A Trauma Anesthesiologist Reflects on 40 Years at Maryland

Just six years before he arrived at the University of Maryland School of Medicine Department of Anesthesiology in 1975 as an Assistant Professor, Colin F. Mackenzie, M.B., Ch.B., administered his first anesthetic to a patient in Zambia using a Schimmelbusch mask — a simple wire frame placed over the patient's mouth and nose, over which gauze was draped and upon which ether was dripped. Now, over 40 years later, he marvels at the technological advances made in his field — including research on ways to make anesthesia delivery and patient monitoring autonomous, the establishment of highly efficient electronic data collection systems, and pioneering work on oxygen-carrying blood substitutes that have already saved lives.

"Forty years ago, I couldn't imagine the technology advances we've made," says Mackenzie, "and we're still continuing to make them."

A native of Great Britain, Dr. Mackenzie was educated at Aberdeen University and School of Medicine in Scotland and pursued his postgraduate training at Aberdeen Royal Infirmary and City Hospitals, University Hospital of the West Indies in Jamaica, and several teaching hospitals in London. He also completed a stint on the Zambia Flying Doctor Service. "Anesthesiology is an acute form of medicine where emergency decision-making is part of the routine," he says, explaining his decision to choose this field. He also enjoyed the field's flexibility, where once board-certified, he could practice in any number of anesthesia subspecialties, such as pediatric, cardiovascular, or obstetric anesthesia. In his case, he "did something different about every seven years," eventually settling on trauma anesthesiology.

After a trip in 1974 to the University of Maryland to visit the Shock Trauma Center, which was already renowned, he liked what he saw. "I had worked with trauma cases before, but the United Kingdom did not have the support and delivery systems that I saw here, like patient transport by helicopter," he notes. "The prehospital system here was so sophisticated in comparison to the rest of the world, with the ability to start treating patients during that 'Golden Hour' after an injury has occurred."

When he came to the University of Maryland the following year, the center was led by R Adams Cowley, the "Father of Trauma Medicine," after whom the Shock Trauma Center is now named. "He was a terrific organizer," recalls Dr. Mackenzie. "He took the 'pie' of trauma patients and evenly split it so that different hospitals throughout the state of Maryland each got a piece of the action," with one hospital becoming better known for pediatric trauma, another for hand trauma, and so forth. At the Shock Trauma Center, Dr. Mackenzie worked with fellow anesthesiologists Crawford Mc Aslan and Baekyho Shin to be the sole Attending-level clinicians for Critical Care and Trauma Anesthesiology services. Together, they published the effects of trauma on respiratory, cardiac, and renal function in major anesthesiology.
journals. It was at the University of Maryland where he met his future wife, Cristina Imle, to whom he has been married for 36 years.

Dr. Mackenzie was appointed the first Director of Anesthesiology Research in 1980 by the then-Department Chair, Martin Helrich, M.D. He served in that position until 1995 and set up the departmental research labs. He was Vice Chairman of the Department of Anesthesiology from 1992 to 2002 and Chief of the Division of Trauma Anesthesia in the Shock Trauma Center from 1996 to 2002. From 2000 to 2005, he served as Director of The Charles C. McC. Mathias, Jr. National Study Center for Trauma and Emergency Medical Services.

The Power of Vital Sign Monitoring
One of the greatest challenges in trauma medicine is figuring out what a patient needs as early as possible in their care. "In trauma patients, there are many uncertainties. When you first encounter a trauma patient, you may not know exactly when they’re injured, where they're injured, or how badly they're injured," Dr. Mackenzie explains. "They often can’t tell you what's wrong. So assistance with decision-making in acute trauma is a key issue." He and his colleagues, including Peter Hu, Ph.D., developed an advanced machine-learning algorithm that can be used with a simple pulse oximeter and blood pressure device to analyze real-time patient data — such as blood oxygen level, heart rate, and blood pressure — and predict with 90 percent certainty whether the patient will need blood, emergency surgery, mechanical ventilation, or other life-saving interventions in the first 48 hours of trauma care. "This is a real step forward," adds Dr. Mackenzie.

The U.S. Department of Defense agreed and has funded the research project: They'd like to have such a tool to use in the battlefield to give advance notice to military personnel about the status of an injured soldier in need of emergency care. The device could be integrated into the military's combat casualty vital signs monitors within secure wireless networks in battle zones.

Investigating Alternatives to Blood Transfusions
Dr. Mackenzie and his team also conducted a Phase 3 clinical trial of a cell-free hemoglobin-based oxygen carrier that was designed to serve as a blood substitute for patients who didn't want blood transfusions (such as Jehovah's Witnesses) or those who couldn't receive them (such as those with autoimmune hemolytic anemia), or when blood was unavailable, such as when a soldier is injured and needs resuscitation in the field. Called HBOC-201, it transports oxygen like blood and stimulates the patient's bone marrow to make red blood cells.

He recalls one patient who was crushed between a wall and a motor vehicle, sustaining a ruptured liver and spleen and a fractured pelvis. A Jehovah's Witness, the patient refused a blood transfusion and was treated with this investigational therapy. Instead of traditional surgery, an interventional radiologist embolized the vessels leading to parts of his liver and spleen (which stopped bleeding from those organs); his fractured pelvis was stabilized; and he received the hemoglobin-based oxygen carrier for ten days. He was able to walk out of the hospital on day 13. "That was a very impressive recovery," says Dr. Mackenzie. "The patient was very grateful."

Dr. Mackenzie’s research interests are focused on improving the care of trauma patients. Although this hemoglobin substitute is not in clinical use, such research is vital to improving the care of trauma patients. Performing clinical trials on critically ill patients is difficult, but the Trauma Center proved to be an excellent place to conduct such research. The research on hemoglobin substitutes is ongoing, and there is great interest in the ability to perform surgery without administering blood.
Continuous Data Collection and Monitoring

One of Dr. Mackenzie's and Dr. Hu’s most significant contributions to patient care at the University of Maryland Medical Center has been a system to continuously gather vital sign data on patients from their first encounter with emergency medical services through trauma hospital discharge. The goal is to use these data to predict outcomes and triage high-risk patients to higher levels of care. The tool was developed in the Shock Trauma Center and has been expanded to certain other areas of the medical center as well. In addition, video monitoring of interventions such as intubations and chest tube insertions have vastly improved success rates and reduced complications for these procedures and, in the case of chest tube insertion, have lowered infection rates.

Dr. Mackenzie and his colleagues are continuing their research on Retention and Assessment of Surgical Performance, a U.S. Army-funded three-year study that has enrolled 95 surgeons from programs in the northeastern U.S., with the goal of developing surgeon performance metrics. The effects of training surgeons and surgical skill retention on vascular exposure and control procedures are being evaluated in cadavers and simulated physical models. The study results may be useful for determining readiness for deployment and the benefits of training, and to determine how long training effects persist before re-training may be required. Dr. Mackenzie will complete a doctoral thesis based on this effort in March 2016.

Reflections

Looking back on his clinical career, he marvels at the many patients he's cared for. "Sometimes we've lost patients for whom we thought we did everything we could. And other times we accomplished some amazing resuscitations, pulling people back from the brink of death whom we didn't expect to save," he recalls.
**Selected Publications (from more than 150) by Colin F. Mackenzie**


