

# Premature Contraction with a Widespread Breakthrough on the Left Atrial Anterior Wall: Where is the Origin?

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## EP Rounds

### Premature Contraction with a Widespread Breakthrough on the Left Atrial Anterior Wall: Where is the Origin?

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## KEYWORDS

Premature atrial contraction; Bachmann bundle; left atrium; pulmonary vein; wide antral circumferential ablation.

## CASE PRESENTATION

A 38-year-old woman was referred to our institution due to skipped beats and general fatigue. Atrial bigeminy was recorded on a surface electrocardiogram (Fig. 1). Although the detailed morphology of premature atrial contractions (PACs) was difficult to discern due to its overlap with T waves, positive P waves in inferior leads

and lead V1 suggested that PACs were originated from the left atrium close to the right superior pulmonary vein (PV).<sup>1</sup> In a 24-hour Holter electrocardiogram, premature atrial contractions (PACs) occurred at a frequency of 30,880 beats per day. Although 1.25 mg of bisoprolol reduced the PAC burden, it had to be discontinued due to sinus bradycardia. Given the severity of her symptoms, we decided to perform catheter ablation for PACs. The activation map of PACs was created on a high-density mapping system (CARTO 3 mapping system, Biosense-Webster, Inc., Diamond Bar, CA). After transeptal puncture, sequential contact mapping of the left atrium was performed using a multispline mapping catheter (Pentaray; Biosense Webster, Inc.). The activation map showed a centrifugal activation with a widespread breakthrough on the anterior wall (Fig. 2A). Local potentials recorded in the earliest activation site preceded the distal coronary sinus potential, which served as a reference, by 110 ms (Fig. 2B). In contrast, the local potentials recorded in the right pulmonary vein were only 10 ms earlier than the reference (Fig. 2C). Where is the origin of the PACs? What is the optimal ablation strategy for this case?

## DISCUSSION

Centrifugal activation with widespread breakthrough suggested that the activation originated from epicardial structures.<sup>2,3</sup> Considering the location of the breakthrough site, it was likely that the PACs originated from the Bachmann bundle or its branches.<sup>3</sup> Extensive ablation was deemed necessary to eliminate these PACs if we targeted the widespread breakthrough. Therefore, despite the local potentials in the right PV being later than those in the anterior wall, we performed wide antral circumferential ablation (WACA) for the right PV to disconnect the PAC origin from the anterior wall (Fig. 3A). Following the completion of right PV isolation, PACs were eliminated, and frequent ectopic beats were observed in the right PV (Fig. 3B). These ectopic beats originated from the antrum of the right superior PV. Additional ablation targeting these ectopic beats was performed; however, they were not completely eliminated. To prevent PV stenosis, further ablation was avoided. The patient was discharged two days post-procedure without any complications, and no recurrence of PACs has been observed over a 28-month follow-up period.

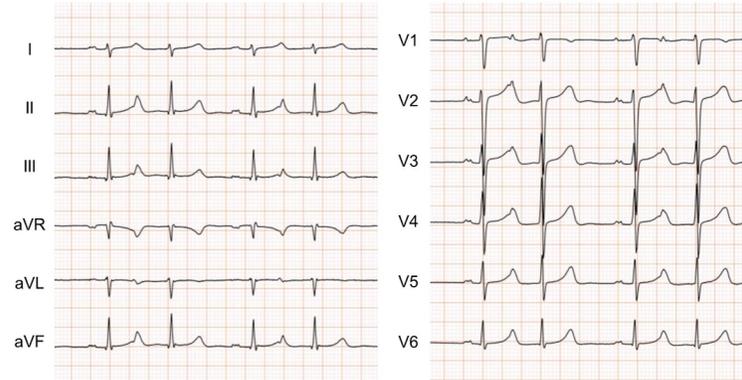
In our retrospective analysis of the baseline left atrial map, we identified a small, blunt prepotential localized to the area associated with the proximal Bachmann bundle (Fig. 3A). We considered this prepotential to represent the far-field sensing of the PAC origin within the proximal Bachmann bundle. In this case, PACs were eliminated during right PV isolation. This phenomenon can likely be attributed to the disruption of the electrical connection between the PAC origin and the distal Bachmann bundle. Additionally, we observed ectopic beats originating from the antrum of the right superior PV after WACA. The disruption of the preferential conduction pathway toward the distal segment of the Bachmann bundle may have unveiled electrical connections between the proximal segment of the Bachmann bundle and the antrum of the right superior PV.

It remains uncertain whether our strategy of isolating the PAC origin in the Bachmann bundle through WACA is applicable to all similar cases, as ablating epicardial structures such as the Bachmann bundle via endocardial ablation poses challenges. However, this case provides critical insights into ablation strategies for PACs originating from epicardial structures like the Bachmann bundle.

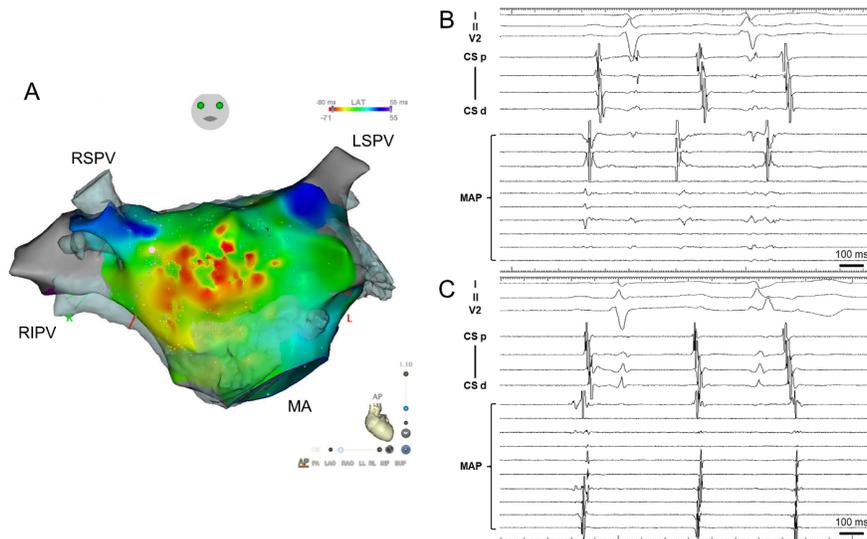
## REFERENCES

1. Kuo JY, Tai CT, Tsao HM, Hsieh MH, Tsai CF, Lin WS, Lin YK, Ding YA, Hou CJ, Tsai CH, Chen SA. P wave polarities of an arrhythmogenic focus in patients with paroxysmal atrial fibrillation originating from superior vena cava or right superior pulmonary vein. *J Cardiovasc Electrophysiol.* 2003 Apr;14(4):350-7.
2. Pathik B, Lee G, Sacher F, Haïssaguerre M, Jaïs P, Massoulié G, Derval N, Sanders P, Kistler P, Kalman JM. Epicardial-endocardial breakthrough during stable atrial macroreentry: Evidence from ultra-high-resolution 3-dimensional mapping. *Heart Rhythm.* 2017 Aug;14(8):1200-1207.
3. Nakatani Y, Nakashima T, Duchateau J, Vlachos K, Krisai P, Takagi T, Kamakura T, André C, Goujeau C, Daniel Ramirez F, Chauvel R, Tixier R, Takigawa M, Kitamura T, Cheniti G, Denis A, Sacher F, Hocini M, Haïssaguerre M, Jaïs P, Derval N, Pambrun T. Characteristics of macroreentrant

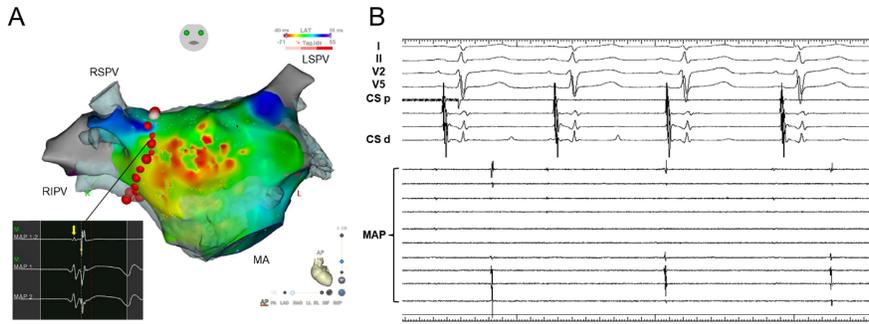
## FIGURES



**Figure 1.** A surface electrocardiogram during atrial bigeminy.



**Figure 2.** Activation map and intracardiac electrograms of premature atrial contractions (PACs). (A) The activation map of the left atrium, showing centrifugal activation with widespread breakthrough in the anterior wall. (B, C) Intracardiac electrograms recorded when the mapping catheter (MAP) was positioned in the anterior wall (B) and right superior pulmonary vein (C). CS, coronary sinus; LSPV, left superior pulmonary vein; MA, mitral annulus; RIPV, right inferior pulmonary Vein; RSPV, right superior pulmonary vein.



**Figure 3.** Activation map and intracardiac electrograms recorded after wide antral circumferential ablation. (A) The activation map with tags indicating ablation sites. A small, blunt prepotential (a yellow arrow) was observed in the point corresponding to the proximal segment of the Bachmann bundle. This point is also indicated by a pink tag in Fig 2A. (B) Intracardiac electrograms with the mapping catheter (MAP) positioned in the right superior pulmonary vein. Abbreviations are as defined in Fig. 2.