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Coronary Vein Exit and Carbon Dioxide Insufflation to Facilitate Subxiphoid Epicardial Access for Ventricular Mapping and Ablation

First Experience

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ABSTRACT

OBJECTIVES This study assessed the feasibility of intentional coronary venous perforation and exit with subsequent pericardial carbon dioxide (CO_2) insufflation as a novel method for assisting subxiphoid pericardial puncture in the setting of epicardial mapping and ablation for ventricular tachycardia. The technique required that coronary venous perforation would not lead to significant bleeding.

BACKGROUND Widespread adoption of first-line endoepicardial ventricular tachycardia ablation has not been taken up because of the risk of lacerating coronary vessels and puncturing the right ventricle with direct subxiphoid puncture.

METHODS A lateral branch of the coronary sinus was subselected using a diagnostic JR4 coronary catheter inside a steerable sheath, via femoral access, and a distal branch then perforated intentionally using a high tip load 0.014-inch angioplasty wire. Either a microcatheter or over-the-wire balloon was then passed over this into the pericardial space, allowing up to 150 ml of pericardial CO_2 insufflation, which allowed direct visualization of subxiphoid anterior pericardial access using a microneedle technique.

RESULTS Intentional coronary vein exit was achieved in all 12 patients. In 1 patient, this confirmed widespread pericardial adhesions and therefore only endocardial VT ablation was undertaken. The other patients underwent successful pericardial CO_2 insufflation and subxiphoid access allowing epicardial ventricular mapping and ablation. The immediate pericardial aspirate was dry or contained serous fluid in all but 1 patient.

CONCLUSIONS We report the first human transcoronary vein exit procedure. Coronary vein exit and subsequent percutaneous subxiphoid anterior access using a microneedle puncture after CO_2 pericardial insufflation can be achieved reliably and safely. (J Am Coll Cardiol EP 2017;■:■–■) © 2017 by the American College of Cardiology Foundation.

Access to the pericardial space may be required to undertake a successful ventricular tachycardia (VT) ablation. A percutaneous access method using the now-termed "large bore needle" technique was first described by Sosa et al. (1). Complications, occasionally requiring emergency sternotomy, associated with this approach have limited widespread first-line endoepicardial VT ablation (2). The overall complication rate ranges from 6% to 25%, with a right ventricular (RV) puncture rate of 5% to 17% in reported case series (3–6). Because of this, several articles have been written that aim to identify which patients might best benefit from a first-line endoepicardial VT ablation. Cardiomyopathy type, 12-lead VT morphology characteristics, pre-procedural imaging, endocardial unipolar mapping, and a prior failed endocardial VT ablation are some of the methods used to guide this decision

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ABBREVIATIONS AND ACRONYMS

CS = coronary sinus

LV = left ventricle

RV = right ventricle

VT = ventricular tachycardia

(7–15). Subxiphoid access is inherently associated with RV puncture because the target space is small, not visualizable, and the right ventricle is a mobile structure. Using a direct anterior versus posterior subxiphoid approach may reduce the likelihood of damage to abdominal viscera but not RV perforation, transection, or coronary vessel damage (4). More recently, subxiphoid access using a micropuncture needle has been shown to reduce the incidence of large pericardial effusions, although the RV perforation rate remained the same (16). In the setting of suture ligation of the left atrial appendage, Rogers and Greenbaum have defined a new technique for accessing the epicardial space using an intentional right atrial appendage exit strategy (17,18). The back end of an angioplasty wire is used to exit the right atrial appendage and a microcatheter is passed over the wire into the pericardial space. The pericardial space is then insufflated with carbon dioxide (CO_2) allowing fluoroscopic visualization of the separated visceral and parietal pericardial layers with subsequent subxiphoid access, affording minimal risk of RV perforation.

We hypothesized that a modification to this technique using an intentional coronary vein exit strategy would be relatively straightforward and safe. We hypothesized that we would be able to exit a lateral coronary vein reliably using a 0.014-inch angioplasty wire allowing for wire feedback and that upon withdrawal of the microcatheter, there would be no clinically significant bleeding from the coronary vein. We report on the first experience of intentional coronary vein exit with CO_2 insufflation of the pericardial space and subxiphoid microneedle puncture for percutaneous epicardial access for VT ablation.

METHODS

SUBJECTS. Consecutive patients undergoing VT ablation between January and May 2016 at the Sussex Cardiac Centre for scar-related, anti-arrhythmic-resistant sustained VT or implantable cardioverter defibrillator shocks were invited to participate in the study protocol. All patients provided written informed consent and had a conventional indication for epicardial mapping and ablation. The protocol was approved by the institutional review board. Procedures were undertaken under general anesthesia with 600 mg of intra-venous teicoplanin antibiotic prophylaxis at induction. When possible, anti-arrhythmic medication was withdrawn at least 5 half-lives before the procedure.

INTENTIONAL CORONARY VEIN EXIT METHOD. Double right femoral venous and single right femoral arterial access was initially obtained using 8-F sheaths. The arterial sheath was used for invasive arterial pressure monitoring. A medium or large curl 71 cm Agilis NxT steerable introducer (St. Jude Medical, Saint Paul, Minnesota) was then placed in the region of the coronary sinus (CS) ostium (**Figure 1**). An ablation catheter (Thermocool Smarttouch Surround Flow D-F curve, Biosense Webster, South Diamond Bar, California, or Tacticath Quartz F curve, St Jude Medical) was then used within the Agilis introducer to advance the Agilis introducer into the CS. After withdrawal of the ablation catheter, fluoroscopic CS venography was undertaken in left and right anterior oblique views using iodinated contrast injection. A lateral CS branch or, if absent, an anterolateral branch, was then identified for intentional perforation and exit. A 5- or 6-F JR4 diagnostic coronary catheter was used to subselect the target venous branch. A high tip load 0.014-inch angioplasty wire (Asahi Confianza Pro 12 or MiracleBros 12, Abbott Vascular, Santa Clara, California) was then used within the JR4 catheter to perforate and exit a small distal lateral vein (Online Video 1). Once the wire was seen to loop around the cardiac silhouette, either an over-the-wire balloon, without inflation, (Ryujin Plus 1.25/1.5 mm, Terumo Interventional Systems, Somerset, New Jersey [2.5-F distal shaft diameter]) or a microcatheter (Asahi Corsair [2.6-F distal shaft diameter]) was then passed over the angioplasty wire into the pericardial space. The angioplasty wire was then withdrawn and a 2- to 5-ml contrast injection performed to confirm pericardial positioning in this series, although this is not an essential step for this technique to be undertaken safely if the wire is seen to loop around the cardiac silhouette.

A CO_2 tank was connected using sterile tubing to a 50-ml Luer-Lok syringe and filled at a flow rate of 1 l/min. Up to 150 ml of pure filtered CO_2 (1.5 ml/kg) was then injected via the microcatheter or over-the-wire balloon, using the hand-held syringe method, into the pericardial space observing the insufflation with left lateral fluoroscopy (19). CO_2 was used as it has the unique properties of high solubility, low viscosity, and buoyancy (19). Invasive arterial pressure monitoring was used to prevent capno-tamponade. Once sufficient space was visible, the pericardium was then punctured anteriorly using a xiphisternal approach with a Quincke type 12-cm 22-G spinal needle (Vygon, Écouen, France). The initial 2 cases were undertaken using a conventional 18-G Touhy needle (marketed by multiple manufacturers);