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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Prone Position of Patients With COVID-19 and Acute Respiratory Distress Syndrome

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The current pandemic, severe acute respiratory syndrome coronavirus 2 (SARS CoV-2), more commonly known as COVID-19, has created significant challenges in the care of these patients as a result of the viral interstitial pneumonia and hypoxemic respiratory failure. The most common signs and symptoms associated with SARS CoV-2 pneumonia include fever, chills, dyspnea, cough, sore throat, muscle pain, and new loss of taste or smell appearing within 2-14 days after exposure to the virus.[1] The interstitial pneumonia and progressive hypoxemic respiratory failure ranges from mild to severe, with the prevalence of acute respiratory distress syndrome (ARDS) reported to be 17%.[2] The gravity of onset of respiratory failure varies, and the risk for severity of illness may be impacted by a person's comorbidities. Conditions placing a patient at high risk include moderate to severe asthma, chronic lung disease, serious heart conditions, immunocompromised state, chronic kidney disease requiring dialysis, diabetes, liver disease, severe obesity, and older age.[1]

The pandemic has been complicated by equipment and personnel shortages, overcrowding of critical care units and hospitals, strict isolation procedures, and significant mortality.[3] ARDS-related mortality has been reported to be between 30-40% and is often complicated by multiple-organ dysfunction syndrome.[4,5] However, if we rely on experts and current practice guidelines, we have a large body of evidence to guide nursing care for patients with severe ARDS.

General guidelines in the care of the adult patient align with current interventions that incorporate escalating actions to address the acute hypoxemic respiratory failure. Supplemental oxygen should be administered to achieve a peripheral oxygen saturation (SpO_2) greater than 92%. The *Society of Critical Care Medicine Surviving Sepsis Campaign COVID-19 Guidelines*[6] found weak evidence supporting the efficacy of high-flow nasal cannula and noninvasive positive pressure ventilation coupled with the possibility of environmental contamination. However, a trial of high-flow nasal cannula or noninvasive positive pressure ventilation may be attempted if the patient's hypoxemic respiratory failure continues to progress, but endotracheal intubation should not be delayed if the patient's oxygenation and ventilation are worsening.[6] Once the patient is intubated and mechanically ventilated, standard ARDS protocols that use low tidal volume ventilation, plateau pressures less than 30 cm H_2O, and higher positive end-expiratory pressure (PEEP) should be followed.[4,6] Other interventions include conservative fluid management, administration of antibiotics, sedation and analgesia, and neuromuscular blocking agents to facilitate ventilation and oxygenation. Hemodynamic monitoring inclusive of respiratory parameters (ie, arterial blood gases and partial pressure of oxygen in arterial blood [PaO_2]/fraction of inspired oxygen [FiO_2] ratio) are central to evaluating ARDS progression and intervention effectiveness.

The 2012 Berlin definition is used to describe the severity of ARDS as mild, moderate, or severe according to oxygenation determined by the PaO_2/FiO_2 (P:F) ratio.[7] The P:F ratio is calculated by dividing the PaO_2 obtained from an arterial blood gas by the FiO_2. For example, a PaO_2 of 82 divided by a FiO_2 50% (0.5) = 164, indicating moderate ARDS (Box 1). Prone positioning is considered an effective intervention and a standard practice for the patient with moderate to severe ARDS if conventional lung recruitment measures fail to improve oxygenation and ventilation.[4,6]

Prone Position for Patients With COVID-19 and ARDS

The pathogenesis of ARDS results in damage to the alveoli and subsequent increased capillary permeability, inflammatory response, and pulmonary edema, with hypoxic vasoconstriction leading to intrapulmonary shunting and severe hypoxemia. The ensuing ventilation-perfusion (V/Q) mismatch directs lung recruitment maneuvers that minimize ventilatory-induced lung injuries (VILIs) to improve the delivery of oxygen to perfused regions of the lungs. In the supine position, dependent areas of the lungs lack adequate ventilation associated with the weight of the ventral lungs, heart, and abdominal viscera.[8,9] As ARDS progresses, the increased edematous lung further reduces ventilation in the dependent dorsal regions of the lungs.[8] Gravitational pressures on the lung vasculature result in more perfusion to the dependent lung fields which are not well ventilated. The result is that areas of the lung with perfusion but poor ventilation worsen the V/Q mismatch and subsequent hypoxemia. Placing the patient in the prone position optimizes the ventilation and perfusion to regions of the once dependent dorsal lung fields. Re-establishing the V/Q relationship

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Box 1
Berlin Criteria for ARDS[7]

Four criteria
1. Onset of symptoms within 1 week of clinical injury/insult
2. Chest radiograph confirms bilateral opacities not explained by effusions or other etiologies
3. Edema is not associated with cardiac failure or fluid overload
4. Oxygenation
   a. Mild: PaO_2/FiO_2 200 to 300 mm Hg with a positive end-expiratory pressure (PEEP) equal to or greater than 5 cm H_2O
   b. Moderate: PaO_2/FiO_2 100 to 200 mm Hg with a PEEP equal to or greater than 5 cm H_2O
   c. Severe: PaO_2/FiO_2 less than or equal to 100 mm Hg with a PEEP equal to or greater than 5 cm H_2O

decreases the intrapulmonary shunting and facilitates more effective oxygenation. Research has supported that prone position redistributes ventilation to dorsal regions, recruiting once unavailable sections of the lungs to optimize gas exchange with well-perfused alveolar units.[3,4] In addition, mechanical ventilation in the prone position has been found to reduce lung strain, minimizing the occurrence of VILIs.[4,9] Once a patient is successfully placed in the prone position, the patient should remain in this position for 12-16 hours.[4,6] However, reports of patients with COVID-19 and ARDS remaining in the prone position for longer durations have been reported.[2,5]

Current practice standards suggest prone position should be considered early in the management of the patient with moderate to severe ARDS, when the P:F ratio is approaching 150 mmHg.[4,6] Contraindications for prone position include, but may not be limited to, extreme obesity, pregnancy, unstable spine, seizures, elevated intracranial pressure, maxillofacial surgery, and hemodynamic instability. Special precautions are required for placing and monitoring a patient in the prone position. Protecting the skin, especially surfaces of the feet, knees, hips, shoulders, and face, should be addressed with protective dressings before placing the patient in the prone position. The National Pressure Injury Advisory Panel[10] provides a user-friendly guide for protecting the skin for patients in the prone position (https://cdn.ymaws.com/npiap.com/resource/resmgr/online_store/posters/npiap_pip_tips_-_proning_202.pdf). The patient should also be repositioned every 2 hours to reduce pressure-associated injuries. The patient's eyes should be lubricated and taped shut to protect against corneal injury. Special care is necessary for management of lines and tubes before and after the pronation procedure. Enteral feedings are held before proning the patient but are often re-established after turn. A period of hemodynamic instability is anticipated after placing the patient in a prone position that is managed with adjusting vasopressor agents. Most importantly, placing a patient in the prone position requires a coordinated team effort to safely position the patient. A video describing the process is available at https://www.aacn.org/blog/ards-covid-19-and-pronation-therapy.[11]

Implications for Practice

Prone position for hypoxemic respiratory failure and ARDS has evolved into an essential and standard therapeutic intervention in the management of ARDS, including patients with COVID-19. Evidence-based protocols should be developed within perianesthisa units to guide the practice of placing and safely monitoring patients in the prone position. Protocols need to address patient selection; team members required and role for the procedure; preprocedure steps (ie, eye protection, skin projection, enteral feeding); management of tubes, lines, and airway; and emergency protocols (eg, accidental extubation, cardiopulmonary instability or arrest). The evidence supports placing patients in the prone position early in the management of ARDS to improve patient survival. The knowledge, skills, and competency to safely implement this essential intervention in the care of patients with moderate to severe ARDS are essential for critical care nurses.

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