VE/VCO₂ slope is increased in patients who fail the spontaneous breathing trial

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Comentario
El trabajo de investigación ha demostrado la superioridad del índice VE/VCO₂ (ventilación necesaria para eliminar 1 litro de CO₂), sobre el parámetro de mayor uso en el retiro del ventilador mecánico (volumen corriente/frecuencia).

Rationale
An increased respiratory rate (f) associated with a tidal volume (TV) reduction, is observed in patients who fails the spontaneous breathing trial (SBT) in weaning of mechanical ventilatory support.

It is measured with the rapid shallow breathing index (f/TV). This inefficient pattern is associated with a rising PaCO₂ despite constant minute ventilation (VE).

Direct assessment of ventilatory inefficiency along SBT has not been reported.

As parallel, in stress conditions as cardiopulmonary exercise test, ventilatory inefficiency is assessed with the VE to CO₂ production ratio (VE/VCO₂), or its slope.

Hypothesis
Ventilatory inefficiency measured as VE/VCO₂ relation, is increased in patients whom fails the T-piece SBT.

Objective
Determine if Ventilatory inefficiency, measured as VE/VCO₂ relation, is increased in patients whom fails the weaning of mechanical ventilatory support.

Methods
1. One-hour SBT was prospectively evaluated in 77 patients.
   A CO₂/flow sensor was installed between the endotracheal tube and T-piece.
2. Follow variables were recorded from a volumetric capnography monitor.
   f, TV, VE and VCO₂ at 1, 15, 30, 45 and 60 minutes were measured.
3. f/VT and VE/VCO₂ relations were calculated.
4. Trial failure was defined according to standard criteria.
   f: respiratory rate
   TV: tidal volume
   SBT: single breath trial
   VE: minute volume
   VCO₂: CO₂ production
Demographics

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<tbody>
<tr>
<td>Male N (%)</td>
<td>46 (59,7)</td>
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<tr>
<td>Age in years (SD)</td>
<td>62 (17)</td>
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<tr>
<td>APACHE II (SD)</td>
<td>15 (2)</td>
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<td>Days on invasive ventilation (SD)</td>
<td>5 (0.5)</td>
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<td>Diagnostic N (%)</td>
<td></td>
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<tr>
<td>Surgical</td>
<td>16 (20.8)</td>
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<tr>
<td>Pneumonia</td>
<td>7 (9.1)</td>
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<tr>
<td>Sepsis</td>
<td>15 (19.5)</td>
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<tr>
<td>Trauma</td>
<td>6 (7.8)</td>
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<tr>
<td>Neurological</td>
<td>8 (10.4)</td>
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<tr>
<td>COPD</td>
<td>1 (1.3)</td>
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<tr>
<td>Others</td>
<td>23 (30)</td>
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<tr>
<td>Outcome, SBT failure N (%)</td>
<td>23 (30)</td>
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STATISTICS: Descriptive.
Means and SD calculation.
StudentsT test.
AUC [CI] of the ROC curves calculation.

Results
Twenty-three patients (30%) failed the SBT.
Variables from SBT failure compared to success patients were the following:
f/VT at 1 min: 79 ± 10 vs 52 ± 3 (p=0.03), and f/VT at 60 min: 91 ± 10 vs 53 ± 3 (p=0.01). VE/VCO2 at 1 min: 44 ± 3 vs 41 ± 2 (p=0.36), and VE/VCO2 at 60 min: 56 ± 6 vs 29 ± 3 (p<0.001).

The AUC [CI] of the ROC curves were 0.66 [0.52 - 0.80], 0.71 [0.57 - 0.86], and 0.81 [0.70 - 0.93] for f/VT at 1 min, f/VT at 60 min, and VE/VCO2 respectively.

<table>
<thead>
<tr>
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<th>1 minute Failure/success</th>
<th>p value</th>
<th>60 minutes Failure/success</th>
<th>p value</th>
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</thead>
<tbody>
<tr>
<td>f/TV</td>
<td>79 ± 10 / 52 ± 3</td>
<td>0.03</td>
<td>91 ± 10 / 53 ± 3</td>
<td>&lt;0.01</td>
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<tr>
<td>VE/VCO2</td>
<td>44 ± 3 / 41 ± 2</td>
<td>0.36</td>
<td>56 ± 6 / 29 ± 3</td>
<td>&lt;0.001</td>
</tr>
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</table>

Comparison between f/TV and VE/VCO2, in patients who failed or succeed to the SBT at 1 and 60 minutes

f: respiratory rate
TV: tidal volume
SBT: single breath trial
VE: minute volume
VCO2: CO2 production
Conclusion
Our data suggest that Ventilatory inefficiency represented by an increased VE/VCO2 along the SBT, is a physiological trait of patients in weaning of mechanical ventilatory support.