Management Specific to COVID-19

Introduction

According to Brigham and Women's Hospital COVID-19 Critical Care Clinical Guidelines, people with COVID-19 generally present respiratory symptoms. More specifically,

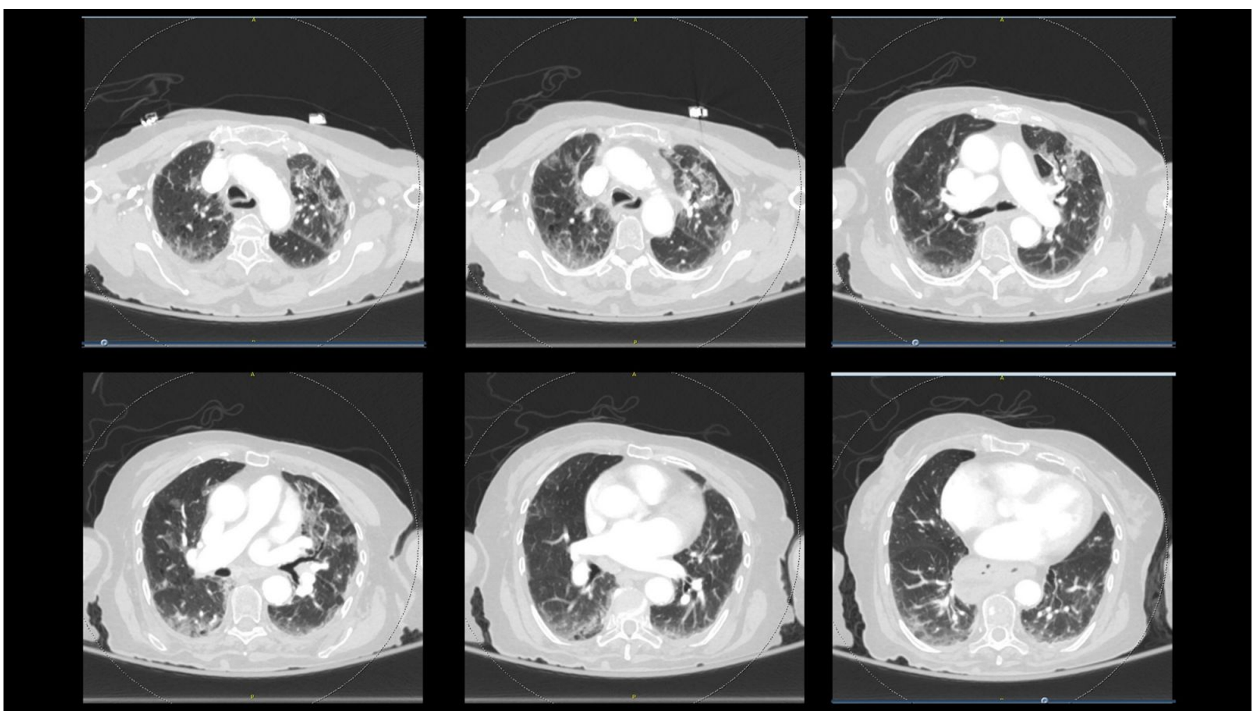
- 46-82% have a cough
- 20-64% experience shortness of breath
- 5-25% exhibit upper respiratory symptoms, including nasal/sinus congestion

The Brigham and Women's Hospital guidelines further state that approximately 20% of those with COVID-19 develop ARDS and 2-25% have a respiratory viral co-infection, and the most common cause of ICU admission for COVID-19 patients is hypoxemic respiratory failure. Among those admitted, intubation is often required within 12 to 24 hours. Of

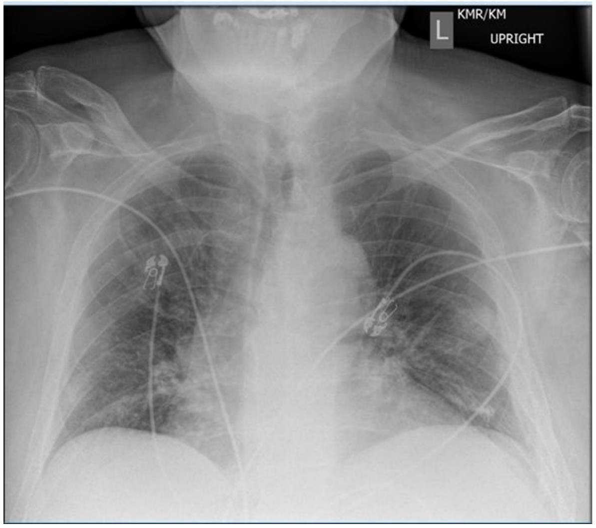
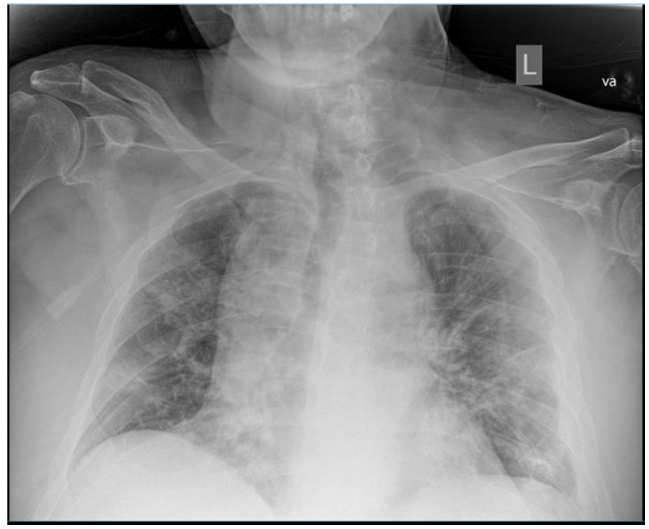
COVID-19 patients who die, about half die from respiratory failure and a third die from concomitant respiratory and heart failure.

Many patients with COVID-19 are presenting with hypoxemia disproportionate to their imaging findings. Hypoxemia arises in ARDS through a mismatch of ventilation and perfusion, predominantly due to shunt,[1–3] with shunt fractions much greater than would be anticipated for their relatively compliant lungs. Patients with COVID-19 have scattered, peripheral ground glass opacities on chest computed tomography scans, indicating ineffective lung units, and as such, shunt appears to be a major cause of the hypoxemia. Dr. Gattioni and colleagues report disproportionate blood flow to these areas, possibly accounting for the profound hypoxemia.[3] They suggest at least two distinct phenotypes, with the low recruitability phenotype presenting with low elastance, high compliance, low recruitability, but yet substantial hypoxemia. They posit that a mechanism for this profound hypoxemia could be loss of V/Q matching from pulmonary arterial vasoplegia. Later, patients progressed to the H phenotype, with high elastance, low compliance, high recruitability, and need for higher PEEP.

The CT scan below demonstrates the mild-moderate ground glass findings in COVID-19.



On presentation, patients are presenting with substantial hypoxemia, with many having oxygen saturations in the 70s, 80s, 90s, and they deteriorate with any exertion. Chest x-ray imaging will vary substantially depending upon where the patient is in the course of their illness.

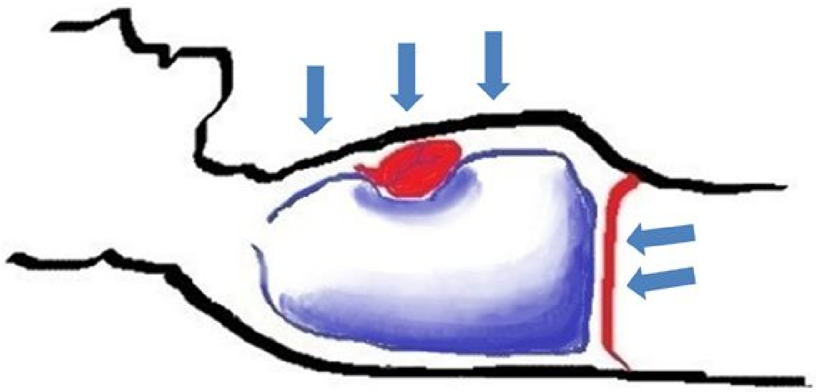



The initial mode of treatment involves providing supplemental oxygen immediately to improve the oxygen saturation. Although patients may or may not be complaining of dyspnea, nearly all hypoxemic patients are noted to be tachypneic. Patients who are tachypneic, generating large tidal volumes, can still induce lung injury from generating large negative intrathoracic pressure and therefore a large transpulmonary pressure. As such, the hypoxemia should be treated to decrease hypoxemic drive.

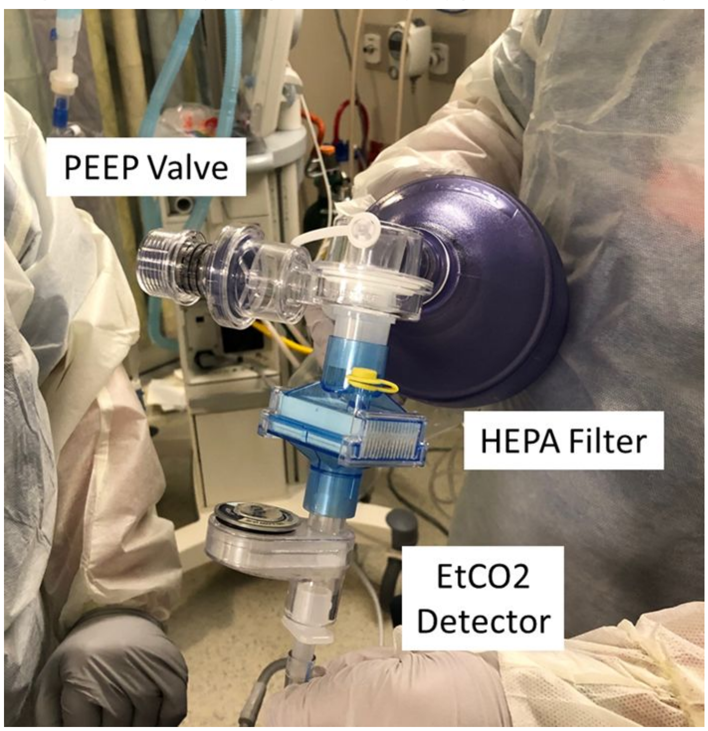
The role of high-flow nasal cannula and non-invasive positive pressure ventilation are controversial in COVID-19. The concerns are for healthcare workers, as the risk of aerosolization has been noted with these modalities, especially non-invasive positive pressure ventilation. Although there are limited data regarding the use of HNFC in COVID-19, a small study of patients with Influenza A showed that 45% avoided intubation, although all more severe patients were eventually intubated.[4]

Similarly, non-invasive positive pressure ventilation (NIPPV) is a common means of respiratory support in many patients, but its use in COVID-19 should be limited. NIPPV failed in 57-85% of patients with Influenza A H1N1 associated ARDS, with failing patients having a higher ICU mortality than those treated with invasive mechanical ventilation.[4,5] Some component of this may be due to patients continuing to generate large tidal volumes and continuing to induce self-inflicted lung injury.[6] Subjects with SOFA score ≥ 5 had a higher risk of NIV failure (odds ratio = 3.3, 95% CI 2.4-4.5).[5] A small study of COVID-19 patients in Wuhan found that 76% failed NIPPV, and the mortality rates were similarly high for both groups.[6] NIPPV also aerosolizes the virus[7] and many recommend that it should be avoided in most circumstances.[7,8] However, there may well be a role for judicious use of non-invasive ventilation in COVID-19. Each institution is developing their own policies and procedures, with some adopting the process widely and others not using it at all.

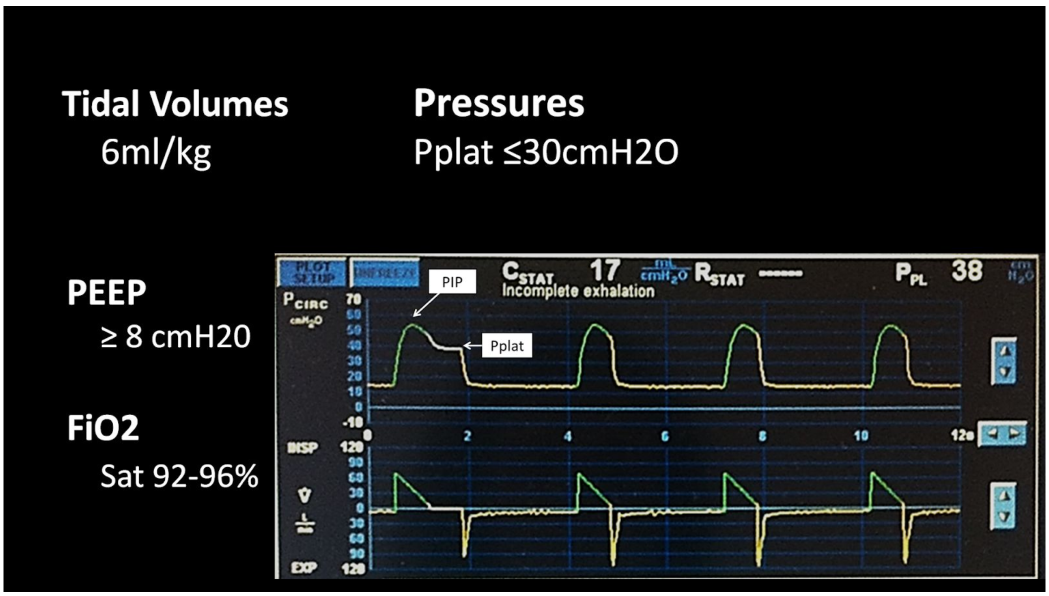
When the decision is made to intubate a patient, the patient can have significant clinical deterioration with COVID-19. The patient arrives with a high work of breathing, generating substantial negative intrathoracic pressure to maintain minute ventilation and V/Q matching. When the patient is intubated, the induction agents and paralytics are administered, the patient is laid in a recumbent position, and the patient will be derecruited.



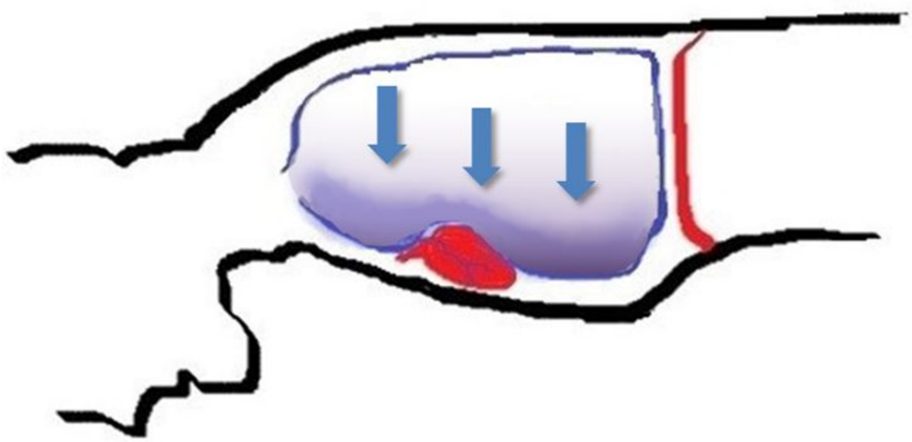
Recruiting the patient can be a substantial endeavor. Typically, we use a bag method with a PEEP valve to recruit patients and prepare them to be placed on the ventilator immediately after intubation. If this method is to be used, a HEPA filter must be placed between the endotracheal tube and the bag. However, many institutions are now foregoing any bagging and instead placing the patient directly on the ventilator to reduce the risk of aerosolization. An advantage is that the patient does not receive any high tidal volume, high-pressure breaths from the bagging. The downside, however, is that recruitment may take longer, and these patients may be profoundly hypoxemic during that time period.



Once the patient is placed on the ventilator, general principles of good ventilator management still apply. The patient should be placed on low tidal volume ventilation, starting with a tidal volume of 6 ml/kg of predicted body weight. The plateau pressure should be checked and monitored, ensuring a value less than 30 cm H_2O. The driving pressure should be less than 15 cm H_2O. These patients likely require a moderate PEEP at least. We recommend starting with a PEEP of 8 cm H_2O and adjusting from there. Please refer to the section on "Ventilation in ARDS" for an in-depth review of performing a recruitment maneuver and a best PEEP trial to assess a patient's compliance to find the optimal peep. While PEEP can improve oxygenation, too much PEEP can be deleterious, causing increased intrathoracic pressure, lung injury, and hemodynamic compromise if severe.



For patients with COVID-19 who have a PaO_2 / FiO_2 ratio of less than a 150, the next step should be placing the patient in a prone position. Many institutions have protocols or guidelines for prone positioning. Prone positioning has been shown to improve mortality in patients with ARDS, and authors are reporting good outcomes with proning in patients with COVID-19. Although a simple procedure, it requires a systems-based approach, with investment from nurses, respiratory therapists, and physicians alike. All attention must be on the patient's endotracheal tube, invasive lines, and position during the turns. Additionally, close attention must be paid to patients in a prone position to ensure that their orbits and eyes are protected, that pressure points are well-supported, that medical equipment is not trapped under the body, possibly causing opportunity for injury or bedsores. Most protocols involve leaving the patient in the prone position for 12 to 16 hours. The patient will be reproned as long as their PaO_2 / FiO_2 ratio remains less than 150 while they are supine. When the patient's PaO_2 / FiO_2 ratio starts to improve, the patient no longer requires routine proning.



For patients with persistent severe hypoxemia, inhaled pulmonary vasodilators can be considered. Inhaled epoprostenol is an excellent pulmonary vasodilator, however, it is not recommended in COVID-19 as it mandates frequent ventilator circuit changes. Therefore, if an inhaled pulmonary vasodilator is needed, inhaled nitric oxide is preferred. We start at 20 parts per million and assess the patient for an improvement in SpO_2. If the patient does not have at least a 20% improvement in the SpO_2, the inhaled pulmonary vasodilator is unlikely to be effective and should not be continued. If the patient is responsive, the pulmonary vasodilator can be continued with gradual weaning as a patient improves clinically over the next several days.

Bacterial superinfection has been noted in 20-30% of patients with COVID-19, and as such, many patients will require antibiotics. Procalcitonin can be useful for assessing COVID-19 alone.

Steroids are not routinely recommended for COVID-19 treatment. However, patients who have another indication for steroids, such as asthma or adrenal insufficiency, should receive them. The surviving sepsis campaign recommends use of steroids in severe ARDS, however, this is not a universal recommendation.

The role of other medications including hydroxychloroquine, azithromycin, and statins, are unclear. We encourage everyone to refer to local protocols for guidance on the use of these medications. Some medications, such as Remdesivir, are being evaluated in clinical trials.

Although CT scans have been shown to be fairly sensitive for the diagnosis of COVID-19, once the diagnosis is made, we do not encourage the routine use of CT scans. Not only does a CT scan pose a risk to a critically ill patient, mandating travel with the associated risks of line pulls, hemodynamic instability, and hypoxemia, but this can lead to infection control issues mandating the cleaning of the scanners as well.

Patients with COVID-19 have been noted to be fairly hypercoagulable with many authors reporting thromboembolic disease, clotting of dialysis lines, and other clinical manifestations of hypercoagulability. D-dimer levels can be elevated (into the thousands). The best practices for initiation of therapeutic anticoagulation, in the absence of a documented thromboembolism, are unclear at this time. Some clinicians are using markedly elevated D-dimer levels, such as greater than 2000, as an indication for anticoagulation, whereas others are basing it upon clotting of lines and other clinical markers.

Bronchoscopy is an aerosolizing procedure and as such, should be minimized or avoided in patients with COVID-19. Additionally, suctioning can be aerosolizing and all healthcare workers in the room should be aware and in appropriate PPE before these procedures are performed.

References:

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