EP Lab Digest 20 YEARS

A product, news & clinical update for the electrophysiology professional

EP Lab Spotlight

Memorial Hospital of Carbondale

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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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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]
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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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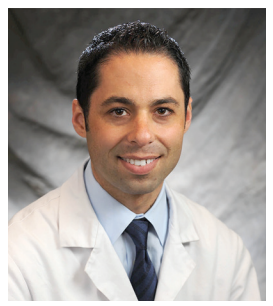
Podcast Interview

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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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]

Although currently first-line treatment, medical therapy has limited efficacy for resolution of IST and its related symptoms.[2] The most common first-line medications for treatment consist of beta-blockers, calcium channel blockers, and ivabradine.[2] Even with prolonged therapy, response is often partial or limited.[2] In these patients with limited response, sinus node (SN) modification with radiofrequency (RF) ablation has been an interventional treatment option; however, in addition to being associated with high procedural complications (permanent pacemaker implantation, phrenic nerve paralysis, or superior vena cava [SVC] syndrome), studies also show a highly variable rate of IST symptom resolution, ranging anywhere from 23%-85% at six months after intervention.[3-6]

A newly emerging SN sparing hybrid thoracoscopic ablation procedure has shown promising results with an interesting anatomical background.[7] The sinoatrial node (SAN) itself can be spatially divided into a superior SAN near the SVC and an inferior SAN near the inferior vena cava (IVC), with pacemaker activity not limited to one aspect and postganglionic sympathetic input to both these areas.[7] This input occurs via the crista terminalis (CT).[8] The basis of this hybrid procedure involves isolation of the superior and inferior SAN by way of CT line ablation as well as SVC and IVC line ablation.[7,8] Further depiction of this hybrid strategy is delineated in Figure 1. The SUSRUTA-IST Registry served to compare clinical efficacy and safety endpoints in patients undergoing this hybrid thoracoscopic ablation procedure with previously described RF-SN modification, and its effect on IST and accompanied symptoms.[9]

Procedural Description

All antiarrhythmic drug (AAD) or IST medical therapy was discontinued prior to ablation such that at least 5 half-life cycles of elimination occurred before the procedure.[9] All procedures occur under general anesthesia, and right lung deflation occurs with single lung ventilation.[7,9] Three working ports are made in the right chest, with camera access obtained at the midaxillary line, and two further ports in the 3rd and 7th intercostal spaces along the anterior axillary line.[7] CO_2 insufflation follows, and posterior pericardial retraction (2 cm anterior to the right phenic nerve) is performed to further facilitate dissection and visualization of the IVC.[7,9] During this time, bilateral femoral access is obtained and SN is identified using electroanatomical 3D mapping.[9]

A bipolar bidirectional RF clamping device (EMR, AtriCure) is then positioned over the SVC-RA junction (with the SVC free of electrodes or catheters).[7] RF applications are performed here, with a transient reduction in HR of around 30%.[7] A similar clamping and RF application is performed in the IVC-RA junction. The third and final step involves CT line ablation with a RF clamping device; this involves the oblique sinus being covered by the posterior jaw, the anterior jaw covering the Waterstone groove, covering the CT, and the distal end of the clamp crossing the line over the SVC and border of the SN.[7] This CT line is then connected to the SVC-RA junction and IVC-RA junction lesion sets, respectively.[9] After this step, a transient junctional rhythm frequently occurs, and then returns to slow sinus rhythm.[7] Adjunctive endocardial ablation can be performed based on operator decision to complete the linear CT ablation and to connect this to the SVC/IVC lesion sets as well[9] (Figure 1). Subsequently, the right atrium is remapped using 3D electroanatomic mapping to assess the lesion set. Any gaps along the lateral wall that have the potential to become a site of reentry are ablated using a RF ablation catheter (Figure 2). The pericardium is then closed and the right lung is reinflated, with a procedural endpoint considered as a >25% reduction in HR or fast junctional rhythm.[7] Patients are then monitored in the postsurgical unit until the pericardial drain is removed.

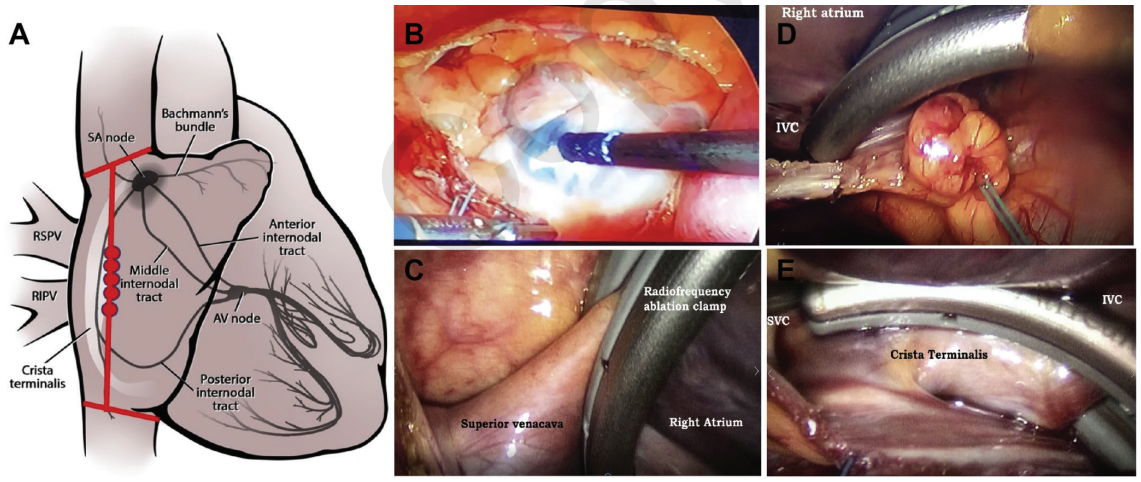

Figure 1. Hybrid ablation approach. (A) Line diagram showing sinus node (SN) in the right atrium (RA) with the "red lines" showing the superior vena cava (SVC)–inferior vena cava (IVC)–crista terminalis (CT) lesions. "Red dots" display the endocardial radiofrequency (RF) lesions delivered to complete the gaps in the CT ablation line done epicardially. (B) SN marked with methylene blue after identifying the earliest SN using 3D electroanatomic mapping endocardially and visualizing the catheter tip. (C) SVC line isolating the SVC-RA junction sparing the SN; care must be taken to stay away from the SN. (D) IVC line-isolation of the IVC-RA junction using a RF clamp. (E) Lateral CT line isolating the CT and connecting the SVC and IVC lines. This area often takes multiple RF clamp applications and is also prone for gaps.

(Reprinted from Lakkireddy D, Garg J, DeAsmundis C, et al. Sinus node sparing hybrid thoracoscopic ablation outcomes in patients with inappropriate sinus tachycardia (SUSRUTA-IST) registry. Heart Rhythm. 2021 Jul 30;S1547-5271(21)01877-4, with permission from Elsevier under a Creative Commons CC-BY license.)

Procedure Feasibility and Study Results

The SUSRUTA-IST Registry served as a comparison study for the above-detailed hybrid procedure in comparison with conventional RF-SN modification techniques. The primary outcome was sinus rhythm restoration and overall mean reduction in daily HR. Secondary outcomes centered around the need for repeat procedures and safety outcomes, including intra and postprocedural complications, and quality of life improvements.[9]

The 100 patients involved in this study were equally divided into hybrid ablation (n=50) and RF-SN ablation (n=50) groups, with an 82% female distribution and mean age of 22.8+0.75 years. Sinus rhythm restoration occurred in all 50 patients in the hybrid ablation group, compared to 84% in the RF-SN group (P=.006). Average immediate postprocedural HR was considerably lower in the hybrid ablation group

(61+9.32 beats/min) compared to the RF-SN ablation group (82.28+2.38) (*P*<.0001). Regarding secondary endpoints of postprocedural complications, acute pericarditis was justifiably higher in the hybrid ablation group vs RF-SN ablation group (92% vs 48%; *P*<.0001); however, the hybrid ablation group (n=4) had a lower rate of progression to chronic pericarditis compared to the RF-SN ablation group (n=6). Additionally, the RF-SN had a higher rate of phrenic injury at 14% vs no cases seen in the hybrid ablation group (*P*<.012). No patients from either cohort required conversion to an open surgical procedure.

Regarding long-term outcomes, 4 (8%) patients in the hybrid ablation group required a second repeat procedure (with no additional procedures thereafter), whereas all 50 patients in the RF-SN group required a second procedure, and 22 (44%) required additional third and/or fourth procedures in this cohort as well. A total of 22/50 patients (78%) in the hybrid ablation group were able to discontinue all HR-reducing medications after the initial procedure, whereas all 50 patients in the RF-SN group required continued medical therapy. Permanent pacemaker implantation (for chronotropic incompetence) differed widely as well, with a 50% rate in the RF-SN group compared to 2% in the hybrid ablation group (*P*<.0001). Finally, although both groups saw an improvement in 6-month postprocedural SAS, SDS, and SF-36, these improvements were more pronounced in the hybrid ablation group compared to the RF-SN group.

Case Presentation

A 27-year-old otherwise healthy female was referred to the EP clinic after initial diagnosis of IST, with presenting symptoms of excessive heart racing with minimal exertion after no improvement with beta blockade. The patient reported a 4-year history of progressively debilitating symptoms, most prominently including palpitations, exercise intolerance, diaphoresis, and presyncope, requiring the patient to take multiple breaks when getting ready for work or while walking to the end of her driveway to retrieve her mail.

The patient was started on ivabradine 7.5 mg BID in addition to extensive counseling on lifestyle modification; however, she continued to have minimal symptom relief. Average 24-hour rates were approximately 115-120 bpm, with stark increases to the 170s after minimal activity. The patient was unable to complete a 6-minute walk test, with severe symptoms and heart rates in the 180s after three minutes of continuous walking.

The patient was then referred for sinus node modification. Given the patient's age, palpitation-prominent symptoms, and severe debilitation, a hybrid ablation procedure was offered and discussed, with subsequent decision to proceed. The patient electively underwent the procedure as detailed above. Figure 2 shows electroanatomical mapping after hybrid ablation. The procedure was uneventful and well tolerated, with the patient having an initial fast junctional rhythm followed by sinus rhythm with rate in the 90s. She was moved to the ICU, and the pericardial drain was removed the following day, with discharge on POD#2.

On close outpatient follow-up, the patient had no evidence of SN dysfunction or bradycardia, phrenic nerve paralysis, or SVC syndrome. Over the next follow-up visits, the patient had near-complete resolution of all symptoms, with a 4- to 6-week period of staged conditioning. She experienced no physical limitations or exertional intolerance during this time. She continued to improve off all rate-lowering medications, with no redo ablations or further procedures.

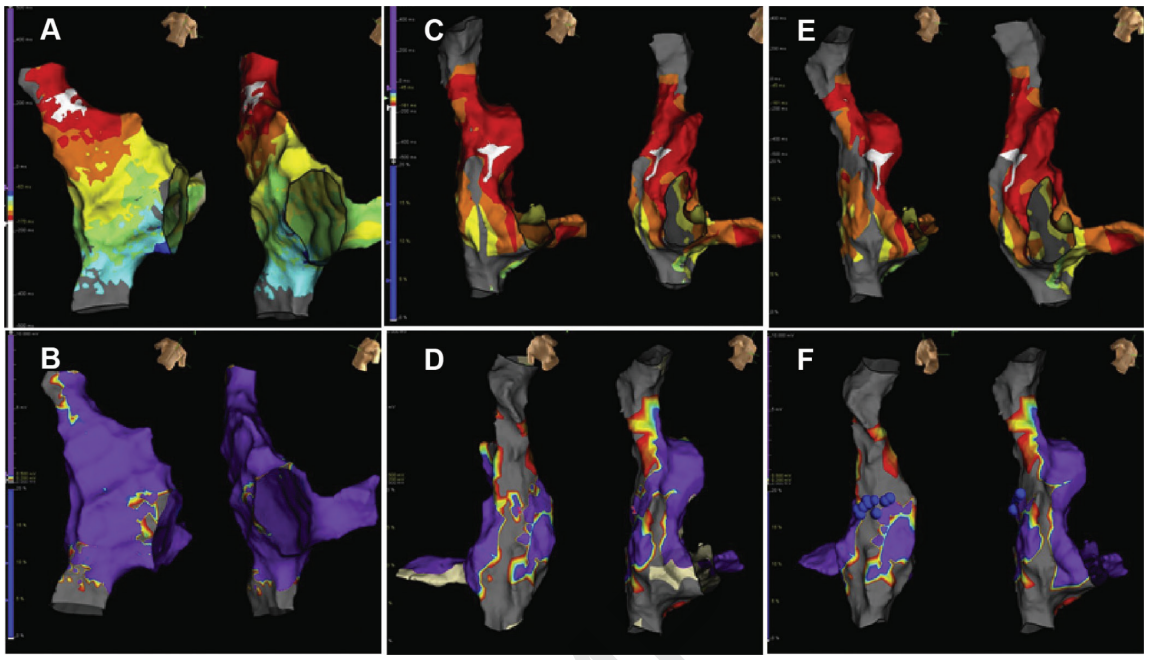

Figure 2. Shows the process of hybrid ablation. (A) White region represents area of earliest sinus node (SN) activity. (B) A relatively healthy right atrium (RA) on voltage mapping. (C) A downward shift in earliest SN activity along the anterolateral aspect of the RA. (D) A gap is noted in the crista terminalis (CT) lesion set. (E) Earliest SN activity seen in white after completion of superior vena cava (SVC)-inferior vena cava (IVC)-CT line lesion sets. (F) Scar manifestation on voltage mapping after SVC-IVC-CT line lesion sets.

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Conclusion

This newly emerging hybrid ablation procedure has shown reassuring early success compared to previously conventional SN modification ablation in refractory patients with IST requiring intervention. Its wider application to IST is both warranted and welcome as more research emerges in this space of cardiac dysautonomia. ■

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