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VEITH 2019

Disclosures
• Specific Disclosures
  • None
• General Disclosures
  • None
• Advisory
  Any views expressed do not reflect the views of the State of Texas or the University of Texas System

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

PE Risk-Benefit Continuum 2016*
Risk of cardiac arrest
Risk of chronic disability
PE Risk-Benefit Continuum 2017
Everything else
Submassive with risk of further embolization
Hemodynamically unstable embolization
Muscular
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)

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

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**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.
Impella
VAD
VA-ECMO

Roles for ECMO in PE
- Stabilization
- Bridging / Temporizing
- Recovery

VA ECMO
VA ECMO
VV ECMO

Massive PE

Algorithm for treatment of patients with massive pulmonary embolism.
**Cardiac Related Death**

**All-Cause Related Death**

**MACE was as high as 27.3%**

**Immediate Role for Cardiopulmonary bypass – Surgical Thrombectomy**

- Stabilization for OR
- CPB for surgery
- Recovery of RV or Lungs
Confirmed PE

Minor / Stable PE
Low Risk
Submassive PE
Intermediate Risk
Massive PE
High Risk

Catheter-directed thrombolysis
Intravenous Bolus thrombolysis
Both +RVD and +Biomarkers

Repeate

Success
Failure

Possible Surgical Embolectomy
Retrievable IVC Filter
Anticoagulation

Anticoagulation

Surgical Embolectomy
Retrievable IVC Filter

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Literature Review

Period between 1995 and 2014
271 patients
73% survival

Extracorporeal membrane oxygenation in acute massive pulmonary embolism: a systematic review

MD Yousuf, Y. Zachariah and A. Vyas

UT VASCULAR

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Table 2. Definitive treatment for PE and survival

<table>
<thead>
<tr>
<th>Definitive Treatment</th>
<th>Success (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECMO + Surgical embolectomy</td>
<td>9 (4.2%)</td>
</tr>
<tr>
<td>ECMO + Catheter embolization</td>
<td>2 (0.8%)</td>
</tr>
<tr>
<td>ECMO + Thrombolysis</td>
<td>7 (3.1%)</td>
</tr>
<tr>
<td>ECMO + Surgical embolectomy + Thrombolysis</td>
<td>2 (0.8%)</td>
</tr>
<tr>
<td>ECMO + Catheter embolization + Thrombolysis</td>
<td>2 (0.8%)</td>
</tr>
<tr>
<td>ECMO + Surgical embolectomy + Catheter embolization + Thrombolysis</td>
<td>1 (0.8%)</td>
</tr>
<tr>
<td>ECMO alone</td>
<td>8 (6.1%)</td>
</tr>
<tr>
<td>Total</td>
<td>16 (10.0%)</td>
</tr>
</tbody>
</table>

PE: pulmonary embolism; ECMO: extracorporeal membrane oxygenation.

SURVIVAL
69%

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Life-threatening massive pulmonary embolism rescued by venoarterial-extracorporeal membrane oxygenation

Filipe Correia, Guillaume Lebreton, Nicolas Bréchet, Guillaume Helmière, Anna Nieszkowska, Jean-Louis Trouillet, Charles Edouard Lapic, Pascal Leprieur, Jean Chastre, Alain Cambier and Matthias Schmidt

Critical Care

RESEARCH
Open Access

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Life-threatening massive pulmonary embolism rescued by venoarterial-extracorporeal membrane oxygenation

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.

90-day survival
47%.
20 patients
5.1 days of VA ECMO
In-hospital survival 95%
RV function preserved 90%
### Risk factors for failure of RV recovery
- History of PE
- Recent immobilization
- Chronic DVT (> 2 weeks)
- Higher BNP
- Higher Qanadli score

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### Qanadli Score
- The arterial tree of each lung is regarded as 10 segmental PAs (three to the upper lobes, two to the middle lobe or lingula, and five to the lower lobes).
- The presence of an embolus in a segmental PA is scored as 1 point, and the presence of an embolus at the most proximal arterial level are scored a value equal to the number of segmental PAs arising distally.
- A weighting factor is used for each value (0 = no defect, 1 = partial occlusion, and 2 = complete occlusion).
- An isolated subsegmental embolus is considered a partially occluded segmental PA and is assigned a value of 1.
- The maximum CT obstruction index is 40.

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### The questions answered

<table>
<thead>
<tr>
<th>VA ECMO</th>
<th>VV ECMO</th>
</tr>
</thead>
<tbody>
<tr>
<td>WHEN</td>
<td>Pre-op</td>
</tr>
<tr>
<td></td>
<td>Peri-op</td>
</tr>
<tr>
<td></td>
<td>Post-op</td>
</tr>
<tr>
<td>HOW</td>
<td>Venous</td>
</tr>
<tr>
<td></td>
<td>Arterial</td>
</tr>
<tr>
<td>WHY</td>
<td>RV support</td>
</tr>
</tbody>
</table>

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To improve the vascular health of the region though high quality prevention, management and therapy, while educating future leaders in vascular care.