The Utilization of a Non-Invasive Ventilator to Compensate for Chest Tube Leak During Extracorporeal Membrane Oxygenation

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Introduction

- Maintaining lung inflation during Extracorporeal Membrane Oxygenation (ECMO) is a critical part of the patient’s clinical management.
- The goal of ECMO is to minimize ventilator induced trauma
- Despite lung protective ventilation, ventilator injury can still occur
- If large air leaks develop clinical progression may be limited.
- A fifty year old male was admitted with cavitation Pneumonia with refractory hypoxemia.
- Despite aggressive conventional ventilatory management, gas exchange failed to be optimized resulting in the need for V-V ECMO cannulation. Despite the utilization of lung protective ventilation the patient developed pneumothoraces of the right lung resulting in several chest tubes needing to be placed.

Methods

- Prolonged paralytic administration, daily bronchoscopies, and placement on High Frequency Percussive Ventilation (VDR-4)* were required to maintain stable gas exchange despite maximizing ECMO parameters.
- Attempts to remove paralytic administration and transition from HFPP resulted in gas exchange deterioration and increase in chest tube air leak. On ventilator day 38 attempts were made to place back on conventional ventilation to reduce the administration of the paralytic.
- The transition to conventional ventilation failed to provide ventilation secondary to the large chest tube leak, which caused ventilator malfunction. Leak compensation via conventional ventilation failed secondary to chest tube leaks greater than 25 liters.
- Also the ability to track ventilatory parameters was diminished, along with continuous activation of leak compensation alarming.
- Decision was made to use the V-60** to maintain lung inflation, reduce paralytic administration and minimize chest tube leak.

Results

- The chest tube leak was reduced from 25 liters to approximately 3-5 liters with no deterioration in gas exchange. (Table 1)
- An additional benefit was that the patient was able to generate triggered spontaneous breaths for the first time since being ventilated thirty eight days ago.
- The ability to track exhaled volumes was enhanced.
- Continuous leak compensation alarms were minimized.
- Gas exchange was maintained

Discussion

- Chest tube leak was minimized and fistula was able to seal
- Spontaneous breathing was achieved
  - Triggering sensitivity was enhanced and maintained secondary to Auto-Trak*** via V-60
- Alarm fatigue was reduced
  - Leak compensation and low volume alarms were minimized
- Ability to monitor gas delivery was enhanced
  - Exhaled volumes will able to be observed and monitored

- Also the ability to track exhaled volumes was enhanced.
- Continuous leak compensation alarms were minimized
- Gas exchange was maintained

Conclusion

- In the presence of large chest tube leaks, conventional ventilators may fail to ventilate adequately or trigger patient spontaneous efforts.
- Inability to monitor exhaled volumes may also be problematic.
- Alarm fatigue and loss of ventilatory monitoring was diminished.
- In this case scenario the V-60 allowed for stable gas exchange in the presence of a large chest tube leak with minimal alarms and monitoring issues.

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*A* Percussionaire-Sandpoint, Id.  **V-60* Phillips-Carlsbad, CA

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**Table 1**

<table>
<thead>
<tr>
<th>Chest Tube Leak</th>
<th>ABG % Spontaneous Breaths</th>
<th>ECMO Parameter</th>
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</thead>
<tbody>
<tr>
<td>&gt;25 liters</td>
<td>7.42 - 41-66</td>
<td>0% 100%/8 bpm</td>
</tr>
<tr>
<td>V-60</td>
<td>3.5 liters 7.41 - 40-69</td>
<td>50% 100%/7 bpm</td>
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</tbody>
</table>

***Auto-Trak technology is designed to address the specific challenges of NIV. By providing auto-adaptive leak compensation, inspiratory triggering, and expiratory cycling, Auto-Trak delivers optimal synchrony in the face of dynamic leak and changing patient demand.***

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