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Number 4



South Dakota **medicine**

THE JOURNAL OF THE SOUTH DAKOTA STATE MEDICAL ASSOCIATION

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Contents

April 2026

Volume 79 | Number 4

South Dakota
medicine

The Journal of the South Dakota
State Medical Association

Editorial

- 147** 2026 USD SSOM Match List – Suzanne D. Reuter, MD, MPH, MIH

President's Comments

- 148** Through the Eyes of Our Student – Keith Hansen, MD

Historical Series: Famous South Dakota Physicians and Scientists

- 152** Frances Oldham Kelsey MD, PhD: The Woman Who Refused to Approve Thalidomide – Emily Eisenbraun, MS III; H. Bruce Vogt, MD
- 153** Alton Ochsner, MD – H. Bruce Vogt, MD
- 154** Earl Rose, MD – H. Bruce Vogt, MD

Historical Series:

- 156** The Creation and Innovation behind Heart Valve Replacements – Velvet Jessen, MS II; and H. Bruce Vogt, MD

The Journal

- 159** Systemic Sarcoidosis Presenting as Toe Dactylitis: A Case Report – Jacob R. Devine, MS IV; Alexander DM Withrow, MS III; Thabuna Sivaprakasam, MD; Mark Graeber, DPM; Andrew J. Erie, MD
- 164** Multiglandular Parathyroid Hyperplasia Including Double Ectopic Glands: A Case Report – Sarah J. Lane, MS IV; William C. Spanos, MD
- 168** Malignant Hyperthermia Crisis During a Laparoscopic Appendectomy: A Case Report – Sean McCann, MS IV; Samuel Jensen, MD
- 172** Literature Review of the Effects of Operating Room Temperature on Surgical Team Performance and Patient Outcomes – Nathan Ochsner, MS II; Riggins Bundy, MS II; Nathan Skelley, MD
- 178** Disparities in Chronic Myeloid Leukemia Mortality Trends in the United States: A Population Based Analysis – Michael Roberts, MS IV; Dawood Shehzad, MD; Tate Blankespoor, MS IV; Joe Reynen, MS IV; Dawlat Khan, MD
- 182** Virtual Reality and the Wide-Awake Hand Surgery Experience at a Rural Health Center – Kyler A. Hardie, MD; Cole D. Tessoroff, MD; Josefine Combs, PsyD; Brooklyn K. VanDerWolde, MS III; Emily A. Wilde, MS III; Hao Li, MD; Elizabeth A. Helsper, MD; Robert E. Van Demark Jr., MD

Special Features

- 186** University of South Dakota Sanford School of Medicine 2026 Residency Match List
- 189** Member News
- 192** SDBMOE Board News – Margaret B. Hansen, PA, MPAS

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ALL-WEATHER INVESTING: PREPARING YOUR PORTFOLIO FOR ANY MARKET

ANDY MULLAN, CFP®, Lead Advisor



When it comes to traveling, one thing is always true: The weather doesn't always stick to the forecast. Clear skies can quickly turn into thunderstorms.

Before a long road trip, what do you do? You prepare. You put on all-weather tires - reliable, steady, designed to handle just about anything the road throws your way. Your investment portfolio should be built with that same philosophy in mind.

Market Uncertainty Is Nothing New

In a world of 24-hour news cycles, there's never a shortage of headlines designed to make investors uneasy. Every year brings its own list of concerns: geopolitical conflicts, elections, predictions of a recession, inflationary pressures, government shutdown threats, just to name a few. But bad news isn't a feature of the market; it's a constant.

These kinds of swings can rattle even seasoned investors. While some stretches feel more turbulent than others, none of it should fall outside the range of what a well-constructed portfolio is designed to withstand. This is why having a globally diversified portfolio, one that includes a mix of stocks and bonds, is so important. Diversification doesn't eliminate volatility, but it helps manage risk and provides balance during unpredictable periods.

Of course, even with the best preparation, we still feel the bumps in the road. A volatile market day or a wave of negative news can make us tighten our grip a little, which is a perfectly natural response. But during these moments, the key is to focus on what you can control, your goals and your investment strategy. A well-diversified, long-term plan is designed to weather market storms, even when the path gets rough.

Reacting Can Do More Harm Than Good

When uncertainty arises, the temptation to "do something" can be strong. However, reacting in the wrong way to short-term events at the wrong moment can lead to long-term consequences. It is important to remember that staying the course is an active decision and, most of the time, the best decision.

Your portfolio should be constructed with long-term success in mind. That means owning a mix of investments that, together, create a portfolio resilient to different types of market conditions so that you don't have to overhaul your entire strategy every time the headlines change.

When markets get rocky, people often ask, "Are your clients freaking out right now?" The truth is, if we've done our jobs well, it's usually pretty quiet. That's because we take the time to really understand each person's goals, provide ongoing investment education, and consistently reinforce the long-term plan. When families know what they're invested in and why, they don't feel the need to react impulsively. They can sleep at night, knowing that we've planned for moments just like this.

Resilience, patience, and discipline are what carry investors through uncertain markets. Those qualities aren't just theoretical; but are intentionally built into your investment strategy.

Stay Focused on What Matters

In a world full of noise and constant headline changes, it's easy to lose sight of the bigger picture, but successful investing isn't about reacting to every twist and turn. It's about preparation, patience, and perspective. Just as you wouldn't cancel a road trip because of a few rain clouds, there's no need to alter your investment plan when markets get stormy. While we can't predict every bump in the road, we can be confident in the path that we've chosen and keep moving forward with clarity and purpose.

At Foster Group, we build our investment strategies to weather the unexpected so you can move forward with clarity and confidence. Do you wonder how to position your portfolio for whatever lies ahead? Let's connect. Being truly cared for means we understand your passions and use proven methods to help you reach your goals.

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2026 USD SSOM Match List

Suzanne D. Reuter, MD, MPH, MIH

The University of South Dakota Sanford School of Medicine students in the class of 2026 learned where they would complete residency training on Friday, March 20 during the Match Day Ceremony that took place in Sioux Falls. This is the first time all campuses celebrated together!

The Match List is featured on page 186 of this issue of *South Dakota Medicine*. The 71 new doctors, following graduation in May, will move on to the next stage of their training at clinics, hospitals, and health care facilities across the nation.

Destinations for USD medical student residencies include 23 states. South Dakota will host 22 USD medical school graduates in-state for their first year of residency training, and 19 students will complete their entire residency in our state. Nebraska will host 13 graduates, while Iowa and Minnesota will host six and five, respectively. California, Tennessee, and

Wisconsin will each host three students.

The most popular residency choice among the class of 2026 is family medicine, with 16 graduates pursuing training in that area. Ten students will receive training in internal medicine, six students in pediatrics, five students in psychiatry, and four students in anesthesiology, dermatology, emergency medicine, general surgery, and neurology. Three matched in OB/GYN and urology residencies.

A record-high 53,373 applicants registered in the 2026 Main Residency Match from all U.S. medical schools and some international medical schools, vying for 44,344 total residency positions offered in the U.S and Puerto Rico.

About the Author:

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Through the Eyes of Our Students

Keith Hansen, MD
President, South Dakota State Medical Association



The SDSMA continues and has always had a strong connection to the University of South Dakota School of Medicine (USD SSOM). The SDSMA promotes and supports evidence-based health care for the patients of South Dakota as well as the practice of medicine. By supporting medical education, SDSMA is embracing the future of medical practice and the care of patients. All USD SSOM medical students are provided membership in the SDSMA and AMA, financed through donations by our physician members. Some of our students become involved in SDSMA and AMA leadership opportunities, bringing forward student concerns to the Policy Council and the AMA. At the Annual AMA House of Delegates, medical students from throughout the U.S. bring issues affecting the future of medicine. The SDSMA Foundation also provides much needed scholarships to USD SSOM medical students; helping to reduce their increasing educational debt. This year the Foundation has set aside over \$300,000 for scholarships, all thanks to our memberships' donations. The SDSMA also allows our student members the opportunity for scholarly activities; including poster and oral presentations at the Annual Leadership Conference as well as the opportunity to publish in *South Dakota Medicine*. These scholarly activities enhance the students' residency applications, which is especially important since the change in USMLE Step 1 to pass/fail. Another important area that the SDSMA is involved with medical education is in promoting the medical humanities.

I want to draw your attention to the 2nd annual Humanities Supplement in *South Dakota Medicine*. This supplement is freely available on the SDSMA website (sdsma.org) and highlights the importance and impact of the medical humanities. The study of the humanities including the arts, ethics, philosophy, history and literature enhance and foster observation, all forms of communication and self-reflection. Prior to entering their clinical rotations, students live in a world of correct or incorrect answers, but once they arrive in the clinic they learn that everything is not always black or white. The humanities introduce our students to ambiguity, which is important for their ability to successfully practice and their self-care. The study of humanities also enhances critical thinking, enhances empathy, and allows the practitioner to treat the whole person and not just the disease process. Sir William Osler (1849-1919), the "Father of Modern Medicine" felt that the humanities were so integral to the practice of Medicine that a physician should spend 15

minutes a day reading in the area of the humanities. This resulted in his famous "bedside library" to promote the study of the Medical Humanities which will improve the practice of medicine and help prevent burnout. Medical education has increasingly been integrating the study of the humanities into the curriculum; with a number of schools offering a master's degree in the Medical Humanities. At USD SSOM, Jerome Freeman, MD and Tim Ridgway, MD have been strong proponents for incorporating the medical humanities into the MD degree curriculum and demonstrating its critical importance in caring for patients. The SDSMA joined with USD SSOM to demonstrate the medical humanities in action at the USD SSOM with the *South Dakota Medicine* Humanities supplement. The cover photo with accompanying essay of the 2nd annual Humanities Supplement is a painting by Eyob Mergia titled "The Immortality of the Human Heart" which is a powerful, pictorial representation of healthcare's journey through the COVID-19 pandemic. Eyob Mergia is an abstract impressionist artist who originally moved to South Dakota from Ethiopia in 1997 and currently resides and works in Las Vegas. The rest of the Humanities Supplement explores medical education and the practice of medicine from the eyes of students, residents and faculty using essays, poems and paintings. The authors explore and reflect on how the arts and humanities impact medicine and the importance of self-reflection. I was humbled and amazed at the wide spectrum of talents our students have as well as their interpretation of patient care. In our busy lives and practices, what we may see as a minor interaction, the student observes and it may have a significant impact on their development as reflected in their prose. These writings in the medical humanities give us the opportunity to observe, reflect and discover the importance these seemingly minor interactions have on our students and patients. The Humanities Supplement reminds me of Osler's famous quote "It is much more important to know what sort of a patient has a disease than what sort of a disease a patient has." I hope you incorporate the latest Humanities Supplement into your Osler "Bedside Library" and explore the importance of the Humanities in medical care through the eyes of our students, residents and faculty.

I'm thrilled to announce that *South Dakota Medicine* will be publishing its 3rd annual Humanities Supplement this fall. Those interested in submitting may contact Elizabeth Reiss at ereiss@sdsma.org. The submission deadline for the 2026 supplement is September 1.



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A New Space of Excellence

for Children's Care in Sioux Falls

A six-story expansion at Avera's main hospital campus in Sioux Falls will create state-of-the-art space for women's and children's services, two related yet distinct areas of inpatient care.

"Women's and children's services are unique and distinct, yet there is a lot of synergy between the groups. As we developed a plan to update and enhance our spaces, we found innovative and creative ways to build signature spaces for both women and children," said Ron Place, MD, Regional President and CEO of Avera McKennan Hospital & University Health Center.

Pediatrics at Avera has been marked by significant growth in the number of providers and specialties.

"We already have excellent pediatric care and growth in specialties at Avera – now we need the state-of-the-art space to deliver expanded options for hospital care," said Katherine Wang, MD, Avera neonatologist and Clinical Vice President of Avera's Women's and Children's Service Line.

"Thankfully, the majority of children are healthy and will never need advanced hospital care. For kids who do need to be in the hospital, we have an excellent team who is ready to care for them. Most kids will need only a regular primary care provider close to home as they grow and develop, so that's a big emphasis in our pediatric care," Wang said.

Over 400 family practice and general pediatric providers see children ages 0-18 throughout the Avera system. Well-child checkups are recommended every year – after those very important first two years when babies have numerous visits. "Primary care providers have a long-term relationship with their patients and monitor developmental milestones. They screen for general health and wellness and help parents by providing guidance about immunizations and what to expect as the child grows," Wang said.

Avera 
Children's



If specialty care is needed, the child can be seamlessly referred to the right place. "It's an entire system approach," Wang said.

"Kids are not tiny adults," Wang said. They require care of specialists trained to deliver their distinct medical specialty in the care of children. Avera offers a growing range of pediatric specialties including cardiology, critical care, endocrinology, gastroenterology, infectious disease, neonatology, nephrology, neurology, orthopedics, psychiatry, pulmonology/sleep medicine and surgery. Pediatric critical care physicians, neonatologists and pediatric hospitalists are available around the clock for hospitalized children.

Behavioral health, including inpatient care, is a vital aspect of the pediatric care continuum. Avera has been the regional leader in behavioral health and psychiatry for decades.

When a child needs hospitalization, Avera strives to keep them close to home when possible. Telemedicine technology extends specialty expertise across the miles.

"We're not only caring for children, we're caring for families and that means keeping children close to home. Mom and dad are less worried if they're 10 minutes away rather than two hours away,"

- Katherine Wang, MD
Clinical Vice President of Avera's
Women's and Children's Service Line



The new children's space will have lots of natural light, spaces for play, interactive nooks and crannies and more. It will feature a two-story treehouse climbing and play area that extends up into the fourth floor, which is the neonatal intensive care unit (NICU). The new NICU will expand upon what Avera began developing in 2015, with family-centered suites.

"What we developed then with the support of generous donors continues to work well. So we are expanding and developing upon what we already have," Wang said. The expanded NICU will have more room for twins and triplets.

"The Avera brand of care is coming alongside families and walking with them through their journey – Avera's compassion in action," Wang said. "Our new space will help us live this care philosophy even better."

With more physicians and more specialties, Avera is continuing to grow and serve more patients. "In early 2027, we will be excited to move all this expertise into a beautiful new space for hospital care that will only serve to elevate women's and children's care at Avera," Wang said.

Learn more at
Avera.org/Childrens

HISTORICAL SERIES: FAMOUS SOUTH DAKOTA PHYSICIANS AND SCIENTISTS

You have probably noticed that we have included a few brief biographies of famous South Dakota physicians and/or scientists or of major discoveries in the advancement of medicine in the last few issues of *South Dakota Medicine*. In February, our subjects were Chester B. McVay, Ernest and John Lawrence. This month we have profiled Earl Rose, Alton Ochsner and Frances Oldham Kelsey. These individuals all had very different and distinguished careers. Ochsner and Rose were native South Dakotans, as were McVay, Ernest and John Lawrence. Although Kelsey's time in our state was limited, she both taught at the University of South Dakota School of Medicine and practiced (locum tenens) for a time in our state. She came to South Dakota with her husband, Fremont, who had been named Chairman of the medical school's Department of Physiology and Pharmacology. She accepted a faculty position in the department at that time. Frances Oldham Kelsey would become a major figure in the history of medicine (in fact considered a hero) working at the US Food and Drug Administration in Washington, DC. There will be a few more figures yet to be profiled in periodic editions of the journal. Some medical students have participated in this project and it has been an enjoyable process. In the articles co-written with the students, they have identified and researched their subjects and took the lead in article authorship. I hope you have found these articles of interest. If you have an idea for a future subject, please let our staff know.

- H. Bruce Vogt, MD



Frances Oldham Kelsey MD, PhD: The Woman Who Refused to Approve Thalidomide

Emily Eisenbraun, MS III; and H. Bruce Vogt, MD

In the 1950s and 1960s around 10,000 children were born with severe limb, organ, ear, and heart abnormalities connected to thalidomide use.^{1,2} Thalidomide was used widely as an antiemetic in pregnancy and treatment for insomnia and anxiety across Europe, Japan, and Australia.³ Thalidomide was never approved by the Food and Drug Administration (FDA) in the U.S. due to concerns about neuritis and drug safety.⁴ Dr. Frances Oldham Kelsey, an FDA reviewer, is credited for her refusal to approve thalidomide in the early 1960s. Interestingly, Dr. Kelsey served as a faculty member in pharmacology at the University of South Dakota and general medicine physician in South Dakota from 1952 to 1960.^{3,5}

Frances Oldham Kelsey was born in British Columbia on July 24, 1914.³ She earned her Bachelor of Science degree from McGill University in Montreal in 1934.³ She then went on to the University of Chicago where she became the first woman to earn a PhD in pharmacology and later received her MD.⁵ Throughout her career she worked for the JAMA and AMA medical journals reviewing papers.^{3,5} She is credited with many contributions to medical science at the FDA, including investigation of quinine malaria treatment, elixir sulfanilamide antibacterial, and thalidomide.^{3,6}

She began work on her first FDA contract in 1937, looking into 105 deaths associated with an antibacterial – elixir sulfanilamide. Sulfanilamide was used to treat infections, but a sweet tasting elixir was added to this bitter-tasting pill.⁶ Her work with Eugene Geiling found this medication contained diethylene glycol, or anti-freeze, which accounted for the sweet taste and deadly effects.⁶ These findings led to congressional action known as the 1938 Food, Drug, and Cosmetic Act, which required ingredient transparency, safety testing, and FDA approval.^{3,6} Later, Kelsey and Geiling worked on finding alternatives to quinine in malaria treatment, as they found this medication was teratogenic.³

In 1952 Dr. Frances Kelsey's husband, Fredmont Kelsey, was offered the position of chairmanship of the Pharmacology Department of the University of South Dakota Medical School in Vermillion.^{3,5} She recounts in her memoir that Dr. Geiling at the University of Chicago, who recommended her husband for the position, was very impressed with the USD Medical School. She states, he was struck "by the school, by the spirit, the enthusiasm, and the type of students that were there."⁴ Dr. Frances Kelsey began an internship in general medicine in 1953 at the Sacred Heart Hospital in Yankton.^{3,5} From 1954 to 1957 she completed research on radioisotopes

and the thyroid, pituitary, and parotid glands, funded by a Lederle Fellowship.⁴ She completed locum work from 1957 to 1960, as a general medical physician across South Dakota.⁴

In 1960, the family left South Dakota and moved to Washington, D.C., where Dr. Frances Kelsey accepted a job as a medical officer for the FDA.⁴ As a medical officer for new drug applications, or NDAs, she was tasked with reviewing drug safety.⁶ Approximately one month after starting this job, Dr. Frances Kelsey received an NDA for a drug called Kevadon, which was the U.S. tradename for thalidomide.^{3,4} In review, she had concerns about clinical trial quality, complaints of peripheral neuritis associated with the drug, and lack of testing in pregnancy.⁴ In 1961, researchers in Germany and Australia began reporting severe limb defects in babies of mothers who utilized thalidomide during their pregnancies.^{5,6} Richardson-Merrell informed the FDA they were pausing their clinical trials in the U.S. until they sorted out the complaints of birth defects coming from Germany.⁴ Finally on March 8, 1962, Richardson-Merrell withdrew their application.^{3,4} The 1962 Kefauver-Harris Amendments and the 1963 Investigational Drug Regulations were passed in the following years to increase safety requirements from companies submitting for NDAs.⁴

By the time the application was withdrawn, the drug had been distributed to approximately 1,200 physicians and 20,000 patients. Because of Kelsey's thorough review process and pushback against Richardson-Merrell, only 17 congenital deformities linked to thalidomide have been identified in the U.S.^{4,6} About half of these mothers were noted to receive this medication overseas before immigrating to the U.S.⁴ Dr. Frances Oldham Kelsey was awarded the President's Award for Distinguished Federal Civilian Service in 1962 by President Kennedy.⁵ She was later promoted to Chief of

Frances Oldham Kelsey receiving President's Award for Distinguished Civilian Service from President Kennedy on Aug. 7, 1962.



Scientific Investigation at the FDA where she served until retiring at 90.^{3,6} She lived to the age of 101, passing away in 2015.^{3,6} She wrote a memoir titled *Autobiographical Reflections* where she recounts her experiences and credits her team for work alongside her.⁶ Interestingly, she opens her memoir recounting a letter from an eighth-grade girl in Vermillion, South Dakota, asking about studying science and medicine surrounded by mostly men.⁴

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Alton Ochsner, MD

H. Bruce Vogt, MD

Alton Ochsner was born on May 4, 1896, in Kimball, South Dakota, and grew up there. Ochsner graduated from the U. of South Dakota and the two-year USD medical school and then transferred to Washington University in St. Louis on the advice of his Uncle Albert John (AJ), who was a surgeon, and who had become his mentor. Alton received his medical degree from Washington University, and then completed one year of

training in internal medicine at the encouragement of Uncle AJ. This was at St. Louis' Barnes Hospital. Following this year, he headed to Chicago where he became Uncle AJ's surgical resident. Subsequently, AJ arranged for Alton to serve two prestigious surgical "residencies" in Europe, one with the famous Swiss surgeon Professor Paul Clairmont in Zurich and the other with Prof. Victor Schmieden in Frankfurt, Germany. Upon returning to the United States two years

later, Alton practiced in Chicago initially and then became a faculty member at the U. of Wisconsin for some time. In 1927 the famous surgeon, Rudolph Mota, announced his retirement as chair of surgery at Tulane University. Upon a recommendation, the Dean at Tulane encouraged Ochsner to apply for the position. Ochsner was offered and accepted the position. He officially became chair in 1927 when Ochsner was only 31 years old.

He became famous world-wide and trained numerous talented surgeons in the new field of thoracic surgeon. This included Michael DeBakey who participated in research with him initially as a medical student. At Tulane, Ochsner created a diagnosis clinic and with it, a teaching method known by medical students as the “bull pen.” In this exercise, a senior medical student would examine a patient, offer a diagnosis and then defend it while being subjected to questions from Ochsner in front of 200 students, house staff and physicians from Charity hospital. He would tell his assistant tasked with selecting a patient for the “bull pen” not to choose a case that was tricky or obscure, but rather something the students would encounter in practice.

Ochsner was very supportive of students, residents and physicians who worked with him. A learning tool he promoted was the use of journals rather than textbooks for information, opining that by the time a textbook was printed, the information was obsolete. In the operating room, Ochsner was known for his composure – no tantrums or cursing. Former residents, however, would admit that there were incidents – rare – when he would lose his calm manner.



Earl Rose, MD

H. Bruce Vogt, MD

Earl Rose was a small-town boy from South Dakota. He was born on the Cheyenne River Indian Reservation in Eagle Butte, South Dakota, on September 23, 1926. At the end of his junior year in high school, Rose dropped out of high school and enlisted in the U.S. Navy serving on the submarine USS Sea Devil in the Pacific Fleet during World War II. Following the war, the vessel was moored in the China Seas. He was discharged in 1946 and matriculated at Yankton College. He received a BA degree in 1949 and then entered the USD School of Medicine. He transferred to the University of Nebraska College of Medicine receiving his medical degree in 1953. Rose completed an internship

Alton Ochsner's contributions to medicine were multifaceted but he was most famous for being the first to link tobacco to lung cancer. In addition to this groundbreaking discovery, he also associated heart disease and disease of other organ systems with tobacco use. The identification of smoking and lung cancer led to a succession of studies linking the hazards of tobacco use to diseases of many other organs. Establishment of the Ochsner Award Relating to Smoking Health is in keeping with these discoveries. Ochsner's development of a teaching program at Charity Hospital in New Orleans and of a leading medical center serving as a model for group practice and medical education (Ochsner Clinic) are other major achievements recognized by physicians and educators.

Among his contributions to surgery and medicine in particular, were his advancements in the technique for blood transfusions, contrast bronchography, colon cancer, coronary artery disease, peripheral vascular disease, and differentiating thrombophlebitis from deep vein thrombosis. He authored 6 books and over 500 manuscripts over the course of his career.

An important credo he taught his learners was, “Don't forget that you're treating real people. You are not treating disease, but people.” Ochsner died in September 24, 1981.

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in Denver and subsequently established a private practice in the Lemmon, SD. From there, Rose moved to Baylor University to take a surgical pathology residency and then a clinical pathology residency at DePaul Hospital in St. Louis. He then subspecialized in forensic pathology training at the Medical College of Virginia (MCV). While training at MCV, he was the Deputy Chief Examiner for the Tidewater Region in Virginia. Following this training, he was recruited to Dallas, Texas, to establish a “scientifically valid medical examiners system” to replace the existing system of elected lay coroners. While in Dallas, Rose got a law degree from Southern Methodist University.

As virtually everyone who was more than a few years of age remembers, on November 22, 1963, President John F. Kennedy was assassinated in Dallas and taken to Parkland Memorial Hospital. A heated exchange erupted between the Secret Service and Rose with the Secret Service intent on taking the body, per the wishes of Jacqueline Kennedy, to Air Force One for return to Washington, DC, and Rose insisting that Texas law required that the autopsy be done immediately at Parkland. It was reported that Rose and a policeman behind him were shoved out of the doorway. Rose said in an interview that he reasoned it would be unwise to escalate the situation and stepped aside. Rose believed to the end of his career that had the autopsy been performed at Parkland, many conspiracy theories would have been prevented. He always believed that Oswald was the sole assassin. Although criticized for his behavior at the time by some, including by William Manchester who wrote, "The Death of a President," with time, this criticism has been considered unjustified.

Rose subsequently performed the autopsies on the assassin Lee Harvey Oswald, officer JD Tippit killed by Oswald when confronted by Tippit in the aftermath of Kennedy's assassination, and Jack Ruby who killed Oswald when the latter was being moved in the basement of the Dallas Police

Headquarters. Ruby died years in 1967 of natural causes.

Following his service in Dallas, Rose was appointed to the faculty at the University of Iowa, where he taught and practiced forensic pathology from 1968 until his retirement. At Iowa, Rose helped develop the national standards for forensic pathology and argued that county medical examiners should be physicians and not laymen. Rose was a very popular professor and an entertaining lecturer. For a number of years, he traveled to Vermillion, SD, upon the invitation of then USD Chair of Pathology and friend Karl Wegner, where he would lecture second year USD medical students.

Upon his retirement, he and his wife Marilyn served as small claims court mediators for Johnson County, Iowa. Rose developed late onset dementia and Parkinson's Disease. Toward the end of his life, he lived in a retirement residence. In the final year of his life, he lost his ability to speak. Following a bout with pneumonia, he was bedridden and died from complications of Parkinson Disease in 2012.

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HISTORICAL SERIES:

The Creation and Innovation behind Heart Valve Replacements

Velvet Jessen, MS II; and H. Bruce Vogt, MD

While cardiovascular diseases are the leading cause of death in the U.S.,¹ most people assume that through surgeries and medical intervention they can have a healthy heart for the majority of their life. Valvular heart disease can contribute to the arrhythmias and structural issues that can result in heart failure or myocardial infarctions.¹ The heart, of course, has four valves (mitral, tricuspid, aortic and pulmonic) that control the flow of blood through the heart and, therefore, the rest of the body. Valvular disease can either be congenital (present at birth) or acquired (e.g. rheumatic heart disease). When a valve is stenotic (narrowing of the valve causing restricted outward flow), regurgitant or insufficient (incomplete closure leading to backward flow) or prolapsed (enlarged or stretched, causing the floppy valves to bulge backward), it can change how much blood is delivered to tissues and muscles throughout the body causing a myriad of symptoms. The heart wants to overcome the faulty valves so it may cause thickening or change in the shape of the walls of the ventricles, structure or function (cardiac remodeling).² The adaptations the heart makes may lead to heart failure. A failing heart will keep a person alive for some time with help, but scientists and physicians were not content to only monitor the heart.

Valvular heart disease affects 2.5% of the U.S. population and is relatively common in the elderly (prevalence of 13.3%).¹ One in eight patients greater than or equal to 75 years of age suffer from valvular heart disease. The prevalence is much less frequent in younger populations, particularly, since the discovery of antibiotics. Prior to the discovery of penicillin, many more young patients had valvular heart disease due to acute rheumatic fever.

Physicians tried to treat valvular disease in numerous ways before development of the modern artificial heart valve. In 1914 Dr. Theodore Tuffier attempted the first surgery for aortic stenosis. Tuffier performed a digital dilation of the valve. It became a standard for treating mitral valve disease in the 1920s.

Dr. Charles Hufnagel carried out the first successful acrylic ball valve prosthesis. It was used in 1952 in a young woman

with severe aortic regurgitation. Four short years later, the first direct vision commissurotomy was performed while physicians used an ice bath to induce hypothermia in the patient.³ A major advancement in heart valve replacement was the caged-ball valve method developed and first used by Dr. Dwight Harken in 1960.⁴ It was proven to be very successful and would be refined many times.

At the same time as the materials for mechanical valves were developed, so were bioprosthetic valves. Bioprosthetic materials are either porcine or bovine pericardial tissues that are treated to remove immune factors that the human body would react to and then used to create a new valve for patients. The first aortic valve homograft was performed in 1962 and bioprosthesis methods have continued to improve over time.¹

The turning point in research for the modern heart valve replacement, however, appears to be attributed to Dr. Lowell Edwards, a surgeon, and Dr. Albert Starr, a retired engineer. The pair developed a mitral valve replacement that then spurred innovation of the modern artificial heart valve. Edwards and Starr started research to invent a valve that could be used to replace the mitral valve. The first valves the pair created were silastic leaflets with a rigid O-ring and a single layer of cloth. The valve worked but had issues with thrombosis. These issues led the pair to develop different types of valves, including a simple ball valve and a shielded valve. The shielded valve was transplanted into a patient and considered successful. The pair would continue to refine their invention and inspired others to do the same.⁵ The Starr-Edwards ball valve has been successfully used for over 50 years and is still used today for mitral and aortic valve implantation, although other valves are being developed.

Blood flow behavior and flow dynamics can now be analyzed and used to further enhance the replacement valves as well as ventricular dynamics and valve biomechanics. Current research relies on integrating analytics with the design to lengthen the time a prosthesis can be functional. While there continue to be advancements in the development of bioprosthetics, mechanical valves have the advantage

of durability lasting up to 30 years compared to the 10-20 years for bioprosthetics.¹ New mechanical valves may be made of pyrolytic carbon, which lowers the thrombogenicity of the valves that has been seen in previous iterations, but substances that are not thrombogenic in nature are still being developed. There are many new types of heart valves under development, but the progress could not have been made without the innovations of the physicians who were determined to fix broken hearts.

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Systemic Sarcoidosis Presenting as Toe Dactylitis: A Case Report

Jacob R. Devine, MS IV; Alexander DM Withrow, MS III; Thabuna Sivaprakasam, MD; Mark Graeber, DPM; and Andrew J. Erie, MD

Abstract

Sarcoidosis is a chronic, idiopathic granulomatous disease primarily affecting the lungs and intrathoracic lymph nodes, although it can involve nearly any organ system, including bones. Osseous involvement of sarcoidosis is uncommon and rarely the initial manifestation of the disease. We present a rare case of toe dactylitis as the sole presenting symptom of systemic sarcoidosis, with further evaluation revealing osseous, pulmonary, lymphatic, and subcutaneous involvement. This case highlights an unusual musculoskeletal presentation of sarcoidosis, as well as the imaging findings that can aid in diagnosis.

Introduction

Sarcoidosis is a chronic, idiopathic granulomatous disease characterized by the presence of non-caseating granulomas in involved tissues. It most commonly involves the lungs and intrathoracic lymph nodes but can affect any organ system, including skin, eyes, liver, heart, and bones.¹

Osseous sarcoidosis is uncommon, with prevalence ranging from 3% to 13% among sarcoidosis patients.^{2,3} Musculoskeletal symptoms are rarely the initial presenting manifestation of sarcoidosis. Instead, osseous involvement is most often identified in patients with known sarcoidosis, who were diagnosed years earlier with the more common pulmonary manifestations of the disease.²

We present a rare case of toe dactylitis as the sole presenting symptom of systemic sarcoidosis. This case illustrates a rare musculoskeletal presentation of sarcoidosis and highlights the imaging findings of osseous sarcoidosis that can assist in the diagnosis.

Case Summary

A 40-year-old Caucasian male with no significant past medical history presented to the podiatry clinic with a 2-month history of progressive swelling and pain in the right second toe. He denied any recent trauma, systemic symptoms, or prior arthritis. Physical examination revealed dactylitis of the right second toe with fusiform swelling and tenderness, but no overlying erythema (Figure 1).

Radiographs of the right foot demonstrated a lace-like

Figure 1. Clinical photograph demonstrates dactylitis of the right second toe with fusiform soft tissue swelling.



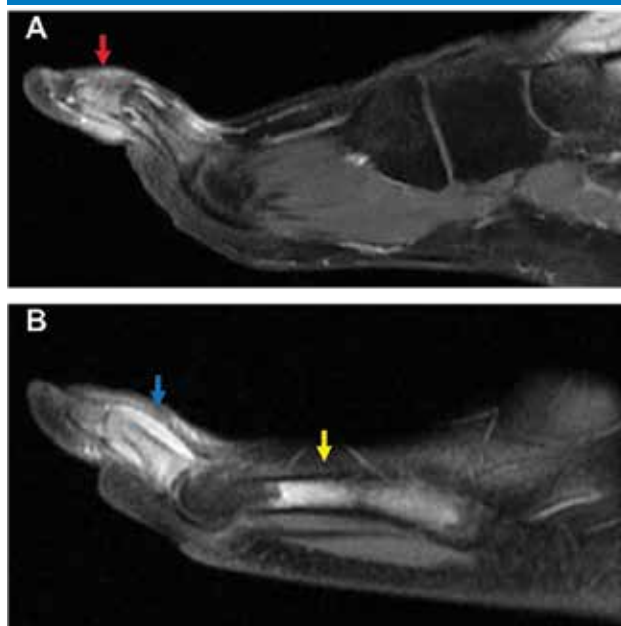
lytic lesion in the middle phalanx of the second toe and an additional subtle lesion in the proximal phalanx of the fifth toe (Figure 2). No periosteal reaction or soft tissue calcifications were present. Laboratory workup, including complete blood count, inflammatory markers, rheumatoid factor, anti-nuclear antibodies (ANA), and uric acid, was all unremarkable. To further evaluate the radiographic findings,

Figure 2. AP radiograph of the right foot demonstrates a lace-like lytic lesion in the middle phalanx of the second toe (red arrow) and an additional subtle lesion in the proximal phalanx of the fifth toe (blue arrow).



an MRI without and with IV contrast was ordered. MRI of the right foot revealed T1 hypointense, T2 hyperintense, and enhancing marrow-replacing lesions in the middle phalanx of the second toe and proximal phalanx of the fifth toe with extra-osseous soft tissue components (Figure 3). There were also marrow-replacing lesions in the first and fifth metatarsals, which were occult on the prior radiographs. The lace-like radiographic appearance, along with the multiplicity demonstrated on MRI, raised the possibility of osseous sarcoidosis. However, since the patient did not have a prior diagnosis of sarcoidosis and there were no other specific symptoms suggestive of such, a CT scan of the chest, abdomen, and pelvis was ordered to assess for other findings of sarcoidosis or potential alternative diagnoses, such as metastases, myeloma, or lymphoma. Subsequent CT imaging revealed bilateral hilar and mediastinal lymphadenopathy,

Figure 3. Post-contrast sagittal T1-fat saturated sequences demonstrate an enhancing marrow-replacing lesion in the middle phalanx of the second toe with extra-osseous extension (red arrow in A). Similar enhancing lesion with extra-osseous extension in the proximal phalanx of the fifth toe (blue arrow in B) and lesion in the fifth metatarsal (yellow arrow in B).



multiple tiny upper-lobe predominant perilymphatic pulmonary nodules, and scattered subcutaneous nodules in the torso and thighs (Figure 4). Systemic sarcoidosis would be a unifying diagnosis for the above findings.

To confirm the suspected diagnosis, a subcutaneous nodule was selected for biopsy rather than bone because of its easier accessibility, and it revealed non-caseating granulomas. The biopsy specimen was negative for acid fast bacilli (AFB) and Grocott methenamine silver (GMS) stains, therefore ruling out infectious organisms. Pulmonary function tests revealed mild restrictive changes, and serum angiotensin-converting enzyme (ACE), Vitamin D, and calcium levels were all within normal limits. The patient was referred to Rheumatology, and based on the constellation of clinical, radiologic, and histologic findings, a diagnosis of systemic sarcoidosis with osseous, pulmonary, lymphatic, and subcutaneous involvement was established.

The patient was started on oral prednisone 40 mg daily, with significant improvement in toe swelling and pain over the subsequent 3 months. A tapering regimen was followed with the addition of methotrexate as a steroid-sparing agent. At 8 months follow-up, the patient's toe symptoms had resolved,

Figure 4. Coronal contrast-enhanced chest CT demonstrates bilateral hilar and mediastinal lymphadenopathy (asterisks in A) and multiple tiny upper-lobe pulmonary nodules (dashed circle in B). Axial contrast-enhanced body CT demonstrates scattered subcutaneous nodules (arrows in C).

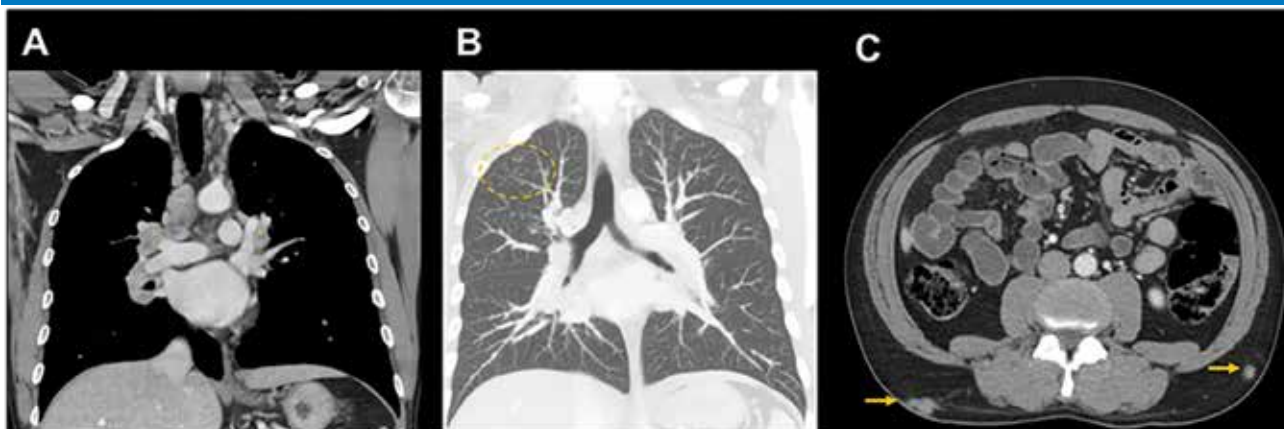


Figure 5. Clinical photograph following 8 months of treatment demonstrates resolution of the prior second toe dactylitis.



and he was otherwise clinically well (Figure 5).

Discussion

Osseous involvement of sarcoidosis is uncommon, and dactylitis related to underlying bone lesions is particularly rare, reported in less than 1% of cases.⁴ Zhou et al. studied a cohort of 1802 patients with sarcoidosis and found 64 patients (3.4%) had bone involvement.³ In this cohort of osseous sarcoid, involvement of the axial skeleton was much more common than the appendicular skeleton (87.5% of cases compared to 29.7%), and none of the patients had

involvement of the feet.³ This is in contradistinction to earlier studies that suggested the hands and feet were the most common locations of osseous sarcoid. This difference can be attributed to earlier studies relying on radiographs to detect osseous involvement, compared to the increased utilization of advanced imaging (MRI, CT, and PET/CT) in more recent studies.^{3,5,6} Osseous lesions located in the hands and feet are much better depicted radiographically than similar lesions in the axial skeleton, while advanced imaging can identify osseous lesions regardless of location.

Patients with osseous sarcoidosis can be asymptomatic from their bone lesions, detected incidentally during imaging performed for other manifestations of sarcoidosis or for unrelated indications. Studies have shown that approximately 50% of patients with osseous sarcoid experience musculoskeletal symptoms, typically bone pain.^{2,3} Lofgren syndrome (triad of arthritis, erythema nodosum, and intra-thoracic lymphadenopathy) is a distinct phenotype of acute sarcoidosis. It can present with arthralgias, but the pathogenesis of Lofgren syndrome is due to circulating inflammatory cytokines rather than focal osseous lesions.⁷

Imaging can play a pivotal role in diagnosing osseous sarcoidosis. Radiographs may show characteristic “lace-like” lytic lesions, a radiographic finding observed in small tubular bones of the hands and feet.^{7,8} This radiographic appearance can be pathognomonic and is typically seen in the setting of clinically suspected or known sarcoidosis. MRI has greater sensitivity in detecting osseous sarcoid lesions, but the MRI findings are nonspecific, often demonstrating multifocal enhancing and marrow-replacing osseous lesions.⁷ Extra-osseous extension and cortical disruption can be seen when

sarcoidosis involves the small bones of the hands or feet.⁵ Because of the nonspecific MRI appearance, osseous sarcoid can be confused for metastatic disease on MRI.⁶ Osseous sarcoid can also show increased uptake on nuclear medicine exams like PET/CT, potentially adding further diagnostic confusion.⁹

While the radiographic appearance of osseous sarcoidosis in the hands and feet can be characteristic, this finding is typically seen in patients with known sarcoidosis. The diagnosis is considerably more challenging when osseous involvement is the sole presenting finding of sarcoidosis. In this scenario, the imaging findings can be confused for other processes, including infection, inflammatory arthritis, and malignancy.^{4,6} Since osseous involvement of sarcoidosis is usually present in multi-organ disease, imaging other potential clinically occult sites of involvement may help assist in the diagnosis and staging. Up to 90% of patients with sarcoidosis have thoracic involvement, with characteristic findings on chest CT including bilateral hilar lymphadenopathy (with or without calcification) and upper lobe predominant perilymphatic pulmonary nodules.⁸ Other manifestations on thoracic and abdominal/pelvic CT include subcutaneous granulomas, hepatosplenomegaly and nodularity, and abdominal lymphadenopathy.⁸ In our case, CT of the chest, abdomen, and pelvis revealed systemic involvement of sarcoidosis and helped clarify the diagnosis. Ultimately, histological confirmation can solidify the diagnosis by demonstrating non-caseating granulomas in the absence of infectious organisms.¹⁰ Routine testing that is recommended to rule out infectious etiologies in presence of non-caseating granulomas includes AFB and GMS stains.^{11,12} The biopsy specimen for our case showed no signs of infectious organisms as both AFB and GMS stains were negative.

Treatment of osseous sarcoidosis aligns with the management of systemic sarcoidosis. Corticosteroids remain first-line therapy, with good response in most cases.¹³ Steroid-sparing agents such as methotrexate, azathioprine, or hydroxychloroquine may be used in chronic or refractory cases.¹⁴ Tumor necrosis factor-alpha inhibitors like infliximab have shown promise in severe or multisystem disease.¹⁵

Conclusion

This case of sarcoidosis presenting with toe dactylitis illustrates a rare musculoskeletal presentation of a systemic disease. Sarcoidosis can affect any organ system and should be considered in patients with unexplained musculoskeletal signs or symptoms, including dactylitis and

lytic bone lesions. Imaging is instrumental in the diagnosis and staging of sarcoidosis. However, it is important to recognize that imaging findings can mimic more ominous diagnoses such as metastases, myeloma, and lymphoma. Ultimately, a multidisciplinary approach involving radiology, rheumatology, pathology, and orthopedic providers is essential for the accurate diagnosis and management of osseous sarcoidosis.

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Multiglandular Parathyroid Hyperplasia Including Double Ectopic Glands: A Case Report

Sarah J. Lane, MS IV; and William C. Spanos, MD

Abstract

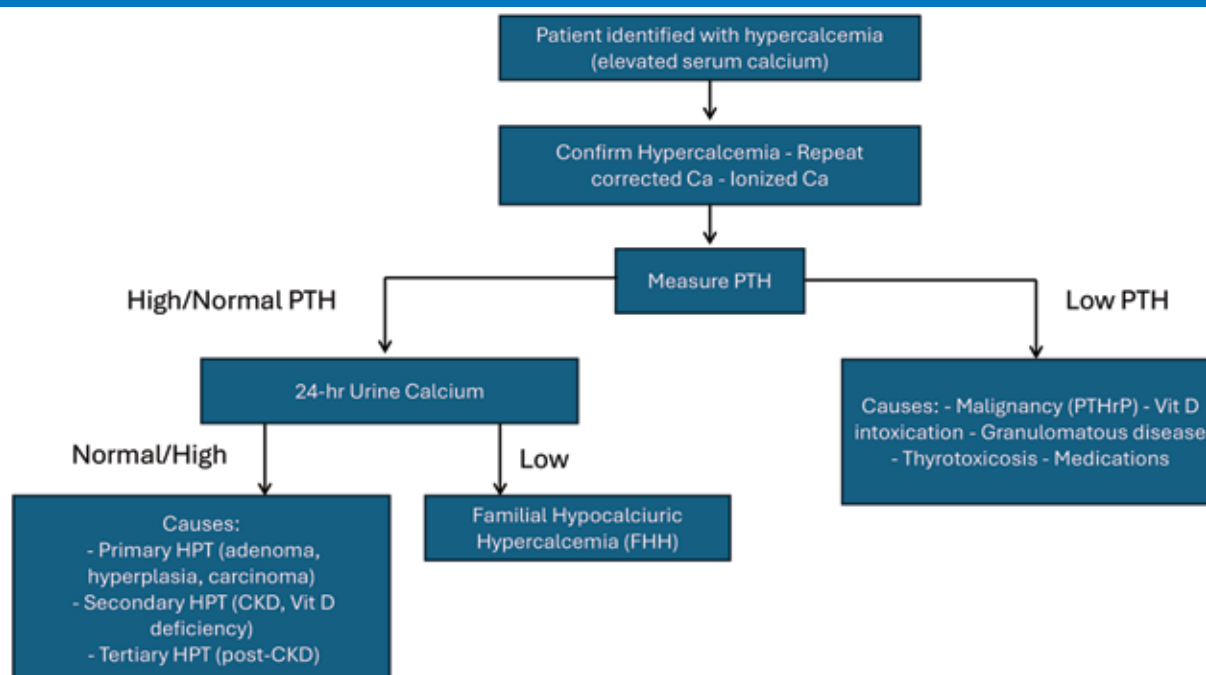
Hyperparathyroidism is a common cause of persistent hypercalcemia and is typically caused by a single parathyroid adenoma. Prompt treatment of hyperparathyroidism is essential to minimize impacts on various body systems such as the skeletal, renal, and cardiovascular systems. Hyperparathyroidism is typically cured by surgical removal of the adenoma, but persistent disease may occur in the presence of multiglandular hyperplasia or remaining adenoma. Further contributing to persistent disease are ectopic parathyroid glands. In this case a 51-year-old male was incidentally found to have hypercalcemia due to hyperparathyroidism. He was ultimately diagnosed with multiglandular parathyroid hyperplasia, with two of these glands in ectopic locations, one within the thyroid and the other in the mediastinum. Multiglandular disease and ectopic location contributed to need for reoperation and throughout the course of treatment, various imaging modalities were unsuccessful in locating hyperplastic parathyroid glands. This case demonstrates the importance of working up incidental hypercalcemia, persistence in treating hyperparathyroidism, and the need for use of various imaging modalities.

Introduction

The parathyroid glands play a major role in the homeostasis of calcium and phosphate, responding to hypocalcemia by releasing parathyroid hormone (PTH), which acts on the kidneys and bones and indirectly on the gastrointestinal

tract.^{1,2} In normal anatomy, there are four parathyroid glands which are located on the posterior surface of the thyroid gland.³ The American Association of Endocrine Surgeons (AAES) outlines workup (Figure 1) first suggesting confirmation of hypercalcemia followed by measuring PTH,

Figure 1. Hypercalcemia workup algorithm adapted from (4).



25-hydroxyvitamin D, creatinine, and 24-hour urine calcium. Hypercalcemia, elevated PTH, and elevated 24-hour urine calcium point to a diagnosis of hyperparathyroidism.^{4,5}

Primary hyperparathyroidism, dysfunction at the level of the parathyroid gland, is the most common cause of hyperparathyroidism, affecting 1-7 per 1,000 adults.^{1,6} The most common cause is a single parathyroid adenoma, accounting for 80-85% of cases.⁶ Remaining cases are due to multiple adenomas (~10%) or hyperplasia of all four glands (~10%).⁷ Notably, adenomas and hyperplasia of the parathyroid glands differ significantly. Adenomas are benign monoclonal neoplasms, typically encapsulated with a rim of normal tissue, while hyperplasia is polyclonal and shows diffuse enlargement.^{7,9} Adenomas are usually larger, often >1 g and >1.5 cm.^{10,11} Yet, routine pathology misclassifies up to 62% of cases, highlighting the need for intraoperative PTH monitoring to detect persistent disease.^{9,12} Molecular testing, though not standard, may also aid distinction.⁹

Various genetic mutations are linked to parathyroid pathology, the most common being multiple endocrine neoplasia type 1 (MEN1). MEN1 is associated with pituitary and pancreatic neoplasms, typically presents as multiglandular hyperplasia, and is seen in ~35% of parathyroid adenomas.^{13,14} Genetic testing for MEN1 is recommended in patients with four-gland parathyroid disease, early-onset disease, or positive family history. If MEN1 is confirmed, screening for pituitary and pancreatic neuroendocrine tumors should be performed.¹⁵⁻¹⁷

Imaging is helpful in surgical planning and first line modalities include US and Technetium-99m (99mTc) sestamibi scintigraphy with single-photon emission computed tomography/computed tomography (SPECT/CT).¹⁸ Four-dimensional (4D) CT and MRI may be used in the case of difficulty localizing parathyroid adenoma(s).^{18,19} Ectopic parathyroid glands may contribute to difficulty in gland identification on imaging and are relatively common, estimated to occur in 15.9% of all patients undergoing parathyroid surgery.³ Among patients with ectopic parathyroid adenomas, 11% have more than one ectopic gland, implying that fewer than 2% of all parathyroidectomy patients have multiple ectopic glands.²⁰ Intraoperative imaging is also available. One such example is PTeye, a technology which uses near-infrared autofluorescence (NARIF), a property unique to parathyroid tissue, to identify parathyroid tissue.²¹

The following case report describes a patient with parathyroid hyperplasia of all four glands, two of which were found to be ectopic. Workup of persistent hypercalcemia led to a

diagnosis of hyperparathyroidism. The patient underwent a parathyroidectomy, but disease persisted for years, necessitating reoperation which was ultimately successful.

Case Presentation

A 51-year-old male presented for regular health maintenance visits and was incidentally found to have hypercalcemia on routine labs. He had no contributing past medical history or family history, including history of pituitary or pancreatic tumors. Initial labs showed an elevated calcium of 11.4 mg/dL (reference range: 8.6 – 10.3 mg/dL), elevated corrected calcium of 11.2 mg/dL, and a PTH of 296.2 pg/mL (reference range: 14 – 72 pg/mL). Urine calcium was also elevated at a value of 572 mg/24h (reference range: 42 – 353 mg/24h).

To investigate hyperparathyroidism, a 99mTc sestamibi scan was subsequently performed showing no evidence of parathyroid adenoma or gland enlargement. A head and neck ultrasound (US) showed a 5 mm solid-appearing lesion within the left midpole and a 7 x 5 x 6 mm soft tissue nodule along the left inferior pole of the thyroid, thought to be a parathyroid adenoma.

Initial Treatment

The patient soon underwent left inferior parathyroidectomy. Intraoperative PTH 10 minutes after removal was 300 pg/mL (pre-op 148 pg/mL), likely due to manipulation of other glands, and a repeat reading was 170 pg/mL. Persistent elevation prompted re-exploration the next day, revealing an enlarged right superior gland, which was removed. Initial intraoperative PTH was 213 pg/mL, dropping to 170 pg/mL after 15 minutes. The left superior and right inferior glands were not identified. Pathology confirmed parathyroid tissue <0.2 g and about 1 cm in both operations.

An intraoperative thyroid nodule biopsy showed a Hurthle cell neoplasm with atypia prompting total thyroidectomy later that year. PTH remained elevated at 314 pg/mL after the parathyroidectomy, decreased to 174 pg/mL following left thyroid lobectomy, and was unchanged after removal of the remaining thyroid lobe. Intra-thyroidal parathyroid tissue, measuring 0.4 cm, was seen on final pathology accounting for the left superior parathyroid gland. Following this surgery, PTH failed to return to normal and remained elevated. Additional US and 99mTc sestamibi scan failed to locate the remaining right inferior parathyroid gland.

Persistent Disease

The patient continued to follow with his primary care physician and endocrinology for persistent hyperparathyroidism. PTH,

Calcium, and 24-hour urine calcium remained elevated for years. A 4D head and neck CT with and without contrast and an MRI neck with and without contrast performed three years after the initial surgery were both unsuccessful in identifying the remaining parathyroid gland. Eight years after the initial operation, a DEXA scan was performed and showed a T-score of -2.1 within the lumbar spine from levels L1-L4, excluding L3, consistent with a diagnosis of osteopenia. This, along with persistently elevated PTH, calcium, and urine calcium, prompted referral and workup for further surgical intervention at a tertiary care center.

Further investigation included a head and neck US and a 4D CT with and without contrast which were initially unrevealing for the remaining hyperfunctioning parathyroid gland. At this time, the patient also endorsed brain fog and fatigue along with longstanding dysphagia, stating that he felt that food was getting stuck before reaching his stomach. Calcium remained stable at 10.8 mg/dL and barium esophagram was normal. Additional imaging was ordered for surgical planning after initial imaging was unrevealing. Another 4D CT with and without contrast and an 99mTc sestamibi scan with SPECT/CT were ordered. Although not identified on initial radiology review, the head and neck surgeon later noted the suspected remaining parathyroid gland in the mediastinum (Figure 2).

Figure 2. Depicts a 4D CT scan showing the remaining parathyroid adenoma (right inferior parathyroid gland) located in the mediastinum as indicated by the arrow.



Additional Surgical Intervention

The patient then underwent an additional neck exploration to identify the right inferior parathyroid gland. Preoperative PTH was 225 pg/dL with a baseline of 195 pg/dL. A Parathyroid Tissue eye (PTeye) was used intraoperatively for identification of the parathyroid gland. During this procedure, the right inferior parathyroid gland was located in the mediastinum, initially confirmed with PTeye. Ten minutes post excision, PTH decreased to 45 pg/dL. A

portion of this gland, roughly the size of a normal gland, was auto transplanted into the right brachioradialis.

Final pathology confirmed identification of the right inferior parathyroid gland in the mediastinum (~0.05 g). Subsequent PTH and calcium values were within normal limits. The patient was diagnosed with multiglandular hyperplasia, given involvement of all four glands and pathological findings inconsistent with adenoma.

Follow-up

Follow-up with the head and neck surgeon one-month post-op showed no complications. PTH and calcium at three months post-op were within normal limits. Lifetime surveillance of PTH and calcium with endocrinology is planned. Although no specific guidelines exist, studies suggest bone mineral density improves within the first year after parathyroidectomy, so a repeat DEXA scan may be considered then.^{22,23}

Discussion

Incidental hypercalcemia, as in this patient, is not uncommon; 1.25% of patients show persistent hypercalcemia on routine labs, often without symptoms, highlighting the role of primary care in evaluation. Primary hyperparathyroidism is the most common cause of persistent hypercalcemia and prompt treatment is important to prevent organ damage, especially to the skeleton and kidneys.^{24,25} Although the above patient had multiglandular parathyroid gland disease, genetic evaluation was not pursued due the patient's age over 40 years old.

Detection of ectopic parathyroid glands due to aberrant location is often difficult and first-line imaging like cervical ultrasound and sestamibi scintigraphy may not detect ectopic parathyroid glands. The use of other imaging modalities such as SPECT combined with either CT or sestamibi, 4D-CT, or MRI may be necessary. A recent case series (n=5) suggests no universal algorithm; 4D CT is often reserved for when other modalities are inconclusive.²⁴ Another study found that sestamibi was only 65% effective in locating ectopic parathyroid glands followed by US and CT showing only 50% success.²⁶ Similar to other studies, this case report outlines the importance of use of various imaging modalities and persistence in clinical correlation in the setting of multiple ectopic glands. It also highlights the benefits of management at tertiary care centers, where surgeons often have fellowship training and access to advanced resources. It also emphasizes importance of surgeon review of imaging.

Conclusion

This case report corroborates the assertion that ectopic parathyroid glands contribute to persistent primary hyperparathyroidism. Further advancement in imaging modalities is necessary to increase success in identifying ectopic parathyroid glands, therefore informing treatment and surgical resection.

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Malignant Hyperthermia Crisis During a Laparoscopic Appendectomy: A Case Report

Sean McCann, MS IV; and Samuel Jensen, MD

Abstract

Cases of malignant hyperthermia (MH) are uncommon, but when they are not recognized early, they can be fatal. Early signs include increased heart rate and end tidal CO₂ (EtCO₂) readings followed by increased temperature. This is the case of 53-year-old man who had a MH crisis after exposure to the volatile anesthetic sevoflurane. His increased EtCO₂ and tachycardia coupled with exposure to known trigger is indicative of MH. The condition was quickly recognized, and he was successfully treated with dantrolene. He recovered without significant long-term complications. This case contributes to the literature highlighting the early recognition and use of dantrolene for successful treatment in MH crises along with help from the MH hotline.

Introduction

Malignant hyperthermia (MH) is a disorder caused by the use of volatile anesthetics or the neuromuscular blocking agent, succinylcholine. It is rare but deadly if not recognized and treated quickly. The pathophysiology involves a rapid shift of calcium out of the sarcoplasmic reticulum of striated muscles leading to widespread contraction. The increased metabolic demand from excessive muscle contraction increases the amount of carbon dioxide produced during cellular metabolism, increases heart rate, and raises the body temperature sometimes to deadly temperatures if not recognized early. This increase in temperature is where the name malignant hyperthermia comes from.¹

While MH is named for the increase in body temperature that accompanies it, the first recognizable signs are usually increased end tidal CO₂ (EtCO₂), tachycardia with possible arrhythmias, and muscle rigidity.² Due to the high rates of mortality if untreated, there is a low threshold for treatment. Dantrolene is the treatment of choice as it interferes with the release of calcium from the sarcoplasmic reticulum.¹

As well as early treatment to prevent mortality, recognition of risk factors is important in prevention. Prevalence is widely varied based on geographic location as there is a strong familial component, and historically men have been more affected than women. The ryanodine receptor 1 has been the most well-known implicated gene. CACNA1S and STAC3 genes have also been shown to put patients at increased risk. This case report looks to draw attention to the presentation, the importance of early recognition, and the treatment of

malignant hyperthermia in practice to increase likelihood of favorable outcomes. It will also add to the published body of evidence of reported cases of malignant hyperthermia to be further analyzed in the future.

Case Presentation

This is the case of a 53-year-old male who presented to the emergency department with complaints of right lower quadrant abdominal pain. Upon further workup he was found to have acute appendicitis and was scheduled for a laparoscopic appendectomy. Medical history included hypertension, hyperlipidemia, prediabetes, and obstructive sleep apnea. Past surgical history listed includes colonoscopy with monitored anesthesia care consisting of a propofol only anesthetic. During his pre-operative examination, the patient stated that he had received general anesthesia previously, which was later found to be false.

At 8:36 induction of anesthesia was performed using propofol, fentanyl and ketamine. Rocuronium was given at 8:37 to provide neuromuscular blockade. The patient was then intubated at 8:39 using an 8.0 endotracheal cuffed tube and volatile inhalation agent sevoflurane was immediately started for maintenance of anesthesia. After induction, the patient required 700 mcg of phenylephrine and 5 mg of ephedrine to maintain perfusing blood pressure.

After treatment, the patient's blood pressure recovered and never experienced prolonged hypotension below a mean arterial pressure (MAP) of 65 mm Hg. Pulse was within normal limits ranging from 60-80 bpm after induction.

EtCO₂ was slightly elevated but stable between 45 and 50 mm Hg. Surgical incision was made at 9:01 and the length of the procedure was quick with the appendectomy completed and the abdomen desufflated at 9:15. At 9:20 the inhaled anesthetic was stopped. The patient had been moved from the surgical table back to the cart where he was lying flat, and at around 9:29 there was an increase in HR from 70 bpm to 120 bpm without a clear explanation. Approximately 5 minutes later, the EtCO₂ increased, from where it had been stable, up to a peak of 85 mm Hg. During emergence, increased heart rate and agitation is expected, but the sustained increase in EtCO₂ is atypical despite increasing minute ventilation. Because the procedure had concluded, the CO₂ used for insufflation had been turned off. The anesthesia team checked for any subcutaneous emphysema that would have been indicative of CO₂ retention. With no flow of gas and no crepitus noted on exam, it is highly unlikely either of these were contributing to the high EtCO₂ readings at the time. Of note, it was discussed that if the laparoscopic surgery was not completed, the team would have considered converting to an open procedure. Along with the persistent increase in heart rate and EtCO₂, there was an increase in temperature from 37.4 C to 38.1 C and at 0934 a malignant hyperthermia (MH) crisis was called by the attending anesthesiologist.

Immediately, interventions were performed to combat the malignant hyperthermia. The volatile gas had already been shut off and the patient was receiving 100% oxygen at 10L/min. Filters with charcoal were put in place on the anesthesia machine tubing to absorb any excess or remaining volatile anesthetic the patient may have continued breathing and the carbon dioxide absorber was also replaced. These interventions limited any additional volatile anesthetic from reaching the patient. Ice packs were applied to the patient's neck and groin at 9:39. At 9:45 the first dose of dantrolene 250 mg IV was given to the patient. This was followed by an additional 100mg IV dantrolene 4 minutes later. In order to monitor hemodynamics and obtain repeat blood samples, an arterial line was placed at 9:43.

The patient's EtCO₂ remained elevated above 60 mmHg despite the administration of dantrolene and thus a repeat dose of dantrolene 350 mg IV was given at 9:57. After that, he responded to the medication as indicated by the decrease in EtCO₂ to around 40 mm Hg where it remained for the remainder of the case. His temperature quickly returned to normal as well. A triple lumen central line was also placed later for central pressure monitoring and possible need

for vasopressor medications. He remained intubated after completion of the procedure out of caution due to the complications with MH intraoperatively and his care was transferred to the ICU. He was given additional dantrolene for the next 24 hours to prevent reoccurrence of a MH crisis.

The MH hotline was contacted during the case, and they were in agreement that, based on the timeline and presentation of the patient's symptoms, this was a true MH event. Along with the interventions that were completed which included the placement of filters, ice on the patient for cooling, and administration of dantrolene, they provided further recommendations. They requested repeat dantrolene dosing of 1mg/kg every 6 hours for the following 24 hours. They also recommended hourly potassium checks and serum creatinine kinase (CK) levels every 8 hours. The patient had only a single mildly elevated potassium of 5.7 meq/L immediately following the procedure and no elevations of his CK.

When transferred to the ICU, his vitals were stable. Based on recommendations from the MH hotline and in concert with the care team, extubation was able to be completed later that afternoon at 1440. While in the ICU he experienced an episode of new atrial fibrillation which required cardioversion. He was started on a beta blocker and was able to maintain normal sinus rhythm thereafter. Retrospective chart review shows that he continues to take the daily beta blocker but does not demonstrate any ongoing or new complications secondary to his malignant hyperthermia crisis. He did not undergo genetic testing nor muscle biopsy to confirm his susceptibility to MH.

Discussion

Recognizing malignant hyperthermia (MH) early is immensely important in successful treatment. As there is no specific confirmatory test during an acute crisis, the constellation of symptoms including hypercarbia, muscle rigidity, and fever after exposure to known trigger such as volatile inhaled anesthetic or succinylcholine is indicative of MH. Additionally, treatment with dantrolene and subsequent recovery of these symptoms is diagnostic. Laboratory derangements showing mixed respiratory and metabolic acidosis, hyperkalemia, and increased serum creatinine kinase are common and supportive of the diagnosis but not required.³ This patient experienced refractory hypercarbia, tachycardia, and increased core body temperature, which, in addition to his acidosis upon first arterial blood gas sampling, is suggestive of MH.

The early recognition seen in this case was paramount to the long-term success of this patient and also all other patients with possible MH. The complicating pieces of this story could explain each one of his MH-like symptoms. It was near the end of the case which usually leads to tachycardia. His underlying appendicitis may have been the cause potentially leading to the fever. He had laparoscopic surgery which could explain his increase in EtCO₂. Any one of these alone may lead one to brush it off as a red herring; however, all three of these signs not responsive to normal treatments must tip the anesthesia provider off to a potential MH crisis.

There are various recommended treatments for management of MH including the immediate cessation of volatile anesthetic and increased flow to 10L/min or greater using 100% oxygen. Minute ventilation should be increased in attempt to exhale excess CO₂, and charcoal filters should be used in order to absorb any remaining volatile gas circulating in the anesthesia machine.⁴

Dantrolene is currently the most powerful pharmacologic tool to be used in treating MH and is the mainstay of treatment. Its mechanism of action is to interfere with the release of calcium from sarcoplasmic reticulum of skeletal muscles. The calcium perpetuates MH and with a peak onset of action of one minute, dantrolene is able to work as an effective and immediate treatment. Dantrolene is metabolized in the liver and can be toxic with long-term use, however in an acute MH crisis the benefits outweigh the risk of associated liver damage.⁵ Doses of 2.5mg/kg should be given, and the patient should be reassessed for changes in EtCO₂. If there is no change, subsequent administrations of the same dose should be administered every 5 minutes until there is improvement in hypercarbia.^{4,6} In this case, dantrolene was used effectively and was able to successfully treat MH.

There is little in the literature published regarding long-term complications from MH. With that, mortality rates are varied but have seen significant decreases since the advent of dantrolene and the push for early recognition and continuous monitoring. Currently, mortality rates stand at approximately 1.4 – 9.5% in the U.S.⁷ Prevention of acute episodes is paramount by completing a thorough history and physical to assess for previous personal or familial complications. Vigilance in family history is especially important as the rates of ryanodine receptor mutations are higher than prevalence of MH suggesting that the mutation demonstrates variable penetrance and can be unpredictable and present even in the absence of family history.³

The MH Hotline is a service provided by the Malignant Hyperthermia Association of the United States (MHAUS). They are a nonprofit group that has been established since 1981 staffed by anesthesiologist around the country to help promote understanding and care for patients with MH and similar disorders. Additionally, they are crucial in aiding in the acute treatment of a MH crisis. According to their website, their goals are to educate medical providers to recognize and treat MH, advise healthcare professionals in the US, help families and susceptible individuals live with MH, and support research. As part of their mission, they provide a 24-hour hotline for healthcare professionals to call in an emergency. This hotline was utilized in this case to the patient's benefit in addition to the benefit of future patients.⁸

Conclusion

This was the case of a 53-year-old male with hypertension, hyperlipidemia, obesity, and obstructive sleep apnea who underwent general anesthesia for a laparoscopic appendectomy secondary to acute appendicitis. During maintenance of his anesthetic using sevoflurane, he demonstrated tachycardia, increased EtCO₂, and increase in body temperature. He was successfully treated with multiple doses of dantrolene and was cooled with ice packs. The volatile inhaled anesthetic was immediately shut off and filtered. He had no known family history of malignant hyperthermia or personal history of anesthesia.

He had a new episode of atrial fibrillation while in the ICU requiring cardioversion. Despite remaining intubated and being admitted to the ICU, his only long-term sequelae after discharge was the addition of a daily beta blocker to prevent repeat episodes of atrial fibrillation. The early recognition of MH in this patient underscores the importance of continuous monitoring and vigilance during the use of MH triggering anesthetic medications, which includes volatile inhaled anesthetics and succinylcholine. There is verified importance of pre-operative evaluation that will help to identify any concerns in the patient's surgical or medical history, such as family or personal history of a MH crisis, but it is not exhaustive in preventing MH crises. If history of MH exists it should prompt the anesthetist to create a plan free of volatile anesthetic gases or succinylcholine. When possible, the patient should also tell family members about their condition as MH is hereditary and the knowledge could prevent future crises. This case helps to demonstrate that early recognition and immediate treatment with dantrolene continues to be the cornerstone of successful treatment and preventing MH related mortality.⁶

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Literature Review of the Effects of Operating Room Temperature on Surgical Team Performance and Patient Outcomes

Nathan Ochsner, MS II; Riggins Bundy, MS II; and Nathan Skelley, MD

Abstract

Introduction/Background: Operating rooms (OR) require precise management to ensure patient safety, with temperature regulation serving as one key factor in reducing surgical complications. This review explores the impact of OR temperature on staff performance, infection rates, and hypothermia outcomes, as well as strategies to minimize adverse effects.

Methods: This literature review synthesizes findings from peer-reviewed studies, meta-analyses, and clinical guidelines identified through PubMed and Google Scholar. A focus was placed on publications written in the past 25 years to maintain the most updated information. The included articles emphasized the effects of OR temperature on staff performance, infection rates, and hypothermia-related outcomes, and all references were cross-checked by two authors for accuracy.

Results: Ambient temperature guidelines of 20-24°C (68-75°F) from the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE) help reduce heat-related stress in the operating room (OR). Cooler environments minimize distractions, fatigue, and impaired performance among staff in the sterile field. Ambient temperatures above guideline ranges are associated with an increased risk of infection, particularly from gram-negative bacteria. Intraoperative hypothermia, however, poses its own risks, including altered pharmacodynamics, increased blood loss, and coagulopathies, while prolonged hypothermia can extend recovery times and hospital stays.

Conclusion: OR temperature plays a critical role in maintaining surgical efficiency and patient safety. Multiple variables must be considered and several intervention methods exist to optimize surgical team performance and patient outcomes.

Introduction

Operating rooms (OR) are typically maintained at cooler temperatures, ranging from 20-24°C (68-75°F).^{1,2} While these are the OR temperature specifications that are established by the American Society of Heating, Refrigerating, and Air-Conditioning Engineers (ASHRAE), exceptions exist for certain surgeries and patient populations, such as cardiac surgery and pediatric patients.^{2,3} All surgeries must carefully regulate OR temperatures to ensure optimal surgical conditions for the staff members and patient while staying within the regulatory guidelines. The purpose of this review is to examine the impact of OR temperature on staff performance, infection rate outcomes, and hypothermia outcomes.

Staff Performance

Operating rooms for the majority of medical specialties have recommended ambient temperatures set by the ASHRAE; however, there are special circumstances to these standards such as cardiac surgery where the average room temperature is 17°C (62.5°F).^{1,3} Reasons for deviating from the standard temperature include the length of surgery, heat produced by surgical lights, and heat retained from wearing gowns and gloves.⁴ Some specialties, such as vascular surgery and orthopedics surgery, use real-time radiographs with C-arm fluoroscopy, requiring these surgical teams to wear lead coverings over their scrubs and underneath their surgical gowns (Figure 1). Lead is a crucial component of surgical safety when using radiographic imaging. The surgical standard for

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Figure 1. Surgical staff in lead standing with C-arm fluoroscopy for real-time radiographs.



lead thickness is a minimum of 0.5 mm.⁵ Additionally, a 0.5 mm full body lead shield can weigh up to 15 pounds or more depending on additional features such as neck guards and wrap around designs. The added weight increases muscle exertion and heat generation, raising the surgical team's core temperature. By decreasing OR temperatures from the standards, the extra heat from the lead coverings can be offset.

Along with increased physical exertion and heat generation from the lead, surgical lighting adds environmental heat for the surgical team. A typical OR has multiple overhead lights to ensure adequate illumination of the surgical field. Each of these lights can house multiple light bulbs.^{6,7} LED lighting decreases energy consumption and heat output compared to incandescent bulbs. Although a single LED bulb produces minimal heat, a surgical light with 80 bulbs—along with multiple overhead fixtures—can still contribute significantly to heat buildup.⁸ Decreasing OR temperatures can also offset this generated heat, similar to the physical exertion experienced from the lead shielding.

Lead and lighting are two of many factors that increase

environmental factors that raise the surgical team's body temperature and alter staff performance. Studies have demonstrated that even a one-degree temperature change can impact the surgical team's performance executing various surgical tasks.^{2,9} Surgical staff that are exposed to increased OR temperatures, can exceed the one-degree core temperature change and have an increased subjective workload, discomfort, perceived exertion, and surgical fatigue.¹⁰ Discomfort, sweat, and dehydration are some distractors from an increase in core temperature, all of these variables can take focus away from the procedure and decrease performance.^{2,9} Another study in burn surgeries found that increased environmental temperature caused increased heart-rate, core body temperature, and fluid loss through sweat for the surgical staff.¹⁰ The sensation of sweating can be distracting and uncomfortable. The surgical team cannot easily address sweating without disrupting the sterile field, which poses an increased risk of infection.⁹ Lowering the OR temperature prevents external factors from increasing core body temperature of sterile-field staff and reduces distractions for the staff in the sterile field.

Not all surgical staff experience the same degree of heat generation, lowering their risk of over-heating. Some surgical team members are not gowned and gloved and sometimes are not protected by lead continuously during surgical procedures. For these team members, lower OR temperatures can be uncomfortable. While the colder ambient temperature is uncomfortable, wearing additional layers such as long sleeves, surgical coats, or using warming blankets can eliminate this discomfort. Additional layers for staff not in the sterile field can help maintain surgical team comfort for those who are in the sterile field, optimize work environment stress, and prevent decreased performance.

Infection Rate Outcomes

Surgical site infections (SSIs) remain a significant global concern, with an estimated 2.5% of patients experiencing an SSI following a surgical procedure.¹¹ SSIs can severely compromise patient outcomes, extend hospital stays, and lead to readmission. The historical reduction in SSIs is largely due to procedural factors such as sterile practice, appropriate PPE, and antibiotic prophylaxis, though ambient factors such as OR humidity, airflow, and temperature may also influence infection risk.¹²

Orthopedic surgeries that involve prosthetic implants, such as total hip and knee arthroplasties, are commonly affected by bacteria living on the skin, such as *S. aureus*, *S. epidermidis*, and *P. acnes*, as well as bacteria usually spread



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through nosocomial routes such as *K. pneumoniae*, *P. aeruginosa*, and *E. coli*.¹³ Despite aseptic precautions, all of these pathogens have the capacity to enter surgical sites in spite of aseptic precautions. Gram-negative bacteria (*K. pneumoniae*, *P. aeruginosa*, and *E. coli*) tend to proliferate more effectively when ambient temperatures begin to rise above the recommended 24°C (75°F).¹⁴ One study analyzing 116,981 procedures from Switzerland found that in months with an outdoor temperature higher than 20°C (68°F) (reference 5-10°C or 41-50°F), which made it more difficult to keep the OR in the proper temperature range, patients were more likely to develop an SSI, with an odds ratio of 1.59 (95% confidence interval 1.27-1.98).¹⁴ Historically, it was a concern that lower OR temperatures contributed to intraoperative hypothermia, which led to decreased immune function and an increased susceptibility to SSIs, particularly gram-positive bacteria (such as *S. aureus*). However, this is now contested as several recent meta-analyses have found that intraoperative hypothermia does not lead to an increased rate of SSI.^{15,16}

Other surgical fields—such as cardiac, neurological, gastrointestinal, and genitourinary—face similar risks, with potential transmission of several of the same bacteria species from both patient skin and surgical contamination. Surgeries involving specific organ systems may also allow for infection by a wider range of species native to their systems, such as abdominal surgeries allowing for *Enterobacteriaceae spp.*, *B. fragilis*, and variable strains of *E. coli*.¹⁷ These types of surgeries follow a similar pattern to orthopedic procedures: higher temperatures are associated with increased infection rates, while the effects of lower temperature are less well understood.¹⁴⁻¹⁶ Several scientific studies suggest that procedural factors (such as surgical duration) and patient factors (such as increased age and comorbidities) have a greater effect on SSI rate than OR temperature.^{17,18}

Hypothermia Outcomes

The normal human core body temperature ranges from 36.1°C (97°F) to 37.2°C (99°F) and deviations from this range can lead to serious injuries. Intraoperative hypothermia is a major concern in the operating room. While it is common for patients to experience a drop in body temperature following the administration of anesthesia, too much of a decrease can cause intraoperative hypothermia. Anesthetics such as propofol can cause a normal decline in body temperature, lowering core temperature by 1–3 °C (34–37 °F) within the first hour of induction.¹⁹ If the drop becomes too severe, a range of acute consequences can occur such as altered pharmacodynamics, increased blood loss, coagulopathy,

and transfusion requirements. With prolonged exposure, hypothermia can prolong recovery and lengthen hospital stays. In severe cases, intraoperative hypothermia may increase chances of mortality. For these reasons, patient core body temperature is commonly monitored and maintained throughout surgical procedures.

Fortunately, several strategies exist to prevent intraoperative hypothermia complications. Patients are usually given warm blankets before and during surgery. Prewarming—raising the temperature of peripheral tissues prior to induction—can reduce the degree of core body temperature drop caused by anesthesia.¹⁹ Patients are often provided with warm blankets during surgery to raise body temperature initially and to serve as passive insulation throughout the procedure. Along with passive, warm blankets, the surgical team provides active skin warming techniques such as forced-air blankets (Figure 2). These devices can deliver temperatures between 32-43°C (90-109°F).^{19,20} Another method is fluid warming. This method is considered less effective compared to force-air blankets but can still increase patients' temperature by around 1°C. Lastly, humidified gasses can generate heat. It is considered the least effective method as it increases patient core temperature approximately 0.5°C (33°F).²⁰ All of these warming methods help prevent intraoperative hypothermia and allow for lower OR temperatures.

Figure 2. Forced-air blanket warmer.



Conclusion

The operating room is a highly controlled environment designed to ensure both patient safety and surgical staff excellence. OR temperature is one of the more controllable factors that can influence surgical outcomes. Elevated temperatures have been shown to negatively affect the productivity of the surgical team present in the sterile field. Individuals not in the sterile field have options to stay warm

to help facilitate an ideal operating room environment. There is evidence linking higher OR temperatures to increased infection rates, therefore, infection prevention must remain a top priority. Furthermore, measures such as warming blankets and warm intravenous fluids should be considered to help prevent patient hypothermia and associated complications

during surgery. Multiple techniques and devices are available to improve OR temperature regulation for both patients and staff members during surgery. Maintaining a proper and ideal operating room temperature is an important consideration for surgical teams.

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SDSMA MEMBER SPOTLIGHT



Peter Paul Lim, MD

Specialty: Pediatric Infectious Disease

Practice location: Avera Medical Group Infectious Disease Specialists

Faculty appointment: Assistant Professor of Pediatrics, USD SSOM

Member since: 2016

WHY I CHOSE MY SPECIALTY

Pediatric infectious disease is a subspecialized field but still converges with all other subspecialties because infections span across organ systems which makes it very interesting to me. I am a subspecialist but a generalist at the same time, to put it short. Furthermore, it holds very important epidemiologic implications, making it a powerful platform to make an impact in our communities through advocacy and policy formation. It is also very cognitive and research oriented, making it a very good field to advance scientific evidence and findings.

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I am an SDSMA member because I like to be involved in our local network of physicians and clinicians to make a difference in our state through scientific advancement, collaboration, education of the younger generation, and through advocacy. It has also given me an opportunity to be connected with like-minded people to form lasting relationships and enrich the same vision for South Dakota's medical community.

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Disparities in Chronic Myeloid Leukemia Mortality Trends in the United States: A Population Based Analysis

Michael Roberts, MS IV; Dawood Shehzad, MD; Tate Blankespoor, MS IV; Joe Reynen, MS IV; and Dawlat Khan, MD

Abstract

Introduction: Chronic myelogenous leukemia (CML) is a myeloproliferative neoplasm with an annual diagnosis rate of 93,000 individuals in the U.S. per year. Advances in therapy have reduced mortality. In this study, we aim to explore trends of CML-related mortality in the U.S. from the years 1999 to 2020 as they pertain to sex, race, year, state and census region.

Methods: CDC Wonder retrospectively identified patients with an age ≥ 45 with CML-related deaths. Data points analyzed included mortality related to sex, race, year, and census region. Statistical analysis for age adjusted mortality rate (AAMR) per 100,000 persons, annual percentage change (APC), and average annual percentage change (AAPC) were calculated via joinpoint regression.

Results: Between 1999 and 2020, there were 32,484 CML-related deaths in the U.S. The AAMR declined across the entire study period. There was a pronounced decrease from 1999 to early 2006 (APC -8.50% for males and -8.30% for females, with the decline plateauing in the following years). Males exhibited higher AAMRs than females throughout the study period. White individuals appeared to have a higher AAMR than black and Hispanic individuals, while Asian individuals (as reported in national datasets) had the lowest rates. The Midwest has a higher AAMR followed by the West, the South, and the Northeast. Notably, from 2018 to 2020, a slight increase in AAMR was observed across all groups.

Conclusion: Disparities of CML related mortality were observed as they relate to sex, race, year, state and census region.

Introduction

Chronic myelogenous leukemia (CML) is a myeloproliferative neoplasm that has an annual diagnosis rate of 93,000 individuals in the U.S. per year.^{1,2} It is theorized that the incidence of CML diagnosis in the U.S. will be increased 35-fold by 2050.³ Current treatment regimens include tyrosine kinase inhibitors (TKIs) such as imatinib, dasatinib and bosutinib.¹ These have caused a reduction in mortality of disease and facilitated the indolent course of the disease.³ In this study, we aim to explore trends of CML-related mortality in the U.S. from the years 1999 to 2020 as they pertain to sex, race, year, state and census region to address healthcare inequalities.

Methods

Population

CDC WONDER database was used to retrospectively identify patients with CML-related deaths with ICD-10 codes (C92.1) and data from the Multiple Cause of Death Public

Use dataset. Patients with an age ≥ 45 through the years 1999 through 2020 and suppressed values were included for the examined data. Ethical approval was not applicable to this analysis due to the use of publicly-available de-identified data and adherence to STROBE guidelines.

Design

Mortality trends were stratified as they pertained to sex, race, year, state and census region. Races examined included Black or African American, White, Asian, American Indian or Alaska Native, and Hispanic individuals. Census regions for analysis included the Northeast, the South, the Midwest, and the West.

Statistical Analysis

Joinpoint regression was used to provide statistical analysis. Data points for analysis included age adjusted mortality rate (AAMR) per 100,000 persons, annual percentage change (APC), and average annual percentage change (AAPC). APCs

were then plotted on graphs using a log-linear regression model. 95% confidence intervals (CI) for APC and AAPC were also calculated. Data points with less than 20 mortality events were not included for analysis due to unreliability.

Results

From the years 1999-2020, a total of 32,484 deaths related to CML were identified. Black or African American individuals comprised 2,908 (8.95%) deaths. White individuals comprised 26,919 (82.9%) deaths. Hispanic individuals totaled about 1,821 (5.6%) deaths.

Year

The AAMR across all data sets saw a statistically significant decrease in mortality from 1999 to the early 2000s and appears stable from the 2000s onwards. APC was statistically significant at -8.46% from 1999 to 2006 (CI: -12.35% to -6.18%) and statistically significant at +7.61% from 2018 to 2020 (CI: 0.35% to 12.01%). AAPC from 1999 to 2020 overall was statistically significant at -2.16% (CI: -2.81% to -1.75%).

Sex

From the years 1999 to 2020, females accounted for 14,267 (43.9%) deaths, while males accounted for 18,217 (56.1%) deaths. In the timeframe of 1999 to 2006/2007, females experienced a decreased AAMR when compared to men. The APC for males from 1999 to 2006 was -8.50% (CI: -14.09% to -5.99%). Both female APC from 1999 to 2007

and from 2007 to 2020 were -8.30% (CI: -10.1% to -6.9%) and +0.92% (CI: 0.21% to 1.83%), respectively. Male AAPC was -2.70% (CI: -3.05% to -2.30%) while female AAPC was -2.42% (CI: -3.05% to -1.76%). This is seen in Figure 1.

Race

Figure 2 highlights AAMR trends stratified by race. White individuals have a higher AAMR than Black, Hispanic and Asian individuals. APC for Black individuals 1999 to 2008 was -8.08% (CI: -13.18% to -5.33%) and from 2008 to 2020 was +0.97% (CI: -0.92% to 4.55%). For White individuals, APC from 1999 to 2005 was -9.09% (CI: -13.49% to -6.48%) and from 2013 to 2020 was +2.07% (CI: 0.45% to 6.98%). APC for Hispanic individuals 1999 to 2006 was -12.79% (CI: -28.75% to -6.81%) and from 2006 to 2020 was +1.10% (CI: -1.01% to 5.64%). The AAPC findings for all accounted races from 1999 to 2020 were statistically significant. AAPC was -3.01% for Black individuals (CI: -3.97% to -2.02%), -2.63% for White individuals (CI: -2.64% to -1.73%), and -3.76% for Hispanic individuals (CI: -5.12% to -2.15%). AAMR related to American Indian or Alaska Native appeared to have less than 20 mortality events each year from 1990 to 2000.

Census Region

Figure 3 highlights the AAMR trends among the four regions. The Midwest had the highest AAMR followed by the West, the South, and the Northeast. APC for the Southern region from 1999 to 2005 was -9.83% (CI: -13.05% to -7.49%). For the Northeastern region, APC from 1999 to 2007 was

Figure 1. Age-adjusted trends of CML-related mortality stratified by sex in the U.S. from 1990-2000.

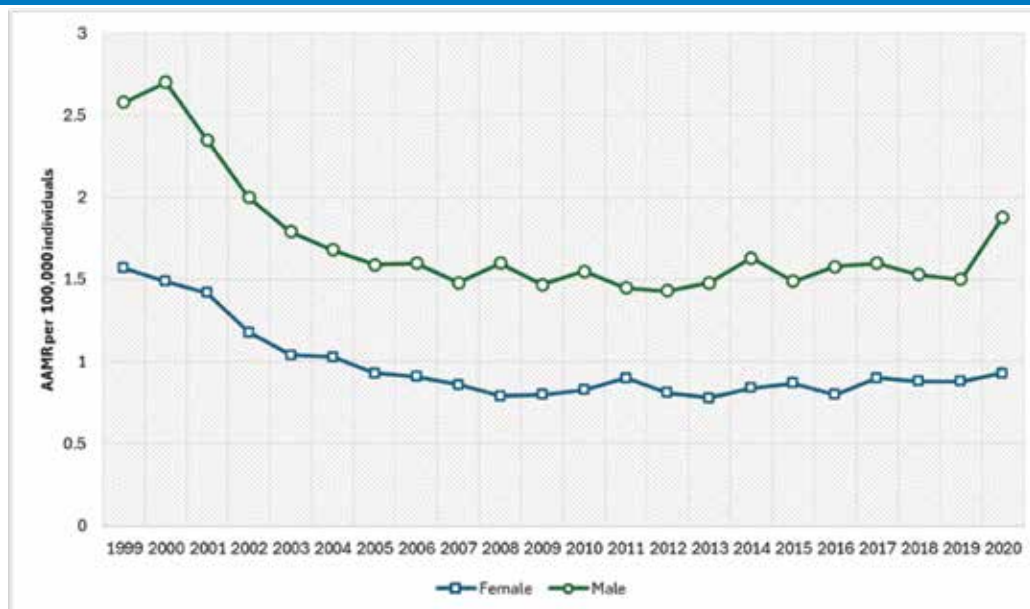


Figure 2. Age-adjusted trends of CML-related mortality stratified by race in the U.S. from 1990-2000.

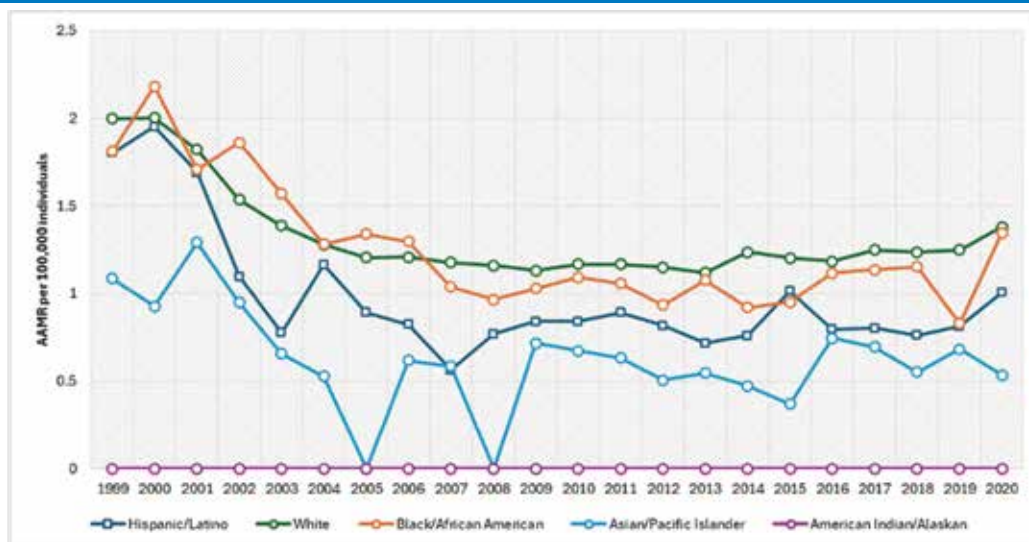
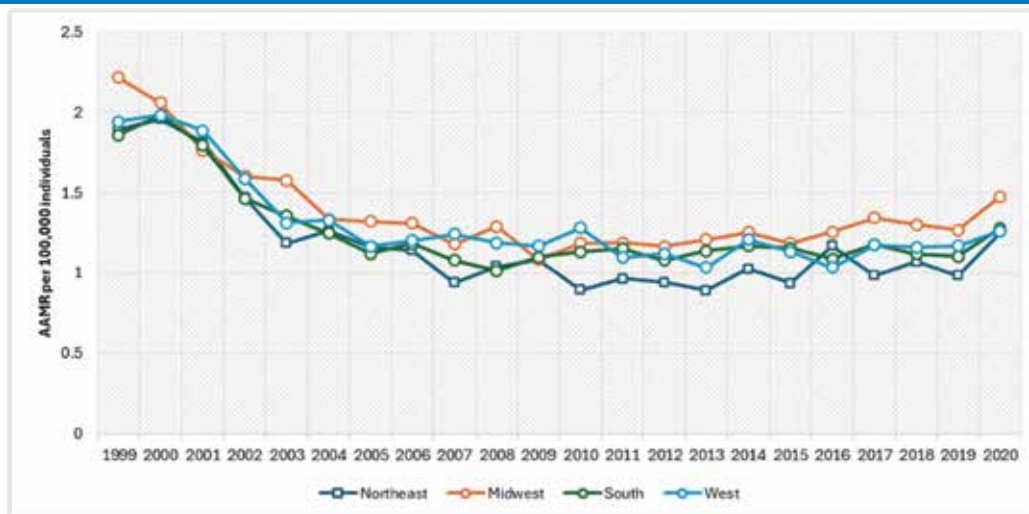


Figure 3. Age-adjusted trends of CML-related mortality stratified by census regions in the U.S. from 1990-2000.



-8.97% (CI: -19.71% to -5.27%). APC for the Midwest was only statistically significant from 1999 to 2004 at -9.08% (CI: -14.99% to -5.74%). For the West, APC from 1999 to 2005 was -9.12% (CI: -13.43% to -6.52%).

Discussion

From the years 1999 to 2020, CML was found to account for 32,484 deaths in the U.S.. All data sets analyzed were found to have a statistically significant decrease in mortality from 1999 to the early 2000s. Imatinib, which is the current gold standard of treatment of CML, was given FDA approval in May 2001.⁴ The subsequent approvals of dasatinib (2006), nilotinib (2007), and bosutinib (2012) have aided in the transformation of CML to a chronic condition for most

patients.³ These medications improved the mortality rate to about 1-2% per year from 10-20% per year.¹ Furthermore, in Figure 3 as, from the early 2000s onwards, the AAMR across all data sets appears stable. However, from 2018 to 2020, there is a statistically significant increase in mortality that could be related to an increased risk of severe COVID-19 infections in individuals with hematological malignancies.⁵

In the context of CML, men are more likely to be affected than females in a 2:1 ratio.⁴ From 1999 to 2020, males had a slightly higher number of deaths when compared to females at 18,217 deaths and 14,267 deaths, respectively. However, when examining Figure 1, it appears that females experienced a decreased AAMR when compared to men in this from

1999 to 2006. This could potentially be explained by the increased prevalence of CML in men when compared to women. A few traditionally “male-dominated” fields such as mining and metal machining have been linked to higher rates of leukemia due to exposure to environmental hazards.⁶

As seen in Figure 2, White individuals have a higher AAMR than Black, Hispanic, and Asian individuals. This could be due to Caucasians being more commonly afflicted by CML worldwide.⁴ The AAPC for Black and Hispanic individuals appeared higher than that of White individuals, highlighting possible disparities as it relates to healthcare access or socioeconomic and biological differences. Furthermore, Black individuals appear to have a longer time frame before reaching their plateau (1999 to 2008) when compared to other races. The prevalence of “suppressed” data or less than 20 mortality events each year from 1990 to 2000 for American Indian or Alaska Native individuals could highlight underreporting.

When examining Figure 4, the Midwest region appears to have a higher AAMR than the other regions. This finding could possibly be explained by a higher incidence of disease in the Midwest. Rural populations are seen to have cancer care disparities that are thought to be related to access to cancer screening, diagnosis and treatment services.⁷

Disparities of mortality were observed as they relate to sex, race, year, state and census region. Thus, highlighting a need to address these healthcare disparities. Future directions include a utilization of treatment-specific data of TKIs to analyze their direct impact on mortality across different data categories. Further studies could better characterize population-level data across the different data sets such as socioeconomic status, access to health care, health literacy, and lifestyle factors.

Limitations

Potential limitations of this study would be a reliance on WONDER and ICD-10 codes. Thus, there is a possibility for misrepresentation or omission of deaths. This study did not account for specific treatment data of the TKIs used to treat CML. Therefore, only indirect inferences about the effect of these treatments on CML mortality could be made.

Conclusion

Through this analysis, disparities in AAMR of CML as it relates to sex, race, year, state and census region were seen. Although all groups seemed to have benefitted from pharmacological treatments such as TKIs, they all exhibited

disparities once AAMR was stratified. Timely identification of these disparities is beneficial as it will help provide equitable care to all patients with CML in the United States.

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Virtual Reality and the Wide-Awake Hand Surgery Experience at a Rural Health Center

Kyler A. Hardie, MD; Cole D. Tessorf, MD; Josefine Combs, PsyD; Brooklyn K. VanDerWolde, MS III; Emily A. Wilde, MS III; Hao Li, MD; Elizabeth A. Helsper, MD; and Robert E. Van Demark Jr., MD

Abstract

Background: Wide-awake, local anesthesia, no tourniquet (WALANT) surgery has been shown to be a safe technique with high patient satisfaction. However, patients may have anxiety about potential pain or the surgical environment. Virtual reality (VR) has been shown to be a safe and effective tool to improve medical procedures. This study aims to show that VR can be used for WALANT hand surgery in smaller hospital systems and describe its benefits.

Methods: 48 patients underwent WALANT using VR in a single facility's in-office procedure rooms from July 2023 to June 2024. Patients completed a preoperative questionnaire that included preoperative anxiety levels, GAD-7, and PHQ-9. Patients also reported intraoperative and postoperative anxiety levels, a "fun score" and whether the patient enjoyed using VR.

Results: 19% of patients (n=9) had GAD-7 scores >10 and 17% (n=8) had PHQ-9 scores >10. ANOVA analysis showed anxiety levels differed before, during, and after surgery ($p<0.01$), and t-tests showed anxiety significantly decreased from preoperative to intraoperative ($p<0.01$), and decreased again from intraoperative to postoperative ($p<0.01$). All patients enjoyed the experience with an average "fun score" of 8.54 out of 10.

Conclusions: Using VR for wide awake (WA) hand surgery is safe, can lower patient anxiety, and results in high patient satisfaction. Because it can be used to both alleviate anxiety and increase a patient's overall experience, VR has great potential for utilization in hand surgery as well as other areas of medicine and surgery.

Introduction

Wide-awake, local anesthesia, no tourniquet (WA or WALANT) is a technique that removes the requirement for operations to be performed with a tourniquet, general or regional anesthesia, sedation, or an anesthesiologist.¹ The technique utilizes 1% lidocaine with epinephrine; epinephrine-induced vasoconstriction limits bleeding and eliminates the need for a tourniquet. Without tourniquet and tourniquet-induced pain, this eliminates the need for general or regional anesthesia with monitored anesthesia care (MAC) and no anesthesia staff.¹ WALANT surgery effectively minimizes bleeding without interfering with the quality of surgery.²

Studies of WA hand surgery report many advantages including high patient satisfaction, preserved intraoperative finger and wrist motion, improved operating room efficiency, fewer opioids post-op, and shorter recovery time.¹ WALANT expands access in resource-limited settings by allowing office-based surgery without anesthesia personnel and has been

shown to be safe, effective, and simple with advantages across clinical, economic, and operative safety domains.^{2,3}

Despite these benefits, some patients and providers express concerns regarding the idea of wide-awake surgery. Patients may have anxiety about potential pain or the surgical environment, and providers accustomed to sedation may have reservation in interacting with awake, potentially anxious patients during the procedures.⁴ A study showed that most patients undergoing WA hand surgery were open to the technique, but wanted reassurance that they would not feel, hear, or see the operation.⁵ Many of these concerns about WALANT may be resolved with the use of virtual reality (VR).

VR is an advanced technology that immerses users in a 3D computer-generated environment via portable headsets. The use of computer-generated auditory and visual stimuli creates the perception that the user has entered a different 'reality.' In medicine, VR has shown promise in reducing discomfort and anxiety in burn care, physical therapy, dentistry, and

psychiatric settings.^{4,6} It has been used intraoperatively with regional anesthesia, and early orthopedic studies demonstrated safe and efficacious results in reducing both patient anxiety and sedation requirements.^{7,8}

In 2019, a randomized control study at a major academic center found that patient experience may be improved with VR during WALANT surgery.⁹ There were no differences in blood pressure, heart rate, or pain scores, while patients using VR exhibited lower anxiety scores during injection, during the procedure, and at the end of the procedure.⁹

This single-center study at a small, rural community hospital further delineates the usage of VR in WA hand procedures (WAVR). This study aims to show that VR can be used for WA hand surgery in smaller hospital systems, as well as describe its benefits including higher patient satisfaction, lower patient anxiety, cost-effectiveness, and the potential to be utilized across many areas of medicine and surgeries in community hospitals.

Methods

The institutional review board (IRB) determined the study did not meet the criteria for human subjects' research. At a single institution with 5 fellowship-trained orthopedic hand surgeons, 1024 patients underwent WALANT surgery in in-office procedure rooms from July 2023 to June 2024. During that time period, 48 patients used VR during their surgical procedure. No formal selection process was used to select patients for using VR. Surgeons offered VR at their discretion when patients appeared nervous when discussing the WALANT procedure. Patients underwent informed consent and were enrolled into the study.

On the day of surgery, patients completed a preoperative questionnaire including a 0-10 anxiety rating, the Generalized Anxiety Disorder-7 Questionnaire (GAD-7), and Patient Health Questionnaire-9 (PHQ-9). The WAVR (Wide Awake Virtual Reality) program was used for the study. WAVR offers a variety of educational and travel videos for patient viewing. Some of the options include a tour of the Space Station and sky diving. During the procedure, patients selected from a variety of VR programs to watch throughout the surgery (Figure 1). Anxiety was reassessed intraoperatively and postoperatively on the same 0-10 scale. After surgery, patients provided a "fun score" (0 = no fun, 10 = very fun) and indicated whether they enjoyed using VR (yes/no). If yes, an additional 0-10 score enjoyment rating was recorded. Heart rate and blood pressure were obtained preoperatively, intraoperatively and postoperatively. Following completion

Figure 1. In-office wide-awake procedure room experience for patient with virtual reality headset.



of the surgical procedure, all of the data was recorded in the patient's EPIC chart by the operating surgeon.

A retrospective review of the records was done and REDcap was used for secure data storage. The chart review and data entry into REDcap was done by the paper's authors. There was no missing data noted in the study.

Results

In this study, 48 patients were included who underwent WALANT hand surgery using a VR headset (40 female, 8 male; mean age: 50 years). Procedures included carpal tunnel release (n=30), trigger finger release (n=11), synovectomy (n=3), DeQuervain's tenosynovitis (n=2), and interphalangeal joint mass excision (n=2) (Table 1).

GAD-7 and PHQ-9 screening taken preoperative showed 19% (n=9) of patients had GAD-7 scores >10 and 17%

Table 1. Patient demographics.

	Patients who underwent in-office WAVR procedures (n=48)
Sex	
Male (n, %)	8, 16.6%
Female (n, %)	40, 83.3%
Age in years (mean, range)	50.10, 18-70
WAVR procedures	
Carpal tunnel release (n, %)	30, 60.5%
Trigger finger release (n, %)	11, 22.9%
Synovectomy (n, %)	3, 6.30%
IP joint mass excision (n, %)	2, 4.20%
De quervain tenosynovitis (n, %)	2, 4.20%

(n=8) had PHQ-9 scores >10 (Table 2). Self-reported patient anxiety was greatest preoperatively, with an average of 5.77 on a scale of 0 to 10, compared to intraoperative and postoperative levels of 3.92 and 2.27, respectively. Analysis of Variance (ANOVA) showed anxiety levels differed ($p<0.01$); t-tests showed decreases from preoperative to intraoperative ($p<0.01$), and intraoperative to postoperative ($p<0.01$). Heart rate (HR) and blood pressure (BP) did not differ significantly across groups: heart rate ($p=0.74$), systolic blood pressure ($p=0.28$), diastolic blood pressure ($p=0.34$) (Table 3). All patients (100%, n=48) reported enjoying the VR headset experience. Among those reporting enjoyment, the mean “fun” score was 8.54/10.

Discussion

Recent literature suggests benefit in using VR during WA hand surgery to reduce anxiety and improve patients’ experience.⁹⁻¹¹ This single-center case series study aimed to evaluate the utilization of WAVR hand surgeries at a rural community hospital.

Table 2. Preoperative GAD-7 and PHQ-9 results.

GAD-7 score	
0-4 (n, %)	20, 41.7%
5-9 (n, %)	19, 39.6%
10-14 (n, %)	4, 10.0%
15+ (n, %)	5, 12.5%
PHQ-9 score	
0-4 (n, %)	30, 75.0%
5-9 (n, %)	10, 40.0%
10-14 (n, %)	4, 10.0%
15+	4, 10.0%

In this cohort, anxiety was highest preoperatively (mean 5.77/10) and decreased during (3.92) and after (2.27) the procedure, with significant pairwise reductions. Vital signs were stable across phases (heart rate $p=0.74$; systolic $p=0.28$; diastolic $p=0.34$), aligning with prior reports that WAVR has negligible physiologic impact. While it cannot be determined whether the slightly higher preoperative anxiety can be differentiated from the expected anxiety before procedures with general anesthetic, the low anxiety both during and after the procedures is consistent with positive VR results. Additionally, the qualitative HR and BP vitals support good tolerance, with no significant differences in preoperative, intraoperative, or postoperative values. The uniformly positive enjoyment responses (100%) and high “fun” score (8.54/10) indicate patients tolerated WAVR well and found it engaging. These results indicate that while patients still have expected preoperative anxiety, VR is a safe and useful tool to improve a patient’s experience during WALANT procedures.

Currently, there are two WAVR systems available to be utilized by orthopedic hand surgeons. Although procedure and turnover times were not formally measured, all surgeons reported that VR integrated smoothly into procedure-room workflows with minimal additional time or effort, consistent with other studies that VR has little impact on procedural time or workflow.⁴

Previous studies suggest patients with “mild anxiety” may have compounded benefits from using VR in WALANT procedures¹¹ and that patients with PHQ-9 and GAD-7 scores indicative of depression or anxiety, respectively, may be good candidates for WAVR procedures. A PHQ-9 >10 (sensitivity 88%, specificity 88% for major depression) and a GAD-7 >10 (sensitivity 89%, specificity 82% for generalized

Table 3. Preoperative, intraoperative and postoperative self-reported anxiety and vital sign results.

	Preoperative, mean (range)	Intraoperative, mean (range)	Postoperative, mean (range)	P-value*
Self-reported anxiety; 0 (no anxiety) to 10 (very anxious)	5.77 (0-10)	3.92 (0-10)	2.27 (0-8)	<0.01
Heart rate	80.88 (61-105)	81.33 (55-103)	80.50 (61-123)	0.74
Systolic blood pressure	137.2 (104-199)	132.1 (91-193)	132.0 (96-188)	0.28
Diastolic blood pressure	79.9 (51-107)	78.3 (54-105)	78.4 (64-108)	0.43

* p-value was generated via ANOVA to examine differences among means of preoperative, intraoperative, and postoperative data.

anxiety) help identify depression and anxiety.^{12,13} Because surgeons offered VR based on perceived anxiousness, we expected many patients to exceed these thresholds; however, only 19% had GAD-7 >10 and 17% had PHQ-9 >10. In our experience, PHQ-9 and GAD-7 did not correlate with hesitancy or preoperative anxiety for the WAVR procedures.

Multiple screening tools are available to specifically assess preoperative anxiety levels and have shown to be effective with revealing a substantial prevalence of undiagnosed anxiety in surgical patients. Several meta-analyses have examined the effectiveness and reliability of various measures for assessing preoperative anxiety, indicating that these measures have good psychometric properties for assessing preoperative anxiety.¹²⁻¹⁴ Approximately 50% of patients experienced preoperative anxiety, supporting strategies to mitigate preoperative anxiety,¹⁵ such as traditional methods,¹⁶ digital platforms like WeChat,¹⁷ and immersive technologies such as VR.¹⁸ A randomized clinical trial found that VR was particularly effective in reducing anxiety and increasing patients' desire for information about their procedures.¹⁸ These results warrant further evaluation of VR in other surgical procedures, in pediatric populations, and across diverse demographics and hospital systems.

From a cost perspective, performing common WA hand procedures in office settings can free operating rooms for more complex revenue-generating cases. A study by Starr et al. found that moving simple hand operations from an ambulatory surgery center to an office setting had a mean cost savings of 82% per case (\$1,137 versus \$206) and effectively opened 821 additional hours of operating room time over 2 years, with projected net profit margins of \$150,413 to \$3.9 million depending on case mix.¹⁹

A limitation of this study was not using a standardized anxiety protocol. A standardized pre-operative anxiety screen might better identify those most likely to benefit from VR, although accurately quantifying anxiety specific to an upcoming procedure is challenging. With no apparent risks or impact to workflow, VR could potentially be offered to all patients undergoing WA in any setting where resources are readily available.-

Conclusions

While patients still have expected preoperative anxiety, VR is a safe and useful tool to improve a patient's anxiety and experience during WALANT procedures. Using VR for WA hand surgery is also safe, cost-effective, and results in high patient satisfaction. Because VR can be used to safely

alleviate anxiety and increase a patient's overall experience, there is great potential for utilization in hand surgery as well as other areas of medicine and surgery.

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University of South Dakota Sanford School of Medicine 2026 Residency Match Listing

Last Name	First Name	PGY-1 Institution Name	PGY-1 Program Name
Bensen	Noah	Center for Family Medicine-SD	Family Medicine
Berg	Tanner	Center for Family Medicine-SD	Family Medicine
Bergeson	Alexander	University of North Dakota	Orthopaedic Surgery
Bien	Heidi	University of Nebraska Med Ctr	Neurology
Blankespoor	Tate	Naval Hospital-Jacksonville, FL	Family Medicine
Blue	Ellie	University of Nebraska Med Ctr	Family Medicine
Blue	Mason	University of Nebraska Med Ctr	Otolaryngology
Carlson	Colton	U Oklahoma COM-OK City	Neurology
Christiansen	Kylie	Aurora St Lukes Medical Ctr- WI	Family Medicine
Cihak	Austin	Mercy Med Ctr- Des Moines-IA	General Surgery
Cody	Mollie	Center for Family Medicine-SD	Family Medicine
Cooper	Carly	Vanderbilt Univ Med Ctr-TN	Anesthesiology
DeHoogh-Kliewer	Hannah	University of South Dakota SSOM	Internal Medicine
Devine	Jacob	University of North Dakota PGY-2 Institution Mayo Clinic-MN	Transitional Year PGY-2 Program Diagnostic Radiology
Dobbs	Kaleb	University of Texas Southwestern	Urology
Dohn	Phil	University of South Dakota SSOM	Psychiatry
Donahoe	Joshua	University of Nebraska Med Ctr	Emergency Medicine
Eddy	Madysen	University of Nebraska Med Ctr	Obstetrics-Gynecology
Fest	Aaron	U Oklahoma COM-OK City	Obstetrics-Gynecology
Fritsch	Luke	Naval Medical Center- San Diego	Psychiatry
Gauer	Tanner	Southern Illinois University	General Surgery
Genant	Wesley	University of Nebraska Med Ctr	Family Medicine
Gerberding	Holly	University of Nebraska Med Ctr	Obstetrics-Gynecology
Goehring	Holly	Center for Family Medicine-SD	Family Medicine
Grady	Belle	University of Kansas- Wichita	Family Medicine
Grimsley	Raina	Central Iowa Health System	Pediatrics
Gruba	Jonathon	University of South Dakota SSOM	Neurology
Hilbrands	Emily	Center for Family Medicine-SD	Family Medicine
Holsing	Joshua	Mercy Med Ctr- Des Moines-IA	Internal Medicine
Howe	Chase	University of South Dakota SSOM	Psychiatry
Hurley	Maureen	University of Minnesota	Internal Medicine
Job	Alexandra	University of South Dakota SSOM	Pathology
Jorgensen	Megan	Mayo Clinic - MN	General Surgery
Kelly	Joseph	University of South Dakota SSOM	Transitional Year
Kenzy	Katelyn	Loma Linda University-CA	Internal Medicine
Kirschenmann	Emily	Center for Family Medicine-SD	Family Medicine
Kittock	Claire	Stanford Health Care-CA	Pediatrics-Medical Genetics
Kohler	Alison	Aurora Health Care/ASMC-WI	Family Medicine

University of South Dakota Sanford School of Medicine 2026 Residency Match Listing

<u>Last Name</u>	<u>First Name</u>	<u>PGY-1 Institution Name</u>	<u>PGY-1 Program Name</u>
Kray	Meagan	University of Nebraska Med Ctr	Anesthesiology
Lambert	Joshua	University of South Dakota SSOM	Neurology
Lane	Sarah	Vanderbilt University -TN	Preliminary Surgery
Leonard	Graham	University of South Dakota SSOM	Psychiatry
Lien	Molly	University of South Dakota SSOM PGY-2 Institution Geisinger Health Systems-PA	Transitional Year PGY-2 Program Dermatology
Lusk	Christina	University of Nebraska Med Ctr	Internal Medicine
May	Kirsten	University of South Dakota SSOM	Pediatrics
McCann	Sean	St Joseph Hospital SCL Health-CO PGY-2 Institution University of Colorado-Denver	Med-Preliminary PGY-2 Program Anesthesiology
McMahon	Haley	Center for Family Medicine-SD	Family Medicine
Meide	Elise	Mountain AHEC-North Carolina PGY-2 Institution University of Iowa	Transitional Year PGY-2 Program Dermatology
Naasz	Leah	University of South Dakota SSOM PGY-2 Institution University of Nebraska Med Ctr	Transitional Year PGY-2 Program Dermatology
Noble	Ethan	Providence St Peter Hospital-WA	Family Medicine
Ogunremi	Oluwafunke	Health Education Services-TN PGY-2 Institution Mayo Clinic-MN	Transitional Year PGY-2 Program Dermatology
Olevson	Collin	Cleveland Clinic- Cole Eye Institute	Ophthalmology
Olson	Callie	University of Nebraska Med Ctr	Pediatrics
Payne	Sydney	University of Kansas-Wichita	Family Medicine
Petereit	Mark	Med Coll Wisconsin Affil Hosps	Emergency Medicine
Pham	Melissa	University of Virginia Med Ctr	Internal Medicine
Popp	Nathan	University of South Dakota SSOM	Emergency Medicine
Reynen	Joseph	University of Connecticut	Emergency Medicine
Roberts	Michael	Mayo Clinic-MN	Internal Medicine
Rook	Amanda	U of Missouri- Kansas City	Ophthalmology
Schild	Lauren	Oregon Health & Science Univ	Pediatrics
Schild	Rachel	University of Iowa	Internal Medicine
Schumacher	Joshua	University of Arizona-Phoenix	Internal Medicine
Shafer	Mariah	Center for Family Medicine-SD	Family Medicine
Smith	Bailey	University of Nebraska Med Ctr	Urology
Stacey	Logan	University of South Dakota SSOM	Internal Medicine
Steffen	Quenton	Creighton University SOM	Urology
Sutton	Hannah	University of South Dakota SSOM	Psychiatry
Thelen	Kianna	University of Iowa	Pediatrics
Vettrus	Noah	University of Toledo-OH	Anesthesiology

One student declined publication of Match site.

Bringing Pediatric Cardiac Care to Patients and Families Across the Region

Calum's Story: Cardiology Care Closer to Home

Calum was born with an atrioventricular (AV) canal defect, a large hole between the upper and lower chambers of his heart, as well as coarctation, a narrowing of the aorta. Through Children's Nebraska's Fetal Heart Program, our pediatric cardiac team began building and preparing Calum's care plan even before he was born.

That plan included a two-stage surgical approach. Immediately after birth, Calum was transported from his hometown of Rapid City, South Dakota, to Children's for surgery to expand his aorta. Six months later, he returned for a second corrective procedure to repair the AV canal defect.

Today, Calum continues to receive expert care close to home. Children's pediatric cardiologists travel to Rapid City to provide pediatric cardiology clinics, allowing patients and families across South Dakota to access specialized care without traveling long distances for every visit. Calum is also followed by Children's Pulmonary Hypertension Program, the first program of its kind accredited as a Regional Clinical Program by the Pulmonary Hypertension Association.

The comprehensive care offered through Children's Criss Heart Center ensures patients like Calum receive the full spectrum of cardiac services from one trusted care team. Our extensive outreach clinic program reduces the need for frequent travel to Omaha, and when visits to our main campus are necessary, Children's supports families traveling more than 90 miles by providing accommodations at the Carolyn Scott Rainbow House. At every step of the way, our team is committed to keeping patients and families informed, supported and cared for.

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In addition to Omaha, Children's conducts outreach clinics in:

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South Dakota: Rapid City and Sioux Falls



Children's Criss Heart Center's Programs and Services Include:

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- Advanced Pediatric Heart Failure & Transplant Program
- Aortopathy Program
- Cardiac Care Unit, an acuity-adaptable floor dedicated to caring for the full spectrum of heart patients
- Cardiac Neurodevelopmental Program
- Cardiac Rehabilitation
- Cardiothoracic Surgery
- Cardiovascular Genetics
- Diagnostic Testing & Advanced Cardiac Imaging
- Electrophysiology
- Fetal Heart Program
- Fontan Program, in partnership with Children's Adolescent Medicine and Gastroenterology, Hepatology & Nutrition
- Interventional Cardiology
- Lipid Heart Clinic
- Pediatric Cardiology
- Pediatric Pacemakers and Implantable Cardioverter Defibrillators (ICD) Program
- Pulmonary Hypertension Program, in partnership with Children's Pulmonology
- Single Ventricle Program



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- Physician lobbyist – serve as a volunteer lobbyist during the legislative session;
- SDSMA PAC – help friends of medicine become elected officials and lawmakers;
- SDSMA committees and task forces – serve the organization and yourself;
- SDSMA appointments to state boards, committees and commissions – the SDSMA is asked to nominate and recommend physicians to fill positions to numerous vacancies every year;
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If you'd like to get involved, give us a call at 605.336.1965 or visit www.sdsma.org for more information.

"For Your Benefit" is the Association's monthly update on programs and services available to physicians through their affiliation with the SDSMA.

Registration Open! 2026 SDSMA Annual Leadership Conference

Advancing Patient Care Through Lifestyle Medicine

The 2026 SDSMA Annual Leadership Conference is **Friday, May 29** at The Catlin (formerly the Hilton Garden Inn) Downtown Sioux Falls.

This year's conference will focus on a comprehensive, evidence-based approach to applying lifestyle medicine to today's health challenges. Physicians will explore practical methods for integrating lifestyle medicine fundamentals into daily clinical practice to improve patient outcomes. The information will provide physicians with actionable strategies to enhance long-term outcomes and elevate their approach to preventive care. Additionally, a poster session will be held at 1:30 where medical students and residents will highlight their work.

Submit a Policy Issue & Participate in the Open Forum

Do you have a policy issue you'd like to bring to the SDSMA's attention? Schedule a time to address the SDSMA Policy Council during the Membership Open Forum. Find a policy submission form at sdsma.org.

Medical Student Poster Session

Be sure to join us for the Medical Student and Resident Poster Session followed by a presentation given by Matthew Schmitz, MS III, author of the #1 abstract, "Conducting a cadaveric suturing laboratory to increase clinical readiness in medical students – an education research project" by Matthew Schmitz, MSIII; Gary Timmerman, MD; William Spanos, MD; Amy Prunuske, PhD; and Taylor Soderling, PhD.

The Annual Leadership Conference is a benefit of your membership – there is **no registration fee for members**. For non-members, the cost is \$95. Tickets are required for the evening Awards & Scholarship Recognition Banquet and are available for purchase at sdsma.org.

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Legal Brief Highlight: Confidentiality of Patient Communication

Both South Dakota law and the HIPAA-mandated federal medical privacy rules generally prohibit the release of health care related information to third parties. However, this legal privilege against disclosure is not without exception. Federal privacy rules and South Dakota law permit, and in some instances even require, the disclosure of information to law enforcement officials and others in specified circumstances.

Individual healthcare related information is protected both under state and federal law, and may be disclosed to a third party only if permitted or required by law. Physicians should exercise care prior to disclosure of any healthcare related information, including knowledge of illegal drug activity. However, reporting the illegal use of drugs or diversion is required when

done in compliance with a court order or court-ordered warrant, subpoena or an administrative request.

Disclosure of healthcare related information is permitted, but not required, in connection with other limited law enforcement related conditions, and is required in certain circumstances, including cases of abuse and neglect.

For more information, download the SDSMA legal brief at sdsma.org. The SDSMA provides legal briefs for member physicians on a variety of rules and regulations that apply to the medical profession. For nonmembers, legal briefs are available for purchase

Retired Physicians: Stay Connected With Your Colleagues

Sioux Falls-area retired physicians: A retired physicians coffee is provided for Sioux Falls-area physicians through the SDSMA and the South Dakota Physician Well-Being Program.

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Copic Tips: What's New on Copic's Podcast?

Copic's *Within Normal Limits* podcast released new episodes recently – a few highlight explore critical issues in healthcare:

- **An Inside Look at Today's Medical School Environment** – Brian Dwinnell, Associate Dean of Student Life at the University of Colorado School of Medicine, shares his insights on medical school admissions, student support, and curriculum changes.
- **A Physician's Journey Through Injury and Return to Practice** – Dr. Catrina Bubier, an OB/GYN physician and member of Copic's Board of Directors, discusses the importance of disability insurance, the emotional challenges of facing a potential end to her career, and the value of planning ahead for unexpected life events.

- **Understanding the Concepts of Psychological Size and Psychological Safety** – Dr. Mark Earnest, Division Head of Internal Medicine at the University of Colorado Anschutz Medical School, shares stories that illustrate the concepts of psychological size and psychological safety in the healthcare setting and emphasizes how leaders must be proactive in recognizing and managing power dynamics.

Tune in to gain insights from experts about key medical liability challenges.



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AMA NAC: Advocacy in Action

At the AMA National Advocacy Conference at the end of February in Washington D.C., the SDSMA spoke with South Dakota's Congressional delegation about Medicare physician payment reform, prior authorization reform, and the federal No Surprises Act. Thank you to the members who led this effort. Pictured are Robert Summerer, DO; Rob Allison, MD; SDSMA CEO Tammy Hatting; Mary Carpenter, MD; Ben Meyerink, MD and Josh Crabtree, MD.



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