Adenosine facilitates dormant conduction across cavotricuspid isthmus following catheter ablation

Pugazhendhi Vijayaraman, MD,* Gopi Dandamudi, MD, FHRS,* Angela Naperkowski, RN,* Jess Oren, MD,* Randle Storm, MD, FHRS,* Kenneth A. Ellenbogen, MD, FHRS†

*From the *Cardiac Electrophysiology, Geisinger Wyoming Valley Medical Center, Wilkes-Barre, Pennsylvania, and †Division of Cardiac Electrophysiology, Virginia Commonwealth University Health System, Richmond, Virginia.*

BACKGROUND Recurrence of trans-isthmus conduction following catheter ablation of common right atrial flutter (AFL) has been reported to be as high as 15%–31% at 3 months with invasive follow-up. Intravenous adenosine has previously been shown to facilitate acute, transient reconnection of pulmonary veins following catheter ablation of atrial fibrillation.

OBJECTIVE To determine whether intravenous adenosine can facilitate dormant trans-isthmus conduction after achieving bidirectional conduction block (BDB) with catheter ablation.

METHODS Thirty-two patients underwent radiofrequency catheter ablation of cavotricuspid isthmus (CTI) for common right AFL at 2 institutions. Once persistent BDB was achieved for 30 minutes and during isoproterenol infusion, 18 mg of intravenous adenosine was injected during coronary sinus pacing. Evidence for transient reconduction across the isthmus was observed. Additional ablation lesions were performed, and adenosine infusion was repeated to reassess for dormant conduction.

RESULTS Thirty-two (men 81%, hypertension 72%, coronary artery disease 15%, congestive heart failure 25%, diabetes mellitus 30%, left atrial size 42 ± 11 mm, left ventricular ejection fraction 51% ± 10%) patients underwent ablation of CTI. BDB was achieved in 30 of the 32 patients. Following adenosine infusion, transient reconduction was observed in 7 of the 30 patients (23%) for 10–45 seconds. Following additional ablation lesions, persistent BDB could be achieved in all 7 patients without evidence for reconduction with repeat adenosine infusion. During a mean follow-up of 19 ± 12 months, only 1 of 30 patients (3%) had clinical recurrence of AFL. None of the patients with transient reconduction after adenosine developed symptomatic recurrence of AFL.

CONCLUSIONS Adenosine infusion can facilitate dormant conduction across CTI following catheter ablation. Persistent BDB can be achieved with additional ablation. Adenosine challenge with additional ablation may improve long-term clinical outcome.

KEYWORDS Atrial flutter; Adenosine; Catheter ablation; Electrophysiology; Dormant conduction

ABBREVATIONS **AFL** = atrial flutter; **BDB** = bidirectional conduction block; **CS** = coronary sinus; **CTI** = cavotricuspid isthmus; **LA** = left atrial; **PV** = pulmonary vein

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Introduction

Catheter ablation of cavotricuspid isthmus (CTI) has become the standard of care for treatment of patients with common atrial flutter (AFL). Recurrence of trans-isthmus conduction following catheter ablation of common AFL has been reported to be as high as 12.5%–31% during follow-up.[1,2] Intravenous adenosine has been shown to facilitate acute transient reconnection of pulmonary veins (PV) following catheter ablation of left atrial (LA) to PV connections for the treatment of atrial fibrillation.[3] Mechanisms by which adenosine facilitates reconnection of LA–PV fascicles remain unclear. It is postulated that adenosine by promoting outward potassium current causes hyperpolarization of cell membranes of PV fascicles and facilitates electrotonic conduction. It is also postulated that this may be specific to PV myocardium.[4] We hypothesized that adenosine may facilitate transient recovery of conduction across the CTI following catheter ablation and establishment of conduction block across the isthmus. The aim of our study was to assess the incidence of transient reconduction across the CTI after achieving bidirectional conduction block (BDB).

Methods

Thirty-two patients with sustained symptomatic common-type AFL referred for CTI at 2 institutions were included in the study. The retrospective study protocol was approved by the institutional review board. Before CTI ablation, anticoagulation with warfarin was maintained for at least 3 weeks. If warfarin was not therapeutic, transesophageal echocardiogram was performed prior to the procedure to exclude intracardiac thrombus. Antiarrhythmic drugs were discontinued before ablation. Under local anesthesia and conscious sedation, right femoral venous access was obtained. A duodecapolar catheter (2-10-2 mm interelectrode

Address reprint requests and correspondence: Dr Pugazhendhi Vijayaraman, MD, Cardiac Electrophysiology, Geisinger Wyoming Valley Medical Center, MC 36-10, 1000 E Mountain Blvd, Wilkes-Barre, PA 18711. E-mail address: pvijayaraman1@geisinger.edu; pvijayaraman@gmail.com

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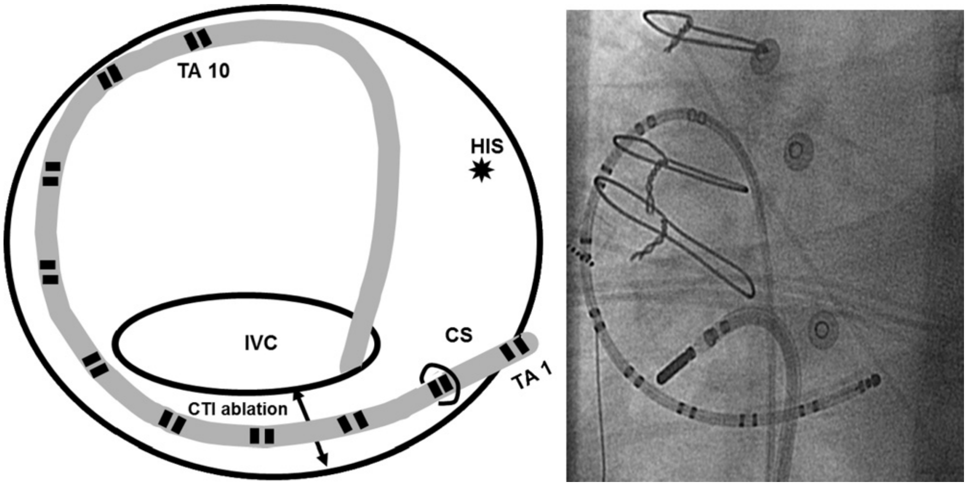

Figure 1 Schematic representation and fluoroscopic view of the duodecapolar mapping catheter in left anterior oblique projection. The distal 2 bipoles are typically positioned in the coronary sinus, and the rest of the electrodes are placed along the tricuspid annulus. The ablation catheter is located lateral to the ablation line in this fluoroscopic view. CS = coronary sinus; CTI = cavotricuspid isthmus; IVC = inferior vena cava; TA = tricuspid annulus.

spacing; Daig, St Jude Medical, St. Paul, MN) was placed along the tricuspid annulus with the distal 2 bipoles in the coronary sinus (CS) (Figure 1). A long ramp or SR0 sheath (Daig) was placed in the right atrium. A Navistar 8-mm or 3.5-mm irrigated-tip ablation catheter (Carto, Biosense Webster, Diamond Bar, CA) was placed in the CTI. Entrainment to confirm the isthmus dependence of the AFL circuit was performed in every patient in whom AFL was present or could be induced at the start of the procedure. If we were unable to induce AFL, CTI ablation was performed during pacing from the CS ostium. Linear lesions were created by use of a point-by-point technique with gradual pullback of the ablation catheter from tricuspid annulus to the inferior vena cava. The bidirectional isthmus conduction block was documented by pacing at 600 ms from the bipoles septal and lateral to the ablation line. The pacing cycle length was decreased to 500 ms if the sinus cycle was less than 600 ms. The last ablation lesion resulting in conduction block was tagged on the 3D point set on the CARTO map. Acute success was defined as bidirectional isthmus conduction block, 30 min after the last radiofrequency application without and with isoproterenol infusion of 2 μg/min. If no resumption of CTI conduction was seen during isoproterenol infusion for 5 minutes, 18 mg of intravenous adenosine was given during CS pacing. If acute reconduction across the CTI was noted, the duration of recovery was documented. Additional ablations were performed at the sites previously tagged to have resulted in conduction block. Intravenous adenosine was repeated again during CS pacing on isoproterenol to confirm the persistence of conduction block. The design of the ablation protocol is shown in Figure 2. All patients were observed in the hospital for at least 4 hours postprocedure. Patients were followed in the arrhythmia clinic with electrocardiogram at 3 months, 1 year, and yearly afterward. Patients with symptoms also underwent event monitoring, as needed.

Results

Thirty-two consecutive patients with common AFL underwent linear ablation of CTI. Patients were 58 ± 9 years of age, and 81% were men. A history of paroxysmal atrial fibrillation was present in 30% of the patients. Hypertension was present in 72%, diabetes mellitus in 30%, congestive heart failure in 25%, and coronary artery disease in 15% of the patients. Mean LA size was 42 ± 11 mm in diameter. Mean left ventricular ejection fraction was 51% ± 10%.

The acute success rate for radiofrequency ablation of CTI was 94% (30 of the 32 patients). There were no com-

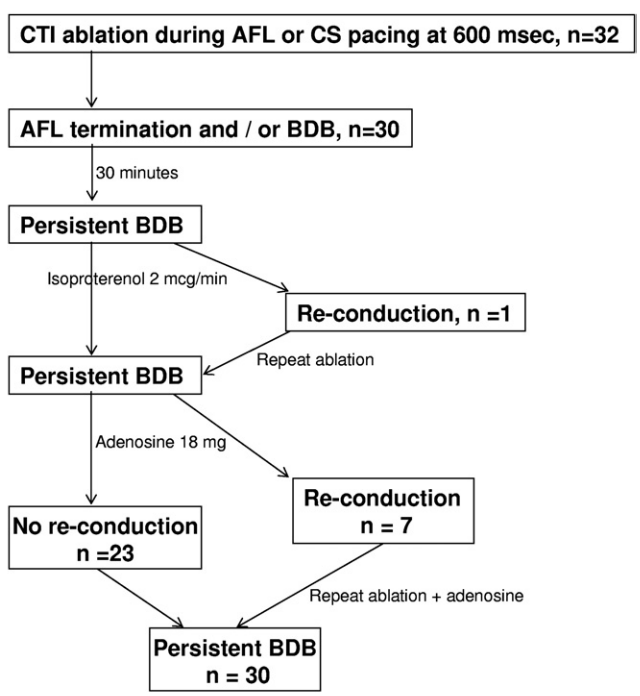

Figure 2 Schematic representation of the ablation protocol. AFL = atrial flutter; BDB = bidirectional conduction block; CS = coronary sinus; CTI = cavotricuspid isthmus.