As mentioned earlier, patients with COVID-19 associated ARDS exhibit high respiratory drive and intense effort. It is suspected that this is not only caused by a gas exchange disorder, but also by the direct invasion of respiratory centers due to SARS-CoV-2.

The role of inspiratory effort in promoting lung damage in COVID-19 may be critical.\textsuperscript{13} This underlines the need to closely and continuously monitor the respiratory drive and effort during assisted spontaneous breathing.

Various methods for monitoring drive and effort are available, most of which was discussed in the introduction of this article.

- **P0.1 measurement as an indicator for respiratory drive**
  Record the respiratory pressure created by patients during the first 100 ms of a triggered, occluded breath in regular intervals. In a study by Esnault et al., none of the patients with a P0.1 < 4 cmH₂O experienced deterioration 24 h after measurement.\textsuperscript{15,18} The first 100 ms of inspiration more closely reflects the inspiratory drive, rather than effort, even though this is not entirely decoupled.

- **Esophageal pressure (P_{es}) as a surrogate for transpulmonary pressure (P_{tp})**
  Negative pressure swings indicate respiratory effort, higher ΔP_{es} demonstrates increasing effort. P_{es} swings of > 15 cmH₂O may represent excessive work of breathing.
5. Weaning

Weaning from invasive ventilation

The path of respiratory failure with Covid-19 is usually neither short nor straight. Consequently, weaning of Covid-19 patients is not straightforward, either.

A main cause for weaning failure in COVID-19 patients is the hypoxemic respiratory failure with hyperventilation and low to normal PaCO₂ values. CARDS specifics also contribute to difficulties in weaning.62 The fibrotic remodeling in late CARDS described by Tonelli et al. may contribute to the challenge of weaning COVID-19 patients from mechanical ventilation.13 In addition, co-morbidities such as renal failure, hepatopathies, cardiac damage and skeletal muscle damage may play a role as well. An early focus on weaning from mechanical ventilation is important as COVID-19 patients frequently require prolonged weaning of up to 6 weeks.62 In particular, the increased respiratory drive and effort described in COVID-19 patients may need to be taken into account.

Downward adaptation of support levels may alternate with required increases, until the patient is eventually weaned and extubated. Automated systems can help to continuously provide the right support level, while at the same time ensuring that no chance is missed of an attempt to have the patients do more respiratory work on their own. Automated spontaneous breathing trials may help to take a profound decision on the right timing and probability of success of an extubation.

- Occlusion Maneuver (P_{occ}) as a measure of muscle pressure
  Negative airway pressure in an occluded inspiration indicates muscle pressure and this respiratory effort
  Target value ≥-10cmH₂O.

- Tidal volume as an indicator of respiratory drive and effort
  High tidal volumes might reflect high drive and effort. No clear cut-off values defined yet. In NIV V_{Te} >9.5ml/kg/PBW was significantly associated with NIV failure. Beware of double triggering and breath stacking in assisted ventilation resulting into excessive tidal volumes potentially promoting P-SILI.

In our article on ventilating patients with COVID-19-associated ARDS, we reviewed relevant literature and four current guidelines to provide a practical overview. For references and details, please visit our website: www.draeger.com/covid-ventilation
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