Efficacy and feasibility of pericardial endoscopy by a subcutaneous approach

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We tested the efficacy and feasibility of percutaneous subxiphoid video pericardial endoscopy in five dogs. After percutaneous subxiphoid puncture, steerable 9F endoscope and 7F irrigated-tip catheters were advanced into the epicardial space. Epicardial vessels were visualized, and basal fat was distinguishable. Lesions created by the irrigated-tip catheter could also be appreciated on the epicardial surface. The endoscopic pericardial procedure was successful and may increase the efficacy and safety of epicardial irrigated radiofrequency catheter ablation.

Keywords
Radiofrequency ablation • Ventricular tachycardia • Epicardium

Introduction

Treatment of ventricular tachycardia (VT) remains a challenge due to inaccessibility of the epicardial ventricular surface via endocardial approach. It is estimated that up to 40% of patients with hemodynamically unstable VT require epicardial ablation after an attempt at endocardial ablation, and 57% of those with previously failed ablations have an epicardial circuit.1 Sosa and Scanavaca2 described a subxiphoid approach for left ventricular epicardial mapping; however, this technique requires significant fluoroscopic-guided catheter manipulation and lacks sufficient visualization of epicardial landmarks. The aim of this study was to test the feasibility and efficacy of a novel percutaneous subxiphoid video pericardial endoscopy approach for epicardial mapping that would allow direct visualization of the ventricular epicardium with minimal use of fluoroscopy.

Methods

Five mongrel dogs weighing 18–20 kg were used. Percutaneous subxiphoid epicardial access was obtained through subxiphoid puncture under fluoroscopic guidance with the use of a Tuohy needle (17 gauge, 120 mm; Hakko Inc., Nagano, Japan) as previously described.3 Standard 10F and 7F sheaths were placed in the epicardial space, and a 9F steerable endoscope (FI-7RBS; Pentax Corp, Tokyo, Japan) was advanced into the pericardial space through the 10F sheath. In two mongrel dogs, a 6F sheath was also placed in the epicardial space through the same puncture hole, and a 5.8F balloon catheter (New Blue Max; Boston Scientific Corp., Watertown, MA, USA) was placed adjacent to the endoscope for prevention of collateral injury during catheter ablation of the left atrium. When three sheaths were inserted, a small skin incision was needed.

The epicardial coronary arteries, ablation catheter (Sprinklr, 7F, 4 mm tip electrode; 10 irrigation holes, one at the central tip of the catheter, three at distal sites, three in the middle body, and three at proximal sites (Medtronic Inc., Minneapolis, MN, USA)); epicardial fat, balloon catheter, and irrigated radiofrequency ablation lesions were observed from the pericardial space and recorded by a video camera. Saline-irrigated radiofrequency catheter ablation was performed at a power setting of 30 W for 30 s under 20 mL/min irrigation. To avoid pericardial tamponade, infused saline was withdrawn from the epicardial space through the sheath.

Results

Fluoroscopy was used at the subxiphoid puncture and succeeding sheath and balloon catheter placement, and thus total fluoroscopic time was <5 min per dog.

The epicardial left anterior descending coronary arteries and veins and their branches, epicardial fat around the left anterior descending coronary arteries and veins and their branches, and atrioventricular groove, ablation catheter, and ablation lesions created at the anterior and lateral left and right ventricles were observed under percutaneous pericardial endoscopy in all five dogs, but, posterior wall could not be observed in all five dogs because of inability of placing the endoscope to the posterior wall (Figure 1).
**Figure 1** Pericardial view of the coronary artery and vein, ablated lesion, and ablation catheter.

**Figure 2** Pericardial view of the epicardial fat, ablated lesion, and ablation catheter under placement of the balloon catheter.
Saline irrigation through a sheath was needed to flush blood from the endoscope lens for visualization because bleeding from the injury to the myocardium or vessels by puncture procedure in two dogs. Epicardial structures were more clearly observed without frequent saline irrigation by concomitant use of the balloon catheter in two dogs (Figure 2).

**Discussion**

A significant percentage of haemodynamically unstable and ablation-resistant VTs have an epicardial component that requires epicardial mapping and ablation.\(^1\) The subxiphoid approach for epicardial left ventricular mapping described by Sosa and Scanavacca\(^2\) does not allow access for targeted epicardial ablations and relies heavily on prolonged use of fluoroscopy. Furthermore, alternative approaches such as coronary vein mapping are inherently restricted to the area of vein distribution. Average fluoroscopy times in one published catheter-based epicardial mapping study were considerably high (48.2 min).\(^3\) Zenati et al.\(^4\) reported epicardial left ventricular mapping using subxiphoid video pericardioscopy; fluoroscopy time was only 10 min and 45 s. However, the system they used (FLEXView System; Boston Scientific Cardiac Surgery, Santa Clara, CA, USA) requires a 15 mm subxiphoid incision and a 5 mm pericardiotomy for its placement in the pericardial space.

The 9F steerable endoscope used in the present study was placed in the pericardial space through pericardial puncture; thus, the procedure was less invasive. However, the system is limited by a small visual field. Thus, identification of target tissue and its relation to the small branch vessels need fluoroscopic guidance. Nakahara et al.\(^5\) reported intrapericardial balloon placement for the prevention of collateral injury during catheter ablation of the left atrium in porcine hearts. Thus, we placed a balloon through a second sheath that was inserted through the same puncture site, and we benefited from a wider visual field. Furthermore, this endoscope could not be placed at the posterior wall of the ventricle because only distal 20 mm part of the endoscope is steerable. Thus, development of a short-length, steerable sheath is needed to observe entire area of the epicardial surface by this endoscope.

**Conclusions**

This new approach to endoscopic visualization of the epicardial space may improve safety and lesion formation during complex ablation procedures.

**Conflict of interest:** none declared.

**References**