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CARDIOVASCULAR PERFUSION
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Spring 2025

The Academy Newsletter

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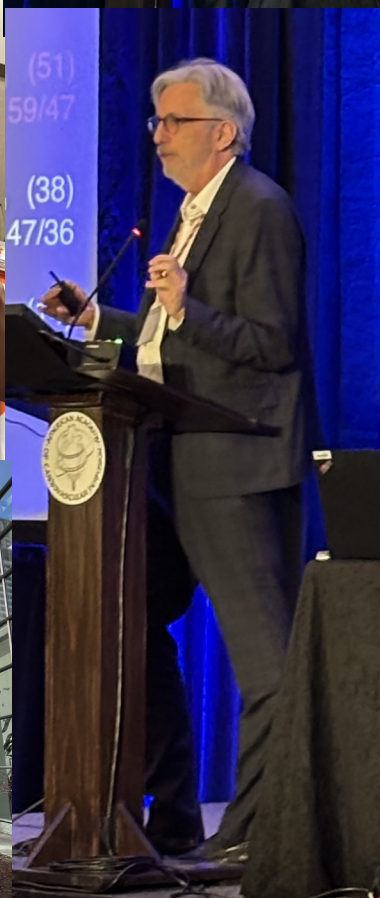

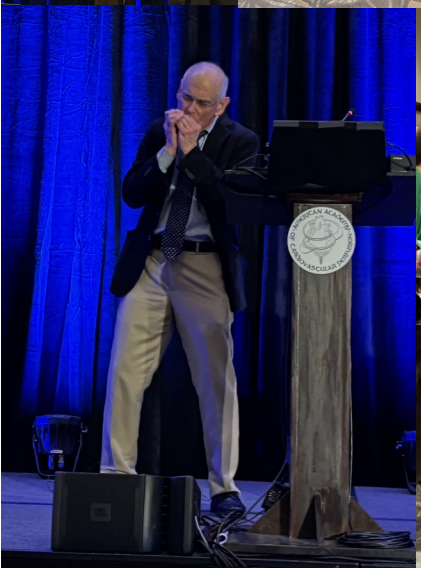



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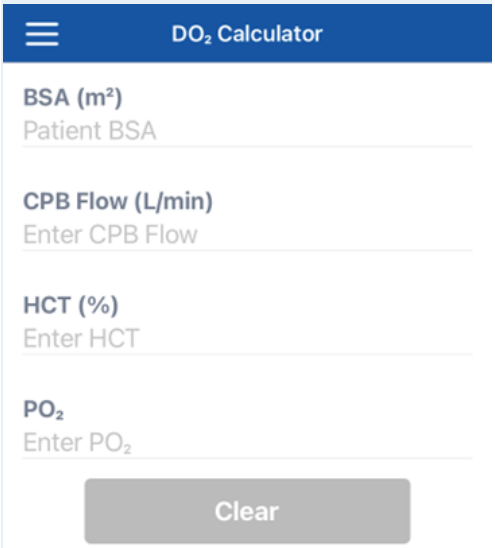
Christa Bond Kampert, LP, CCP
University of Maryland Medical Systems- St. Joseph Medical Center

Clifford Edwin Fonner
Maryland Cardiac Surgery Quality Initiative

EVALUATING THE IMPACT OF MAINTAINING PATIENT DO2 TO REDUCE ACUTE KIDNEY INJURY (AKI)

The incidence of acute kidney injury (AKI) associated with insufficient DO2 levels has been investigated within our profession. Previous studies have suggested that maintaining a DO2 level of 280 ml O2/min/m^2 or greater during cardiopulmonary bypass (CPB) shows a reduction in AKI. Our institution performed a prospective approach of optimizing DO2 values during CPB with monitoring AKI incidence while comparing AKI incidence with our past clinical practice.

DO2 values were prospectively collected on 1,418 patients from 2021-2023. These values were collected from the initiation of CPB and every 30 minutes until CPB termination. The Invosurg App was utilized by the perfusionist to document DO2 after each arterial blood gas. This program required input values for BSA, blood flow, hematocrit, and PO2 and these values were stored in an excel document. If the DO2 was below 280 ml O2/min/m^2, CPB flow was often increased, but no other adjustments to patient care were made. A retrospective analysis was performed on 1,405 patients undergoing CPB from 2018-2020 to evaluate the incidence of AKI.



After the inclusion of DO2 monitoring and adaptive practice, the incidence of AKI was 17.2%. During the retrospective analysis, the incidence of AKI was 18.64%. The adaptive practice approach with monitoring and optimizing DO2 resulted in an average decreased incidence of AKI of 1.44% during that time period. When comparing practice changes between time periods, our program performed more complex cases as time progressed, with the mean STS PROM increasing from 1.56% (2018-2020) to 1.67% (2021-2023), and cardiopulmonary bypass (CPB) times rising from 99.46 minutes to 112.89 minutes. Despite these challenges, the AKI rate decreased with the more recent time period, respectively due to the continual DO2 monitoring and adaptive practice technique.

With continually monitoring DO2 values during a case, our practicioners were able to adjust CPB flow to maintain a DO2 of 280 ml O2/min/m^2 or greater. As our practice progressed with utilizing the proactive approach of optimized DO2, the incidence of AKI was reduced while the complexity of cases increased. Monitoring DO2 values during CPB was shown to improve a perfusionist's awareness of optimizing patient care.

Sanjay Patel , CCP
Michael E. DeBakey VA Medical Center
Houston, Texas

William Cohn and **Daniel Timms**
BiVACOR, Inc.

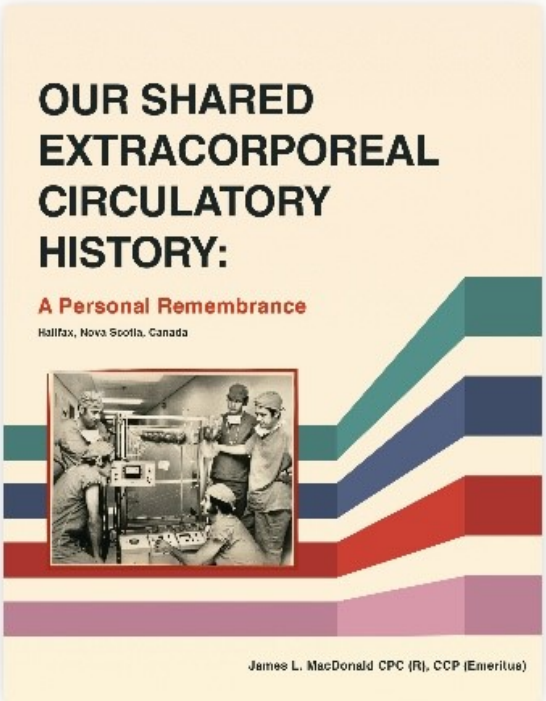
FIRST-IN-HUMAN EARLY FEASIBILITY STUDY OF BiVACOR TOTAL ARTIFICIAL HEART

Here we present the experience of In Human-Early-Feasibility study of a novel, magnetically levitated rotary BiVACOR Total Artificial Heart.

The BiVACOR Total Artificial Heart (BTAH) is designed to support both, pulmonary and systemic flow with a single, magnetically levitated rotor with double sided impellers.

On November 17, 2023, FDA approved BiVACOR TAH for Bridge To Transplant, Early Feasibility Study in the USA for an initial five patients, expandable to twenty total patients.

Between July 9, 2024 and November 1, 2024, a total of five patients were implanted with the BiVACOR TAH at various institutions in the USA. Patients were on BiVACOR support from 4 to 28 days before undergoing heart transplantation. Extubation times varied from postoperative day one to postoperative day four. All patients were discharged from hospital. A sixth patient in Australia was discharged home with BiVACOR support. At the time of this publication, he has been on BiVACOR support for more than 75 days.



Jim MacDonald, a retired Cardiovascular Perfusionist, provides a nostalgic look into his and other colleagues earlier era and ongoing cardiac experiences. The author makes specific references to the inaugural cooperation between the pioneering Cardiac Surgeon and the Heart Lung Technologist merging open heart surgery interface following the eagerly anticipated and historical introduction of the much awaited extracorporeal technological innovation, namely, that of the Heart Lung Machine!

Those interested should go to the Books app on your iPhone, tap Book Store or Audiobooks (which is free), to browse titles, or tap Search to look for a specific title, author, series, or publisher - tap the book cover to see more details, read a sample and read the publisher's description. Apple Books is an ebook reading and store application by Apple, Inc.

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† Medtronic usability data and design verification on file. Compared to Nautilus™ Smart technology.

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Michael Broadway, BS, RRT
Victoria Solimene, BS, BMS
Rush University Cardiovascular Perfusion Program
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Getting Vertical: The Surprising Benefits of Verticalization Therapy for VV-ECMO Patients - A Six-Year Retrospective Dive

With the increasing demand for veno-venous extracorporeal membrane oxygenation (VV ECMO) in the adult patient population since the H1N1 pandemic, clinicians worldwide continue to refine methodologies for treating the most clinically challenging patients with reversible respiratory pathologies. Likewise, acute respiratory distress syndrome (ARDS) has remained one of the most fatal respiratory disease processes in critical care medicine within the United States and worldwide, with mortality rates difficult to analyze, capturing varying ranges according to the degree of severity from 27%-45%1. Traditional methods of treatment for VV ECMO patients often include a chronological approach of lung rest, supportive measures, adjunctive therapy (pharmaceuticals, antibiotics, antivirals, steroids, etc), then weaning sweep while simultaneously increasing ventilator support as gas exchange, condition of the chest x-ray, and overall resolution of the indication for ECMO improve. It is inherent, however, that the most difficult cases may persist for weeks, if not months on a treatment modality that is intended to be used for short term unburdening of the native system. In such complex instances, periods of diuresis may result in acute kidney injury (AKI), necessitating continuous venovenous hemodialysis (CVVH), which significantly increases mortality rate–up to three times higher–for patients who did not require dialysis prior to admission2. With the rise to prominence of prone positioning, compelling evidence suggests that alterations in dorsal to ventral pulmonary blood flow improves morbidity and mortality outcomes in the ARDS patient population. When conventional methods of conducting the traditional chronology of a VV ECMO course fail, prone positioning is often considered along with other novel approaches such as dual oxygenator systems, the addition of stress dose steroids, renal replacement therapy (RRT), and inhaled nitric oxide (iNO). Alongside this, aggressive ventilator modes–under the influence of neuromuscular blockade–may be used to recruit the lung, ultimately resulting in diaphragmatic inhibition and atrophy which increases mortality3. Sparse literature presently exists on the quantifiable relationship between novel therapies such as verticalization and overall improvement of patient outcomes for the VV ECMO patient population.

In its inception, ECMO was a treatment modality used to improve survival outcomes for neonates suffering insult from clinical decompensation secondary to meconium aspiration syndrome (MAS), persistent pulmonary hypertension of the newborn (PPHN), sepsis, congenital diaphragmatic hernia (CDH), and other disease processes with tenuous treatment plans. Over the course of time survival rates for preterm infants rose across the board in part due to a constellation of improved care techniques including advanced screening tac-

About the Authors:

Michael is a current Rush University Perfusion student graduating in May 2025. He is a former Respiratory Therapist and ECMO Specialist. He would like to thank the faculty at Rush University, and the staff at Lurie Childrens, The Hospital of the University of Pennsylvania, and UH Harrington Heart and Vascular Institute for helping him get started on his perfusion journey.

Victoria is a current Rush University Perfusion student graduating in May 2025. She worked as an anesthesia technician before pursuing a career in perfusion. She would like to thank the faculty in the Rush University Cardiovascular Perfusion Program, as well as the staff at Northwestern Memorial Hospital, NewYork-Presbyterian Weill Cornell Medical Center, and Loyola University Medical Center for helping her navigate the world of perfusion as a student.

tics, high frequency oscillatory and jet ventilation (HFOV/HFJV), instillation of pulmonary surfactant, iNO, and surgical techniques. Conversely, adult ARDS has suffered a persistently high rate of mortality during this time1. Analysis of the rate of mortality prior to the institution of the Berlin Criteria in 2012 is unclear, as prior to this patients with disease processes that are no longer considered to meet the criteria of ARDS were likely included such as cardiogenic pulmonary edema and chronic respiratory failure. The Berlin Criteria outlined several important changes to the former classification system including the removal of acute lung injury from classification and replacing it with mild to moderate to severe ARDS. The relationship of pulmonary alveolar-arterial gradient was maintained, and PaO2 to FiO2 ratio (P/F Ratio) was also added. Alongside this, ARDS patients are required to meet a general series of four main presentations: 1) acute onset 2) P/F ratio ranging from <100 for severe ARDS, 100-200 for moderate ARDS, and 200-300 for mild ARDS 3) condition of the chest x-ray (CXR) including signs of diffuse bilateral opacification consistent with reticulogranular/honeycomb patterns, or more commonly referred to as 'white out' 4) non-cardiogenic origin.

Technology such as the Catalyst Kreg Bed allows patients who are cannulated for ECMO to be verticalized and safely placed into standing position for periods of time prior to attempts at ambulation. This improves safety by reducing susceptibility to femoral site hip flexion, orthostatic hypotension, and pressure ulcerations4. Verticalization therapy also allows for the restoration of pulmonary blood flow to the basilar segments for patients who cannot otherwise be proned, and may be a feasible alternative to proning difficult patients on VV ECMO4,5,6,7. During the COVID-19 Pandemic, several institutions reported success with their COVID VV ECMO patients by encouraging early extubation and mobility8,9,10. The 2021 Extracorporeal Life Support Organization (ELSO) guidelines however, stated that there was insufficient data to use "awake ECMO" as a guideline11. Rush University Medical Center (RUMC) instituted the use of the Catalyst Kreg Bed as a standard goal for their VV ECMO patients beginning in 2019 until the present. This can be compared to the years of 2016-2019 when the use of the Catalyst was less conformed. It can be theorized that a combination of early extubation and early mobilization may result in improved outcomes specific to survival to decannulation from ECMO, survival to discharge from hospital admission, and disposition at discharge. When branching clinical decision making, low cost, non-invasive interventions are often considered at the top of the hierarchy of early decisions.

While alternative strategies for optimizing mechanical ventilation on VV ECMO such as ultra-lung protective ventilation and 'lung casting' with APRV-TCAV exist, mechanical ventilation inherently incurs risk of ventilator associated pneumonia, diaphragmatic atrophy, and susceptibility for tracheostomy. Perhaps, aggressive liberation from the ventilator may help catalyze progression towards other restorative aspects of ICU recovery including physical and occupational therapy. Imagine the aesthetic of a patient with a completely opacified chest x-ray, walking around the ICU awake, oriented and speaking. While this may require higher sweep gas flow, potentially tandem oxygenator configuration,

and more liberal oxygenation/SvO2 thresholds, it seems as if this approach certainly beats a bedridden ECMO patient on heavy sedation for weeks on end. The resiliency of the awake and active patient may be an unquantifiable tool that we can use to our advantage while they are unburdened with ECMO support. Additionally, should the patient ultimately wind up being a candidate for bridge to lung transplantation, there is less ground to make up from a functional capacity standpoint if they are alert and able to participate in physical therapy (PT).

In 2020 a study by Marhong et al. found that over 90% of centers adhere to the practice of weaning ECMO off prior to liberation from the ventilator12. This means that the practices performed at RUMC are significantly in the statistical minority-despite boasting survival rates above the ELSO benchmark standard.

We aim to establish correlation between seven different variables (survival by overall percent to decannulation, survival by overall percentage to discharge, disposition at discharge, average days spent concurrently intubated and on VV ECMO support, average days spent until first verticalized, average days spent until in chair position, and average days until first ambulated with physical therapy) to determine if promoting awake ECMO, early extubation, verticalization, and aggressive physical therapy improves survival metrics in the patient population seen from 2016-2023 at RUMC. Our research team is currently analyzing the data for this project. We aim to present valuable findings that may inspire other institutions to take similar initiatives.

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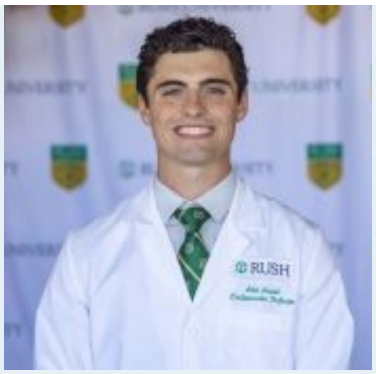

Luke Juricek
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Luke is a 2nd year cardiovascular perfusion student graduating from Rush University this summer. He attended Lewis University where he graduated with a bachelor's degree in biology and will be joining University of Chicago as a perfusionist in June.

Mannitol Administration in the Cardiac Patient; Do the Kidneys Appreciate It?

Patients undergoing cardiopulmonary bypass are subject to a diverse array of physiological changes and challenges, from things like dilution, lack of pulsatile flow, systemic immune responses, adequacy of perfusion, complex physiological states, and much more. One of the most common diagnosable insults to patients undergoing cardiopulmonary bypass is the occurrence of acute kidney injury (AKI).[1] Due to the kidney's high sensitivity to oxygen delivery and blood flow, the development of acute kidney injury is fairly common in patients undergoing cardiopulmonary bypass, with occurrence in up to 30% of patients.[2]

The occurrence of AKI is detrimental and poses a challenge to patients and their post-operative recovery, with patients experiencing renal insult seeing an acute rise in mortality.[3] Therefore, the development of strategies to mitigate the occurrence of AKI is a topic that is often discussed and these strategies are utilized daily to protect the patient's kidneys. One of those strategies that is commonly employed is the use of diuretics during the bypass run to promote diuresis and facilitate kidney function. A common diuretic used for this purpose is mannitol.

The theory behind diuretic use is sound. Mannitol is frequently utilized as an osmotic diuretic and free radical scavenger.[4] By increasing the osmotic pressure of fluid in the renal tubules, free water excretion is increased.[5] Additionally, mannitol was shown to cause a redistribution of systemic blood flow to renal blood flow while maintaining perfusion to filtration ratios and oxygen demand.[6] Animal studies have shown that mannitol can maintain glomerular filtration rates through a mechanism related to a reduction in renal tubule swelling, through the increased intratubular osmotic pressures. Reducing renal tubule swelling will consequently reduce the obstruction of the renal tubules.[7]

However, the evidence towards intra-operative mannitol use has been contradictory, with more research needed on patients at high risk of acute kidney injury.[2] As of today, mannitol is not considered an evidence-based intervention by the Society of Thoracic Surgeons.

There exists a degree of variability in mannitol usage across institutions, with some avoiding administration altogether, while others administer it routinely. With the lack of support in the literature and the STS not deeming the practice as evidence-based, more literature is required to determine whether mannitol administration may actually be detrimental to the cardiac patient's renal function.

We are currently in the data analysis phase of a retrospective cohort study of patients who received mannitol intraoperatively, with the primary outcome being the occurrence of AKI according to the RIFLE-AKIN criteria. It is hoped that the data we have collected will clarify some of the conflicting literature and help standardize the utilization of mannitol as renal-protective diuretic used on cardiopulmonary bypass.

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Thank You

The Academy would like to thank the members of the Program Committee, Fireside Chat Committee and their collaboration with the Simulation Committee, the Membership Committee, especially Tom Klein for all of the work he has done for the new database, the Student Liaison Committee, and all of the Past Presidents who offered their support, for making 2024 a successful year.

We would like to especially thank Tami Rosenthal who is rotating off of Council this year after many years of leadership and service.

Chandler Clifton, Ashton Warlick, and Thuc Trinh
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Enhancing Perfusion Education: The Role of Chatbots in Simulation-Based Training

The integration of artificial intelligence (AI) in medical education is rapidly transforming how students acquire knowledge, develop skills, and prepare for complex clinical scenarios. The specialty of cardiovascular perfusion has shown to be a field that requires precise decision-making, technical expertise, and rapid problem-solving capabilities that can have a major impact on the outcome of cardiovascular care. This has led to the implementation of simulation-based training, which has developed into the cornerstone of perfusion education. This not only allows students to implement their didactic training but offers students an opportunity to refine their skills in a controlled, risk-free environment.

The research we conducted introduced a chatbot, we call PerfusionPal, which was designed to simulate AI assistance as an adjunct tool in perfusion simulation training. This research aimed to determine whether integrating AI assistance into simulation-based learning could enhance student performance, improve efficiency, and foster better decision-making. With the increasing adoption of AI in various aspects of healthcare, understanding its role in perfusion training deems critical for future curriculum development.

Artificial intelligence is being increasingly utilized in healthcare education to support learners in various capacities. AI-driven chatbots can provide instant feedback, offer evidence-based recommendations, and guide users through complex problem-solving exercises. A study by Banerjee et al. (2021) revealed that 58% of physicians believe AI has a positive impact on clinical training, emphasizing its potential to enhance learning experiences. Similarly, AI has been incorporated into surgical education, nursing simulations, and even diagnostics, demonstrating promising results. Despite these advancements, its application in perfusion education remains largely unexplored, creating an opportunity to investigate its effectiveness in simulation-based training. This opened the door for our study, which was designed as a pilot randomized controlled trial involving 21 first-year students enrolled in the Cardiovascular Perfusion Master's Program at Rush University. Participants were randomly assigned to either an experimental group that had access to PerfusionPal during simulations or a control group that completed simulations without the chatbot assistance.

This study aimed to measure three key outcomes¾assessment scores, completion time, and reservoir checks. The primary outcome we evaluated was comparing a pre and post-assessment score that evaluated knowledge based acquisition during the duration of our simulations. The secondary outcome looked to evaluate the efficiency of simulation training by comparing completion times for both the experimental and control groups. While also comparing the frequency of reservoir checks as a secondary out-

come to determine if there was any impact on practice adherence and if the use of a chatbot produced any attentional deficits

Two distinct perfusion scenarios were created to assess the impact of AI on student performance. During the first simulation students were required to diagnose and resolve high arterial line pressure, a common perfusion-related issue. This scenario tested their ability to recognize signs of obstruction, investigate possible causes, and communicate their findings effectively. In the second scenario, students had to identify and address inadequate ACT levels caused by antithrombin III (ATIII) deficiency. The exercise emphasized the importance of anticoagulation management and decision-making under pressure.

Data was collected before, during, and after the simulations through pre- and post-assessments, observational tracking, and survey responses. These assessments were designed to measure both theoretical knowledge and practical application skills. Statistical analyses was conducted to compare performance metrics between the control and experimental groups. Baseline data, including demographic information, prior healthcare experience, and familiarity with AI technology, were also analyzed to account for potential confounding variables.

While data analysis is still be conducted to determine the viability of our research, we believe the use of AI-driven assistance in perfusion simulation has the potential to revolutionize training by enhancing decision-making skills, reduce cognitive overload, improve outcome efficiency, and reinforce key concepts by offering immediate feedback boosting overall learners' confidence and readiness for real-world scenarios.2 If our research is proven effective, AI integration could be expanded to include personalized learning pathways tailored to individual student progress. Potentially even adaptive simulation scenarios that adjust difficulty based on learner performance to really focus on progressive growth and quality training.

As the medical field continues to evolve, it is crucial to embrace technological advancements that enhance education and patient safety. The landscape of perfusion education is undergoing a transformation, driven by advances in AI and simulation-based learning. This study represents an important step toward understanding how AI can complement traditional training methods. By leveraging AI chatbots to provide real-time feedback and guidance, we can better prepare the next generation of perfusionists for the challenges of modern clinical practice.

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About the Authors:

Chandler, Ashton, and Thuc are second-year perfusion student at Rush University, set to graduate in May 2025 with a Master's in Cardiovascular Perfusion. All very passionate about enhancing clinical outcomes and perfusion education, they are hoping to continue implementing this post-graduation as they begin their careers in perfusion. Chandler, Ashton, and Thuc are all excited to contribute to the evolving landscape of cardiovascular care and strive to make an impact not only for their patients, but for the teams they will be joining.

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MEMBERSHIP DEADLINE	**December 3, 2025**
PRE-REGISTRATION	**January 10, 2026**
HOTEL REGISTRATION	**January 10, 2026**
2025 ANNUAL MEETING	**February 4-7, 2026**

Welcome to New Members

The American Academy of Cardiovascular Perfusion would like to welcome the following individuals into membership in The Academy.

Fellow Member
Katherine Gray DeAngelis
Amy Ging
Mark Martin
William Nicotra

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Bezaire, Jennifer
Buel, Shane
Capone, Chelsea
Cooper , Nolan
Detweiler, Annie
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Hall, Rory
Johnson, Sarah
Jones, Elisabeth
Jones, Rachel
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Kelly, Dannielle
Kramer, Amy
Lagorio, Christy
Lung, Kara
Matyasovsky, Karen
McGil, Kimberle
Milestone, Kalli
Miller, Randy
Motazedi, Mina
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Parker, Anita
Plaxco, Liam
Porembski, Jennifer
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Richards, Grant
Sharpe-Friend, Meghann
Staunton, Sharon
Thompson, Sarah
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Varner, Caleb
Voitik, Alexis
Williamson, Kelly

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Riedy, Andrew
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Torres, Nancy
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Vannice, Michael
Vasquez, Angela
Viana, Taylor
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Walny, Madison
Wu, Timothy
Yeatts, Jordan

Awards Committee Selects Winning Student Paper Presentations

Anne Krueger

Daniel Spencer

Brittney Waters

Six students received awards for their paper presentations at the Annual Seminar in Denver.

2025 – Jeffrey B. Riley Best Student Paper Presentation Award ($1000)
Anne Krueger - Exploring Cell Free DNA As A Biomarker For Evaluating Cardioplegia Efficacy In Cardiac Surgery

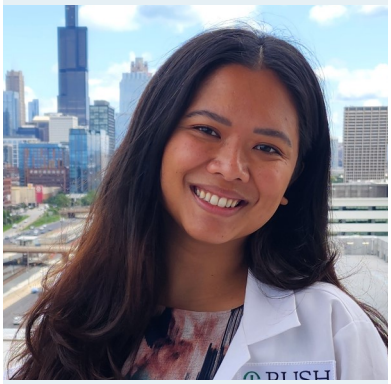
2025 – Richard Adams Student Paper Presentation Award ($500)
Daniel Spencer - Efficacy Of Video Visual Aids In Conjunction With Lecture And Laboratory Didactic Courses For Perfusion Students

2025 – Aaron G. Hill Student Paper Presentation Award ($500)
Brittney Waters - County-Level Distribution Of Extracorporeal Membrane Oxygenation In South Carolina

2025 - Lawrence Awards ($500)
Camille Dang - Relationship Between Number Of Days Primed And Efficiency Of Oxygenators: A Pre-Experimental Study

Ethan Forsberg - Postoperative Hemoglobin Changes Following Ultrafiltration In Cardiac Patients

Nicholas Ownbey - Pressure Drop Across Common Left Ventricle Vent Catheters



Camille Dang

Ethan Forsberg

Nicholas Ownbey

2026 Annual Meeting

St. Petersburg, Florida
February 4-7, 2025

Our Host Hotel

Hilton St. Petersburg Bayfront
333 1st Street S St. Petersburg FL 33701

Reservations: 1-800-HILTONS
(1-800-445-8667)

Single/Double Occupancy: $245.00

Remember to mention that you will be attending the Annual Conference of The American Academy of Cardiovascular Perfusion (AACP).

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