

Utility of a 64-pole basket catheter to detect non-pulmonary vein trigger in patients with paroxysmal atrial fibrillation



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Introduction

Catheter ablation (CA) of paroxysmal atrial fibrillation (AF) represents an important therapeutic strategy, particularly for patients with drug-resistant symptoms. While pulmonary vein isolation (PVI) is a well-established strategy, AF recurs in around 30% of patients.¹ Identification and ablation of non-pulmonary vein (PV) foci is also important to reduce recurrence.² Many of these foci have already been described.³ Some foci, such as the superior vena cava (SVC) and left atrial posterior wall (LAPW), are well known and relatively simple to treat, but others are easily overlooked or difficult to access for ablation.

We present 2 patients with non-PV foci, detected using a 64-pole basket catheter.

Case report

Case 1

A 65-year-old woman presented with recurrent AF, 7 years after 2 PVI treatments. Her symptoms had been well controlled with antiarrhythmic drugs, but she gradually developed worsening palpitations owing to rapid AF and sinus pauses. On admission, her electrocardiogram showed sinus rhythm with a rate of 56 beats per minute and echocardiography demonstrated normal cardiac function without left atrial enlargement. A third session of CA was performed using an open-irrigated contact-force catheter (ThermoCool Smart-Touch SF; Biosense Webster, Diamond Bar, CA) with an electroanatomic mapping system (CARTO 3; Biosense Webster). Propofol combined with dexmedetomidine by continuous infusion was used for sedation. During the procedure, 4 PVs were isolated, and non-PV foci were detected at the

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SVC, LAPW, and interatrial septum, all of which were successfully ablated. Although her AF became more difficult to induce, we noticed an atypical focus somewhere in the right atrium (RA), which we were unable to localize. This unfortunately led to ongoing symptoms. Eight months later, we were able to localize this untreated focus using the basket catheter (other catheters had been unable to adequately localize this focus), and this area was successfully ablated. We constructed a voltage map with a ring catheter using the EnSite Precision 3D mapping system (Abbott, Plymouth, MN), followed by a contact force-sensing catheter to confirm the low-voltage area. An isoproterenol infusion and atrial burst pacing were used to induce continuous AF, after cardioversion. A 48 mm 64-pole basket catheter (Constellation; Boston Scientific, Cambridge, MA) was placed in the RA, and a triggered atrial premature complex (APC) was repeatedly observed originating from an area close to the low-voltage zone in the lower posterior RA (Figure 1A and B). This zone was also confirmed to be low voltage by a contact force-sensing catheter before radiofrequency application. The AF terminated in 3 seconds with cycle length gradually prolonged by radiofrequency application to this area (Figure 2A and B). At follow-up, 6 months after the procedure, the patient reported infrequent minor palpitations and a portable monitor detected APCs with no AF recurrence.

Case 2

A 64-year-old woman was referred to our hospital with persistent palpitations 8 months after PVI and presyncope owing to bradycardia-tachycardia syndrome. On admission her electrocardiogram showed sinus rhythm with a rate of 64 beats per minute and echocardiography showed left atrial dilatation (diameter 50.4 mm). We performed a second CA under sedation using the same procedure as in case 1 above. After performance of PVI and LAPW isolation with the EnSite Precision 3D mapping system (Abbott) and the Flex-Ability ablation catheter (Abbott), AF was induced with isoproterenol and adenosine. The AF inducibility was unreliable and it was difficult to precisely locate the non-PV foci, although we suspected they were originating in the RA based

KEY TEACHING POINTS

- Eliminating non-pulmonary vein (PV) foci of atrial fibrillation is important to maintain sinus rhythm.
- Detecting the precise location of non-PV foci is difficult, especially in multiple non-PV foci and atrial fibrillation with low inducibility.
- A 64-pole basket catheter is useful to detect non-PV foci in such difficult cases.

on intracardiac activation patterns. Using a 48 mm 64-pole basket catheter (Constellation; Boston Scientific) in the RA, we could detect multiple non-PV foci around the superior and inferior regions of the interatrial septum (Figure 3A–C). After radiofrequency application to each individual site (Figure 3B), inducibility from this area vanished. We also ablated the opposite side of the septal wall at the same location. Since the procedure, the patient has been asymptomatic, with no recurrence of AF.

Discussion

The PV is the major focal point for AF and ablation of this area is the cornerstone of intervention, but around 20% of

patients have non-PV foci.^{2,4,5} Even if PV foci are successfully isolated, recurrence of AF is more likely if non-PV foci are not detected. However, if non-PV foci are identified and completely eliminated, the AF recurrence rate is equal to that in patients without non-PV foci.² Furthermore, patients with bradycardia-tachycardia syndrome may avoid pacemaker implantation. However, the combination of AF and sick sinus syndrome is associated with higher rates of recurrence owing to presence of non-PV foci, and their elimination is therefore critical.⁶

After a rough estimation is made of AF foci by analyzing intracardiac activation patterns recorded from a multipolar coronary sinus and RA/SVC catheter, more detailed mapping is required to detect the precise location of non-PV foci.^{3,7} Several mapping strategies have been reported. Santangeli and Marchlinski³ describe manipulation of multiple catheters guided by P-wave morphology and the use of intracardiac activation patterns of triggered APCs to detect non-PV foci. They also recommend detailed pace mapping of common non-PV sites. Self-reference mapping using the PentaRay catheter (Biosense Webster) is another strategy, documented by Matsunaga-Lee.⁸ However, the authors mention that use of these multielectrode catheters is limited by the need to reproduce the AF in the same site.

The presence of multiple non-PV foci makes localization more difficult. Non-PV, non-SVC, and non-LAPW foci are challenging, as focal ablation of precise trigger sites is

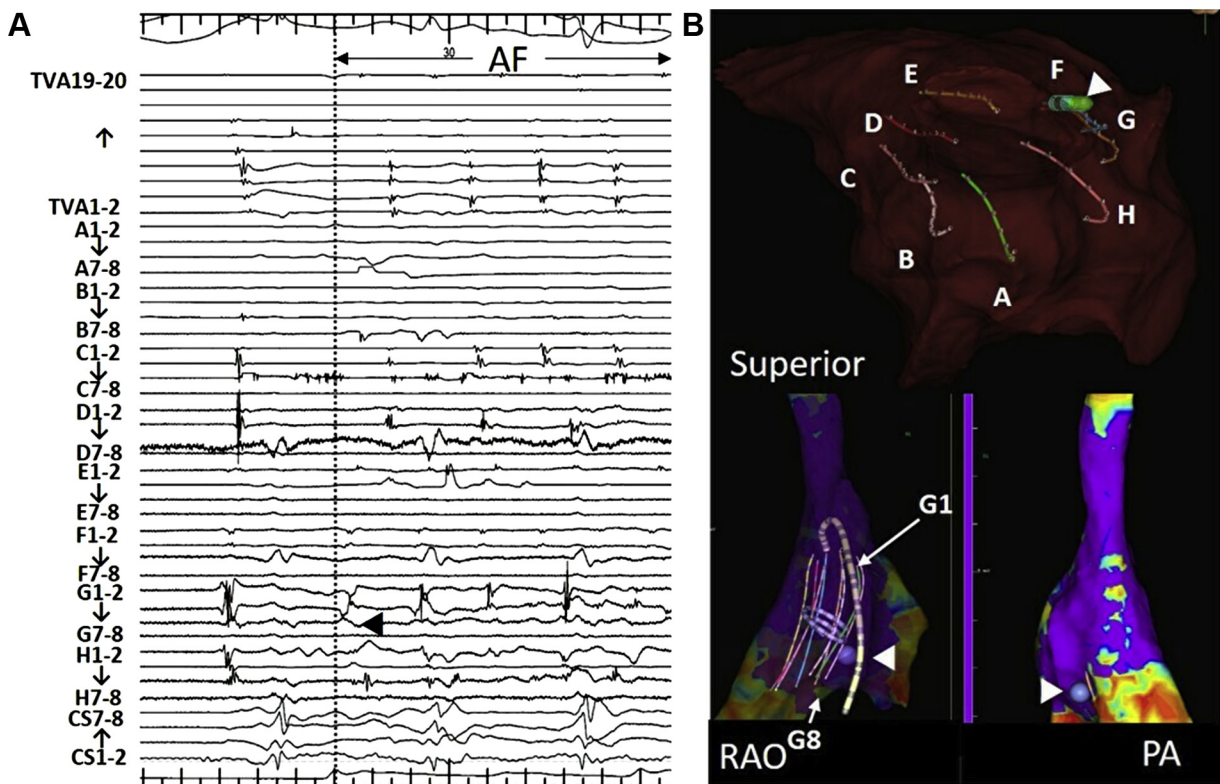


Figure 1 A: Cardiac tracing exhibiting the onset of atrial fibrillation (AF) triggered by an atrial premature complex (APC) originating from the lower right atrium. The earliest atrial activation of the APC (black arrowhead) is recorded at the G5-6 electrode of the 64-pole basket catheter. B: Voltage map of the right atrium and catheter position. Radiofrequency application to the green tag (white arrowhead) terminated the AF. CS = coronary sinus; PA = posteroanterior; RAO = right anterior oblique; TVA = tricuspid valve annulus.

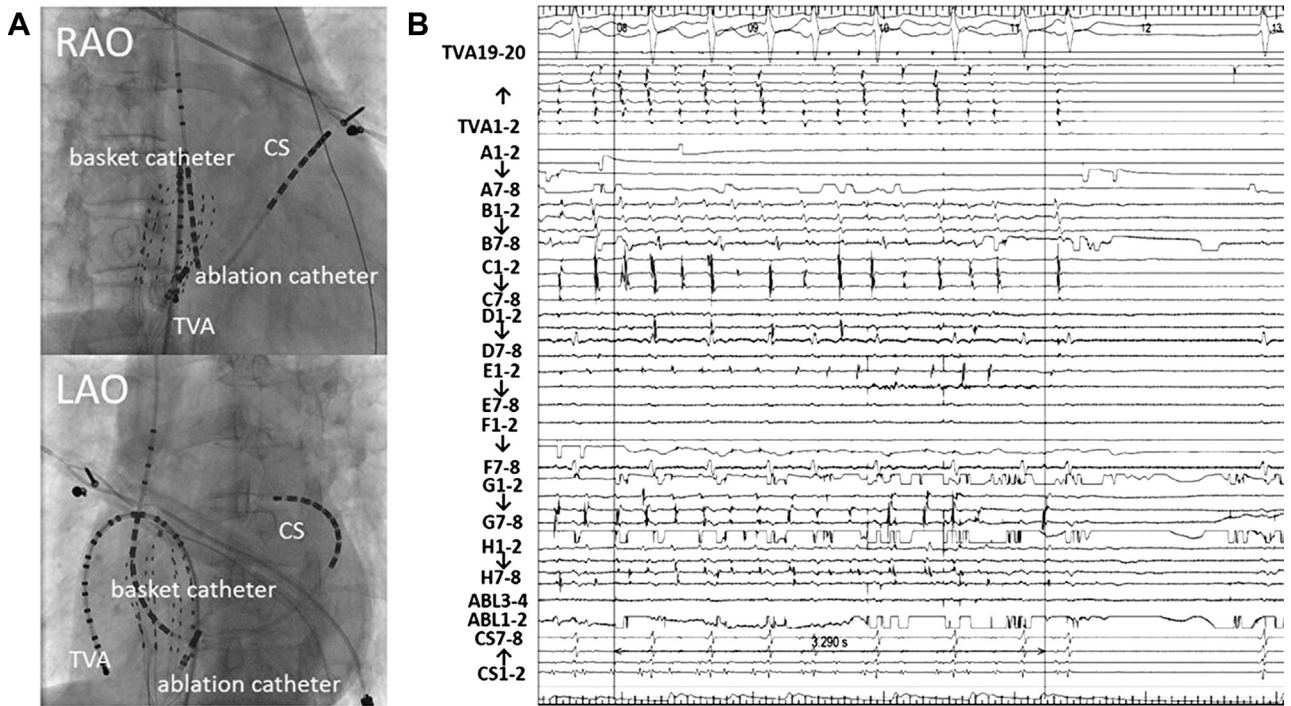


Figure 2 A: Successful radiofrequency application and catheter positions. B: Atrial fibrillation terminates 3 seconds after radiofrequency application to the earliest activation site of the triggered atrial premature complex. ABL = ablation catheter; CS = coronary sinus; LAO = left anterior oblique; RAO = right anterior oblique; TVA = tricuspid valve annulus.

required. Empiric isolation of SVC and LAPW may be useful to simplify mapping of non-PV foci originating from areas other than the SVC or LAPW. After isolating the SVC and LAPW, we searched for the typical anatomic regions including the coronary sinus, ligament of Marshall, crista terminalis, and Eustachian ridge.³ However, in case 1 above, although the SVC and LAPW were isolated, the accurate

location of non-PV foci in the RA was not possible using a multielectrode catheter owing to their atypical location; and in case 2, after LAPW isolation, it was difficult to detect non-PV foci because the inducibility was relatively low and multiple triggers arose from the interatrial septum. Nevertheless, we were able to detect non-PV triggers in both cases. Therefore, our strategy could be useful to search

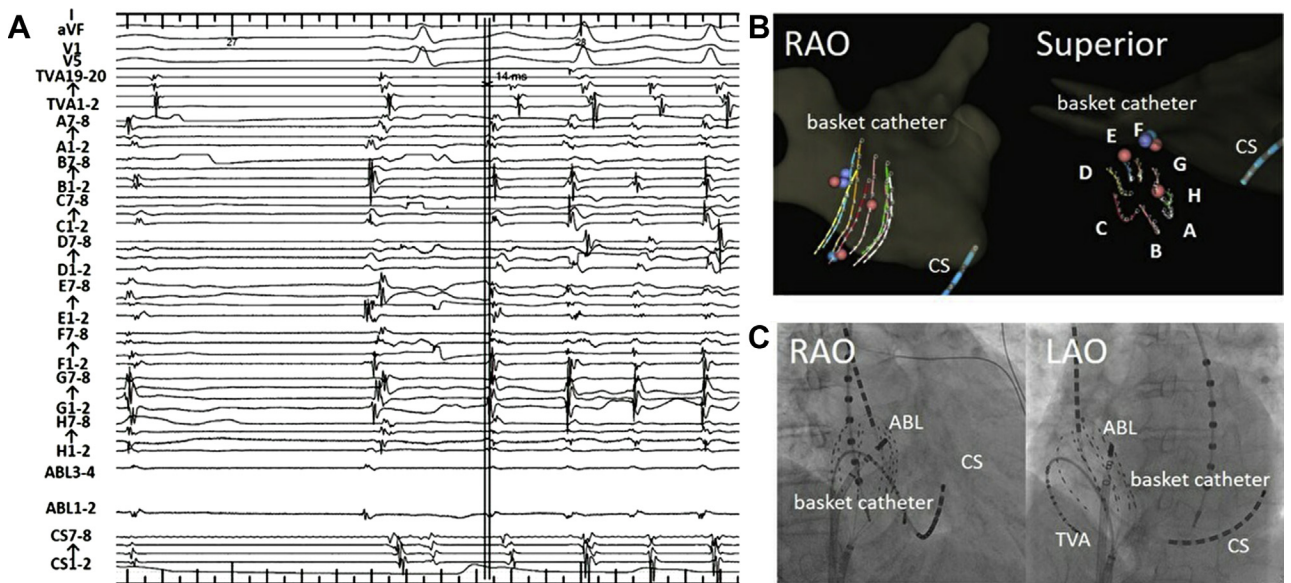


Figure 3 A: Representative intracardiac activation pattern of a non-pulmonary vein focus in case 2. The earliest atrial activation was recorded 14 ms ahead of P-wave onset by a 64-pole basket catheter. B: Catheter positions and representative ablation points on 3D mapping. Red tags are the ablation points from the right atrium, and the blue tags are from the left atrium. C: Catheter positions during radiofrequency application to the right atrial septum. ABL = ablation catheter; CS = coronary sinus; LAO = left anterior oblique; RAO = right anterior oblique; TVA = tricuspid valve annulus.

for triggers arising from not only typical regions, but also atypical regions.

There are several advantages in this strategy. First, 64-pole multielectrode basket catheters cover a wider angle than other catheters. Second, the EnSite Precision 3D mapping system (Abbott) can help to detect the precise location of ectopic foci by showing the basket catheter in their system. Finally, voltage mapping can help detect AF foci, as atrial ectopy is associated with diseased myocardium.⁹

Using a multielectrode basket catheter combined with a 3D mapping system has previously been reported in patients with right-sided atrial tachycardia,¹⁰ but this is the first publication documenting the use of a basket catheter for non-PV foci of AF.

Conclusions

A 64-pole basket catheter was useful to detect non-PV foci, especially multiple non-PV foci and AF with low inducibility.

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