PiCCO & Echocardiography
Using Synergies

This document is intended to provide information to an international audience outside of the US.
Why should we use PiCCO Technology?

»Because we should follow international recommendations«

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Twenty international experts were invited by the European Society of Intensive Care Medicine to evaluate new evidence and revise the 2006 guidelines in the field of shock. The evaluation of hemodynamic monitoring was also mentioned, which is highly recommended by the experts. In critically ill patients, advanced hemodynamic monitoring identifies the factors that contribute most to the hemodynamic disorders and on which therapy physicians should focus.¹
The following is the ESICEM’s recommended evaluation process regarding less invasive hemodynamic monitoring in critically ill patients:

1. **Acute circulatory failure**
   - **Central venous catheter**
   - **Clinical assessment**
   - **Lactate**
   - **Echocardiography**
   - **Arterial catheter**

2. **Associated severe ARDS?**
   - **No**
     - **Positive response to initial therapy**
     - **Continue with same hemodynamic monitoring until shock resolution**
   - **Yes**
     - **Insufficient response to initial therapy**
     - **Transpulmonary thermodilution systems or Pulmonary artery catheter (especially in case of RV dysfunction)**

All patients in acute circulatory failure should be assessed with basic examination and Echocardiography. If additional ARDS is present or initial therapy fails, thermodilution technologies are recommended.²

The PICCO Technology provides a dynamic, minimally invasive measurement of cardiac output and its determinants (preload, afterload, contractility) as well as the quantification of pulmonary edema for a targeted treatment. It is a clinically proven tool for hemodynamic assessment and management during shock.³

**Recommendations**

The consensus on circulatory shock and hemodynamic monitoring (task force of the ESICM) recommends:¹

- When further hemodynamic assessment is needed, Echocardiography is the preferred modality to initially evaluate the type of shock as opposed to more invasive technologies. (Level 2; Quality of Evidence QoE moderate (B))
- In complex patients, additionally use PAC or transpulmonary thermodilution to determine the type of shock. (Level 1; QoE moderate (B))
- Measuring CO and stroke volume to evaluate the response to fluids or inotropes in patients that are not responding to initial therapy. (Level 1; QoE low (C))
- Using transpulmonary thermodilution or PAC in patients with severe shock especially in the case of associated ARDS. (Level 2; QoE low (C))
**PiCCO Technology & Echocardiography**

**Complementary use in critically ill patients**

- Echocardiography is a useful diagnostic tool for the initial assessment of critically ill patients.
- Echocardiography is not suitable for long-term hemodynamic monitoring because:
  - Time consuming
  - Operator dependent
  - Sequential evaluation
- Additional limitations in the ICU:
  - PEEP
  - Tissue edema
  - Patient positioning
- For Echocardiography, special training and experience are required to perform an ultrasound examination.
- Valuable information missed with Echocardiography is related to the Lung Water and Pulmonary Permeability.
- Echocardiography neither replaces PiCCO nor contradicts the use of PiCCO Technology and vice versa.
- PiCCO monitoring findings may trigger an Echocardiography examination and vice versa.

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**Side-by-side comparison PiCCO Technology & Echocardiography:**

<table>
<thead>
<tr>
<th></th>
<th>Echocardiography (discontinuous)</th>
<th>PiCCO Technology (discontinuous and continuous)</th>
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<tbody>
<tr>
<td><strong>Volumetric</strong></td>
<td>• Excellent visual assessment</td>
<td>• Global end diastolic Volume (GEDI)</td>
</tr>
<tr>
<td><strong>Hemodynamic</strong></td>
<td>• Left ventricular enddiastolic/systolic area</td>
<td>• Dynamic parameters (SVV/PPV)</td>
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<tr>
<td><strong>Assessment</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Cardiac Function</strong></td>
<td>• Left ventricular ejection fraction</td>
<td>• Global ejection fraction</td>
</tr>
<tr>
<td><strong>Assessment</strong></td>
<td>• Regional wall motion abnormalities</td>
<td></td>
</tr>
<tr>
<td><strong>Lung Water/ Pulmonary Edema</strong></td>
<td>• Very basic assessment</td>
<td>• ELWI → quantitative reproducible value</td>
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<tr>
<td></td>
<td></td>
<td>• Reduces daily x-rays for assessment of the lung edema</td>
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<tr>
<td><strong>Pulmonary Permeability</strong></td>
<td>• No</td>
<td>• PVPI → quantitative reproducible value</td>
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<td></td>
<td></td>
<td>• Differentiates between inflammatory and cardiogenic edema</td>
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<tr>
<td><strong>Continuous</strong></td>
<td>• No, sequential evaluation: 2- max. 3 times per day</td>
<td>• Yes, for pulse-contour-analysis</td>
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<tr>
<td><strong>Measurement</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Time required per</strong></td>
<td>• &gt;15min</td>
<td>• &lt;5min</td>
</tr>
<tr>
<td><strong>measurement</strong></td>
<td></td>
<td></td>
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<tr>
<td><strong>Requirement</strong></td>
<td>• Qualified Senior Doctor</td>
<td>• Nurse or Junior Doctor</td>
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<tr>
<td>to perform the</td>
<td></td>
<td></td>
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<tr>
<td>measurement**</td>
<td></td>
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<tr>
<td><strong>Reproducibility of</strong></td>
<td>• Poor, subjective and user-dependent</td>
<td>• Fully reproducible, objective and user-independent</td>
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<tr>
<td><strong>measurement</strong></td>
<td></td>
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<tr>
<td><strong>Consensus</strong></td>
<td>• As initial assessment</td>
<td>• As additional assessment</td>
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<td><strong>recommendation</strong></td>
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<td>in the literature</td>
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Literature references:


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