Hybrid surgical vs percutaneous access epicardial ventricular tachycardia ablation

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BACKGROUND There is limited experience of surgical epicardial access in the contemporary era of ventricular tachycardia ablation after cardiac surgery.

OBJECTIVES The purpose of this study was to describe our institutional experience with surgical epicardial access and the influence of surgical approach and compare outcomes with those of a propensity-matched percutaneous epicardial access control group.

METHODS We performed a retrospective study of consecutive surgical epicardial ventricular tachycardia (VT) ablation cases from a single center. Surgical cases were propensity-matched to percutaneous epicardial ablation controls and short-term and long-term outcomes were compared.

RESULTS Between 2004 and 2016, 38 patients underwent 40 surgical epicardial access procedures (subxiphoid, n = 22; thoracotomy, n = 18). The indication was prior coronary artery bypass grafting (45%), valve surgery (22%), or ventricular assist device (VAD) (10%). The mean procedure time was 444 minutes (standard deviation, 107 minutes). Mapped epicardial geometry area was 149 cm^2 (interquartile range 182 cm^2), which comprised 36% of the mapped epicardial geometric area of a percutaneous control group. Subxiphoid access gave preferential access to the inferior and inferolateral left ventricular segments and was less frequently able to access the anterior, anterolateral, and apical segments compared with a thoracotomy approach. When compared with results from a propensity-matched percutaneous-access group, short-term outcomes, complication rates, and 1-year survival free from a combined end point of VT recurrence, death, or transplantation were not statistically different.

CONCLUSIONS Surgical epicardial access after cardiac surgery for ablation of VT in patients with careful preprocedure evaluation can be performed with acceptable safety with no statistical difference in long-term outcomes compared with a propensity-matched percutaneous epicardial cohort. The region of left ventricular epicardium that can be mapped is limited compared with that of percutaneous cases and is determined by the surgical approach.

KEYWORDS Ablation; Cardiac surgery; Epicardial; Surgical access; Ventricular tachycardia

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Introduction

Successful percutaneous epicardial access for ablation of ventricular tachycardia (VT) can be achieved in most patients at experienced centers. Access failure is usually due to the presence of pericardial adhesions.[1,2] Adhesions are an almost universal finding in the post–cardiac surgery population. Although mechanical adhesiolysis from a percutaneous approach is feasible, there are risks of catastrophic complications.[3–5] Surgical epicardial access is an alternative approach. However, experience with this technique is limited in the era of 3-dimensional mapping, and results from this approach have, to the best of our knowledge, never been compared with results a matched control group of patients who underwent the percutaneous procedure.[6–8]

We report our experience using a surgical approach for epicardial access, and we compare the outcomes of epicardial VT ablation with results from a propensity-matched percutaneous-access control group.

Methods

The study population comprised 38 consecutive patients who underwent mapping and ablation using a hybrid surgical technique at the University of California Los Angeles Cardiac Arrhythmia Center between 2004 and 2016. Baseline

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demographics and procedural data were extracted from electronic patient records after our institutional review board approved the study.

The decision to gain epicardial access was based on the following characteristics: electrocardiogram (ECG) features suggestive of an epicardial site, unsuccessful endocardial ablation and mapping that indicated an epicardial focus, epicardial scar on cardiac magnetic resonance imaging (CMR), or substrate known to be associated with epicardial circuits.[9] Patients were considered for surgical access if they had undergone prior cardiac surgery or if ablation under direct vision was required (eg, VT near coronary arteries).

Patient preparation

Patients with coronary artery bypass grafting (CABG) were evaluated preprocedure with invasive or computed tomography coronary angiography to determine graft patency and its relation to the planned surgical approach. The surgical approach was based on the likely origin of a documented VT from surface ECG or prior mapping. If ECG or mapping was unavailable, the scar location on images was used to determine the approach with the highest yield. Where available, the scar was assessed from the results of prior CMR before implantable cardioverter defibrillator (ICD) implantation. From 2013 onward, we performed the wideband technique for late gadolinium enhancement CMR sequences in patients with non–MRI-conditional implantable devices.[10] In our early experience, 8 patients had a surgical-access procedure performed in the operating room with standby cardiopulmonary bypass and were then transferred to the electrophysiology (EP) lab. Later, procedures were performed entirely in the EP lab with standby cardiopulmonary bypass unless patients were considered to be at high risk of requiring additional surgical intervention or had planned cardiac surgery.

Noninvasive programmed electrical stimulation (PES) via an ICD was performed to document baseline VT morphologies under conscious sedation before general anesthesia.

Epicardial access

Our approach to percutaneous and surgical access has been described previously.[2,8] For subxiphoid surgical access, an epigastric midline incision extending over the xiphoid process was made. Deep dissection to the diaphragmatic pericardial surface was undertaken. After pericardiotomy, adhesiolysis by bunt dissection was performed to the inferior and inferolateral surfaces, after which an 8F sheath was placed (SL0, St Jude Medical, St Paul, MN) or the ablation catheter was directly advanced. If anterior thoracotomy was used, single-lung ventilation was planned as required. Fluoroscopy was used to assess the optimal intercostal incision site. Thereafter, the incision was extended to the pericardium and dissection was used to free the anterior and lateral surfaces.

After surgical access was obtained, in all cases, a limited segment of myocardium could be directly visualized, depending on the route of access. For those segments, the catheter tip was directly placed on the myocardium by hand. However, for all cases, most segments could not be directly visualized, and therefore the catheter or catheter and sheath were placed into the pericardial space and manipulated in accordance with percutaneous-only procedures. Representative epicardial geometry areas for both surgical-access types are shown in Figure 1. All logged events were recorded on the EP recording system (CardioLab, GE Healthcare, Chicago, IL). Procedure times were divided into time from incision to catheter insertion into the pericardial space, mapping time, and ablation procedure duration. For cases in which surgery was performed prior to transfer to the EP lab, only the time from incision to wound drape was considered, to exclude transit time. EP procedure time was calculated from the start of mapping to the start of surgical closure. Closure time was calculated from the start of closure to procedure end, defined as sheath removal. Patients who were having additional planned cardiac surgery at the time of the VT ablation were excluded from procedural time analysis.

Mapping and ablation

Following access, high-density electroanatomic mapping with CARTO (Biosense Webster, Diamond Bar, CA) or NavX (St Jude Medical, St Paul, MN) was performed using a multipolar catheter (2-2-2 duodecapolar, Livewire, St Jude Medical) or ablation catheter (ThermoCool, Biosense Webster, Diamond Bar, CA; FlexAbility, St Jude Medical; Chilli, Boston Scientific, Natick, MA). Standard cutoffs were used to define scar ($<$0.5 mV) and normal ($>$1.5 mV) tissue. All abnormal late or fractionated electrograms were tagged.[11] If required, endocardial mapping was performed via the transseptal or retrograde aortic approaches under anticoagulation.

PES was repeated and activation and entrainment mapping were performed where VT was tolerated. Prior to ablation, patients underwent coronary angiography and high-output pacing to avoid coronary artery or phrenic nerve injury. Ablation at 20–50 W was directed to sites of diastolic activation during tachycardia or at border-zone sites where pace-mapping match $>$10 of 12 leads was obtained. Further ablation was then directed to predefined abnormal electrogram sites to achieve a goal of complete elimination. PES was repeated as required, and further VTs were targeted at the operator's discretion. In cases in which patients were noninducible or had unmappable VT, complete elimination of local abnormal electrograms and ablation of border zones with good pace-mapping matches were performed where possible.

Electroanatomic map analysis

Electroanatomic maps were retrospectively analyzed. Only post–cardiac surgery patients were considered for area and segmental analysis. Electroanatomic map area was quantified using proprietary area measurement tools from the

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