Journal of the American Heart Association

ORIGINAL RESEARCH

Feasibility and Safety of Laparoscopic-Guided Epicardial Access for Ventricular Tachycardia Ablation

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BACKGROUND: The usual approach to epicardial access in patients with Chagas cardiomyopathy and megacolon is surgical access to avoid bowel injury. However, there are concerns regarding its safety in cases of Chagas cardiomyopathy with reports of prolonged mechanical ventilation and high mortality in this clinical setting. The aim of this study was to examine feasibility and complication rates for ventricular tachycardia ablation performed with laparoscopic-guided epicardial access.

METHODS AND RESULTS: This single center study examined complication rates of the first 11 cases of ventricular tachycardia ablation in patients with Chagas cardiomyopathy, using laparoscopic guidance to access epicardial space. All 11 patients underwent epicardial VT ablation using laparoscopic-guided epicardial access, and the complication rates were compared with historical medical reports. The main demographic features of our population were age, 63±13 years; men, 82%; and median ejection fraction, 31% (Q1=30% and Q3=46%). All patients were sent for ventricular tachycardia ablation because of medical therapy failure. The reason for laparoscopy was megacolon in 10 patients and massive liver enlargement in 1 patient. Epicardial access was achieved in all patients. Complications included 1 severe cardiogenic shock and 1 phrenic nerve paralysis. No intra-abdominal organ injury occurred; only 1 death, which was caused by progressive heart failure, was reported more than 1 month after the procedure.

CONCLUSIONS: Laparoscopic-guided epicardial access in the setting of ventricular tachycardia ablation and enlarged intra-abdominal organ is a simple alternative to more complex surgical access and can be performed with low complication rates.

Key Words: epicardial ablation ■ laparoscopy ■ ventricular tachycardia

Sudden death has been recognized as one of the most prominent features of Chagas disease since its initial description: Sustained ventricular tachycardia (VT) is the main cause of sudden death in this population.[1,2] Recently, with the large-scale use of the implantable cardioverter-defibrillator (ICD) for the prevention of sudden death in patients with chronic chagasic cardiomyopathy, recurrent VT has been increasingly observed—commonly appearing in concert with electrical storms.[3–5]

VT ablation is widely accepted as the first-line therapy in patients with structural heart disease and VT unresponsive to medical therapy.[6] Nevertheless, in Chagas cardiomyopathy, epicardial access is necessary in most cases because of the marked predominance of scar on the epicardial surface.[7] In addition, intra-abdominal organ injury is one of the main issues when approaching the pericardial space,[8] particularly in Chagas disease, because of its common association with megacolon.

One alternative to the percutaneous subxiphoid approach, first described by Scanavacca et al,[9] is an approach through a surgical pericardial window. However, there are concerns regarding its safety in

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Supplementary Material for this article is available at https://www.ahajournals.org/doi/suppl/10.1161/JAHA.120.016654

For Sources of Funding and Disclosures, see page 5.

JAHA is available at: www.ahajournals.org/journal/jaha

CLINICAL PERSPECTIVE

What Is New?

- Laparoscopic-guided epicardial access is feasible and associated with low complication rates when used for ventricular tachycardia ablation in patients with Chagas cardiomyopathy.

What Are the Clinical Implications?

- Our findings support that laparoscopic-guided epicardial access can be used as an alternative to traditional subxiphoid surgical window in patients at high risk for intra-abdominal organ injury.

Nonstandard Abbreviations and Acronyms

ICD	implantable cardioverter-defibrillator
VT	ventricular tachycardia

patients with Chagas cardiomyopathy, a population subset that is highly prone to malnutrition.[10] Prolonged mechanical ventilation and high mortality rates in patients with Chagas cardiomyopathy and megacolon have also been reported.

In 2015, our team described the first case of laparoscopic-guided percutaneous subxiphoid epicardial access,[11] a simple alternative to the surgical window, which can be performed in most electrophysiology laboratories. In this case series, we examine the feasibility and safety of VT ablation performed via laparoscopic-guided epicardial access.

METHODS

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Patient Population

The subjects included in this case series were consecutive patients with Chagas cardiomyopathy referred for VT ablation and intra-abdominal organ enlargement (mostly megacolon), precluding the traditional percutaneous approach to epicardial access (Figure 1). All patients provided written informed consent for the ablation procedure. The study protocol was approved by the institutional review boards at the Hospital das Clínicas and Faculdade de Medicina, Universidade Federal de Minas Gerais, Minas Gerais, Brazil. Patient data were prospectively collected in the VT database.

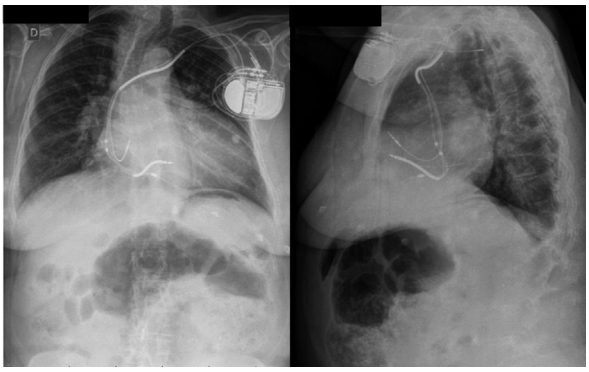

Figure 1. Radiographic appearance of the abdomen in a patient with megacolon before ablation.
Massive dilation of the sigmoid colon precludes safe traditional percutaneous approach to subxiphoid epicardial access.

Ablation Procedure

VT ablation was performed from January 2015 through September 2018. All patients underwent the procedure under general anesthesia and with arterial-line monitoring, using commercial, open-irrigated therapeutic catheters and tridimensional mapping systems. Initially, femoral vein access was obtained, and catheters were placed in the coronary sinus and in the right ventricle. Afterward, a trocar was placed in the umbilicus scar and a 30° optic laparoscope was inserted into the peritoneal cavity to allow for the direct puncture of the diaphragm surface and pericardial space (Figure 2). Intraperitoneal pressure levels were maintained below 10 mm Hg (ranging from 8 to 10 mm Hg) to avoid hemodynamic instability.

Subsequently, a single epicardial puncture was performed under direct visualization of the diaphragm, toward the posterior aspect of the heart, avoiding the puncture of intra-abdominal organs and vessels. Attention was paid to keep a shallow angle of the needle related to the ventricular wall to avoid inadvertent right ventricular puncture.

After epicardial access was obtained, the optic laparoscope and trocar were withdrawn and programmed ventricular stimulation was performed. If VT was hemodynamically stable, tachycardia was mapped and ablated. If VT was not stable, extensive substrate ablation was performed, using the scar homogenization technique, as described elsewhere.[12] High-output pacing was performed to assess the phrenic nerve capture. Additional endocardial ablation was performed when necessary or tolerated (attention was paid to total procedure time so as to not prolong it unnecessarily). When endocardial ablation was performed (always through transeptal access), total anticoagulation time was maintained >350 seconds. In all patients, the detailed epicardial voltage map was performed, using

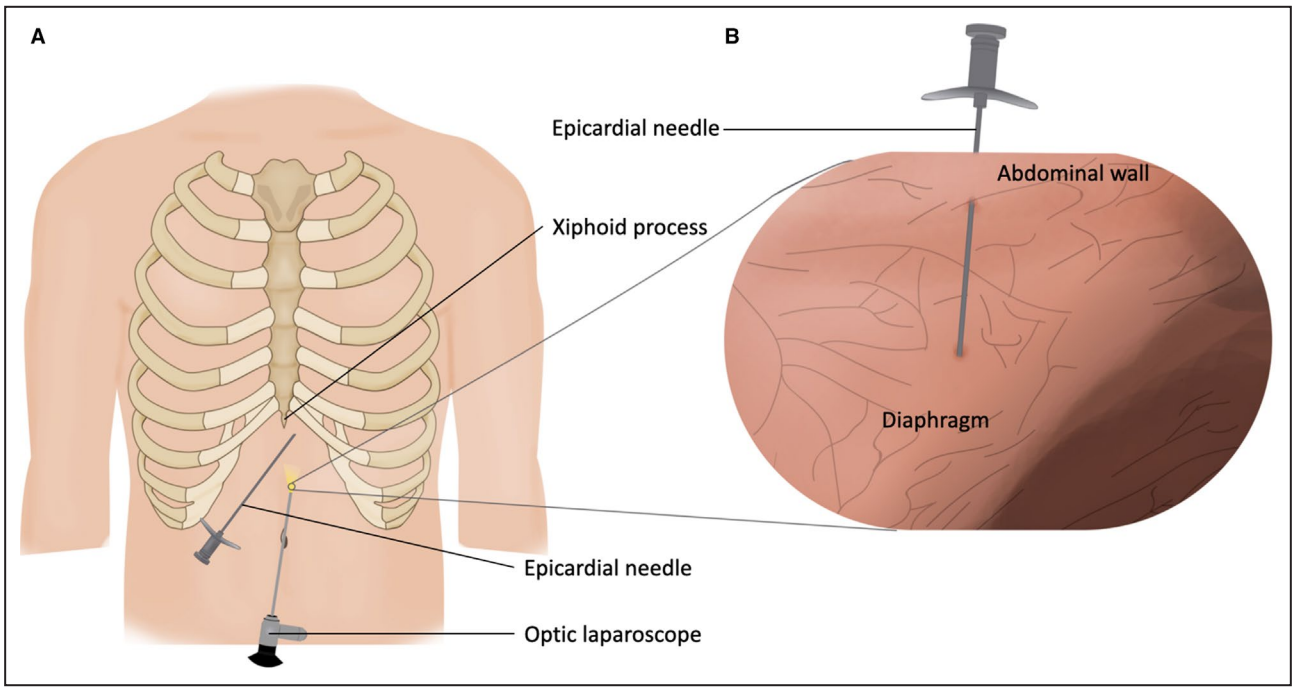

Figure 2. Schematic illustration showing laparoscopic-guided epicardial access.
A, Front view presenting epicardial needle placed on traditional subxiphoid region and optic laparoscope placed at umbilicus scar. **B**, View from optic laparoscope perspective showing epicardial needle crossing the abdominal wall and the diaphragm.

3-dimensional mapping systems. Radiofrequency delivery was achieved with a commercial open irrigated-tip catheter at a power of 40 to 50 W, seeking to achieve monomorphic VT noninducibility at the end of the procedure.

Postablation pericardial care included the administration of steroids (methylprednisolone, 250 mg) into the pericardium and the immediate removal of pericardial sheaths, unless there was persistent bleeding, in which case a percutaneous drain was left in the pericardial space.

Outcome Assessments

All patients were followed according to our standard of care after VT ablation. After hospital discharge, all patients were seen in outpatient clinics with defibrillator interrogations at least every 4 months.

RESULTS

Demographic data are outlined in Table 1. The mean age of our population was 63±13 years, 82% were men, and the median ejection fraction was 31% (Q1=30% and Q3=46%). Nine patients (82%) presented New York Heart Association class III or IV heart-failure symptoms. Ten patients had an ICD previously implanted for secondary prevention of sudden death (the subject without an ICD was referred for ablation because of very frequent and symptomatic nonsustained VT). Ten patients were referred for VT ablation because of electrical storms refractory to drug therapy.

Laparoscopy was used in 10 patients for megacolon and in 1 patient for hepatomegaly (Figure 3). Regarding the risk of acute hemodynamic decompensation, the mean PAINESD (P, pulmonary disease; A, age; I, ischemic cardiomyopathy; N, New

Table. Demographics of the Study Population

Age, y	63 (±12.9)
Male sex (%)	9 (82)
NYHA	
I or II	2 (18)
III or IV	9 (82)
Ejection fraction (%)	
Median	31
First quartile	30
Third quartile	46
ICD	
Primary prevention	0
Secondary prevention	10 (91)
Chagas cardiomyopathy	11 (100)
Electrical storm	10 (91)
Megacolon	10 (91)
Hepatomegaly	1 (9)

ICD indicates implantable cardioverter-defibrillator; and NYHA, New York Heart Association.

Figure 3. Preprocedure image showing hepatomegaly (drawn line) with left lobe enlargement precluding traditional percutaneous subxiphoid epicardial access.

York Heart Association; E, ejection fraction; S, VT storm; D, diabetes mellitus) risk score was 17, pointing to a high-risk population for VT ablation with expected high mortality.[13,14]

Procedure Data

Epicardial access guided by laparoscopy was achieved in all patients. Epicardial access was performed with a large bore needle in 8 patients,[9] using the micropuncture technique in 3 patients.[15] An epicardial basal scar was present in all patients. Mean ablation procedural time was 279±96 minutes. Seven patients (64%) received vasopressors during the procedure with mean infusion duration of 45 hours (± 40 hours).

One patient was receiving inotrope support even before the procedure (awaiting a heart transplant). This patient underwent mechanical support with intra-aortic balloon counterpulsation because of poor hemodynamic status. In 9 patients, extubation occurred at the end of the procedure and in the remaining 2 patients on the next day.

Complications

There were 2 major periprocedure complications: 1 patient presented cardiogenic shock, demanding mechanical support, whereas another patient presented phrenic nerve paralysis, which was managed conservatively. In 1 patient, an epicardial drainage catheter was left to manage a low flow of blood into the pericardial space at the end of the procedure. We considered that, because of the patient's megacolon, an urgent percutaneous pericardiocentesis would not be possible. The drainage catheter was removed 24 hours after the procedure.

No in-hospital death was reported, except for the patient awaiting heart transplant, who was transferred to another service unit, where he died of refractory heart failure.

DISCUSSION

Recently, our team performed a meta-analysis[16] to evaluate ICD implantation for secondary prevention of sudden death in Chagas cardiomyopathy. Although, there were no randomized studies for secondary prevention, pooled analysis of nonrandomized studies showed no benefit of ICD in overall mortality in this population. This finding, coupled with a very high burden of ventricular arrhythmias,[3–5] raises the hypothesis that arrhythmia control in Chagas disease is critical to improve survival because shocks delivered by the ICDs may impair quality of life[17,18] and can also increase mortality.[19–21] Therefore, ablation strategies that actually prevent the recurrence of VT, or at least decrease the burden of ventricular arrhythmia, are direly needed in the treatment of patients with Chagas cardiomyopathy.

Laparoscopic-guided epicardial access was developed in our medical service in 2015[11] to overcome the problem of megacolon and refractory VT in Chagas cardiomyopathy, most often requiring a surgical window to access the epicardial surface.

As previously stated, this population has, on many occasions, severe malnutrition[10] and there are concerns about prolonged ventilation and high mortality rates in patients with Chagas cardiomyopathy and gastrointestinal injury (M.I. Scanavacca, MD, PhD, unpublished data, 2011). In addition, left lobe liver injury is a rare, but well-described complication of epicardial puncture.[22]

Our initial experience in performing laparoscopy to avoid intra-abdominal organ injury shows that this procedure is safe and can be undertaken in most electrophysiology laboratories. In this small population with severe cardiomyopathy, the major complication rate was 18%; however, no complication was directly associated with laparoscopy in itself.

Large trials and registries[23,24] report major complication rates ranging from 8% to 10%. Nevertheless, in addition to known concerns when analyzing complication rates in small populations series, our population had severe cardiomyopathy with high rates of predicted acute hemodynamic decompensation and mortality (mean PAINESD risk score of 17).[13,14]

An intriguing finding in our case series is the absence of major pericardial bleeding. This finding could be explained by the operator's indirect visualization of the ventricular wall through the diaphragm surface (Video S1), allowing a shallow angle of the needle related to the ventricular wall (caution should be taken in this regard, as we are a high-volume epicardial VT ablation center). It should be pointed out that, after the withdrawal of the optic laparoscope and trocar, epicardial catheter manipulation is performed as usual in the traditional subxiphoid epicardial technique.

Regarding the laparoscopic procedure, low intra-abdominal pressure (limited to 10 mm Hg) levels and the removal of pneumoperitoneum early in the procedure are most likely key points to hemodynamic stability, and attention to these steps must be paid. Moreover, careful placement of the optic trocar must be performed because of the risk of organ injury caused by laparoscopic access.

Our case series cannot provide definitive information on whether laparoscopic-guided epicardial access must replace the surgical subxiphoid window for patients when abdominal organ enlargement precludes traditional epicardial access. However, our results encourage electrophysiologists to consider laparoscopic access as an alternative to traditional subxiphoid access, a simple technique that can be performed in many laboratories.

In conclusion, laparoscopic-guided epicardial access for VT ablation is a feasible and safe alternative technique to reach the epicardial surface and can be easily employed in patients with VT and intra-abdominal organ enlargement.

ARTICLE INFORMATION

Received March 30, 2020; accepted June 24, 2020.

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Sources of Funding

None.

Disclosures

None.

Supplementary Material

Video S1

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Supplemental Material

Supplemental Video Legend:

Video S1. Laparoscopic guided epicardial access. Video showing view from laparoscopic camera guiding epicardial access, which was performed with a large bore needle. Initially, the epicardial needle crosses the abdominal wall and, subsequently, the diaphragm. We can see clearly the cardiac movements on diaphragm wall, allowing optimal needle entry angle. Thereafter, the guidewire is advanced into the pericardial space (fluoroscopic view) and finally the sheath is advanced over the wire. Best viewed with Windows Media Player.