Using Central Venous Oxygenation (ScVO2) to Facilitate the Weaning of IABP in MI-Related Acute Heart Failure

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No conflict of interest to declare
The balance between the systemic oxygen delivery and oxygen consumption is the mainstay in managing the critically-ill.


Mixed venous oxygen saturation (SVO2) of PA blood has ever been used to reflect the balance between systemic oxygen delivery and consumption. (Reinhart K, et al. Curr Opin Crit Care 2005;11:259–263.)

The central venous oxygenation (ScVO2), as a surrogate of global tissue oxygenation, has been adopted as the primary guide in treating patients with septic shock or severe sepsis, advocated by “goal-directed therapy.”


The horizon of ScVO2 has been broadened to monitor the disease process of complicated acute coronary syndromes (ACS).

Time Series of SaO2/ScVO2 of the Survivors

• ScVO2 reflects the evolution of complicated ACS

Hypothesis

\[ \text{VO2} = \text{stroke volume (SV)} \times \text{Heart rate} \times \text{Hb} \times 13.4 \times (\text{SaO2} - \text{ScVO2}) \]

- Tissue oxygen uptake or consumption (VO2) should be maintained as constant as possible by systemic circulation in order to maintain the homeostasis.
- The SV mostly depends on myocardial performance in ACS as preload is kept optimal.
- Constant or optimal care of HR, Hb and SaO2 in ACS
- \( \text{ScVO2} = \text{Myocardial performance} \)
  - Explaining the interim heterogeneity of the time series
  - Overall trend showed increment of ScVO2 as the disease improved.
Patients of complicated ACS depend on IABP for better cardiac output, and thus better tissue perfusion.

Weaning IABP has been a process of try-and-error, and monitored by conventional hemodynamic parameters.

The decision-making of weaning IABP, lacking objective guide, is full of speculation and is also time-consuming, taking probably half a day.
Introduction (4)

- ScVO2, as a marker of global tissue perfusion, reflects the disease status of complicated ACS.
- We hypothesize that ScVO2 could offer prognostic significance during the process of weaning IABP.
Methods & Patients (1)

- Prospective observational cohort
- Inclusion criteria
  - Patients of “complicated ACS”:
    - STEMI or NSTEMI of Killip 3 and 4
    - ACS with acute cardiogenic lung edema.
  - All of them received IABP via femoral route
Methods & Patients (2)

- Exclusion criteria
  - Non-complicated ACS: MI of Killip I and II
  - ACS patients needing IABP for other reasons (e.g. PCI related complications)
  - Unsuccessful initial resuscitation: refractory hypotension while admitted to the unit, which means unable to maintain mean arterial blood pressure (MAP) above 65 mmHg by any means, indicating failure of initial resuscitation at other sites
  - Disease entities that needed immediate surgical attention.
  - Concomitant septic and cardiogenic shock, which could not be clearly delineated.
Methods & Patients (3)

- Exclusion criteria (con’t)
  - Patient’s or family’s unwillingness: those who refused suggested therapy or asked discharge against medical advice
  - Age less than 18 years old
  - Pregnancy
  - Contraindications for central venous catheterization
  - Uncured cancer or any other status of iatrogenic immunosuppressant, such as post-organ transplant, or undergoing chemotherapy
Methods & Patients (4)

- Insertion of a 3-way CVP cath to SVC in ICU
- Weaning of IABP started after 48-hour of use
- ScVO2 checked by co-oxymetry method
  - Concomitant blood gas analysis of both peripheral arterial and central venous blood
  - Immediately before weaning IABP (1:1) ➔ 1Hr of (1:2) IABP pumping, then blood gas analysis ➔ 1Hr of (1:3) IABP pumping, then blood gas analysis

- Primary endpoint
  - Success to wean off from IABP without any ensuing in-hospital major cardiovascular events (MACEs)
Results

- 66 cases of weaning IABP in complicated ACS enrolled in 1.5 years
  - 57 cases succeeded to wean off from IABP
  - 9 cases failed to wean off, and MACEs ensued after removing IABP
    - 1 mortality due to cardiogenic shock ➔ no resuscitation as patient’s family requested DNR
    - 4 cases required re-application of IABP in 24 hours for recurrent AHFS
    - 4 cases of recurrent cardiogenic lung edema ➔ needing re-institution of heart failure treatment
### Demographics of the enrollee

<table>
<thead>
<tr>
<th></th>
<th>Success Group</th>
<th>Failure Group</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (year-old)</td>
<td>63.8±14.6</td>
<td>64.0±18.3</td>
<td>0.966</td>
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<tr>
<td>BMI</td>
<td>24.6±22.3</td>
<td>25.4±4.6</td>
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<tr>
<td>LDL</td>
<td>96.0±39.8</td>
<td>100.5±27.3</td>
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<tr>
<td>AC sugar (mg/dl)</td>
<td>196.5±74.2</td>
<td>253.5±110.7</td>
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<tr>
<td>Serum Creatinin</td>
<td>1.06±2.54</td>
<td>1.63±0.54</td>
<td>0.713</td>
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<tr>
<td>Peak CK</td>
<td>3123.5±2913.1</td>
<td>4210.5±2655.8</td>
<td>0.328</td>
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<tr>
<td>Peak CKMB</td>
<td>298.5±391.2</td>
<td>646.5±322.4</td>
<td>0.277</td>
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<td>TIMI Score</td>
<td>5±1.5</td>
<td>4.5±0.6</td>
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<tr>
<td>HR before weaning</td>
<td>94.0±14.0</td>
<td>96.3±13.1</td>
<td>0.658</td>
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<tr>
<td>MAP before weaning</td>
<td>88.6±11.3</td>
<td>82.7±5.8</td>
<td>0.133</td>
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<tr>
<td>SaO2 (%)</td>
<td>98.5±1.4</td>
<td>97.9±1.4</td>
<td>0.233</td>
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<tr>
<td>LVEF (%)</td>
<td>42.5±14.7</td>
<td>44.5±9.0</td>
<td>0.941</td>
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</tbody>
</table>
ScVO2 of Success to Wean off IABP

P=0.374
ScVO2 of Failure to Wean off IABP

ScVO2 42.7%

P < 0.0001
Success vs. Failure to Wean off from IABP

<table>
<thead>
<tr>
<th>SCVO2 Group</th>
<th>Success to Wean</th>
<th>Fail to Wean</th>
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<tbody>
<tr>
<td>50.0</td>
<td></td>
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<tr>
<td>60.0</td>
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<td>70.0</td>
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<td>80.0</td>
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<tr>
<td>90.0</td>
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ScVO2 values:
- P = 0.525
- P = 0.012
- P < 0.0001

IABP Supporting Ratio

Success to wean

Fail to wean
Conclusion

- ScVO2 is valuable in identifying trends in the balance between oxygen delivery and consumption.
- In complicated ACS, ScVO2 could more vividly reflect the disease status, especially the myocardial performance during the weaning process of IABP.
- ScVO2 offered an objective index to guide the weaning process of IABP and made rapid decision possible (within 2 hours).
- ScVO2 as one of the indices of tissue oxygenation could be applied not only in the field of sepsis but also in cardiovascular diseases.
Thank You for Your Attention