

What ECMO Means To Your ED

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• What ECMO Means To Your ED	Slide 1:
• Disclosures	Slide 2:
▼ Objectives	Slide 3:
• Describe the uses of ECMO in the emergency department	
• Understand the basics of ECMO	
• Understand program implementation	
▼ ED are Skilled Experts	Slide 4:
• Treating acute respiratory and cardiac failure	
• High acuity patients	
• Vascular access	
• Dealing with uncertainty	
• Time critical actions	
• Teamwork	
▼ Conventional Therapies Fail You	Slide 5:
• NIPPV	
• Intubation	
• Vasopressors	
• Chest compressions	
▼ Ultimate Supportive Care	Slide 6:
• Take over native organ function	
• Pump blood (Circulatory Support)	
• Oxygenate (Gas exchange)	
• Remove carbon dioxide	
• Regulate temperature	
▼ Can Not Cure	Slide 7:
• Used in adults who are at very high risk of death with a reversible cause	
▼ Bridge (time)	
• Physiologic stabilization/improvement	
• Time for diagnostics	
• Procedures	
• Tissue recovery	
▼ Applications	Slide 8:
• Cardiac arrest	
• Pulmonary embolism	
• ARDS	
• Asthma	
• Hypothermia	
• Myocardial infarction	
• Damage Control Surgery	

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<ul style="list-style-type: none"> • Septic cardiomyopathy 	
<ul style="list-style-type: none"> ▼ Baby Esperanza 	Slide 9:
<ul style="list-style-type: none"> ▼ John Gibbon (1950) <ul style="list-style-type: none"> • Developed blood oxygenator ▼ Bob Bartlett <ul style="list-style-type: none"> • Cardiothoracic surgeon • Experimental ECMO machine that avoided blood reservoir and extreme anticoagulation 	
<ul style="list-style-type: none"> ▼ 1975 <ul style="list-style-type: none"> • Immigrant pregnant mother crossed from Baja headed for Los Angeles • Went into birth and taken to Orange County Medical Center • Baby girl born • Meconium birth and subsequent chemical pneumonitis and respiratory failure • Even with maximal ventilatory support, the baby was unable to sustain adequate oxygenation. • Placed on ECMO • After three days, the baby was weaned from bypass and recovered completely. • The nurses named the baby Esperanza, meaning hope. • Teenager 	Slide 10: Slide 11: Slide 12:
<ul style="list-style-type: none"> ▼ Failed Adult ECMO Trials <ul style="list-style-type: none"> • Zapol, 1979 • CESAR Trial, 2009 • Early randomized trials showed higher rates of complications in adults who received it and no survival advantage. • Proponents of using it in adult patients believe that these poor outcomes were at least partially due to limited training, intensive anticoagulation, and excessive volume and pressure during mechanical ventilation. • Enthusiasm stalled • Little used in adults 	Slide 13:
<ul style="list-style-type: none"> ▼ 2009 <ul style="list-style-type: none"> • Dramatic increase in ECMO use 	Slide 14:
<ul style="list-style-type: none"> ▼ H1N1 (2009) <ul style="list-style-type: none"> • Wide-spread use of ECMO • Massive number of successful cases ▼ Improvements had come from <ul style="list-style-type: none"> • Technical improvements in circuit • Advances in critical care 	Slide 15:

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<ul style="list-style-type: none"> ▼ ED ECMO Trials <ul style="list-style-type: none"> • CHEER Trial, 2015 • ELSO Registry • Minnesota Resuscitation Consortium • EROCA 	Slide 16:
<ul style="list-style-type: none"> ▼ Venoaerterial (VA) ECMO Circuit <ul style="list-style-type: none"> • Complete or partial cardiac and respiratory support ▼ Drainage cannula <ul style="list-style-type: none"> • Femoral vein • Advanced to right atrium ▼ Return cannula <ul style="list-style-type: none"> • Femoral artery • Retrograde flow against native cardiac output • Competent aortic valve • Retrograde flow • Ipsilateral leg ischemia ▼ High LV pressures <ul style="list-style-type: none"> • Inotropes, balloon pumps, fix dysrhythmias 	Slide 17:
<ul style="list-style-type: none"> ▼ Venovenous (VV) ECMO Circuit <ul style="list-style-type: none"> • Complete or partial support of lung function • Most useful for isolated respiratory failure with adequate cardiac function ▼ Bicaval double-lumen catheter <ul style="list-style-type: none"> • Internal jugular vein • Drainage from SVC and IVC • Return jet directed at tricuspid valve • Reduces recirculation • Single cannula insertion • Facilitates ambulation/therapy • Patients stay on vent 	Slide 18:
<ul style="list-style-type: none"> ▼ Components <ul style="list-style-type: none"> ▼ Pump <ul style="list-style-type: none"> • Centrifugal Pump • Sealed casing • Easy to prime • Low hemolysis • Magnetically driven • Flow dependent on pressure • Set RPM ▼ Membrane Oxygenator 	Slide 19:

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<ul style="list-style-type: none"> • Easy to prime • Efficient gas exchange • Low resistance • Low risk for clotting ▼ Cross-Flow <ul style="list-style-type: none"> • Blood • Oxygen ▼ Silicon Membrane <ul style="list-style-type: none"> • Microporous • Retains proteins and cells ▼ Blender/Gas Mixer <ul style="list-style-type: none"> • Mixes air and oxygen • Controls flow rate (Sweep gas) 	<p>Slide 20: Slide 21:</p>
<ul style="list-style-type: none"> • Cardiohelp ▼ Cannulas <ul style="list-style-type: none"> • Arterial 15-21 Fr • Venous 23-25 Fr ▼ Choosing the Right Patient <ul style="list-style-type: none"> • Toughest part • Will benefit from ECMO • Comorbidities • Has an “out” clause ▼ Not too sick <ul style="list-style-type: none"> • Severity of organ failure • Duration of organ failure • Irreversible MSOF 	<p>Slide 22:</p>
<ul style="list-style-type: none"> ▼ Indications for ED ECMO <ul style="list-style-type: none"> • Out-of-hospital cardiac arrest without ROSC ▼ Cardiogenic shock <ul style="list-style-type: none"> • Myocardial infarction • Drug overdose ▼ Respiratory failure <ul style="list-style-type: none"> • Pulmonary embolism • ARDS • Status asthmaticus 	<p>Slide 23:</p>
<ul style="list-style-type: none"> ▼ Absolute contraindications <ul style="list-style-type: none"> • Uncontrolled active hemorrhage • Terminal illness 	<p>Slide 24:</p>

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<ul style="list-style-type: none"> • Irreversible or end-stage heart or lung failure in patients who are not candidates for transplant • Preexisting severe neurologic disability 	
<ul style="list-style-type: none"> ▼ Relative contraindications <ul style="list-style-type: none"> • Advanced age 	Slide 25:
<ul style="list-style-type: none"> ▼ Non-cardiac arrest <ul style="list-style-type: none"> • Trauma, Hanging, Drowning, ICH, Respiratory • Irreversible neurologic injury • Malignancy, solid-organ transplant, or immunosuppression • Unable to anticoagulate • Pregnancy/Postpartum • More than 7 days of mechanical ventilation • Multiorgan failure (especially renal failure) 	
<ul style="list-style-type: none"> ▼ Decision Making <ul style="list-style-type: none"> • Clinical Triggers for evaluation • Time critical • Information limited • Decision support • Review all decisions • Shares cases / Review Registry • Be willing to be wrong bothways 	Slide 26:
<ul style="list-style-type: none"> ▼ Initiating ECMO <ul style="list-style-type: none"> ▼ Activation <ul style="list-style-type: none"> • Hospital-wide ▼ Circuit configuration <ul style="list-style-type: none"> • Seems that should Self-evident that VA VV ▼ What might seem purely respiratory, may still require VA ECMO <ul style="list-style-type: none"> • ARDS with acidemia • Pulmonary embolism ▼ Cannula sizing <ul style="list-style-type: none"> • Ultrasound • Flurosocopy ▼ Cannulation <ul style="list-style-type: none"> • What could possibly go wrong • Not the same as arterial or femoral line • Size can expose your deficiencies • Landmark based approach • Never underestimate the damage you can do with a needle and cannula • Circuit Priming 	Slide 27:

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• Beginning Flow	
▼ Circuit Control	Slide 28:
▼ Blood Flow (oxygen)	
• Pump RPM, Preload, Afterload	
▼ Resistance	
• Cannula size	
▼ Sweep Gas Mixture (oxygen)	
▼ FDO ₂	
• Increases oxygen partial pressure	
▼ Gas flow rate	
• Controls carbon dioxide removal	
• Temperature	
▼ Ventilator	
• LTV vs Lung rest	
• Anticoagulation	
▼ Circuit Monitoring	Slide 29:
• BIS monitoring	
• Pulse-oximetry multiple limbs	
• Pulmonary artery catheter	
▼ Labs	
• Patient ABG	
• Pre- / Post-ABGs	
▼ Lactic acid	
• Marker of tissue hypoxia	
▼ Plasma free hemoglobin	
• Marker of hemolysis	
• Fibrinogen	
• HIT Labs	
▼ Problems	Slide 30:
▼ Bleeding	
• 43% of patients	
• Cannulation / Surgical sites	
• Intracranial hemorrhage	
• Gastrointestinal hemorrhage	
• Renal Failure	
• Pump Thrombosis	
• HIT	
• Limb ischemia	
• Infection	

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<ul style="list-style-type: none"> • Mechanical devices 	
<ul style="list-style-type: none"> ▼ ECPR Example 	Slide 31:
<ul style="list-style-type: none"> ▼ Entrance Criteria <ul style="list-style-type: none"> • Witnessed arrest • Bystander CPR • Initial rhythm VF/VT • Remains in arrest 15 min after ACLS • 3 shocks / ACLS without ROSC • Arrives in ED 	Slide 32:
<ul style="list-style-type: none"> ▼ Minimization of pulse checks <ul style="list-style-type: none"> • TEE monitoring • Amiodarone 300 • Continue nurse-led protocolized resuscitation 	
<ul style="list-style-type: none"> ▼ Stage 1 Vascular Access <ul style="list-style-type: none"> ▼ Placement of 5 Fr arterial catheter, 9 Fr venous catheter <ul style="list-style-type: none"> • Artery shrinks, vein expands 	
<ul style="list-style-type: none"> ▼ ECMO Criteria <ul style="list-style-type: none"> • EtCO₂ >10 • PaO₂ > 50 • LA <18 • Time < 90 min • Place of ECLS cannulas • ECMO commences within 90 min of collapse • Cardiac cath lab 	Slide 33:
<ul style="list-style-type: none"> ▼ Building an ED Program <ul style="list-style-type: none"> ▼ Identify all stakeholders <ul style="list-style-type: none"> • Multi-disciplinary • Multi-departmental • Champions ▼ Institutional Commitment <ul style="list-style-type: none"> • Capital Expenses • Ongoing expenses • Training support • Process / Protocols 	Slide 34:
<ul style="list-style-type: none"> ▼ Team Approach <ul style="list-style-type: none"> ▼ EMS <ul style="list-style-type: none"> • Liason / Protocols • ED Nurses & Physicians ▼ Cardiac Interventionalists 	Slide 35:

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<ul style="list-style-type: none"> • Early cardiac cath lab activation • Acceptance of adjusting quality metrics 	
<ul style="list-style-type: none"> ▼ Critical Care <ul style="list-style-type: none"> • Admissions and inpatient cares 	
<ul style="list-style-type: none"> ▼ Neurology & Neurocritical Care <ul style="list-style-type: none"> • Protocols for temperature management • Timing of prognostication • Neuroimaging • Vascular / Cardiothoracic Surgery 	
<ul style="list-style-type: none"> ▼ Program Components <ul style="list-style-type: none"> ▼ Training & Simulation <ul style="list-style-type: none"> • Initial & Ongoing • Multidisciplinary / Multidepartment • ECMO Call System • Nurse-led Protocolized Resuscitation • Departmental Flow • Streamlined ED Exit ▼ Go / No-go Status <ul style="list-style-type: none"> • Hospital capacity • Bed / Staff Availability 	Slide 36:
<ul style="list-style-type: none"> ▼ Program Operations <ul style="list-style-type: none"> • Daily Multidisciplinary Rounding • Monthly Operational Meeting • Monthly multidisciplinary ECMO Conference • ECMO Database, research projects, presentations, publications • Credentialling • Operational Committee 	Slide 37:
<ul style="list-style-type: none"> ▼ Culture of Safety <ul style="list-style-type: none"> • Checklists • Order Sets • Continuous Team Training & Simulation • Case Tracking & Review • Partner with ELSO ▼ Spare equipment <ul style="list-style-type: none"> • Spare circuit • Clamps 	Slide 38:
<ul style="list-style-type: none"> ▼ Summary <ul style="list-style-type: none"> • ECMO can provide temporary advanced cardiopulmonary physiologic support for reversible conditions. 	Slide 39:

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Outline

Slide

- Patient selection is critical for clinical and program outcomes.
- An ED ECMO requires a multidisciplinary multi-departmental commitment to a high-risk high-acuity protocolized process.