



The
Academy
NEWSLETTER

THE AMERICAN ACADEMY
OF
CARDIOVASCULAR PERFUSION
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SUMMER 2018

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THANK YOU TO ALL OF MY ADULT PERFUSION COLLEAGUES!

I am a pediatric perfusionist. That is my professional title and I own it with pride. I have said many times that doing pediatric cases allows me to practice the full range of perfusion techniques because, after all, some of my 16-20 year old patients have body surface areas as big or bigger than many of the patients in an adult only center. In addition, I have argued that, "my" patients (being kids) have a lot more "living" to do than the average adult senior citizen whose main activity is working the television remote. Before the shouting begins let me continue. Recently, my mom received the diagnosis of severe aortic stenosis and, without going into too many details, she was not an ideal candidate for median sternotomy and cardiopulmonary bypass (CPB). Therefore, my hubris was greatly diminished when I mentioned that she might be a candidate for transaortic valve replacement or, wait, is that transapical valve replacement? After looking it up, I corrected myself and used the common nomenclature of Transcatheter Aortic Valve Replacement/Implantation (TAVR/TAVI). I recalled the PARTNER¹ trial back in New York where the adult perfusionists would crash on extracorporeal membrane oxygenation (ECMO) or CPB with 80 plus-year-old patients but I had little knowledge of what had been happening since. Therefore, my mom had questions that I could not answer so I called my adult perfusion colleagues for help. Yes, the ones who were only pumping the old people like my mom! In addition, there were moments during all of that when I imagined I was having chest pain and I am certainly no senior citizen (although the AARP seems to think differently). How humbling life can be.

Originally, TAVR procedures were staffed by adult perfusionists who stood by ready to initiate emergent ECMO or CPB. Moreover, many of you still stand-by for TAVRs like my friends and colleagues down in Tacoma who are at the ready during "TAVR Tuesdays". Hence, the encouraging results from the PARTNER trials¹⁻² and from individual centers around the world have saved many lives and supported an amazing leap in medical technology for these patients. My mom is doing well and her congestive heart failure symptoms are quickly abating. Now, I continue to watch television with her as she flips channels and her grandchildren get to enjoy her for more years to come. Therefore, to all adult perfusionists I am sending a huge thank you for being excellent at what you do!

After a quick glance at the current list of American Academy board members, you might notice four pediatric perfusionist guiding the organization (including me). Because of this, there has been some concern that the next meeting could contain more pediatric content than many would care to hear (or attend). Therefore, I am writing to relay my assurance that the next international meeting will be dynamic, diverse and interesting to all perfusionists who are looking for a great educational experience. The Academy owes that to all of you (and to my mom).

Respectfully,
Kevin Charette, CCP
President, AACP

¹Leon MB, Smith CR, Mack M, PARTNER trial investigators et al. Transcatheter aortic-valve implantation for aortic stenosis in patients who cannot undergo surgery. N Engl J Med. 2010 Oct 21;363(17):1597-607.

²Baron SJ, Arnold SV, Wang K, PARTNER 2 Investigators et al. Health Status Benefits of Transcatheter vs Surgical Aortic Valve Replacement in Patients with Severe Aortic Stenosis at Intermediate Surgical Risk: Result From the PARTNER 2 Randomized Clinical Trial. JAMA Cardiol. 2017 Aug;12(8):837-845.

ON BYPASSES

Remembering Kimray

Introduction

Like me, Garman Kimmell (see Figure 1) was a Kansan. He grew up in Wichita, the son of a land speculator for oil and gas drilling projects. Garman attended Wichita State University for two years, but transferred to Oklahoma University because of its renowned petroleum engineering program. Garman had a knack for creative and “out of the box” thinking. He once glued feathers to a crow that had suffered a wing injury. Upon tossing the bird into the air, it spiraled briefly in all directions looking like it would surely crash. Garman’s glue did the trick however, and the crow soared gracefully beyond the trees and eventually out of sight. In 1948, he founded Kimray, a manufacturing company in Oklahoma City specializing in oil and gas equipment. Along the way, Garman met and befriended Dr. Allen Greer, the first American Board-certified thoracic surgeon in Oklahoma. This unlikely acquaintance would prove worthwhile in a way no one could possibly have predicted.



Figure 1
Garman Kimmell, founder of Kimray.

Enter Dr. Nazih Zudhi

In 1957, Dr. Greer was part of the search team that brought Dr. Nazih Zuhdi to Oklahoma City to help build an open-heart surgery program. Dr. Zuhdi was more than qualified. He had spent time in Dr. Clarence Dennis’ laboratory from 1952 to 1956. He then joined Dr. C. Walton Lillehei’s team in Minneapolis helping refine Dr. Richard DeWall’s helical coil bubble oxygenator and Dr. Vincent Gott’s disposable plastic sheet oxygenator. In Zuhdi’s mind, Oklahoma was a far-away place known largely for hot summer winds and red clay soil. And yet it reminded him of his upbringing in Syria; a land vast in size and respite from the noisy bustling cities. And so, in the fall of 1957, Zuhdi boarded a train in Minneapolis and headed south to his new position at the Oklahoma University Medical College. Greer was waiting for him at the station, as was Dr. John Carey. Within months, the three formed a medical partnership.

Enter Kimray

In 1957, the most accepted methodology for perfusion was normothermia using DeWall’s helical bubble oxygenator. As such, this is what Zuhdi assembled and tested in early 1958 as a starting point for his new open-heart program. And as DeWall had done before him, Zuhdi immersed the helical coil in a vat of warm water. Thermal regulation (namely cooling) of the patient was desired by many investigators, but external heat exchangers were cumbersome and increased the overall priming volume of the circuit. In 1952, Dr. Frank Gollan devised a crude bubble oxygenator that included an integral venous-side heat exchanger. Zuhdi came up with a

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Hays, Kansas

brilliant, if not similar, idea. Why not place a heat exchanger inside the plastic coil of the DeWall helical oxygenator? In doing so, the patient could be heated or cooled by a heat exchanger that also served to volume-reduce the circuit. Greer suggested to Zuhdi that he contact his old friend Garman Kimmell. If the Kimray Company could produce pumps, valves, and piping for the oil industry, then surely it could fashion a piece of metal to fit inside a coil of mayon tubing. Within days, Kimray machinists presented Zuhdi with a gleaming, polished heat exchanger made of 22-gauge stainless steel measuring 325 centimeters in length (see Figure 2).

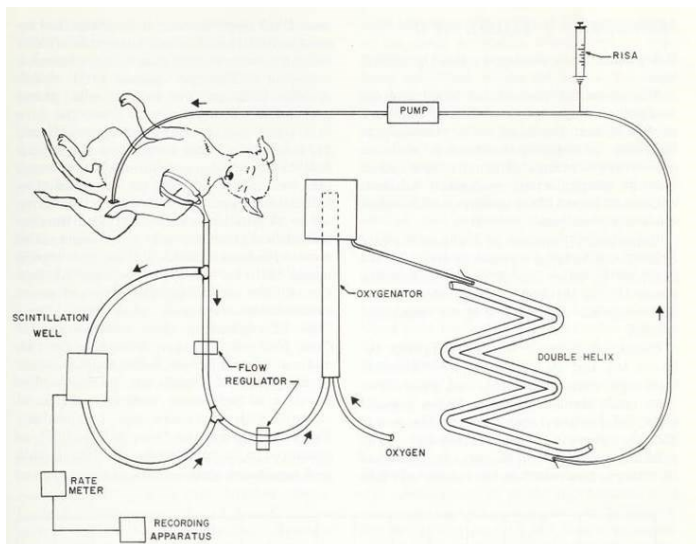


Figure 2

Schematic of early CPB circuit showing Kimray heat exchanger inside helical coil (lower right).

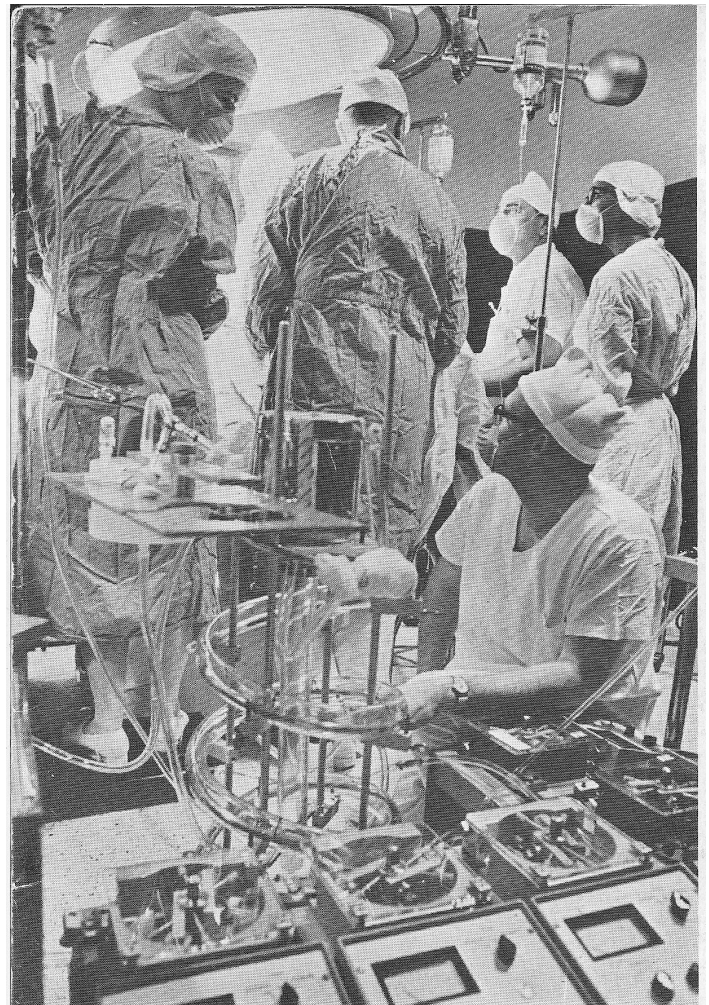


Figure 3

DeWall helical coil oxygenator with Kimray heat exchanger inside (center of photo).

As an aside, the first issue of the Journal of Extra-Corporeal Technology published in 1968 featured a cover photo of a young Minnesota perfusionist named Ed Berger running a DeWall helical bubble oxygenator with the Kimray heat exchanger (see Figure 3). Next, Kimray assembled two 30-gallon insulated trash cans to serve as reservoirs for the hot and cold water necessary to regulate the patient's temperature (see Figure 4). On occasion, a leak would spring from one or both reservoirs, flooding the operating room floor. The enormity of one such incident caused Zuhdi's perfusionist to perch herself atop her stool to avoid getting wet. Undeterred, Zuhdi challenged Kimray to produce a self-contained unit that could deliver thermostatically-controlled water in a re-circulating fashion. Appear-

ing on the market around 1960, the Kimray heater-cooler (see Figure 5) enjoyed mostly regional success until around 1980. For a brief time, Texas Medical Products served as the sole distributor. The device required ice chips for cooling and featured three water baths (warm, tepid, and cold). Kimray also devised de-bubbling chambers from stainless steel canisters, and made precise determinations for how much Dow Corning Antifoam A should be applied. For his company's efforts, Garman Kimmell was named "technical physicist" of the open-heart team and was often present during early surgeries performed by Zuhdi, Greer, and Carey (see Figure 6).

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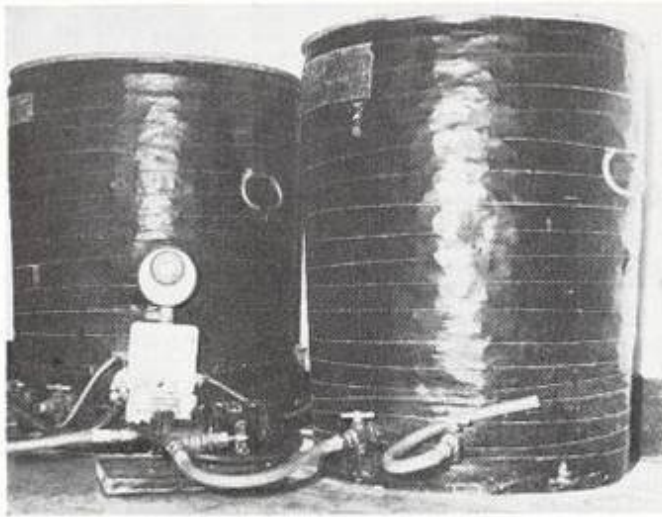


Figure 4
Insulated trash cans used as hot and cold water reservoirs (constructed by Kimray).

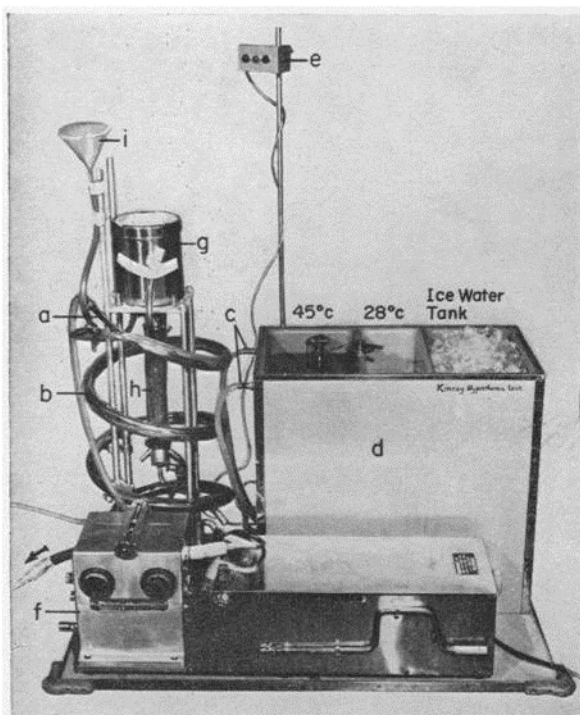


Figure 5
Kimray heater-cooler (labeled as "d") shown along side the DeWall oxygenator and pump.



Figure 6
Garman Kimmell checking the de-bubbling chamber he devised for use with the DeWall helical coil oxygenator in 1959.

Conclusion

How fascinating that the science of early heart lung machines often rested at the steps of companies like Kimray. Researchers often found solutions to problems in the most unusual or obscure places. And while Kimray's contributions to our field are but a distant memory, it's worth remembering that historical developments in medicine rarely follow the direct path that hindsight often assumes.

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JECT 1st Issue published December 1968.

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40th Annual Seminar of The American Academy of Cardiovascular Perfusion



**Hammock Beach Resort
200 Ocean Crest Drive
Palm Coast, Florida
February 6-9, 2019**

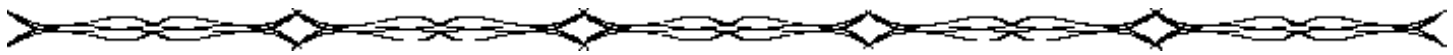
(Tentative Program)

Wednesday, February 6, 2019

9:00 AM – 2:00 PM	REGISTRATION
3:30 PM - 4:00 PM	Opening Business Meeting <i>Fellow, Member, Senior and Honorary Members</i>
4:00 PM – 7:00 PM	Manufacturers' Breakout Rooms

Thursday, February 7, 2019

7:00 AM	REGISTRATION
7:00 AM – 8:00 AM	Video Presentations
8:00 AM – 09:30 AM	Scientific Paper Session
9:30- AM – 11:30 AM	Fireside Chats
11:30AM - 1:00PM	Lunch
1:00 PM – 3:00 PM	Special Scientific Panel Session Hot Topics and Current Trends



3:00 PM – 3:30PM	Break
3:30PM – 5:30PM	Special Scientific Panel Session Education, Communication and Collaboration with Industry Partners
06:00PM	Sponsor's Hands-On Workshop & Reception

Friday, February 8, 2019

7:00 AM	REGISTRATION
7:00 AM – 8:00 AM	Video Presentations
8:00 AM – 9:30 AM	Scientific Paper Session
9:30- AM – 11:30 AM	Fireside Chats
11:30AM - 1:00PM	Lunch
1:00 PM – 3:00 PM	Special Scientific Panel Session Extracorporeal Support - In & Out of the Operating Room
3:00 PM – 3:30PM	Break
3:30 PM – 5:30 PM	Memorial Session Charles C. Reed Memorial Lecture Thomas G. Wharton Memorial Lecture (Kevin Charette)
6:30 PM	Induction Dinner <i>All Attendees and Guests</i>

Saturday, February 9, 2019

7:00 AM	REGISTRATION
7:00 AM – 8:00 AM	Video Presentations
8:00 AM – 9:30 AM	Scientific Paper Session
9:30 AM – 10:00 AM	Break
10:00 AM – 11:30 AM	Special Scientific Panel Session Complex Congenital Heart Surgery
11:30 AM – 1:00 PM	Lunch
1:00 PM – 3:30 PM	Special Scientific Panel Session Perfusion Considerations For The New Perfusionist
3:30 PM – 5:30 PM	Fireside Chats
5:30 PM	Closing Business Meeting <i>Fellow, Senior and Honorary Members Only</i>

THE ACADEMY TO OFFER LIVE WEBCAST

The American Academy of Cardiovascular Perfusion will again be offering a live webcast of our 2019 Annual Meeting in Palm Coast, Florida. The General Sessions of the meeting will be broadcast in high quality streaming video. There will also be an opportunity for attendees to ask questions, thus qualifying for Category I CEUs from the American Board of Cardiovascular Perfusion.

The Student Section

Effects Of Glycocalyx On The Endothelium In Consideration For Cardiopulmonary Bypass

Glycocalyx is an endogenous glycoprotein. The main components are Sydecin-1 and Heparan Sulfate. Along with glycolipids, forms a gel like pericellular matrix known as the Endothelium Glycocalyx Layer(EGL). Under normal conditions, this layer lines the luminal side of all vasculature and capillary beds. Impact of the effects of cardiac surgery and CPB on EGL is generally overlooked and little attention/study given. Difficult to find common grounds on the measurements of the EGL from various sources. However, the average thickness is approximately .2-.5 micrometers in the capillaries, 2-3 micrometers in small arteries, and 4.5 micrometers in some carotid arteries. EGL maybe be compared to a gel like coating to the slime on the scales of a fish. A wide range of functions have been proposed, such as protection, upholding the integrity of the endothelial cell surface and maintaining vascular permeability.

Other EGL ancillary function would be acting as mechanical transducer. By detecting variations in shear stress the Glycocalyx can facilitate vascular tone controlling vasodilation or vasoconstriction when needed. It serves as a immunogen against cancer by blocking cancer signals. It is involved in fertilization by aiding early embryonic cell division. Glycocalyx acts as identity marker to determine self from foreign cells. This function is especially important in fighting off infection and also plays a vital role in organ and tissue transplantation. Being the protective barrier between the endothelial cell surface and blood formed elements, the EGL is responsible for the regulation of the supply of nutrients, oxygen, and removal of waste products such as

carbon dioxide through passive and active permeability. These soluble components live in a state of dynamic equilibrium with the blood stream and the Glycocalyx acts as a gate keeper determining the micro/macromolecules movements across cellular barriers. This barrier is semipermeable to certain macromolecules like larger proteins, (such as Albumin), it is negatively charged and cannot be penetrated by large cells such as RBC's and large molecules like Dextran. Glycocalyx will bind to plasma proteins, which will help to maintain the plasma protein in the vascular space creating a vascular oncotic pressure increase. Thus, the outward movement of fluid will be opposed by the oncotic pressure that is directed inward. Glycocalyx is involved in fertilization by aiding early embryonic cell division.

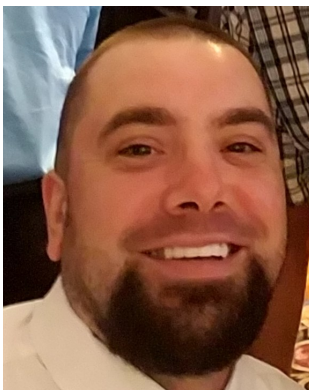
The vessels and capillaries have to withstand the stress of blood flowing over the endothelial surface. This non-stick coating will enhance the flow of blood by reducing the stress at the wall reducing capillary leakage, inflammation, and blood clotting. It regulates the clotting of blood and prevents platelet and leukocyte adhesion. This mechanism is important in controlling inflammation and tissue edema.

Glycocalyx is a natural trigger to stimulate the production of Nitric Oxide (NO), a major factor in controlling blood pressure blood flow distribution and inhibition of complement activators from the cells of the endothelium. This layer stores anti-oxidants which protect the Glycocalyx from oxidative stress and together with Nitric Oxide increase blood flow to various organs when necessary. EGL will engage more available capillaries in the microvasculature

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when there is an increase in blood flow. It has been observed that regulation of flow distribution impaired when the EGL is compromised.

Glycocalyx serves multiple critical functions in maintaining the integrity of the endothelial system but can easily succumb to stress and easily damaged. SIRS, hemodilution, hypothermia, anesthesia, mechanical fluid dynamic, suctioning, rewarming gradient, protamine-heparin complex (salt), donor blood transfusions, surgical trauma, hypoxia, low flows, hemorrhagic shock, hypovolemia, ischemia, and reperfusion injury are factors that will contribute to the damage and loss of glycocalyx during CPB. Patients with type 2 diabetes show loss in EGL in retinal vessels. The shedding of heparan sulfates in particular, can directly activate leukocytes, and platelets. Leukocytes and platelets release heparanase which will further degrade sulfate chains and lead to a destructive cycle. The severity of insult can be ascertained by measuring Syndecan-1 and Heparan Sulfate levels, which are the two major components that are shed upon injury. When significant degradation occurs, the endothelium will be exposed to blood and blood formed elements. This exposure will lead to decrease in NO production, macromolecule leakage, increased leukocyte/platelet adhesions, increased oxidative stress, endothelial degradation, edema caused by capillary leakage, and the loss of optimal capillary flow distribution. Endothelial exposure may lead to various types of bacterial infection such as endocarditis. Endothelial damage is almost always preceded by EGL shedding. Literature show that shear stress in the vasculature is proportionally related to Glycocalyx synthesis. The variation in shear stress can explain the variation in EGL dimensions. Studies in continuum are comparing pulsatile and continuous flows on CPB relative to the effects on glycocalyx. Some researchers speculate that dimensions seem to recover around four hours post op when pulsatile flow was used. This recovery was absent in the non-pulsatile flow trials.

In closing, the Endothelial Glycocalyx Layer is an extremely important and delicate physiological aspect of the vasculature and should be taken into consideration with the administration of cardiopulmonary bypass. While the effects of cardiopulmonary bypass have been proven to induce shedding of the endothelial Glycocalyx layer, the question that needed to be asked is how can the shedding be minimized and if possible, how can we regenerate Glycocalyx di-

mensions post op? How can we reduce shedding brought on by shear forces? Is there truly an advantage with pulsatile flow on bypass? Researchers suggested that maintaining a physiological albumin blood concentration before cardiovascular surgery may be adequate for protection. Fresh frozen plasma is seemingly at the forefront of this theory. Vascular Health Sciences are currently working on a seaweed extract that is rich in sulfated polysaccharides and glycoaminoglycans (building blocks for Glycocalyx). Natural antioxidants and polyphenols from various fruits and plant sources are also being explored as possible components for consideration for the rebuilding of the EGL. Perhaps these products could be constituents that should be added to priming solution for the perfusion system? While we have limited knowledge of the EGL it is important that we keep pushing forward with striving for the development of the administration of various assays to create new protocols of protection and regeneration of the endothelial Glycocalyx layer.

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2019 Annual Academy Meeting Host Hotel



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Please mention that you will be attending the Annual Conference of The American Academy of Cardiovascular Perfusion when making your reservations.

Important Academy Dates

The ACADEMY ANNUAL MEETING DEADLINES

ABSTRACT DEADLINE	October 15, 2018
MEMBERSHIP DEADLINE	December 6, 2018
PRE-REGISTRATION	January 4, 2019
HOTEL REGISTRATION	January 7, 2019
2019 ANNUAL MEETING	February 6-9, 2019

Others Meetings

38th Annual Cardiothoracic Surgery Symposium (CREF 2018)

September 6 – 9, 2018
 Westin San Diego Gaslamp Quarter
 910 Broadway Circle
 San Diego, CA 92101
 Phone: 619-239-2200
 Website: <https://www.crefmeeting.com>
 Contact Name: Susan Westwood
 Contact Phone: 1-805-541-3118
 Contact Email: susan@crefmeeting.com

20th Annual Update on Perfusion Conference

October 25 – 27, 2018
 Medical University of South Carolina
 151 A Rutledge Avenue
 Charleston, SC 29425
 Phone: 843-792-6505
 Website: <http://www.musc.edu/chp/cvp/conference>
 Contact Name: Laura Reid
 Contact Phone: 843-792-6505
 Contact Email: reidlau@musc.edu

18th European Congress on Extracorporeal Circulation Technology

Grand Hotel
 Salerno, Italy
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