VEITH 2018

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Disclosures

Specific Disclosures
None

General Disclosures
None

Chest VTE Guidelines

The 2016 CHEST Antithrombotic Therapy for Venous Thromboembolism Disease guidelines do not mention ECMO in the management of massive PE

Indications for ECMO

- Acute Respiratory Distress Syndrome
- Hypercapnic Respiratory Failure
- Lung Transplant Candidates

Contraindications

Relative Contraindications
- High-pressure ventilation (plateau airway pressures over 30 cm of water) for more than 7 days
- High FiO2 requirements (over 80% for more than 7 days)
- Limited vascular access
- Inability to accept blood products
- Any condition or organ dysfunction that would limit the likelihood of overall benefit from ECMO, such as severe, irreversible brain injury or untreatable metastatic cancer

Absolute Contraindications
- Contraindication to anticoagulation
- ECMO as bridge to lung transplantation if transplantation will not be considered

Murray Score

<table>
<thead>
<tr>
<th>Murray Score</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
</tr>
</thead>
<tbody>
<tr>
<td>PaO2/FiO2 on 100% O2</td>
<td>≥40</td>
<td>30-49</td>
<td>20-29</td>
<td>10-19</td>
<td>&lt;10</td>
</tr>
<tr>
<td>CHA2DS2-VASc Score</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>PEEP (cmH2O)</td>
<td>≤5</td>
<td>6-8</td>
<td>9-11</td>
<td>12-14</td>
<td>≥15</td>
</tr>
<tr>
<td>Cardiac output index (mL/kg/min)</td>
<td>≤30</td>
<td>30-70</td>
<td>70-115</td>
<td>115-170</td>
<td>≥170</td>
</tr>
</tbody>
</table>
Extracorporeal Life Support Organization (ELSO) guidelines:

- Patients with ARDS and a Murray Score of 3-4 may be considered for ECMO cannulation in the correct clinical setting.
- Patients with a Murray Score >2 could be considered for transfer to a center with ECMO capabilities.

**PE: Indicators of Poor Outcome**

**ESC criteria** (based on consensus; lack of validation)

<table>
<thead>
<tr>
<th>Criteria</th>
<th>Mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>High risk: Cardiovascular shock or persistent hypotension</td>
<td>&gt; 30 %</td>
</tr>
<tr>
<td>Intermediate risk: Lab (troponin, BNP) ging RV dysfunction</td>
<td>1-30 %</td>
</tr>
<tr>
<td>Low risk: normal labs (troponin, BNP); normal RV function</td>
<td>&lt; 1 %</td>
</tr>
</tbody>
</table>

**Roles for ECMO in PE**

ECMO is a means of improving oxygenation and clearing CO₂

**Indication in PE:** Progressive hypoxemia or acidosis with intact RV function, unresponsive to best medical treatment

**Roles for ECMO in PE**

ECMO is a means of unloading the right ventricle and supporting systemic circulation in massive PE

**Indication in PE:** Progressive right ventricular failure associated with pulmonary arterial hypertension, unresponsive to medical treatment

**Veno-venous**

**Veno-arterial**
Roles for ECMO in PE
- Stabilization
- Bridging / Temporizing
- Recovery

Massive PE

Algorithm for treatment of patients with massive pulmonary embolism.

Cardiac Related Death
All-Cause Related Death
**Outcomes After Surgical Pulmonary Embolectomy for Acute Pulmonary Embolus: A Multi-Institutional Study**

**Massive PE**
- Overall 12% in-house Mortality
- 24%

**Sub Massive PE**
- 9%

**UT VASCULAR**

**Outcomes of Pulmonary Embolus for Acute Pulmonary Embolism**

**MACE was as high as 27.3%**

**Without ECMO**
- 30 day Survival
- 17.2%

**With ECMO**
- 41.4%

**P=0.043**

**Additional Role for Cardiopulmonary bypass – Surgical Thrombectomy**
- Stabilization for OR
- CPB for surgery
- Recovery of RV or Lungs

**UT VASCULAR**
**Confirmed PE**
- Minor / Stable PE: Low Risk
- Submassive PE: Intermediate Risk
- Massive PE: High Risk

**Anticoagulation**
- Catheter-directed thrombolysis
- Intravenous Bolus thrombolysis

**Possible Surgical Embolectomy**
- Anticoagulation
- Retrievable IVC Filter

**SOUTH TEXAS CENTER FOR VASCULAR CARE**
**Literature Review**
Period between 1995 and 2014
- 271 patients
- 73% survival

**Extracorporeal membrane oxygenation in acute massive pulmonary embolism: a systematic review**
HD Younias, P. voiced, and A. Yavuzer

**SURVIVAL**
69%

**Table 2. Definitive treatment for PE and survival**

<table>
<thead>
<tr>
<th>Definitive Treatment</th>
<th>Survival (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECHOM + Surgical embolectomy</td>
<td>9 (49.2%)</td>
</tr>
<tr>
<td>ECHOM + Catheter embolectomy</td>
<td>2 (40%)</td>
</tr>
<tr>
<td>ECHOM + Thrombolysis</td>
<td>7 (41.7%)</td>
</tr>
<tr>
<td>ECHOM + Surgical embolectomy + Thrombolysis</td>
<td>2 (100%)</td>
</tr>
<tr>
<td>ECHOM + Catheter embolectomy + Thrombolysis</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>ECHOM + Catheter embolectomy + Catheter embolectomy + Thrombolysis</td>
<td>1 (100%)</td>
</tr>
<tr>
<td>ECHOM + Catheter embolectomy + Thrombolysis</td>
<td>8 (46.7%)</td>
</tr>
<tr>
<td>ECHOM alone</td>
<td>16 (100%)</td>
</tr>
<tr>
<td>Total</td>
<td>100%</td>
</tr>
</tbody>
</table>

FE: pulmonary embolism; ECHOM: extracorporeal membrane oxygenation.

**VA ECMO**

**UT VASCULAR**

**SOUTH TEXAS CENTER FOR VASCULAR CARE**
**Life-threatening massive pulmonary embolism rescued by venoarterial-extracorporeal membrane oxygenation**
Filippo Cori,1,2 Guillaume Lefebvre,1 Nicolas Belchat1, Guillaume Hetkinan,2 Ania Nieszkowski,2 Jean-Louis Tourelle1,2 Charles-Edouard Levy,1 Pascal Lepirme,1 Jean Chastre,2 Alain Cambier3 and Matthias Schmidt4,5,6

**Critical Care**

**RESEARCH**

**Open Access**

**UT VASCULAR**

**SOUTH TEXAS CENTER FOR VASCULAR CARE**
**17 high-risk PE patients**
- Median age 51 (range 18-70) years, SAPS II 78 (45-95)
- VA-ECMO for 4 (1-12) days.
- 15 (82%) patients with pre-ECMO cardiac arrest,
  7 (41%) were cannulated during CPR,
  8 (47%) underwent pre-ECMO thrombolysis.

**UT VASCULAR**
The questions answered

**Thrombectomy**
- **WHEN**: Submassive PE with RV dysfunction
- **HOW**: Open Chest
- **WHY**: RV support

**ECMO**
- **PREOP**
- **POST OP**: CPB, O₂ support

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**VA ECMO**
- **WHEN**: Pre-op, Peri-op, Post-op
- **HOW**: Venous
- **WHY**: RV support

**VV ECMO**
- **WHEN**: Pre-op, Peri-op, Post-op
- **HOW**: Arterial
- **WHY**: Venous, O₂ Support

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Table 3: Studies on patients with acute, massive, high-risk PE on VA ECMO support included in the systematic review.

<table>
<thead>
<tr>
<th>Reference</th>
<th>Inclusion criteria (n)</th>
<th>+ ECMO</th>
<th>Mechanism of RV failure</th>
<th>ECMO support</th>
<th>Length of ECMO support (days)</th>
<th>Length of hospital stay (days)</th>
<th>Survival (n)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Melby et al. (ES) 1994-1999 7</td>
<td>7</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Rigo et al. (BE) 1998-2005 10</td>
<td>10</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Scheller et al. (US) 1988-1996 6</td>
<td>6</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
<tr>
<td>Paul et al. (BE) 2006-2011 5</td>
<td>5</td>
<td>0</td>
<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>57</td>
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<td>10</td>
<td>3</td>
<td>0</td>
<td>0</td>
<td>57</td>
</tr>
</tbody>
</table>

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Figures:
- **Fig. 1**: Flow chart. (RV = right ventricle, VA = veno-arterial, ECMO = extracorporeal membrane oxygenation.)
- **Fig. 2**: Flow chart. (RV = right ventricle, VA = veno-arterial, ECMO = extracorporeal membrane oxygenation.)

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**South Texas Center for Vascular Care**

**Critical Care**

**Open Access**

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**South Texas Center for Vascular Care**

90-day survival: 47%.