Left ventricular tachycardia ablation in a toddler via a transapical approach: A new tool for the armamentarium

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Introduction
Catheter ablation of drug-refractory ventricular tachycardia (VT) that occurs in infancy can be challenging owing to the small size of the heart and vessels compared to the ablation catheters. We present a toddler with incessant left ventricular (LV) tachycardia that was successfully treated by radiofrequency catheter ablation with an 8 French irrigated-tip catheter via a transapical approach. This technique can further expand the armamentarium for treating such patients.

Case report
A 14-month-old 10 kg toddler with no past medical history presented to our institution with incessant VT at a rate of 210–240 beats/min (Figure 1). She had an exanthema several weeks prior and further testing was consistent with a likely viral myocarditis. She had a positive serology for HHV-6, elevated biomarkers (proBNP at 35,831 pg/mL; troponin I 0.348 ng/mL), and evidence of early and late gadolinium enhancement at the inferobasal LV region on cardiac magnetic resonance imaging.

Medical management with intravenous steroids, esmolol, amiodarone, and lidocaine failed to suppress the arrhythmia and her LV ejection fraction was at 10%. At that point the patient was brought to the electrophysiology laboratory for a VT ablation with extracorporeal membrane oxygenation support. Under general anesthesia extracorporeal membrane oxygenation was established utilizing the internal jugular vein and the common carotid artery.

A quad catheter was placed in the right ventricular apex and a Mariner SC 5 F radiofrequency ablation catheter (Medtronic Inc, Minneapolis, MN) was advanced into the left ventricle via a retrograde approach. A Velocity 3-dimensional mapping system (St Jude Medical, St Paul, MN) was used for mapping. Right ventricular pacing to entrain the tachycardia demonstrated an automatic focus as the mechanism. Activation mapping localized the earliest site in the inferior basal left ventricle right under the posterior leaflet of the mitral valve (-39 msec pre-QRS).

At that location the maximum power that could be delivered using a nonirrigated catheter was 3–5 watts, which only led to seconds of VT suppression.

An angiogram of the femoral artery demonstrated a complete arterial occlusion with the existing sheath/catheter, which prohibited the insertion of an 8 F irrigated catheter via a retrograde approach. A transseptal approach was discarded because it was felt that the curve needed to get to the inferobasal LV was not achievable by any of the existing catheters. A left anterior minithoracotomy, using a 5-0 Prolene purse string with felt pledgets, was created 5 mm from the apex of the heart. Using a modified Seldinger technique, an 8 F side-arm vascular access sheath was advanced into the left ventricle and secured. An 8 F ThermoCool (Biosense Webster, Diamond Bar, CA) irrigated-tip catheter was then advanced into the left ventricle through the sheath. Under transesophageal echocardiogram, fluoroscopy, and signal guidance, the catheter was advanced toward the desired place, under the posterior leaflet of the mitral valve. The basic irrigation flow of 2 mL/min resulted in a local temperature of \(33^\circ C\), given her small heart, which prevented the initiation of ablation. To overcome this, the irrigation was first turned off and only started 2–3 seconds into the lesion in order to be able to deliver the desired 20 watts of power. At that site the VT was terminated 3.9 seconds into the lesion. Ablation was continued for 30 seconds and then the power was increased to 30 watts for another 30 seconds (Figure 2). Postablation ventricular burst pacing on and off isoproterenol could not reinduce the VT. A chest tube was placed at the end of the case to relieve a left-sided pneumothorax, created at the time of thoracotomy; we had no further complications and the patient was discharged from the hospital 2 weeks later in sinus rhythm with an LV function that had already normalized.

Comments
To our knowledge, this represents the first case report of a successful VT ablation via a transapical approach in a toddler. Prior groups have reported this technique in adults...
with prosthetic mitral and aortic valves, but its feasibility at this age was never tested before.

In this particular case we felt that the tachycardia was likely a result of a prior viral myocarditis that had created an area of local fibrosis as well as a derangement in automaticity leading to a focal VT.

The current dimension of the ablation catheters poses the greatest challenge when it comes to maneuvering in small hearts and, as shown in our case, with respect to power delivery in the left ventricle of young patients. Not only do the arterial diameters represent a challenge when it comes to attempting a retrograde approach, but also the curvatures and bending radius of the catheters pose a challenge when maneuvering inside of the heart and when attempting to place the catheter at a basal location when the approach is transseptal. This case demonstrates the feasibility of a direct transapical approach for the ablation of VT in young children. But we believe that miniaturizing the ablation catheters that can deliver high-power lesions is needed for the advancement of arrhythmia treatment in children.

**Figure 1**  Electrocardiogram showing the ventricular tachycardia (VT) rate and morphology at the time of presentation. Note a right bundle, concordant across the precordium, and left superior axis VT, consistent with an inferobasal exit site.
References

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Figure 2  Panel 1: Anterior–posterior (AP) fluoroscopy view showing the catheter across the apex of the left ventricle with the tip (arrow) in the inferobasal left ventricular region. TEE = transesophageal echocardiography. Panel 2: Transesophageal echocardiographic view with the arrow pointing to the tip of the catheter. Panel 3: Three-dimensional map showing the earliest site of activation and site of arrhythmia suppression. Panel 4: Termination of the ventricular tachycardia.