to weeks prior to being admitted to the hospital, thus increasing their likelihood of being malnourished upon presentation. In these patients, enteral nutrition is often further delayed by the presence of shock and life-threatening hypoxemia, hypercapnia or acidosis, during the early course of ICU admission. Studies of the interaction between infectious diseases and host nutritional status have generally shown that poor host nutrition leads to increased pathogenicity of the infecting agent [10]. Consequently, critically ill COVID-19 patients may have significant nutritional deficits and more aggressive early nutritional support with TPN may be warranted. Additionally, such patients are at increased risk for refeeding syndrome and associated electrolyte disturbances that may further contribute to arrhythmias and hemodynamic instability. Careful attention to electrolyte replacement during re-feeding is necessary.

Ensuring adequate enteral nutrition in patients who are critically ill with COVID-19 has proven to be challenging due to intestinal dysmotility, bowel ischemia, malabsorption as well as the unique challenges in delivering care while minimizing exposure to staff. Tube feeding intolerance from intestinal dysmotility and the frequent need for proning increase the risk of aspiration, which is potentially catastrophic in this population with COVID-19 associated acute respiratory distress syndrome (ARDS). Nutritional deficits present at the time of ICU admission further complicate nutritional management. Given these challenges, more nuanced nutritional guidelines are needed to help guide critical care clinicians. Such guidelines might include recommendations for testing of absorption, reduced tolerance of elevated gastric residual due to the risk of aspiration, early initiation of PN to achieve nutritional goals, and increased vigilance in monitoring for refeeding syndrome and its associated complications. The collective clinical experiences from the United States and from other highly affected areas around the world should be quickly leveraged to formulate recommendations and guidelines to increase patient safety and provider awareness of these unique challenges.

Conflict of interests

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