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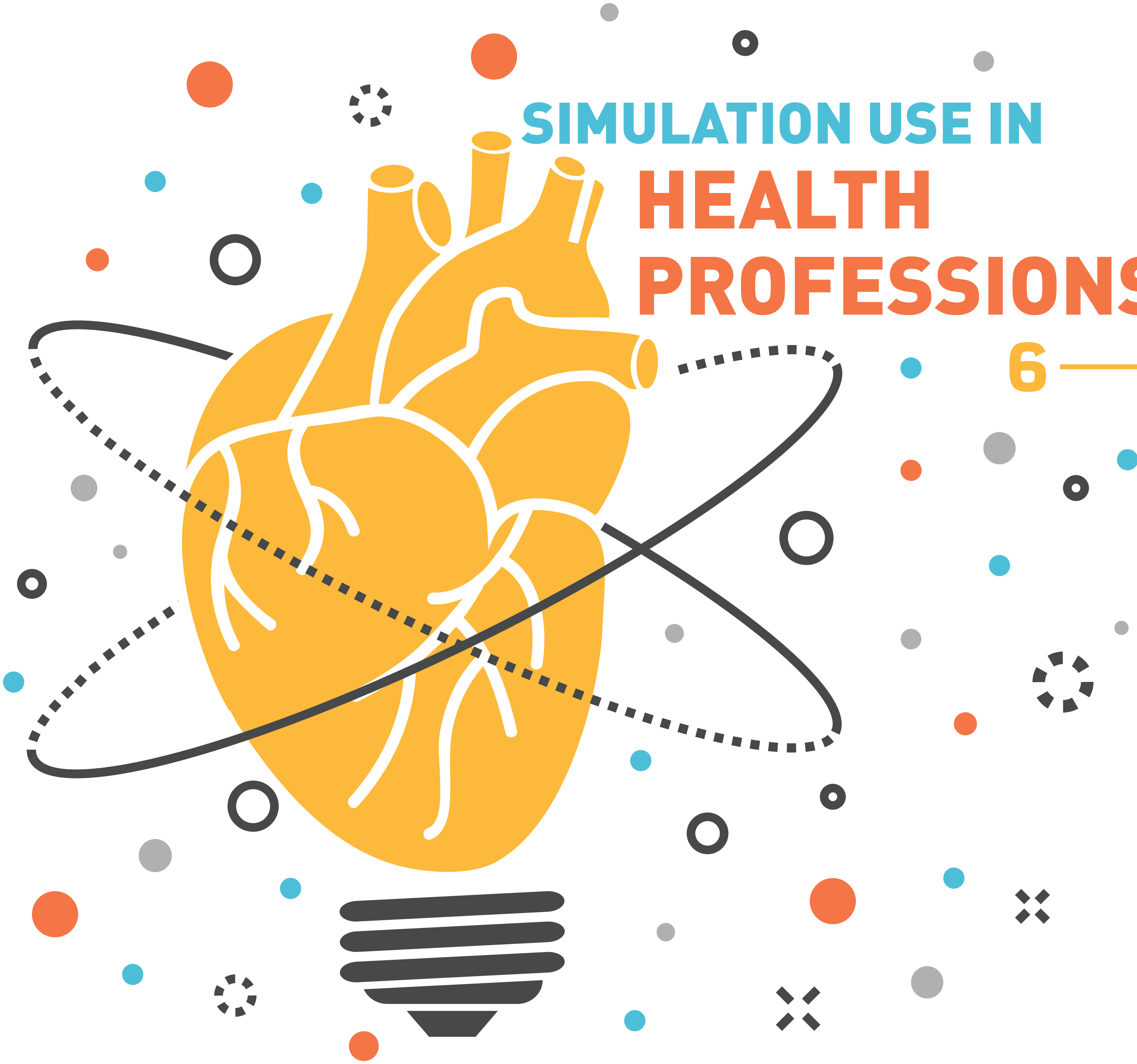

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330 N. Wabash Avenue
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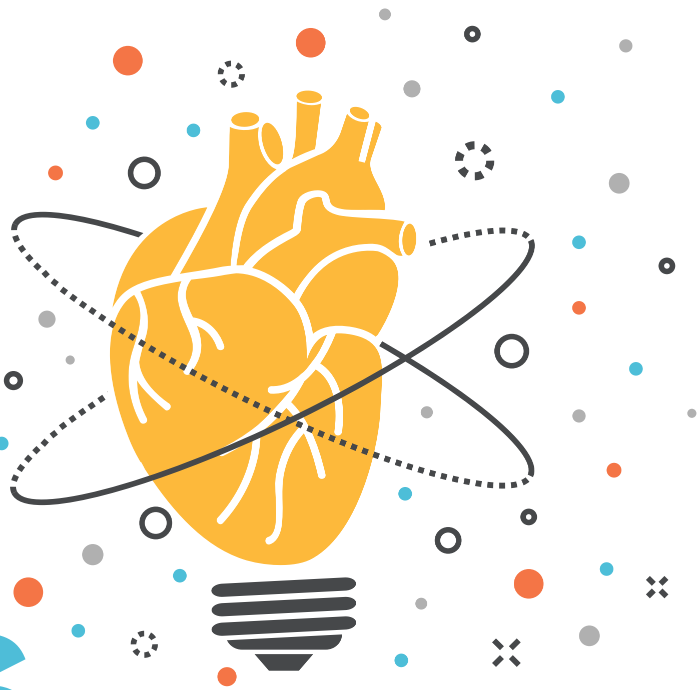

COLUMNS

DEPARTMENTS

MANY HANDS MAKE LIGHT WORK

Kenny Shann,
CCP

THE MORE DIVERSE THE POOL OF TALENT IS, THE MORE POTENTIAL THE ORGANIZATION HAS FOR **POSITIVE IMPACT AND GROWTH** IN OUR PROFESSION.

The older I get the faster time goes by. It's June — wasn't it New Year's Eve yesterday? One of the things I've realized is that time is my most precious commodity. And that is not unique to me. The one thing we all have in common is the clock. We all have only 24 hours in the day, seven days a week and 365 days a year. We are pulled in many directions and wear many different hats. Like you, I am always striving to create balance in my life while giving the right amount of time and effort to each task to which I am committed, whether it be AmSECT president or my children's soccer coach.

My mother worked in human resources for more than 20 years, and I learned from her that people are an organization's most precious resource. AmSECT could not function without the generous donation of time given by our volunteers. An organization can only be as effective as our volunteers are committed to their work. AmSECT is lucky to have such wonderful supporters. I would like to extend my sincere appreciation to all the volunteers who make this organization function. We thank you for the valuable gift of your time!

That said, the need for volunteer engagement continues. You know the saying, "Many hands make light work." Often, the burden falls to the same generous people, and as gracious as these folks are, there is risk of burnout and fatigue. Every single one of us has unique talents and strengths. The more diverse the pool of talent contributing to AmSECT is, the more potential the organization has for positive impact and growth in our profession.

I know that sometimes volunteering is intimidating, and that at times we need to feel personally invited to dip our toe in the water. Please consider this your invitation. In 2005, AmSECT's president-elect, Al Stammers, invited me to participate on a new committee focused on best practices in perfusion. Accepting this invitation 12 years ago was one of the best decisions of my career. It opened the door to many more professional opportunities, including serving on the board of directors and as president. It gave me the chance to learn from more experienced professionals. I listened, watched and learned from individuals such as Bob Groom, Al Stammers and Rob Baker. These individuals accepted me, encouraged me and provided me

guidance that I still use today. It is difficult to find that kind of mentorship if we stay in the recesses of our own institutions. Risk-taking and allowing yourself to be vulnerable is scary at first, but the benefits can be far reaching.

Over the next year, AmSECT will be focusing significant energy on volunteer engagement in an effort to ensure volunteers have a positive experience. To begin, we are reviewing and revisiting our committee structure. Current committees will be evaluated for structure and relevance. Dysfunctional committees will be reorganized (because no one wants to feel that their time is being wasted), and dormant committees will be eliminated, if warranted. Each committee will have defined goals so that volunteers understand how their time will be spent. It is important to have clear objectives so that volunteers can accomplish their goals and move on to other tasks or feel like they have reached an end point and closure to that volunteer experience.

As always, we are carefully examining the needs of our society, and, at this point, it is a priority to extend the invitation to talented, generous prospective volunteers. We encourage all members to volunteer; start small — baby steps can lead to larger distances. When you give a little, you will always be surprised by how much more you get back.

IT IS IMPORTANT TO HAVE **CLEAR OBJECTIVES** SO THAT VOLUNTEERS CAN ACCOMPLISH THEIR GOALS AND MOVE ON TO OTHER TASKS OR FEEL LIKE THEY HAVE REACHED AN END POINT AND CLOSURE TO THAT **VOLUNTEER EXPERIENCE.**

SIMULATION USE IN HEALTH PROFESSIONS

The importance of experiential and active learning techniques in the initial and ongoing education of health professionals has received increased attention over the past decade. The science of how people learn, coupled with the complex nature of acquiring the knowledge, skills and attitudes required of all healthcare professionals has contributed to increased use of simulated experiences in health professions education.

The effectiveness of simulation in clinical practice has been the subject of much research, and requires an understanding of the principles and best practices that facilitate learning. Confucius' early quotations and the work of Kolb and Knowles related to the science of learning have also persuaded us to include active learning strategies that are known to have a positive influence on the acquisition of new knowledge and skills.

**"I HEAR AND I FORGET.
I SEE AND I REMEMBER.
I DO AND I UNDERSTAND."[1]**

Many years of research specific to the science of learning has provided important insight regarding instructional design best practices:

- Learners remember more when presented with less.
- Learners remember most when the material relates to the situation at hand.
- The human attention span is 10-15 minutes long.
- Optimal learning is 20 minutes into a long lecture.
- Learners remember:
  - Twenty percent of what they hear
  - Thirty percent of what they see
  - Fifty percent of what they see and hear
  - Eighty to 100 percent of what they apply, especially if immediate
  - Retention is greatly increased by involvement of more senses (e.g., audible, visual, touch, writing)
- Taking notes (even if never re-read) increases retention by 50 percent.[2]

Mindy Blackwell, MS, CCP

SIMULATED EDUCATIONAL ACTIVITIES SIGNIFICANTLY **ENHANCE LEARNING** THROUGH FORMATIVE FEEDBACK, REPEATED PRACTICE AND VARIATION OF DIFFICULTY WITHIN A CONTROLLED, **SAFE ENVIRONMENT.**

Due to the diverse learning preferences of allied health professionals, the appropriate use of educational technologies tailored to the individual's learning style will need to be integrated into existing educational models. This commentary provides an overview of the use of simulation in clinical education.

Simulated educational activities significantly enhance learning through formative feedback, repeated practice and variation of difficulty within a controlled, safe environment.[3] Simulation can be delivered in many ways, from low-fidelity, part-task simulation to completely integrated immersive environments (fully simulated operating rooms), with higher fidelity being more beneficial. Fidelity is determined by the degree of realism the scenario portrays. The advanced use of simulation has become increasingly important in many healthcare disciplines.

An August 2016 editorial in *The Journal of the Society for Simulation in Healthcare*, by the newly appointed editor-in-chief, reminds readers of the tremendous success the journal has experienced since its debut in 2006 and while under the leadership of the founding editor-in-chief Dr. David Gaba. The journal was accepted for indexing by PubMed in 2008, and due to increased interest in publishing, the number of issues per year was increased from four to six in 2010. Currently, the journal is the official publication for 21 national, international and professional societies or associations.[4] A quick review of the topics covered in 2016-2017 is helpful in gaining an appreciation of the many ways simulation has been implemented in the education, certification and recertification of healthcare professionals.

SIMULATION TRAINING FOR PRACTICING HEALTHCARE PROVIDERS

The Institute of Medicine report in 1999 brought to light the amount of preventable harm experienced by patients each year due to flaws in the healthcare system. This number is actually increasing, with more than 400,000 episodes of preventable harm to patients each year in America.[5] Simulation-based training strategies are increasingly being used by healthcare teams because of the proven effectiveness in mastery learning and teamwork competencies.[6] These simulations typically take place at the point of care instead of a dedicated simulation center.

This method of training is reported to be beneficial by avoiding the logistical challenges of scheduling the learning activity in a simulation center. The close proximity to patient care areas makes the simulated experience feel more like the "real" thing. Simulated cases using the same equipment and space are categorized as functional fidelity and are reported to be the most critical for learning. But another critical component is the presence of physical fidelity within the simulation. This type of activity contributes to the realism of the training by increasing the stress level and anxiety, and often presenting extraneous information during the performance of psychomotor tasks.[7]

Team learning can be greatly accelerated with the use of simulated cases for high-risk, low-volume events such as cardiac surgery for complex congenital defects in adults. Critical elements of this type of program can be used to evaluate communication, cooperation and coordination during a simulated scenario. Procedural competency and experiential knowledge of the adverse events that are possible with new techniques makes simulation a valuable tool for safe practice and patient outcomes.

SIMULATION SCENARIOS, IN GENERAL, CONTAIN THE FOLLOWING KEY COMPONENTS:

- Learning objectives pertaining to the overall goal of the simulated activity.
- Theoretical basis for the scenario based on best practices according to the current knowledge base.
- Cognitive, psychomotor and affective experiences that contribute to the transfer of knowledge from the classroom to clinical environments.
- Debriefing, either during scenario or at the end of the simulated case, which has been reported to be the most crucial component of a simulation experience.

EXAMPLE OF A SIMULATION OF CRITICAL EVENTS OCCURRING IN POST-OPERATIVE CPR

Cardiac surgery patients present unique challenges when cardiac arrest occurs in the post-operative period. The reported rate of arrest in this patient population can be as high as 2.9 percent. Recognizing the need for special procedures surrounding the use of chest compressions, some providers recommend the use of defibrillation prior to the use of chest compressions. As this differs from the ACLS standard protocol, the cardiac team at Mayo Clinic developed a simulation model incorporating the changes best suited for this patient population.[8] Remote need for CPB in an emergent tumor resection procedure, air embolism during modified ultrafiltration procedure, and non-technical skills, such as communication and teamwork, are just a few examples of simulation use in OR team training.[9]

THE USE OF SIMULATION FOR THE MAINTENANCE OF CERTIFICATION

Simulation has been increasingly utilized in health professions education; however, the required use in program accreditation or professional certification is not uniform across disciplines.

The American Board of Cardiovascular Perfusion added High-Fidelity Perfusion Simulation as a secondary perfusion activity beginning with the 2014-2015 recertification cycle. Case credit requirements for reporting can be found on the ABCP website. Currently, there are four ABCP-recognized simulation centers. There is an annual renewal requirement of the simulation center's eligibility. The reporting of simulated perfusion activity is at the discretion of the CCP and is not a requirement for certification renewal. Simulated cases are not allowed for initial CCP certification.[10]

The American Board of Anesthesiology Maintenance of Certification program (AMOC) for U.S.-trained physicians, initially credentialed in 2000, has incorporated a simulation-based component to accompany the professional practice and improvement requirement.[11,12] The maintenance of certification (MOC) requirements vary widely among the health professions. Simulation as the sole method for recertification or maintenance of certification has not been adopted.

CURRENT SIMULATION MODELS

Biomed Simulation, Inc., has developed a perfusion simulator system that is designed to simulate a patient before, during and after cardiopulmonary bypass for open heart surgery. It can also be used as a patient simulator for VA or VV ECMO. It is a programmable, high fidelity (HF) simulator system designed to attach to any heart-lung or ECMO machine circuit. It is intended both as a teaching tool, and as a tool for evaluating the performance of an operator in the conduct of simulated cardiopulmonary bypass or ECMO.[13]

The company has sold the Califia systems worldwide: U.S., Canada, France, Belgium, Germany, China, Turkey and the Netherlands. Manufacturers have purchased these systems, as have schools and large hospitals. The hospitals are generally university-based with new or remodeled simulation centers. HF simulation is used for ECMO training, ECMO disaster drills, and training anesthesia and cardiothoracic surgery residents.

CONCLUSION

The experiential learning model has proven to be an invaluable resource for certain patient populations undergoing cardiac surgery. Multi-institutional studies looking at the positive attributes surrounding this type of education are needed.

REFERENCES:

1. Kolb D. Experiential learning: experience as the course of learning and development. Englewood Cliffs, New Jersey: Prentice Hall; 1984.
2. Knowles M. Self-directed learning: A guide for learners and teachers. San Francisco, Jossey-Bass; 1984.
3. Lateef F. Simulation based learning: Just like the real thing. Journal of Emergency, Trauma, Shock. 2010 Oct; 3(4):348-52.
4. Simulation in Healthcare: The Journal of the Society for Simulation in Healthcare: Volume 12(1), February 2017: p 1-8.
5. Michael A. Rosen, Ph.D.; et al. Simulation in Continuing Education for the Health Care Professions: A Systematic Review. Journal of Continuing Education in The Health Professions. 2012; 32(4):243–254.
6. Impact of an open-chest extracorporeal membrane oxygenation model for in situ simulated team training: a pilot study. Interactive Cardiovascular Thoracic Surgery. 2014; 18(1):17-20.
7. William Dunn, MD, et al. Simulation, Mastery Learning and Healthcare. The American Journal of the Medical Sciences. 2017; 353 (20): 156-165.
8. Simulation incorporating cardiac surgery life support algorithm into cardiac intensive care unit practice. Simulation in Healthcare. 2016; 11:419-424.
9. Educational program in crisis management for cardiac surgery teams including high realism simulation. Journal of Thoracic and Cardiovascular Surgery. 2014; 144(1): 17-24.
10. American Board of Cardiovascular Perfusion. abcp.org/.
11. Robertson Jamie M.; et al. Operating Room Team Training with Simulation: A Systematic Review. Journal of Laparoendoscopic & Advanced Surgical Techniques, 2017; 27(5).
12. Gallagher CJ, Tan JM. The current status of simulation in the maintenance of certification in anesthesia. Int Anesthesiol Clin. 2010; 48(3): 83-99.
13. Biomedical Simulation Califia Simulator. https://www.biomedsimulation.com.

Mindy Blackwell, MS, CCP, has been an assistant professor and the director of the cardiovascular perfusion program since she joined Rush in 2014. Prior to coming to Rush, her professional work included clinical support for both adult and pediatric ventricular assist device patients. She has been a perfusionist for 25 years, the majority of that time involved in perfusion education and in pediatric and adult perfusion practice. Her research interests include anticoagulation in pediatric mechanical circulatory support and the science of learning.

LEARNING BADGES

Dawn M. Oles,
MHPE, CCP, LP

A BADGE IS **RECOGNITION** FOR YOUR **HARD WORK** AND SOMETHING CONCRETE TO SHARE WITH YOUR COLLEAGUES AND SUPERVISORS.

Do you remember being a Boy or Girl Scout? Do you remember earning merit badges and pins to proudly display on your uniform after completing multiple requirements and learning tasks? Some of you may have been in the military. The tradition of accomplishment badges in the military is as old as the military itself. If you understand the markings on a military uniform, then you can distinguish how long the person has served, honors they have earned and skills they have mastered. Organizations award badges as incentives to fulfill requirements, learn new things and practice skills to broaden horizons. Badges are quickly becoming a new avenue for continuing education.

Over the past year, AmSECT University has been actively working on creating several learning badges to award a digital token to those learners who have immersed themselves in additional post-graduate education — those who desire to become experts in a particular subject matter. We believe that it is our organizational responsibility to encourage continuing education through individualized learning paths so learners can plunge into knowledge that advances careers. These badges represent a different approach to credentials and can be displayed on your CV, Facebook, LinkedIn and other social media platforms.

The three badge projects currently being developed are the Perfusion Certification Review Course, Blood Management and Extracorporeal Life Support (ECLS) learning badges. The Perfusion Certification Badge will be released early this summer. Enrollment will begin late this summer in the ECLS Learning Badge, and then later this year for the Blood Management Badge. We are in the process of creating a new college to house the ECLS materials. Mindy Blackwell of Rush University and Jeff Riley are heading up this project. The Blood Management project is being managed by Mark Lucas and Michelle Tozer.

Each learning badge consists of approximately 30 hours of study. As enrollment begins, you will notice the ECLS classes will not be traditional lecture or PowerPoint presentations. The classes are being designed using interactive software where the learner will be given a scenario and tasked with solving a problem before moving on to the next section. The idea is to challenge learners' understanding through decision processes that result in simulated consequences (both good and bad) that may be experienced clinically.

After completing 15 core requirement classes, learners will choose between the adult or pediatric track. The core classes are a combination of materials common to both tracks. Some examples of the core requirement classes:

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Principles of VA ECMO, Indications/Contraindications, Systemic Inflammatory Response, Pharmacology, Management of Anticoagulation, Quality Management, Basic Circuit Interventions, Understanding Ventilation Dynamics, Ethics of ECLS and so on.

The adult and pediatric tracks then diverge to differentiate between the various anatomy, pathophysiology, circuit designs, cannulations, complications and bedside management techniques that these two groups no longer have in common. To complete the requirements for the badge, the learner must choose elective classes from a list. Learners will track their progress through the badge tab at the top of their menus. There is no timeline to complete the requirements for the learning badge.

A badge is recognition for your hard work and something concrete to share with your colleagues and supervisors. But, more importantly, a badge gives you more knowledge to deliver better care to your patients. If you are interested in working with either team to develop scenarios, please contact me through the AmSECT office.

I would like to take a brief moment to welcome Michelle Tozer and Zach Beckman. Tozer is a practicing perfusionist at Massachusetts General Hospital and has accepted the position of co-dean for the College of Blood Management. She will be working with Mark Lucas. Zach Beckman is joining us from Inova Fairfax Hospital and will be sharing dean responsibilities with Dave Fitzgerald in the College of Leadership. Several other co-dean positions are available. If you have ever thought of becoming a perfusion educator, AmSECT University is a great way to get involved and share your expertise.

One last note: AmSECT University has begun to archive old class material. Classes are reviewed after they have been posted for two or three years. Each class is reviewed for relevancy and educational content. If the dean feels that the information is outdated, no longer relevant or there is a new class that has replaced it with current information, the class will be archived. Each college contains an archive subcategory. Learners can continue to access these classes for historical purposes. We will continue to award ABCP Category I CEU's for another couple of years. Thank you for your continued support of AmSECT University.

Dawn Oles, MHPE, CCP, LP, has been a perfusionist for more than 20 years. She recently accepted a part-time perfusion position in Anchorage, Alaska, after serving as the director of perfusion education at the Mayo Clinic in Rochester, Minnesota. Dawn's passion for perfusion education is exemplified in her role as provost of AmSECT University. Dawn also enjoys hiking and art quilting.

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THE EVOLVING ROLE OF SIMULATION IN HEALTHCARE AND ALLIED HEALTH EDUCATION

Isaac Chinnappan,
MS, CCP, LCP, FPP, CPBMT

THE MODE OF **TEACHING** SHOULD BE WIDE-RANGING BASED ON INDIVIDUAL STUDENT ESSENTIALS.

The healthcare education programs in the United States in medicine, nursing, pharmacy and other allied health professions have been widely recognized as among the finest in the world.[1] Therefore, it is no longer a question of whether an individual can retain or access facts, but rather how they use, evaluate and apply facts to the day-to-day challenges of healthcare individuals and communities. There is a need to focus on the content and format of interprofessional education, as well as the relative rareness of interprofessional curriculums.

LEARNING IN THE FUTURE

Learning methodology in healthcare is rapidly changing and growing to meet the challenge of a new era in which the expectations and demands of our patient population are shifting at an accelerating pace. In the next decade, teaching and learning methods will depend on a personalized learning model, like competency education, which tends to be more student-centered. The current grade-based evaluations should move toward competency and clinical-based evaluations.

Grade-based evaluations may help a student to gain a higher grade point average (GPA) even if the student doesn't fully understand or master clinical skills. Competency-based clinical education may facilitate students' comprehension and achievement of mastery in a set of objectives before moving to the next level. Also, it facilitates deeper understanding and more meaningful ways in which students can excel in clinical approaches.

The competency-based learning systems evaluate each student's clinical progress beyond their learning targets and offer direction to learn in areas in which they are deficient.[2] The competency-based clinical education may also facilitate an independent or student-specific learning model. Student-specific learning systems may facilitate educating students based on their skill level. All students are not equal or lacking in attainment of specific skills. The mode of teaching should be wide-ranging based on individual student essentials.

Healthcare education constitutes a wide spectrum of specifics. Each specific requires a systematic stage of entry-level education, professional edification, clinical training and evidence-based practice. Though our existing system of education provides the mechanism of learning at different levels, medical error is still considered a critical cause of death.[3] Healthcare teaching institutions should concentrate on producing ideally competent healthcare providers to meet the demands and expectations of our patients and society.

SIMULATION MAY HELP TO UNDERSTAND AND LEARN FASTER IN A SAFE WAY, BUT IT WON'T PRODUCE **SKILLFUL PROFESSIONALS** BY ITSELF.

THE REAL FUTURE IS SIMULATION

Our current education systems focus their curricula more on theoretical subjects, such as science courses, analytics, quantitative problem solving and routine classroom lectures. This technique may help students to understand and develop mastery in theoretical concepts. But, innovation could be achieved through team-oriented, critical thinking, competency-based evaluations and practical problem-solving skills.[4]

Simulation-based training is evolving as a strategic technique for developing professional and technical skills and interdisciplinary teamwork required of today's healthcare professionals. Simulation-based education facilitates everything from realistic emergency drills to low- or high-frequency events in healthcare.[5] Most professionals believe that simulation-based education and training provides a safe opportunity to practice various scenarios, but its real benefits to healthcare professionals, the healthcare system and especially patients are still being debated.

EVOLUTION OF PERFUSION EDUCATION

Perfusion education has evolved significantly throughout its 70 years. The "pump technician" role has evolved to the technologist level. The science, technology, biomedical instrumentation and educational processes related to cardiopulmonary bypass have undergone continual change and transformation. Formal educational training programs have grown from the level of a certificate credential to providing master's level programs. The roles of perfusionists have expanded from "in cardiac surgery" to "in medicine."[6]

SIMULATION-BASED LEARNING – PROS AND CONS

Simulation-based learning in healthcare has become an instrumental tool for perfusion education and attaining the goal of improving students' skill and patient safety during cardiopulmonary bypass. Simulation facilitates students to learn by doing, self-evaluate their skills and practice correcting themselves on mistakes that may be harmful in clinical settings. Errors in simulation-based learning aren't harmful. Many patients don't like or are not comfortable when students are performing a procedure on them under supervision. By practicing in SIM lab setting first, students may improve their skills in a low-pressure environment that allows for building the confidence that's required to perform in clinical practice.

Simulation-based education is not complete and not always able to mimic or recreate real-life situations. Simulation may help the students to understand the mechanism of clinical scenarios in a non-clinical environment through technological inputs, but it won't teach the real language of physiology that constitutes clinical scenarios in the operating room.[7] There's really no true substitute for real-life patient care. Simulation may help to understand and learn faster in a safe way, but it won't produce skillful professionals by itself.[8]

In SIM sessions, everything is doable and fixable, but in clinical settings, we need to understand various mechanisms to fix an issue. Therefore, the evolving role of simulation-based education both in healthcare and allied health is inevitable. The combined learning through SIM sessions in a non-clinical setting and through exposure in real clinical settings could facilitate producing skillful and competent entry-level healthcare providers.

REFERENCES:

1. Gold J. The Ten Pillars Shaping the Future of Health Science Education: External Forces, Ongoing Evolution and Future Trends. National AHEC Organization. Retrieved from: https://www.nationalahec.org/pdfs/TheFutureofHealthScienceEducation-ExternalForcesOngoingEvolution.pdf.
2. The Future of Learning: Education in the Era of Partners in Code. KnowledgeWorks Forecast 4.0. Retrieved from: http://www.knowledgeworks.org/future-learning.
3. Why Discuss the Future of Healthcare Education? HalldaleGroup. 2014. Retreived from: http://www.halldale.com/camls-2014/why-future-healthcare-education#.WQSzTdLyuUk.
4. Herzlinger R, et al. Innovation in Health Care Education: A Call to Action. HealthAffairsBlog, Jan. 29 2015. Retrieved from http://healthaffairs.org/blog/2015/01/29/innovation-in-health-care-education-a-call-to-action.
5. Simulation-The very real future of health care education. OHSU Extra, Spring 2013.
6. Toomasian JM, et al. The evolution of perfusion education in America. Perfusion, 2003 Jul; 18(4):257-65. Retrieved from: https://www.ncbi.nlm.nih.gov/pubmed/14575415.
7. Pros and Cons of Simulation in Healthcare. The Academy of Professional Development Blog, Jan. 1 2017. Retrieved from: https://www.academyprodev.com/blog/pros-and-cons-of-simulation-in-healthcare.
8. Pros and Cons of Training in Health Care Simulation Labs. Living Arts College Medical Blog, Apr. 10 2014. Retrieved from: http://www.living-arts-college.edu/medical/blog/?p=131.

Isaac Chinnappan, MS, CCP, LCP, FPP, CPBMT, is associate program director and clinical coordinator of the perfusion program at Vanderbilt University and senior pediatric perfusionist at Monroe Carell Jr. Children's Hospital in Nashville, Tennessee.

Stefanie Cavanaugh, *CCP*

PERFUSION EDUCATION AND PROGRAM DEVELOPMENT: WE ARE ALL IN THIS TOGETHER

THE ANSWER MAY BE TO CREATE MORE EDUCATIONAL CROSSOVER AND COOPERATION VIA COMPETENCIES, POLICIES AND PRACTICE.

Collaboration can be a powerful tool that creates challenges as collaborating programs develop and change over time. This is a story of three intertwined programs (two pediatric and one adult) and decisions without clear right or wrong answers that set up opportunities for perfusion education in the setting of program development.

In 2014, Mary Bridge Children's Hospital (MBCH) in Tacoma, Washington, formed a partnership with Seattle Children's Hospital (SCH) to rebuild its pediatric cardiac program. In an effort to unify the programs and streamline both practices, MBCH's perfusion mirrored SCH's equipment and techniques. For each case, knowledge is shared, strategy is reviewed and techniques are discussed. This collaboration has not only helped to increase the caseload at MBCH but has also provided the perfusionists from both institutions with a greater depth of knowledge through shared experiences.

MBCH and Tacoma General Hospital (TGH) are part of MultiCare Health Systems and therefore share the same personnel, equipment and resources. TGH has a busy adult program that continues to expand and seek out new technologies. Since MBCH does not do cases every day, the educational experience for staff participating in the TGH adult program is invaluable. However, there is often a mismatch between the standardization of equipment (heart-lung and ancillary machines) between MBCH, SCH and TGH.

For example, the adult cardiac program at TGH needs to replace older heart-lung machines. Because of the shared resources between MBCH and TGH, there has been an inclination to merge the two programs in regard to equipment. However, this equipment may then be different from that used at SCH. Although using the same equipment as TGH would be advantageous for MBCH, without education and practice, the unity with SCH could be compromised. The answer may be to create more educational crossover and cooperation via competencies, policies and practice.

Reinforcing the value of education as the solution is TGH's interest in pursuing a different electronic record-keeping system from that which has historically been used at SCH. A hard stop to purchasing new technology perhaps should not be dictated by collaboration and the desire to standardize across institutions; it should be celebrated as an educational opportunity for all involved.

For example, if MBCH wants to purchase the Spectrum platform (Spectrum Medical), and SCH currently uses Connect (LivaNova), there is an opportunity created for members of both teams to learn and become familiar with both devices. Education via experience and competencies supported by updated policies, procedures and guidelines are the cornerstones of success for all teams involved.

In closing, little hearts (kids) may not just be small (adult) hearts, but if you work in collaboration with an adult institution, as well as with other pediatric programs, then resolving questions of standardization versus institutional differences may be best served by ongoing, collaborative perfusion education. Cross-educational opportunities between all three programs (MBCH, TGH and SCH) continue to exist and exemplify how learning should never end in our professional careers as perfusionists.

LEARNING SHOULD NEVER END IN OUR PROFESSIONAL CAREERS AS **PERFUSIONISTS.**

Stefanie Cavanaugh, CCP, is a staff perfusionist at Tacoma General Hospital and Mary Bridge Children's Hospital in Tacoma, Washington. She has been practicing since 2009 and is currently working toward becoming a Pediatric Fellow in the American Society of Extracorporeal Technology. She is passionate about perfusion but also loves to be outdoors exploring, running, hiking and playing when she is not working.

THE NEXT BIG THING?

Laura Dell'Aiera,
BS, CCP

LESS INVASIVE APPROACHES APPEAL TO PATIENTS AND HEALTHCARE PROFESSIONALS ALIKE. PATIENTS BENEFIT FROM QUICKER HEALING AND LESS PAIN.

According to *Forbes*, the question of every day is: "What's the next big thing that's going to change everything?"[1] This question can apply to every type of business, and, like it or not, healthcare is a business. We've seen a lot of changes and "next big things."

One thing that seems to not only be sticking, but growing by leaps and bounds, is minimally invasive techniques. Less invasive approaches appeal to patients and healthcare professionals alike. Patients benefit from smaller scars, quicker healing and less pain. Providers have found a decreased risk of bleeding and better outcomes with many procedures.

In order to be less invasive, the technology and products to meet the vision had to be developed. In recent years, companies have begun doing just that. The vision is coming to fruition, partially due to new cannula availability. In particular, percutaneous ventricular assist device (pVAD) and extracorporeal membrane oxygenation (ECMO) cannulation has revolutionized the course of treatment for some cardiac failure patients. Some of the newest are the dual lumen cannulas, which are making it possible to create only one incision and insert only one cannula, all while having the function of two. Dual lumen simply means that the single cannula has two separate passageways or "arms." Here we will talk about three different options for this type of cannula.

THE AVALON CANNULA

Created by Maquet, the Avalon cannula uses one "arm" of the cannula to serve as a drainage side. [2] This design brings blood from two different openings much like a traditional venous cannula would. One opening is at the tip of the cannula and sits in the inferior vena cava (IVC). The second drainage port is more proximal and sits in the superior vena cava (SVC). The other side of the cannula serves as a return lumen. This side has a single opening that lies between the two drainage ports at the level of the RA. This port, when placed properly, angles blood outflow toward the tricuspid valve.

The Avalon cannula serves to provide veno-venous support and has proven to do so when it is placed properly. Many articles suggest that a hospital new to the use of these cannulas should use fluoroscopic guidance to assist in placement and avoid complications from malposition. The cannula is designed to be radiopaque in order to be seen clearly on imaging.[3] Another option is to place the cannula by transesophageal echocardiography (TEE) guidance. This cannula is available in sizes 13, 16, 19, 20, 23, 27 and 31 fr.

IN ORDER TO BE LESS INVASIVE, THE **TECHNOLOGY AND PRODUCTS** TO MEET THE VISION HAD TO BE DEVELOPED. IN RECENT YEARS, COMPANIES HAVE BEGUN DOING JUST THAT.

THE ORIGEN CANNULA

Similar to the Avalon, the OriGen cannula is produced by OriGen Biomedical.[4] This cannula is not currently available but is expected to become available within the year. Previously, the company dealt with a recall of their 13 fr dual lumen cannula in April 2015. The entire line is now being revamped and boasts many new features. There are percutaneous and cut-down kits available for insertion. The tip of the cannula is radiopaque for better visualization on imaging.

Placement of drainage and return ports are separated rather than simply opposite one another in order to reduce recirculation. The cannula is wire reinforced at its tip to prevent kinking, and the entire cannula is now made of a material called PEBAX, which will help the cannula recover from any potential kinks. This cannula will be available in sizes 13, 16, 19, 23, 28 and 32 fr.

THE PROTEK DUO CANNULA

The final dual lumen cannula that should not be mistaken for either of the above is the PROTEK Duo cannula. This cannula was brought to the U.S. by Chalice Medical Ltd., based in the United Kingdom, through Cardiacassist Inc.,[5] established in Pittsburgh. This cannula will be inserted via right internal jugular vein (RIJ) just as the cannulas above, but it should then be advanced past the tricuspid valve, into the right ventricle (RV), and through the pulmonary artery (PA) valve with the tip sitting in the PA.

There are three sets of drainage ports that sit in the right atrium (RA), and the open tip of the cannula serves as the return port in the PA. This cannula will then allow the RV to rest, serving as a percutaneous right ventricular assist device (RVAD). However, using this as an “RVAD” is considered off-label use, as it was approved for veno-veno (V-V) ECMO. The cannula will be placed in exactly the same way in either assist situation. One major draw of this cannula is the minimal recirculation that is allowed due to the placement of the cannula. It also possesses some of the same qualities as the above cannulas such as wire reinforcement and radiopacity.

Currently, the cannula is available only as a kit, which includes the dual lumen catheter; the company’s centrifugal pump, called the TandemHeart pump; and tubing to create the circuit. Also available from this company is their TandemLung oxygenator, designed to attach to their Voyager Vest, which would allow the patient to ambulate while on V-V ECMO.

While researching these three cannulas, I found many articles about research and development in the realm of percutaneous RVAD and ECMO options. It would behoove all of us to keep our eye on the horizon for this new technology; it may just be the next big thing!

REFERENCES:

1. Conner, Cheryl. (2014). Patterns: How to Predict the Next Big Thing in Business. Forbes. Retrieved from: https://www.forbes.com/sites/cherylsnappconner/2014/07/16/pattern-recognition-how-to-predict-the-next-big-thing-in-business/#7e81eb393b79
2. https://www.maquet.com/int/products/avalon-elite/
3. Javidfar J., Wang D., Zwischenberger JB., Mongero L., Sonett J., & Bacchetta M. Insertion of bicaval dual lumen extracorporeal membrane oxygenation catheter with image guidance. ASAIO Journal, 57, 203-205. Retrieved from: https://www.ncbi.nlm.nih.gov/pubmed/21499077
4. http://www.origen.com/products/ECMO-Respiratory/Catheter
5. http://www.tandemlife.com/

Laura Dell'Aiera, BS, CCP, works as a staff perfusionist at the University of Rochester Medical Center and has previous experience working as a staff member at Geisinger Medical Center. Her professional interests lie in research and education.

SEARCHING FOR THE LETHAL CORNER

Gary Grist, *BS, RN, CCP Emeritus*

HUMAN BEINGS ARE **COMPLICATED BIOLOGIC MACHINES,** ... AND PROBLEMS WITH MACHINES ARE USUALLY PREDICTABLE.

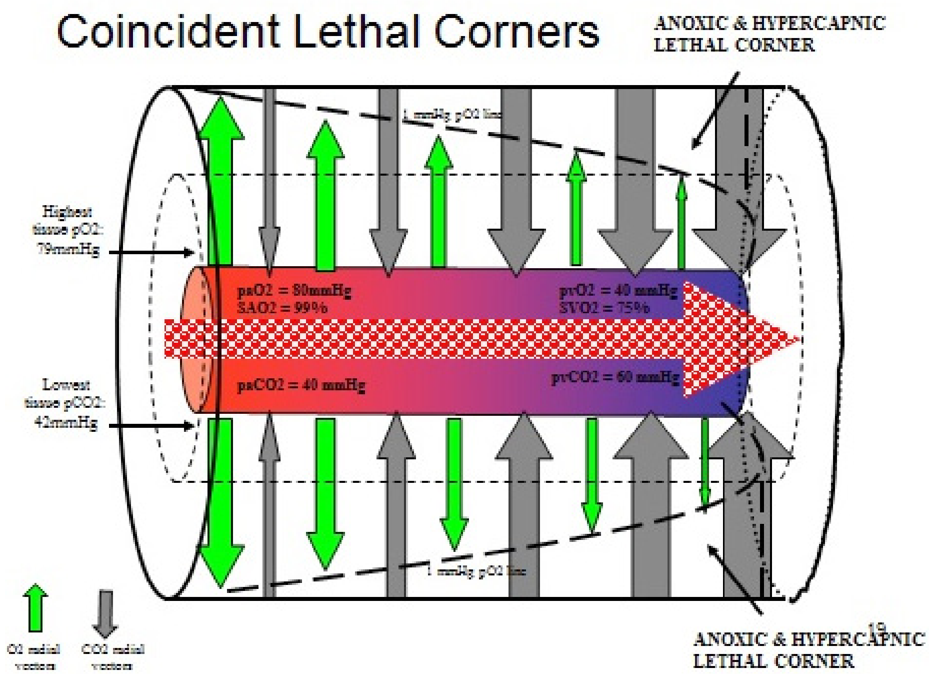
In November 1990, I was searching the medical library for new ideas pertaining to the perfusion profession. Having been a perfusionist since 1968, I knew all the common pertinent facts relating to cardiopulmonary physiology and extracorporeal support. In my early years, I quickly noticed that despite providing oxygenation and good perfusion using my cardiopulmonary bypass (CPB) pump, there were still disturbing complications after CPB in a few patients.

The universal fallback explanation: Inflammatory response to the pump caused many complications; the patient's own physiologic weaknesses contributed as well. Improvements in circuits, priming and technique had ameliorated many of those complications, but not removed them entirely. I grudgingly accepted the inflammatory explanation for many years until extracorporeal membrane oxygenation (ECMO) came along.

The children's hospital for which I worked started its ECMO program in 1986. Most ECMO patients survived the extended exposure to an extracorporeal circuit. Why didn't the inflammatory response injure or kill them? The standard explanation: Most patients could tolerate, even acclimate to, the inflammatory mediators if exposed to circuits for an extended period of time. Those that didn't survive? Many rationalized they probably could not tolerate it for unknown reasons.

Also troubling, ECMO patients who seemingly were not as sick as others died from an unexpected complication. These patients often gradually deteriorated under conservative treatment until it was determined that ECMO was needed, and implemented in a controlled and relaxed environment. In the neonatal population with which I was working, the average age before ECMO initiation among non-survivors was 4.4 +/- 5.8 days (n = 31). By contrast, other neonatal ECMO patients who seemed sicker and required more rapid ECMO implementation did well and recovered without severe complication. Among these neonates, the average age of survivors before ECMO initiation was only 2.4 +/- 3.6 days (n = 163) — a full two days earlier.[1] Did the two-day delay while conservative treatments were attempted play a role in the demise of these patients?

Another mystery: Most of the patients who died had a lethal complication not directly related to their pulmonary or cardiac disease. Brain bleeds and brain infections were very common, as was organ failure or simply failure to improve. The usual explanation was that their shock and/or hypoxia before ECMO had caused the damage. That didn't always make sense; many patients did not experience severe hypoxia or shock before ECMO. They were often placed on ECMO simply because the high ventilator settings or the



Theorectical concept of a Krogh cylinder during reduced perfused capillary density showing capillary blood flow, oxygen and CO2 vectors and coincident anoxic and hypercapnic lethal corners.

Figure 1

need for high doses of support medications were hazardous. If the ventilator and medications failed, others, by contrast, who were placed on ECMO emergently due to severe shock or hypoxia subsequently did well and recovered.

The physicians with whom I worked felt that each patient was different and that there was no way to predict the outcome with certainty. Human beings are complicated biologic machines, but machines nonetheless. And problems with machines are usually predictable. That is why preventative maintenance is performed; we know what is going to break before it breaks and why.

I felt that doctors and perfusionists had missed something very important — some, as yet, unknown concept or principle. As I wandered through the library's stacks that November evening, I opened an article by Popel that discussed how oxygen was distributed at the capillary level.[2] Terms that were completely new to me: the oxygen pressure field, the Krogh cylinder, perfused capillary density, radial and axial oxygen vectors, and the lethal corner. I followed the references and was introduced to August Krogh, Ferdinand Kreuzer, Dietrich Lubbers, Niels Lund and Paul Schumacker.[3-8]

These articles presented a new concept to me: the oxygen pressure field theory (OPFT). Oxygenation is usually evaluated with single digit arterial or venous p02 or hemoglobin saturation values; for example, pa02 = 100 mmHg, pv02 = 35 mmHg, Sa02 = 98 percent, Sv02 = 70 percent. But OPFT is different. Using the Krogh cylinder as a mathematical model, OPFT explains how oxygen is distributed outside of the vascular system within tissues in a wide field of partial pressures with values ranging from being equal to the arterial p02 to as low as zero.

Theoretically, the area containing zero oxygen can vary in size from inconsequential to large enough to cause tissue death (the lethal corner). This lethal corner can develop despite normal cardiopulmonary function and oxygen delivery. I went to experienced perfusionists and doctors with whom I worked and asked them. They had never heard of OPFT either.

Our ECMO program was about four years old and had worked on 120 patients with 75 percent survival rate, which were acceptable results at the time. As I explained earlier, there was no rational explanation for the seemingly random deaths. Could OPFT solve the mystery? I was in the perfect situation to answer that question. I was the chief perfusionist in an active pediatric ECMO program. Each child on ECMO was closely followed with every blood and physiologic test pertinent to critical care during extracorporeal support. These tests were repeated at regular intervals to monitor for progress and safety. All I had to do was closely observe these tests, keeping in mind that I was trying to discern the oxygen pressure field (if it existed) and detect the lethal corner (a portent of death) if it developed.

I consulted with Stanley Hellerstein, MD. Stan, a nephrologist who, in the absence of a hematologist at the hospital, had been caring for all the sickle cell (SC) children. He was the smartest doctor I ever knew. I came to know him years earlier when he had asked me to help him with exchange transfusions on SC children who had strokes due to their illness.

I asked Stan what number or parameter at which I could look to quantify how sick a cardiopulmonary (CP) patient was — i.e., detect the lethal corner. He told me, in his experience, if the CP patient could maintain a normal anion gap (AG), they would most likely survive. He thought I should study the patient's AG before and during ECMO.

As I reviewed the labs on the first 120 ECMO patients, I found that patients with normal AGs during ECMO had the lowest mortality, and patients with high AGs had the highest mortality. Of all the expired patients, half had high AGs while the other half still had normal AGs. An elevated AG had good positive predictive value for death. But a normal AG had poor negative predictive value for survival. Nonetheless, this was an important first step in discerning the oxygen pressure field and searching for the lethal corner.

I concluded that the elevated AG was a reflection of the conversion of a portion of the tissues (those in the lethal corner) to anaerobic oxygenation resulting in the production of organic acids like lactic acid. I would later find that for each milliequivalent per liter (mEq/L) that the AG was above the normal limit, mortality would increase by an additional 10 percent. For example, patients with an average AG of 10 mEq/L during ECMO had a 10 percent mortality. Patients with an AG of 15 mEq/L had about 50 percent mortality. And the unfortunate patients with an average AG of 20 mEq/L had 100 percent mortality. In essence, the magnitude of the AG told me how big the lethal corner was. I would later refer to this as an "anoxic lethal corner."

Despite finding this lethal corner using the AG, there was something important missing. I still had dead patients with normal AG values. My focus had been on studying the effects of anaerobic metabolism due to the lack of oxygen at the cellular level. But after being placed on ECMO, patients had all the oxygen they needed. Unexpectedly, the second piece of the puzzle had nothing to do with oxygenation.

I came across a 1991 article by Johnson and Weil describing how the CO2 gradient between the arterial and venous blood gases could be used to predict mortality in cardiac patients.[9] I was taught to use venous blood gases early on in my career. I had always insisted on drawing both arterial and venous gases on ECMO patients and my CPB patients. But I had not considered that an elevated pvCO2 was an indication of intercellular CO2 retention, which caused a detrimental pH change in the cells, stopping their normal metabolic processes despite adequate oxygenation.

In reviewing those expired ECMO patients with normal AG values, I found that they had elevated pvCO2 values. This was the other puzzle piece! I noticed for every 1 mmHg that the CO2 gradient was above normal, the mortality increased by 10 percent. For example, patients with an average CO2 gradient of 7 mmHg had about 10 percent mortality. Those with a gradient of 12 mmHg had about 50 percent mortality. And those with a 17 mmHg gradient had 100 percent mortality. This, then, was another type of lethal corner, not caused by oxygen deprivation, but by intracellular CO2 accumulation: a hypercapnic lethal corner (see figure 1).

Since the AG scale for mortality and the CO2 gradient scale for mortality were about the same (10 percent increase for each unit increase above normal), I determined that the AG and CO2 gradient scores could be added together as a "viability index" score.[11] I found this to be true in older patients as well, not just neonates. After reviewing 294 ECMO patients, those with an average viability index score of 17 (AG of 10 + CO2 gradient of 7) had 5 percent mortality. Those with a viability index score of 27 (AG of 15 + CO2 gradient of 12) had about 50 percent mortality. Those with an index score of 37 ((AG of 20 + CO2 gradient of 17) had virtually 100 percent mortality. The one thing that seemed to violate this rule was if a patient had a lethal anatomy such as certain congenital diaphragmatic hernia or cardiac patients. In that case, maintaining a low score on ECMO could not save the patient.

I concluded that when patients with a lethal corner were placed on ECMO and suddenly reperfused, they suffered a reperfusion injury that led to the most common lethal complications. Some of my data was published in 2009 and 2010, 19 years after discovering August Krogh's Oxygen Pressure Field Theory.[1,10]

So, should hope be abandoned for ECMO patients with a lethal corner? No! Rather, we should consider a "reperfusion strategy" for the most vulnerable patients before and during ECMO that counteracts the ravages of reperfusion injury.

This article does not have the scope to list all the many details about what I found in my search for the lethal corner. Those can be seen on my website: perfusiontheory.com.

REFERENCES:

1. Grist G, Whittaker C, Merrigan K, Fenton J, Pallotto E, Lofland G. Defining the late implementation of extracorporeal membrane oxygenation (ECMO) by identifying increased mortality risk using specific physiologic cut-points in neonatal and pediatric respiratory patients. J Extra Corpor Technol. Dec 2009;41(4):213-219.
2. Popel AS. Theory of oxygen transport to tissue. Crit Rev Biomed Eng 1989; 17(3):257-321.
3. Krogh A. The rate of diffusion of gases through animal tissues with some remarks on the coefficient of invasion. J Physiol Lond 1918; 52:391-408.
4. Krogh A. The number and distribution of capillaries in muscles with calculation of the oxygen pressure head necessary for supplying the tissue. J Physiol Lond 1918; 52:409-415.
5. Kreuzer F. Oxygen supply to tissues: the Krogh model and its assumptions. Experientia 1982; 38(12):1415-26.
6. Lubbers D. Fundamentals and significance of local oxygen pressure measurements and pO2 histograms in the evaluation of oxygen supply to organs and organisms. In: Ehrly, AM, editor. From Determination Of Tissue Oxygen Pressure In Patients. pages 1-13. Oxford, New York: Pergamon Press, 1983.
7. Lund N. Skeletal muscle surface oxygen pressure fields in normal human volunteers and in critically ill patients. In: Ehrly AM, editor. Determination Of Tissue Oxygen Pressure Fields In Patients. Oxford, New York: Pergamon Press; p 53-59, 1983.
8. Schumacker PT, Samsel RW. Analysis of oxygen delivery and uptake relationships in the Krogh tissue model. J Appl Physiol 1989; 67(3):1234-44.
9. Johnson BA, Weil MH. Redefining ischemia due to circulatory failure as dual defects of oxygen deficits and of carbon dioxide excesses. Crit Care Med 1991; 19(11):1432-8.
10. Grist G, Whittaker C, Merrigan K, Fenton J, Pallotto E, Molitor-Kirsch E, Ostlie D, O'Brien J, Lofland G. Identifying Neonatal and Pediatric Cardiac and Congenital Diaphragmatic Hernia Extracorporeal Membrane Oxygenation Patients at Increased Mortality Risk. J Extra Corpor Technol. Sep 2010; 42(3):183-190.
11. Grist G. The Viability Index: A survival score for perfusion patients. Progress in Pediatric Cardiology. Jan 2008;24(2): 101–111.

Gary Grist, BS, RN, CCP Emeritus, was a perfusionist from 1968 through 2014 and is now retired. His career highlights include winning the AmSECT Award of Excellence in 2015, the AmSECT Research Award in 2010, the AmSECT Perfusionist of the Year in 2002 and the Excellence in Nursing Award in 1995 from The Children's Mercy Hospital in Kansas City, Missouri.

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1. Data on file | 2. Bharat Datt MD, CCP, et al. Blood only cardioplegia with the Quest MPS. Canadian Perfusion Canadienne: 19(1) April: 31-37
3. Kevin Fleming, BS CCP, et al. Perfusionist-Controlled Microplegia. The Department of Cardiovascular Perfusion, Toledo Hospital, Toledo, OH

SUCCESS IS A PRODUCT OF **PREPARATION**

Shahna Bronson,
CCP

EMBRACE YOUR PASSION TO CREATE SAFER, BETTER CARE. **READ, STUDY AND GROW.**

Successes in perfusion technology are built on the proper usage of many safety devices and intentional equipment design features. Our heart-lung machines have a plethora of safety devices, including level detectors, air bubble detectors, air-oxygen analyzers, high-pressure alarms, retrograde flow alarms, stop linked arterial pumps to cardioplegia pumps, one-way valves and temperature alarms. Our equipment includes an oxygenator, reservoir, cardioplegia circuit, vacuum kit, hemoconcentrator and so on, each with a purpose.

In order to understand emerging technology, we must understand that which currently exists. Each manufacturer is devoted to the research and development of the safest, most productive and most cost-appropriate products available. Understanding the existing technology (such as the blender) sets the foundation for safely embracing emerging technology.

When discussing this month's article with a mentor, I struggled with the idea of taking a piece of equipment (that is used every day by every perfusionist) and making this month a positive contribution to *AmSECT Today*. I asked, "Why would we want to discuss a blender? We all use one, regardless of brand, and everyone knows how to use a blender, right?" But, have any of us read the instructions for use (IFU), taken the time to dissect it and learned about all its working parts, the troubleshooting to go along with it and the necessary knowledge of use? No, we have not.

As Anthony J. D'Angelo said, "Develop a passion for learning. If you do, you will never cease to grow." Remind yourself of the inner workings of one of our daily used tools and continue to grow. Embrace your passion to create safer, better care. Read, study and grow. Part

Figure 1

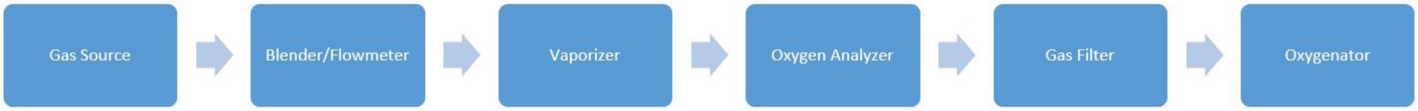
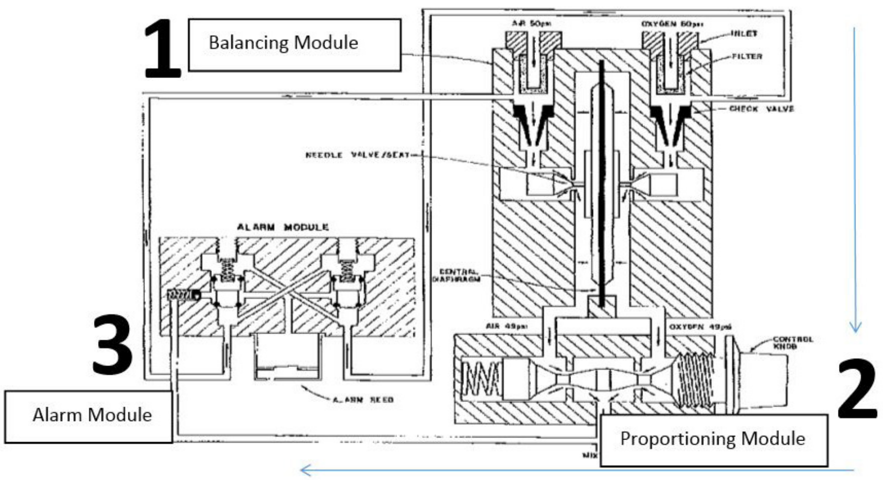


Figure 2



(side profile of Air-Oxygen Blender)

Figure 3

of being a professional is protecting yourself from mistakes and protecting the patient from your mistakes. We will make mistakes. We are human. We learn from our mistakes and learn from reviewing prior information.

This segment will break down the Sehcrist Air-Oxygen Blender's components, simplifying the science and using the evidence to improve our knowledge of not only the equipment but also to discuss how vital routine simulation, wet labs, peer discussions and troubleshooting practices can be improved.

When first thinking of the Sechrist Blender (Figure 1), it's important to understand the flow path of air and oxygen to the oxygenator. In order to sort it all out, I created the flow chart in Figure 2.

O2 and air enter the blender and mix together, the pressures are equaled out, it goes to the vaporizer and gets mixed with isoflurane, flows through the oxygen (O2) analyzer to determine content, then finally moves through the gas filter and into the oxygenator.

Research suggests that not every perfusion department uses an oxygen analyzer. This appears to be institutionally chosen regardless of the fact that the manual says, "Oxygen concentration must be monitored downstream by a calibrated oxygen analyzer."[2]

Now that we know how the flow of air and oxygen gets to the oxygenator, let's try to learn more about the actual Sechrist blender and how it works. The Sechrist blender is intended to "mix medical-grade air and medical-grade oxygen, at operator-selected ratios, for delivery to patients through various types of respiratory care equipment" and "the Flowmeter will allow flow of the air-oxygen mixture from 1 - 10 LPM."[2]

According to sechristind.com, the Air-Oxygen Blender is:

ACCURATE

The precise design of Sechrist mixers provides assurance of oxygen concentration accuracy within + 1 percentage point, even in circumstances involving wide variances in supply gas pressures. Bleed flow, located on the bottom of the proportioning module, is necessary in order to maintain FIO2 accuracy at very low flow settings.

FILTRATION

Sechrist mixers incorporate integral filtration of supply gases. A 0.1-micron water trap/filter is provided for the air inlet connection, and both gas supply connections are protected by 7 micron sintered stainless steel (non-corroding) filters.

ALARM/BYPASS SYSTEM (REED ALARM)

In the event of a supply gas failure, an audible alarm is triggered, as well as an assurance that gas from the remaining supply source will continue to be delivered. The unit will operate satisfactorily with inlet pressures of 30-70psi providing that the pressures are within 20 psi of one another.[4]

- Please note: If you are low on the air, you will then deliver 100 percent oxygen.
- If you are low on oxygen, then you will be delivering 21 percent oxygen room air.

Do you remember this picture from your perfusion school notes? The Sechrist blender works via three modules:

1. Balancing Module: Gases enter this module and pressures are equalized.
2. Proportioning Module: Gases then enter this module and are mixed to the user-specified concentrations.
3. Alarm/Bypass Module: This continous flow of gases enter the alarm/bypass module where an audible alarm will activate if there is a loss of a gas pressure or the loss of the supply of a gas.

Although simplified, the mechanics of the Sechrist Air-Oxygen Blender are fairly easy to understand. The gases go in the blender, they're mixed and set to the proportions set by perfusion, and if there is a loss of gas supply or pressure, the reed alarm will notify staff.

What if there is a problem? How do you know the blender is working? What do you

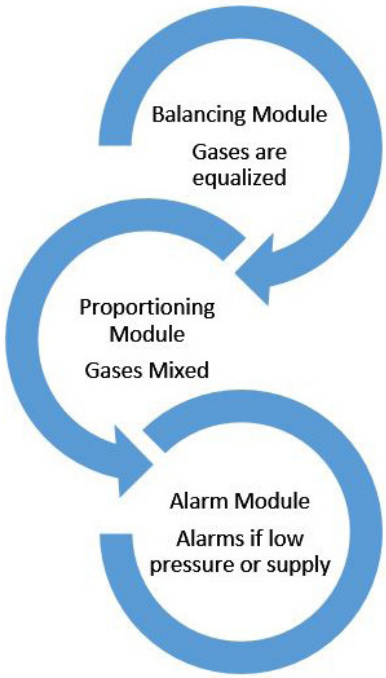


Figure 4

do if you think it might not be working? What are the best troubleshooting skills for an air-and-oxygen blender issue? If you're concerned that there's an issue, you should follow:

BLENDER TROUBLESHOOTING 101

1. Verify Gas Flow
   - First, do the obvious — feel for it (back of hand): Is there gas coming out of the green gas line?
   - Oxygen analyzer — verifies oxygen content of the gases going to your oxygenator.
   - Look — is the arterial blood coming out of the oxygenator brighter red than the venous?
   - In-line blood gas analyzer/trending device (CDI-Terumo).
   - Draw blood gas to check.
2. Verify Gas Delivery
   - Gas source — are the air and O2 connected? Is the reed alarm going off?
   - Flow meter/blender functioning — this is where having an oxygen analyzer would be critical.
   - Gas line going into/out of vaporizer.
   - Is the gas line from vaporizer to oxygenator damaged?
   - Is the gas filter attached to oxygenator?

If all these are checked and nothing is wrong, then it's time to diagnose the oxygenator.

So, why in this day and age, when we have technology that is so precise and sophisticated, are we still having a conversation about blender troubleshooting?

In 2007, Webb and a group of colleagues conducted "a small, direct-interview-type survey following a near-miss, and found that required training should not be isolated to a single individual or individuals involved in the near miss." Thirty cardiac personnel, including both perfusionists and cardiac anesthesiologists from four separate facilities, were queried as to how they would respond to a similar event, and, in particular, if they were aware of a gas flow meter on the anesthesia machine that could be attached to a CPB oxygenator.

Approximately 93 percent of those surveyed were unaware that anesthesia machines contain an oxygen flow meter that can be readily attached to any CPB oxygenator. In the surgical suite where this near-miss occurred, the anesthesia oxygen flow meter was roughly 4 feet from the heart-lung machine, and connections between devices would have taken < 20 seconds.[3]

Ninety-three percent of perfusionists and anesthesiologists! This is about nine out of 10 perfusionists and anesthesiologists that were asked. In four different facilities, they were unaware that the oxygenator could be hooked to the anesthesia machine. I firmly believe that they answered the way they did because they hadn't taken the time to walk into the OR, look at the anesthesia machine and develop a plan of action in case of oxygen/blender failure. This survey and its results are proof that we are not preparing for catastrophic events. Regardless of the fact that this data is from 2007, I assume there would be similar results in 2017.

Troubleshooting practices are essential to success. We have to practice mistakes, we have to talk about mistakes and we have to learn from mistakes. These practices help us to think about complications, think about how to solve them and how to fix any issues we may come across. Discussions of critical mistakes and/or situations may prevent a future error, or, better yet, save a life!

Research suggests that if a blender is routinely calibrated by a proper Biomed department, an actual failure of the air-oxygen blender is unlikely. Instead, the errors in oxygenation may be more likely to occur at the site of the vaporizer. Because of the fact that (1) vaporizers are filled by humans (we have to remember to fill, and fill properly, caps put back on), and (2) the vaporizers get jostled. If the vaporizer isn't seated properly, it has the ability to "leak" gas instead of sending the gas through the oxygen analyzer, through the gas filter and into the oxygenator.

After an in-depth reminder of how a basic item on our heart-lung machine works, we can "not only improve continuity, but may also reduce liability and medical mishaps."[3] We are more confident in the use and knowledge of a Sechrist Air-Oxygen Blender. We have found simplicity in the face of the chaos. We have read, studied and grown.

I have a date with an anesthesia machine.

REFERENCES:

1. Tom Rath, CCP, MS. University of Iowa Perfusion Technology.
2. Sechrist 3500 O2 Blender Manual
3. Byrne, John G, et al. Oxygenation Failure During Cardiopulmonary Bypass Prompts New Safety Algorithm and Training Initiative. JECT. 2007; 39:188–191.
4. www.sechristusa.com

Shahna Bronson, CCP, has been a certified clinical perfusionist for 15 years, earning her Certificate of Perfusion from The Cleveland Clinic in 2001. She is an executive member of The International Consortium for Evidence-Based Perfusion and has been an AmSECT member since 2012.

ISSUE IN **REVIEW**

Thomas B. Rusk,
CCP, Editor-In-Chief

1. Which of the following is true regarding the "lethal corner" concept?

a. Developed following discovery of Oxygen Pressure Field Theory

b. Tied to both anion gap (AG) and veno-arterial carbon dioxide (CO2) gradient values

c. Informs what ECMO patients are likely to experience reperfusion injury with support

d. All of the above

2. True or False: The volunteer engagement initiative AmSECT is beginning means the society highly values current volunteers and is seeking to encourage others to share their time, energy and talents with our profession.

3. Which of the following is inaccurate regarding perfusion simulation?

a. Allows learners to safely evaluate their skills and practice areas of weakness

b. Represents a perfect substitute for real-life clinical experience

c. May count toward recertification with American Board of Cardiovascular Perfusion

d. Can be designed to achieve varying levels of fidelity to clinical practice

4. True or False: Most learners remember 80 percent of what they hear, but only 20 percent of what they apply.

5. The review of how an oxygen blender works and how to troubleshoot a suspected failure was motivated by which of the following?

a. A need for understanding current technology in order to understand future technology

b. Seeing a small study which identified that many professionals did not consider the oxygen flow meter on an anesthesia machine in troubleshooting a blender failure

c. A and B

d. None of the above

6. True or False: For perfusionists working at several centers with adult and pediatric patients, questions of standardization versus institutional difference may be best answered with ongoing, collaborative perfusion education.

7. The "next big thing" discussed in this issue as revolutionizing percutaneous mechanical circulatory support is:

a. Dual lumen cannulas now available from various manufacturers

b. Ultrasound guidance for faster vessel access

c. Interdisciplinary rapid response teams

d. None of the above

8. A current student perspective on the areas of perfusion education most changed by technology includes which TWO of the following?

a. Concept visualization using 3-D animation

b. Perfusion simulation

c. Pharmacology learning using online resources

d. Electronic charting

Self-Quiz Answers

1. D
2. True
3. B
4. False.
5. C
6. True
7. A
8. B & D

EXISTING AND EMERGING TECHNOLOGY: PERFUSION EDUCATION

Jordan Hendricks

THE MORE WE CAN **PRACTICE** IN AS REAL A SITUATION AS POSSIBLE, THE BETTER THE RESPONSE WILL BE FOR STUDENTS IN THE CLINICAL SETTING.

Over the past 60 years, the technology used in cardiac surgery has changed dramatically. We are living in a society that thrives on technology, and if it isn't pushing the boundaries, then it quickly becomes obsolete. For perfusion education, the biggest changes I see are found in high-fidelity simulation training and electronic charting systems.

Before simulation, perfusionists began honing their clinical skills on patients. Understanding theory is well and good, but actually using the clamps and turning the knobs builds the muscle memory and feel for what is truly happening on bypass. These skills are critical to have safe patient outcomes post cardiopulmonary bypass. This is why a high-fidelity simulation is becoming the standard pre-clinical practice for perfusion students. It allows the students to learn in a safe environment, but also modifies the experience so the student never feels complacent. Simulation can create a constantly changing environment in which the perfusionist must be aware and respond to many evolving scenarios.

At the Medical University of South Carolina (MUSC), we have a couple simulators, allowing us the best opportunity to practice and gain confidence learning new skills. This was beneficial in forming habitual routines like weaning on and off bypass, delivering cardioplegia, adjusting blood gas parameters and managing pressure and flow dynamics. After we were comfortable with these basics, we would practice different failures that could occur on pump, such as an oxygenator change-out, massive air embolism, malignant hyperthermia or power failure.

There is a phrase that Navy Seals use, "The more you sweat in peace time, the less you bleed in war time." This is equally realistic to use in our profession. The more we can practice in as real a situation as possible, the better the response will be for students in the clinical setting. At MUSC, we had a couple of days where we worked together with the cardiac residents. We ran through various failures that could potentially happen on pump. It was operated as realistically as possible, and served as a great learning experience for everyone involved. It built confidence in one another to experience a catastrophe in a safe environment, so that when met in real life, we would be prepared.

The other major technology that is changing perfusion education is electronic charting. While many facilities are still using paper charting to record data, it is often input later into an electronic format. We live in an electronic world, so it would seem that electronic charting is the best way for case data to be recorded, reviewed and stored. The use of electronic charting is helping to save time, and allows us to have greater accuracy in recording data. It allows a perfusionist to focus more on patient management than charting. While this still comes with a caution — to not get complacent on observing changes in values that you would have otherwise noticed by handwriting them into a chart — it does offer some great benefits.

Electronic charting is often customizable, so you can have a chart set up for your team the way you like it. The chart can even be catered to specific case types. For instance, the chart can help provide a script of events that should be occurring throughout the case and prompt you for times and doses of medications to be given. The other huge benefit to electronic charting is the legal support given, should a case arise where your data needed to be reviewed. If your charting is captured automatically, you can safely say you didn't manipulate your values. There are often times where comments can be used to explain unusual circumstances during a case. However, not all electronic charting systems are the same with regard to inputting comments or flagging clinical events.

Like all medical equipment, there is a variety in what is available. Some perfusion groups have made their own electronic charts, while others have modified charting from other professions for perfusion use, and there are industry-designed systems. I feel fortunate to have used a couple different designs, and what I can say about them is that none of them are perfect and none replace the perfusionist. This is why I can see charting technology changing more in the future, evolving with our needs and becoming more user-friendly. No one wants to call IT in the middle of a case, but that is the risk we take when we rely on electronic charting alone. Part of being a perfusionist is knowing the limitations of our technology.

I can't pretend to know the future, but I certainly see that technology will keep evolving in this field. We should all learn to embrace it, change it and mold it into the tools needed to improve our practice while striving for safer patient outcomes.

Jordan Hendricks is from Utah and has a bachelor's in microbiology. He is currently a senior student at Medical University of South Carolina and anticipates graduation in May 2017. He is also a grateful husband and proud father of two wonderful kids. He recently accepted a position in Abilene, Texas.

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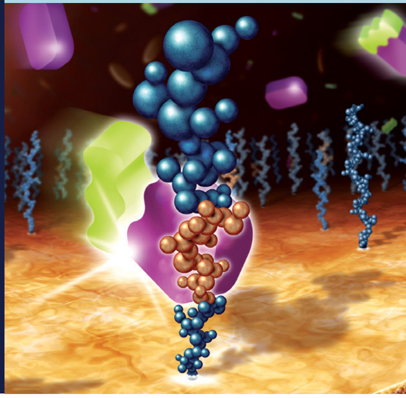

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1. Kreisler KR, Vance RA , Cruzzavala J, Mahnken JD. Heparin-bonded cardiopulmonary bypass circuits reduce the rate of red blood cell transfusion during elective coronary artery bypass surgery. J Cardiothorac Vasc Anesth. 2005;19(5):608-611.
2. Olsson C, Siegbahn A, Henze A, et al. Heparin-coated cardiopulmonary bypass circuits reduce circulating complement factors and interleukin-6 in pediatric heart surgery. Scand Cardiovasc J. 2000;34(1):33-40.
3. Svenmarker S, Haggmark S, Jansson E, et al. Use of heparin-bonded circuits in cardiopulmonary bypass improves clinical outcome. Scand Cardiovasc J. 2002;36(4):241-246.
4. Heyer EJ, Lee KS, Manspeizer HE, et al. Heparin-bonded cardiopulmonary bypass circuits reduce cognitive dysfunction. J Cardiothorac Vasc Anesth. 2002;16(1):37-42.

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