EP Lab Digest 20 YEARS

A product, news & clinical update for the electrophysiology professional

EP Lab Spotlight

Memorial Hospital of Carbondale

Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS

Memorial Hospital of Carbondale is the largest tertiary healthcare system in Southern Illinois, covering 16 counties in the local referral network. With the partnership of Southern Illinois Healthcare (SIH) and Prairie Heart Institute (PHI), we have provided comprehensive cardiovascular care for Southern Illinoisans for decades. The hospital is a semi-academic facility with a strong affiliation with the Southern Illinois University (SIU) School of Medicine, providing the clinical training site for the family medicine residency program and first-year SIU medical school; our electrophysiologist also mentors and supervises medical students from SIU School of Medicine.

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In This Issue

Cover Story

A Novel Sinus Node Sparing Therapy for Patients With Intractable Symptomatic Inappropriate Sinus Tachycardia: Case Study and Insights From the SUSRUTA-IST Study

Rishi Charate, MD[1]; Adnan Ahmed, MD[1]; Jalaj Garg, MD, FACC, FESC[2]; Dhanunjaya Lakkireddy, MD[1]
[1]Kansas City Heart Rhythm Institute, Overland Park, Kansas; [2]Loma Linda University International Heart Institute, Loma Linda, California

Inappropriate sinus tachycardia (IST) is a cardiac dysautonomia defined as a resting heart rate (HR) of >100 beats/min, a mean HR of >90 beats/min over a 24-hour period, and an exaggerated response to exercise or stress with accompanied debilitating symptoms including palpitations, generalized weakness, dizziness, tremors, exercise intolerance, and presyncope.[1]

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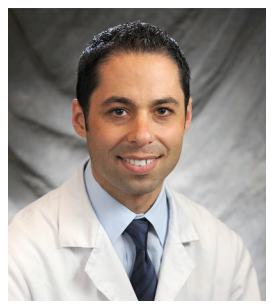
Podcast Interview

Advanced Lead Extraction Techniques: Current Approaches and Future Trends

Podcast interview by Jodie Elrod



In our next episode of The EP Edit podcast, we're featuring a discussion on advanced lead extraction techniques. Dr. Jonathan Salcedo, cardiac electrophysiologist with Silicon Valley Cardiology / Palo Alto Medical Foundation (PAMF) - Sutter Health, is joined by Dr. Robert Schaller, Director of the Cardiac Lead Extraction Program at Penn Medicine, to discuss their approach to lead extraction.

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HMP Global

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Spotlight Interview: Memorial Hospital of Carbondale

Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS

With the most advanced technology and equipment, PHI at Carbondale delivers rapid diagnosis and effective treatment to cardiovascular patients in Southern Illinois as well as in nearby rural areas of Kentucky and Indiana. Our team is passionate about providing the highest quality of care to patients.

When was the EP program started at your institution? Who manages your EP lab?

Our lab was started in 2013 by Daniel Correa De Sa, MD, Sylvan Crouse, RN, RCIS, RCES, LaDonna McCain, RN, BA, RCIS, and Ronald Scott Holland, RT(R). We later recruited Christopher Nenonen, RN, RCIS, and Kimberly Bunting, RT (MR), to join our EP team.

Our EP team works together to improve quality in all aspects of the lab. The current director of the EP lab is Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS (Dr. Kritt). Pamela Shadowens, BSN, MSN, is the operations manager of the cardiac cath, structural heart, electrophysiology, and peripheral vascular labs. Emily Beever, RN, and Lindsey Baldi, BS, RT(R)(CT)(MR)(VI), RCIS, RCES, are the clinical coordinators of the EP lab. The director of the cardiovascular service is Christine McIntyre, RN, MHA, FACHE, AACC, who is the major force behind our EP service line.

Tell us about your EP space.

Our dedicated EP lab is located on the same floor as our 3 cardiac catheterization labs. Our hybrid operating room (OR), which is located on a different floor and shared with the structural heart program, is used for laser lead extractions.

Are employees cross-trained?

The cath lab staff are cross-trained to do device procedures, but not ablations. Our EP lab staff are dedicated to EP only. However, since all of our EP staff had extensive experience working in the cath lab before joining our team, certain EP procedures requiring interventional tools and techniques (eg, venoplasty and alcohol ablation) can be performed without help from the cath lab team.

What is the number of staff members? What is the mix of credentials at your lab?

Our EP team consists of a cardiac electrophysiologist (Dr. Akrawinthawong), 5 physician assistants, 1 nurse practitioner, 4 RNs, and 1 RT(R). Three RNs are trained as EP techs. We have two staff members who are RCES certified, and they plan to coach the rest of the staff and encourage everyone to certify eventually. A second team is being recruited at this moment to cover an additional EP lab in the future.

Figure 1. **Prairie Heart Institute (PHI) in Carbondale, Illinois.**

What types of the procedures are performed at your facility? What types of complex ablations are performed?

Our EP lab performs ablations for all arrhythmias, including supraventricular tachycardia (SVT), ventricular tachycardia (VT), PVC, atrial fibrillation (AF), atrial flutter (AFL), AV node, and arrhythmias in adult congenital heart disease. All cardiac implantable electronic device (CIED) implantation is available, including for loop recorders, pacemakers, leadless pacemakers, and conventional and subcutaneous defibrillators, as well as left atrial appendage (LAA) closure. Since last year, we have been implanting 100% MRI-conditional pacemakers and ICDs. Approximately 10-15% of our ICDs were subcutaneous and 5% of our pacemakers were leadless (Micra VR or Micra AV [Medtronic]). Laser/mechanical lead extraction is also available.

Approximately how many catheter ablations (for all arrhythmias), device implants, lead extractions, and LAA closures are performed each week?

The number of cases varies from week to week. In an average week, we perform about 10-12 major ablations and 20-25 device implantations. We perform approximately 4 LAA closures and 3-4 laser lead extractions per month. This is the data from one dedicated EP room and one hybrid OR room. We anticipate our case volume to be higher once the second EP lab is launched next year.

Tell us more about your upcoming EP lab expansion.

We are in the process of adding one more EP lab to accommodate our growing patient volume. We are also in the process of recruiting a second electrophysiologist to join our practice. The number of EP patients has significantly increased in the past year, from an average of 15-20 patients per day to about 25-30 patients per day. Our schedules for clinical visits and EP procedures are completely booked 2-3 months in advance.

In what other ways has your program or hospital expanded?

In addition to the rapid expansion seen in our practice in the past 6 months, our subspecialist colleagues have focused on establishing specific lines of service (eg, lipidology clinic, structural heart program). In line with this development, the director of our EP lab, in close collaboration with the heart failure clinic (under Muhammad Khan, MD, FACC), built comprehensive AF and VT clinics in July 2019. This collaboration is unique in the non-university hospital setting. We are proud

of this development, as it helps complete the picture of comprehensive cardiovascular care for our high-risk patients, who frequently suffer from both arrhythmia and decompensated heart failure. Our laser lead extraction program is supported by the cardiothoracic surgery team (Russell McElveen, DO, and Junaid Haroon, MD); a cardiac surgeon and team scrub in as backup outside the surgical field and are ready for immediate sternotomy if needed.

Tell us about your device clinic, including the staffing model.

The device clinic is staffed by 5 employees who have more than 10 years of experience. We have 2 RNs performing wound and routine device checks. Others mainly manage remote monitoring, device checks, and communication with patients. Our device clinic actively manages 4000-5000 patients. Our electrophysiologist reviews any concerning tracings/device interrogations each day to avoid delays in patient care. Over the weekend, we work closely with our remote monitoring company representatives and on-call cardiologists on urgent/emergent alerts.

What types of EP equipment are most frequently used in the lab? What imaging technology is used?

We use the LabSystem Pro EP Recording System (Boston Scientific) for electrogram recording and StimLab (Micropace III) for EP stimulators. We use CARTO 3 (V7, Biosense Webster, Inc., a Johnson & Johnson company) and its new features (eg, Coherent and Parallel Mapping), and plan to use the same mapping system in our second EP lab. We use diagnostic catheters from various companies; one of our more commonly used diagnostic catheters is the Polaris X Catheter (Boston Scientific) for coronary sinus recording. We mainly use mapping and ablation catheters from Biosense Webster. We will also have a mobile Rhythmia HDx Mapping System (Boston Scientific) available for certain conditions (eg, atypical atrial flutter or VT). We use Siemens for ultrasound imaging. For CIEDs, the hospital has contracts with Medtronic, Boston Scientific, and Abbott. We have also been implanting the DX lead (BIOTRONIK).

How do you manage vessel closure?

In the past year, we have significantly improved our lab turnover time (15- to 20-minute decrease) as well as our vascular access complication rate (<1%). Our routine venous closure device is the VASCADE MVP venous vascular closure system (Cardiva Medical), which can be used for 6-12 French (Fr) sheaths. If larger than that, we apply figure-of-eight suture or Perclose (Abbott) to improve the turnover rate of the lab. For arterial access, we either use Angio-Seal (Terumo), Perclose, or VASCADE arterial closure devices. Manual compression is very rarely selected, and used only on a case-by-case basis.

Figure 2. Southern Illinois Healthcare (SIH), in strong partnership with PHI and Southern Illinois University (SIU). Memorial Hospital of Carbondale is a major tertiary care center in southern Illinois.

What new initiatives or technologies have recently been added to the EP lab, and how have they changed the way you perform procedures?

We have been using the Zero-Gravity suspended radiation protection system (BIOTRONIK) to help reduce fatigue and orthopedic injury in all ablation cases. It has been very useful and allows us to perform a long duration procedure (eg, VT ablation) without feeling back pain or fatigue at the end of the day. Only our PVC/VT ablations and device cases require fluoroscopy, as all other ablations are done with a zero fluoro approach. We also use the Starling SV noninvasive hemodynamic monitoring system (Cheetah Medical), which helps anesthesiologists effectively manage hemodynamics for high-risk patients; this device provides real-time feedback of hemodynamic data without a Swan-Ganz catheter. In addition, we are in the process of linking our data such as 3D mapping images to cloud-based storage to help protect patient information from being lost.

How is shift coverage managed? How does your lab schedule team members for call?

A typical shift goes from 7:00 AM to 5:00 PM. While our staff does not take emergent or night call, our lab hours sometimes go beyond the typical day due to add-on or challenging cases. Any extra working hours are fairly compensated. Our general cardiologists cover for urgent/emergent pacemakers if needed.

Tell us what a typical day might be like in your EP lab.

We usually start our day with outpatient procedures, followed by add-on inpatient procedures. For patient safety, we try to schedule high-risk patients or those requiring general anesthesia early in the day. We have at least 2 AF ablations per day. For other procedures, we aim to start no later than 7:30-8:00 AM and finish no later than 5-6 PM. Procedures such as cardiac resynchronization therapy (CRT) implants are usually scheduled later in the day.

Who handles procedural scheduling?

Our office nurse, Diane Moore, is the key person who schedules all EP procedures.

How is inventory managed at your EP lab? Who handles the purchasing of equipment/supplies?

Our inventory is managed by Coty Cole, who works closely with our team. SIH's inventory staff manage purchasing of all equipment and supplies. We ensure 2 sets of uncommon equipment for specific cases are stocked and available for use anytime. Our EP lab also maintains a list of equipment anticipated to expire within 2 months, which ensures that no equipment goes unused.

What type of quality control/assurance measures are practiced in your EP lab?

Every 3 months, our lab coordinator's team analyzes the data for all procedures performed in our EP lab, focusing on outcomes and indications. We participate in two of the American College of Cardiology's (ACC) NCDR registries: the EP Device Implant Registry and Atrial Fibrillation

Figure 3. Our state-of-the-art EP lab.

Ablation Registry. The data is discussed in the first month of every quarter (4 times a year). We also record first-case start time, duration of procedure, anesthesiology duration in preparing/starting/finishing the case, lab turnover duration, success rate of same-day discharge, and rehospitalization rate within 30 days after the procedure. All of this helps with feedback and improves the quality of our EP service.

What are the best features of your EP lab's layout or design? What would you include on a "wish list"?

We are proud of the wide procedural area in our lab. A small room in the back stores our equipment and can be easily reached during procedures. Electrical cables are nicely organized and stored inside the well-shielded conduits — this allows us easy access if something malfunctions. We look forward to construction of a second EP lab for the convenience of lab use.

Have you developed a referral base?

While we mainly receive patients from southern Illinois, the city of Carbondale is located along the border of nearby states such as southwestern Indiana, southeastern Missouri, and western Kentucky. We receive several referrals from these locations because there is limited EP service available in those areas. This provides us with numerous SVT patients, and PHI's STAT heart program (ST-elevation myocardial infarction [STEMI] referral network) provides us with AF and VT patients. We have also developed good relationships with several private practices as well as Heartland Regional Medical Center and Marion VA Medical Center.

What changes have you made to improve lab efficiency and workflow?

We implement a time-tracking log to evaluate the time the patient is rolled into the EP lab, anesthesiology time, procedure start and finish time, and time the patient is moved to the recovery room. Every 3 months, we calculate the average time to determine the rate-limiting step, how it can potentially be improved, and perform a root cause analysis to solve the identified delayed step. We always have the standard equipment set up for procedures to ensure that we repeat the steps of the procedure in the same fashion every day. We believe that speed comes from efficient processes that can be repeated every day by all staff and operators.

How do you ensure timely case starts and patient turnover?

We schedule the first and second outpatients for a 5:30 AM arrival every day; the next patients are scheduled to present approximately 2 hours before their procedure to allow for adequate time for preprocedural evaluation. With this strategy, we have enough time to rectify minor lab test abnormalities (eg, electrolytes) as well as for the anesthesiology team to evaluate and prepare the patient. We aim to load the first patient in the procedural room at 7 AM, and try not to go past 7:30 AM. For turnover time, which is case finish time to the time the patient is moved to the recovery room, our goal is 20 minutes. Having 2 EP labs will definitely help guarantee the starting time of the next case. Around 15-30 minutes before the procedure finishes, the next patient can be prepared in the next room if available and ready by the time the operator finishes the case.

How are new employees oriented and trained at your facility?

New employees are trained based on the primary role they are expected to perform. Once they are skillful with the primary role, we try to increase their versatility by rotating them to other tasks. We use a "buddy" system in which a key person in one role is paired with a new employee to provide guidance. Official orientation is provided by SIH cath lab staff, and continued training sessions are performed monthly through class teaching, especially for pacing techs.

What types of continuing education (CE) opportunities are provided to staff? How is travel time to conferences managed?

Our lab always tries to offer the EP-related training provided by industry to our staff whenever possible, especially if it takes place over the weekend when our staff is not on call. For the Heart Rhythm Society's (HRS) annual scientific sessions, we budget 2 people per year to attend and we cover all related costs. No procedures are scheduled for that week, so that I can attend the meeting with them. EP lab staff who do not travel to the conference can opt to work on the cath lab side or use vacation time.

What options for CE are available to your mid-career staff?

In addition to the opportunities mentioned earlier, we also always discuss interesting findings from cases, especially electrograms or anatomy of individual cases, as instant learning from cases stimulates curiosity. As director of the EP lab, I set a mentality to train staff as my own fellows in EP; I also learn some techniques from their cath lab experience, especially interventional techniques. This two-way learning process helps promote camaraderie, fun at work, and a team atmosphere. We have a monthly dedicated teaching session driven by staff questions as well as other learning materials. Mistakes are addressed immediately for learning purposes; human error is natural and mistakes happen, and we take every opportunity to learn from them. Striving to be better than yesterday is crucial.

How is staff competency evaluated?

Positive reinforcement is used to promote desired behaviors. With the education obtained from cases, didactic discussion, and questions, our staff grows every day in this sophisticated field. We regularly apply the "see one, do one, teach one" concept in our work.

How do you prevent staff burnout and promote team building?

We have an "EP lab happy hour" on evening weekdays when all of us socialize and build camaraderie. I believe in the "friend and family" concept when building my EP team. I try to create an atmosphere

of coming to work every day with friends and family rather than giving orders. Tasks are assigned to individuals based on the talents and passion I've seen from my own observation and discussion with them. Our staff enjoys their responsibilities, takes ownership of their work, and have a hard-working mentality working in the lab.

What committees are staff members asked to serve on in your lab?

We have monthly EP council meetings during which all EP business is discussed and solved in an organized fashion. Staff members are asked to bring up any issues they have and give feedback to the director of the cardiovascular service. As the EP lab director, I run the meeting with a prepared agenda.

How do you handle vendor visits to your department?

Our EP lab is very friendly to vendors. They usually contact us directly for clinical support or staff training, and schedule a date and time to visit. We have a very good relationship with industry and vendors. Several of our previous cath and EP lab employees successfully progress to industry if they prefer. It is a close community where everybody knows each other well.

How is patient education managed?

Patient education starts the day our patients are scheduled for a procedure. I created a diagram (Figure 8) that we use to describe the EP procedure to patients. A pamphlet with more details is also provided for further study. On the day of the procedure, we again share the illustration and provide a step-by-step explanation of the procedure to the patient and their family to ensure that they have good knowledge and understanding. This proves to be very helpful if they need to reference it later when speaking with referral physicians or family members. Some of our patients have even used it as memorabilia and hang this diagram on their wall. While I personally manage the process of education from start to finish, our excellent nursing staff help fill the gap on other miscellaneous details (such as time of procedure, preparation, medications to be held off, etc.) that I may not be available for. The MyChart feature on Epic EMR also allows us to communicate with fewer phone calls.

Describe a particularly memorable case from your EP lab and how it was addressed.

Two memorable cases serve as testaments to the quality of our staff. The first case was our first epicardial VT ablation. The patient was a 70-year-old man with severe non-ischemic cardiomyopathy and incessant VT episodes leading to several appropriate ICD shocks despite use of mexiletine and a very significant dose of amiodarone (800 mg daily). After 3D activation mapping and extensive endocardial VT ablation, we realized we would never have this patient out of VT storm without utilizing an epicardial VT ablation approach. This high-risk procedure had never been done at this hospital, but my staff worked amazingly well to coordinate surgical backup as well as the tools and equipment needed to prepare for a worst-case scenario. We achieved non-inducibility of sustained VT at the conclusion of the epicardial VT ablation over the basolateral and lateral left ventricle (Figure 9). This patient went through a long course of medical treatment and had a left ventricular assist device (LVAD) as destination therapy for his severe heart failure, with no hospitalization in the past 6 months for decompensated heart failure.

A second case highlights the eagerness of our staff to learn and improve their knowledge in the EP field. This patient with AF underwent pulmonary vein (PV) isolation in 2015 and repeat ablation in 2019 for recurrent AF. The patient, who was then experiencing symptomatic persistent AF with rapid ventricular response, was referred to us. During the procedure, all 4 PVs remained electrically isolated without other SVTs inducible as a trigger. We performed posterior wall isolation, but AF incessantly occurred during the procedure. We decided to perform vein of Marshall (VOM) alcohol ablation due to the recent breakthrough of knowledge about the procedure and its role in AF pathogenesis. We pursued a femoral approach (instead of the conventional jugular approach) to minimize radiation exposure to the operator. One of our staff members who is very experienced with coronary and peripheral intervention contributed tremendously to the success of this procedure with the appropriate choice of sheath (Ansel guiding sheath [Cook Medical]) to engage the coronary sinus os and advance further into the VOM, facilitating alcohol ablation, with a repeat 3D map of the left atrium confirming the result after our ablation (Figure 10). For the last 12 months, the patient has been free from AF (confirmed from his device) without use of any antiarrhythmic medication.

Figure 4. The device clinic/office team at Prairie Heart Institute. Back row (from left to right): Kaitlin Behnken (EP advanced practice nurse [APRN]); Heather Alexander, LPN; Korissa Toler, LPN; Jennifer Gaffney, RN; Linda Taylor, LPN; Megan Welch, RN; Christine Eaton, LPN. Front row (from left to right); Diane Moore, RN; Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS (Dr. Kritt); Autumn Holder. Not pictured: Chelsey Jackson. *(Picture was taken before the Covid-19 pandemic.)*

Does your lab use a third party for reprocessing? How has it impacted your lab?

Historically, our EP lab did not use a third party for reprocessing. We now use reprocessing to help reduce the cost of each case without compromising quality. Since last year, we have been using Biosense Webster's service to reprocess their own products. Starting in January 2022, we plan to use Stryker Sustainability Solutions for other products, especially diagnostic catheters. Despite use of these services, we do not hesitate to use new equipment and tools instead of reprocessed ones if we think the quality is not up to the standard.

Approximately what percentage of ablation procedures are done with cryo vs radiofrequency? Why?

Our ratio of cryo to radiofrequency ablation is approximately 5% vs 95%. The reason is that our

Figure 5. **EP lab staff/team. Our key mappers (from left to right): Andrew Palazzolo, BS; Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS (EP Lab Director); Sylvan Crouse, RN, RCIS, RCES; Ronald Scott Holland, RT(R); LaDonna McCain, RN, BA, RCIS; Christopher Nenonen, RN, RCIS; Kimberly Bunting, RT (MR). Not pictured: Timothy Galvez, BS, Executive Clinical Account Specialist.** ***(Picture was taken before the Covid-19 pandemic.)***

Figure 6. **Watchman team. Back row (from left to right): Raelyn Blumenstock, RT; Kendra King, RDMS; Krittapoom Akrawinthawong, MD, MSc, FACC, FHRS; Muhammad Khan, MD (TEE Specialist); Sylvan Crouse, RN, RCIS, RCES; LaDonna McCain, RN, BA, RCIS; Chip Drozda (Territory Manager at Boston Scientific). Front row (from left to right): Kimberly Bunting, RT (MR); Kacey Garden, RT, RCIS; Jean Thompson (Clinical Representative at Boston Scientific); Ronald Scott Holland, RT(R). Not pictured: Daniel Hagler, RDMS; Raed Al-Dallow, MD.**

patient population is quite unique. The majority have persistent AF, have undergone a previous ablation from nearby states, or required SVT ablation in the same index procedure with AF ablation. Our staff are well trained in both types of ablation.

Do you use contact force sensing technology during radiofrequency ablation of AF?

Yes, we use the ThermoCool SmartTouch SF Ablation Catheter (Biosense Webster) with ablation index as our default AF ablation.

Does your lab perform His bundle pacing?

At this point, about 1-2% of our patients receive His bundle pacing. A few general cardiologists in our practice perform pacemaker implantation, and the majority of my referrals are for upgrading the device to a CRT. Once in a blue moon, if the patient does not have a suitable coronary sinus branch for a CRT device, His bundle pacing is used as a bailout method to avoid epicardial lead implantation. We began to achieve 98-99% successful CRT device implantation once we fully adopted the Interventional CRT (iCRT, Merit Medical) tools and techniques developed by Dr. Seth Worley.

Do you have a primary approach for LAA occlusion?

We mainly use the Watchman device (Boston Scientific), and have transitioned to using the Watchman FLX in the past 6 months.

What are your thoughts on the use of NOACs in patients with non-valvular AF?

Our cardiology group highly promotes NOACs as the first option for all non-valvular AF patients if there is no contraindication or insurance coverage limitation. New evidence and guidelines point toward its use as the primary anticoagulant method. More than 90% of non-valvular AF patients in our practice take NOACs.

Tell us more about your care of patients with AF.

In our dedicated AF program, contributing factors that have been shown to reduce AF burden or recurrence are identified, addressed, and modified for all patients to achieve better long-term outcomes of rhythm control. More evidence now points toward a rhythm control strategy as the preferred approach. A checklist of these contributing factors, including weight loss, blood pressure control, and HbA1C levels, is addressed at every clinic visit to ensure that goals are met.

Multidisciplinary care is provided to AF patients with a solid collaboration between our EP service, primary care physicians, general cardiologists, sleep specialists, bariatric specialists, nutritionists, and neurologists. We collaborate with our weight loss and bariatric surgery clinics for patients who have a BMI over 35 or cannot lose weight on their own. For obstructive sleep apnea, we screen patients with questions and have a very low threshold for

Figure 7. **Left: Routine atrial fibrillation ablation in EP lab 1 with the CARTO 3 (version 7, Biosense Webster). Right: A case of parietal band PVC ablation using the Rhythmia HDx Mapping System with DirectSense technology (Boston Scientific) in EP lab 2 (currently under construction).**

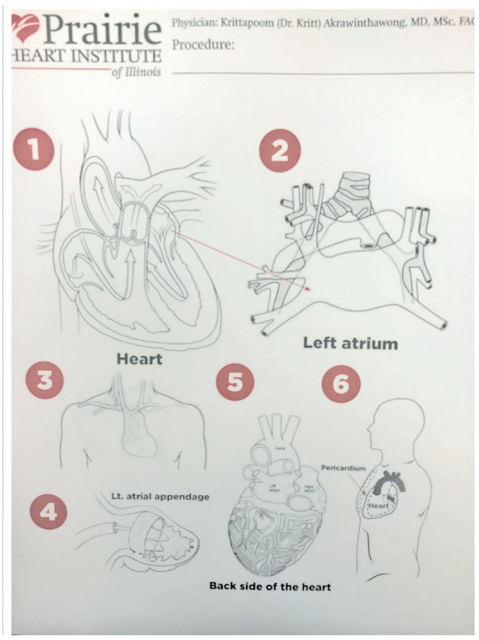

Figure 8. **Left: Patient diagrams developed by Dr. Kritt for the purpose of simplifying complex EP procedures for patients. Our patients use this for personal reference and it has proven to be an easy way for them to remember information about their procedure. Right: Since 2019, our EP lab has participated in the Project My Heart Your Heart with the Frankel Cardiovascular Center at the University of Michigan. Through this program, we donate explanted pulse generators with a battery of 3 years or more with the hope that they will be given to people in need around the world.**

referral to the sleep specialist, who can provide comprehensive care from sleep testing to continuous positive airway pressure (CPAP) titration. I also educate our primary care physician and general cardiologist colleagues on early referral of new-onset AF, before it evolves into persistent or long-standing persistent AF. A general cardiologist is routinely consulted on newly diagnosed ischemic stroke cases to evaluate for possible occult AF as an etiology. Loop recorders are also used in this patient population, based on results from the CRYSTAL AF trial.

What other innovative EP techniques are being utilized in your lab?

We try to stay updated with the newest innovations and techniques available in the EP field. In addition to performing alcohol ablation (eg, VOM ablation for recurrent AF patients or alcohol ablation for PVC/VT patients), we are now working on bipolar ablation. For device procedures, we practice i-CRT using a balloon-anchoring technique or antegrade and retrograde snaring techniques. We are also excited about pulsed field ablation.

Are pediatric cases performed in your lab? Do you offer a formal transition program between the pediatric and adult clinic? Does your institute also have an associated cardiovascular genetic research clinic?

The minimum age of our patients is 18 years old. Patients younger than 18 are referred to children's hospitals in St. Louis or Nashville. However, we routinely perform ablation and device procedures for adult congenital patients who develop arrhythmia related to previous surgery. We had several patients in this area (eg, atrial flutter in Scimitar syndrome, CRT in surgically corrected levo-transposition of the great arteries [L-TGA], AF or VT ablation in tetralogy of Fallot, and SVT ablation in Holt-Oram syndrome) in the past year. For genetic diseases as well as channelopathy, we are fortunate to receive genetic testing assistance from Barnes-Jewish Hospital in St. Louis. We also recently identified in genetic testing a rare familial fasciculoventricular pathway with hypertrophic cardiomyopathy that is not the classic Danon disease and not related to the lysosome-associated membrane protein 2 (LAMP2) gene.

What is your method for device infection prophylaxis?

Standard infection prophylaxis is practiced along with (1) screening to make sure that there is no ongoing infection with the patient before the procedure, (2) intravenous antibiotics before the incision is made, (3) no oral antibiotics after the procedure, and (4) routine use of an absorbable antibiotic envelope (mainly the TYRX Absorbable Antibacterial Envelope [Medtronic]) for pulse generator changes or device upgrades. I personally believe that education plays a major role in preventing infection after implantation. Our device clinic nurses invest a lot of time on wound care education to patients. Wound checks are routinely performed in the device clinic 1-2 weeks after implantation. For patients in remote areas who may be concerned about an early infection, a photo of their wound is sent to our clinic (with consent) and medical advice is provided to prevent unnecessary visits and traveling. With this approach, our incident of device infection is much lower than the national database (<1% at our institute).

How do you use the NCDR outcome reports to drive QI initiatives at your facility?

We have annual NCDR data reported and provided to the physician, followed by a discussion regarding the root cause analysis of adverse outcomes/events that could have been prevented and improved. We always benchmark our institute's data to the national level and strive for better statistics in all parameters to improve our own quality improvement.

How have electronic health record (EHR) systems improved your quality of care?

I consider the EHR to be one of the best innovations in healthcare. It definitely improves healthcare for patients, especially in terms of speed of care and transition of care from one facility to another. Detailed patient information is kept private and updated. Certain features such as verbal dictation and pop-up warning messages have allowed for a

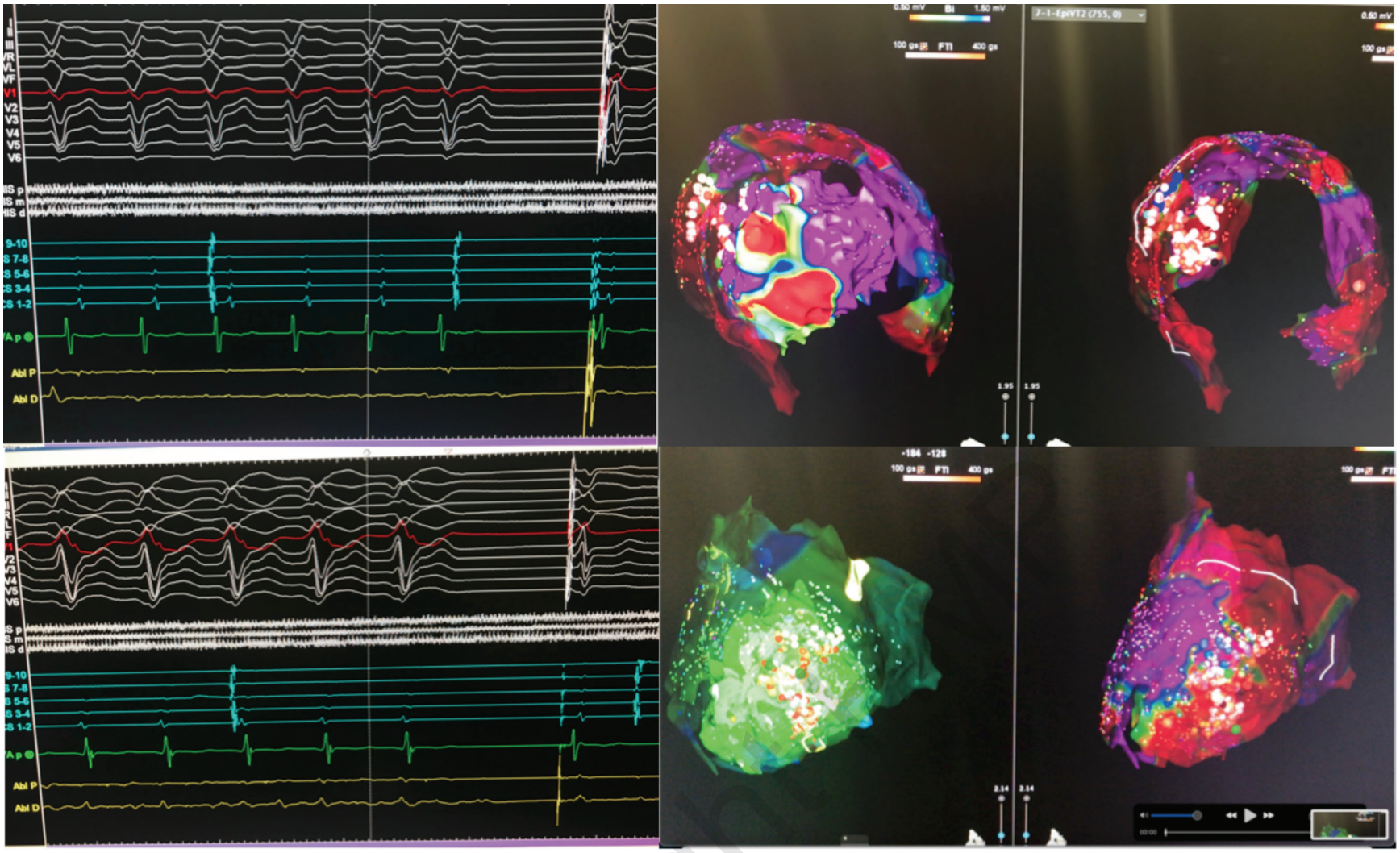

Figure 9. Our first epicardial ventricular tachycardia (VT) ablation at Memorial Hospital of Carbondale in November 2019. We successfully terminated the incessant VT with ablation using radiofrequency energy guided by an activation map during VT storm. We achieved non-inducibility at the conclusion of the procedure.

more efficient quality of care. I look forward to the time when all healthcare systems around the world can be linked together. This will surely reduce and ultimately fix inadequate distribution of subspecialties in remote areas. We have also learned how powerful EHR systems, combined with telehealth, can be in the continuity of care for patients during the Covid-19 pandemic.

What are some of the dominant trends you see emerging in the practice of electrophysiology?

Early AF ablation is clearly a trend — both U.S. and European practice guidelines in AF management support catheter ablation as early management. Also, several channelopathy conditions that had been focused on preventive measures have shifted toward ablation once a clear substrate of arrhythmia is identified (eg, Brugada syndrome). New technology has also allowed for minimized device size and leadless devices. We will surely see all wireless features on devices in the near future. It is exciting to have such cutting-edge technology to support and advance our knowledge of EP.

Do you utilize remote monitoring of CIEDs? What clinical and economic benefits have you seen?

Yes, we use remote monitoring for all vendors. There are several benefits. Our patients are reassured that their device information is closely monitored and they will receive prompt notification. We review more than 50-100 reports per day to ensure patient safety and care without delay. This also prevents several unnecessary emergency room and clinic visits, which contributes to reducing healthcare costs. Certain features of the device can also prevent admission of decompensated heart failure patients.

PHI also uses the BodyGuardian (Preventice Solutions) for cardiac monitoring. It is a user-friendly system with a cableless patch and small touchscreen display. It sends alerts to our clinic for any detected arrhythmia before patients finish their monitoring period. Other features include PVC burden calculation as well as onset and termination of arrhythmia.

Has your lab achieved EP accreditation?

Not currently, but we are looking into cardiac electrophysiology accreditation by the Intersocietal Accreditation Commission (IAC).

How do you see social media changing the field of healthcare?

Social media plays a significant role in healthcare. Patients are much more educated now about healthcare and the procedures they receive. Information is available with one click. For our EP community, we share (HIPAA-compliant) knowledge about our EP cases on social media platforms such as Facebook, YouTube, and Twitter. Social media can help healthcare move at a faster pace and minimize problems in healthcare distribution.

How do you see digital technologies changing the field of EP?

Digital technologies have been amalgamated into the EP practice, from basic self-monitoring of heart rhythms with a smartphone or Apple watch to more advanced technology such as artificial intelligence. These technologies have shaped healthcare to be more connected and reduce the gap of knowledge between patients and physicians. Healthcare in the modern era will be more transparent, accessible, and efficient.

What trends have you seen in your procedures and/or patient population?

The patient population in our rural area is more open minded to invasive procedures that they are not familiar with. More people are now being

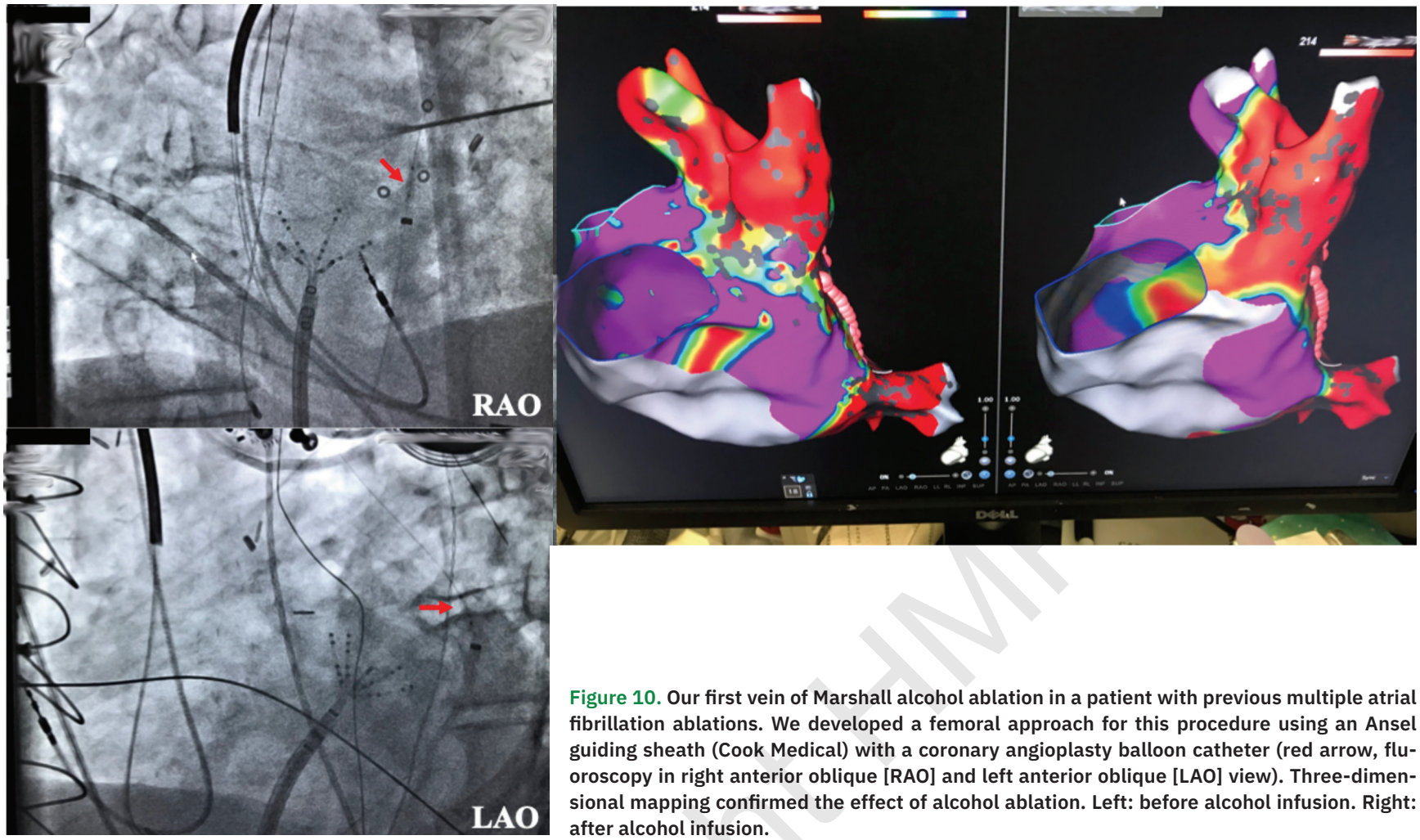

Figure 10. Our first vein of Marshall alcohol ablation in a patient with previous multiple atrial fibrillation ablations. We developed a femoral approach for this procedure using an Ansel guiding sheath (Cook Medical) with a coronary angioplasty balloon catheter (red arrow, fluoroscopy in right anterior oblique [RAO] and left anterior oblique [LAO] view). Three-dimensional mapping confirmed the effect of alcohol ablation. Left: before alcohol infusion. Right: after alcohol infusion.

referred from nearby states for the procedures we provide. Our patients are very pleased with the close-to-home services they can receive rather than traveling a longer distance and waiting for care.

Describe your city or general regional area. How is it unique from the rest of the U.S.?

Our location in southern Illinois allows us to cover a tremendous number of patients. Even though the size of the hospital seems to be small, we capture a population size of 2-3 million, which keeps our cardiovascular service extremely busy. The Prairie STAT Heart Program, which is a unique network for STEMI fast track, also supplies us with a significant amount of VT patients. Unfortunately, the Southern diet has also led to higher numbers of cardiovascular disease. For heart transplants, we gratefully receive support from major universities in the area such as Vanderbilt University and Washington University at St. Louis.

What is considered historic about your EP program or hospital? Has your program or hospital recently experienced any "firsts"?

I recently performed some of the first procedures in this area, including a completely fluoroless ablation, epicardial VT ablation, VOM alcohol ablation for AF, sympathectomy for refractory VT (in collaboration with interventional neurology), and laser lead extraction. I am in the process of developing a relationship with our cardiac surgeons for intraoperative VT ablation during coronary artery bypass grafting (CABG) or valve replacement/repair. Hybrid AF ablation is also an appealing option and we are waiting for more evidence to direct its use. Through our partnership with the heart failure service, the team is also starting to implant the Barostim Neo (CVRx) for neuromodulation in severe heart failure patients.

In what ways has the Covid-19 pandemic impacted your hospital, EP lab, or practice?

Covid-19 really affected our healthcare system in several ways. From our EP lab experience, we have now implemented several measures to ensure our staff members are safe without compromising or delaying patient care. First, we reprioritized the urgency of patients requiring the procedure; for example, highly symptomatic patients or those prone to be admitted with decompensated heart failure, as well as patients with tachycardia-induced cardiomyopathy, have much higher priority compared to other elective procedures. The Watchman procedure was on hold for 2 months before we restarted again. We are still testing for Covid 3 days before procedures, with the plan to have the test result available at least 24 hours before the procedure date. Patients are aware of the restriction that they cannot go in public until the day of their procedure, and they have been cooperating very well. So far, we don't have a case that turned positive after a procedure. In addition, clinic appointments have been spaced out to prevent patients from being crowded in the lobby, and only a family member can accompany the patient if needed. This policy is similar for patients coming in for procedures. For company personnel such as device representatives, only one person is allowed for a case. Fortunately, we did not lose any clinic or EP lab staff members during the economic constraint from the pandemic. We quickly adjusted to the situation, even though our patient volume from March to May 2020 was decreased.

Please tell our readers what you consider special about your EP lab and staff.

I am proud of our EP lab staff, who dedicate their time and energy to patient care. They are experienced and have an unmatched enthusiasm and passion in EP. They go the extra mile to help patients and embrace new ideas and methods. I feel like they are both my EP fellows and colleagues at the same time. ■

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