

Prone positioning in ARDS

Appropriate use of prone positioning can improve patient outcomes.

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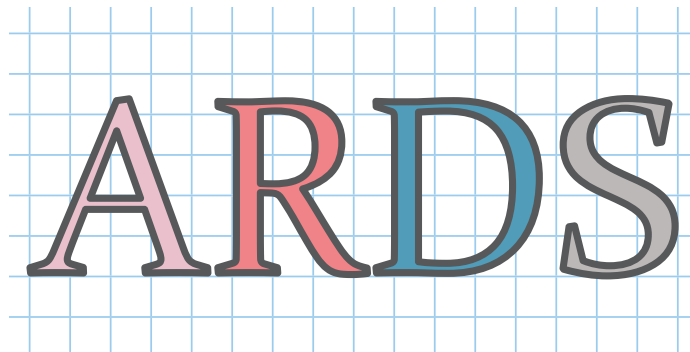
Paul Welsh*, who is 66 years old, is brought to the emergency department (ED) by his family. He's experiencing increasing fatigue, fever, chills, and a productive cough. He reports that he's been in relatively good health until about a week ago, when he noted a sore throat and "cold symptoms." He visited his primary care provider, who prescribed azithromycin. Mr. Welsh, who has type 2 non-insulin dependent diabetes, hasn't been vaccinated for pneumonia.

Margaret, the ED nurse, notes that Mr. Welsh is dyspneic and mildly confused with disorientation to date and time. She applies oxygen at 2 L via nasal cannula. On physical exam, Margaret notes bilateral wheezing and crackles throughout the lower lobes. Mr. Welsh's vital signs are temperature 96.8° F (36° C), apical heart rate (HR) 118 beats per minute (bpm) and regular, respiratory rate (RR) 28 breaths per minute with accessory muscle use, oxygen saturation 87%, and blood pressure (BP) 98/60 mmHg (seated). Margaret increases the oxygen to a 40% nonrebreather mask, and the provider writes orders for a stat chest X-ray and blood work for arterial blood gas. The patient is admitted to the telemetry unit for continued evaluation and treatment of progressive community-acquired pneumonia.

The next morning, Sarah, the telemetry unit nurse, observes that Mr. Welsh is more confused and that his blood gases are rapidly de-

teriorating. He's transferred to the intensive care unit (ICU) for mechanical ventilation.

Mark, Mr. Welsh's nurse in the ICU, notes that his lab values reveal



leukocytosis and respiratory acidosis (pH 7.31, carbon dioxide 48 mEq/L, bicarbonate [HCO₃]⁻ 24 mEq/L) with hypoxemia and a blood lactate concentration of 5 mmol/L. The fraction of inspired oxygen (FiO₂) percentage can't be reduced from 100% on the ventilator, and the target tidal volume remains set at 6 mL/kg of predicted body weight to protect lung tissue. Mark increases suctioning because of purulent secretions. Aerobic and anaerobic blood cultures are sent to the lab. Positive end-expiratory pressure (PEEP) is added to the mechanical ventilator settings in an attempt to avoid alveolar collapse. Chest radiography reveals bilateral infiltrates and noncardiac pulmonary edema.

After the provider orders vasopressor norepinephrine, titrated to maintain a mean arterial pressure (MAP) of 65 mmHg, Mr. Welsh's BP and HR stabilize. Inotropic therapy with dobutamine at 20 mcg/kg/min is added because of continued hypoperfusion despite achieving a desired MAP.

Mr. Welsh is diagnosed with pneumonia, which has contributed to the development of acute respiratory distress syndrome (ARDS). (See *All about ARDS*.)

Mark considers whether Mr. Welsh would be a candidate for prone positioning. Mark knows that the nurse is responsible for initiating the discussion with the interprofessional critical care team to use this technique to improve oxygenation. His facility has an established proto-

col for prone positioning, which is essential for successful use of this technique.

Prone positioning and ARDS

Turning the patient with ARDS from a supine to a prone position can increase pulmonary capillary perfusion and oxygenation. The physiologic changes (fluid shifting from the posterior lung, allowing undamaged alveoli to be filled with oxygenated blood) that occur when turning a patient into a prone position improve ventilation. Prone positioning also promotes pulmonary toileting and alveoli opening, and it has been associated with a decrease in ventilator-induced acute lung injury.

Prone positioning as a therapeutic intervention for ARDS has been studied for decades, with inconclusive results regarding the benefits to patients. However, recent studies have shown that early application of prone positioning for several hours at a time significantly reduces

All about ARDS

Acute respiratory distress syndrome (ARDS) is an acute inflammation of the lungs, caused by direct or indirect injury, that leads to pulmonary edema and hypoxemia. Examples of direct lung injury include pneumonia (as is the case with Mr. Welsh), lung trauma, thoracic surgery, near-drowning, fat emboli, and toxic gas inhalation. Indirect injury can result from complications such as sepsis, multiple blood transfusions, burns, cardiopulmonary bypass, noncardiogenic shock, and pancreatitis.

ARDS causes major disruption in respiratory function at the level of gas exchange. Increasing pulmonary edema and alveolar collapse creates a physiologic dead space, where no gas exchange can take place in the pulmonary capillaries.

Lengthy hospital stays related to ARDS lead to alarmingly high costs, and 75,000 deaths in the United States can be attributed to ARDS annually.

- In the United States, approximately 78 per 100,000 people are diagnosed with ARDS each year.
- Risk factors for ARDS include comorbidities such as diabetes and obesity.
- Demographic risk factors associated with ARDS are race (non-Caucasian) and age (> 55 years).
- Despite major advances in ventilator management, ARDS mortality is 40% to 50%.

the mortality of mechanically ventilated patients with moderate to severe ARDS.

Candidates

Patients in the early stages of ARDS who have been mechanically ventilated for fewer than 36 hours are good candidates for prone positioning (typically, prone positioning is recommended within the first 24 hours of an ARDS diagnosis). However, also consider prone positioning when patients have progressed to moderate to severe ARDS and have refractory hypoxemia with partial pressure of arterial oxygen (PaO_2)/ FiO_2 ratio less than 150 mmHg.

Before placing a patient in the prone position, note these contraindications: increased intracranial pressure, instability of the spine, acute lethal arrhythmias, and postcardiac and ophthalmologic surgeries. (See *Prone positioning contraindications*.) In addition, patients who are hemodynamically unstable on increasing vasopressors aren't candidates for prone positioning.

The technique

The physical act of turning a ventilated patient to the prone position can be intimidating, even for a well-trained staff. Before any organization implements the prone posi-

Prone positioning contraindications

Note these contraindications when considering prone positioning for patients with acute respiratory distress syndrome:

- severe arrhythmias
- pelvic fracture
- intracranial hypertension
- spine instability
- recent sternotomy/cardiac surgery
- peritoneostomy.

Relative contraindications include:

- tracheostomy (only within the first 24 hours)
- bronchopleural fistula
- alveolar hemorrhage
- ophthalmologic surgery
- intraocular pressure
- pregnancy
- facial trauma.

tioning protocol, the critical care team must be skilled in this technique. Proper education and practice can reduce complications related to position changes, such as accidental extubation or obstruction of the endotracheal tube and dislodgment of I.V. and arterial tubing. Developing an interdisciplinary critical care team (such as a code team) specialized in prone position-

ing of ARDS patients can minimize mechanical challenges and increase confidence, which may then lead to greater use of the protocol. Some organizations, however, may want to consider using rotating beds to reduce the risks associated with turning and skin breakdown.

To minimize complications of prone positioning, the repositioning team should include an anesthesia provider stationed at the head of the bed to stabilize the endotracheal tube and a minimum of three additional nurses or therapists. Each should have specifically designated responsibilities, such as monitoring vital signs, securing invasive lines, preparing suction equipment, and ensuring proper body alignment to reduce stress on pressure points, joints, and neck. (See *Prone positioning protocol*.)

After the team determines that a patient is a candidate for prone positioning, discuss appropriate sedation and the possible addition of neuromuscular blocking agents before repositioning. Best practice suggests maintaining prone positioning for between 17 to 20 consecutive hours per day. Perform an initial arterial blood gas assessment just before turning the patient from supine to prone, 1 hour after placement in the prone position, and then at 4-hour intervals.

Immediately after placing the patient in the prone position, assess him or her for acute complications such as prolonged hypotension, bradycardia, prolonged decrease in pulse oximetry, and cardiac arrest. Complications that require immediate cessation of prone positioning include:

- hemoptysis
- oxygen saturation < 85% by pulse oximetry
- PaO_2 < 55 mmHg for more than 5 minutes
- HR < 30 bpm for more than 1 minute
- systolic blood pressure < 60 mmHg for 5 minutes.

Patients are considered to be tolerating the initial position change when they don't have any obvious compli-

cations and they're hemodynamically stable, with a partial pressure of oxygen (PO₂) > 80 mmHg on arterial blood gas. Once the patient is back in the supine position, watch for indications that the prone position is being well tolerated, such as improved oxygenation for at least 4 hours after the last proning session or a decrease in the PaO₂/FiO₂ ratio of more than 20% compared to the ratio in the supine position.

Supporting the patient

Patients undergoing prone positioning need nutritional support and protection from pressure injuries.

Studies have shown that patients in prolonged prone positioning can receive enteral nutrition safely with no differences in gastric residual volumes or vomiting when compared to patients who are mechanically ventilated in the supine position. Strategies to help prevent enteral feeding complications include medications (such as metoclopramide or bromopride) to increase gastric motility and the inverse Trendelenburg position while lying prone. In addition, monitor gastric residual volumes, and check the patient's oral cavity for food or vomit every 2 hours. Adequate nutrition also helps prevent skin breakdown.

Studies have found that patients in the prone position for extended periods have a higher risk for pressure injuries on the face and the anterior chest wall. To reduce this risk, use hydrocolloid dressings on bony prominences, such as the forehead, chin, and shoulders. And turn and reposition the patient every 2 hours to redistribute pressure and reduce friction. Repositioning the head every hour and providing ocular and eyelid protection can help reduce skin breakdown.

Improving outcomes

Increasing survival rates for mechanically ventilated patients with ARDS is possible using an evidence-based strategy, such as turning them from supine to the prone position,

Prone positioning protocol

Use these best practices when implementing prone positioning of patients with acute respiratory distress syndrome:

- Obtain an order for prone positioning.
- Assess the patient's hemodynamic status and oxygenation to determine his or her eligibility.
- Administer sedation and neuromuscular blocking agents as ordered.
- Provide eye care/lubrication, and tape eyelids if indicated.
- Ensure that the patient's tongue is inside the mouth, insert a bite block if needed, provide oral care as needed, and suction as necessary.
- Secure the airway/endotracheal tube.
- Perform anterior skin care, and place hydrocolloid dressings on bony prominences, chin, and forehead.
- Position the patient's face away from the ventilator to prevent tube kinking; reposition the patient's head hourly to prevent skin breakdown.
- Empty any drainage bags.
- Place electrocardiogram electrodes on the patient's posterior chest.
- Assign interprofessional team member repositioning responsibilities (airway/lines/tubing).
- Monitor the patient's response to prone positioning. Obtain arterial blood gases within 1 hour of repositioning and then at 4-hour intervals.

when it's accompanied by ongoing education and training of interprofessional teams. Nurses who are adequately skilled in a prone position protocol can confidently care for critically ill patients with ARDS and ultimately improve outcomes.

Revisiting Mr. Welsh

Because of Mr. Welsh's refractory hypoxemia and acute respiratory acidosis, he's identified as a candidate for prone positioning. He is placed in the prone position for 18 consecutive hours for 3 days. On day 4, arterial blood gases stabilize for over 4 hours in the supine position and adjustments of ventilator settings are made to decrease FiO₂ and discontinue PEEP. Mark continues to suction copious secretions and monitor Mr. Welsh's vital signs, including pulse oximetry, which stabilizes at 94%. Mr. Welsh remains hemodynamically stable and is successfully extubated the next morning. ★

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*Names are fictitious.

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