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SPECIALIST EDUCATION in ExtraCorporeal Membrane Oxygenation (ECMO)
Abstracts

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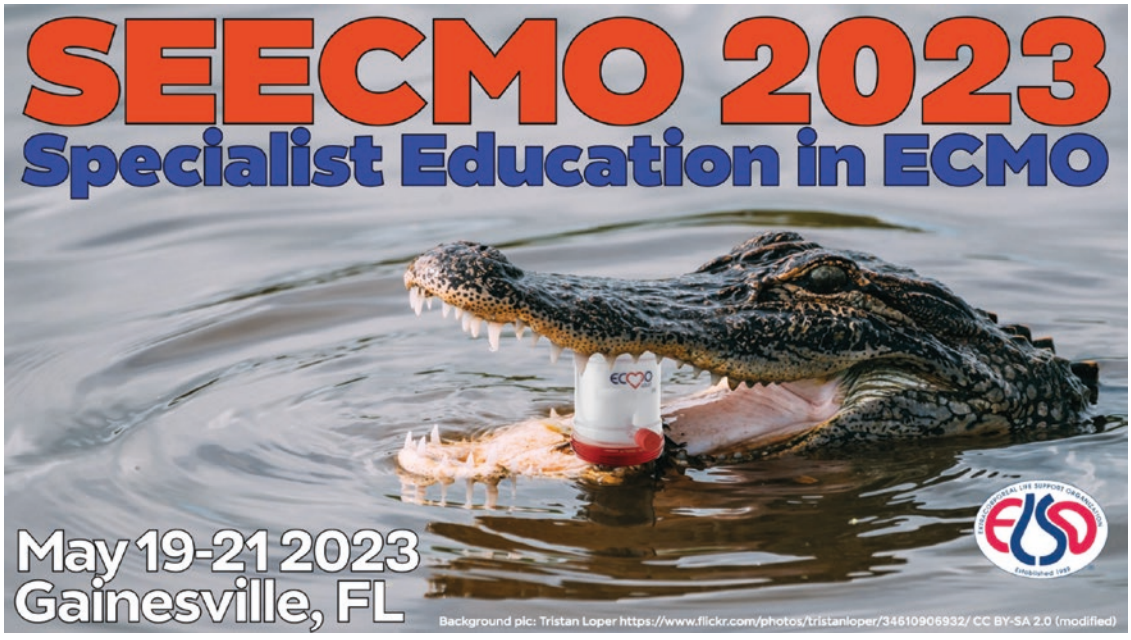

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Cardiology in the Young

SEECMO 2023 Poster Abstracts

Presented at the Specialists Educational Extracorporeal Membrane Oxygenation Conference 2023 at the University of Florida, Gainesville, Florida, United States of America

Poster judges: Professor Robert H Bartlett MD FELSO,

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Gainesville, Florida, Unites States of America | 19-21 May 2023

The Safe Addition of Nitric Oxide to the Sweep Gas of the Extracorporeal Membrane Oxygenation Circuit *Winning Abstract*

Michael A. Brock MD, Sukumar Suguna Narasimhulu MBBS, Mark S Bleiweis MD, Jeffrey P. Jacobs MD, Joseph Philip MD, Kevin Sullivan MD, Jose Hernandez-Rivera MD, Zasha Vazquez-Colon MD and Giles J. Peek MD

Extracorporeal life support has become a widely-accepted technology provide short-term mechanical circulatory support for the heart, lungs, or both. However, there is a high morbidity associated with extracorporeal life support, in large part due to the systemic inflammatory response caused by the blood-circuit interaction. Studies have demonstrated the beneficial effects of adding nitric oxide to the cardiopulmonary bypass circuits of children undergoing cardiac surgery. The addition of nitric oxide to the sweep gas of the extracorporeal life support circuit has been proposed as a method to reduce the systemic inflammatory response. Here, we describe our single-centre experience of adding nitric oxide to the sweep gas for the extracorporeal life support circuit in 19 patients in a paediatric cardiac intensive care unit. The outcomes of this cohort were then compared, retrospectively, to 30 patients who underwent extracorporeal life support without the addition of nitric oxide to the sweep gas. There were no incidences of clinically significant methemoglobinemia in either group. There were no differences in the frequency of adverse bleeding events between the groups. Using a cutoff of 2% the use of nitric oxide in the sweep gas did not increase the probability of having an elevated methaemoglobin level The addition of nitric oxide to the sweep gas appears safe. A multicentre randomized control trial is needed to determine the efficacy of this seemingly beneficial therapy.

Abstract updated 11 October 2023.

Exploring Preoperative Factors in 19 Patients Undergoing Cardiac Transplantation Requiring Extracorporeal Membrane Oxygenation

Matthew S. Purlee BS, Mark S. Bleiweis MD, Jeffrey P. Jacobs MD, Yuriy Stukov MD and Giles J. Peek MD

Aims: We reviewed preoperative factors for all patients undergoing cardiac transplantation while requiring extracorporeal membrane oxygenation since initiation of our transplant program to determine common risk factors associated with this rare cohort.
Methods: A single-centre retrospective study of all patients who underwent cardiac transplant while on extracorporeal membrane oxygenation from 07/09/1989 to 12/31/2022 was conducted. Continuous variables are presented as mean±standard deviation or median [interquartile range] (range). Categorical variables are presented as N (%).
Results: Nineteen patients received cardiac transplantation while requiring extracorporeal membrane oxygenation at our institution. Most of these patients were male (n = 15, 79.0%) and transplants were most common in adult patients (n = 16, 84.2%). Most patients required cardiac transplant

due to acquired heart disease (n = 16, 84.2%), and mean age at transplant was 39.8±19.0 years. These patients were high risk at time of transplant, with 70.6% (n = 12) requiring inotropic support, 64.7% (n = 11) having an underlying cardiac arrhythmia, and 50.0% (n = 10) requiring prior cardiac surgery. 41.2% (n = 7) of patients also presented in renal failure. 26.3% (n = 5) of these patients went on to receive multiple organ transplants involving cardiac transplantation. Post-operative length of stay was 37.1±53.4 days. At last follow up, 13 (68.4%) of patients were alive with a median follow up time of 1.46[0.1,2.3] (0,12.9) years.
Conclusion: Our single centre analysis of all 19 patients undergoing cardiac transplantation while receiving extracorporeal membrane oxygenation treatment revealed inotropic support, a previously diagnosed arrhythmia, and prior cardiac surgery as common risk factors in this cohort.

Extracorporeal Membrane Oxygenation Use in Patients with Bronchopulmonary Dysplasia: A Single Centre Review

Goeto Dantes MD, Katya Van Anderlecht MS, Joel Davis RRT-NPS, Lisa Lima MD, Matthew Paden MD, Allison F. Linden MD, MPH and Sarah Keene MD

Purpose: Formerly preterm paediatric patients with bronchopulmonary dysplasia represent a subgroup who may not be considered extracorporeal membrane oxygenation candidates due to perceived poor outcomes. The goal of this work was to determine outcomes for patients who carried a diagnosis of bronchopulmonary dysplasia and subsequently required extracorporeal membrane oxygenation for respiratory failure.
Methods: A single centre retrospective review was performed of previously premature (<34 week) patients diagnosed with bronchopulmonary dysplasia who were subsequently admitted to the neonatal or paediatric intensive care unit and treated with extracorporeal membrane oxygenation for respiratory failure between 01/2010-06/2022 (n = 20). Demographic and clinical data, including extracorporeal membrane oxygenation run characteristics and complications, were collected.
Results: The median birth weight and gestational age were 0.91kg (interquartile range 0.35kg) and 26 weeks (interquartile range 2.17weeks) respectively. Median chronological age at cannulation was 49 weeks (interquartile range 14 weeks). Infectious aetiologies of pneumonia were 70% viral, 20% bacterial and 10% unknown. Half of patients were cannulated via venovenous extracorporeal membrane oxygenation, the remainder were venoarterial and one required conversion from venovenous to venoarterial. The average time on extracorporeal membrane oxygenation was 237 hours (range 4-575 hours). Survival to discharge was 12/20 (60%) and 12/17 (70%) excluding the three extracorporeal cardiopulmonary resuscitation patients. Five of the 12 (42%) survivors required new or additional home oxygen and 3/12 (25%) were noted to have ongoing neurodevelopmental/behavioural concerns on long term follow up.
Conclusion: Patients with underlying bronchopulmonary dysplasia who require extracorporeal membrane oxygenation have comparable mortality and long-term neurodevelopmental outcomes to other paediatric patients with respiratory failure. This information can be useful for consideration of extracorporeal membrane oxygenation candidacy and family counselling.

Taking from Toddlers: Transcatheter Atrial Stent Removal Following Extracorporeal Membrane Oxygenation Support

John-Anthony Coppola MD, Yuen Lo Yau Leung MD, Himesh Vyas MD, Susana Cruz Beltrán MD, Sukumar Suguna Narasimhulu MD, Giles J. Peek MD, Jeffrey P. Jacobs MD, Mark S. Bleiweis MD and James Fudge MD

Background: Left atrial decompression is performed in patients on venoartieal extracorporeal membrane oxygenation to help offload the left ventricle wall stress and prevent the development of left atrial hypertension. Atrial stents are utilized to ensure patency of the created septal defect and post extracorporeal membrane oxygenation support they require removal.
Cases: Two previously healthy toddlers developed cardiopulmonary failure one due to respiratory syncytial virus bronchiolitis and the other secondary to sepsis and parainfluenza virus. Both patients required venoartieal extracorporeal membrane oxygenation for cardiopulmonary support. Echocardiograms showed left ventricle dilation and poor left heart decompression; thus left atrial decompression was recommended. For each case, percutaneous transeptal puncture was performed using the Baylis VersaCross system. Creation of an atrial septal defect was performed using a Palmaz XL 4010 stent delivered on a 12 mm NuMed BIB balloon. After recovery of cardiac function, stent removal was planned in preparation for extracorporeal membrane oxygenation decannulation. A 20Fr GORE DrySeal sheath was utilized for stent removal via the femoral vein. Two gooseneck snares were used from the internal jugular and femoral veins to control and crimp the stent. In one case, the snares alone were used removed the stent via the GORE sheath. In the second case, the Onocor ONO retrieval device was used to extract the stent through the GORE sheath. There were no complications with stent removal in either case.
Conclusion: Transcatheter removal offers a less invasive approach to retrieve an atrial septal stent after extracorporeal membrane oxygenation support.

Novel Hypothesis for Decreasing Haemolysis and Prolonging Oxygenator Life Whilst on Extracorporeal Membrane Oxygenation Utilizing Inhaled Nitric Oxide to the Oxygenator

Sukumar Suguna Narasimhulu MBBS, MPH, Michael A Brock MD, Mark S Bleiweis MD, Jeffrey P Jacobs MD, Joseph Philip MD, Kevin Sullivan MD, Jose Hernandez-Rivera MD, Zasha Vasquez-Colon MD and Giles J. Peek MD

Background: Extracorporeal membrane oxygenation-associated haemolysis causes considerable morbidity due to inhaled nitric oxide depletion, coagulopathy, and acute kidney injury. To date we do not have any targeted therapies for decreasing haemolysis in this setting. inhaled nitric oxide plays a major role in vascular homeostasis modulating basal and stress-mediated smooth

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muscle relaxation, endothelial expression, and platelet function. We describe a novel way of using inhaled nitric oxide to the oxygenator to decrease haemolysis, possibly prolonging the use of the oxygenator.
Methods: We attached the inhaled nitric oxide injector module to deliver 20 parts per million of inhaled nitric oxide before the oxygenator to a patient with evidence of severe haemolysis.
Results: A 2-month-old, 6-kilogram black female infant was admitted to the Cardiovascular Intensive Care Unit in extremis and placed on Veno-arterial extracorporeal MEMBRANE OXYGENATION. Initial labs showed a plasma free haemoglobin: 40 mg/decilitre, lactate dehydrogenase: 735 international unit/litre and platelet count: 340 thousand/cubic millimetre. By 14 days on venoartieal extracorporeal membrane oxygenation the patient's haemolysis worsened with plasma free haemoglobin: 550 mg/decilitre, lactate dehydrogenase: 1072 international unit/litre and platelet count: 73 thousand/cubic millimetre and had visible fibrin clots on the oxygenator. We added inhaled nitric oxide to the oxygenator instead of replacing it. All labs stabilized and we were able to extend the life of the oxygenator till the patient had a ventricular assist device placement. The labs pre-ventricular assist device placement showed: plasma free haemoglobin: 100 mg/decilitre, lactate dehydrogenase: 363 international unit/litre and Platelet Count: 120 thousand/cubic millimetre. Total venoartieal extracorporeal membrane oxygenation time of 24-days on single oxygenator.
Conclusions: Using inhaled nitric oxide in this application may be a novel way to reduce haemolysis. Further large scale studies will be needed to delineate whether this is effective.

A Novel Approach to Using Negative Pressure Wound Therapy to Manage Extracorporeal Membrane Oxygenation Site Deterioration

James Brian BSN, RN, CWON and Cindy Westbrook BSN, RN, CWON

Background: Chlorhexidine gluconate dressings are standard for extracorporeal membrane oxygenation sites to prevent catheter-related bloodstream infections. In many patients, fluid shifts cause moisture collection under cannula dressings, leading to tissue breakdown and erosion, often resulting in topical yeast infections. Traditionally, Negative Pressure Wound Therapies have been shown to manage wound drainage, encourage tissue proliferation resulting in accelerated wound healing. With this knowledge, we developed a novel approach to managing extracorporeal membrane oxygenation dressings.
Methods: In a large academic health centre, our Wound Team treated 23 extracorporeal membrane oxygenation site complications. While maintaining cannula stability, a 3-level stepwise approach was introduced. 1: Chlorhexidine gluconate impregnated dressings. If moisture identified, Wound Team consulted; 2: Initiate silver hydrofiber with multilayer silicone foam secondary dressing. If significant drainage and tissue breakdown around the cannula site continued, medical teams notified; 3: negative pressure wound therapies dressing is placed to manage drainage and promote healing. Use of silver impregnated Collagen matrix is often integral part of 2 and 3 level dressings.
Results: Stepwise approach to extracorporeal membrane oxygenation site management leads to a decrease of dressing changes. Consistent healing in the compromised extracorporeal membrane oxygenation sites were noted.
Discussion: Introduction of negative pressure wound therapies and a stepwise approach to cannula site dressings has improved wound care frequency and healing in this population. Further research is needed to see if this innovative approach will work in various types of cannula site applications, improve infection related outcomes, reduce length of cannulation and decrease risk of recannulation.

Creating a Culture of Resiliency in an Extracorporeal Life Support Program

Monika Collins MSN RN, Alicha Gibbs BSN RN, Erin Glikes BSN RN, Jordan Andrews BSN RN, Kumi McCool BSN RN and Beth Fournier BSN RN

As we entered the endemic phase of Coronavirus disease 2019, it became increasingly apparent within our Extracorporeal Membrane Oxygenation Centre that an irrepressible extracorporeal life support culture no longer existed. Attrition rates rose to programmatic highs as we lost both seasoned and novice clinicians to their pursuit of more sustainable work environments. Recognition was given to the pervasive trauma exposure of extracorporeal membrane oxygenation clinicians, attributing its origin to the immense criticality of these patients. As we optimized our labour force and stretched to maintain the ability to care for extracorporeal membrane oxygenation patients, we took a step back as a program to set into action purposeful strategies for sustainability. One such strategy was to initiate education concentrating on the concepts surrounding clinician resiliency and how to foster its culture. Extracorporeal Membrane Oxygenation Leadership developed didactic sessions introducing constructs of trauma and the direct impact upon extracorporeal life support clinicians' resiliency. This presentation was given during staff meetings as well as adopted into the core curriculum of our Extracorporeal Membrane Oxygenation Centre's training course. Additionally, we partnered with our Palliative Care Team to host sessions on extracorporeal life support ethics and palliation and presented appropriate support tools for staff. Since beginning the education in fall of 2022, the Extracorporeal Membrane Oxygenation Team attrition rate has fallen from 50% (2021) to 2.5% (2023). It is our opinion that extracorporeal life support clinician resiliency is a central aspect of an extracorporeal membrane oxygenation program and should be carefully monitored. The complexity of patients we care for continues to expand daily. Therefore, incorporation of tailored education for trauma recovery is essential to the sustainability of clinicians within extracorporeal life support.

What is the weakest point of a secured aortic cannula in central extracorporeal membrane oxygenation?

Yuriy Stukov MD, Kayla Lucas, Jeffrey P. Jacobs MD, Omar M. Sharaf BS, Matthew Purlee, Tatiana Delaleu, Mark S. Bleiweis MD and Giles J. Peek MD

Introduction: Institutional variation and surgeon preference account for variability in the techniques used to safely secure the aortic cannula during central veno-arterial extracorporeal

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membrane oxygenation in patients with an open chest. The purpose of this study is to evaluate and compare the stability and mechanisms of failure associated with each of these techniques during application of excessive force.
Methods: The experimental stand was constructed using a Fisher Castaloy laboratory clamp tool holder and three-prong extension clamps. Prolene® sutures were snared around gripping rods. Three experimental groups were used and varied by polypropylene size and aortic cannula type. Each Prolene® suture was secured within tourniquets using either a haemostat or medium haemostatic clips. The cannula was snared with silk ties to either one or two tourniquets. Force was applied to a three-way stopcock connected to the side port of the aortic cannula. The force applied was 9.8 Newtons (1 Kilogram) initially and increased exponentially if the cannula remained secure.
Results: In the stand model, two purse-string sutures secured by two clips held cannulae most reliably at the highest forces.
Conclusions: Larger diameter suture can withstand higher forces. Two haemostatic clips can secure Prolene® within tourniquets with the same efficiency as a mosquito. In the stand model, the weakest point of a secured aortic cannula was the number of ties around the cannula and tourniquets.

Extracorporeal Membrane Oxygenation and Molecular Adsorbent Recirculating System in Acute Liver Failure: A Systematic Review

Rohit Sharma MD, Shiva F Naidoo MD, Tristan Nguyen-Luu MD, Greg Simonetti MD, Prashant Kumar Singh MD, Michael Madden DO, PhD and Wasique Mirza MD

Introduction: The use of albumin recirculation was first introduced in 1993 and was implemented clinically in 1996. Although molecular adsorbent recirculating system is FDA-approved for treating protein-bound drug poisoning and hepatic encephalopathy in decompensated chronic liver disease, it has also been used off-label for many other conditions with varying success rates. Conflicting data has been reported on the effectiveness of molecular adsorbent recirculating system including the RELIEF study group which showed no significant difference between liver transplantation-free survival & standard medical therapy group. Limited data on use of molecular adsorbent recirculating system and extracorporeal membrane oxygenation exists in literature.
Methods: This systematic review was conducted to evaluate the use of extracorporeal membrane oxygenation and molecular adsorbent recirculating system in patients with multi-organ failure including liver failure. A comprehensive literature search was conducted using electronic databases including PubMed, MEDLINE, and Cochrane Library. The following keywords and MeSH terms were used: "extracorporeal membrane oxygenation," "ECMO," "molecular adsorbent recirculating system," "MARS," "acute liver failure," and "multi-organ failure".
Five articles with a total of 22 patients were included, with an average age of 46.71 years (SD 8.7 years). The primary indications for extracorporeal membrane oxygenation and molecular adsorbent recirculating system were acute respiratory distress syndrome (7), heart failure (4), malignant arrhythmia (4), post-cardiotomy syndrome (4), acute myocardial infarction (2), and asthma (1). 17 were on venovenous extracorporeal membrane oxygenation, and 5 patients were on venoartieal extracorporeal membrane oxygenation. The majority of patients (77.27%) were successfully weaned off extracorporeal membrane oxygenation and molecular adsorbent recirculating system. However, the overall 30-day mortality was 50%. In conclusion, extracorporeal membrane oxygenation and molecular adsorbent recirculating system may be a viable option for patients with multi-organ failure and acute liver failure.

Enhancement of Educational Strategies in a Busy Extracorporeal Membrane Oxygenation Centre

Monika Collins MSN RN, Kumi McCool BSN RN, Erin Glikes BSN RN, Jordan Andrews BSN RN, Alicha Gibbs BSN RN and Beth Fournier BSN RN

Medical University of South Carolina's extracorporeal membrane oxygenation program consists of approximately 40 extracorporeal membrane oxygenation specialists trained in the delivery of extracorporeal life support across the life span - neonatal to adults. Despite Platinum Level Designation as Extracorporeal Life Support Organization Centres of Excellence for both the paediatric and the adult extracorporeal membrane oxygenation programs, our institution has experienced high attrition and turnover like others nationally. This erosion experience has resulted in an Extracorporeal Membrane Oxygenation Team comprised of staff with less experience collectively. Given the fluctuation and variance of patient populations encountered at any given time, our team has the propensity for decreased exposure to any of the 3 extracorporeal membrane oxygenation platforms we utilize. Our Extracorporeal Membrane Oxygenation Leadership Team recognized the need to create and facilitate alternative educational models. The intention of these models is to assist with maintenance of proficiency on each institutional extracorporeal membrane oxygenation pump. While a multitude of targeted extracorporeal life support resources are provided to the Extracorporeal Membrane Oxygenation specialists (training manuals, study guides, in-situ training), our extracorporeal membrane oxygenation Leadership Team concluded that the creation of additional visual aides were necessary. Videos demonstrating both basic and emergency skills were created and paired with QR codes for ease of accessibility. These videos have become an invaluable resource for specialists and an integral part of our institutional training model.

Intraarrest Transport, Extracorporeal Cardiopulmonary Resuscitation and Early Invasive Management in Refractory Out-of-Hospital Cardiac Arrest: An Individual Patient Data Pooled Analysis of Two Randomized Trials

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Background: Refractory out-of-hospital cardiac arrest treated with standard advanced cardiac life support has poor outcomes. Transport to the hospital and in-hospital extracorporeal

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cardiopulmonary resuscitation initiation may improve outcomes. We performed a pooled individual patient data analysis of two randomized controlled trials evaluating extracorporeal cardiopulmonary resuscitation based approach in out-of-hospital cardiac arrest.

Methods: Individual patient data from two published randomized controlled trials were pooled. Both trials enrolled refractory out-of-hospital cardiac arrests and compared: intra-arrest transport with in-hospital extracorporeal cardiopulmonary resuscitation initiation (invasive approach) versus continued standard advanced cardiac life support. The primary outcome was 180-day survival with favourable neurological outcome (defined as Cerebral Performance Category 1-2). Secondary outcomes included: cumulative survival at 180 days, 30-day favourable neurological outcome, and 30-day cardiac recovery.

Findings: Two hundred eighty-six patients were included. Of those randomized to the invasive (n = 147) and standard (n = 139) groups, respectively: the median age was 57 (interquartile range 47-65) and 58 years (interquartile range 48-66), and the median duration of resuscitation was 58 (interquartile range 43-69) and 49 (interquartile range 33-71) minutes (p = 0·17). In a modified intention to treat analysis, 45 (32·4%) in the invasive and 29 (19·7%) patients in the standard arm survived 180 days with a favourable neurological outcome [absolute difference (absolute difference), 95% confidence interval: 12·7%, 2·6-22·7%, p = 0·015]. Forty-seven (33·8%) and 33 (22·4%) patients survived to 180 days [hazard ratio 0·59 (0·43-0·81); log-rank test p = 0·0009]. At 30 days, 44 (31·7%) and 24 (16·3%) patients had favourable neurological outcomes (absolute difference 15·4%, 5·6-25·1%, p = 0·003), 60 (43·2%) and 46 (31·3%) patients had cardiac recovery (absolute difference: 11·9%, 0·7-23%, p = 0·05), in the invasive and standard arms, respectively.

Interpretation: In patients with refractory out-of hospital cardiac arrest, the invasive approach significantly improved 30- and 180-day neurologically favourable survival.

Extracorporeal Membrane Oxygenation cannula measurement reduces cannula malposition complications

Joseph Luu RN, Jennifer A. Guy BSN, Tiffany Johnson BSN, RN, Alexandra Krueger BSN, Amber Stempf BSN, Catherine Zimmermann BSN and Lucian A. DurhamIII M.D., Ph.D.

Veno-Venous Extracorporeal Membrane Oxygenation provides mechanical support for the lungs and Venous-Pulmonary Artery Extracorporeal Membrane Oxygenation is supportive of the lungs and the right side of the heart. This type of support is achieved via access of the right internal jugular vein with a dual lumen cannula. The aim of this qualitative review is to provide a standardized method for evaluating right internal jugular extracorporeal membrane oxygenation cannula position to prevent or provide early detection of malpositioning, thus maximizing patient safety, staff efficiency, and cost effectiveness. Patients requiring extracorporeal membrane oxygenation are at risk for developing intensive care unit acquired weakness, which can lead to increased rates mortality. Early rehabilitation and mobilization of critically ill patients is an essential part of their recovery and return to independence. Cannulation duration and patient mobility puts them at risk for cannula migration. Malpositioning of the cannula may result in harm to the patient or decompensation, necessitating emergent return to the operating room for repositioning or recannulation, which increases risk to the patient and can be costly. The most common cause of cannula migration is long-term patients losing skin integrity at suture sites anchoring the cannula. Assessing the sutures and measuring the cannula daily have improved outcomes by preventing malposition of the extracorporeal membrane oxygenation cannulas. If the sutures were not intact, the team would re-anchor the cannula after confirming proper positioning. Since adopting the protocol for measuring and documenting cannula position, there have been 4 instances of cannula malposition compared to 16 - 18 events annually from previous years.

Extracorporeal Membrane Oxygenation Safety Checklist

Catherine Zimmermann BSN, RN, Amber Stempf BSN, RN, Jennifer Guy BSN, RN and Tiffany T. Johnson BSN, RN

A proper extracorporeal membrane oxygenation circuit check at the beginning of each shift and upon the return from any procedures or any off unit activities is an essential part of emergency prevention. After several safety events related to the gas module being connected to an inappropriate source, a physical safety checklist was created and attached to each circuit cart. This checklist is a quick reference guide for bedside nurses to complete at the beginning of each shift and is required to be completed by two trained extracorporeal membrane oxygenation personnel upon patient return to room or following an oxygenator or circuit exchange. One person reads off the items on the checklist while the perfusionist confirms each safety item was completed. This checklist is completed following any patient arrival, transportation, mobilization, and any equipment or circuit changes. Having a physical checklist attached to each extracorporeal membrane oxygenation cart ensures that there are no key components of a circuit exam that are accidently missed. This checklist also ensures that the individuals involved in caring for both the patient and circuit are aware of all components and prescribed settings. The checklist includes; gas line connections, AC power to red outlet, oxygen line moved from tank to blender, heater cooler on, water level is appropriate, continuous temperature monitoring, cannulas secured, sweep and FiO2 settings, low flow alarms, two clamps near the pump, continuous renal replacement therapy connection, and device specific checks.

High Fidelity Extracorporeal Membrane Oxygenation Simulation and Education

Tiffany T. Johnson BSN, RN, Jennifer A. Guy BSN, Alexandra Krueger BSN, Joseph Luu RN, Amber Stempf BSN, Catherine Zimmermann BSN, BRONCHOPULMONARY DYSPLASIA, Adam Ubert M.D and Lucian A. DurhamIII M.D., Ph.D.

Emergent complex clinical situations are used in the creation and development of extracorporeal membrane oxygenation simulations. Multidisciplinary extracorporeal membrane oxygenation

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simulation focuses on facilitating hands-on management of complex patient scenarios. The extracorporeal membrane oxygenation multidisciplinary team is comprised of cardiothoracic surgery, critical care anaesthesia, Registered Nurse Extracorporeal Membrane Oxygenation coordinator, perfusionist, respiratory therapist, charge nurse, and the bedside nurse who work together through scenarios in a safe practice environment; ensuring the future successes of the entire care team when presented with similar clinical situations. These extracorporeal membrane oxygenation simulations scenarios can include complications of air entrainment, malposition of cannulas, oxygenator and circuit exchanges, surgical complications, complication of bleeding and coagulopathy, accidental decannulation, and component failures. The team collaborates to assess the patient and move through the scenario to intervene appropriately and debrief on the actions taken to meet the desired learning objectives. The Froedtert Simulation Centre team utilizes SIM Man 3G™ along with the Eigenflow 2™ Extracorporeal Membrane Oxygenation simulator and the ASL5000 Lung solution for the extracorporeal membrane oxygenation high fidelity simulations. An extracorporeal membrane oxygenation circuit is connected to the Eigenflow 2 Extracorporeal Membrane Oxygenation Simulator™. The extracorporeal membrane oxygenation simulation development team consists of the extracorporeal membrane oxygenation clinical program manager, Registered Nurse Extracorporeal Membrane Oxygenation Coordinators, Cardiothoracic Surgeon, Intensivist, Perfusionist and Simulation Operations Specialists who collaborate and develop new simulations bi-annually. Multidisciplinary teams are then provided with patient scenarios in the high fidelity simulation environment that have been developed to mimic real encounters. The team utilizes their assessment and engage in hands on interventions to progress through the scenario in an effort to meet the objectives of learning for that simulation.

Bubbles! Safety with In-Circuit Continuous Renal Replacement Therapy

Lauren Espeso BSN, RN, CCRN-CSC-CMC, AdventHealth Orlando and Michele Rodriguez BSN, RN, CCRN-CSC-CMC, AdventHealth Orlando

When the adult extracorporeal membrane oxygenation patient does not have enough sites for an additional line, in-circuit access is utilized to run continuous renal replacement therapy. To do this safely our centre chose to create a separate access piece, instead of utilizing the existing pre – post oxygenator pigtails to keep the numbers of times directly accessing the oxygenator to a minimum. Our access is a 3/8 tubing heat bonded to two featured 3/8 connectors, with two 3-way stopcocks and placed in the drainage/venous cannula at time of cannulation, or sterile bedside procedure by the Extracorporeal Membrane Oxygenation Specialist.

Our team utilizes a two-person access/de-access process for continuous renal replacement therapy initiation, discontinuation, troubleshooting and emergencies. One Extracorporeal Membrane Oxygenation Specialist verbalizes their actions, "on to the circuit" "off to the circuit" when accessing/de-accessing, starting/stopping continuous renal replacement therapy, and alarm troubleshooting. The second Extracorporeal Membrane Oxygenation Specialist watches and stops the process if any issues that could compromise the circuit is noted. ESs utilize wet-lab and high-fidelity simulation during orientation to practice verbalization, step-by-step processes, and complications before performing the skill in-situ. Continuous renal replacement therapy alarm management and troubleshooting is also done by the extracorporeal membrane oxygenation specialist. Troubleshooting more than a few seconds requires stopcocks to be off to the patient, and longer than 2 minutes requires a new continuous renal replacement therapy cartridge to prevent fibrin and clots from being sent to the pump/oxygenator. Further wet-lab practice and high-fidelity simulation is also performed through the year to maintain skills. Double verifying during initiation, discontinuation, and troubleshooting helps decrease the risk of an air event while running in-circuit continuous renal replacement therapy.

Implementation of a New Oxygenator in Infant and Paediatric Extracorporeal Membrane Oxygenation Circuits

Elizabeth M. Malick MEd, RRT-NPS, Theresa R. Fieo BSN, RN, CCRN and Susan B. Williams MSN, RNC, CIT

Introduction/Background: A major component of an extracorporeal circuit is an oxygenator. The extracorporeal membrane oxygenation centre at Children's Hospital of Philadelphia evaluated two oxygenators distributed by Abbott into their Extracorporeal Membrane Oxygenator circuits after supply issues impacted Children's Hospital of Philadelphia's ability to meet equipment demands through their current supplier. Children's Hospital of Philadelphia contacted Abbott for an alternative option to pilot as soon as approval for US release was obtained.

Aim: Evaluate the paediatric Abbott oxygenators in extracorporeal membrane oxygenation circuits at Children's Hospital of Philadelphia for its ability to support patient needs without device failure.

Methods: Prior to patient use, the Abbott oxygenator was approved by our hospital device committee and simulated in an extracorporeal membrane oxygenation wet lab along with the Children's Hospital of Philadelphia perfusion team. An assessment and evaluation tool were developed to analyse data for interpretation of performance.

A quantitative study on Abbott oxygenator function in extracorporeal membrane oxygenation circuits at Children's Hospital of Philadelphia was conducted. Data was collected on circuits that utilized an Abbott oxygenator. Such data included: time stamped documentation of clot formation, failure, lung pressures, and frequency of component changes.

Results: Six extracorporeal membrane oxygenation runs utilized this oxygenator, making Children's Hospital of Philadelphia the first institute in North America to trial and pilot them in the infant and paediatric extracorporeal membrane oxygenation population.

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Conclusion: Children's Hospital of Philadelphia has established that both the AMG PMP Infant and Paediatric Abbott oxygenators are a safe, reliable alternative to use in extracorporeal membrane oxygenation circuits.

Extracorporeal Membrane Oxygenation + Impella + Left Arterial Reperfusion Solution

Susan B. Williams MSN, RNC, James Connelly BS, RRT-NPS, FELSO, Kats Maeda MD, Richard Melchior CCP, Kyle Weinberger BSN, Benjamin Kozyak MD and BRONCHOPULMONARY DYSPLASIA

Background: Right neck cervical extracorporeal membrane oxygenation cannulation and left arm perfusion injury is uncommon until a left axillary Impella device is used in tandem with venoarterial extracorporeal membrane oxygenation for a previously healthy 12-year-old.

Case presentation: 12-year-old male with no prior medical history presented with biventricular dysfunction and evidence of significant inflammation and multiorgan system dysfunction. He was supported on venoarterial extracorporeal membrane oxygenation (Right neck) and Impella (Left axillary). He required serial head Computerized Tomography scans to monitor a left posterior cerebral artery ischemic stroke (prior to extracorporeal membrane oxygenation) with haemorrhagic conversion.

4 days into an unremarkable extracorporeal membrane oxygenation + Impella run, sans neuro complications, bedside clinicians noted poor left extremity perfusion as evidenced by lack of pulses and mottled left arm and hand. Clinicians immediately discussed emergent reperfusion options.

Discussion/Conclusion: The innovative solution to improve perfusion to his left hand and arm was to utilize the existing left radial arterial line. The addition of extension tubing to shunt some arterial blood back to the left hand with extracorporeal membrane oxygenation arterial blood via a bridge stopcock cut into the extracorporeal membrane oxygenation CardioHelp system was fast and efficient (~100-200 ml/kilogram/min flow via this shunt). Of note, at our institution, we add this connector and stopcock upon build of the CardioHelp circuit in anticipation of future need for dialysis or bridge loop for low flow trials. This unique manoeuvre of using existing patient arterial access linked to stopcock port on the arterial limb of the extracorporeal membrane oxygenation circuit made for a quick transition for reperfusion without the need for an additional surgical procedure.

New Extracorporeal Membrane Oxygenation Specialist Virtual Hybrid Training Program

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Introduction/Background: The Extracorporeal Membrane Oxygenation Specialist Certification Program is designed as an elective certification for a blended team of Intensive Care Unit Staff, inclusive of registered nurses and registered respiratory therapists, to further their knowledge, skills, and expertise as an intensive care unit clinician. Hospital certification to educate into the role of Extracorporeal Membrane Oxygenation Specialist requires extensive didactic and clinical specifics. This blended certification program includes e-Learning modules, precepted time with a mentor at the extracorporeal membrane oxygenation pump, and opportunities to test skills during a hands-on water drill. The content focuses on many topics including improving patient safety by reducing variability in extracorporeal membrane oxygenation competency by filling educational gaps between professions for this low volume high risk mode of life support. This new program will create standardized training that will be offered more frequently than previous iterations of the certification program.

Aims: Transition from 72 hours of didactic classroom lectures, 40 hours precepted hands-on training, final written exam and 4-hour water drill to rolling virtual modules, with simultaneous precepted time, final exam, and water drill.

Streamline training from once a year to quarterly, inclusive of self-paced sequential LL Modules utilizing adult learning, precepted time and completion Of Extracorporeal Membrane Oxygenation Orientation Competency/Safety checklists.

Financial responsibility by decreasing above status cost centre adjustments for 3 12-hour classroom days + precepted time (total 116 hours) to approximately 40 hours of self-directed virtual; hands-on training time.

Assess transfer of learning by utilizing the eParamus platform to administer pretest, Modules, posttest, behaviour competency checklist data and remediate education as needed.

Methods: Collaboration with Children's Hospital of Philadelphia's Nursing Professional Development instructional design team to develop a platform, utilizing adult learning strategies to create a virtual hybrid training modality for a blended team of intensive care unit registered nurses and registered respiratory therapists interested in advancing their professional development by training into the role of Extracorporeal Membrane Oxygenation Specialist.

Deploy Pilot Part 1 online Modules (8 sections) to a sample size of staff interested in Extracorporeal Membrane Oxygenation Specialist training.

Beta test the Extracorporeal Membrane Oxygenation Specialist training program and evaluation tool.

Results: Development of this robust adult topic specific education required collaboration and testing of several virtual platforms and months of testing, editing and ongoing development of part 2 Modules (10 sections). Increased times throughout the year for clinical professionals to start and work towards Extracorporeal Membrane Oxygenation Specialist Certification. This will result in regular growth of the extracorporeal membrane oxygenation team in addition to future opportunity for these learners to move into more advanced extracorporeal membrane oxygenation roles.

Conclusion: The extracorporeal membrane oxygenation specialist role includes an accelerated understanding of neonatal, paediatric, and cardiac extracorporeal membrane oxygenation pathophysiology, modes of extracorporeal membrane oxygenation, variable circuits, safety, and harm prevention, and troubleshooting for circuit mechanical and patient complications

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associated with extracorporeal membrane oxygenation life support. This platform has the potential to expedite extracorporeal membrane oxygenation specialist training, maintain and measure competency and build extracorporeal membrane oxygenation skill sets to continue safe expert care of the extracorporeal membrane oxygenation patient in all Children's Hospital of Philadelphia intensive care units.

Registered Nurse and Respiratory Therapist Extracorporeal Membrane Oxygenation Specialist Supported Interhospital Transport Process Development

Deidra Fellows BSN, RN, CCRN

Increased application of extracorporeal membrane oxygenation has resulted in the necessity to utilize growing numbers of registered nurse and registered respiratory therapist extracorporeal membrane oxygenation specialists to manage every aspect of extracorporeal membrane oxygenation support including interhospital transport. To improve efficiency, productivity, and cost management AdventHealth Orlando moved to expand the responsibilities of its extracorporeal membrane oxygenation specialist team from in hospital bedside management alone to support interhospital extracorporeal membrane oxygenation transport. After considerable research on critical care and extracorporeal membrane oxygenation interhospital transportation, and upon agreement with all stakeholders an enhanced extracorporeal membrane oxygenation interhospital transport process was developed by the extracorporeal membrane oxygenation team. This process included the development of extracorporeal membrane oxygenation specialist and critical care transport training and simulation, logistical transport needs such as equipment and supply utilization, and standards of care aligning with critical care transport and extracorporeal membrane oxygenation hospital policy. Thus far the AdventHealth Orlando extracorporeal membrane oxygenation team has experienced decreased times for departure for retrieval improving delays in care and improved interdisciplinary transport communication aiding in developing individualized transport emergency planning and pre-admission planning for the receiving team. As an extracorporeal membrane oxygenation centre of excellence and advance cardiopulmonary provider it is imperative that AdventHealth Orlando ensure these services are accessible to the community and that EXTRACORPOREAL MEMBRANE OXYGENATION transport is safe and efficient. Therefore, it is the purpose of this presentation to illustrate the benefits of a systemic multidisciplinary interfacility extracorporeal membrane oxygenation transport program and outline the steps taken by the AdventHealth Orlando extracorporeal membrane oxygenation team in establishing the standards, training, and process followed in launching a successful extracorporeal membrane oxygenation specialist driven interfacility transport program.

Central extracorporeal membrane oxygenation Cannulation for Severe Amlodipine Intoxication

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Calcium channel blocker poisonings comprise up to 38% of deaths by cardiovascular drug ingestions. Amlodipine is a dihydropyridine calcium channel blocker commonly used for the management of hypertension. Its mechanism resides in the blockage of the LITRE-type calcium channels in peripheral vascular smooth muscle reducing the peripheral vascular resistance that can potentially lead to a life-threatening vasodilatory shock in toxic ingestions.

Calcium channel blocker poisoning management is focused on re-establishing normal organ perfusion through fluid administration and vasoactive infusions and reversing the drug effect by administering calcium, insulin, lipid emulsion, and glucagon infusions. In cases refractory to medical therapies, hemodynamic support with extracorporeal membrane oxygenation might be necessary, usually requiring higher flows than usual to compensate for the vasodilation, hence necessitating central cannulation.

The Impact of Symptoms Duration and Management of Coronavirus Disease 2019 Associated Severe Acute Respiratory Distress Syndrome on the Venovenous Extracorporeal Membrane Oxyanion Outcomes

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Introduction: Veno-venous extracorporeal membrane oxygenation is well established supportive intervention for patients with coronavirus 2019 severe acute respiratory distress. It is unclear if the duration of symptoms and noninvasive and invasive mechanical ventilation before extracorporeal membrane oxygenation might impact the clinical outcomes.

Methods: We examined coronavirus disease 2019 patients supported for severe acute respiratory distress syndrome by veno-venous extracorporeal membrane oxygenation at a quandary care institution. The study period was extended from April 1, 2020, to January 1, 2021.

Results: Forty-six patients with confirmed coronavirus disease 2019 were included in our analysis. The mean age was 44.83 +/- 10.46 years old, and the majority were males (63%). 54.3% of coronavirus disease 2019 patients supported by veno-venous extracorporeal membrane oxygenation survived hospital discharge. The univariant hazards ratio showed that the prolonged duration of coronavirus disease 2019 symptoms

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before initiating extracorporeal membrane oxygenation reduced the chance of hospital discharge (hazard ratio = 0.932, 95% confidence interval = 0.878-0.99, p = 0.023). Despite not being statistically significant, the longer the duration of the non-invasive mechanical ventilation, the lower the chance of hospital discharge for extracorporeal membrane oxygenation patients (hazard ratio = 0.895, 95% confidence interval = 0567-1.415, p = 0.636). However, the use of intravenous steroids led to increased hospital discharge, albeit the result remains statistically insignificant (hazard ratio = 1.545, 95% confidence interval = 0.621-3.846, p = 0.35).
Conclusion: Duration of the coronavirus disease 2019 symptoms and the extended use of non-invasive mechanical ventilation could be associated with poor outcomes for patients supported by veno-venous extracorporeal membrane oxygenation

Technique of Blood Return from Percutaneous VENO-VENOUS EXTRACORPOREAL MEMBRANE OXYGENATION at Mayo Clinic Rochester

Molly Bryant CCP, Tammy Friedrich MSN, RN and Megan Osterhaus BSN

Blood conservation in Extracorporeal Membrane Oxygenation is a crucial component in extracorporeal membrane oxygenation practice. A technique utilized at our centre to mitigate preventable blood loss in veno-venous percutaneously cannulated extracorporeal membrane oxygenation patients is to return the extracorporeal membrane oxygenation circuit blood to the patient immediately preceding decannulation. Patients are screened for anticipated tolerance of the autotransfused blood volume (500-600 ml) and, in the absence of suspected vascular complications associated with cannulation, veno-venous extracorporeal membrane oxygenation decannulation is performed in the Intensive Care Unit. The described technique is for patients supported with the Cardiohelp device utilizing a litre bag of Plasmalyte-A, the Cardiohelp emergency prime line and a one-litre pressure bag. Circuit volume displacement is controlled by the pressure bag for the Plasmalyte-Awhile the Cardiohelp is set to zero revolutions per minute. Each limb of the extracorporeal membrane oxygenation circuit, inlet (access) and outlet (return), is clamped in succession to flush each component individually. Once this technique is completed, documentation of Plasmalyte-A volume instilled, and total time of blood return is added to the patient's electronic medical record.

Pump Controlled Retrograde Trial Off Technique Used for Veno-Arterial Extracorporeal Membrane Oxygenation Decannulation in a Child with Pulmonary Hypertension

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Background: Pump controlled retrograde trial off is a technique used to evaluate a patient's candidacy for extracorporeal membrane oxygenation decannulation where the pump revolutions are reduced and the patient's intrinsic cardiac output will drive the circuit flow retrograde. This will convert the circuit into a controlled arterio-venous shunt and eliminates any cardiorespiratory support that the pump may provide to the patient. This method allows for easy reversibility of the trial, provides an accurate assessment of patient's candidacy for decannulation, and avoids risk of clot formation.
Case: We present the case of a 14-month-old male with past medical history of Trisomy 21, complete atrioventricular septal defect, and coarctation of the aorta status post coarctation repair with end-to-side anastomosis and pulmonary artery banding as an infant followed by complete atrioventricular septal defect repair with two patch technique at 6 months of age. At approximately 14 months of age, the patient required emergent intubation and Veno-Arterial Extracorporeal Membrane Oxygenation cannulation due to a severe pulmonary hypertensive crisis. The patient underwent two pump controlled retrograde trial off sessions to evaluate for decannulation. The first trial was performed on day 4 of cannulation and revealed suprasystemic right ventricular pressure as estimated by the tricuspid valve regurgitation jet. A second trial was performed on day 12 of extracorporeal membrane oxygenation support in the Cardiac Catheterization Lab with hemodynamic evaluation demonstrating improved right ventricular pressure of 60% systemic. The patient was successfully decannulated after 14 days of extracorporeal membrane oxygenation support and discharged to home with medications for pulmonary hypertension management.
Conclusion: Pump controlled retrograde trial off technique was a successful way to evaluate this patient's severe pulmonary hypertension while avoiding circuit clot formation or significant patient hemodynamic compromise. With this approach, the team was able to titrate pulmonary hypertension medical management effectively and determine appropriate timing for decannulation.

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