Mechanical Ventilation Training of Pulmonary Critical Care Fellows During The COVID-19 Pandemic

Introduction:

Mechanical ventilation (MV) management is an essential skill expected of Pulmonary and Critical Care Medicine (PCCM) fellows to master during their medical training. However, mastery of the competencies required for proficiency is not standardized or tailored to fellowship trainees. The unprecedented emergence of the SARS-CoV-2 pandemic has highlighted the need for advanced operator competency in MV to improve patients' outcomes; however, there are no standardized MV curricula for rapid mastery. Our objective is to create a standardized MV curriculum using simulation and evidence-based practices for SARS-CoV-2 infection (COVID-19) for PCCM fellows.

Study Design/Methodology:

The curriculum targeted new PCCM fellows to assess competency and knowledge in the following key topics: indications for MV, the implementation of rapid sequence intubation for patients with COVID-19, initiating MV and ventilator bundle per best practices, recognizing and directing the management of mucous plugging, ventilator desynchrony, ARDS, auto-PEEP, developing a care plan for proned patients, and adhering to best practices in ventilator liberation. The MV curriculum consisted of the following sequential steps:1) A baseline written knowledge test consisting of fifteen multiple-choice questions (MCQs), including MV topics and the latest evidence-based practices, and discovered pathophysiology of the COVID-19. Discrimination and difficulty indices were used to narrow to the final fifteen MCQs from a pool of fifty tested on five PCCM attendings and eight PCCM fellows. The internal consistency and reliability were calculated using item-total correlation and Cronbach alpha coefficient. 2) A one-on-one 90-minute session using a high-fidelity simulation manikin (SimMan® 3G), a lung simulator (ASL 5000™ Lung Simulator), and a mechanical ventilator to test baseline competencies within clinical scenarios. 3) A 10-minute structured debriefing session tailored per each fellow's knowledge gap as determined by a 50-point competency assessment checklist from the simulation. 4) Accumulated running time of 160 minutes of short didactic video modules with remote tracking for completion. 5) A 60-minute hands-on session in small groups of 1 to 3 fellows for basic knobology, waveforms, and various modes of MV. 6) A 90-minute one-on-one simulation reassessment session. 7) A written knowledge post-test two weeks from the baseline testing. 8) A post-training confidence survey using a 5-point Likert scale.

Results:

In July 2021, eight first-year PCCM fellows completed the training. The average MCQ score increased from 7 ± 3 to 10 ± 2 questions (maximum of 15), which equated to a 43% improvement ($P<0.05$), while the simulation scores improved from 16 ± 4 to 31± 4 (maximum of

50 points) or a 93% improvement ($p<0.05$) (as shown in Figure 1). Comparing the simulation reassessment to the baseline session, fellows showed statistically significant improvement in simulation-based skills ($P<0.05$). Specifically, the significant improvement was in ability to assess indications for MV, implementing rapid sequence intubation for patients with COVID-19, initiating MV & ventilator bundle per best practices, recognizing and directing the management of mucous plugging, determining and solving ventilator desynchrony, deploying evidence-based practices for ARDS, and developing a care plan for proned patients. The post-training survey response revealed improved learner confidence in all competencies (see Table 1).

Discussion and conclusion:

Our new MV curriculum using video didactics, hands-on small group sessions, and high-fidelity simulation testing allowed for improvement in knowledge and skills of MV use in PCCM fellows during the pandemic. This was further reinforced by self-reported improvement in confidence in managing MV by first-year PCCM fellows. This new curriculum will need to be validated in another setting with a larger sample size.