SCA NEWS

SOCIETY OF CARDIOVASCULAR ANETHESIOLOGISTS

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SCA Society of Cardiovascular Anesthesiologists

PRESIDENT'S MESSAGE

SOCIETY OF CARDIOVASCULAR ANETHESIOLOGISTS

Amanda Fox
MD, MPH
President
Society of Cardiovascular Anesthesiologists

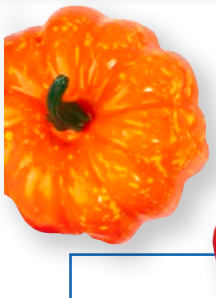
Dear SCA Members,

I hope you all had a chance to enjoy some downtime over the summer and that your fall is off to a good start. The SCA is such a versatile and robust professional organization thanks to the work of you, our members, and the time, energy, and expertise you volunteer to our committees, sub-committees, and councils. As our discipline shifts and evolves with medical and technological change, these groups are essential to advancing the mission and vision of the SCA: to transform perioperative cardiovascular and thoracic care through education, research, and global collaboration.

The 2026 Call for Committee and Sub-committee Volunteers is now open, and **the submission window will close Friday, October 31, 2025, at 11:59 pm Central.**

CLICK HERE

For me, the real gift of our society is the ability to connect and engage with fellow professionals who face shared clinical issues, research questions, or multidisciplinary transformation goals through such groups. These are wonderful spaces for networking, learning, potential research collaboration/innovation, mentorship, and the fostering of lifelong friendships. As such these groups do their best work when their membership includes a range of identities, perspectives, and professional experience levels, so we encourage each of you to apply.



Here are some important details about the application process:

- Applications are for a two-year term, running from April 2026 to April 2028.
- You may apply to a maximum of three committees.
- Each application will be reviewed by the respective committee chair.
- Members may only serve on one committee at a time unless a president-approved exception is granted for additional positions.
- Members currently serving on a committee who wish to be considered for another term must complete an application.
- Applicants will be notified of the status of their application(s) in late February, 2026.

SCA Society of Cardiovascular Anesthesiologists

Please see page 10 for the list of committees included in the 2026 Call for Volunteers.. Next to each committee name is the number of available open "member-at-large" positions. Please note this number includes new openings, as well as positions for current committee members that may apply for a second-term renewal. Please refer to our **Committees and Task Forces** web page for details on each committee and the committee chair's name and contact.

Any questions regarding the Call for Volunteers or the application process can be directed to Mary Lunn, SCA Operations Associate, at mary@veritasamc.com. Questions about specific committees and their work may be sent directly to the chair of the particular committee of interest.

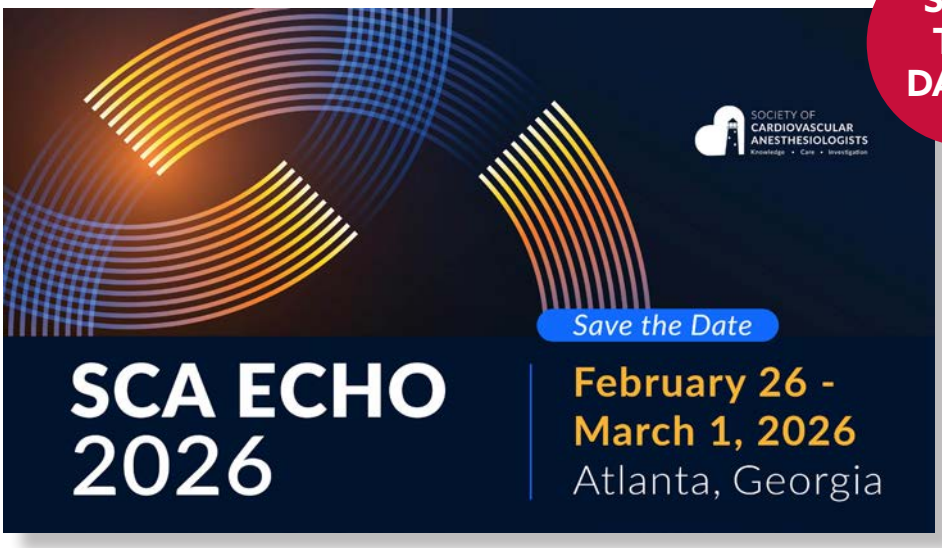
In December, I will send more information about our roster of upcoming 2026 meetings and events, including our Annual Meeting and Workshops in Nashville, Tennessee, from April 23-26. These forums offer wonderful opportunities for committees to meet in person and to present and involve the larger SCA membership in their work, so I look forward to connecting with many of you in-person in the new year. In the interim, I look forward to connecting with many of you via our array of online forums and initiatives, and do not hesitate to reach out to me or to members of the Executive Committee or Board of Directors, if we can be of support.

Wishing you all a wonderful fall.

Amanda Fox, MD, MPH

Join Us for Our Exceptional 2026 Meetings

SAVE THE DATES!



Please join us for a special evening of celebration and camaraderie at our Boots & Bling Bash.

A formal invitation with additional details will follow in the coming months.
We can't wait to celebrate with you!

Support Your Society through the SCA Endowment

Your donation plays a pivotal role in the Society of Cardiovascular Anesthesiologists' (SCA) ongoing mission to lead, innovate, and excel in the field of cardiovascular anesthesiology. Every contribution is directed towards funding cutting-edge research, supporting educational programs, and developing resources that enhance patient care.

By investing in the advancement of knowledge and treatment strategies, your generosity not only aids in the education and development of current and future anesthesiologists but also contributes to improving the outcomes for patients facing cardiovascular diseases across the globe. In essence, your support empowers the SCA to continue its vital work, ensuring that the most advanced care and groundbreaking research continue to evolve and reach those in need.

The SCA Endowment Fund online donation page is available. Making an online donation is quick, easy, and secure.

To complete the online donation form CLICK HERE

SCA Career Center — FIND THE BEST!

Make use of our employer account features below to quickly post your latest job openings, search through viable employee resumes, and manage your applications to select the ideal candidate.

Get started now — new team members are just a few clicks away!

Visit **SCA Career Center** for more details and to get started on your search.

Renew Your Membership Today!

You are a valued member of the SCA community. Do not miss out on all the NEW member benefits! Continue receiving your SCA benefits uninterrupted by renewing today.

Renew Online

You can login to your membership account to pay your dues online with the option to enroll in auto renew.

If you have any questions about your membership or the renewal process, please contact the SCA Team at 855.658.2828 or info@scahq.org.

Don't Miss Out!

Get Your SCA and WICTA Swag

The holidays are right around the corner. Do not forget SCA branded t-shirts, sweatshirts, mugs, and more are now available for purchase!

Start shopping today by clicking on the link below.

VIEW SCA SWAG STORE

the ANESTHESIOLOGY annual meeting

American Society of Anesthesiologists®

Attending the ASA Annual Meeting?

San Antonio, Texas
Henry B. Gonzalez Convention Center

See you there!

Visit the SCA at our Meet-Up Lounge!
Sunday, October 12, 2025
10:30 am – 11:15 am
Exhibit Hall – Lounge A

Journal of Anesthesia & Analgesia — How to View Free Access Articles

Below are links to the three SCA sections of the A&A Journal. Each month, these links automatically update with new publications. "Free Access" articles will have a "Free" tag just below the article details. ***After one year, all A&A articles become complimentary.***

Cardiovascular and Thoracic Anesthesiology
Cardiovascular Pathophysiology and Outcomes
Hemostasis and Thrombosis

Coming Soon!

Images in CT Anesthesia Corner

We are looking for submissions for the new *"Images in CT Anesthesia"* section of our newsletter. Submission to include a brief case description, brief discussion, 2-3 images (CT, MRI, X-Ray, etc), and 2-3 references.

Please send all submissions to section editor, Kelly Ural, kural@ochsner.org

2026 Kaplan Leadership Development Award

Applications for the 2026 Kaplan Leadership Development Award will be accepted through January 18, 2026. The award is designed to assist cardiothoracic and vascular anesthesiologists in their career by granting funding to further their leadership development through coursework and leadership-specific studies.

The Kaplan Leadership Award will be adjusted accordingly to offer an aggregate of $5,000 to either one recipient or divided among two. $5,000/$2,500 from the SCA Endowment, with a $5,000/$2,500 match from the applicant's institution to fund a leadership education strategy.

Click here to submit an application by January 18!

Questions? Please email **operations@scahq.org.**

Get Involved
SHAPE THE FUTURE

The Society of Cardiovascular Anesthesiologists (SCA) is excited to introduce three new opportunities for members to contribute, connect, and shape the future of our specialty.

SCA Announces Three New Opportunities to Get Involved

Special Interest Group in Critical Care Medicine

Critical care is a vital component of the cardiac surgical journey, and anesthesiologists are at the forefront of caring for cardiothoracic patients. By establishing this group, the SCA continues to advance its mission to "transform perioperative cardiovascular and thoracic care through education, research, and global collaboration." SCA's new Critical Care Medicine Special Interest Group (SIG) will:

- Provide a professional "home" for intensivists specializing in cardiothoracic critical care.
- Strengthen collaboration and community among SCA members across the entire perioperative course.
- Create an environment for shared learning in the management of mechanical circulatory assist devices (MCS).
- Engage and encourage cardiothoracic intensivists—including those not formally trained in cardiac anesthesiology—to join SCA.
- Give resident early involvement in the SCA through interactions with and mentorship by leaders of the sub-specialty and other cardiothoracic anesthesiologists

Join Us

If you are interested in becoming part of the **Critical Care Medical Special Interest Group,** please click the link at right. You will be added to the roster and included in all future communications from the group.

CLICK HERE

Education Committee

SCA's new Education Committee will play a central role in guiding the Society's lifelong learning strategy and ensuring the highest standards of educational programming.
This Committee will:

- Recommend and evaluate the scope and curricula of SCA's educational activities.
- Set education priorities in collaboration with the Board of Directors.
- Ensure SCA maintains excellence in CME and ACCME accreditation.
- Support and advise related committees on strengthening educational content and delivery.

Call for Volunteers opens on October 1.

Private Practice Council

SCA recognizes the unique contributions and challenges faced by members in private, community-based, and independent practice settings. The newly established Private Practice Council will:

- Provide input and recommendations to SCA leadership on issues impacting private practice.
- Identify and address educational, professional, and operational needs.
- Create peer-to-peer networking and learning opportunities.
- Ensure the private practice voice is represented in SCA programs, resources, and advocacy.

If you are interested in joining the Private Practice Council send an email with your cell phone number (to be added to the SCA Private Practice WhatsApp group) to SCA's Executive Director at operations@scahq.org.

These three new opportunities reflect SCA's commitment to excellence and member engagement. Whether your passion lies in critical care, education, or private practice, your voice and expertise can make a difference.

April 2026-
April 2028
Term
Selection

CALL FOR VOLUNTEERS
Now Open!

Support your Society's strategic goals and initiatives by serving one of its committees! The Call for Volunteers will be open October 1 - 31 to fulfill the 2026-2028 term. Please use this link to submit an application:

CLICK HERE

Below are the committees that have openings. The number after the committee's name indicates the number of available member-at-large positions. Please note this list is subject to change.

- Abstract Review Committee **(19)**
- Acute Kidney Injury **(AKI)** Sub-Committee **(7)**
- Atrial Fibrillation Sub-Committee **(6)**
- Blood Management Sub-Committee **(6)**
- Bylaws Committee **(4)**
- Clinical Practice Improvement **(CPI)** Committee **(2)**
- Continuing Medical Education **(CME)** Committee **(2)**
- Echo Program Planning Committee **(4)**
- Economics and Governmental Affairs Sub-Committee **(4)**
- Education Committee **(2)**
- Enhanced Recovery After Cardiac Surgery (ERACS) Sub-Committee **(6)**
- Enhanced Recovery After Thoracic Surgery(ERATS) Sub-Committee **(4)**
- Ethics Committee **(5)**
- Guidelines and Standards Sub-Committee **(6)**
- Health Equity and Professional Advancement (HEPA) Committee (8)
- History Council **(3)**
- International Council **(4)**
- Kaplan Leadership Award Sub-Committee **(5)**
- Mechanical Circulatory Support Sub-Committee **(6)**
- Mobile App Sub-Committee **(3)**
- Newsletter Sub-Committee **(3)**
- Online Education Sub-Committee **(6)**
- Quality, Service, and Value Committee **(6)**
- Research Committee **(9)**
- SCA STS Database Sub-Committee **(5)**
- Scientific Program Planning Committee **(11)**
- Social Media Sub-Committee **(5)**
- Member Engagement Committee **(5)**
- Thoracic Anesthesia Symposium **(TAS)** Program Planning Committee **(2)**
- Transplantation Sub-Committee **(8)**

Click Here to learn more about the committee's mission, benchmarks, and leadership.

For questions related to the Call for Volunteers, please email committees@scahq.org.

Spotlight on the ARC Question Bank

The SCA Adult Cardiothoracic Anesthesiology (ACA) question bank is one of the first question banks intentionally designed to facilitate preparation for the ABA Adult Cardiothoracic Anesthesiology board exam. Created entirely by cardiac anesthesiologists, it aims to cover the ACA board exam content outline, with high quality questions and explanations, to serve as a self-assessment and a studying tool for cardiothoracic anesthesiology physicians and trainees.

In this interview with Dr. Hesham Ezz, MD, an assistant professor of Cardiothoracic Anesthesiology and Critical Care, the chair of the Anesthesia Review Course committee and co-creator of the SCA ACA question bank, we shine the spotlight on the thought and process of creating the question bank and the future next steps.

By
Hesham Ezz, MD
and
Gina Linganna, MD

Where did the idea of creating the question bank come from?
As physicians, studying for exams in a question-based format is creature comfort that stems back to medical school. It is an active form of learning that provides simultaneous self-assessment and is convenient for the busy adult learner.

With the first cycle of the ABA cardiac anesthesia board exam, the SCA released the ARC: A Review Course, curated and edited by Dr. Gina Linganna, one of my colleagues and inspiring mentors. While I personally benefited from the focused nature of the review course and ease of access, I felt that the natural next step was creating a question bank with high quality questions and explanations that would cover the exam.

What is unique about the SCA ACA question bank?
This is one of the first question banks created by cardiac anesthesiologists for cardiac anesthesiologists. It is also one of the only resources that is designed with the ABA ACA content outline as its blueprint.

How was the first release of the question bank received by the exam takers?
After the initial release of the question bank in September 2024, we received incredibly helpful feedback by surveying the users who sat for the ABA exam.

Most users picked the SCA question bank as a study resource because it was created and edited by practicing cardiac anesthesiologists. I am very proud to say that this translated to more than two thirds of the users feeling that the questions were representative of the exam itself. Additionally, users reported that the answer explanations were comprehensive and focused on the objectives of the ABA content outline. Our user feedback was also constructive and inspired our next steps in growing the question bank.

What were the next steps and what should we expect with the future releases?
We took our users feedback to heart and consulted with colleagues from the National Board of Echocardiography and the American Board of Internal Medicine who chaired committees for question writing for high stakes board exams.

Accordingly, we created the ARC committee to have a formal writing group. The committee is formed of 11 very talented and highly dedicated members. The writing and reviewing process became more formalized and efficient through our monthly meetings. I am very happy with what this group was able to achieve and very excited to announce that the second release of the question bank is with added, reviewed, and reorganized content. This updated version will be finalized in time for our next round of trainees and physicians preparing for the exam.

There is so much more we would like to do to provide the maximum value to our SCA members and to cardiothoracic anesthesiologists, both nationally and internationally. I am very excited for the potential for this valuable resource and all the great things our committee members can do under guidance and support by the SCA leadership.

How do I get the ARC Question Bank?
The question bank is available at https://scahq.org/education/arc-question-bank/. All new questions and revisions will be uploaded by October 1. The question bank is $200 for SCA members and $350 for non-members. The subscription remains in place 1-year from the date of purchase.

Opening Soon! 2026 HEPAC Rising Star Scholarship Program

The Society of Cardiovascular Anesthesiologists' Health Equity and Professional Advancement Committee (HEPAC) invites CA-1 residents from historically underrepresented groups in medicine (URiM) who are committed to promoting health equity to apply for the Rising Star Scholarship Program. This scholarship empowers residents to become leaders who address health disparities and serve communities in greatest need by providing early exposure to cardiovascular anesthesiology through attending the SCA Annual Meeting, presenting a poster, and engaging with SCA members and leaders. Our selection process is designed to be fair and comprehensive, evaluating each candidate's accomplishments, leadership abilities, and commitment to our mission.

The goals of this scholarship are:

- To expose URiM residents to the clinical practice of cardiothoracic anesthesiology by attending the SCA annual meeting.
- To give URiM resident scholars early involvement in the SCA through interactions with and mentorship by leaders of the sub-specialty and other cardiothoracic anesthesiologists.

SCHOLARSHIP INFORMATION

Ten scholarships will be awarded in 2026!

REQUIREMENTS

- Nomination of URiM resident by the program director or cardiothoracic faculty.
- The nominee must be an academically promising URiM CA1 resident in good standing in an ACGME-accredited residency program.
- Each nominee must submit an essay addressing the following (maximum 500 words):
  - Describe how their unique background and experiences have informed their commitment to patient care and health equity
  - Nominee's understanding of the challenges and opportunities in advancing health equity and fostering inclusive leadership and career development within cardiovascular medicine
  - Nominee's interest in CV anesthesia
- A letter of support from the program director and one additional letter of recommendation from a faculty member.
- The CV of the nominee.
- Recipients must be members of the SCA, or agree to become one, to accept the scholarship. Non-members will receive a complimentary, one-year resident/fellow membership to meet this requirement.

FUNDING

$1,000 travel stipend; complimentary basic registration to the 2026 SCA Annual Meeting.

EVALUATION AND SELECTION

Scholarship applications will be reviewed and selected by the Scholarship Review and Selection Sub-Group of the HEPA Committee at the SCA. Up to 10 scholarships will be awarded yearly.

Watch Your Inbox for Details!

Questions? Please write to us at hepac@scahq.org

Application will be accepted November 1, 2025 through January 18, 2026.

Watch your inbox for details!

SPOTLIGHT

Awesome Woman Interview

Kayla Knuf, MD, FASE

Brooke Army Medical Center
San Antonio, Texas

I am a cardiac anesthesiologist at Brooke Army Medical Center in San Antonio, TX where I have practiced since completing fellowship. After earning my medical degree from a civilian institution, I entered active-duty service in the United States Air Force, completing both residency and fellowship while in service. I have deployed as part of a Critical Care Air Transport Team, providing in-flight critical care for injured service members. Currently, I serve as an Associated Program Director for the San Antonio Uniformed Services Health Education Consortium (SAUSHEC) Anesthesiology Residency, where I am dedicated to advancing medical education and supporting the development of future military anesthesiologists.

1. What led you to become a Cardiovascular/Thoracic Anesthesiologist?
When I began residency, I knew little about fellowships, and they weren't on my radar during the early part of training. Late in my CA-1 year, however, I discovered that I was drawn to managing complex cases with critically ill patients and appreciated the advanced skill set required in cardiac anesthesia, including TEE. I also found that I enjoyed the camaraderie within the CT operating room and felt inspired by the CT anesthesia faculty I worked with, motivating me to pursue a path that would allow me to develop into the kind of clinician and mentor they embodied.

2. How did you hear about the SCA?
I heard about SCA through a mentor while I was applying for fellowship.

3. What roles have you held for the society?
I have contributed to the society through online education initiatives, annual meeting poster reviews, and moderating poster sessions. I have served on the Online Education Committee for four years and currently hold the position of Vice Chair.

4. What is one of your greatest achievements as a Cardiovascular/Thoracic Anesthesiologist?
One of my greatest achievements has been helping residents build confidence in managing complex cardiac cases while continuing to grow myself. Teaching in the OR forces me to communicate clearly, stay current, and model calm decision-making under pressure. It's rewarding to see residents progress from uncertainty to independence, and it continually challenges me to improve while ensuring our patients get the safest, highest quality care.

Additionally, deployment was a meaningful personal and professional milestone for me. It challenged me to care for patients under difficult and sometimes austere conditions, requiring flexibility, teamwork, and a willingness to put the needs of others first. Serving as part of a Critical Care Air Transport Team allowed me to use my anesthesiology training to care for critically ill patients in flight, doing my best to keep them stable and safe during their journey. The experience deepened my appreciation for service and strengthened my resilience, reminding me of the privilege it is to care for others and reinforcing my commitment to grow as both a physician and an educator.

5. Do you have any advice for fellows and residents?
My biggest piece of advice is to remember that training is finite. Residency and fellowship are undeniably hard—long hours, demanding work, and moments when you feel unseen. In the middle of it, you may never wish for a single extra day of training. But when it ends, you will face challenges and experiences you haven't yet encountered, and in those moments,

you may find yourself wishing you had just a little more time to prepare. Remind yourself daily: this season won't last forever. Lean into every day, every case, and every opportunity that comes your way. Your future self—and your future patients—will thank you for making the most of this time.

6. Have you experienced any difficulties as a woman in the field?
I have been fortunate to work with many supportive colleagues and mentors, and I truly love what I do. Yet the fact that we still need to ask whether women are treated differently speaks volumes. I've experienced moments when assumptions were made about my role or capabilities simply because of who I am. In those moments, I've chosen to keep showing up, to speak up, and to stand alongside others so that everyone feels seen, valued, and supported.

7. Do you have any advice for other women in the field?
Be true to yourself—as both a woman and a person. Get involved in the things that bring you joy and fulfillment even if it isn't aligned with what others think you should be doing. At the end of the day people are drawn to authenticity and you will find yourself surrounded by people who seek to lift you up.

8. How do you balance work and personal life?
Balancing work and personal life is challenging, and the greatest success I've found comes from setting clear boundaries with myself and with others to keep them in sync. I've learned that there are seasons for everything, and there will be times when your balance is disrupted. Regular self-check-ins have helped me recognize when I'm off course and given me the opportunity to adjust when needed.

9. What is something you enjoy doing outside of work?
Outside of work I enjoy working out, reading for fun, and spending time with my family, friends, and pets.

10. Would you change anything about the path you took to get to where you are now?
Honestly, I wouldn't change much. If anything, I would remind myself not to rush. It's tempting to put your head down and focus on the next milestone—graduating residency, finishing fellowship, getting a promotion—and in doing so, you risk missing unexpected opportunities or detours worth taking. Overall, I'm grateful for the path I've taken and for the people who have supported me along the way.

11. What was the best piece of advice you received?
Be someone people want to work with. While your skills matter, how you treat people matters just as much. I've seen this principle open doors and build trust time and time again, whether in the operating room or during military service. It's a reminder to stay kind, dependable, and steady, even on the hardest days—because the way you show up for others is often what they remember most.

New!

OUR History is YOUR History

Your SCA History Council Needs You!

In April 2022, SCA President Dr Andrew Shaw initiated the formation of an SCA History Task Force chaired by Dr Glenn Gravlee. Its mission was to develop a timeline of significant SCA accomplishments, generate a virtual library of important historic documents, and establish an SCA history site on scahq.org. In the Fall of 2023, SCA President-Elect Dr Kathy Glas approved its transformation to a standing History Council (HC) with Dr Gravlee as its Chair. In April 2024 an HC Executive was formed with Dr Robert Sladen (Chair), Dr Jamie Ramsay (Vice-Chair) and Dr Gravlee (Past Chair). The full HC membership is appended below.

The Task Force created a large physical timeline board that was exhibited at the SCA Annual Meetings in Portland in 2023 and Toronto in 2024. It is not intended to be detailed or complete, but to draw attendees' attention to SCA History. Instead, a dynamic and ever-growing virtual timeline was created on the SCA website. It includes links to more in-depth information about SCA's significant contributions to its membership and cardiac anesthesiology at large. An ongoing series of Oral History video-interviews is posted on the HC website. Initiated with SCA Past-Presidents, it now also includes individuals who have made historic contributions to SCA and cardiac anesthesiology.

The History Council also provides an active resource to members attending the annual SCA Meeting. At the 2023 SCA Annual Meeting, Drs Joyce Wahr and MaryBeth Brady moderated a panel entitled Celebrating 45 years of SCA! Past, Present and (You Are!) the Future. This year's meeting in Toronto featured a video interview with Dr Edward Lowenstein, one of the primary innovators of opioid anesthesia for cardiac surgery in the 1970s. Dr Gravlee moderated it as an introduction to a panel on opioids in cardiac anesthesia today. At the 2026 SCA meeting in Nashville, the HC will present a full panel on The Evolution of Anesthesia for Cardiac Surgery.

There are a number of works in progress, including links to classic historic papers on the HC website, and the publication of an SCA History Highlights in celebration of the SCA 50th anniversary in 2028.

Here's what we need you to do:

- **Visit the HC website at scahq.org.** You can find the link to our site by scrolling to the bottom of the scahq.org landing page, or go directly **Here**
- **Explore the Timeline and the Oral Histories**
- **Give us your feedback** for enhancements or additions to the HC website, or other activities that you would like to see the HC undertake.
- **Give us suggestions for historic vignettes** you would like to see posted on the SCA Newsletter
- **Let us know** if there are any SCA activities in which you would like to participate more actively

Robert N Sladen MBChB, FCCM
Chair, SCA History Council

SCA History Council Membership (Fall 2025)

Robert Sladen MD (Chair), James Ramsay MD (Vice-Chair), Glen Gravlee MD (Past Chair), MaryBeth Brady MD (SCA Board Liaison), Kathryn Glas MD, Eugene Hessel MD, Jerry Reves MD, Alan J Schwartz MD, Andrew Shaw MD, Linda Shore-Lesserson MD, Jeffrey Songster MD, Heather Spiess, Joyce Wahr MD

In addition to the above, all SCA Past-Presidents are Honorary Members of the History Council.

Please email your comments and suggestions to operations@scahq.org.

Intraoperative RV Failure During a "Low-Risk" Procedure Case Summary

Mark Lewandowski, MD
CA-2, Anesthesiology
Wake Forest
School of Medicine

A 45-year-old woman (81.6 kg) with a history of ESRD secondary to type II diabetes (status post deceased donor renal transplant three months prior, with baseline creatinine 1.4–1.5), CAD s/p PCI ×4 (most recently six years prior), and hypertension presented for incision and drainage of a right thigh abscess. Preoperative evaluation was notable for hypertension, baseline anemia (Hgb 11.8), and glucose of 158. She was afebrile with normal rate and rhythm. A transthoracic echocardiogram obtained two months prior demonstrated preserved LVEF, concentric LV hypertrophy, and a moderately dilated right ventricle with normal systolic function.

She had previously tolerated a general anesthetic with native airway and propofol infusion for wound exploration.

Intraoperative Course

Anesthetic induction included propofol 2 mg/kg and fentanyl 100 mcg. An AirQ LMA was placed, and sevoflurane was used for maintenance. The patient was spontaneously breathing 6–9 breaths/min. Shortly thereafter, noninvasive blood pressure readings became unobtainable. Phenylephrine boluses were administered, but the patient developed 4 mm ST-segment depressions. A subsequent BP reading of 78/45 improved after repeat phenylephrine, with resolution of ST changes.

During closure, sevoflurane was discontinued. The patient again became profoundly hypotensive with cyanosis and weak palpable pulses. Bag-mask ventilation with 100% FiO_2 was initiated. Epinephrine 10 mcg was given with transient improvement, but she rapidly progressed to pulseless electrical activity (PEA) with $ETCO_2$ drop to 8–13. ACLS was initiated. ROSC was achieved after ~2 minutes of compressions and 1 mg epinephrine. Cyanosis resolved promptly with compressions.

The LMA was removed, and the airway secured via endotracheal intubation. Post-ROSC, arterial line placement and focused cardiac ultrasound revealed concentric LV hypertrophy and a thickened myocardium. RV dilation was not obvious, though windows were limited. The patient was initiated on an epinephrine infusion and transferred to the SICU.

Discussion

This case highlights acute intraoperative RV failure as a cause of hemodynamic collapse in a patient undergoing a seemingly low-risk procedure.

Preexisting risk factors included:

- Documented RV dilation with systemic hypertension and LV hypertrophy
- Coronary artery disease
- Recent renal transplant with possible volume-dependence

Intraoperative precipitants likely included:

- Reduced venous return with positive pressure ventilation
- Increased pulmonary vascular resistance from hypoxia and cyanosis
- Systemic vasodilation from volatile anesthetics
- Phenylephrine boluses, which may have worsened RV afterload by raising PVR despite improved systemic pressures

The improvement in cyanosis only with chest compressions suggests impaired RV output and acute RV overload, transiently relieved by external forward flow.

Key Teaching Points

- RV dysfunction can present suddenly and catastrophically, even in "low-risk" cases.
- Recognition relies on hemodynamic patterns: refractory hypotension, cyanosis, and PEA arrest.
- *Management principles:*
  - Maintain preload but avoid RV overdistension
  - Minimize PVR (optimize oxygenation, avoid hypercarbia, acidosis, and excessive PEEP
  - Support RV contractility (epinephrine, dobutamine, milrinone)
  - Maintain systemic pressures to preserve RV coronary perfusion
- Point-of-care ultrasound is invaluable in diagnosis and guiding therapy.

Take-Home Message

Patients with known or suspected RV dilation warrant heightened vigilance in the OR, even for minor procedures. Careful anesthetic planning, early use of invasive monitoring, and awareness of RV physiology may help prevent catastrophic decompensation.

Jose Rose, MD
Boston Medical Center
Winchester, MA

Joshua Sebranek, MD
University of Wisconsin
Oregon, WI

Health Equity and Professional Advancement (HEPAC): The Natural Evolution of DEI

The terms Diversity, Equity, and Inclusion (DEI) gained prominence following the Civil Rights Act of 1964, with the aim of increasing representation and ensuring that individuals felt respected and valued within organizations. Over the decades, the national conversation around DEI has continued to evolve. Institutions are now reassessing how they describe and prioritize equity-related initiatives, with greater emphasis on shared goals such as fairness, access, and representation. Even prior to the recent focus on DEI, leaders in many fields advocated for reframing diversity work to emphasize its tangible benefits—advancing innovation, strengthening decision-making, and improving outcomes.

In response, many organizations are adopting terminology that highlights universally understood priorities while reducing the risk of distraction from differing interpretations of language. In healthcare, this has translated into a sharper focus on health equity, professional advancement, social impact, and belonging—principles that integrate mission-critical objectives and align with institutional values. As an example, the Mayo Clinic's Office of Belonging has described its mission as "improving health equity and advancing belonging and supporting health and wellness for all."

The benefits of diversity in healthcare are well established.[1-4] A 2025 review demonstrated that diversity in the healthcare workforce enhances innovation, strengthens risk assessment, and improves patient outcomes, particularly when patients and providers share aspects of identity.[1] Studies further show that diverse teams foster clearer communication, more culturally competent clinical decisions, and higher levels of patient satisfaction, while also driving organizational performance.[2] In research and healthcare delivery, inclusive participation builds trust, identifies nuanced needs, and produces more effective interventions. For example, broadening access to clinical trials improves treatment relevance and confidence among underrepresented groups.[3] At the organizational level, cultures that actively support DEI and belonging have been linked to stronger community health outcomes.[4]

Within this broader landscape, the Society of Cardiovascular Anesthesiologists' DEI Committee has transitioned to the Health Equity and Professional Advancement Committee (HEPAC). This evolution is a deliberate step to ensure that the committee's name clearly reflects its mission and impact. HEPAC's scope includes:

1. Identifying and addressing inequities in patient care (health equity).
2. Creating environments that promote leadership opportunities, professional growth, and long-term career retention for all (professional advancement).
3. Ensuring that education, research, and policy support the wellbeing of individuals and communities (social impact).
4. Fostering spaces where all individuals feel respected, valued, and celebrated for their unique contributions (belonging).

This transition underscores continuity rather than departure. The committee remains firmly committed to the principles of fairness, inclusion, and excellence in patient care. By redefining its identity as HEPAC, the committee highlights a natural evolution—one that emphasizes shared values, strengthens engagement, and reinforces the patient- and provider-centered benefits of a diverse and supported healthcare workforce.

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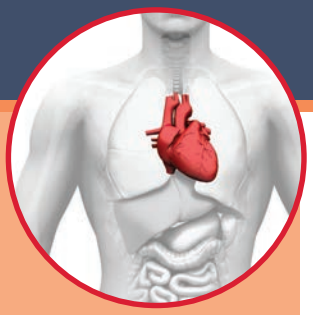

ECHO CORNER

Evaluation of the Etiology and Severity of Mitral Regurgitation

LEARNER NOTIFICATION

Society of Cardiovascular Anesthesiologists
Activity Title: 2025 SCA Echo Corner **(Evaluation of the Etiology and Severity of Mitral Regurgitation)**
Release Date: 10/1/2025
Expiration Date: 10/1/2027
Activity Type: Enduring Material

Acknowledgement of Financial Commercial Support
No commercial support was received for this educational activity.

Acknowledgement of In-Kind Support
No in-kind support was received for this educational activity.

Accreditation Statement
The Society of Cardiovascular Anesthesiologists is accredited by the Accreditation Council for Continuing Medical Education (ACCME) to provide continuing medical education for physicians.

The Society of Cardiovascular Anesthesiologists designates this enduring activity for a maximum of *.25 AMA PRA Category 1 Credits*™. Physicians should claim only the credit commensurate with the extent of their participation in the activity.

Description:
The mission of the SCA Newsletter Sub-Committee is to inform the membership of the activities of SCA. The goal of the SCA Newsletter Sub-Committee is to produce and distribute the SCA official newsletter, the SCA Newsletter, six times per year. Each issue of the SCA Newsletter publishes education material including ECHO Corner. ECHO corner cases focus on clinical case presentation of diverse echocardiographic diagnosis encountered in clinical practice relevant to cardiothoracic anesthesiologists.

Educational Information

Physician Practice Gap:

Echo corner of the SCA newsletter is a written clinical case presentation with echocardiographic images and videos followed by multiple choice questions with explanations. The ECHO corner case review focuses on detailed and concise presentation of clinical findings accompanied by findings on transesophageal echocardiographic (TEE) exam to support the clinical diagnosis. The cases include a written portion with case description, TEE images, and TEE video clips. Three to five multiple choice question are presented to discuss the case. Each question provides an explanation of answer choices and includes a brief discussion of the topic present in each case.

- Cardiothoracic anesthesiologists may have limited expertise in precise quantification of regurgitation severity (e.g., effective regurgitant orifice area, vena contracta width).
- Cardiothoracic anesthesiologists can be inexperienced in diagnosing systolic anterior motion (SAM) or predicting its likelihood based on pre- and intra-repair findings.

Needs that Underlie the Gap
There is a need to provide education to clinicians on how to perform echocardiographic assessment of mitral valve pathology, including 3D qualitative and quantitative of the MV. There is a need to provide clinicians with relevant echocardiographic techniques to determine the risk of SAM prior to MV repair and identify SAM post MV repair.

DESIGNED to Change/Outcome:
Note that in the field of intraoperative echocardiography in general improvements in patient outcomes are difficult to measure because most of the examinations are diagnostic and not therapeutic which are more determinative of outcomes.

Educational Objectives
After completing this activity, the participant should be better able to:

- Evaluate the anatomy and function of the mitral valve, including leaflets, annulus, chordae tendineae, and papillary muscles
- Assess risk of complications such as systolic anterior motion (SAM) of the mitral valve or left ventricular outflow tract obstruction
- Confirm the severity of mitral regurgitation and mitral stenosis

Satisfactory Completion
Learners must complete an evaluation form to receive a certificate of completion. Partial credit of individual sessions is not available.

Contact Information
If you have questions regarding your CME certificate, please contact **Natalie Baus at nbaus@veritasamc.com.**

Disclosure of Financial Relationships
As an accredited provider of the ACCME, SCA adheres to all **ACCME Standards for Integrity and Independence in Accredited Continuing Education.**
The following individuals in control of content development for this activity have indicated that they do have financial relationships with ACCME defined ineligible companies within the past 24 months. All financial relationships have been mitigated. All have indicated that they have no financial relationships to disclose.

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1. Go to **https://scauniversity.pathlms.com/courses/112526**
2. Login and evaluate the meeting.
3. Print all pages of your certificate for your records.

ECHO CASE

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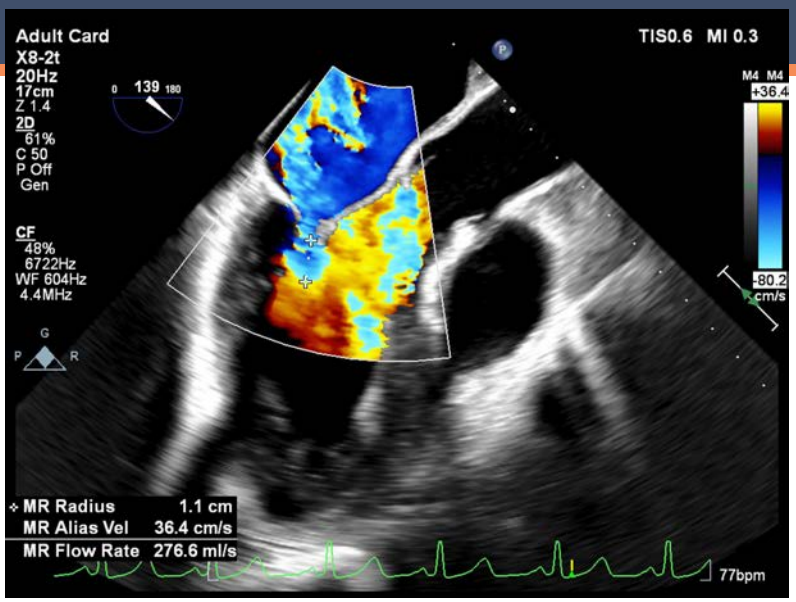
CASE PRESENTATION

A 60 year-old female with a past medical history significant for COPD presented with symptoms of exertional dyspnea and paroxysmal nocturnal dyspnea. On work up, she was found to have severe mitral regurgitation and was scheduled for surgical intervention. The following TEE images was obtained prior to cardiopulmonary bypass.

WATCH VIDEO


Adult Card
X8-2t
20Hz
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C 50
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WF 604Hz
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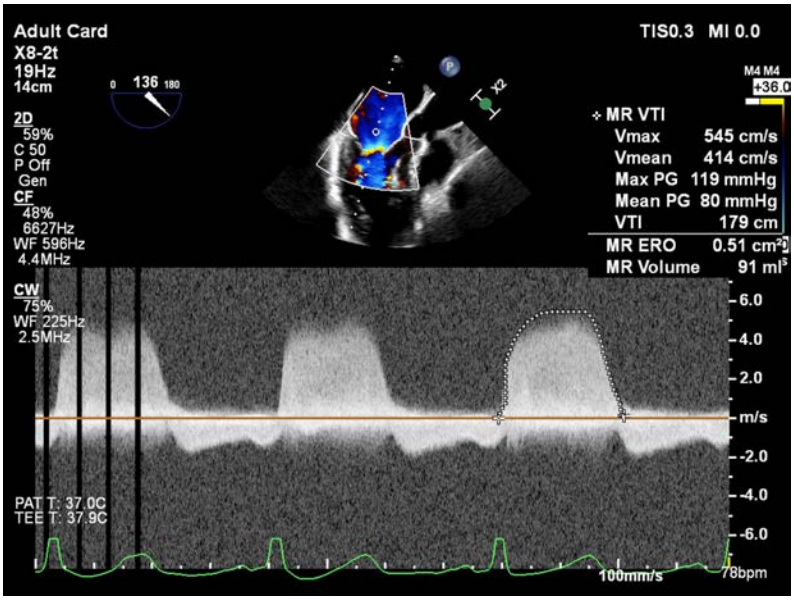
TIS0.6 MI 0.3
M4 M4
+36.4
-80.2
cm/s
MR Radius 1.1 cm
MR Alias Vel 36.4 cm/s
MR Flow Rate 276.6 ml/s
77bpm


Adult Card
X8-2t
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14cm
2D
59%
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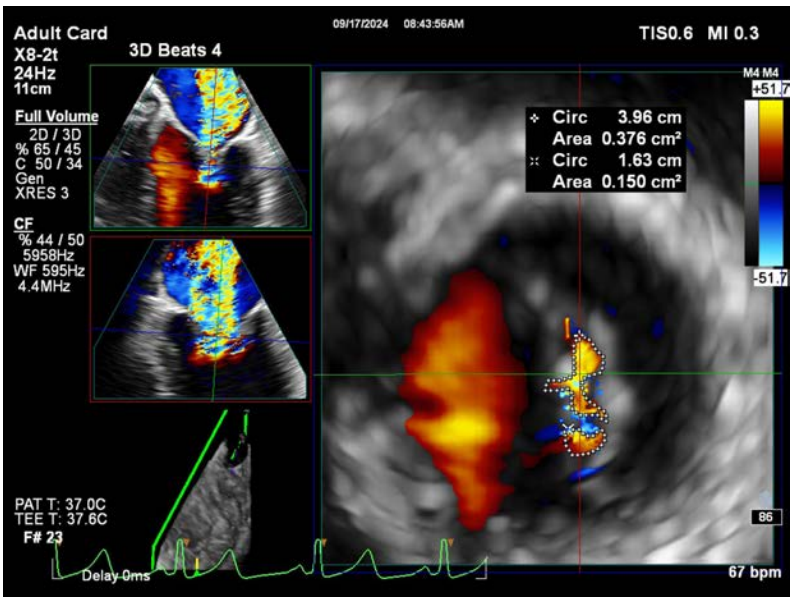
48%
6627Hz
WF 596Hz
4.4MHz
CW
75%
WF 225Hz
2.5MHz
TIS0.3 MI 0.0
M4 M4
+36.0
MR VTI
Vmax 545 cm/s
Vmean 414 cm/s
Max PG 119 mmHg
Mean PG 80 mmHg
VTI 179 cm
MR ERO 0.51 cm²
MR Volume 91 ml
6.0
4.0
2.0
m/s
-2.0
-4.0
-6.0
PAT T: 37.0C
TEE T: 37.9C
100mm/s
78bpm


Adult Card
X8-2t
24Hz
11cm
Full Volume
2D / 3D
% 65 / 45
C 50 / 34
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XRES 3
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% 44 / 50
5958Hz
WF 595Hz
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09/17/2024 08:43:56AM
3D Beats 4
TIS0.6 MI 0.3
M4 M4
+51.7
-51.7
Circ 3.96 cm
Area 0.376 cm²
Circ 1.63 cm
Area 0.150 cm²
PAT T: 37.0C
TEE T: 37.6C
F# 23
Delay 0ms
86
67 bpm

Question 1: What is the severity of this patient's MR?

A) Mild
B) Mild-Moderate
C) Moderate
D) Moderate-Severe
E) Severe

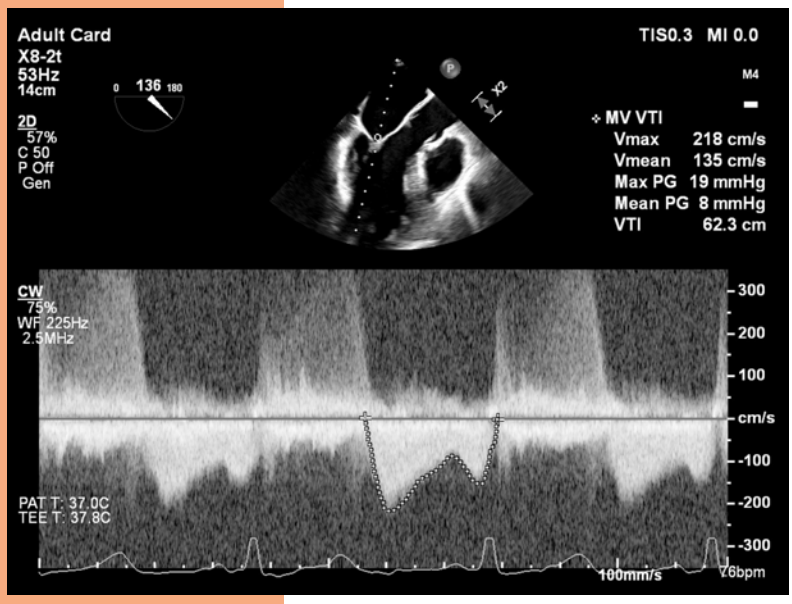
Further TEE evaluation prior to cardiopulmonary bypass revealed the following:

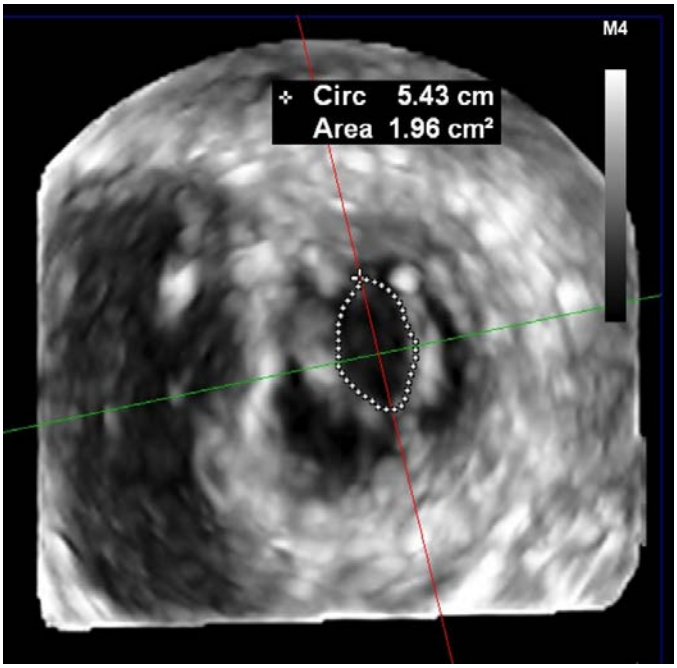
WATCH VIDEO WATCH VIDEO

Question 2: What is the most likely etiology of this patient's Mitral Regurgitation?

A) P2 Prolapse
B) Functional MR
C) Rheumatic Mitral Valve Disease
D) Endocarditis

Diagnosis of rheumatic mitral valve disease was confirmed. Further evaluation of MV function revealed the following:

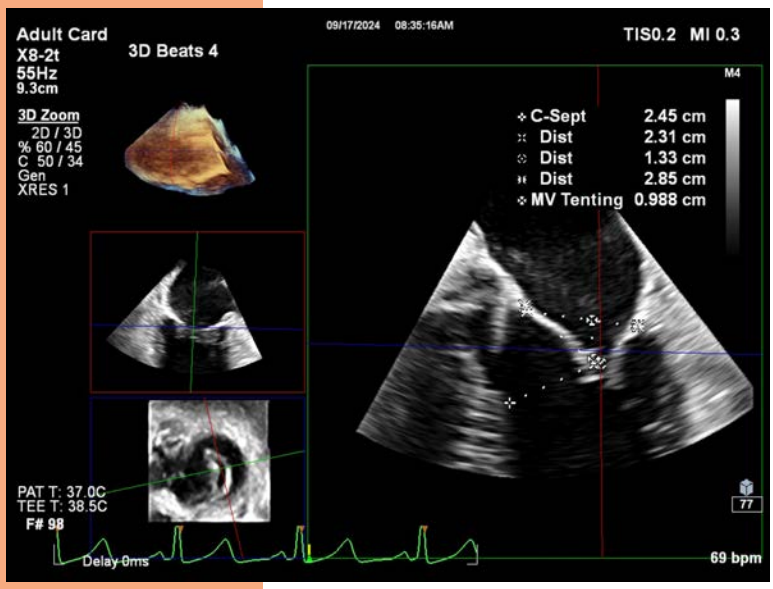


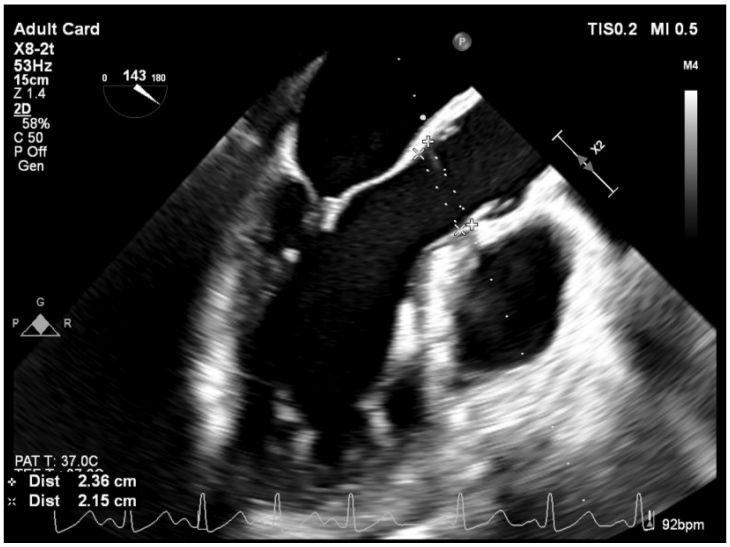


Question 3: What is the severity of this patient's Mitral Stenosis?

A) Mild
B) Mild to Moderate
C) Moderate
D) Moderate to Severe
E) Severe

The following measurements are made to assess risk of systolic anterior motion of the anterior mitral leaflet (SAM) in this patient.





Question 4: Which of the following findings increases the chance of SAM after surgical repair?

A) C-Sept 2.5 cm
B) LVOT 2.15 cm
C) A-P Ratio 1.73
D) Basal Septal Thickness of 1.2 cm

The patient underwent a mitral valve replacement with a Mitris Resilia Bioprosthesis.

Question 5: What features of the Mitris Resilia Valve make it an attractive option in this patient compared to other bioprosthetic valves (e.g. Mosaic Valve)?

A) Increased durability
B) Low profile/stent height
C) Larger EOA
D) No differences

Question 1:

Answer: (E) Severe

In the mid-esophageal long axis view, there is an eccentric, posteriorly-directed MR jet that traverses the atrial wall, which is known as Coanda effect. A 3D vena contracta, which can be used as a surrogate measurement for EROA, has been measured as 0.526 cm2. This calculation is the result of adding two regurgitant jets, recommended by current guidelines. By the PISA method, the MR radius is found to be 1.1 cm. That plus an aliasing velocity of 36.4 cm/s coupled with an MR Vmax of 545 cm/s yields an EROA of 0.51 cm2 by PISA. Additionally, the VTI of 179 cm leads to a calculated regurgitant volume of 91 mL. The EROA >0.40 cm2 by both 3D and by the PISA method, with a regurgitant volume >60 mL, and the Coanda classifies this lesion as severe mitral regurgitation.

Question 2:

Answer: (C) Rheumatic Mitral Valve Disease

The images shown demonstrate findings associated with rheumatic mitral valve disease. Rheumatic valve disease results from an immune mediated injury following an infection with Group A Streptococcus. The mitral valve is the most susceptible to damage and the disease can progress over decades. Rheumatic heart disease affecting the mitral valve can present as mitral stenosis, mitral regurgitation, or both. The 3D Image provided demonstrates classic findings seen in rheumatic mitral valve disease, including commissural fusion and a resultant "fish mouth" appearance as the valve opens. The mid esophageal long axis image demonstrates the classic "hockey-stick" or "doming" appearance of the anterior mitral leaflet during diastole, which is due to the restricted leaflet motion associated with rheumatic mitral valve disease. P2 prolapse is not seen in this image; however, it is worth noting that this lesion would be associated with an anteriorly directed jet, while this patient's MR is posteriorly directed and is likely due to restricted leaflet motion. Functional MR would demonstrate a central jet without any discernible leaflet pathology.

Question 3:

Answer: (C) Moderate

The ASE guidelines for the use of Echocardiography in Rheumatic Heart Disease were published in 2023 with updated classification of mitral stenosis severity (Figure 1).

Table 1 Classification of Mitral Stenosis Severity

	Progressive		
	(Mild)	(Moderate)	Severe
Valve area (cm^2)	>2.5	2.5-1.6	≤1.5
Pressure half-time (milliseconds)	<100	100-149	≥150
Mean gradient (mmHg)*	<5	5-9	≥10
Systolic pulmonary artery pressure (mmHg)	<30	30-49	≥50

*At a heart rate of 60-80 beats per minute

Figure 1. Classification of mitral stenosis severity.

Though this particular case demonstrates a mean gradient of 8 mm Hg, caution must be used while interpreting this value with concomitant severe MR. In this setting, the use of other measurements such as 3D planimetry (valve area) can be helpful in assessing the true severity of mitral stenosis. The mitral valve area (MVA) by 3D planimetry measures 1.96 cm2 in this patient, classifying the lesion as moderate mitral stenosis. When measuring MVA by planimetry, it is important to position the short axis plane parallel to the mitral valve orifice at the tip of the mitral valve leaflets to avoid overestimating the area. 3D planimetry has been shown to be more accurate and reproducible than 2D planimetry for this reason. Multiplanar imaging used in 3D echocardiography allows for the correct positioning of the short axis plane.

Question 4:

Answer: (A) C-Sept 2.5 cm

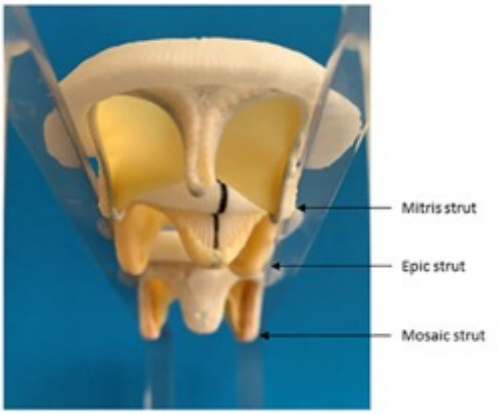
On echocardiography, there are various measurements made to assess the risk of SAM of the mitral valve after a mitral valve repair. Maslow et. al studied these measurements in 1999, many of which remain in use today. Specifically, they cited a C-Sept distance <2.5 and an A-P Ratio of <1.3 (indicating a greater contribution of the posterior leaflet to the coaptation of the mitral valve prior to repair) to be significantly associated with the risk of SAM after repair. Guidelines published by the ASE in 2020 also discuss recommended measurements for SAM risk. There are multiple independent predictors of SAM post MV repair, which include: a thick basal interventricular septum (>15 mm), a short C-sept distance (<25 mm), a narrow aorto-mitral angle (<120 degrees), an A-P Ratio of <1.3, and an LVOT Diameter of <2.0 cm.

Question 5:

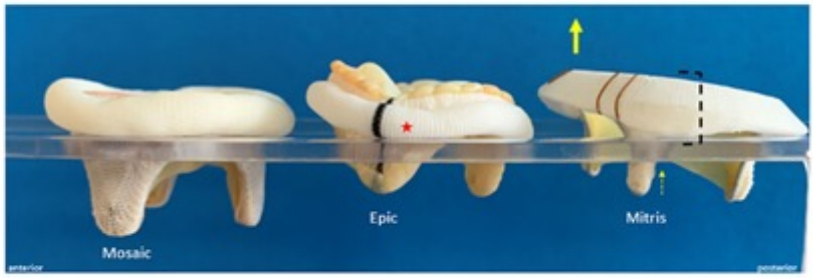
Answer: (B) Low profile/stent height

The Mitris valve has a lower profile compared to other valves on the market. The manufacturers state that the stent height is as low as 7 mm making it an especially attractive option for patients with a small left ventricular outflow tract. The Mosaic valve has a minimum stent height of 11 mm. The Mitris valve has a similar EOA to other valves on the market such as the Mosaic. While it is theorized that the Resilia tissue utilized in the Mitris bioprosthetic results in longevity, it is too soon to draw conclusions as only 7-year data is available at this time.

(A)



(B)



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Lung Isolation with a Bronchial Blocker Placed in the Lateral Position for Patients Undergoing Thoracic Surgery: A Multicenter, Randomized Clinical Trial

Li, H., Chu, L., Ye, H., Zhang, Y., Li, M., Hua, Y., ... & Fang, X. (2025). Lung isolation with a bronchial blocker placed in the lateral position for patients undergoing thoracic surgery: A multicenter, randomized clinical trial. Journal of Clinical Anesthesia, 104, 111869

Reviewer:

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Summary

This is a multicenter, randomized trial of 306 adult patients undergoing first-time thoracic surgery. 152 patients underwent the induction of general anesthesia with the placement of a single-lumen endotracheal tube and a bronchial blocker all while in the lateral decubitus position, and 154 patients underwent the same procedures while in the supine position and were subsequently positioned in the lateral position. The primary outcome was the incidence of bronchial blocker malposition. Secondary outcomes included the number of times the blocker required repositioning, as well as perioperative complications, intubation duration, and satisfaction scores. The authors report that 1/152 (0.7%) of the patients in the lateral group experienced blocker malposition vs. 39/154 (25.3%) in the supine group, P<0.001. Reposition was required (median [interquartile range]) in 0[0,0] patients in the lateral group vs. 1.0 [1.0, 2.0] in the supine group, with a reported P value less than 0.001. Postural injuries were also said to be more common in the supine group.

Strengths

The study was randomized, multicenter, and had a large number of patients.
The data reviewers were blinded to the patient assignments.

Limitations

The anesthesiologists and surgeons were not blinded to the patient assignments and the primary outcome was somewhat subjective.

Two of the references in the introduction were misrepresented and this casts doubt on the basis of the study and the outcomes reported. The authors claim that their reference (8), (here reference 1), found that the shift from the supine to the lateral position increased the risk of airway injuries. It did not. The reference found that the risk of minor airway injuries was lower among patients randomized to use of an endobronchial blocker compared to those intubated with a double-lumen endotracheal tube. Likewise, the authors assert that their reference (9), (here reference 2), concluded that position shifting increased the risk of "postural complications including brachial plexus nerve injury", (reference 3) , when in fact the study was of women undergoing abdominal surgery in the supine position, and thus unrelated to the current study.

The results as reported are muddled and inconsistent. It is reported that 25.3% of the supine group had initial malposition, versus 0.7% of the lateral group, but this is a subjective assessment by clinicians who knew the group assignment of the patient, and it is impossible to reconcile with the report that only one patient in the supine group required blocker repositioning. It is equally difficult to understand how one repositioning in the supine group could be statistically significantly higher than zero in the lateral group, yet they report P<0.001. Regardless, this is clinically insignificant.

The authors state in their introduction that the usual standard of care is their supine technique (supine intubation and placement of the blocker then lateral positioning, with a final check of blocker placement). However, the reference that they cite to support this claim (reference 7 in the original), (here reference 4) , once again does not mention the issue of patient positioning.

There were numerous exclusion criteria which indicate the impractical nature of lateral intubation and thus its unsuitability as a standard of care.

Conclusion and Clinical Implications

This is a poorly conceived and researched study that adds nothing to best practices in the use of bronchial blockers. Supine induction, endotracheal intubation, and blocker positioning, with subsequent bronchoscopic evaluation of balloon placement during position changes and surgical manipulation, should remain the sine qua non of safe practice.

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A Randomized Trial of Intravenous Amino Acids for Kidney Protection

Landoni, G., Monaco, F., LK, T., Baiardo Redaelli, M., Bradic, N., Comis, M., ... & Bellomo, R. (2024). A randomized trial of intravenous amino acids for kidney protection. The New England journal of medicine, 391(8), 687-698.

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Summary
This is a randomized, multinational, double-blind, placebo-controlled trial of adult patients undergoing elective cardiac surgery requiring cardiopulmonary bypass (CPB), in which 1752 patients (the placebo group) received an infusion of lactated Ringer's solution and 1759 patients in the treatment group received an infusion of a balanced mixture of amino acids (AA) (Isopuramin™ 10%, Baxter Pharmaceuticals) at a dose of 2g/kg of ideal body weight per day, for up to three days. The primary outcome was the occurrence of acute kidney injury (AKI) within the first week after surgery defined using the Kidney Disease: Improving Global Outcomes (KDIGO) creatinine criteria. Secondary outcomes included were the severity of AKI using the same KDIGO criteria, the use and duration of kidney-replacement therapy during the hospitalization, duration of ICU stay, duration of mechanical ventilation, and death. The researchers report that AKI occurred in 26.9% of the treatment group and in 31.7% of the placebo group (RR, 0.85; 95% CI, 0.77 to 0.94; P=0.002). Stage 3 AKI occurred in 1.6% of the treatment group vs. 3.0% of the placebo group (RR, 0.56; 95% CI, 0.35 to 0.87). There were no other differences in outcomes and no safety events were reported.

Strengths

- **Rigorous study design –** multinational, randomized, double-blind, placebo-controlled
- **Rigorous statistical and sub-group analyses**
- **Consistency of effect among study sites**

Comports well with previous clinical (reference 1) and experimental (reference 2 and 3) data indicating a renoprotective effect of proteins and amino acids during cardiopulmonary bypass, in cardiac surgery patients as well as in animal models.

Limitations

- **336 patients underwent hemofiltration during CPB** which complicates the measurement of serum creatinine, although such use was roughly equal in both groups.
- **Biomarkers or histologic examination of acute tubular injury were not obtained**

While there were reductions in AKI, "there was no difference in the incidence of any outcomes that affect how patients function in terms of general health, including the use of kidney-replacement therapy..." (reference 4) , mortality, serum creatinine after 30 days or quality of life.

Conclusions and Clinical Implications
This study confirms previous experimental and clinical data which indicates that a protein load can be renoprotective, including in patients undergoing CPB. In this study an infusion of AA led to modest reductions in AKI without a significant impact on the need for renal replacement therapy, time of mechanical ventilation, or mortality. In short, this is a low-cost intervention with few, if any downsides. Its potential uses could be expanded to other settings, such as off-pump cardiac surgery, major vascular or abdominal procedures, etc. Given the solid basic science underpinnings of this concept, it is worthwhile to evaluate it in other surgical settings. Further investigation appears warranted.

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Intravenous Amino-acid Infusion to Prevent Acute Kidney Injury after Cardiac Surgery: A Review of the Evidence Losiggio, Rosario et al. The Annals of Thoracic Surgery, Volume 120, Issue 2, 256 – 266

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Opioid Dose Variation in Cardiac Surgery: A Multicenter Study of Practice

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Reviewer:
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Background

There have been trends in opioid dosing regimens with some providers moving towards low-opioid, multimodal pain management.

Method: Retrospective review.

Strength: The opioid practices of 794 anesthesiologists across 30 hospitals were evaluated, totaling just under 60,000 cases.

Weaknesses: Only evaluated MPOG institutions. Data stems from 2014-2021, which may not reflect rapidly adjusting prescribing practices. This is highlighted by the authors, stating that in 2021 the average fentanyl equivalents were nearly 500 mcg lower than in 2014. Several excluding factors ASA 5, emergency, circulatory arrest, mechanical circulatory support, extremes of case duration, or any methadone use.

Results

1) Fentanyl remains the work-horse opioid in cardiac anesthesia (86% of cases)

2) The mean fentanyl equivalents given 1139 mcg, however with wide standard deviation.

3) 60% of the dose variation was explained by institution and practitioner, not patient or case.

4) Younger, and larger patients and longer cases received higher doses of opioids.

Conclusion

Wide variation in practices remain, however a significant factor affecting prescribing is the environment and anesthesiologist, not necessarily patient or case related factors.

Therefore, room to tailor opioid prescribing practices to patient related factors remain.

Incidence of Concurrent Cerebral Desaturation and Electroencephalographic Burst Suppression in Cardiac Surgery Patients

Ramachandran RV, Behera A, Hussain Z, et al. Incidence of Concurrent Cerebral Desaturation and Electroencephalographic Burst Suppression in Cardiac Surgery Patients. Anesth Analg. 2025;140:1086–1092. doi:10.1213/ANE.0000000000007209.

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Background

Perioperative neurocognitive disorders are common after cardiac surgery and significantly affect outcomes.[1,2] EEG burst suppression (BS) during cardiac surgery has been linked to postoperative neurocognitive complications such as delirium.[3] Algorithms using perioperative EEG to guide anesthetic depth may reduce such morbidity.[4,5] While often linked to deep anesthesia, burst suppression can also result from cerebral hypoperfusion due to hypotension, anemia, or emboli, which is likewise associated with delirium.[6-8] Cardiac surgery patients are particularly vulnerable during cardiopulmonary bypass, especially near cross-clamp removal.[9,10] Whether intraoperative cerebral desaturation ($rScO_2$ decline) and BS occur together—and in which surgical phases this co-occurrence is most likely—remains uncertain. This study assessed the association between cerebral desaturation and BS, with attention to cardiopulmonary bypass (CPB) phase-specific risk.

Methods

This was a retrospective analysis of prospectively collected EEG and cerebral oximetry data from 51 patients (>60 years) undergoing coronary artery bypass and/or valve surgery with CPB at BIDMC, enrolled in the PANDORA trial (NCT04093219). Aortic surgeries were excluded. Frontal EEG (SEDline, Masimo) and near-infrared spectroscopy cerebral oximetry were continuously recorded from the preoperative holding area through surgery, with clinicians blinded to monitoring data. Burst suppression ratio (SR) and cerebral desaturation (>10% below baseline) were defined per 1-minute intervals. Associations with surgical phases were analyzed using generalized linear mixed-effects models, adjusting for demographic and anesthetic covariates

Results

Primary association: Presence of cerebral desaturation increased the odds of BS by ~50% (OR 1.52, 95% CI 1.11–2.07; P=0.009).

Phase Effects (vs pre-CPB):

- Desaturation was far more likely during CPB (OR 22.1, 12.4–39.2) and post-CPB (OR 18.2, 12.2–27.3), both P<0.001.
- BS was less likely post-CPB (OR 0.69, 0.59–0.81; P<0.001).
- Concurrent desaturation + BS surged during CPB (OR 52.3, 19.5–140; P<0.001) and remained higher post-CPB (OR 12.7, 6.39–25.2; P<0.001).
- Within CPB, the interval after cross-clamp removal to CPB end carried markedly higher odds of desaturation (OR 6.59, 3.62–12) and concurrent events (OR 10.0, 4.01–25.1), both P<0.001.

Anesthetic Dose Effect:

Each 0.1% increase in inhaled agent concentration increased the odds of BS ~8-fold (OR 7.81, 6.26–9.74; P<0.001).

Discussion

This study explored the incidence and timing of concurrent cerebral desaturation and EEG burst suppression in cardiac surgery patients. The authors highlight that perioperative neurocognitive disorders remain a major concern, with both cerebral desaturation and burst suppression independently associated with postoperative delirium and cognitive decline.[8,11,12] The findings

demonstrate that concurrent cerebral desaturation and burst suppression occurred in a clinically significant subset of patients, particularly during the late CPB period and rewarming phase. This timing aligns with known vulnerability windows, such as embolic load during aortic unclamping and fluctuations in cerebral perfusion.[9,13] The study underscores that such overlap may not simply represent excessive anesthetic depth, but rather a critical interaction between anesthesia, systemic physiology, and cerebral oxygen delivery.[14]

The authors suggest that intraoperative monitoring integrating both cerebral oximetry and processed EEG could provide valuable real-time feedback. Anesthesiologists may be able to distinguish between anesthetic-induced suppression and perfusion-related changes, thereby guiding more tailored interventions such as adjusting mean arterial pressure, hematocrit, ventilation, or anesthetic dosing. Importantly, this multimodal approach may help identify periods of compounded cerebral vulnerability that are otherwise not obvious with a single modality.

While the study was not powered to directly link concurrency with neurocognitive outcomes, it provides a strong rationale for future prospective trials testing multimodal brain monitoring algorithms. Limitations include the observational design, lack of long-term follow-up, and potential variability in monitoring thresholds. Nonetheless, the work represents an important step toward refining intraoperative brain protection strategies in cardiac surgery, reinforcing the need for individualized, physiology-guided anesthetic care.

Conclusion

Cerebral desaturation is associated with intraoperative BS, most prominently during CPB—especially from cross-clamp removal to CPB termination. Simultaneous EEG and NIRS monitoring may enable targeted interventions to mitigate BS and potentially improve postoperative cognition.

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Fine-Mapping the Association of Acute Kidney Injury with Mean Arterial and Central Venous Pressures During Coronary Artery Bypass Surgery

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Summary
This retrospective single center study explores the severity and duration of perioperative hypotension and venous congestion – MAP <65 mm Hg, CVP >12 mm Hg, as well as their interaction component on associations with AKI following cardiac surgery. Time weighted averages beyond these thresholds have been linked to the degree of AKI, but there is no clear protective effect when steering patients away from these exposures. Prior studies across virtually all severe outcomes (including pre-publication manuscripts) point strongly to an inflection point and clear non-linear relationship. It is unclear whether relationships hold at the peripheral ranges, often due to decreased sampling at these points. It is also still unclear how perfusion pressure and venous congestion interplay on tissue protection within the renal vascular beds. Pre-, on-, and post bypass relationships inevitably demonstrate an evolving picture due to phases of inflammation, vascular tone, rewarming and changes in volume across tissue compartments.

It has previously been hypothesized that an MAP >65mmHg and CVP between 8 and 12 may be associated with a protective effect.

1372 patients undergoing CABG between July 1, 2016, and October 31, 2019 were selected from the Johns Hopkins STS registry and merged with data from the institutional EHR. All available patients were included with no a priori sample size calculations.

1119 patients remained after exclusion by the following criteria:

- End-stage renal disease or baseline serum creatinine >4 mg/dL (n=31).
- Surgical procedure requiring more than 1 aortic cross-clamp period (n=9).
- Intraoperative use of extracorporeal membrane oxygenation (n=4)
- Multiple surgical procedures during the same hospitalization (such as reoperation for bleeding or graft failure) (n=12).
- Insufficient hemodynamic (data in the electronic health record [EHR]) (n=117).

The following covariates were chosen for adjustment:

- age,
- male/female,
- body mass index,
- comorbidities (history of hypertension, diabetes, myocardial infarction, congestive heart failure, stroke, peripheral vascular disease, chronic lung disease),
- medications (beta blocker, angiotensin- converting enzyme inhibitor/receptor blocker, statin),
- preoperative left ventricular ejection fraction (LVEF),
- baseline hematocrit,
- baseline creatinine,
- surgical posting details (redo-sternotomy,
- emergent case, use of intra-aortic balloon pump),
- intraoperative characteristics (total procedure length, length of CPB, vasopressor inotrope dose, transfusion of packed red blood cells, and total crystalloid administered).

14 categorical values of narrow discrete hemodynamic ranges of MAP and 10 for CVP were created with 70 combined sections. The cumulative time within each range was recorded based on a 1-minute resolution of the records.

AKI was defined primarily as a creatinine rise ≥0.3 mg/dl from baseline at 48 hours post-surgery, and as a secondary outcome of the same criteria / or an increase ≥1.5X baseline within 7 days after surgery.

Initially, logistic regression was conducted running on the total number of minutes within each range. Various novel strategies developed by Dr. Crainiceanu were applied to minimize the potential for a type 1 error and correlation with adjacent and wider exposure categories in ranges of 19, 15, and 20mm Hg. Sensitivity analyses were also conducted of AKI with MAP across each phase of surgery, stratified by LVEF <40%, GFR 60, and presence or absence of shock. This was similarly completed for CVP increments of 4, 6, and 8mmHg CVP across each phase of surgery, for LVEF <40%, GFR 60, as well as presence or absence of shock.

Heat maps of the combined categories illustrated the relative distributions and numbers across each range. The highest density was with MAP 65-75 / CVP 6-8, having a mean peak of 17 minutes with a standard deviation of 14 minutes. The same category had 960 patients with 80% of these patients demonstrating at least 5 minutes within range.

A maximum Odds Ratio value when adjusted for all covariates was found to lie with the combination MAP 55-65/ CVP16-18 at 1.49 (SD:1.23,1.83). The most protective value was with a MAP range of 95-105 / CVP of 6-8 at 0.72 (SD 0.58,0.90). When adjusted for all covariates, and adjustments were made for correlation and multiple comparisons, the maximum OR value remained significant at the p=0.05 level at 1.40 (SD:1.07,2.07). The MAP 95-105/CVP 6-8 section lost significance with an OR of 0.72 (SD: 0.48,1.06).

338 patients (28%) had AKI within 48 hours. Higher mean BMI was associated with AKI, as was hypertension, congestive heart failure, chronic lung disease, low hematocrit, low GFR, STS mortality risk, duration of procedure, length of bypass, and volume of RBC transfusion.

Strengths

The FLexible Accumulation ModEl (FLAME) (R package flame) was used, which can take into account the number and duration of exposure episodes. This has associated tools that can run through comprehensive and thorough simulations.

The authors demonstrated a model that assigned a 37% accumulated increased odds for AKI in comparing one 60-minute episode of hypotension to 60 one-minute exposures – in spite of the total duration being the same. This tool realistically models the multiple distinct episodes of varying duration and intensity which can commonly occur throughout the perioperative period, and which cannot be specified a priori. FLAME allows the modelling of the odds of injury following a continuous exposure as being non-linear rather than that of multiple episodes with the same accumulated time exposure. A persistent episode of hypotension lasting 20 minutes would certainly have been addressed by any anesthesiologist within seconds of identification, with a selection of pressors, vasoactive agents and other interventions. The interventions themselves whilst protective of myocardial and cerebral vascular beds may still contribute to selective renal medullary bed ischemia and hypoxia. Presumably with multiple short periods of hypotension, the affected tissues may have opportunities to recover between episodes, or even have an enhanced recovery if there is a hypoxic / ischemic preconditioning effect. The renal medulla, despite typically having low O2 partial pressures at its baseline is notably vulnerable, with well documented declines in O2 partial pressure during bypass, and instantaneous urine O2 partial pressures being closely aligned with measures of medullary ischemia /hypoxia.[4,5,6] and ensuing AKI.

FLAME represents an advance on previously available Cox time - dependent covariate, and generalized additive models with scalar exposures. These advances were needed as new tools due to the development and availability of modern high temporal resolution databases.

RAF (Flexible Accumulation Model) is a function within FLAME where initially it is presumed to be linear in a generalized linear model. Further developments introduced penalized splines within RAF to try and model long linear relationships. By assigning a RAF value for each episode of hypotension, FLAME is able to model for each hypotensive episode within each patient. This separates it from a GLM (generalized linear model) of FLAME where the RAF value is assumed to be linear. RAF does not have to take on any pre specified shape. It is adaptable without pre

specification to take into account the different phases of cardiac surgery. Toker et al.'s quite justified concern regarding the risk of type 1 errors should be reasonably well addressed with these evolving iterations of FLAME.

In their review, Toker et al. caution in "considering the risk of Type I errors despite multiplicity corrections.". This is an intriguing point since it is addressed to an extent in Appendix 2 with a statement that the adjustments were made using a method developed by author Ciprian Crainiceanu.[7]

The entire R code is freely available at https://github.com/jhuwit/fine_mapping_sim

Limitations

Toker et al.,[1] make valid points regarding the single center retrospective nature of the study, although the STS component contribution and standardization should make future collecting of comparative data across institutions fairly straightforward. They also make reasonable points regarding Cardiac output, renal vascular bed autoregulation, tissue O2 supply and demand ratios, and the expected physiological changes throughout the perioperative period. Although the effects on inflection points in unadjusted models can be readily blunted in adjusted models with intraoperative variables that may hold stronger associations, this does not take away from the rigorousness and value of this study. The intention was clearly to conduct a preliminary study with the intention of elucidating any protective effect or risk in the degree, severity, and length of individual time exposures rather than total time of MAP, CVP and any MAP/ CVP interaction component

In Toker et al.'s statements: "Nevertheless, their analysis fails to adequately consider the intricate physiologic interactions that can complicate hemodynamic interpretation.....", and "However, methodological constraints and a lack of consideration for larger physiologic aspects limit the therapeutic utility of their findings." come across as a little harsh. Goeddel et al. clearly addresses this in the limitations section.

It may be challenging to extract relevant variables from the STS database, let alone extract these from institutional patient's charts post hoc.

Continuous intraoperative cardiac output monitoring is not as widely adopted as in the recent past.

The setting up and establishing of standardized targets bases on MAP and CVP should not come at the expense of more valuable input from echocardiography, PA and peripheral arterial line derived measures of CO, SV, SVR etc., and potential direct measures of renal metabolic activity, ureteric outflow and urine O2 partial pressure.[3,4]

Conclusions

An accumulated time of MAP alone between 45-60mmHg held the highest odds ratio across all four models (unadjusted, adjusted without intraoperative covariates, adjusted for all covariates, and adjusted plus correction for correlation of data and multiple testing). Only the MAP range of 90-95 mmHg showed a significant decreased odds ratio across all four models.

When looking at the accumulated times of CVP, the ranges 12-14mmHg, 14-16mmHg, and 16-18mmHg barely demonstrated significant odds ratios for AKI in all four models

MAP ranges between 90-95, CVP of 4-6 was associated with decreased Odds Ratio.

MAP ranges<65 and CVP ranges>12 were associated with an increased Odds Ratio.

MAP of 65 - 75 with a CVP 8 - 12 was not associated with any protection.

Clinical Relevance to Practice

AKI is common following cardiac surgery and is strongly associated with severe measures of adverse outcome. There are currently almost no renal protective strategies or reliable real time monitors for renal function.

Recent advances in high resolution EMRs have opened up opportunities for real time risk prediction, as has the development of computational packages capable of handling the complexity of the data in an appropriate manner.

As opposed to biological markers, hemodynamic data is immediately available for processing.

It is unclear based on the level of current evidence whether combinations of MAP and CVP offer substantive decreased odds of renal injury, since the lower end of the standard deviation is close to 1, with a commensurate low effect size.

Although the signal for an increased odds of AKI with a MAP of <65mm Hg, and CVP > 12mm Hg seems more established.

Suggestions for future clinical trials were suggested. Real time renal vascular bed blood flow and tissue / urine O2 partial pressure monitoring may offer some potential for improvements in renal protective strategies.

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Association Between Arterial Hyperoxia and Mortality in Pediatric and Adult Patients Undergoing Extracorporeal Membrane Oxygenation: A Systemic Review and Meta-Analysis[1]

Gu WJ, Shi R, Cen Y, Ye YY, Xie XD, Yin HY.
Anesth Analg. Published online December 20, 2024. doi:10.1213/ANE.0000000000007348

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Summary
Hyperoxia has been shown in various settings to have detrimental effects on patient outcomes, presumably due to the generation of free-radical oxygen species and resultant inflammatory effects, nitrosative stress, and vasoconstrictive effects.[2] While hyperoxia has been demonstrated as detrimental by meta-analysis in all-comers to critical illness,[3] the effect of hyperoxia in the context of extracorporeal membrane oxygenation (ECMO) support remains unclear. This systemic review and meta-analysis of 13 cohort studies examined the effect of hyperoxia on mortality in patients on ECMO support. Notably, the authors analyzed multiple types of patients on ECMO, including multiple modalities (i.e., veno-arterial [VA-ECMO], veno-venous [VV-ECMO], and extracorporeal cardiopulmonary resuscitation [ECPR]) and both pediatric and adult patients. Their primary goal was to examine whether there was an association between hyperoxia and 28-day mortality, which they examined utilizing odds ratios (OR) and corresponding 95% confidence intervals. The authors found a significant association between hyperoxia and mortality across multiple thresholds of hyperoxia, ranging from PaO2s of ≥100mmHg to ≥300mmHg (ORs 1.43-1.56). The authors additionally examined effects of hyperoxia by ECMO modality, looking for associations between mortality and hyperoxia in VV-ECMO, VA-ECMO, and ECPR and found there to be significant associations of hyperoxia with mortality for VA-ECMO (OR 1.38, 95% CI 1.18-1.62) and ECPR (OR 1.55, 95% CI 1.28-1.87) but no relationship demonstrated for VV-ECMO (OR 1.41, 95% CI 0.75-2.64). Finally, associations were distilled by age, for which a significant association was found between hyperoxia and mortality for adult patients at all hyperoxia levels as well as pediatric patients, wherein the two studies including pediatric patients found increased mortality for PaO2 ≥100mmHg (OR 2.23, CI 1.56-3.19). Finally, authors reported whether there was an association between hyperoxia and neurologic events noted in the included studies. Four of the included studies reported neurologic complications. One such study in pediatric patients found no association between PaO2 levels and neurologic complications,[4] but the three adult studies[5,6,7] that reported neurologic complications noted that hyperoxia was associated with worse neurologic outcomes.

Strengths
- Meta-analysis
- Analyzed all types of ECMO support
- Analyzed both pediatric and adult patients

Limitations
- While the authors allowed for RCTs or observational studies in their screening protocol, the studies that met inclusion criteria were only observational. Twelve of the thirteen included studies were retrospective cohort studies, and one was a prospective cohort study
- Implications for VV-ECMO are less clear – only two included studies looked at VV-ECMO, and there was no clear evidence of hyperoxic injury for VV-ECMO
- There was heterogeneity of the cut-off PaO2 criteria in different studies for a definition of "hyperoxia" (i.e., PaO2 cutoffs ranges from 100mmHg to 300 mmHg)
- Values for included studies were categorical (i.e., hyperoxic versus non-hyperoxic) rather than continuous PaO2 values, and there was no ability to determine a time-dose effect (i.e., longer versus shorter hyperoxia times were not accounted for)
- Unable to distill whether there may be different results for disparate, specific patient populations on ECMO support

Conclusions

This meta-analysis of observational studies demonstrates an association of mortality and hyperoxia while on ECMO. This result was demonstrated across VA- ECMO and ECPR and applied to both pediatric and adult patients. The association for patients on VV-ECMO is less clear given the paucity of studies included, and a cutoff or time-dose for "hyperoxia" for these patients is unclear.

Clinical Relevance to Practice

Overall, this study supports the notion that normoxia may be desirable for patients on ECMO support, and hyperoxia may be specifically harmful for patients on ECMO support. This may be more pertinent for VA-ECMO and ECPR than for VV-ECMO. The reason for this distinction between ECMO modalities is unclear but may relate to the heterogeneity of causes for hyperoxia and hypoxia in these patients. The authors provide specific examples that while low PaO2 may be seen in VA-ECMO due to North-South syndrome, divergent causes, such as high cardiac output or recirculation may be the culprits in VV-ECMO. This said, given that only two VV-ECMO studies met inclusion criteria, it is difficult to draw substantive conclusions from this data.

Despite a heterogeneity of defined "hyperoxia" in these studies, no clear effect based on a specific PaO2 level appears to have been generated, i.e., the association did not appear worse with escalating hyperoxia but was generated for all degrees of hyperoxia. Notably, only categorical cutoffs were generated in the included studies: hyperoxia duration and intensity were not recorded in these observational trials. Overall, this makes it difficult to determine how to practically act upon these results, as it is unclear what dose of hyperoxia is truly associated with worse outcomes (i.e., is it worse to have a short duration of very high hyperoxia or is it worse to have long duration with a lower degree of hyperoxia?).

Finally, given the observational nature of all studies included, these results point to the need for future randomized controlled trials (RCT) related to hyperoxia and ECMO support. While the authors attempted to include RCTs, there was a paucity of available RCT data, making it difficult to control for confounding causes of mortality. As a result, the findings should be interpreted with caution, but it may be considered reasonable to avoid hyperoxia where possible for patients on ECMO support, especially those on VA-ECMO and ECPR.

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A Randomized Trial of Acute Normovolemic Hemodilution in Cardiac Surgery

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Summary
Patients who undergo cardiac surgery are at an increased risk of allogenic red-cell transfusion. Blood transfusions are not only costly and limited, but are a known risk factor for adverse perioperative outcomes. Acute normovolemic hemodilution (ANH) is a well-known blood conservation technique that is commonly performed during cardiac surgery. Prior studies, including a meta-analysis of 29 randomized controlled trials, have shown a reduction in red-cell transfusion when ANH is utilized and this previously lead to a class IIa recommendation, level of evidence A, by the American College of Cardiology and the American Heart Association in 2021. However, recent statements have noted that a majority of prior studies weren't powered to assess safety and observed variations in hemodilution procedures across studies. This study aimed to test the hypothesis that ANH would reduce the need for allogenic red-cell transfusion for patients undergoing cardiac surgery with cardiopulmonary bypass (CPB).

This was a multinational, randomized control trial that involved patients from 32 centers and 11 different countries. All adults patients undergoing cardiac surgery with CPB from April 2019 to December 2024 were randomly assigned to received ANH (minimum withdrawal of 650mL of whole blood prior to the administration of heparin) or usual care. The primary outcome was the transfusion of at least one unit of allogenic red cells during the hospital stay. Secondary outcomes included death from any cause within 30 days of the operation, bleeding complications and ischemic events.

A total of 2,010 patients underwent randomization with 1,010 patients assigned to the ANH group and 1,000 to the usual care group. A total of 274 patients in the ANH group (27.3%) received at least one red-cell transfusion compared to a total of 291 patients in the usual care group (29.2%) (relative risk, 0.93; 95% confidence interval, 0.81 to 1.07; P=0.34). Secondary outcomes of postoperative bleeding (38 patients, 3.8%, in the ANH group vs 26 patients, 2.6%, in the usual care group) and death within 30 days (14 patients, 1.4%, in the ANH group vs 16 patients, 1.6%, in the usual care group) were similar as well. Overall, the investigators found that ANH did not reduce the number of patients receiving allogenic red-cell transfusion, modify the risk of surgical bleeding, or was associated with any difference in safety outcomes.

Strengths

- The article has not only highlighted the importance of blood conservation techniques during cardiac surgery, but also addressed the limitations of prior studies evaluating the same topic.
- This was a multinational, multicenter, randomized control trial that screened over 7,000 candidates and had a relatively large sample size of 2,010 patients. The number of patients enrolled in this study was almost equivalent to the overall number of patients enrolled in

previous trials combined.
- A very broad and reproducible inclusion criteria that included all adult patients undergoing cardiac surgery with CPB (coronary artery bypass grafting, valve replacement, and/or aortic surgery).
- The baseline characteristics for the two groups were very similar with the only significant difference being in gender with females representing 21.7% of the ANH group vs 18.6% in the usual care group. Median duration of bypass and crystalloid administration prior to bypass were also similar between the two groups.
- Relatively narrow 95% confidence interval (relative risk, 0.93; 95% confidence interval, 0.81 to 1.07; P=0.34).
- Protocol published prior to study completion. Robust statistical analysis which included accounting for variability across centers.

Limitations

- A common transfusion protocol was not mandated. Recommendations were made but centers had the option to apply their own protocols.
- All types of cardiac surgeries were included, regardless of the associated risk for bleeding, which leaves open the possibility of a true difference being difficult to detect if the incidence of bleeding outcome is lower than expected.
- The study compares ANH with usual care but doesn't describe what "usual care" is for other institutions such as if retrograde autologous priming was performed or not.
- The timing of transfusion between the two groups was not mentioned.

Conclusion and Clinical Implications

The authors concluded that ANH did not alter the rate of red-cell transfusion or was associated with any difference in safety outcomes for patients undergoing cardiac surgery. Given the known risk of transfusion for patients undergoing cardiac surgery this study highlights the importance of finding additional blood conservation techniques that may prove superior in terms of decreasing

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Association of Impaired Relaxation Mitral Inflow Pattern (Grade 1 Diastolic Function) with Long-Term Noncardiovascular and Cardiovascular Mortality

Young et al., JASE (2025)

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Summary
This prospective community cohort analysis from the Olmsted County evaluates whether grade 1 diastolic dysfunction—defined by an impaired relaxation mitral inflow pattern (E/A ≤0.8) as per Mayo Clinic algorithm—predicts cause-specific mortality independent of age, sex, and comorbidities.

The Olmsted County Heart Function Study (OCHFS) is a community-based study in Olmsted County, Minnesota, designed to prospectively monitor cardiac function in randomly selected participants aged 50 years or older through serial evaluations.

The present analysis drew on data from the final clinical evaluation of the OCHFS, conducted between 2002 and 2004, which included 1,402 participants. Individuals were excluded if they had left ventricular systolic dysfunction (LVEF <50%), moderate or greater valvular disease, a clinical history of heart failure, or conditions known to interfere with standard echocardiographic assessment of diastolic function—such as atrial fibrillation, mitral annular calcification or stenosis, left bundle branch block, or prior mitral valve repair/replacement. The remaining cohort was followed for mortality outcomes through March 2023, with over 90% of survivors having complete follow-up at 20 years. Cardiovascular mortality was defined as death due to myocardial infarction, heart failure, stroke, valvular heart disease, or arrhythmia, whereas non-cardiovascular mortality encompassed other causes, including malignancy and dementia. Echocardiographic studies were acquired by one of three experienced sonographers and subsequently interpreted by two expert echocardiographers. For diastolic function classification, the investigators applied the Mayo Clinic algorithm rather than the 2016 ASE/EACVI recommendations.

Grade 1 diastolic function was common (26%) and associated with higher all-cause mortality (HR 4.05; 95% CI 3.22–5.09), and—importantly—remained associated even in those with isolated impaired relaxation without clinical/echo comorbidities (HR 2.71; 95% CI 1.89–3.88). After adjustment, associations persisted for cardiovascular mortality (grade 1 HR 2.43; 95% CI 1.16–5.05), while links with non-cardiovascular death attenuated, though death due to dementia remained higher with grade 1 (age/sex-adjusted HR 2.30; 95% CI 1.54–3.45). The study argues against considering impaired relaxation in older adults as "normal for age," highlighting it as a potential biomarker of both cardiovascular and cognitive risk.

Study Design and Methods

- **Robust, long follow-up and community cohort:** Nearly two decades of follow-up with >90% complete tracking in survivors strengthens outcome ascertainment and temporality.
- **Clear, pragmatic definition of grade 1:** The Mayo algorithm preserves a distinction between normal and impaired relaxation (E/A ≤0.8) even with normal filling pressures—addressing potential reclassification artefacts from 2016 ASE/EACVI criteria.
- **Cause-specific mortality analyses:** Differentiating cardiovascular vs non-cardiovascular deaths (including a notable signal for dementia) provides clinical granularity rarely available in community echo cohorts.
- **Sensitivity analysis in "isolated" impairment:** Demonstrates prognostic value of impaired relaxation even without DM/HTN/CAD, LA enlargement, LVH, or RWMA—clinically relevant for patients who would otherwise be labeled "normal."

Limitations

- **Single, predominantly Caucasian community:** Generalizability beyond Olmsted County is limited; external validity across diverse ethnicities and healthcare settings remains uncertain.
- **Algorithm choice and guideline divergence:** Using the Mayo algorithm (vs 2016 ASE/EACVI) intentionally maintains grade-1 categorization; prognostic differences may partly reflect definitional choices rather than pure biology.
- **Limited echo variables and subgroup depth:** Lateral e_2 not collected; disease-specific mortality in the "isolated" subgroup underpowered for detailed breakdown; small numbers for some endpoints (e.g., grade 2–3) constrain inference.
- **Dementia classification nuance:** Some dementia deaths may have vascular underpinnings; misclassification between cardiovascular and non-cardiovascular categories cannot be fully excluded.

Conclusions

In a community sample without HF and with preserved LVEF, an impaired relaxation mitral inflow pattern (grade 1) is not benign. It independently predicts cardiovascular mortality and aligns with a higher risk of dementia-related death. These findings support retaining a diagnostic distinction for grade 1 diastolic function rather than subsuming it into "normal," reinforcing impaired relaxation as an early risk biomarker along the HFpEF continuum and possibly the heart-brain axis.

Clinical Relevance to Practice

- **Reporting:** Echo reports should explicitly label impaired relaxation (E/A ≤0.8) as abnormal (grade 1) even when resting filling pressures appear normal, avoiding a blanket "normal diastolic function" label in such cases.
- **Risk communication and prevention:** Treat grade 1 as a red flag prompting cardiovascular risk optimization (BP, glycaemia, weight, lipids, fitness) and surveillance for HFpEF evolution—consistent with the concept of Stage A/B HF prevention.
- **Cognitive health awareness:** Incorporate brief cognitive screening or risk discussion in older patients with grade 1, while recognizing causality is not established; coordinate with primary care for broader dementia risk mitigation.
- **Follow-up:** Schedule periodic re-evaluation of diastolic indices and LA size/strain (if available), especially in patients accumulating comorbidities.

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Utility of an Echocardiographic Machine Learning Model to Predict Outcomes in Intensive Cardiac Care Unit Patients

Aghezzaf et al., Journal of the American Society of Echocardiography, April 2025

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Summary

This multicenter prospective study evaluates the prognostic utility of a machine learning (ML) model based on transthoracic echocardiography (TTE) parameters to predict major adverse events (MAEs) in patients admitted to intensive cardiac care units (ICCUs). The authors developed an XGBoost-based model using five key echocardiographic features and demonstrated its superior predictive performance compared to traditional clinical scores such as GRACE, TIMI, ACUTE-HF, and qSOFA. The model was validated internally and externally, showing promise for early risk stratification.

Methods

- **Design:** Prospective, multicenter study across 39 French ICCUs (ADDICT-ICCU cohort).
- **Population:** 1,499 consecutive patients (mean age 63 years, 70% male) with TTE performed within 24 hours of admission. An additional 200 patients at Lille University Hospital formed an external validation cohort.
- **Exclusions:** Patients admitted with cardiogenic shock or resuscitated cardiac arrest, or without urine drug assay results.
- **TTE Parameters:** 16 variables measured per guidelines; feature selection performed using random survival forests.
- **Model Development:** Extreme Gradient Boosting (XGBoost) selected after comparison with logistic regression, random forest, and LASSO. Cross-validation and SHAP analysis were used to ensure interpretability.
- **Primary Outcome:** I n-hospital MAEs (all-cause mortality, resuscitated cardiac arrest, or cardiogenic shock).

Results

- **MAEs:** Occurred in 67 patients (4.5%) in the main cohort and 28 patients (14%) in the external validation cohort.
- **Key Predictive TTE Features:**
  - LVOT VTI
  - E/e_2 ratio
  - Systolic pulmonary artery pressure (sPAP)
  - Tricuspid annular plane systolic excursion (TAPSE)
  - LVEF
- **Performance:**
  - **AUROC in testing set:** 0.83 (XGBoost) vs 0.76 (logistic regression), 0.66 (ACUTE-HF), 0.60 (TIMI), 0.58 (GRACE).
  - **External validation AUROC:** 0.74, still superior to traditional scores.
  - **Incremental value:** Addition of the ML model improved clinical + biomarker-based Cox models (C-index 0.80 vs 0.73; p=0.012).
- **Calibration:** Good model fit demonstrated by Hosmer–Lemeshow test (p=0.911).

Strengths

- Large multicenter prospective cohort.
- Robust methodology with internal and external validation.
- Use of explainable ML (SHAP values) to enhance interpretability.
- Demonstrated incremental prognostic value beyond clinical and biological data.

Limitations

- External validation limited to a single center.
- Performance declined in validation cohort (AUROC 0.74 vs 0.83).
- Exclusion of patients with cardiogenic shock at admission or durable MCS.
- Only short-term, in-hospital outcomes assessed; no long-term follow-up.
- Practical implementation and integration into workflows not evaluated.

Conclusion

The study provides compelling evidence that an ML model based on basic echocardiographic parameters offers superior prognostic accuracy compared to existing scores in ICCU patients. While promising, broader validation and integration into clinical decision-support systems are required before routine implementation. Future research should focus on long-term outcomes and randomized trials assessing clinical utility.

PRO CON

INTRODUCTION OF PROS AND CONS:

All Anesthesiology Residents Should Have Training in Transthoracic Echocardiography

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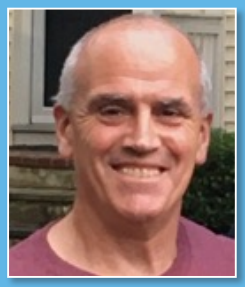

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Introduction and Terminology

Point of care ultrasound (PoCUS) has expanded across all of medicine for rapid bedside diagnostics and procedural guidance.[1,2,3] Within PoCUS, focused cardiac ultrasound (FoCUS) refers to a limited, goal-directed transthoracic assessment for immediate hemodynamic questions, whereas comprehensive TTE follows the cardiology model for full imaging and quantification.[1,2,3,4] The TTE spectrum thus ranges from a two-view FoCUS to a full echocardiographic study. Historically, cardiology regulated TTE performance, interpretation, and reporting to ensure test quality and practitioner competence.[4,5] With ultrasound's expansion, rapid bedside TTE by non-cardiologists is increasingly recognized. Multiple societies now online training, assessment, and certification (e.g., anesthesiology, critical care), but requirements vary widely in CME requirements, exam numbers, and mentoring.[4,5,6,7] Cardiology, critical care, and anesthesiology societies have their own certification processes that range from basic to advanced or level I to level III.[4,8,9] These are just a few examples of the expanding list of societies/groups that have or are establishing criteria for training, testing, and certification.

How this Frames the Debate

If a universal baseline for TTE training during anesthesiology residency is adopted there would have to be a recognized body to regulate the process. The ASA and SCA already have teaching and certification programs in place that could be adhered to. However, these come at a price.

https://scahq.org/education/non-cme-education/basic-tte-program/

https://www.iteachu.com/catalogue/sca/

However, these programs provide cognitive scaffolding and case exposure to standardize language and views. Programs seeking a heavier proof-of-competence model can look to the SCA advanced echocardiography or American Society of Chest Physicians and Society of Hospital medicine (CHEST/SHM) PoCUS certificate pathways. The ACC/ASE standard represents the most comprehensive TTE training aimed at independent interpretation and laboratory leadership.

The TTE education, training and assessment of anesthesia and other non-cardiology residents is in its infancy compared to what has been established for cardiology by the. While a benchmark for training has been established for cardiology, other societies, based on their own realities and resources, are not likely to attain similar case numbers with similar supervision and teaching. As a result there are now multiple levels of training ranging from exposure to performance and then to a supervisory role. Qualifications are further determined by attaining a testamur status and then ultimately certification. However, until insurers deny payments for individual practitioners, the decision as to who can perform and/or interpret any particular test is left up to the hospital in conjunction with individual departments. Although there is strong support that billing be limited to individuals with documented training, a positive testamur status, and certification, ultimately, the determination as to who can perform, interpret, and bill for ultrasound tests is locally determined i.e. institution and departments. The argument against this is concerns over quality of care.

Framing the Question

Since TTE has moved from a "nice to have" to a "routine adjunct" to assess cardiac and pulmonary dysfunction and guide management in the perioperative period, the question for this Pro Con is whether or not anesthesiology residents should be comprehensively trained to perform TTE and achieve certification. A separate question, is to what standard should this

training be directed to provide some minimum standard of care, and what the standard of care should entail.

The table below provides a map of the certification/training landscape across specialties. Across societies, "training" spans different structured coursework, minimum numbers for cases performed and supervised, and required CME/educational materials. This map is intended to frame the subsequent PRO and CON essays by clarifying difficulties in defining a universal baseline.

While knowledge is power, a balance needs to be achieved between credentialling for the purpose of credentialling and service quality and quality of care.

	Levels	Total Exams Exams Performed	Exams Performed for MOC Total/Performed	CME Hours Initial CME Hours MOC	Duration of Training	Exam Cost	Comments
American Society of Echocardiodgraphy/Society of Cardiac Anesthesiologist (ASE/SCA) Guidelines in Training for Perioperative Echocardiography							
	Basic/Advanced/ Direction	150/300/450 50/150/300	50/50/50 25/25/25	20/50/NS 15 per 3-Years	NS	$1295 q 10 Years	Adult Echo Certification Level II Exams 150/300
American College of Cardiology/American Heart Association (ACC/AHA) Guidelines for Training for Transthoracic and Transesophageal Echocardiography							
	Basic/Advanced/ Direction	150/300/750 75/150/300	25-50	NS 5/5/ > 5...Per Year	3,6,12 Months	$1295 q 10 Years	Exams are broken down into case types: e.g. valve, contast, stress, VAD etc etc
Society and Critical Care and Critical Care Echocardiography (CCE)							
	Critical Care Echo Certification	150 complete critical care TTE (optional 50 TEE)	NS	Complete ≥ 1 year of Critical Care Fellowship 750 Hours Clinical Experience	Complete ≥ 1 year of Critical Care Fellowship	$1295 q 10 Years	Eligibility via Fellowship or Practice Hours
Canadian Anesthesiologists Society and Canadian Society of Echocardiography							
	Basic/Advanced/ Direction	150/300/450 100/200/300	50/50/50	50/50/75 Over 2 Years 50/50/75 Over 4 Years	3,6,9 Months	Refer to NBE Exams	Third Party Certification
American Society of Anesthesiologists Point of Care Ultrasound (PoCUS)							
	MultiSystem PoCUS Certification	50 cardiac, 30 lung, 30 gastric, 30 abdominal free-fluid 10% Supervised	NS	Successful Completion of: On-Line PoCUS Modules	NS	Member $400 to 1540 Non-Member $1760 to 2420	Multisystem Scope (Not Cardiac Only)
American Board of Emergency Medicine/American Emergency Medicine Ultrasound (ABEM-AEMU)							
	Advanced Emergency Ultrasound Designation	300 studies performed/ supervised +500 reviews/ yr over 24 mo	NS	NS	60 Months	$470 application + $1,745 exam q 5 years	Pathway not open to Anesthesia Diplomats EM Pathway Only

Table 1. TTE/PoCUS Training and Certification Pathways—Program Planning Snapshot
Abbreviations: ACC—American College of Cardiology; ASE—American Society of Echocardiography; TTE—Transthoracic Echocardiography; NBE—National Board of Echocardiography; TEE—Transesophageal Echocardiography; ASA—American Society of Anesthesiologists; SCA—Society of Cardiovascular Anesthesiologists; CHEST—American College of Chest Physicians; SHM—Society of Hospital Medicine; ABEM—American Board of Emergency Medicine; AEMUS—Advanced Emergency Ultrasound; FPD—Focused Practice Designation; EUFAC—Emergency Ultrasound Fellowship Accreditation Council; MOC--Maintenance of Competence; PoCUS—Point-of-Care Ultrasound.

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All Anesthesiology Residents Should Have Training in Transthoracic Echocardiography

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In the dynamic field of perioperative medicine, anesthesiologists are increasingly required to conduct comprehensive point-of-care evaluations that extend beyond the conventional confines of the operating room. Among the innovations transforming bedside diagnostics, point-of-care ultrasound (POCUS) is a modality that revolutionizes bedside assessment of cardiac, pulmonary, and volume status.

POCUS has emerged as a non-invasive, dynamic, and high-yield modality that can significantly enhance real-time clinical decision-making. Specifically, transthoracic echocardiography (TTE) provides rapid, real-time insight into a patient's hemodynamic and respiratory status.

With proficiency and training in POCUS, and more specifically, TTE, anesthesiologists can evaluate systolic and diastolic ventricular function, major valvular abnormalities, volume status, pericardial effusion, pneumothorax, pulmonary edema, and pleural effusions without leaving the bedside or awaiting a formal echocardiogram. These findings can substantially influence anesthetic management, fluid therapy, and decisions regarding escalation of care. One prospective study reported that FOCUS TTE studies conducted by anesthesiologists correlate with cardiologist findings by up to 90% (1). Notably, TTE complements existing monitoring tools without delays associated with formal imaging studies and the need for specialized consultations.

Given its expanding role in hemodynamic evaluation, lung pathology assessment, and procedural guidance, training in POCUS, including focused cardiac ultrasound (FoCUS), should be an integral component of anesthesiology residency programs.

What is the rationale for providing anesthesiology residents with training in TTE?

- ***It Enhances Clinical Decision-Making***

Early exposure to TTE training augments, rather than supplants, traditional clinical skills among residents.[2]

TTE training enhances anesthesiologists' comprehension of complex physiological processes by offering immediate feedback on interventions, such as fluid boluses, inotrope initiation, or ventilation adjustments. For residents, this experience fosters a more profound integration of physiological knowledge with clinical practice and expedites the transition from knowledge-based learning to decision-making proficiency.[3]

POCUS and TTE are highly valuable tools and skills to acquire, enabling the rapid and accurate assessment of various entities that impact anesthetic management. For patients in shock, Bedside ultrasound and TTE have a diagnostic area under the ROC curve over 0.95 to differentiate and diagnose obstructive, cardiogenic, hypovolemic, and mixed shock relevant to immediate clinical decision-making.[4]

TTE offers a non-invasive, rapid, and repeatable method for assessing preload, ventricular function, valvular integrity, pericardial pathology, and volume responsiveness. While pulmonary artery catheters and central venous pressure provide hemodynamic values through surrogate variables, TTE provides a direct visualization of cardiac structures and function. This precision enables anesthesiologists to tailor interventions based on the patient's real-time physiological status.

Furthermore, TTE enables the evaluation of responses to therapeutic interventions and helps avoid unnecessary procedures or consultations when results are normal.

- ***Accessible Learning Curve***

One of the most persuasive arguments for universal training is the challenging yet attainable

learning curve. Research from intensive care unit (ICU) literature indicates that even short, structured training-like a 10-hour course in limited TTE for intensivists-can lead to high levels of competency, with 94% of studies conducted adequately and 84% interpreted correctly.[5-6]

FoCUS protocols and structured curricula have been established and validated across numerous residency programs globally. Institutions that have implemented TTE training report enhanced resident confidence, earlier diagnoses, and reduced unnecessary diagnostic delays.

Several accrediting bodies and societies, including the American Society of Anesthesiologists and European Society of Anesthesiology and Intensive Care, now prioritize POCUS in their educational objectives.

Initial training typically focuses on acquiring basic views (subcostal, parasternal, and apical), which facilitate a qualitative assessment of ventricular size and contractility, the presence of pericardial effusion, and the dynamics of the interventricular septum.[7] Integrating echocardiographic information with the medical history, physical examination, and other complementary data is crucial for perioperative decision-making.[8]

- ***It Builds Competence in Hemodynamic Assessment***

Anesthesiology residents receive training in the management of complex hemodynamic conditions. The application of TTE enhances the comprehension of preload, contractility, and afterload by offering a visual perspective. When TTE is integrated with venous excess ultrasound (VExUS) or inferior vena cava (IVC) assessment, it aids in the personalization of fluid and vasopressor therapy.

The integration of TTE into anesthesiology practice empowers clinicians to function as immediate diagnosticians rather than merely as proceduralists. As training programs expand their echocardiographic curriculum, and certification pathways become more established, the argument for routine TTE competence among cardiac anesthesiologists is both practical and compelling.

- ***It Prepares Residents for Diverse Practice Settings***

Not all anesthesiologists operate within academic institutions that offer continuous cardiology support or access to transesophageal echocardiography. In community- or resource-constrained environments, transthoracic ultrasound may serve as the sole imaging modality, enabling anesthesiologists to conduct immediate and autonomous assessments and interventions.

Although a TTE assessment does not replace a more comprehensive cardiac evaluation, deferring the assessment to a cardiology consultation would result in increased costs, prolonged hospital stays, and delays in clinical decision-making, which could adversely affect patient outcomes.[9] By reducing dependency on external interpretation anesthesiologists proficient in TTE can initiate diagnostic and therapeutic actions without awaiting external input. This capability is especially valuable in urgent or emergent cases, where the differential diagnoses include, but not limited to, conditions such as tamponade, severe ventricular dysfunction, or dynamic outflow tract obstruction, all of which can be rapidly identified with a focused TTE examination.

Mastering TTE avoids unnecessary delays and consults in a substantial proportion of cases, supporting its utility in streamlining perioperative management and resource utilization.[2]

- ***It Improves Patient Safety***

The capacity to swiftly identify complications or deterioration at the bedside significantly enhances patient safety. The patient population undergoing non-cardiac surgery is becoming older and more morbid, particularly patients with coronary artery disease and performing preoperative TTE may help predict postoperative cardiac complications.[10] While TTE is not typically performed or recommended for every high-risk patient, preoperative bedside TTE can be useful in adapting anesthetic goals and management. This can be done without patient transport, minimizing risk and enabling continuity of care by clinicians who are already familiar with the patient's intraoperative course.

During the postoperative period, particularly in the ICU, the continued availability of anesthesiologist-performed TTE extends the scope of perioperative monitoring. Bedside assessments of hemodynamic instability can be conducted quickly and efficiently, helping to rule out the most critical and severe conditions.

- ***Cost-Effectiveness***

Strategic integration of TTE training into anesthesiology education represents more than just a clinical upskilling opportunity-it offers healthcare systems a tangible pathway to financial optimization. These financial benefits could arise from optimized anesthetic management, timely clinical interventions, decreased surgical delays and cancellations, reduced reliance on prolonged diagnostic investigations, and shorter ICU admissions and hospital stays. A study by Neale and colleagues found that performing just two focused TTE exams per day yielded over AUD $100,000 in annual savings at one institution. Wider adaption of this practice could amplify cost savings across healthcare systems without compromising care quality.[11]

- ***It Aligns with Global Competency Standards***

Prominent organizations such as the ASA, ESAIC, and WFSA advocate the inclusion of ultrasound proficiency as an essential skill for contemporary anesthesiologists. The residency period represents the ideal phase to impart foundational skills of image acquisition, interpretation, and integration into clinical practice.

The incorporation of TTE into anesthesiology residency programs is imperative, aligning with the specialty's role as a perioperative physician and enhancing patient safety, diagnostic precision, and clinical efficiency.[12-14] As ultrasound devices become increasingly portable and cost-effective, the primary obstacle to their widespread adoption is the provision of adequate training.

Such training should encompass didactic instruction in basic physics, anatomy, and TTE indications alongside practical scanning experience and structured assessments, including image interpretation examinations, to ensure competency.[15,16] This initiative should commence with faculty development, necessitating curriculum adjustments to address the evolving requirements for proficiency in POCUS, including TTE. Training educators is crucial for maintaining high-quality education and mentorship.

Integrating this with existing POCUS training, such as vascular access, gastric ultrasound, and regional anesthesia, can establish a comprehensive multimodal learning pathway that reinforces ultrasound as an extension of the anesthesiologist's physical examination.

Conclusion

Perioperative transthoracic echocardiography (TTE) conducted by anesthesiologists enhances the quality of cardiovascular care by delivering prompt and accurate hemodynamic assessments, thereby diminishing unnecessary reliance on cardiology services. This approach not only optimizes clinical outcomes but also underscores the anesthesiologist's role as a comprehensive perioperative physician.

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Should Residencies Provide Comprehensive TTE Training to Achieve Certification?

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Ultrasound, including transesophageal and transthoracic echocardiography (TTE), has become a significant component of anesthesiology residency training over the past decade.[1,2,3,4,5,6] The availability of ultrasound machines, high-fidelity simulators, and increasing awareness of potential value has made ultrasound and TTE training a growing part of anesthesia resident education. Given this significant expansion, an important question arises: Should formal certification in comprehensive TTE become a requirement of a residency program's curriculum? While we agree that ultrasound education is valuable we present our arguments for why it is not practical that a requirement for comprehensive TTE training to be implemented.

While perioperative TTE (PTTE) is a highly useful tool for an anesthesiologist, there are currently no uniform formalized standards for certification in PTTE from governing bodies across the medical field among subspecialities.[7,8,9,10] The American College of Cardiology (ACC), American Heart Association (AHA), and American Society of Echocardiography (ASE) have published advanced training guidelines with "levels" to guide expectations of cardiology trainees; however, these guidelines are not aimed at anesthesiology residents, and are not actual certifications themselves.[7,8,11] Advanced transthoracic echocardiography certification is achieved through the National Board of Echocardiography (NBE) ASCeXAM (Certification for Adult Echocardiography). The NBE also provides certifications for critical care echocardiography, basic and advanced perioperative transesophageal echocardiography.[7,8,9,10,11,12] Notably, perioperative transthoracic echocardiography certification is not offered.

Subramaniam and colleagues published an institutional example of what competencies may be served by basic and advanced PTTE.[13] The basic PTTE competency is indicated for use in diagnosing hemodynamic instability and hypoxemia. The basic exam includes the five standard views in TTE: Parasternal long axis, parasternal short axis, apical four-chamber, subcostal four-chamber, and subcostal inferior vena cava. The goals are to qualitatively assess volume status, biventricular function, major valvular pathology, and the presence of pericardial effusion. Lung and pleural ultrasound are valuable adjuncts to this level. These skills mirror the content outline for the American Board of Anesthesiology (ABA) APPLIED examination.[14,15] Thus, they argue that this level should be achieved by all anesthesiologists in approximately twenty-five proctored TTE examinations. Sharkey and colleagues conducted a national Delphi survey of experts in perioperative TTE, finding broad agreement with the skills outlined by Subramaniam. However, their findings emphasized that achieving competency in basic TTE requires performing a minimum of fifty examinations.[16] Even if a concentrated period of training yields 40-50 exams, the use of TTE thereafter is limited by case opportunity and machine availability.[17,18]

The advanced PTTE competency reported by Subramaniam is utilized for a more detailed perioperative evaluation in high-risk patients.[13] This level includes thirteen views and more quantitative measurements, such as left ventricular ejection fraction calculation by the Simpson's method, for example. These more advanced techniques require more training, more time, and more experience. The authors estimate that non-cardiac anesthesiologists could obtain competency in 150 TTE exams performed and interpreted.[8,13] They note that this level of competency is useful for cardiac anesthesiologists and critical care echocardiography certified physicians. As mentioned above, these designations of basic and advanced PTTE mirror the designations used in transesophageal echocardiography (TEE) certification. Lastly, Subramaniam and colleagues strongly suggest the establishment of standards for advanced PTTE. If we are to propose that residency programs provide comprehensive training for PTTE certification, there must first be a clear standard of what that certification is.[13]

The question of whether residencies should provide comprehensive TTE training also begs the question of what we define as comprehensive in relation to the scope of an anesthesiologist.

CON

As previously mentioned, there are published standards in the field of cardiology.[7] For instance, physicians seeking NBE's Certification for Adult Echocardiography (ASCeXAM) are expected to have interpreted 300 studies, with at least 150 of those being personally performed followed by an exam to attain testamur status, and a couple of years of maintenance with continued CME for certification.[7] This covers topics such as stress echocardiography, which would be outside of the scope of anesthesiology practice. In the perioperative arena, similar requirements exist for transesophageal echocardiography. Applicants seeking NBE's Advanced Perioperative TEE certification also need to log a minimum of 300 studies. Sonographers require > 500 studies before applying for certification. Given the myriads of cardiovascular and pulmonary pathologies that exist there is ample support for the more extensive training. Non-cardiology societies, to accommodate fewer resources and the need to assure training, education, and certification, have designed different criteria to achieve a testamur status and certification, even to the point of defining different levels of expertise ranging from basic to advanced or levels I,II, and III respectively.[7]

The National Board of Echocardiography differentiates between Basic and Advanced perioperative echocardiography regarding testing, certification, and more important, clinical meaning (https://www.echoboards.org/certification/)

> *"The application of a basic perioperative TEE examination is limited to non-diagnostic use within the customary practice of anesthesiology. Because the goal of and training in basic PTE is focused on intraoperative monitoring rather than specific diagnosis, except in emergent situations, diagnoses requiring intraoperative cardiac surgical intervention or postoperative medical/surgical management must be confirmed by an individual with advanced skills in TEE or by an independent diagnostic technique."*

> *"The application of an advanced perioperative TEE examination is to utilize the full diagnostic potential of perioperative TEE including direction of the perioperative surgical decision-making process."*

Given that multiple societies have their own standards and even their own certifications, it is not clear to which standard training should be guided by.

With the current structure of most anesthesia residency programs, achieving these numbers could be incredibly challenging, if not impossible.[9] There is also a question of clinical utility and goals to complete testamur or certification status for either basic or advanced echocardiography.[9,13,19,20] Without dismissing the potential value of proficiency in performing and interpreting PTTE to answer answering important questions, it is evident that achieving and then sustaining technical skills are limited by resources, teaching and subsequent utilization, the latter to, after residency, maintain skills and certification.[8,13,19,20] A follow-up report of 115 PTTE trained residents reported that < 40% had utilized any TTE skills after residency and fewer than 25% had achieved testamur status.[13,19]

In residency programs, resources (i.e. machines) and dedicated time are limited such that attaining a minimum number of exams performed and reviewed to satisfy societal recommendations is unlikely for even only basic proficiency.[8,17,18,20] In addition, the costs are not insignificant including machines, staff time, formal lectures, and, if desired, a simulator, the latter of which are > 30-40,000 dollars.[21]

The amount of information and techniques that trainees learn and are tested on for board certification are growing. A salient example in this case is the increased scope of ultrasound interpretation in the ABA APPLIED examination.[9,14,15,20] Over the course of the next two years, abdominal and airway ultrasound will begin to be tested in addition to the current cardiac and lung exams. The time and resources needed to reach an advanced level in PTTE for anesthesiology trainees would likely not be of sufficient clinical value to justify the cost. Specifically regarding TTE training, a residency program should evaluate the ultimate yield of routine training for residents, who, in their futures, will have limited resources and opportunity to maintain skills, i.e. number of future exams performed.

Ultimately this question points toward balancing departmental goals, teaching skills, and

resources to assure 'adequate' teaching and skills development of the resident. These are importantly balanced with quality of the exam and accuracy of the interpretation, which are critical toward patient outcome. What defines a minimum or adequate amount of training may not ensure optimal patient care. Different societies have adopted their own criteria to meet the needs, realities, and practicalities of those societies i.e. benchmarks vary.[7,8,9,10,11]

If, as defined by the SCA, there exists both basic (hemodynamic monitoring) and advanced (diagnostic and interpretive abilities) levels, with the former requiring someone of the latter to interpret and diagnose findings, then what does it really mean to attain only a basic level of competency? What is the true goal of 'monitoring' alone as it ultimately requires interpretative and diagnostic skills to determine dysfunction and pathophysiology. Determining a patient's volume status, gross biventricular function, presence of important valvular abnormalities, and presence of pericardial effusions can help in the development of an anesthetic plan and contribute to patient safety, but these require diagnostic skills. This prompts the question as to whether or not accepting anything less than advanced skills and a comprehensive training is embracing mediocrity. The risk of inadequate skills and interpretation translates into erroneous decisions, poor patient care and outcome. If sincere in their desire to train residents programs should provide comprehensive training for all their residents. Given the suggested educational rigor, mentoring, and the number of cases performed and reviewed, a requirement that anesthesia residency programs 'fully train' residents is impractical for most programs, especially when considering the skills learned are unlikely to be utilized and retained.[13,19]

While a comprehensive knowledge and skill in PTTE is an undeniable benefit, residency programs are better to introduce PTTE and limiting comprehensive training to those who are likely to pursue the skill after residency. Residency programs should concentrate quality efforts on the fewer more motivated residents than to embrace a mediocre job on all.

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