CASE

1 Bipolar RF Ablation of Deep-Seated Outflow Tract Ventricular Tachycardia

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Mentorship plays a pivotal role in shaping clinical expertise. During my fellowship under Dr. C. Narasimhan, I learned the importance of comprehensive mapping, precise ablation strategies, and the application of novel techniques for outflow tract premature ventricular contractions (PVC) ablation. This case report reflects those principles and their clinical relevance.

CASE REPORT

A 38-year old lady with recurrent drug-refractory palpitations and presyncope was referred for radiofrequency ablation (RFA). Echocardiography showed left ventricular ejection fraction of 46% suggestive of arrhythmia induced cardiomyopathy (AIC). The baseline ECG revealed ventricular trigeminy (Fig. 1a), with the focus suspected to arise from the right ventricular outflow tract (RVOT) septum. Activation mapping demonstrated the RVOT postero-septal region as the earliest activation site, occurring 28 ms before the surface QRS (Fig. 1b). RFA was delivered using an irrigated catheter at 35 W and 43°C for 120 sec. The PVCs disappeared after 45 seconds but recurred within three minutes. Additional RF applications did not eliminate the arrhythmia, and the mapping suggested a broader area of early activation within the RVOT septum. Given the persistence of PVCs, adjoining structures were mapped—Left ventricular outflow tract (LVOT), anterior mitral commissure (AMC) and anterior interventricular vein (AIV). The left coronary cusp (LCC) demonstrated the earliest electrogram at 30 ms pre-QRS (Fig. 1b). After angiographic confirmation of a safe distance from the left main coronary artery, RF energy was delivered at the LCC. PVC acceleration followed by transient suppression was observed; however, recurrence occurred within minutes.

Mapping of the AMC and AIV showed EGMs coinciding with the PVC onset. PVC demonstrated a maximum deflection index (MDI) of 0.68, suggesting either a deep-seated focus in the outflow tract septum or an epicardial origin. As epicardial access was considered less favorable for the LV summit region, bipolar radiofrequency ablation (B-RFA) of the outflow tract septum was planned. Dedicated B-RFA hardware was unavailable, a custom setup was constructed (Fig. 2) based on a technique learned from Dr. C. Narasimhan.

CASE DISCUSSION

Standard RFA employs a unipolar configuration, with energy delivered between the catheter tip and a cutaneous ground patch. Most outflow

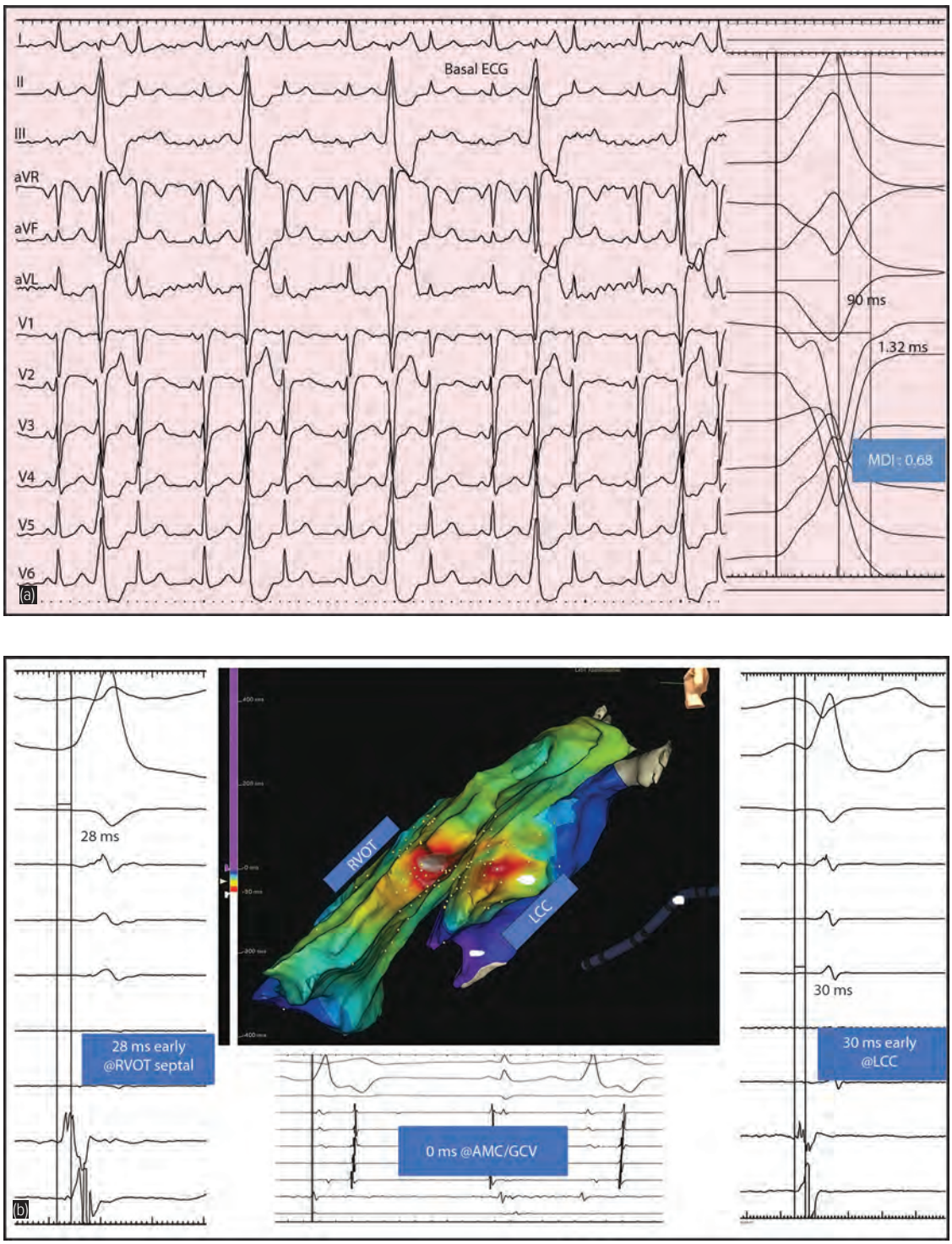
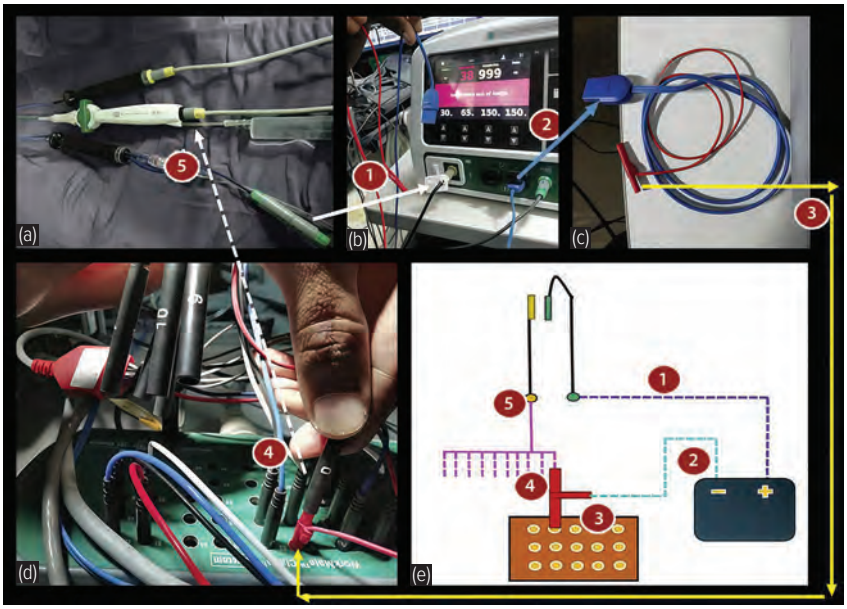


Fig. 1: (a) Basal ECG showing PVC with MDI: 0.68 suggestive deep seated origin/epicardial; (b) RVOT septal area-28 ms early; LCC early by 30 ms/AMC on time 0 ms. Three dimension NAVIX guided activation map of PVC showing RVOT and LCC showing early signals. *PVC*: Premature ventricular contractions; *MDI*: Maximum deflection index; *RVOT*: Right ventricular outflow tract; *LCC*: Left coronary cusp; *AMC*: Aorto mitral continuity.



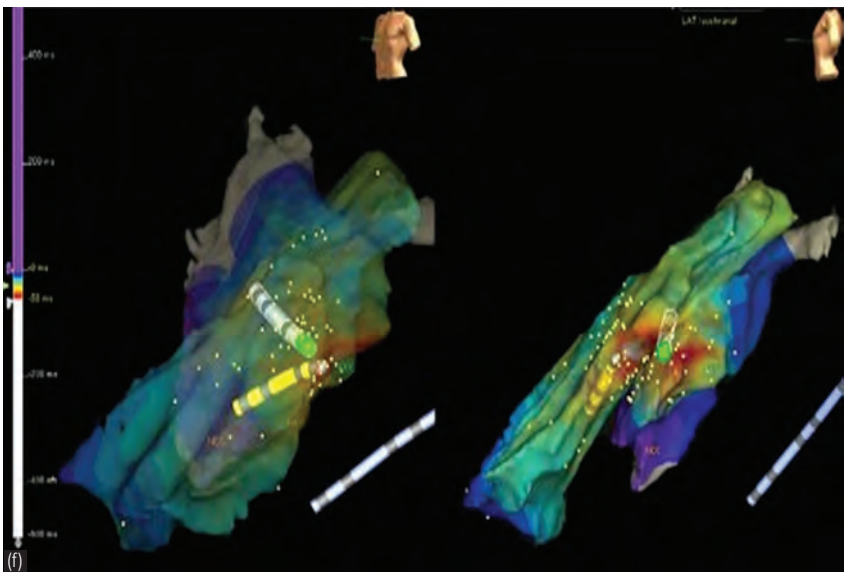


Fig. 2: (a) From above to below coronary sinus decapolar catheter with black handle, Flexability™ open irrigated ablation catheter attached with a 50 ml syringe with white handle and Therapy™ Cool flex™ ablation catheter attached to the standard irrigation line of the ablator system with black handle; (b) Standard radiofrequency ablator; (c) Red colour jumper cable with a custom blue cable; (d) Junction box with attached red color jumper cable. One end of the jumper cable is attached to the ablator and another end to the decapolar cable; (e) Pictorial representation of the bipolar ablation circuit. (1) Therapy™ Cool flex™ ablation catheter from left coronary cusp is connected to the anodal port of the ablator through an 85641 ablation cable (white arrow from fig. a to b). (2) A custom cable was attached from the cathode port of the ablator to T-cable (blue arrow from fig. b to c). (3) T-cable was attached to the junction box (yellow arrows connecting fig. c to d). (4) Another end of the jumper cable was attached to an Inquiry decapolar cable (white arrow from fig. d to a). (5) Inquiry decapolar cable is attached to the Flexability™ ablation catheter from right ventricular outflow tract; (f) Three dimensional NAVIX guided activation map of premature ventricular contraction in left anterior oblique and left lateral view showing ablation catheter in the left coronary cusp (green tip) and decapolar catheter (yellow body) in the right ventricular outflow tract during bipolar ablation.

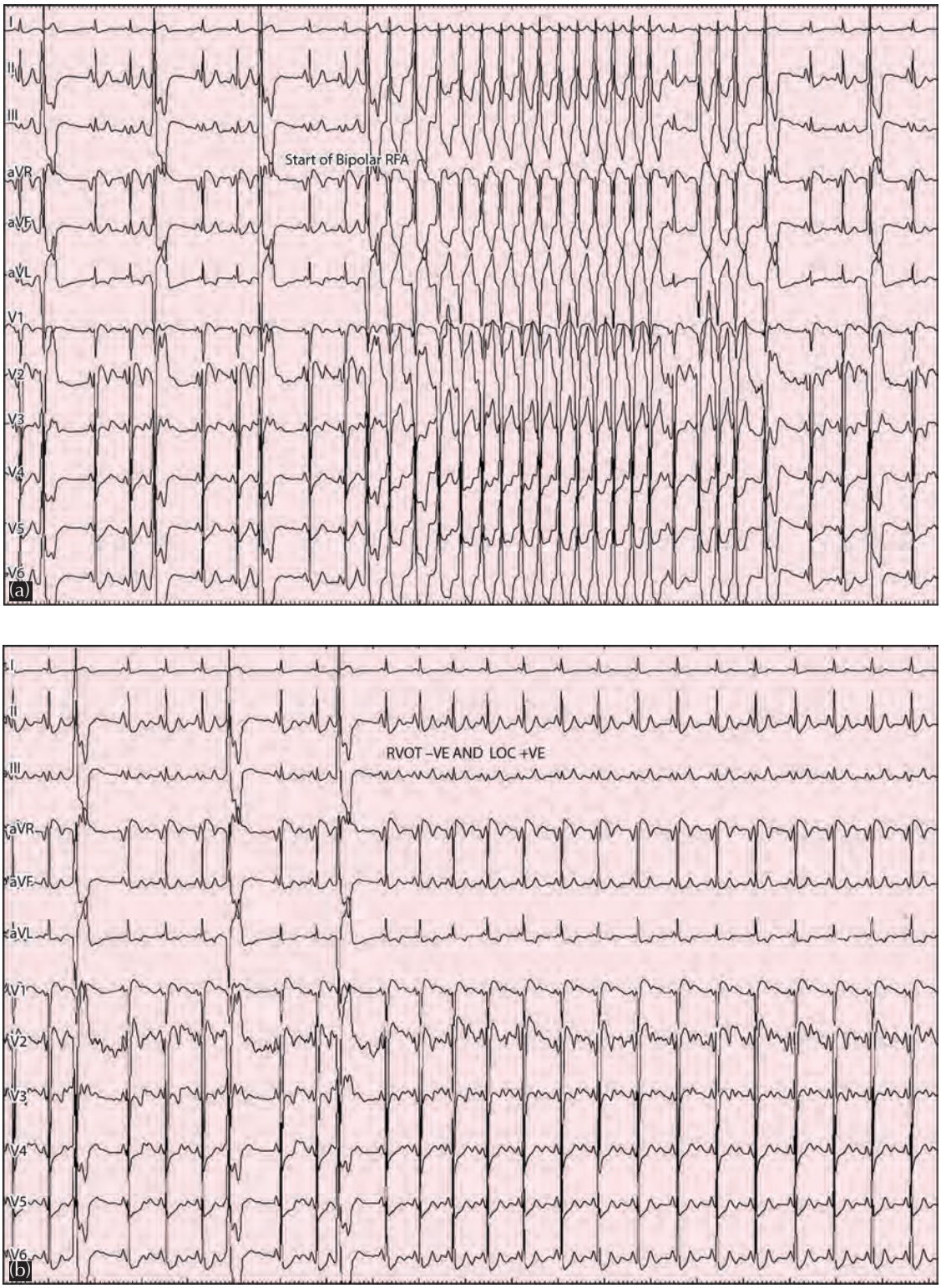


Fig. 3: (a) Start of bipolar RFA resulting in acceleration of PVCs and (b) subsequently complete silence of PVCs.

tract PVCs can be effectively treated using unipolar RFA (U-RFA) with good long-term success. Recurrence is commonly attributed to poor tissue contact, incomplete mapping, or a deep-intramural focus within the outflow tract septum. Irrigated catheters improve lesion depth but may still be inadequate for deep-seated sources. Ablating from both sides of the septum, either via sequential unipolar RFA (SeU-RFA) or simultaneous unipolar RFA (SiU-RFA) has been described,[1] although simultaneous delivery requires two RF generators. In this case, the U-RFA circuit was custom-modified into a bipolar RFA configuration, replacing the surface dispersive patch with a second ablation catheter serving as the return electrode.[2–4] A distal port of a de-capolar cable and a jumper cable were used to complete the setup. This approach allowed focused energy delivery between two intracardiac electrodes, enhancing lesion depth and deeper penetration. The NavX impedance-based mapping system facilitated real-time visualization of both the active and return catheters as well as the associated intracardiac electrograms (Fig. 2). For safety, the LCC catheter was designated as the active pole, allowing reliable temperature monitoring, while the RVOT septal catheter served as the return electrode. When the B-RFA was done using LCC end as active ablation point and RVOT end as grounding, RVOT ventricular tachycardia was initiated immediately and it subsequently terminated (Fig. 3). A vigorous induction protocol was used post RFA to check the recurrence, but PVC did not recur. During three months of follow-up, LVEF was normalized and neither 24-hour Holter nor exercise ECG revealed any PVC. This case demonstrates the feasibility, safety, and practical applicability of bipolar RFA across the outflow tract septum in a highly resistant PVC substrate using readily available electrophysiology lab components.

CONCLUSION

In cases of deep-seated outflow tract septal ventricular arrhythmia, where conventional open-irrigated unipolar RFA fails to achieve adequate lesion depth, bipolar radiofrequency ablation (B-RFA) offers a valuable and effective alternative. This approach enhances energy delivery across the septal substrate and can be implemented using standard components readily available in most electrophysiology laboratories.

I remain deeply honored to have trained under Dr. C. Narasimhan, whose teachings continue to shape my clinical decision-making. His emphasis on meticulous anatomical understanding, systematic mapping, and thoughtful ablation strategies has been instrumental in guiding complex procedures such as this one. His mentorship fosters critical thinking, innovation, and adaptability, qualities essential for achieving optimal patient outcomes in challenging arrhythmia cases.

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