

A case of successful termination of an atrial tachycardia ablated from the pulmonary artery during rapid ventricular pacing



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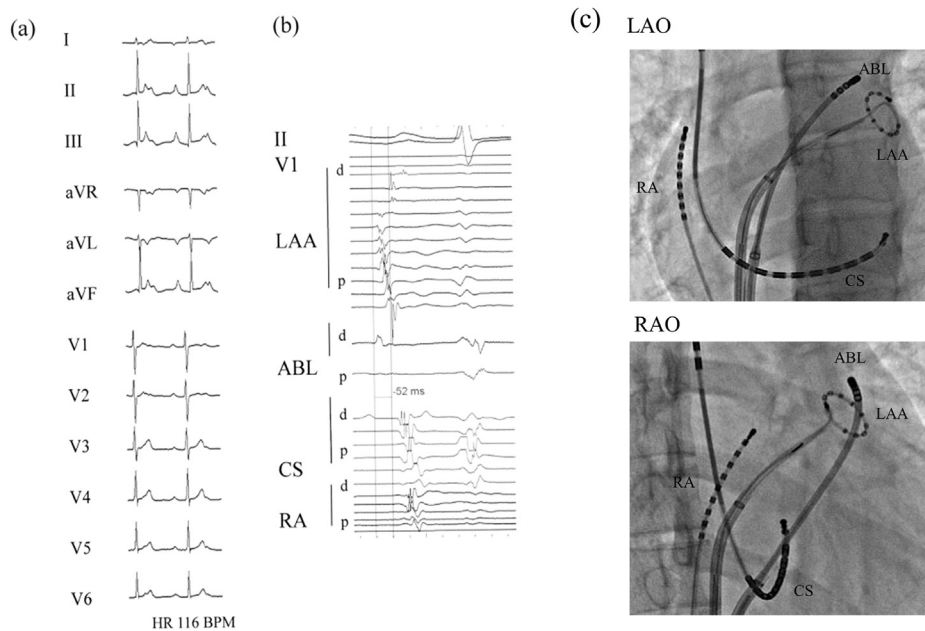


Figure 1 a: Surface ECG recorded during atrial tachycardia (AT). P-wave polarity during the AT was positive in leads II, III, aVF, and V₁ and negative in leads I and aVL. The AT cycle length was 510 ms. b: Findings from ablation in the pulmonary artery. The earliest local atrial potential preceded P-wave onset by 52 ms. Ablation from that site temporarily accelerated the AT rate (116 to 159 bpm); however, the AT could not be successfully terminated. c: Catheter location at the earliest activation site of AT. The ablation catheter was located on the anterior side of the left atrial roof. ABL = ablation catheter; CS = coronary sinus; LAA = left atrial appendage; LAO = left anterior oblique; RA = right atrium; RAO = right anterior oblique.

Introduction

The local blood flow may prevent the formation of transmural lesions by convective heat loss to the blood during radio frequency energy application. In this case, we attempted a novel approach for atrial tachycardia from areas adjacent to the coronary arteries.

KEYWORDS Catheter ablation; Pacing; Atrial tachycardia; Coronary flow; Bachmann bundle

ABBREVIATIONS AT = atrial tachycardia; ATP = adenosine 5'-triphosphate; RF = radiofrequency (Heart Rhythm Case Reports 2015;1:133-136)

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Case report

A 21-year-old woman with no history of significant illness who was suffering from frequent palpitations was referred to our institution. Findings from chest radiography, laboratory tests including thyroid hormone level, and echocardiography were within normal limits. An incessant atrial tachycardia (AT) was observed. Total cardiac beats were 157,093 per day (mean heart rate 109 bpm, peak heart rate 163 bpm).

After obtaining written informed consent, electrophysiologic study and catheter ablation were performed. All antiarrhythmic drugs were discontinued 1 week before the procedure. Four electrode catheters were inserted via the right femoral and cervical veins and positioned in the coronary sinus (6Fr 20-pole wide band catheter, St. Jude Medical,

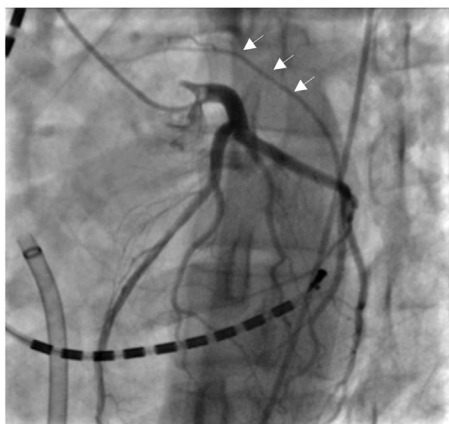
KEY TEACHING POINTS

- A direct recording of the Bachmann bundle can be obtained by a catheter located in the pulmonary artery. This is the first study to demonstrate successful ablation of an atrial tachycardia approached from the pulmonary artery.
- The Bachmann bundle region is supplied by the left sinonodal artery in up to 40% of patients.
- Local coronary blood flow can prevent the formation of transmural lesions by convective heat loss to the blood. Local coronary flow can be reduced by rapid ventricular pacing maneuvers, which are a novel approach to tachyarrhythmias originating from areas adjacent to the coronary arteries.

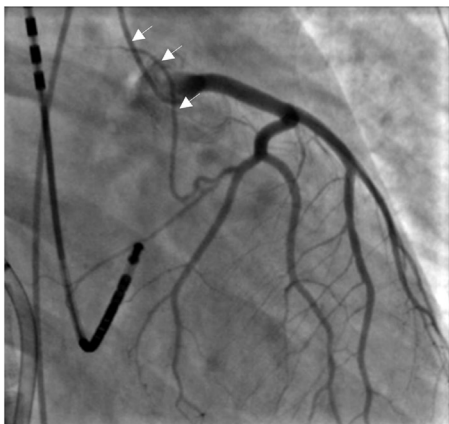
Minneapolis, MN), right atrium (6Fr 20-pole catheter, St. Jude Medical), and left atrium (20-pole spiral catheter, Optima, St. Jude Medical). Intracardiac electrograms and surface ECGs were monitored continuously and recorded using an EP Workmate recording system (St. Jude Medical).

During electrophysiologic study, an incessant AT was observed with its earliest atrial activation recorded in the septal region. The AT persisted irrespective of spontaneous AV block. An intravenous bolus of 20 mg adenosine 5'-triphosphate (ATP) during the tachycardia temporarily terminated the AT without AV block; however, the tachycardia spontaneously recurred. A 3-dimensional map (CARTO XP, Biosense Webster, Diamond Bar, CA) was used to determine the earliest site of AT activation in both the atrium and aortic valve. Radiofrequency (RF) energy was delivered to the earliest activation site in the left coronary cusp, but the AT was not successfully terminated. We then searched in the area of the pulmonary artery. An earliest activation site preceding P-wave onset by 56 ms was identified at the pulmonary artery valve (Figure 1). RF energy up to 50 W applied using a 4-mm irrigation-tip catheter (Navistar, Thermocool, Biosense Webster) at the earliest activation site at the pulmonary artery valve could not terminate the AT. However, the atrial rate temporarily accelerated during RF application. Coronary angiography revealed that the AT origin was adjacent to the sinonodal artery branching from the left circumflex branch. Multi-detector computed tomography showed that the sinonodal artery was included in the Bachmann bundle, which was

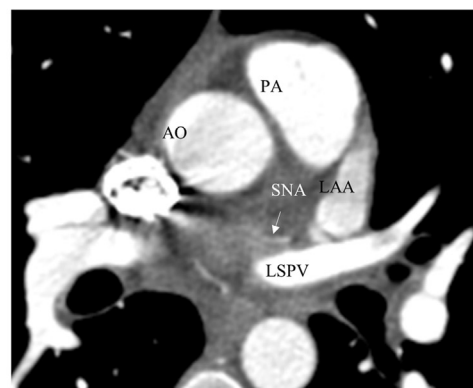
(a) LAO



RAO



(b) Horizontal



Longitudinal

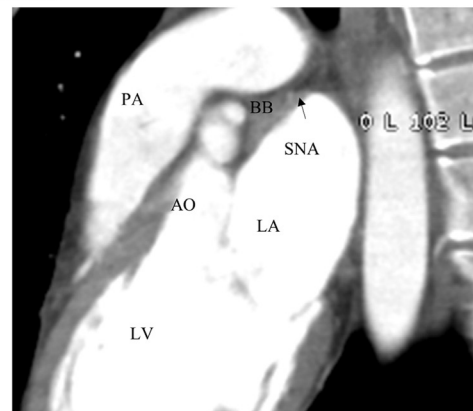


Figure 2 a: The sinus nodal artery (SNA) from the left circumflex artery along the left atrial roof is clearly visible (arrowheads) in fluoroscopic views. b: Multidetector computed tomographic image. Horizontal axis shows the left SNA (arrow) running along the left atrial (LA) roof between the left atrial appendage (LAA) and left superior pulmonary vein (LSPV). Longitudinal axis shows the Bachmann bundle (BB) coexisting with the SNA (arrow) and located between the LA roof and the pulmonary artery (PA). AO = aorta; LV = left ventricle.

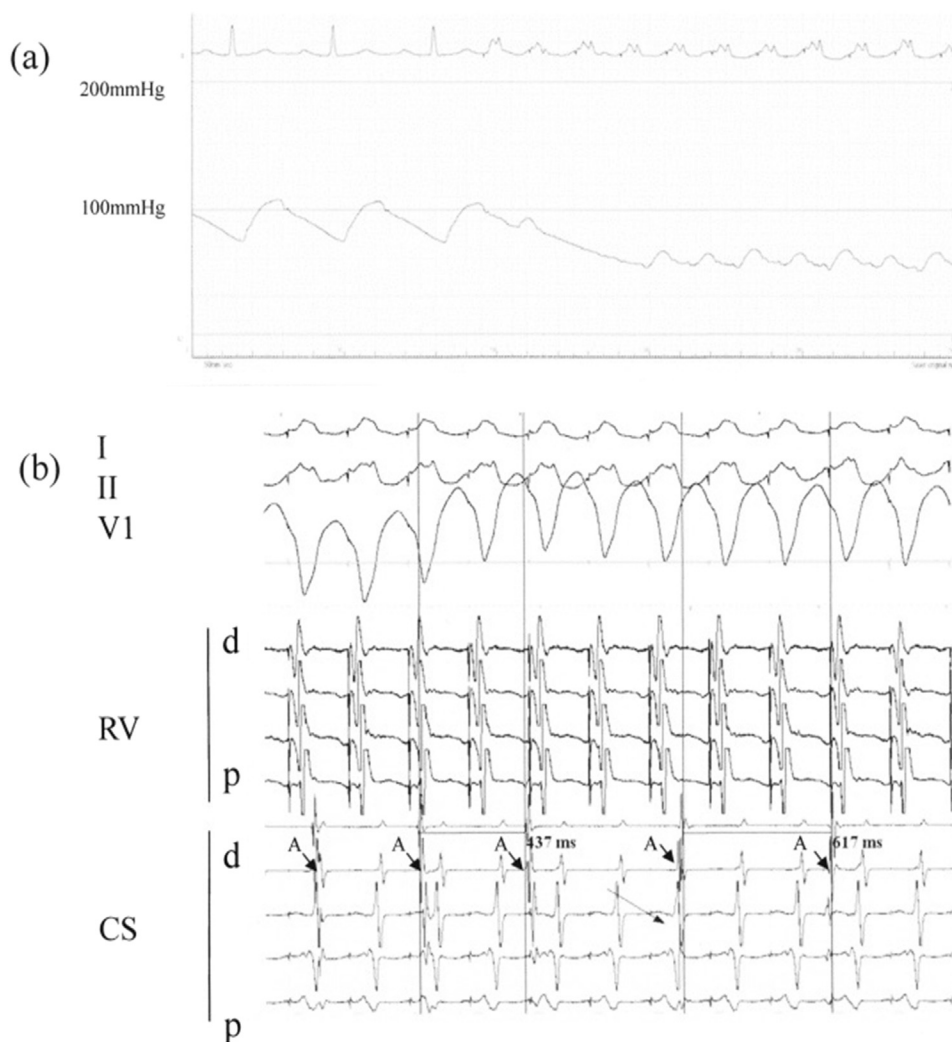


Figure 3 a: Pressure monitoring during rapid ventricular pacing. Systemic systolic pressure decreased suddenly from 110 to 70 mm Hg during the pacing maneuver. b: Radiofrequency energy application up to 50W successfully terminated the atrial tachycardia (AT) after 20 seconds from the start of the application. During ventricular pacing, activation of the atrium and ventricle became dissociated. However, we could easily identify the change in atrial activation sequence, with remarkable prolongation of the AT cycle length (437 to 617 ms, long arrow).

accessible from the pulmonary artery (Figure 2). Systolic blood pressure significantly decreased with rapid right ventricular pacing, and RF application at 50 W successfully terminated the AT (Figure 3). Coronary angiography repeated after RF delivery did not reveal any significant coronary abnormalities.

Discussion

We report the case of a patient with a focal AT ablated from the pulmonary artery, which was adjacent to the left sinonodal artery. RF application under rapid ventricular pacing that presumably prevented any heat loss effect from local coronary blood flow successfully terminated the AT.

A tall P wave with a narrow P-wave duration on leads II and III of the 12-lead ECG may represent the features of a focal AT originating from the Bachmann bundle, which runs epicardially through the anterosuperior portion between both

atria. The Bachmann bundle might be a predisposing cause of ATs because it includes a unique conduction system. In this case, the mechanism of AT might have been increased automaticity given the tachycardia's continuous persistence and ATP sensitivity. In histologic analyses, the Bachmann bundle contains 5 types of myocardial cells: myofibril-rich, myofibril-poor, broad transitional cells, transitional cells, and P cells. The P-cells in the Bachmann bundle are similar to the P-cells in the sinoatrial and/or AV node¹; therefore, the Bachmann bundle potentially could be associated with increased occurrence of automaticity. It is generally difficult to record direct Bachmann bundle potentials because it is a distinct structure separate from the atrium; however, a previous report suggested that the Bachmann bundle and the epicardial surface of the left atrial appendage could be accessed by a catheter located in the pulmonary artery.² In addition, mapping of both pulmonary arteries can include far-field atrial potentials of both atrial regions, which can provide useful information to differentiate right and left atrial

tachycardia.³ To the best of our knowledge, this is the first report of successful termination of a focal AT from the Bachmann bundle via a pulmonary artery approach.

In this case, the left sinoatrial artery, which arises from the left circumflex artery, ran through the left atrial roof beside the Bachmann bundle. Angiographic assessment demonstrated that the sinoatrial artery arising from the left coronary artery can be visually observed in 35% of patients,⁴ and multidetector computed tomographic data have shown that the Bachmann bundle region is supplied by the left sinoatrial artery in 40% of patients.⁵ The epicardial coronary arteries could be possible obstacles to creating transmural lesions during RF ablation because local coronary blood flow can prevent the formation of transmural lesions by convective heat loss to the blood.⁶ Our prior study also supported the observation that local coronary blood flow, even from small vessels, could protect the atrium from any transmural damage from RF applications in the mitral isthmus area.⁷ Temporary balloon occlusion of the coronary sinus to reduce local coronary flow may facilitate achieving transmural conduction block at the RF site⁸; however, other alternative methods have not been reported. A rapid ventricular pacing maneuver can be a novel, simple promising method to reduce coronary artery flow adjacent to RF lesions by sudden reducing cardiac perfusion pressure. The blood flow of both atria is also simultaneously reduced under rapid ventricular pacing, so use of an irrigated-tip RF catheter or alternative energy likely is essential for effective RF energy application to terminate AT. Hence, rapid ventricular pacing can be useful for creating better cryolesions by the cryoballoon balloon technique by reducing the local temperature at ablation sites.⁹ Further studies on preventing thermal damage

to the coronary arteries as a result of vessel trauma and proving the efficacy of rapid ventricular pacing maneuvers are needed. Left coronary arterial visualization obtained in advance could provide useful information, especially in patients in whom RF energy applications were unsuccessful.

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