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OF
CARDIOVASCULAR PERFUSION
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Fall 2025

The Academy Newsletter

Message from the AACP President

"Autumn is a second spring when every leaf is a flower."
Albert Camus

It has become that time of year when we brush the sand off our toes and trade those summer activities in for fall festivities that include back to school traditions, taking a walk through the forest among the brilliantly colored foliage, deciding on that fun Halloween costume, enjoying the get together for a sporting event and eventually all that is involved with Thanksgiving. Albert Camus's words above are beautiful but also pay homage to the concept that the fall season is a time for renewal of knowledge and a time to learn. Let's allow this fall season to be that for our newly appointed perfusion education students, recent graduates that are studying for their board certifications, associates that are learning new clinical skills and our esteemed senior perfusionists perfecting their craft. Each one of us needs to embrace the continuation of learning and strive to become better clinicians than we were the previous day.

As the fall season moves forward, we will learn more from perfusion science research published in our professional journals, obtain recently introduced innovative technologies from our industry partners and grasp advanced practice techniques acquired from our colleagues. Each of these examples are in the effort to improve care for our patients. This continuation of learning is exactly what Albert Camus was hoping to evoke from his quote.

Many of you are performing novel research studies, investigating areas of perfusion science and others that have developed nov-

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el techniques that improve our clinical practice. This is the perfect time to think about where you could share your newly acquired perfusion science knowledge or learn from your esteemed colleagues. The AACP Annual Meeting would be a great opportunity to share your information and experiences along with acquiring more information regarding particular topics in our profession.

The 2026 AACP Annual Meeting will be held in warm, sunny and nautical St. Petersburg, FL, February 4th-7th. This meeting will be held at the Hilton Bayfront, which is in the picturesque marina area of Old St. Pete. There are beautiful views of the waterfront, walking areas filled with restaurants, shopping and entertainment. The world-renowned Salvatore Dali Museum is located across from the hotel, it is a short trip to the beach and there is so much more to enjoy!

The meeting will include special sessions concentrating on: (1) thought provoking debates (2) adult congenital single ventricle with concentration on learning about how different disciplines will handle this patient population (3) industry session that sheds light on the domestic and global economic world of supply and demand, research and development and the future outlook with each company (4) innovative concepts concentrating on pediatric practice with groundbreaking translational research. Our Reed Lecture will be from a decorated armed forces veteran that will provide an inspirational speech regarding his experiences in the military that will encourage you in your professional career and personal life. There will be thought provoking fireside chats along with advanced perfusion science presentations in our scientific paper sessions. The call for scientific abstracts has been given, please submit your abstract for the chance to be selected and present in front of an esteemed audience. All abstracts will be peer reviewed for publication in Perfusion.

I hope each of you enjoy this fall season with your friends and family. We look forward to seeing all our colleagues and industry partners at our annual meeting in St. Petersburg, FL this winter!

Richard W. Melchior , MPS, CCP, FPP, FACCP
AACP President

Call For Abstracts

The deadline for abstract submission for the 47th Annual Seminar of the AACP is **October 15th, 2025**. Please submit your abstract to office@theAACP.com using the Abstract Submission Form available on the AACP website.

Lauren Duva
Master of Science in Cardiovascular Perfusion Program

Institute of Emerging Health Professions

Thomas Jefferson University
Philadelphia, Pennsylvania

Lauren Duva is a cardiovascular perfusion student at Thomas Jefferson University, graduating in May 2026. Her passion for perfusion was sparked by two close friends who are practicing perfusionists, and after observing open-heart surgeries firsthand, she was captivated by the precision, responsibility, and impact of the role. She presently have 115 cardiopulmonary bypass cases completed toward my program's 150-case requirement, and a personal goal of exceeding 200 cases before graduation.

Lauren holds a Bachelor of Science in Nursing from Neumann University, which she earned a year early while working full-time at Penn Medicine. Her nursing experience in high-risk obstetrics, maternal/child health, and hospital-based case manage-

Case Report: Coronary Artery Bypass Grafting in a Patient with Alpha-Gal Syndrome Using Bivalirudin Anticoagulation

Introduction

Alpha-gal syndrome (AGS) is an IgE-mediated allergic reaction to galactose α-1,3-galactose (alpha-gal), a carbohydrate found in all mammals except primates and humans. Because humans lack this molecule, exposure, most commonly through bites from the lone star tick (*Amblyomma americanum*), triggers sensitization and the development of alpha-gal specific IgE antibodies. Clinically, AGS manifests as delayed allergic reactions, typically 2 to 6 hours after eating red meats such as beef, pork, or lamb, with symptoms ranging from gastrointestinal distress to urticaria, angioedema, or anaphylaxis (Marchant & Vickery, 2024). Additional reviews on AGS outline perioperative considerations and clinical presentation (Leder et al., 2024; Shishido & Wormser, 2025).

AGS is an emerging public health concern in the United States. The Centers for Disease Control and Prevention (CDC) estimates that up to 450,000 Americans may have been affected between 2010 and 2022, though only about 110,000 suspected cases were confirmed through testing during that period (CDC, 2023). While fewer than a dozen cases were documented in 2009, by 2018 more than 34,000 suspected cases had been identified through commercial alpha-gal IgE testing (Binder et al., 2023). Awareness among healthcare providers remains limited; a 2022 CDC and Alpha-Gal Syndrome Coalition survey found that 42% of providers were unaware of AGS, and 35% lacked confidence diagnosing or managing it (Bayles et al., 2023). Clinical presentations vary, with 60–75% of patients experiencing anaphylaxis, 30–40% exhibiting cardiac symptoms, and about 20% presenting solely with gastrointestinal symptoms (Bayles et al., 2023). Given the widespread use of mammalian-derived products in cardiac surgery, namely bioprosthetic valves and unfractionated heparin, perioperative management of patients with AGS presents unique challenges. (Rinehart et al., 2025) This case describes a successful coronary artery bypass grafting (CABG) procedure in a patient with AGS utilizing bivalrudin (Angiomax), a direct thrombin inhibitor (DTI).

Case Description

A 66-year-old male with a history of multivessel coronary artery disease (CAD), hypertension, hyperlipidemia, and Alpha-gal syn-

ment has provided a strong foundation in patient care and adaptability, which are skills she now applies in the cardiac operating room.

Lauren lives in Moorestown, NJ, with her husband and three young daughters, ages 6, 5, and 3. Although balancing family and school is challenging, she is motivated by the example she sets for her children and her commitment to contributing meaningfully to patient outcomes.

Lauren looks forward to the continued development of her clinical skills and progressing into a capable and valuable member of the cardiac surgical team and the perfusion field.

drome presented with non–ST-elevation myocardial infarction (NSTEMI). He had undergone prior percutaneous coronary interventions with stenting. Coronary angiography revealed severe multivessel disease. Echocardiogram showed preserved left ventricular ejection fraction (EF 55–60%) with normal right ventricular function. Surgical revascularization was recommended.

The patient reported a known diagnosis of AGS, confirmed by clinical history and symptomology, involving profound urticarial rash and joint pain several hours after ingesting mammalian meat products. Given his allergic response to mammalian-derived substances, standard use of porcine- or bovine-sourced heparin was contraindicated.

Preoperative Considerations

Due to the patient's diagnosis of Alpha-gal syndrome, a collaborative multidisciplinary decision was made by the surgical team to use bivalirudin (Angiomax) for intraoperative anticoagulation. Bivalirudin was selected over other direct thrombin inhibitors (DTIs) because of its relatively short half-life of approximately 25 minutes. Bivalirudin is a synthetic direct thrombin inhibitor that acts independently of antithrombin III (AT-III) and is free of mammalian components, making it suitable for patients with Alpha-Gal Syndrome. It binds both circulating and clot-bound thrombin and has no platelet activation, with some platelet-inhibitory effects. Bivalirudin is primarily metabolized by circulating proteases (80%), with minimal renal excretion (20%), and its short half-life make it a safe and effective heparin alternative in AGS patients undergoing cardiac surgery (Virtua, 2020). Per institutional protocol, suction was to be diverted to the cell salvage system for autotransfusion with acid citrate dextrose (ACD), an anticoagulant used in lieu of heparin. ACD functions by chelation with calcium, interrupting the coagulation cascade and therefore inhibiting clot formation (Erdoes et al., 2022).

Operative Details

The patient underwent coronary artery bypass grafting (CABG) × 3. Perioperative vascular access included a left radial arterial line and a right internal jugular central line; a Swan-Ganz catheter was not placed. Following induction of general anesthesia, patient was prepped and draped in normal sterile fashion. A standard median sternotomy was performed, the left internal mammary artery was freed from the chest wall while the the right great saphenous vein was harvested endoscopically from the right leg for grafting. Institutional protocol for cardiopulmonary bypass using bivalrudin anticoagulation was implemented, which required maintaining an activated clotting time (ACT) greater than 2.5 times patient baseline. Baseline ACT was 141 seconds, and an initial post-bolus ACT of 435 seconds was achieved. Central arterial cannulation was performed

using a 20 Fr Medtronic EOPA cannula, and venous drainage was established with a 29/37 Fr AViD dual-stage cannula (Edwards Lifesciences). Following post-bolus ACT and just prior to the initiation of cardiopulmonary bypass, a dose of 50 mg of bivalirudin was added to the non-heparin coated CPB circuit primed with 1500 mL Plasmalyte, along with 12.5 g mannitol, and 12.5 g albumin. Bypass was initiated without incident, and the aorta was cross-clamped. A 1:4 solution of cardioplegia was used to induce cardiac arrest, with blood flushed from CPG lines both pre and post-dosing. For the duration of bypass, a bivalrudin maintenance infusion was maintained at a rate of 2.5 mg/kg/hr, with titration in 0.25 mg/kg/hr increments to maintain therapeutic ACT levels as needed. ACT monitoring was performed every 15 minutes throughout CPB, along with arterial blood gases (ABG) every 30 minutes. The arterial filter purge line connected to a filtered port of the cardiotomy remained open throughout CPB to ensure continuous flow through the reservoir. All clamped lines in the circuit were flushed every 10 minutes to prevent stagnation. Suctioned blood was diverted to the cell salvage system anticoagulated with ACD, with care taken to avoid pooling of blood in the chest. The left internal mammary artery (LIMA) was grafted to the left anterior descending artery (LAD), and saphenous vein grafts (SVGs) were placed to the obtuse marginal (OM) and posterior descending artery (PDA). Fifteen minutes prior to termination of CPB, the bivalirudin drip was stopped per protocol. Cardioplegia and bypass circuits continued to be flushed appropriately. Close monitoring of ACTs continued. Cardiopulmonary bypass (CPB) time was 85 minutes, and aortic cross-clamp time was 69 minutes. Bypass was terminated with no adverse outcomes present.

Following the termination of bypass, the autotransfusion collection bag containing 85 mL of PRBCs was noted to be clotted off at the tubing connection where filling occurs. A decision was made by the operative team to discard. At this time anesthesia administered 2 units of fresh frozen plasma (FFP), 2 units of packed red blood cells (PRBCs), and 1 unit of platelets from anesthesia. Desmopressin was administered to support hemostasis. Three chest tubes were placed by surgical team—two mediastinal drains Y-connected and one in the left pleural space. Temporary ventricular pacing wires were positioned.

This meticulous interdisciplinary approach to anticoagulation and circuit management allowed for successful conduct of CPB without thrombotic complications related to the Alpha-gal–driven avoidance of heparin.

Postoperative Course

The patient was transferred to the ICU in stable condition and was extubated on POD 1, with an uneventful postoperative course. A follow-up transthoracic echocardiogram demonstrated a preserved left ventricular ejection fraction of 55–60%, normal right ventricular function, and patent coronary bypass grafts. The patient recovered without complication and

was discharged home in stable condition on POD 5.

Discussion

This case highlights the successful use of bivalirudin as an alternative to heparin for anticoagulation during cardiac surgery in a patient with alpha-gal syndrome (AGS). As AGS becomes increasingly recognized, it presents important implications for perioperative care, particularly due to the presence of alpha-gal residues in commonly used bioprosthetic valves and heparin. In a retrospective review of more than 8,800 cardiac surgery patients, Hawkins et al. (2021) identified 17 individuals with confirmed alpha-gal IgE sensitivity. Of those, four (24%) experienced severe allergic reactions following high-dose intravenous heparin administration prior to cardiopulmonary bypass, suggesting that even purified heparin may retain residual alpha-gal or trigger cross-reactivity in sensitized individuals.

This case also adds to institutional experience with bivalirudin. Within one month, three patients—one with AGS, and two others with heparin allergy or HIT—underwent CPB using bivalirudin. While no CPB or patient-related complications occurred, two cases encountered clotting in the cell salvage system despite using non-heparin anticoagulants and maintaining therapeutic ACTs. This likely reflects stagnation in processed blood lacking residual bivalirudin. Recommended protocol revisions include disabling auto-start features in the cell salvage and minimizing time from processing to reinfusion. In the third case, the team avoided autotransfusion altogether due to minimal blood loss.

Conclusion

As the prevalence of tick-borne illness and AGS rise, preoperative identification and tailored anticoagulation strategies are critical for cardiac surgery. This case illustrates that CABG with bivalirudin anticoagulation is feasible and safe in AGS/heparin contraindicated patients when institutional protocols are rigorously followed. Further research and procedural standardization are needed to optimize outcomes and manage intraoperative complications related to bivalirudin use.

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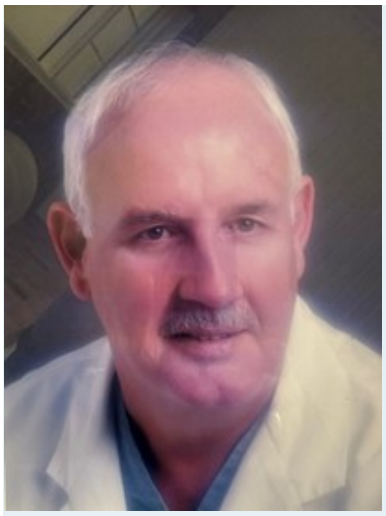
Live Webcast of the AACP Conference

The AACP will be offering a Live Webcast of the 2026 Annual Seminar in St. Petersburg, FL.

Virtual attendees will be able to stream all of the General Sessions, as well as have two virtual Fireside Chats each day, exclusively for virtual attendees, ensuring qualification for Category I CEUs.

Virtual attendees will have the opportunity to again ask questions of the moderators,



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Reflections Within One's Rear View Mirror

How might one attempt to revisit a previous extracorporeal circulation (ECC) related mishap - particularly one that might still echo into the present day of my fellow Cardiovascular Perfusionist colleagues? Perhaps the best approach might well be to provide yourself, the reader, with what I would consider to be, an informative, extracorporeal related historical background, leading up to the explanation of this singular perfusion related mishap?

As one might readily understand, there is little, to no reason, to venture back into any ones personal extracorporeal history, less you should find, that tidbit golden nugget of clinical reality - one that just might serve to influence you, the readers, daily extracorporeal reality? That said, within the last several decades, there have been many occasions whereupon I had cautioned our Perfusion students in regards the realization of the ever present potential for several specific Cardiopulmonary Bypass (CPB) related incidents, i.e, the much earlier era realization of the "necessity" for emergent extracorporeal oxygenator change out (1)! As such, clinical recognizable signs of, possible oxygenator failure, was to be reviewed in many such a student interaction! I was to learn, early on within my career, the essential ingredient in capturing the attention of students, was to always, "speak to the student and never at them"! Clinical related experience is of little value, to others, if not effectively shared! That said, the genesis of what I had often referred to as my "fickle finger of fate" (FFOF) scenario, would have to do with my personal premonition, that on a certain day and, at a certain time, as a practicing Perfusionist, the FFOF would make its, unannounced and most unwelcome visit, within the clinical domain of my personal CPB procedure! Within that reality, I believe it important to set the stage in my providing, you the reader, a "reflection in my personal rear view mirror" leading up to MY, most unwanted, 1980s, FFOF, VISIT (😳!)

Setting The Stage: in the early 1980s, the COBE Membrane Lung (CML), eventually referred to in this sited incident, had become the selective oxygenator, of choice, in our UH adult extracorporeal practice. Years prior to the clinical introduction of the CML, I would remember my much earlier era clinical interface utilizing the first generation of the Galen/COBE OptiFlo Bubble Oxygenator, one of the first of its kind, hard shell Bubble Oxygenator with its "newly incorporated cardiotomy reservoir and heat exchanger" (👍)! The Galen OptiFlo, so named after the Greek Physician, Galen, was the first commercially hard shell bubbler type oxygenator having been introduced, by COBE Cardiovascular, in the mid 1970s. Similar to many centers within North American, we had entered a period of trialing several newer commercially available "bubbler" generation firstly, within the Dalhousie University Research Lab, followed by the clinical interface, of several, within our Victoria General Hospital, Halifax, Nova Scotia, adult open heart surgery!

Yours truly, and several of my American Perfusion colleagues, had been invited by COBE Cardiovascular, Lakewood, Colorado, to lend our hand in their initial CML design prior to the release of their new "easy to prime", flat plate parallel open oxygenator design. As was anticipated, the introduction of the CML, into the extracorporeal armamentarium of our adult clinical cases, had resulted in the sought after, "persistent and predictable clinically results (😁)"!Within that realization, the new CML oxygenator design was to become the initial work horse for many adult cardiac centres within this 1980s era, as it was, within UH (👏). For the readers interest, many of these earlier era oxygenators, such as several earlier "bubblers" as well as membrane oxygenator iterations, would be historically documented within the AACP Newsletter by my friend, and colleague, Kelly Hedlund (2). Without question, we were to live through evolutionary times, within our daily CPB extracorporeal membrane oxygenator interface reality, within both North America as well as elsewhere, within the extracorporeal world! As was reflected in the 1964 song, by Bob Dylan, "for the times, they were a- changin".

With that tidbit of extracorporeal history having been recalled, the technological extracorporeal (🙀) would continued to tick on in our pursuit of the ever evolving, let us say, "simpler open membrane design iterations", of the future day. In that vein, in and about 1983, we would next make our clinical decision to move, as you might have guessed, to the newer CML open ECC interface with its incorporated newer COBE Stockert modular roller pump configuration, shown in the below photo during its actual clinical interface, within the clinical domain of UH, London, Ontario.

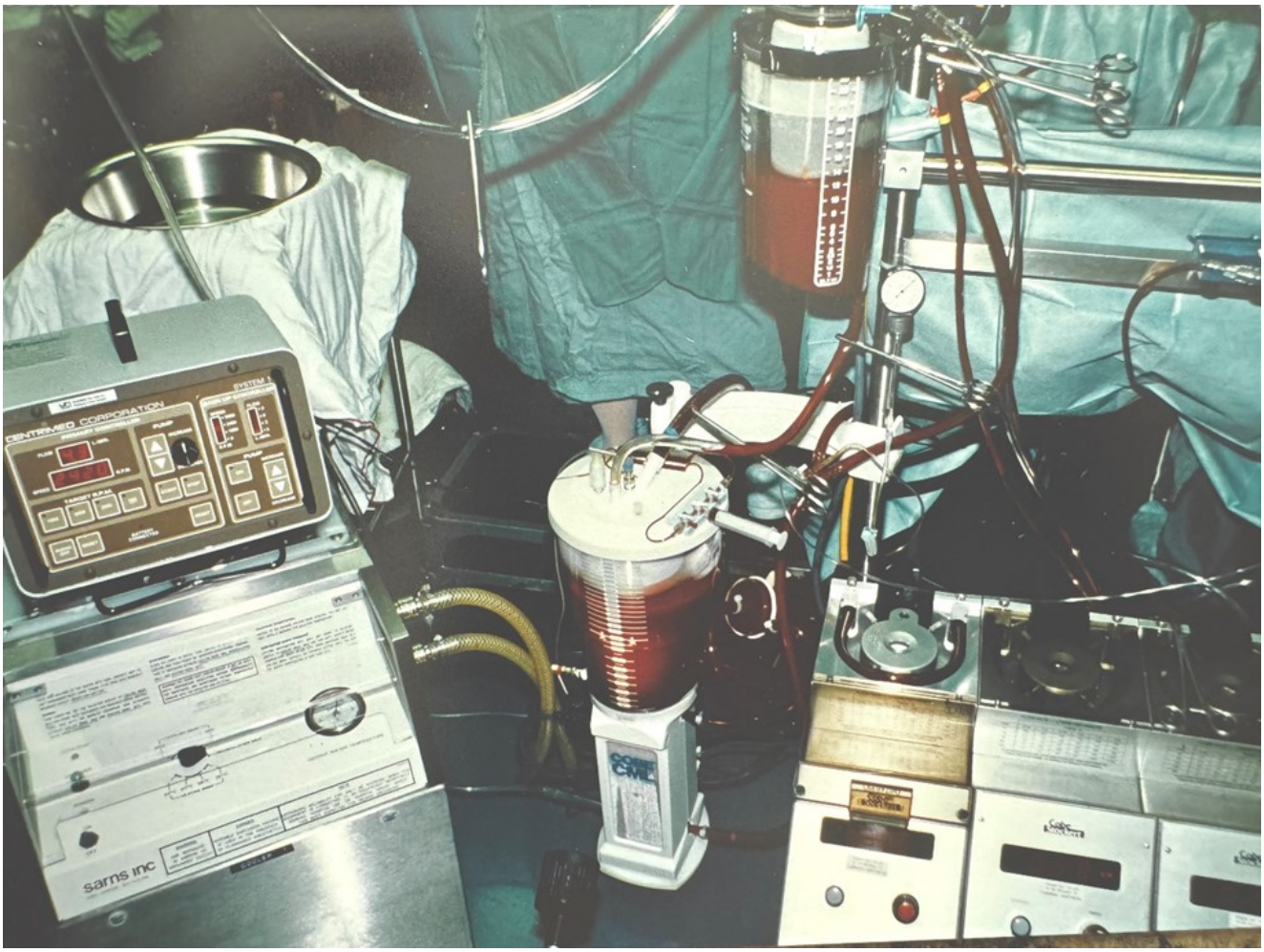

Figure 1. The CML, center, and the COBE Modular HLM shown with the Bentley Cardiotomy Reservoir.

*Figures 2 and 3. The CML interface with its Venous Reservoir and, of interest, the first Canadian use of the Sarns Centrimed System 1-48 ml Centrifugal Venous Pump head shown being used with its Centrimed Control Module positioned upon the Sarns Heater Cooler Unit - **the Sarns heater cooler had removed our "dependency on stationary wall water mounting" and would, now allow, open heart surgery to be performed, in ANY adjacent OR, during cardiac emergencies👍.*

Our CPB technology was still evolving! There were soon to be, other extracorporeal related concerns on the horizon in association with our, so called, routine CPB interface reality! In the 1980s, CPB incident reporting, was to provide the Perfusionists pertinent, essential and relevant incident reporting information, albeit, just around the timing of our imminent, FFOF, "VISIT" (😖)!

CPB Incident Reporting: we had entered a new extracorporeal arena which would necessitate the more physiological and clinically dependable, membrane oxygenator, type interface. Within Halifax, the bubble type oxygenator would eventually, be replaced by several, even earlier iterations, of initial membrane oxygenator designs, such as the Lande-Edward, the Kolobow Spiral Coil, in and around 1972. Within our specific clinical reality of the early 1980s, as was also true of others, our ever evolving extracorporeal armamentarium had become, anything, but static! These newer membrane oxygenator designs, such as the CML, were to play their contributing clinical role as would the initial investigation in regards the recognition of the newly associated wording, pathophysiology of CPB! In addition, we had now entered the era of a "new educational tool" in respect the recognition, occurrence and reporting of several CPB related incidents! These newer membrane technologies, among other important considerations, would focus on the continued attempt in respect to the reduction in both static priming volumes and, as importantly, its accompanying, reduction in donor blood usage given the era of non-hemic priming, within modern day cardiac surgery(3). These newer extracorporeal membrane oxygenator interface, with there incorporated "dependability, ease of use" were to also witnessed reported perfusion related safety factors by way of incidents having occurred during routine CPB (😧)! As importantly, these clinical incident interface realities would be reported, within our 1980s Perfusion related journals of the day, by well noted investigative Cardiovascular Perfusionists, such as Palanzo, Mills, Stofer, Kurusz, Miller, et al., all of whom, would not only report CPB related incidents but, as importantly, had also made suggestions in reference to, how best to recognize and to resolve, any such extracorporeal related incidents (4,5,6,7,8,9)! On a personal note, I would define the relationship between a CPB related incident and an accident, in that they both, while having the potential for negative patient injury, would result in only one being successfully, avoided, or NOT! These crucial incident reports, were representative of "the canary in the coal mine" and, as such, had resulted in emergency protocols being presented and published at regional, as well as, national Perfusion meetings, i.e, the AACP, AmSECT and our Canadian, CSCP! As such they would specifically focus on the cause, prevention and the resolution of many associated CPB related incidents, having occurred, during routine open-heart surgery (😖)! These informative surveys would encourage Perfusion Departments, to adopt appropriate protocols (methods to recognize and to prevent these serious CPB concerns) which would selectively focus on the diagnosis and the primary cause of perfusion related incidents, errors, mishaps, accidents, misadventures, etc., whatever might be your choice of specific wording!! As importantly, was the suggestion that human error could, would and did play, its participatory role, in several such observed, CPB related misadventure! As a result, Quality Assurance Manuals were, next, to be considered a must, on every Perfusion Departments shelf! With that stated, for many years, I had offered our students, my personal abbreviated definition of what I had thought Quality Assurance to simply be, that is, "to do the right thing, right, the first time" - a kind of self taught repetition so it would become second hand nature, to always, do it correctly, the first time (👍)! That said, I would encourage the reader to review the "James Reason's Swiss Cheese Model" which describes a difficult but precise pathway towards human error as "an unintentional act being divided into three different categories, slips, lapses and mistakes" with all these acts leading towards the specific occurrence, of a CPB related hazards or mishap (10)! After all, was it not on its way to, eventually VISIT, yours truly(😖)!

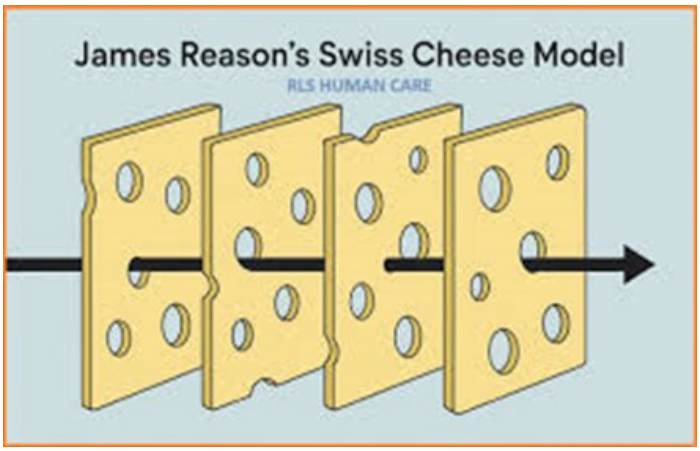

Figure 4. As applied to CPB accidents, the above model views safety systems as a series of barriers, each with potential weaknesses (holes), represented by slices of Swiss cheese. Should these weaknesses align, in a straight line, an accident "WILL OCCUR")!

Over these several past decades, I had personally given thought, to the following consideration, "would CPB fail the human or would the human fail CPB? As an observation, the folly of CPB related human error would seem not to be shared, as much, within our present Perfusion related literature! That might be the positive educational influences, in reference to the published CPB related incidents, having been provided us by our previously mentioned Perfusionists colleagues (👏)! Of equally important consideration would be "the agreed upon approach, by the informed open heart team", in respect to a TEAM discussion towards an organized resolution" to ANY such singular life threatening CPB patient related concern! With this very important historical safety background having been provided let us touch on, just one other very important CPB clinically related reality, that being, the initial and ongoing necessity for extracorporeal systemic hypothermia. SIDE BAR: this very essential clinical reality, would eventually, "impact our personal critical clinical decision making interaction", that is, pending our personal FFOF, unscheduled, "VISIT"!

Systemic Hypothermia: given the initial era integration (marriage) of both open heart surgery and CPB, within the early 1950s, surface hypothermia was to provide its, more than important, historical background contribution and direct linkage to the clinical introduction of systemic extracorporeal core cooling, by way of the HLM (👍)! During the mid to late 1960s, it is certainly on point to say, open heart centers had adopted, the clinical necessity for routine extracorporeal systemic core cooling, in ALL open heart patients, to 28 degree C, regardless of the specific cardiac surgical case scenario, albeit to reduce the patients overall systemic metabolic demand by 6% per degree, drop! You can do the math (😉). Profound hypothermia, with and without circulatory arrest, was to be used ONLY on the occasional, more difficult, open heart surgical procedures, given this initial era. Out of historical respect, no mention of hypothermia could be sited without special historical recognition, of both Dr. William (Bill) Bigelow, of Toronto, Canada (11) (one of my oral examiners) as well as to Sir Brian Barrett- Boyes, of New Zealand! Their initial surface hypothermia historical contributions would prove "pivotal" in regards its associated clinical necessity "for both neurological as well as myocardial protectiveness", now being afforded the open heart patient, specifically, during this introductory era of both CPB and open heart surgery! The reader is respectfully reminded, that during this much earlier introductory era, the prototype HLM of that day, had incorporated "non disposable" stainless steel Mayo Gibbon Vertical Screen and the Kay Cross Rotating Disc type Film Oxygenators (the latter which I had trained on), during this historical but evolutionary era! Systemic core cooling would continue to be "the so necessary extracorporeal safety adjunct" and would remain so to this very day! SIDE BAR: of clinical interest, towards the mid 1990s, UH would not always utilizing routine systemic hypothermia. We would, simply, allow our open heart patients core temperature, to drift, to 34/35 C degrees, by way of radiated heat loss from the patients open chest. As such, Clinical Perfusion Services, UH,

would be directly involved with several investigative cerebral protective studies, i.e, pH stat vs alpha-stat, etc., while conducting routine CPB procedures (12,13). With this peak back into OUR "reflective rear view mirror" having been provided, I thank, YOU, the reader, for your professional accommodation (👍).

FINALLY, The "VISIT": in the early 1980s, Clinical Perfusion Services, UH, had observed several isolated occurrences, specifically, the occasional observed decrease in the oxygen transfer rate functionality, while using the CML, during routine CPB. In finding a suitable clinical response, this would require a corresponding increase, in FiO2, while at 28 degrees C, from the usual FiO2 of 50 to 60 %, with the occasional, FiO2 increase to 80% in order to maintain our usual acceptable PaO2 within the desired 150 to 250 mmHg range. These occurrences, although somewhat worrisome, were being actively investigated, by ourselves, in consultation with COBE Laboratory, in Denver, Colorado. During this "ONE specific open heart case", I had been called into the OR to offer my assistance. The young male patient, was undergoing a "right ventricular disconnection procedure" for the repair of a Wolf-Parkinson-White Syndrome (WPW). For these patients, the usual NORMOTHERMIC CPB procedure, would require continuous and accurate inter-operative EKG interpretation thus, the requirement, for a normothermic perfusion. The attending Perfusionist, had incorporated our usual Bentley PO2 Differential Oxygen Analyzer in concert with the Bentley Venous In Line Saturation Monitor. The FiO2 setting, upon my entering the OR, had been changed to 100%! The arterial blood was, "NOTICEABLY darker" as was also being reflected within our inline PO2 Monitor (🤢)! Within a "MINUTE" of my entering the OR, the immediate and obvious diagnosis of OXYGENATOR FAILURE was, "PROMPTLY MADE", in lieu of the decreasing arterial oxygen saturations, having been more than visible, to the naked eye!! In consultation with the open heart team, the decision was immediately made, to perform an emergent elective oxygenator change out, given the failing CML. SIDE BAR: I would remind the informative reader of one very important caveat: this specific young male patient was being maintained, on full CPB, at **37 degrees C!!

With the open heart team fully comprised, and with the "confidence of the attending surgeon", we would discontinue CPB and the CML oxygenator was changed out with full CPB, once again reinstituted, in a timely and safe manner. To our "absolute astonishment", there was an unexpected, realization of continued poor oxygenation!! At this very PIVOTAL MOMENT I was to have my epiphany, "it could NOT be the CML oxygenator"! My thoughts immediately, returned to the lessons I had, specifically and intentionally, taught our students, over these many past decades, that being, the necessity "to ALWAYS check both your primary, as well as your secondary, oxygen supply source", should you ever encounter ANY oxygenator related concern! WE SIMPLY, HADN'T done that! We had neglected to perform "this basic scanning technique" having had observed the desaturating arterial blood! The "FFOF" had, finally, made its erroneous and unannounced visit into our UH operating room (😖)! We were confronted, as also was our patient, with our PERSONAL CPB related human error! A SIMPLE scanning of our secondary oxygen supply would have allowed us, to quickly had observed, the following startling realization: the oxygen delivery line, had somehow, become DISCONNECTED from our inline Anesthesia Isoflurane vaporizer, during the conduct of CPB (😳)! A SIMPLE scanning of our existing SECONDARY oxygen supply, would have SHOWN the INITIAL cause (culprit) and would have provided us, the obvious and the "immediate RESOLUTION in regards this patient related incident"! The CML had, indeed, NOT failed - HUMAN ERROR was the leading cause of this, potential catastrophic, patient related mishap! The previous, lower than acceptable PaO2, having been previously observed when using the CML, had "LULLED" us into the false realization, the CML oxygenator, had indeed, finally FAILED!! We were thinking to ourselves, during the CML change out, why had we NOT discontinued the CML use (😖)? The REMEDY, in our resolving this serious incident, was both immediate and SIMPLE - once isolated, the secondary oxygen supply line was, QUICKLY and simply, reattached to the Isoflurane vaporizer!! This simple resolution to this serious clinical incident had been MISSED! That said, the O2 transfer capacity, of the second CML, would return to normal (😅) after a brief period of oxygenator transfer catch up

(membrane oxygenators are O2 transfer limited unlike the previous bubblers) with the FiO2 setting remaining at a FiO2 of 100 %! During the change out procedure, the surgery had continued and the patient was, eventually, removed from routine CPB. Honestly, this specific case scenario, was considered to be, anything, but routine!! After this "near miss" patient related incident, the case was fully reviewed and an Internal Incident Report filed. Unfortunately, secondary to this erroneous oxygenator change out, this young patient was administered two units of donor packed red blood cells (PRBC), having become necessary secondary to the additional crystalloid prime having been required secondary to the oxygenator change out procedure. Obviously, we were to follow up with this young patients after his arrival within the ICU. He was hemodynamically stable, pupils were equal and reactive, both within the OR and our ICU, and he was extubated the following day. He was discharged, from hospital, a week later (🙏)!

Given this historical sequence having been provided, prior to this human error incident, in full disclosure, the "Reason's Cheese Model" requirements, had been realized or, had it? Why had we assumed "this false sense of security in our initial critical decision making" while the CML was under investigation? Why did all the arrows not perfectly align, or had they? Why had we "not scanned the secondary oxygen supply"? Why did the teacher not do what he had taught, so many of his students, over so many past decades? Why had I not, when initially called into the OR that fateful day, just SCANNED the secondary oxygen supply (ironically, we had visualized the primary), then, no doubt, the immediate patient related problem, would have been QUICKLY and immediately resolved! If only we had performed "our usual customary scanning", this erroneous CML change out, would NOT, have occurred!! We had overlooked our every day scanning technique! We had regrettable, been "LULLED" into an inappropriate decision making scenario" given the reoccurrence of a lower than expected CML oxygenator transfer rate, functionality! SIDE BAR: another important contributing factor: the secondary oxygen supply line, via the anesthetic vaporizer, was obscured from our vision, by the sterile drape used to isolate ourselves from the sterile operative field. This is NOT offered as an excuse, it was our everyday sterile drape isolation reality! To prevent any potential reoccurring of this human error incidents, we would next change the color of all oxygen delivery lines, within the CPB circuit, to a visible, green colored tubing. We had relocated the positioning of the anesthesia vaporizer so as to allow "full scanning visualization" of the newly installed secondary green oxygen delivery lines, both into and out of, the Isoflurane Vaporizer. With full scanning visualization, thus provided, we next made the necessary changes within our, soon to be re-edited, Pre-Bypass Check List (👍)!

As the reader might expect, I was to revisit this isolated CPB related "human error incident" many times, given our "inappropriateness of critical decision making"!! All said, our "Oxygenator Change Out Protocol" had played its intended role, regardless of the origin of this particular patient related incident. As the old adage says, we literally, "did not see the forest for the trees"! Oscar Wilde once said, "experience, is simply, the name we give our mistakes"! I would, encourage the reader, to maintain this adage within his/her, personal, extracorporeal memory bank!

I would be remiss if I did not reference the reflective words of Dr. C. Walton Lillehei, the "American Father Of Open Heart Surgery" who had written: "experience is a great teacher, good judgement comes from experience and experience comes from bad judgement"(14). These are indeed, sage words of wisdom, given his historical and influential earlier era cardiac related experiences!! No matter the tenure of one's years, "the telling of this FFOF tail", had found its unforgettable genesis within two experienced Perfusionists having been "lulled" into this unfortunate clinical scenario reality - "thus, experience comes from bad judgement"! More importantly, the silent recipient of our specific extracorporeal care, this young normothermic cardiac surgical patient, was NOT to have suffered untoward consequences, albeit, the associated clinical necessity for the intra-operative transfusion of two units of packed red blood cells (PRBC). This blood transfusion might NOT have happened had this

specific error, had not occurred! SIDE BAR: More recently, the published literature has noted the long term effect of blood transfusions, during open heart surgery, could be associated with negative overall patient related effect, i.e., higher long term mortality in low risk patients (15,16)! Within this very reality, two Cardiovascular Perfusionists, were to leave their singular, but "experienced fingerprints", all over this CPB patient related human error incident - "experience is a good teacher"!

All said, there had been much water (experience) under my extracorporeal bridge as was, so true of others of that era, having being revisited "within my rear view mirror" (😉). With this in mind a much earlier era, but personal extracorporeal introduction, entitled, "Our Shared Extracorporeal History - A Personal Remembrance" is referenced for your perusal, should you so choose to further explore, "YOUR" earlier CPB extracorporeal history (17)! Within this realization, should but a FEW readers, capture the essence of this specific human error incident, within his/her extracorporeal memory bank then, your thoughtfulness, in revisiting this incident, would have successfully found "its INTENDED professional audience"! Within that reality, it is my personal and professional hope that this, my unfortunate 1983 "VISIT", nor any other CPB related incident, would NEVER present itself within YOUR, nor any of our fellow Cardiovascular Perfusionists, CPB clinical reality (👀)!

A few words dedicated to the open heart team! The overall well-being of our cardiac patient, be it either within or outside the OR proper, is best reflected in the four words contained within the Hippocratic oath, "primum non nocere". Let these words, serve as a subtle reminder of, "our shared responsibility within the open heart team of today and, all the tomorrows, as yet to come". Within this disciplined focus, "all of YOU, within your Cardiac team, are the experienced hands in the care of the cardiac patient"! It is, within this knowledge, we ALL SHARE in this enshrined oath to, "first, do no harm" (👍)!

The reader would note the use of the explanatory word "why" being reflective within my rear view mirror. The dictionary would define the word "why" to be centered around reasons and explanations? Within that realization, I am reminded of the 1992 lyrics, by Annie Lennox, in her reflective song, "WHY"……."this is the fear- this is the dread - these are the contents of my head - these are the years that we have spent - this is what they represent - this is how I feel - you know how I feel"……..with this referenced, your extracorporeal journey would continue, wherever your personal extracorporeal "experience" might take yourselves and, as importantly, the silent recipient of our care, the cardiac patient?

With kindest regards , your extracorporeal colleague,
Jim MacDonald CPC (retd) CCP (Emeritus)

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47th Annual Seminar of
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Wednesday, February 4th, 2026

1:00 pm – 5:00 pm	REGISTRATION
2:30 pm – 5:00 pm	**Manufacturers' Breakout Rooms**
5:00 pm – 5:30 pm	Opening Business Meeting *Fellow, Member, Senior, and Honorary Members*
5:30 pm – 7:00 pm	**Special Scientific Panel Session – Pro/Con Debates** *Perfusion Education – AI/VR vs Traditional Education Model (Didactic/Clinical)* *MS vs Certificate Program*

Thursday, February 5th, 2026

7:00 am – 10:00 am	REGISTRATION
7:00 am – 7:45 am	Historical Video Presentation and Breakfast
7:45 am – 9:30 am	**Special Scientific Panel Session – Adult Congenital Surgery** Multi-Disciplinary Approach for Surgical Correction of Aging Failing Fontan Surgical Considerations and Correction Anesthesia Care Plan Perfusion Management ICU Intensivist care plan
9:30 am – 11:30 am	**Fireside Chats** Current State of the States OR Team Dynamics Pediatric / Adult Congenital MCS Simulation: From Low to High Fidelity Including VR & AI Student Only Forum
11:30 am – 12:30 pm	Lunch (Historical Presentations)
12:30 pm – 2:30 pm	**Special Scientific Panel Session – Healthcare Economics with Industry Partners** Industry Partners and the Economics of Cardiac Surgical Supplies
2:30 pm – 3:00 pm	Historical Presentation and Break
3:00 pm - 5:00 pm	**Scientific Paper Session**
5:30 pm – 8:30 pm	**Sponsor's Hands-On Workshop & Reception**

Friday, February 6th, 2026

7:00 am – 10:00 am	REGISTRATION
7:00 am – 7:45 am	Historical Video Presentation and Breakfast with Sponsors/Exhibitors
7:45 am – 9:30 am	**Special Scientific Panel Session – NRP and Transplantation** NRP - How to measure outcomes and develop best practice Ethical Considerations on NRP from a Clerical POV Physiology of NRP and reperfusion injury/recovery Gift Of Life Video - Story from Parents of a Donor advocating for NRP
9:30 am – 11:30 am	**Fireside Chats** NRP - Religious and Ethical Considerations Pediatric Practice Developments Simulation: From Low to High Fidelity Including VR & AI The Education and Precepting of Our Future Colleagues Women in Perfusion
11:30 am – 1:00 pm	Historical Video Presentation and Lunch
1:00 pm – 2:45 pm	**Special Scientific Panel Session – Pediatrics** Neurometabolic optical monitoring for brain-directed management of ECLS Whole Body Perfusion During Arch Reconstruction / STAR Technique Acute Heart Failure and Care Considerations Beating Heart Transplant
2:45 pm – 3:15 pm	Historical Video Presentation and Break
3:15 pm – 5:00 pm	**Memorial Session** *Introduction* *Charles C. Reed Memorial Lecture* *Jeremiah Grisham, Chief Master Sergeant, USAF* *Thomas G. Wharton Memorial Lecture* *Richard Melchior, President, AACP*
6:30 pm	**Induction Dinner** *All Attendees and Guests (pre-registration required)*

Saturday, February 7th, 2026

7:00 am – 10:00 am	REGISTRATION
7:00 am – 8:00 am	Historical Video Presentation and Breakfast
8:00 am – 10:00 am	**Scientific Paper Session**
10:00 am –12:00 pm	**Fireside Chats** Career Development and Progression ECMO and VAD Challenges Errors and Terrors
12:00 pm	Closing Business Meeting *Fellow, Senior, and Honorary Members Only*

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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**

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