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Special Article

Michael K. Cahalan: In Celebration of His Life and Contributions to Cardiac Anesthesiology

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Dr. Michael K. Cahalan, former chair of the Department of Anesthesiology at the University of Utah School of Medicine, died March 9, 2019, at the age of 69 after a brief illness. He was a giant in anesthesiology and a pioneer in the development of transesophageal echocardiography applications in anesthesia. He made many other important contributions to the specialty of anesthesiology, having achieved a notable measure of success in all the traditional missions of academics, including research, teaching, clinical care, and administration. In this summary, his early life, education, and the contributions he made to the practice of anesthesiology in general and to cardiac anesthesia and echocardiography in particular are reviewed. The attributes that made Cahalan a model in the profession of anesthesiology that all can strive to emulate also are described.

Key Words: Michael Cahalan; history; echocardiogram; transesophageal echocardiography; University of Utah

If your actions inspire others to dream more, learn more, do more, and become more, you are a leader.

—John Quincy Adams

DR. MICHAEL K. Cahalan, former chair of the Department of Anesthesiology at the University of Utah School of Medicine, died March 9, 2019, at the age of 69 after a brief battle with acute myelogenous leukemia (Fig 1). He was a giant in anesthesiology and a pioneer in the development of transesophageal echocardiography (TEE) applications in anesthesia.[1] He made many other important contributions to the specialty of anesthesiology, having achieved a notable measure of success in all the traditional missions of academics, including research, teaching, clinical care, and administration.[2]

Early Years and Education

Mike, as he was commonly known to his associates, was born in 1949 in Harrisburg, Pennsylvania, the son of a former Navy nurse and a Pennsylvania state police officer. Growing up with an older sister (Elizabeth) and brother (Thomas), they lived in a rural stretch of Pennsylvania north of Harrisburg, called Stony Creek, where Mike and Thomas learned to swim, fish, hunt, and hike (see supplementary material for excerpts from an interview with Thomas Cahalan). The Cahalan kids cherished the idyllic setting that provided the backdrop for their childhood. Cahalan and Thomas took up competitive swimming at the local YMCA. They attended parochial elementary schools (both brothers were altar boys) and public middle schools and then attended Mercersburg Academy boarding school where they were members of the swim team. Cahalan had tremendous loyalty and respect for the Mercersburg Academy, believing that it played the most important role in his education and personal development.

Cahalan then attended Harvard University after rebuffing numerous other Ivy League colleges (1967-71). There he competed as an All-American swimmer, serving as captain of the

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Fig 1. Michael Cahalan, 1949-2019, former professor and chair of anesthesiology, University of Utah.

swim team for 2 years (first junior to be so selected). Many believe that he might have become an Olympian had his best event, the 50-yard freestyle, been an Olympic event at the time. Cahalan graduated Harvard with a degree in chemistry and then matriculated at Temple University Medical School to begin his medical education in 1971.

After graduating from Temple with distinction (Alpha Omega Alpha), he started his graduate medical education with a medical internship at Milton S. Hershey University Medical Center, where occasionally he could squeeze in a round of golf with his brother, Thomas. A residency in anesthesiology at the University of California, San Francisco (UCSF) followed. His early training in San Francisco included a research fellowship under Dr. Edmond Eger, during which he studied volatile anesthetics. His interactions with Eger marked the beginning of a life-long friendship and passion for clinically oriented research.

Professional Career and Personal Life

After completion of his medical training, Cahalan joined the faculty at UCSF, where he eventually emerged as a senior, influential professor (1979-2001). Early in his career at UCSF, Cahalan expressed an interest in working in cardiac anesthesia but at first was declined. Under the mentorship of Dr. William Hamilton, he eventually was accepted onto the cardiac team and quickly emerged as the chief of anesthesia for pediatric and adult cardiac surgery. Cahalan's focus on cardiac anesthesia eventually led to his groundbreaking work with TEE.

During his training at UCSF, he met and married Marianne Troy, head cardiac surgery nurse at UCSF. They shared a vibrant and active life for more than 42 years and spent most of their leisure time together. Golfing, fishing, swimming, camping, cooking, and traveling were among their passions. They golfed and fished together often, which was an important time for sharing and communicating, helping to strengthen their marriage (see supplementary material for excerpts from an interview with Marianne Cahalan). Cahalan also loved to read, especially astrophysics and poetry.

Having firmly established his reputation for excellence as an academic anesthesiologist, Cahalan was recruited by a number of prestigious departments of anesthesiology, but none of these opportunities were persuasive to him. Eventually Dr. K.C. Wong, a fellow member of the IARS (International Anesthesia Research Society) Board of Trustees, invited Cahalan to consider the chair position in Salt Lake City. Cahalan acquiesced as a personal favor to Wong. Skeptical at first, after several visits to Utah, Cahalan was won over and in 2001 he accepted an appointment as professor and chair of the Department of Anesthesiology at the University of Utah School of Medicine. He served in this capacity for 14 years and remained on the faculty until his premature death (see supplementary material for excerpts from a eulogy delivered at Cahalan's memorial service). Cahalan's tenure at the University of Utah was characterized by rapid expansion of the clinical services and growth in the research and education missions.

Contributions to Echocardiography

Cahalan is largely responsible for introducing TEE to cardiology in the United States and popularizing its use in anesthesiology internationally.[2–4] Although some primitive 2D TEE mechanical scanners and linear probes were described between 1977 and 1980, it was not until Jacques Souquet, working in conjunction with the Varian Corporation, developed a phased-array transducer mounted on the end of a gastroscope that TEE became a practical reality.[1] These new TEE probes were evaluated clinically by cardiologists Dr. Michael Schluter and Dr. Peter Hanrath in Hamburg, Germany, and their preliminary results were highlighted at an international conference held in Hamburg in 1981.

The early subsequent use of TEE took different directions in the United States and Europe. Cardiologists in Germany and The Netherlands rapidly began using TEE in awake patients to aid in the diagnosis of a variety of cardiac pathologies. In the United States, cardiologists seemed reluctant to adopt this new technology. In the early 1980s, Hanrath sent prototypes (first M-mode transducers and then the 2D transducers mounted on gastroscopes) to 2 leading echocardiologists in the United States—Dr. James Seward at the Mayo Clinic and Dr. Nelson Schiller at UCSF, who passed them on to anesthesiologists.[1]

At UCSF, Schiller spoke with Hamilton, chair of the Department of Anesthesiology, who put him in contact with 2 young faculty members, Cahalan and Dr. Michael Roizen. At that time (1981-1983), a cardiology fellow from Hanrath's group in Germany, Dr. Peter Kremer (Fig 2), came to UCSF and collaborated with Cahalan and Roizen to investigate the new TEE instruments. At the 1982 fall annual meeting of the American Society of Anesthesiologists (ASA) and at several cardiology meetings, this UCSF team started the American TEE

Fig 2. Peter Kremer, cardiology fellow from Hanraths's group in Germany who brought probes to the University of California, San Francisco and worked with them for 2 years, standing before a poster presentation of work on transesophageal echocardiography he did with Cahalan and Roizen at a cardiology meeting in 1982.

Photo reprinted from Kaplan JA, et al.[1]

"revolution" when they presented their results in monitoring cardiac and vascular surgery patients with this new TEE probe, displaying the high-quality recordings and images obtained (Fig. 2–4). They described its usefulness in assessing filling and function of the left ventricle and in detecting myocardial ischemia and intracardiac air during cardiac and vascular surgery.[3,4] Subsequently they described TEE's superiority to the

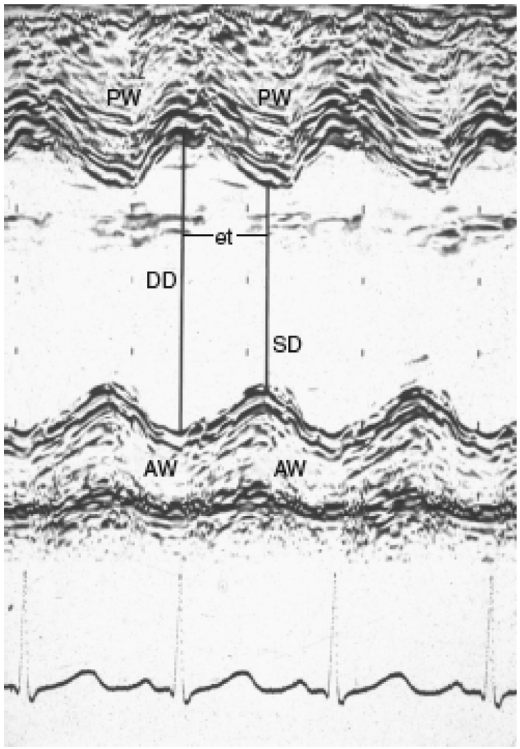

Fig 3. High-fidelity transesophageal M-mode echocardiogram from the first Hanrath-Souquet probes used in surgery at the University of California, San Francisco, circa 1981.

Photo reprinted from Kaplan JA, et al.[1]

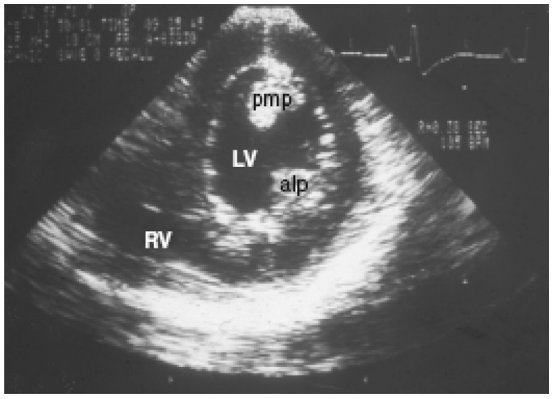

Fig 4. Two-dimensional image (transgastric midpapillary short-axis view) recorded from the first 2-dimensional Hanrath-Souquet transesophageal probe used in surgery at the University of California, San Francisco, circa 1982.

Photo reprinted from Kaplan JA, et al.[1]

pulmonary artery catheter in assessing preload adequacy in the operating room[5] and its usefulness in evaluating the hemodynamic changes during anaphylaxis[6] and surgery for pheochromocytoma.[7]

Leveraging the enthusiasm generated by the advent of this new technology, Cahalan took a sabbatical in the Department of Cardiology at the Thorax Centrum of Erasmus University in Rotterdam, The Netherlands, from 1985-1986, further solidifying his echocardiography expertise. On this strong foundation, upon his return from the sabbatical in Europe, Cahalan emerged as an early pioneer and champion of the intraoperative use of TEE.

As previously mentioned, Schiller of UCSF played a pivotal role in Cahalan's interest in TEE. He wrote:

> *It would not be a gross understatement to state that Mike Cahalan, during his tenure as head of Cardiothoracic Anesthesia at UCSF, had a huge positive influence on the medical careers of many, including my own. And, more importantly, as a result, the face of cardiovascular anesthesia was changed profoundly. By his vigorous advancement of intra-operative TEE Mike improved the safety and outcomes of cardiac surgery. When Varian engineers approached me, a noninvasive cardiologist, to test an ultrasound device that required the invasive insertion of a probe into the esophagus, I was resistant because I took pride in keeping all ultrasound diagnostic methods strictly noninvasive. After considerable thought, I began to wonder if this new invasive device could bring the power of echocardiography into the operating room and thereby provide the means of improving the safety of surgery. I approached Dr. William Hamilton, then chair of anesthesia with the idea and he paired me with Mike to explore its utility. From the moment Mike recognized the potential of the highly resolved and informative cardiac images that resulted from this device he was convinced of its huge potential, and TEE became a standard technique of cardiac surgery (at UCSF). In considering Michael Cahalan in the context of academic perfection, few individuals could have done what he accomplished. His devotion to the highest ethical standards, to*

innovative research and to education were peerless. Those of us fortunate enough to be his colleagues will always consider themselves fortunate.

–Nelson Schiller (personal communication to the authors, May 2019; abbreviated by the authors)

In 1987, Cahalan authored one of the first review articles on TEE[8] and played crucial roles in developing the initial ASA/SCA (Society of Cardiovascular Anesthesiologists) guidelines for perioperative TEE[9] and its update in 2010,[10] the American Society of Echocardiography (ASE)/SCA guidelines for performing a comprehensive intraoperative TEE examination,[11] and guidelines for training in perioperative TEE.[12] He contributed much to the acceptance of cardiac anesthesiologists as qualified echocardiographers by cardiology colleagues and nurturing (along with Dr. Daniel Thys and many other colleagues) anesthesiologists' collaboration with echocardiologists and the American Society of Echocardiography (ASE). He produced one of the first educational CD-ROMs on TEE and presented multiple ASA refresher course lectures on this topic at ASA annual meetings.

Thys, past president of the SCA and leader in development of guidelines and standards for TEE by anesthesiologists, highlighted the role of TEE, collaboration of cardiac anesthesiologist with other societies, and the establishment of the National Board of Echocardiography (NBE) in his review of the history of cardiac anesthesia.[13] He offered the following perspective on the contributions of Cahalan:

My initial exposure to intraoperative echocardiography was very different than his. In 1980, I worked with a cardiac surgeon and an echocardiographer who were eager to explore applications of epicardial echocardiography in cardiac surgery. When Joel Kaplan became Chairman of Anesthesiology at Mount Sinai in 1983 our team also entered the practice of intraoperative transesophageal echocardiography. Since I had previously become acquainted with Michael Cahalan at various scientific meetings, I immediately inquired whether I could spend a few days with him at UCSF to observe his echo activities. Michael readily agreed and welcomed us with the gracious hospitality for which he was so well known. It became immediately obvious to us that Mike approached his application of TEE with great intellectual rigor and a perfectionist attitude. He demanded a lot of himself, but in the process of pursuing excellence, he greatly advanced the practice of intraoperative echocardiography for all of us. He was even tempered and fun to be with, yet always determined and focused on the future. With that initial visit to San Francisco we laid the seeds for many future collaborations. Every subsequent encounter with Michael was always immensely pleasurable and uplifting. I will very much miss Michael.

–Daniel Thys (personal communication to the authors, May 2019; abbreviated by the authors)

Dr. Jack Shanewise, previously at Emory University and now at Columbia University, was involved in the development of a number of the guidelines related to perioperative TEE in the late 1990s and early 2000s and related the pivotal role Cahalan played in the following:

I really didn't get to see Mike in action until 2001 on the ASE/SCA Task Force for Training Guidelines in Perioperative Echocardiography, which he chaired. The problem was, there were no published training guidelines in perioperative echocardiography, as there had been in cardiology, a situation the new task force was supposed to remedy. The task force consisted of 4 cardiologists, 4 cardiac anesthesiologists and Mike. Before we met there was a wide gap in recommendations. Mike presided at this first meeting with his signature quiet, calm, polite, but firm finesse. He managed to keep a group of frank antagonists not only at peace, but also on track to hammer out a compromise agreeable to all. After many months guidelines were developed which were endorsed by both the SCA and ASE boards, the training guidelines document was published in Anesthesia and Analgesia *and the* Journal of the American Society of Echocardiography *in 2002, with Mike Cahalan as the first author. The next year, the NBE launched its board certification in perioperative TEE based on those numbers, and in 2007, the ACGME incorporated them into the program requirements for Adult Cardiothoracic Anesthesiology fellowships. These great steps forward for our specialty were the direct result of the leadership skills of Mike Cahalan—an immensely accomplished and focused individual without a selfish bone in his body; whose engaging, humble demeanor tended to mask his unbending determination. They still stand to this day.*

–J Shanewise (personal communication to the authors, May 2019; abbreviated by the authors)

Dr. Jonathan Mark, professor of Anesthesiology at Duke University (where many of the innovations of advanced TEE in the United States were accomplished) and an experienced TEE educator and practitioner, wrote the following about Cahalan:

While only 3 years senior, my friend Mike was always a role model for me. In the early 1980s, we practiced on different coasts—I was in Boston, he was in San Francisco. And when I was asked to start an intraoperative echocardiography program at Brigham and Women's Hospital, I knew whom to call. Mike was so generous with his time and supportive in his guidance, encouraging a focus on clinical quality and a commitment to learning and research from the outset. I remember a phone call from more than 30 years ago, during which he shared pearls for success; including choosing an important clinical problem that could be meticulously studied in our clinical practice. This drove our team to work together and perform careful, detailed examinations, which would provide value to our patients and lay building blocks for a clinical research enterprise.

–Jonathan Mark (personal communication to the authors April, 2019)

Table 1
Important Echocardiography-Related Articles That Include Contribution by Cahalan

1. Cahalan MK, Kremer P, Schiller NB, et al. Intraoperative monitoring with two-dimensional echocardiography (abstract). Anesthesiology 1982;57:A-153.[3]
2. Roizen ME, Kremer P, Cahalan MK, et al. Monitoring with two-dimensional echocardiography: Patients undergoing supraceliac aortic occlusion (abstract). Anesthesiology 1982;57:A-152.[4]
3. Roizen MF, Beaupre PN, Alpert RA, et al. Monitoring with two-dimensional transesophageal echocardiography. Comparison of myocardial function in patients undergoing supraceliac, suprarenal-infraceliac, or infrarenal aortic occlusion. J Vasc Surg 1984;1:300-5.[15]
4. Schlüter M, Hinrichs A, Thier W, et al. Transesophageal two-dimensional echocardiography: Comparison of ultrasonic and anatomic sections. Am J Cardiol 1984;53:1173-8.[16]
5. Beaupre PN, Roizen MF, Cahalan MK, et al. Hemodynamic and two-dimensional transesophageal echocardiographic analysis of an anaphylactic reaction in a human. Anesthesiology 1984;60:482-4.[6]
6. Beaupre PN, Kremer PF, Cahalan MK, et al. Intraoperative detection of changes in left ventricular segmental wall motion by transesophageal two-dimensional echocardiography. Am Heart J 1984;107:1021-3.[17]
7. Smith JS, Cahalan MK, Benefiel DJ, et al. Intraoperative detection of myocardial ischemia in high-risk patients: Electrocardiography versus two-dimensional transesophageal echocardiography. Circulation 1985;72:1015-21.[18]
8. Gussenhoven EJ, Taams MA, et al. Transesophageal two-dimensional echocardiography: its role in solving clinical problems. J Am Coll Cardiol 1986;8:975-9.[19]
9. Cahalan MK, Litt L, Botvinick EH, Schiller NB. Advances in noninvasive cardiovascular imaging: Implications for the anesthesiologist Anesthesiology 1987;66:356-72.[8]
10. Cahalan MK, Lurz FC, Schiller NB. Transoesophageal two-dimensional echocardiographic evaluation of anaesthetic effects on left ventricular function. Br J Anaesth 1988;60:99S-106S.[20]
11. Smith JS, Roizen MF, Cahalan MK, et al. Does anesthetic technique make a difference? Augmentation of systolic blood pressure during carotid endarterectomy: Effects of phenylephrine versus light anesthesia and of isoflurane versus halothane on the incidence of myocardial ischemia. Anesthesiology 1988;69:846-53.[21]
12. Taams MA, Gussenhoven EJ, Cahalan MK, et al. Transesophageal Doppler color flow imaging in the detection of native and Björk-Shiley mitral valve regurgitation. J Am Coll Cardiol 1989;13:95-9.[22]
13. Cahalan MK. Pro: transesophageal echocardiography is the "gold standard" for detection of myocardial ischemia. J Cardiothorac Anesth 1989;3:369-71.[23]
14. Rulf EN, Prakash O, Polak PE, et al. The incidence of myocardial ischaemia with moderate doses of fentanyl and sufentanil. J Cardiothorac Anesth 1989;3:6.[24]
15. Urbanowicz JH, Shaaban MJ, Cohen NH, et al. Comparison of transesophageal echocardiographic and scintigraphic estimates of left ventricular end-diastolic volume index and ejection fraction in patients following coronary artery bypass grafting. Anesthesiology 1990;72:607-12.[25]
16. Kuecherer HF, Muhiudeen IA, Kusumoto FM, et al. Estimation of mean left atrial pressure from transesophageal pulsed Doppler echocardiography of pulmonary venous flow Circulation 1990;82:1127-39.[26]
17. Muhiudeen IA, Roberson DA, Silverman NH, et al. Intraoperative echocardiography in infants and children with congenital cardiac shunt lesions: Transesophageal versus epicardial echocardiography. J Am Coll Cardiol 1990;16:1687-95.[27]
18. Himelman RB, Kusumoto F, Oken K, et al. The flail mitral valve: Echocardiographic findings by precordial and transesophageal imaging and Doppler color flow mapping. J Am Coll Cardiol 1991;17:272-9.[28]
19. Roberson DA, Muhiudeen IA, Silverman NH, et al. Intraoperative transesophageal echocardiography of atrioventricular septal defect. J Am Coll Cardiol 1991;18:537-45.[29]
20. Roberson DA, Muhiudeen IA, Cahalan MK, et al. Intraoperative transesophageal echocardiography of ventricular septal defect. Echocardiography 1991;8:687-97.[30]
21. Kuecherer HF, Kusumoto F, Muhiudeen IA, et al. Pulmonary venous flow patterns by transesophageal pulsed Doppler echocardiography: Relation to parameters of left ventricular systolic and diastolic function. Am Heart J 1991;122:1683-93.[31]
22. Muhiudeen IA, Roberson DA, Silverman NH, et al. Intraoperative echocardiography for evaluation of congenital heart defects in infants and children. Anesthesiology 1992;76:165-72.[32]
23. Cahalan MK, Ionescu P, Melton HE Jr, et al. Automated real-time analysis of intraoperative transesophageal echocardiograms. Anesthesiology 1993;78:477-85.[33]
24. Sutton DC, Cahalan MK. Pro: TEE is a routine monitor. J Cardiothorac Vasc Anesth 1993;7:357-60.[34]
25. Sutton DC, Cahalan MK. Intraoperative assessment of left ventricular function with transesophageal echocardiography. Cardiol Clin 1993;11:389-98.[35]
26. Foster E, Cahalan MK. The search for intelligent quantitation in echocardiography: "eyeball," "trackball" and beyond. J Am Coll Cardiol 1993;22:848-50.[36]
27. Benson MJ, Cahalan MK. Cost-benefit analysis of transesophageal echocardiography in cardiac surgery. Echocardiography 1995;12:171-83.[37]
28. Cahalan MK, Foster E. Training in transesophageal echocardiography: in the lab or on the job? Anesth Analg 1995;81:217-8.[38]
29. van Son JA, Vander Woude JC, Cheng W, et al. Surgical closed atrial septotomy under transesophageal guidance. Ann Thorac Surg 1995;60:1403-4.[39]
30. Rouine-Rapp K, Ionescu P, Balea M, et al. Detection of intraoperative segmental wall-motion abnormalities by transesophageal echocardiography: The incremental value of additional cross sections in the transverse and longitudinal planes. Anesth Analg 1996;83:1141-8.[40]
31. Lambert AS, Miller JP, Merrick SH, et al. Improved evaluation of the location and mechanism of mitral valve regurgitation with a systematic transesophageal echocardiography examination. Anesth Analg 199988:1205-12.[41]
32. Shanewise JS, Cheung AT, Aronson S, et al. ASE/SCA guidelines for performing a comprehensive intraoperative multiplane transesophageal echocardiography examination: Recommendations of the American Society of Echocardiography Council for Intraoperative Echocardiography and the Society of Cardiovascular Anesthesiologists Task Force for Certification in Perioperative Transesophageal Echocardiography. J Am Soc Echocardiogr 1999;12:884-900.[11]
33. Russell IM, Silverman NH, Miller-Hance W, et al. Intraoperative transesophageal echocardiography for infants and children undergoing congenital heart surgery: The role of the anesthesiologist. J Am Soc Echocardiogr 1999;12:1009-14.[42]
34. Lambert AS, Miller JP, Foster E, et al. The diagnostic validity of digitally captured intraoperative transesophageal echocardiography examinations compared with analog recordings: A pilot study. J Am Soc Echocardiogr 1999;12:974-80.[43]
35. Miller JP, Lambert AS, Shapiro WA, et al. The adequacy of basic intraoperative transesophageal echocardiography performed by experienced anesthesiologists. Anesth Analg 2001;92:1103-10.[44]
36. Cahalan MK, Abel M, Goldman M, et al. American Society of Echocardiography and Society of Cardiovascular Anesthesiologists task force guidelines for training in perioperative echocardiography. Anesth Analg 2002;94:1384-8.[12]
37. Aronson S, Butler A, Subhiyah R, et al. Development and analysis of a new certifying examination in perioperative transesophageal echocardiography. Anesth Analg 2002;95:1476-82.[45]

(*continued*)

38. Odell DH, Cahalan MK. Assessment of left ventricular global and segmental systolic function with transesophageal echocardiography. Anesthesiol Clin 2006;24:755-62.[46]
39. Yeates TM, Zimmerman JM, Cahalan MK. Perioperative echocardiography: Two-dimensional and three-dimensional applications. Anesthesiol Clin 2008;26:419-35.[47]
40. American Society of Anesthesiologists and Society of Cardiovascular Anesthesiologists Task Force on Transesophageal Echocardiography. Practice guidelines for perioperative transesophageal echocardiography. An updated report by the American Society of Anesthesiologists and the Society of Cardiovascular Anesthesiologists Task Force on Transesophageal Echocardiography. Anesthesiology 2010;112:1084-96.[10]

Cahalan also advocated and nurtured the expansion of the use of echocardiography (transthoracic echocardiography and TEE) to the wider practice of noncardiac anesthesiology and critical care medicine and developed innovating training for anesthesiology residents at Utah and subsequently a fellowship in echocardiography. Dr. Dan Vezina, a young TEE expert at UCSF, followed Cahalan to Utah and worked with him to establish their highly regarded TEE fellowship, a program that currently is directed by another acolyte of Cahalan, Dr. Joshua Zimmerman.[14]

As a consummate educator, Cahalan also was an early adopter of technology in education, mastering the difficult task of seamless incorporation of echocardiography clips into presentation software. His 1996 book, *Intraoperative Transesophageal Echocardiography*, won first prize for electronic media in the 1997 British Medical Association Medical Book Competition. As a co-editor of the Barash et al. textbook *Clinical Anesthesia*, Cahalan enthusiastically encouraged chapter authors to incorporate graphics suitable for turning into companion videos, beginning with the 7th edition.

Table 1 lists some of the pioneering articles in echocardiography that Cahalan helped generate; these works reflect the extensive collaboration with cardiologists and the mentoring of more junior anesthesiologists characteristic of Cahalan's research career. These studies were among the early ones that described the utility of TEE in the detection of myocardial ischemia; the need to assess multiple views to identify perioperative ischemia; the role of various views to assess mitral regurgitation; the use of TEE to evaluate prosthetic valves, left atrial pressure, and cardiac output; and the utility of TEE to facilitate endovascular cardiac procedures. He also published studies assessing the cost benefit of TEE and the diagnostic accuracy and precision of anesthesiologist echocardiographers.

Other Contributions to Anesthesiology

When he arrived to become chair at Utah, the department was facing significant challenges, especially in terms of fiscal stability. Under Cahalan's leadership, financial strength gradually was established, enabling a period of unprecedented growth and clinical expansion. As at UCSF, Cahalan mentored and helped many of his faculty to become leaders in their fields. He also supported controversial and innovative research on treating major depressive disorder with anesthetic agents. After stepping down as chair, Cahalan served as an important mentor and advisor to Dr. Talmage Egan who faced the difficult task of filling Cahalan's shoes as his successor.

In his professional life, Cahalan was a "triple threat," succeeding in all the traditional missions of academic endeavor. He authored or co-authored more than 80 scientific articles, 5 books, and 19 book chapters and served as editor of multiple medical journals and books. He was a visiting professor or invited speaker more than 275 times around the world. Some of his other notable publications (eg, not related to echocardiography) are listed in Table 2.

He was an ASA member and took on high-level leadership roles in many professional and scientific societies in anesthesiology, echocardiography, and cardiology and chaired many symposia. He became ASA director for the Utah Society of Anesthesiologists in 2011. He mentored generations of anesthesiology residents and faculty colleagues in San Francisco and Salt Lake City, demonstrating a keen ability to assess talent and help individuals develop their strengths. His leadership style was always congenial and fair-minded. Cahalan perhaps will be best remembered for his character—calm, kind, funny, and ready to entertain with a story. His point of view was informed by compassion and a strong moral compass. He put others at ease and accomplished more with persuasion than exertion of his administrative power. He was a great mentor and he received his greatest pleasure in helping others succeed.

Table 2
Other Articles That Included Cahalan's Contribution

1. Cahalan MK. Equations. Br J Anaesth 1980;52:356.[48]
2. Cahalan MK, Johnson BH, Edger EI 2nd. Relationship of concentrations of halothane and enflurane to their metabolism and elimination in man. Anesthesiology 1981;54:3-8.[49]
3. Cahalan MK, Johnson BH, Eger EI 2nd, et al. A noninvasive in vivo method of assessing the kinetics of halothane metabolism in humans. Anesthesiology 1982;57:298-302.[50]
4. Forrest JB, Buffington C, Cahalan MK, et al. A multi-centre clinical evaluation of isoflurane. Can Anaesth Soc J 1982;29:S1-69.[51]
5. Forrest JB, Cahalan MK, Rehder K, et al. Multicenter study of general anesthesia. II. Results. Anesthesiology 1990;72:262-8.[52]
6. Eger EI 2nd, Lampe GH, Wauk LZ, et al. Clinical pharmacology of nitrous oxide: an argument for its continued use. Anesth Analg 1990;71:575-85.[53]
7. Cahalan MK, Weiskopf RB, Eger EI 2nd, et al. Hemodynamic effects of desflurane/nitrous oxide anesthesia in volunteers. Anesth Analg 1991;73:157-64.[54]
8. Cahalan MK, Hashimoto Y, Aizawa K, et al. Elderly, conscious patients have an accentuated hypotensive response to nitroglycerin. Anesthesiology 1992;77:646-55.[55]
9. Desjardins G, Cahalan MK. Subspecialty accreditation: Is being special good? Curr Opin Anaesthesiol 2007;20:572-5.[56]
10. Weeks HR 3rd, Tadler SC, Smith KW, et al. Antidepressant and neurocognitive effects of isoflurane anesthesia versus electroconvulsive therapy in refractory depression. PLoS One 2013;8:e69809.[57]

Conclusion

Michael Cahalan made many contributions to cardiac anesthesia. Chief among these numerous contributions was the introduction of TEE to the practice of both cardiac anesthesiologists and American cardiologists, but, more notably, he was an inspirational clinician, researcher, educator, mentor, and humble human being.

Acknowledgment

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Conflicts of Interest

The authors have no conflict of interest other that the fact that Dr. Cahalan was a friend, colleague and mentor of both of the authors, and co-authored a book chapter by one of the authors (EAH)

Supplementary materials

Supplementary material associated with this article can be found in the online version at doi:10.1053/j.jvca.2019.09.027.

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