

Multielectrode basket catheter: A new tool for curing atrial fibrillation?

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Over the last decade, considerable advances have been made in both the understanding and the curative treatment of atrial fibrillation (AF), with excellent results even in patients with persistent and permanent AF. Pulmonary vein (PV) isolation as initially proposed by Haissaguerre et al^{1,2} has several disadvantages and a relatively low success rate, particularly in patients with long-lasting AF. PV isolation is much less effective, particularly in patients with persistent AF, because PV isolation alone affects only triggers of AF. Therefore, it has become increasingly clear that to improve the clinical outcome of PV isolation strategy, elimination of PV triggers alone may not be sufficient but must be combined with substrate modification.^{3,4} Success rates have improved with the evolution and development of PV isolation, but more extensive and deeper lesions have brought the spectra of important complications, such as atrio-esophageal fistula and cardiac perforation. If PV isolation with more extensive lesions can produce better outcomes, the crucial question is how extensive the lesions must be to maintain or even increase the success rate while minimizing risk and complications. PV disconnection has been guided by different mapping systems. More recently, circumferential lesions around PV ostia have been reported in patients with paroxysmal or persistent AF by using the Constellation multielectrode basket catheter in combination with the Astronomer nonfluoroscopic three-dimensional navigation system.⁵ Isolation of PV antra guided by intracardiac echocardiography has been reported as an alternative approach for curing AF, but this technique has some technical limitations. Because the PV antrum has a large diameter, a stationary Lasso catheter located in just one position in order to locate PV potentials cannot map its circumference. The oblique nature of the antral-left atrium interface makes stabilization of the Lasso catheter difficult, particularly at challenging sites such as anterior segments of the left PVs or septal segments of the right PVs. Therefore, in patients undergoing PV antra isolation, catheter stability, although time-consuming, should be considered a crucial endpoint. In

addition, PV potentials may be confused with left atrial appendage potentials, particularly around the left PVs where pacing maneuvers are often required.

In this issue of *Heart Rhythm*, Yamada et al⁶ present their observations on catheter ablation of the PV antrum guided by a multielectrode basket catheter (Constellation, EP Technologies, Boston Scientific, San Jose, CA, USA), raising the important question as to how much ablation is required to achieve good outcomes while minimizing complications. The multipolar catheter was placed transseptally into each PV to record its activation during ectopic beats, sinus rhythm, or coronary sinus pacing.

This new approach, defined as “minimally extensive pulmonary vein antrum isolation,” was performed in 55 consecutive symptomatic patients with paroxysmal AF.⁶ The authors used the multielectrode basket catheter (31-mm diameter, 64 electrodes mounted on eight flexible, self-expanding splines) to target PV antra potentials, which were defined as fusion of PV and left atrial potentials around PV ostia. The exact position of the multielectrode basket catheter in relation to the PV ostium was determined by angiography. A navigation system (Astronomer, Boston Scientific, San Jose, CA, USA) was used for guiding the ablation catheter inside or near the multielectrode basket catheter. Not surprisingly, the right inferior PVs were more difficult to cannulate or map than were other PVs, confirming the results of previous studies using the same system.⁵ In many cases, circumferential ablation of right inferior PVs was performed with a deflectable circular catheter. In other cases, PV mapping was not performed because the small size of the ostia did not permit stable positioning of the multielectrode basket catheter. As in a previous study,⁵ conduction gaps were frequently observed. This finding likely was due to the unstable position of the multielectrode basket catheter, which is particularly common in challenging sites such as the border of ipsilateral PVs or between the left superior PV and left atrial appendage. The averages of the total procedure times and fluoroscopy times were relatively short (145 and 59 minutes, respectively). No major complications such as PV stenosis or left atrial flutter were reported, but carbonization adherence to the splines can occur and may be associated with an increased risk for neurologic sequelae or stroke.⁵ During 11-month follow-up,

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84% of patients were free of symptomatic paroxysmal AF without drugs after the first procedure. After repeat procedures, 93% of patients were free of recurrences without drugs during a mean follow-up of 6 months. The results of this study are intriguing because they show different activation patterns at the junction of the LA–PVs during sinus rhythm and ectopy to obtain complete elimination of all distal PV potentials using less extensive ablation. The authors attempted to map PV antrum potentials in all PVs based on ECG, fluoroscopy, and venography. Once stabilized, the system could record and ablate the transverse activation pattern, which in all probability reflects activation of the circle of myocardium at the PV antrum. The authors defined PV antrum potentials as single sharp potentials due to fusion of the PV and left atrial potentials around the PV ostia and transverse activation as the simultaneous activation of electrode pairs along the spline. They proposed that PV ablation targeting such potentials, for the first time defined as minimally extensive PV ablation, would target the transition zone between the PV ostium and left atrium. The targeted spline of the multielectrode basket catheter was bumped by the ablation catheter as in segmental PV isolation. Although this “minimally extensive PV isolation” was associated with a good short-term outcome, daily monitoring or extended monitoring with auto trigger devices was not done, which likely resulted in missing asymptomatic episodes of AF after the procedure.

The results of this study suggest that, among patients with paroxysmal AF, ablation of PV antrum potentials at the transition zone, as defined here and identified by the multielectrode basket catheter, can be considered a useful electrophysiologic target for minimally extensive ablation to permanently isolate PV antra even using standard radiofrequency power settings. However, the results are preliminary and must be confirmed by studies with a larger number of patients and longer follow-up. Unfortunately, the mechanisms of initiating, maintaining, or perpetuating AF are different, complex, and certainly multiple, and it is reasonable to believe that they cannot be eliminated altogether by PV or PV antra isolation alone.⁷ How much minimally extensive PV antra isolation, as described here, differs from PV isolation and whether the approach with the multielectrode basket catheter in the left atrium really is safer and more effective than PV isolation require a comparative study and a much larger number of patients. In our opinion,

a substantial limitation of this approach is the fact that deployment of the multielectrode basket catheter was impossible in many patients and that the circular catheter was required, particularly for the right inferior PV, which is considered a challenging site. In addition, the potential usefulness of this new approach in patients with long-lasting AF remains to be demonstrated. Although PV isolation by multielectrode basket catheter guided by electrophysiologic parameters such as PV antra potentials does not appear to require as extensive ablation as conventional PV isolation, we do not see the evolution of technology in this setting as a big step forward in the therapy for AF unless at least more than one of all the mechanisms of AF can be affected by such tools.

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