Massive Pulmonary Embolism
Percutaenous
ECMO/RVAD

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Massive Pulmonary Embolism with Hemodynamic Compromise

Mechanical Support During/After Cardiac Arrest

VA

VA ECMO Stand-by

Safety Lines

Systemic Thrombolytics

Mechanical Support Prior to Cardiac Arrest

VA

RP/Proteck

Circ 2004 8;110 Metaanalysis of thrombolytics in PE
Mean survival for extracorporeal cardiopulmonary resuscitation patients after 6–20, 20–45, 45–60, and 60–135 minutes of mechanical cardiopulmonary resuscitation (CPR) (** p = 0.001) Wengenmayer et al. Critical Care 201721:157
ECPR registry data showing average times to execute ECMO

• Duration of mechanical CPR until VA-ECMO support
  • OHCA 72.2 ± 7.4 minutes
  • IHCA patients 49.6 ± 5.9 vs.

• Notification at time zero (ECMO team part of PERT)
• Deployment system
  • Team Members pre specified duties
  • Practice Drills to maintain efficiency
Massive Pulmonary Embolism with Hemodynamic Compromise

Mechanical Support After Cardiac Arrest
- VA

Massive Pulmonary Embolism

Mechanical Support Prior to Cardiac Arrest
- VA
- RP/Proteck

Safety Lines ECMO Stand-by

Systemic Thrombolytics

Circ 2004 8;110 Metaanalysis of thrombolytics in PE
Massive PE
Massive PE

• ECHO RV dysfunction without hemodynamics is a weak predictor of mortality and alone cannot support Mechanical Support Initiation. Cardiol Res. 2017 Aug; 8(4): 143–146.

• CT Burden/Obstruction Index alone cannot support Mechanical Support Initiation
  • Does not predict mortality over vitals in this population
Hemodynamics + ECHO
Registry 1000 PE
Kasper et al JACC 1997
In Hospital Mortality

McConnell sign
Hypotension 5 Dobut
Hypotension Shock > 5 Dobutamine
CPR

mortality
Factors favoring MCS

1. Escalating Vasopressor requirements
2. Requiring intubation
Hemodynamic Collapse with Intubation

- Rosenberger et al - Fifty-two consecutive patients undergoing emergent pulmonary embolectomy
  - 19% cardiac arrest
  - 17% severe decompensation
  - Overall mortality 25%

Mechanism
- Sedation lowering SVR
- Positive pressure ventilation increasing RV afterload

Factors favoring MCS

1. Vasopressor requirements
2. Requiring intubation
3. Serum Lactate
Factors favoring MCS

• Lactate Prior to CPR ≤6mmol/L
  • 82.4% sensitivity and 84.6% specificity for predicting survival to discharge. George B, et al. A retrospective comparison of survivors and non survivors of massive pulmonary embolism receiving VA ECMO sup port. Resuscitation 2018; 122:1 retro n=32
    • Also catheter directed > Systemic survival
  • D’Arrigoa et al. resuscitation.2017.10.005 retro n = 17
Factors favoring MCS

1. Vasopressor requirements
2. Requiring intubation
3. Serum Lactate
4. Thrombus in Transit
Thrombus in Transit Predicts Higher Mortality

- Visualization of Thrombus on Echo in Right Heart is a predictor of increased mortality
  - Mortality rate with no therapy 100%
  - Mortality rate with heparin 30%
  - Mortality rate with Embolectomy 23%
  - Mortality with thrombolysis 11%

- Rose et al Chest 2002
Factors favoring MCS

1. Vasopressor requirements
2. Requiring intubation
3. Serum Lactate
4. Thrombus in Transit
5. Shock despite Lytics

- N = 21 of 43 screened
- 45% survival in the cohort when ECMO followed other therapies
- 80% survival when ECMO initiation occurred before other therapies

Only 1 patient was not alive at 90 days
50% resolved on anticoagulation alone
No patients died after surgical embolectomy
Management Algorithm of VA-ECMO for Massive PE

1. Cannulation with a 25 Fr venous drainage, 17- to 19-Fr arterial return, and 6 Fr distal perfusion cannula

2. Extubate, if possible. If extubated pre-cannulation, utilize moderate sedation for awake cannulation

3. Full systemic anticoagulation

4. Continue VA-ECMO until
   a.) Neurologic status is determined, if unclear
   b.) End-organ function is optimized
   c.) 5 day trial of full systemic anticoagulation

5. Once above criteria are met, repeat TTE:
   a.) Neurologic death determined → Withdrawal of care
   b.) RV function normal → Decannulation
   c.) Persistent RV dysfunction → Repeat CTA and Surgical Pulmonary Embolectomy

6. IVC Filter within 48 hours after decannulation
Protocol

- A 6F distal perfusion line was placed in the superficial femoral artery first if able unless the patient was actively requiring cardiopulmonary resuscitation (CPR).
- **Pre-close or Post-Close is possible with both 17 and 19 Fr cannula**
- In non-intubated patients, moderate sedation with 0.5 mg/kg ketamine and local anesthetic agent with 20 to 30 mL of 2% lidocaine was used before cannulation.
• Same Cohort but N = 30
• 53% responded to AC alone
• 47% required embolectomy
Massive Pulmonary Embolism with Hemodynamic Compromise

1. Vasoppressor requirements
2. Requiring intubation
3. Serum Lactate
4. Thrombus in Transit
Perc RVAD
Impella RP Case Series

• 5 patient Case series from Detroit Medical Center with 100% survival  
  J Interv Cardiol. 2018 Aug;31(4):518-524

• 2 Cases Texas Heart impella plus Ekos  
  Tex Heart Inst J. 2018 Jun 1;45(3):182-185
Perc RVAD

**Impella RP**
- Xray
- No intubation
- Intracorporeal
- Thrombus Sensitive

**Proteck DUO**
- Xray C-arm
- No intubation
- Extracorporeal
- Thrombus Forgiving
Massive Pulmonary Embolism with Hemodynamic Compromise

High Risk Signs VA risk and Access
- VA
- RP/Duo

Massive Pulmonary Embolism

No High Risk Signs

VA ECMO for Cardiac Arrest With or without ROSC

1. High Vasopressor requirements
2. Requiring intubation
3. Serum Lactate
4. Thrombus in Transit

Safety Lines Mechanical Support Stand-by