For hospitals and other healthcare facilities

Use of BiPAP may delay or remove the need for mechanical ventilation in COVID-19 patients

Prepared by
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With the ongoing COVID-19 pandemic, a critical shortage of mechanical ventilators is anticipated in many countries. In the United States alone, an estimated 160 million people could be infected, resulting in 2.4 million hospitalizations.\(^1\)

As many as 1-3% of those infected by COVID-19 may develop acute respiratory distress syndrome (ARDS) that could range from mild to severe.\(^2\) The problem at hand is twofold: not enough beds in the ICU to care for patients and not enough ventilators to support those with respiratory failure.

As a result, the medical community will likely return to the use of noninvasive ventilation (NIV) devices to help manage hypoxic respiratory failure earlier in the course of treatment for COVID-19.\(^3,4\) Bi-level positive airway pressure (BiPAP) machines are NIV devices that may be adjusted and used to delay or substitute for mechanical ventilation in certain COVID-19 patients. This could help conserve ICU beds and mechanical ventilation equipment for more critical cases.

During this time, the U.S. Food and Drug Administration is temporarily waiving objections to such device modifications when they do not create an undue risk. This includes BiPAP to treat appropriate patients.\(^5\)

### Management of ARDS

The goals for managing ARDS include\(^3\):

- Maintaining oxygen PaO\(_2\) above 55 mm Hg
- Oxygen saturations better than 88%
- Blood pH above 7.25

ARDS severity based on PaO\(_2\)/FiO\(_2\) ratio while receiving 5 cmH\(_2\)O CPAP\(^6\):

- Mild—ratio of 200–300
- Moderate—ratio of 100–200
- Severe—ratio <100

The only treatment found to improve survival is a low tidal volume (TV) strategy on ventilator support (6 cc/kg ideal weight).\(^4,7\)
Which patients should use BiPAP?

- COVID (+) or pending status
- Those considered for use of NIV with face mask
- Moderate ARDS (P/F ratio of 100–200)
- Hemodynamically stable
- Mean SOFA ≤2
- Those with any chronic illness not in exacerbation during ICU stay

When to use noninvasive BiPAP

Early in the course of care, clinicians may consider use of helmet interface or face mask with BiPAP to support respiratory status. To reduce risk to healthcare providers:

- Clinicians should use local best practices for noninvasive ventilation
- Bag valve masks (BVMs) and other ventilator equipment should be equipped with HEPA filtration to filter expired air and minimize aerosolization

EMS organizations: Consult ventilator equipment manufacturer to confirm the appropriate filtration capability and the effect of filtration on positive-pressure ventilation.

What to consider when using invasive BiPAP after intubation

- In general, if patients have lung failure and not more than 2 organ systems in failure, BiPAP devices may support them adequately
- An endotracheal tube with BiPAP has not been evaluated in COVID-19 patients, nor are there formal recommendations from critical care societies or associations
- While early intubation is generally the goal if a patient is not stabilizing quickly, use with BiPAP as an alternative measure is a clinical decision to be made by physicians to support the respiratory care of their patients
- Bedside clinicians should consider the severity of failure in multiple organs or other symptoms of worsening ARDS

If the patient isn’t stabilized quickly (within 30 minutes) after noninvasive BiPAP, clinicians may elect to intubate and continue use with the BiPAP machine.

This can provide a means to ventilate/oxygenate patients until a standard ventilator and ICU bed become available, or in lieu of these resources if they are not available.
How to use

Smart BiPAP for ventilation

Intubate

Average Volume-Assured Pressure Support (AVAPS)

Initial settings

- Pmin: 10
- Pmax: 20
- EPAP: 5–10
- FiO₂: 100%
- Goal Min Vent: 8–15 liters/minute
- TV: 4–6 cc/kg

Before proceeding, check these 3 settings

1. Choose Pmax setting close to the Mean Airway Pressure that the machine is giving back
2. AVAPS mode will adjust Pressure Support to desired TV
3. May need to change EPAP to: >10 to achieve saturation >90% OR adjust FiO₂ to maintain PaO₂ >60

ABG 30 minutes, make adjustment as necessary based on pH levels or O₂

If pH is not over 7.25
- Then will likely need adjustment of Pmax

If O₂ saturations are less than 90%
- Then adjust EPAP as necessary

When to use the AVAPS capability

Many newer standard NIV devices are equipped with an algorithm-based BiPAP mode for AVAPS, providing functionality much closer to that of a standard mechanical ventilator. AVAPS allows clinicians to set:

- TV (average)
- Respiratory rate
- Expiratory positive airway pressure level
- Higher concentration of oxygen
Minute ventilation moves along a continuum during ARDS

Minute Ventilation at the Extremes: Preintubation
What will happen when you take control of the patient’s respiratory drive?

- Risk: Auto-PEEP
- Risk: Barotrauma
- Risk: Inadequate Compensation

Normal Minute Ventilation
5–8 LPM

COPD
Asthma

Salicylates
DKA Rhabdo
Severe Acidosis

6 breaths per min 500 mL to start-check pressures

LOW NORMAL HIGH

When initiating BiPAP, begin by matching the patient’s ventilatory needs based on their breathing rate and ideal TV.

Intubate

Standard BiPAP

Begin with settings

IPAP: 8  EPAP: 4  \( \text{FiO}_2 \): 100%

Assess

- Minute ventilation
- RSBI <105

Titrate IPAP to TV:
4–6 cc/kg

Titrate EPAP that’s comfortable or maintains \( \text{O}_2 \) saturations >90%

ABG 30 minutes, make adjustment as necessary based on pH levels or \( \text{O}_2 \)

If pH is not over 7.25

Then will likely need adjustment of Pmax

If \( \text{O}_2 \) saturations are less than 90%

Then adjust EPAP as necessary

Equipment useful at bedside during invasive BiPAP

Use of BiPAP with intubation may require equipment normally used for patients on mechanical ventilation:

- Suction device—to remove pulmonary secretions
- Pulse oximeter—to measure saturation of oxygen in blood
- BVM (often referred to as an Ambu® bag)—to provide positive pressure ventilation
- Telemetry system—to measure vital signs (e.g., heart rate, breathing, blood pressure)

Glossary

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>ABG</td>
<td>arterial blood gas</td>
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<tr>
<td>ARDS</td>
<td>acute respiratory distress syndrome</td>
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<tr>
<td>AVAPS</td>
<td>average volume-assured pressure support</td>
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<tr>
<td>BiPAP</td>
<td>bi-level positive airway pressure</td>
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<tr>
<td>BVMs</td>
<td>bag valve masks (often referred to as Ambu bags)</td>
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<tr>
<td>CPAP</td>
<td>continuous positive airway pressure</td>
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<tr>
<td>DKA Rhabdo</td>
<td>rhabdomyolysis in diabetic ketoacidosis</td>
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<tr>
<td>EPAP</td>
<td>expiratory positive airway pressure</td>
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<tr>
<td>HEPA</td>
<td>high efficiency particulate air</td>
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<tr>
<td>IPAP</td>
<td>inspiratory positive airway pressure</td>
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<tr>
<td>Minute ventilation</td>
<td>the amount of gas a patient inhales and exhales in one minute</td>
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<tr>
<td>NIV</td>
<td>noninvasive ventilation</td>
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<td>RSBI</td>
<td>rapid shallow breathing index</td>
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<td>SOFA</td>
<td>sequential organ failure assessment</td>
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<tr>
<td>TV</td>
<td>tidal volume</td>
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This information was intended for use by healthcare professionals. If you are an individual who is not a healthcare professional, call your doctor for medical advice. Or if you are experiencing a medical emergency, call the emergency medical services in your jurisdiction.
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