Percutaneous Transapical Access With Closure for Ventricular Tachycardia Ablation

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In patients with mechanical aortic valve prosthesis undergoing left ventricular (LV) endocardial ablation, retrograde catheter access through the aortic valve carries an unacceptable risk of catheter entrapment and death, and the atrial trans-septal approach remains the only routinely used option. Because of the circuitous path required to reach subaortic and other LV regions via the trans-septal route, ablation catheter contact force may not be sufficient for successful energy delivery. Therefore, additional techniques for a more direct access to the LV may be advantageous, including ventricular trans-septal access, and transapical access via surgical mini-thoracotomy. Percutaneous transapical access to the LV combines the advantages of a direct LV access (abundance of catheter maneuverability and contact force needed for ablation energy delivery) with the convenience of a nonsurgical technique (performable in the electrophysiological laboratory). Growing experience with this approach and advances in available closure options after transapical sheath removal, allow for this technique to be implemented without the previously documented complications.

Case Report

Clinical History

A 74-year-old man with ischemic cardiomyopathy and mechanical aortic prosthesis (29-mm bileaflet St. Jude valve placed at the age of 60 years) received recurrent shocks from his implantable cardioverter-defibrillator for monomorphic ventricular tachycardia (VT). Two previous ablations using a trans-septal puncture to access the LV failed to control the arrhythmia burden because of inadequate catheter contact with the basal LV septum, the critical arrhythmogenic substrate (Figure 1A). His coronary arteries were characterized by a codominant system with known right coronary artery in-stent stenosis (95%), which could not be percutaneous revascularized because of inability of the balloon to cross the lesion. Transthoracic echocardiography showed decreased LV systolic function (39%) with interior-septal regional wall motion abnormalities that were most prominent at the base (aneurysmal segments).

Because of multiple recurrent shocks for slow VT (rate, 118–125 beats per minute) despite antiarrhythmic medications (amiodarone, carvedilol, and mexiletine), a third ablation was planned. Given the inability to use retrograde LV access because of the risk of catheter entrapment, a novel technique using a transapically placed sheath to facilitate electrophysiological mapping and ablation contact with LV basal regions not well reached trans-septally was devised (Figure 1B).

Procedure Description

Preprocedural imaging revealed no evidence of the left lung covering the LV apex, a large wrap around left anterior descending artery, and an inferoseptal LV aneurysm without thrombus (gadolinium delayed enhancement in the basal inferior and basal septal areas were consistent with previous infarction). During the procedure, the relationship of the left anterior descending artery, diagonals, and the LV apex was confirmed with a coronary angiogram (Figure 2A), then the LV apex was manually palpated and visualized on transthoracic echocardiography. A 10-cm LV puncture needle was introduced through the LV apex under echocardiographic, hemodynamic, and fluoroscopic guidance (Figure 2B), and exchanged over a 0.35-mm wire for a 6Fr dilator, which was, in turn, replaced by an 8Fr short sheath (Terumo Medical Corporation, Somerset, NJ; Figure 2C). After this, an activated clotting time >250 s was maintained with heparin. Mapping of the LV using an irrigated 3.5-mm tip ablation catheter with Smart Touch technology (Biosense Webster Incorporated, Diamond Bar, CA) placed through the transapical sheath (Figure 3) revealed inferoseptal scar interspersed with fractionated late potentials. Programmed electric stimulation induced 3 different VT morphologies (VT1 exit site was in the aortomitral continuity, VT2 exit site was in the basal inferior LV septum, and VT3 exit site was in the basal mid-LV septum; Figure 1C), but these tachycardias were not hemodynamically tolerated and required electric cardioversion. Therefore, substrate-based ablation was performed, which used pace mapping, as well as identification of fractionated low amplitude late potentials (≤40 W with 30 cc flow and targeting 5–10Ω drop in impedance). Repeat programmed electric stimulation at the
end of the ablation did not show any evidence of inducible VT. Fluoroscopic, three-dimensional mapping (including Smart Touch technology showing consistently contact force of >10 g), and intracardiac echocardiographic visualization (Data Supplement) confirmed adequate catheter contact during ablation.

After ablation, the heparin anticoagulation was reversed with protamine, and a 6-mm Amplatz vascular plug II (AGA Medical Corporation, Golden Valley, MN; Figure 2D, 2E, and 2F) was deployed to close the LV apex. Nitinol mesh design of the plug with its multilobar architecture provided superior conformability. Clear disc markers improved visualization (the proximal and distal disc markers allowed visualization and hence accurate placement of the device discs on the epicardial and endocardial surfaces), whereas the conformable middle lobe allowed for complete occlusion of the myocardial tract. An intact coronary circulation was demonstrated in Figure 2F. Continuous visualization of the pericardial space during 60 minutes after the sheath removal was accomplished with transsthoracic echocardiography, and no effusion was seen. Repeat echocardiogram on the morning after the procedure also did not show any pericardial, and chest x-ray confirmed absence of pleural effusion or pneumothorax.

Outcome
Patient recovered from the procedure without complications, and he had no recurrence of VT during the available 120-day follow-up period (interrogation of his implantable cardioverter–defibrillator revealed no detected or treated VTs).

Discussion
In this article, we report an uncomplicated left VT ablation accomplished by a multidisciplinary team via the percutaneous transapical approach using preprocedural imaging, intra-procedural angiography, and closure strategy with a vascular plug. This technique could be safely performed at experienced centers on a subset of patients with mechanical aortic valve in whom the endocardial left VT ablation is complicated by inadequate catheter contact from the atrial trans-septal access.

The approaches to endocardial LV ablation in patients with mechanical aortic valves are transatrial, transventricular, open surgical, and transapical access. The traditional atrial trans-septal approach in which the LV is accessed through the mitral annulus constitutes the first line approach, and it should be sufficient for the successful ablation of the majority of LV locations, particularly if combined with the use of deflectable long sheath (Agilis, St. Jude Medical, Minnetonka, MN) or with internal jugular access. When an alternative technique for left VT ablation is needed (including patients with both aortic and mitral mechanical valves), the LV transapical access provides a feasible option, particularly for ablating in the basal regions of the LV as the maneuverability in the apical LV close to the transapical sheath may be limited.

The increasing experience of cardiologists in centers with sophisticated structural programs that require transapical LV access for perivalvular leak closure4 provides a vital platform for expanding this approach into electrophysiology. The necessary support for safe implementation of the transapical technique includes expertise with several imaging modalities, including transthoracic echocardiography, intracardiac echocardiography, preprocedural computed tomography with angiography, and fluoroscopic peri-procedural angiography. Arrangements for a timely cardiovascular surgery backup should also be present.

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Disclosures
None.

References

Key Words: catheter ablation • catheterization closure device • ventricular tachycardia
Figure 1. A, Intracardiac echocardiogram still frame images and cartoon representations of the previous ablation attempts in which the catheter tip aimed at the left ventricle (LV) basal posterior septum did not achieve sufficient contact (white asterisk—irrigation fluid from catheter tip). B, Improved contact of the ablation catheter tip with the basal posterior LV septum when the transapical access is used. C, Electro-anatomic voltage map of the LV basal posterior and septal regions after the ablation via the transapical approach. AoV indicates aortic valve; LA, left atrium; LAO, left anterior oblique; MV, mitral valve; RA, right atrium; RAO, right anterior oblique; RV, right ventricle; and VT, ventricular tachycardia.
Figure 2. Fluoroscopic still frame images highlighting the preprocedural angiography (A), needle puncture through the left ventricle (LV) apex with confirmation by contrast injection (B), placement of LV transapical short 8 Fr sheath with contrast injection (C), positioning of the vascular plug during sheath removal (D), vascular plug in place (E), and postprocedural coronary angiography (F).

Figure 3. A. Ablation catheter accessing the left ventricle via a transapically placed short sheath (empty white arrow) below the patient’s left nipple (full black arrow). B and C. Right and left anterior oblique views depicting the transapically placed catheter (empty white arrow), the full white arrow highlights the mechanical aortic valve.
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