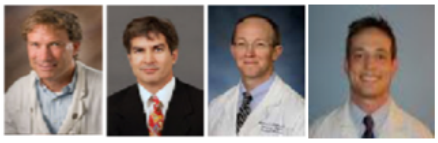
critical care perspectives in emergency medicine



ECMO in Cardiac Arrest and Massive PE

Key Article #1

Yannopoulus D, et al. Advanced reperfusion strategies for patients with out-of-hospital cardiac arrest and refractory ventricular fibrillation (ARREST): a phase 2, single centre, open-label, randomized controlled trial. Lancet. 2020; 396:1807-16.

Background

- OHCA responsible for > 350,000 deaths annually in North America
- Up to 80% of patients who survive OHCA present with an initial shockable rhythm
- Approximately 50% of patients with vfib present with refractory vfib unresponsive to initial standard treatment
    - Refractory - failure of at least 3 shocks to establish ROSC
- Many of these patients have CAD
- Many facilities around the world have initiated ECMO programs that focus on ECPR for this patient population. However, there is limited evidence thus far that demonstrates increased survival.

Objective

- To compare survival to hospital discharge between emergency department-based standard ACLS resuscitation versus early ECMO-facilitated resuscitation.

Study

- Phase 2, single-center, open-label, safety and efficacy, pragmatic, randomized clinical trial
- Performed at the University of Minnesota Medical Center and 3 EMS agencies with geographic proximity to the hospital
- Inclusion:
    - All consecutive adults 18-75 years of age
    - Initial OHCA rhythm of VF or pulseless VT
    - No ROSC after 3 defibrillation attempts
    - Body habitus to accommodate the LUCAS device
    - Estimated transfer time to the ED of < 30 min
- Exclusion
    - Sustainable ROSC within the first 3 shocks
    - DNR patients
    - Blunt or penetrating trauma
    - Drowning

    - Overdose
    - Pregnancy
    - Prisoner
    - Nursing home patient
    - Terminal cancer
    - Active GIB or internal bleeding
    - Contrast allergy or contraindication to emergency angiography
- Interventions
    - Standard ED ACLS Resuscitation
        - Patients taken the ED
        - Resuscitation continued per standard ACLS guidelines for at least 15 min after arrival or at least 60 min after 911 call
        - Declaration of death at the emergency physician's discretion
        - If ROSC achieved, the EP transferred the patient for angiography, angioplasty, and circulatory support as per the protocol
    - ECMO-facilitated Resuscitation
        - Patients were taking directly to the cardiac cath lab regardless of the presence of pulses on hospital arrival
        - On arrival, the patients had an ABG drawn
        - Resuscitation discontinued if:
            - $ETCO_2 < 10$ mm Hg
            - $PaO_2 < 50$ mm Hg
            - Lactate > 18 mmol/L
        - If none of these met, then patient cannulated and placed on VA-ECMO
        - Angiogram done and revascularization performed as indicated
    - All patients who survived to admission were treated in a dedicated cardiac ICU.
    - Post-ROSC care not protocolized
        - Usually 24 hrs of TTM, Head CT, continuous EEG, and neuroprognostication after 72 hrs
- Outcomes
    - Primary outcome – survival to hospital discharge
    - Secondary outcomes
        - Survival and functionally favorable status at hospital DC, 3 months, and 6 months (mRS of 3 or lower)
    - Incidence of adverse events

Results

- <u>Study terminated early by NIH DSMB</u>
- Patients
    - 36 patients assessed; 30 met all inclusion and no exclusion criteria
    - Standard ACLS Group: 15
    - ECMO-facilitated Group: 15 (1 patient withdrew consent)
    - Mean age: 59 years

    - Gender: 83% male
    - Characteristics of groups well balanced
- Primary outcome – survival to hospital discharge
    - Standard ACLS Group: 7% (1 out of 15 patients)
    - ECMO-facilitated Group: 43% (6 out of 14 patients)
- Secondary outcomes – cumulative survival, mRS, CPC at hospital DC, 3 months, and 6 months
    - Standard ACLS Group: the 1 patient who survived had an mRS of 5 and CPC of 4 at hospital DC and died before 3-month evaluation
    - Survival at 3 and 6 months improved in ECMO-facilitated Group
    - Patients in ECMO-facilitated Group had prolonged hospitalization and deconditioning
- No unanticipated serious adverse events related to ECMO observed

Limitations

- Single center study at a highly experienced ECMO center
- Only 30 patients
- Study terminated early
- All patients had OHCA in a public location and received bystander CPR
- ECMO is a highly resource-intense therapy

Authors Take Home Points

- ECMO-facilitated resuscitation for patients with OHCA and refractory VF significantly improved survival to hospital discharge and functional status compared with standard ACLS resuscitation.

Key Article #2

Scott JH, et al. Venoarterial extracorporeal membrane oxygenation in massive pulmonary embolism-related cardiac arrest: A systematic review. Crit Care Med. 2021; online ahead of print.

Background

- Massive PE accounts for 8-10% of PEs
- Massive PE defined by ACCP as acute PE with sustained hypotension (SBP < 90 mm Hg or SBP drop > 40 mm Hg from baseline) for at least 15 min, or requiring vasopressor or inotropic support
- Massive PE leading to cardiac arrest has a mortality of approximately 95%
- VA-ECMO in massive PE can unload the RV and prevent cardiac arrest by establishing organ perfusion and tissue oxygenation
- Recently, ESC 2019 Guidelines suggest VA-ECMO for massive PE (Class IIb) in the right clinical setting. AHA guidelines recommend pushing thrombolytics in confirmed massive PE (Class IIa), but thrombolytics have an increased risk of bleeding in CPR.
- RCTs on VA-ECMO or thrombolytics in massive PE are lacking

Objective

- To explore the role of VA-ECMO in massive PE-related cardiac arrest and analyze predictors of death

Study

- Systematic Review
- Included Articles
    - Described scenarios of massive PE with cardiac arrest managed with VA-ECMO
    - Reported survival to discharge
    - English language
- Excluded Articles not really specified
- Outcomes
    - Primary outcome - survival to discharge
    - Secondary outcomes - Impact of age, systemic thrombolysis before ECMO, ECMO cannulation during CPR or after ROSC, and hospital location of ECMO cannulation on mortality
    - Occurrence rate of major bleeding

Results

- 77 studies
    - 301 patients
    - Mean age: 48 years
    - Gender: 63% females
- Primary outcome – survival to discharge
    - 61% (183/301 patients)
- Secondary outcomes
    - Age
        - 3x increased risk of death for patients > 65 years of age
        - OR 3.56; p=0.02
    - Cannulation during CPR
        - 7x increased risk of death
        - OR 6.84; p=0.01
    - Systemic thrombolysis before ECMO
        - 51 patients received lytics prior to ECMO
        - 67% survival to discharge
        - No increased risk of death between those who got lytics prior to ECMO compared to those that did not
        - 6 patients had major bleeding event but all survived
    - Location of cannulation
        - ED – 35 patients
        - Cardiac Cath Lab – 15 patients
        - ICU – 10 patients
        - OR – 10 patients

        - Med Surg Floor – 3 patients
        - NO difference in risk of death among these locations
    - Major bleeding
        - 21 patients with reported 76% survival
    - Neurologically intact (CPC of 1) at hospital discharge
        - 88% (53 of 60 patients)
- Multivariate analysis
    - Increased risk of death for age > 65 years of age (OR 3.08) and cannulation during CPR (OR 5.67) compared to those cannulated after ROSC

Limitations

- Reporting bias prevalent in ECMO literature
- This study only reported survival to DC, not short-term or long-term survival
- Not surprisingly, there was heterogeneous reporting of clinical variable (neuro status at DC, bleeding rates, duration of CPR, etc.).
- Did not have sufficient detail to comment on patient specific conditions such as presence of comorbidities

Authors Take Home Points

- The use of VA-ECMO in the management of massive PE-related cardiac arrest resulted in a survival rate of 61% of patients in this systematic review.
- Age > 65 years of age and cannulation during CPR were identified as factors associated with increased mortality.