EDITORIAL
http://dx.doi.org/10.4070/kcj.2011.41.8.431

Print ISSN 1738-5520 / On-line ISSN 1738-5555

Open Access

Large Circular Ring Catheter Ablation Versus Anatomically Guided Ablation of Atrial Fibrillation: Back to the Future for Successful Catheter Ablation of Atrial Fibrillation?

Hui-Nam Pak, MD

Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System, Seoul, Korea

Refer to the page 447-452

Historical Perspective

Radiofrequency catheter ablation of atrial fibrillation (AF) is an effective rhythm control strategy, and its efficacy has been proved to be superior to anti-arrhythmic drugs.[1-3] Recently, the European Society of Cardiology's 2010 revised guidelines for AF management suggested catheter ablation as the first-line treatment in patients with paroxysmal lone AF.[4] When Haissaguerre et al.[5] initially reported catheter ablation of AF, it was focal ablation of the pulmonary vein (PV) origin of AF. The rationale for PV ablation was the existence of arrhythmogenic Purkinje fibre-like cells inside the PV,[6] and reproducible PV triggers initiating AF.[7] In 2002, multipolar circular ring catheter for mapping of the PV was introduced in performing catheter ablation of AF. Multipolar ring catheter is useful for the detection of arrhythmogenic PV and specific localization of foci triggering AF.[8] Therefore, multipolar circular ring catheter guided segmental ostial ablation of arrhythmogenic PV was the standard therapy for AF ablation in the early and mid 2000s. However, there is a substantial risk of PV stenosis associated with ostial ablation after RF energy delivery. Therefore to reduce the risk of PV stenosis, the ablation strategy has changed to circumferential PV isolation at the level of PV antrum, which is 10-15 mm outside the PV ostium.[9] Although reproducibly defined arrhythmogenic PV isolation demonstrates a clinical outcome comparable with empirical 4-PV isolation,[10] most of the patients with AF who underwent catheter ablation have multiple PV foci in multiple veins and hence circumferential bi-antral ablation with electrical isolation of 4 PVs became the cornerstone of catheter ablation of AF.

Meanings of Pulmonary Vein Isolation

In 2000, Pappone et al.[11] reported that anatomically guided circumferential PV ablation without monitoring the PV potential is good enough for catheter ablation of AF. In their technique, high-power radiofrequency energy was delivered and additional linear ablation was performed.[11] Although an outstanding clinical outcome with short procedure time was reported, this technique was not reproducible among other invasive electrophysiologists. In spite of such limitations, this linear ablation design is still being used in many other electrophysiology institutes for the ablation of long-standing persistent AF.[12]

Currently, many electrophysiologists are using a compromised technique for circumferential ostial PV isolation and anatomical wide area circumferential PV ablation; wide circumferential PV isolation.[13] As compared with segmental ostial ablation, wide circumferential PV isolation targets the peri-PV ostial triggers or drivers, ganglionate plexi, and critical mass reduction,[14][15] as well as the elimination of PV triggers. Therefore, elimination of PV potentials has the effect of a significant conduction delay or enough radiofrequency en-

Correspondence: Hui-Nam Pak, MD, Division of Cardiology, Severance Cardiovascular Hospital, Yonsei University Health System, 50 Yonsei-ro, Seodaemun-gu, Seoul 120-752, Korea
Tel: 82-2-2228-8459, Fax: 82-2-393-2041, E-mail: hnpak@yuhs.ac

• The author has no financial conflicts of interest.

ergy delivery around the PV antrum, rather PV isolation itself has an anti-arrhythmic effect.

Multipolar Ring Catheter Guided Antral Ablation

As compared with anatomically guided antral ablation without monitoring of the PV potential,[11] multipolar catheter guided circumferential PV isolation shows a change in the PV potential sequence or PV conduction delay. Therefore, multipolar circular ring catheter provides the location of critical preferential conduction between the left atrium and PV, and minimizes unnecessary radiofrequency energy delivery. However, the main limitation of multipolar ring catheter guided ablation is the discrepancy of a distance of 10-15 mm between the ablation site and mapping site. Therefore, the elimination of PV potential is an indirect reflection of enough radiofrequency energy delivery around the PV antrum. To reduce this discrepancy, Jang et al.[16] reported the efficacy and feasibility of 30-35 mm diameter, large-sized, multipolar ring catheter for circumferential antral ablation. This large-diameter, multipolar circular catheter is designed for mapping of the PV antrum by direct contact. The large-sized, circumferential ring catheter guided antral ablation and anatomically guided antral ablation utilizing three-dimensional electroanatomical mapping were compared, and the superiority of large-sized ring catheter mapping in terms of the immediate PV isolation success rate and short-term clinical outcome was reported. It was a reasonable result proving the superiority of antral potential mapping compared with anatomically guided ablation of AF, but the large-sized, circular mapping catheter and the conventional 25-mm circular mapping catheter for circumferential PV isolation were not compared in this study. In contrast, the large-sized circumferential ring catheter may reduce the discrepancy by monitoring the antral potential, however, it might be difficult to maintain catheter stability because the antral shape is not circular but rather elliptical. Large-sized, multipolar ring catheter sometimes cannot monitor the PV potential or potential in the ligament of Marshall, because PV potential is maintained by epicardial conduction after antral ablation in some patients. There is some risk of char formation at the contact surface between the mapping catheter and radiofrequency ablation catheter due to the "edge effect". Therefore, additional study comparing the large-sized and the conventional circular mapping catheters is warranted in the future.

Conclusion

Circumferential PV ablation became the cornerstone of catheter ablation of AF. Although the pathophysiology of AF is being uncovered with the development of ablation technology of AF, a more effective and safer mapping or ablation technology is required to improve the clinical outcome. We expect fast and efficient catheter technology, such as duty-cycled, large-sized circular ring catheter[17] for mapping and ablation of the PV antrum in the future. It appears that conventional contact mapping by a well-designed mapping catheter assumed more importance in catheter ablation of AF than high-technology three-dimensional computer processed image guided mapping; back to the future.

Acknowledgments

This work was supported by a grant (A085136) from the Korea Health 21 R&D Project, Ministry of Health and Welfare and a grant (2010-0010537) from the Basic Science Research Program run by the National Research Foundation of Korea (NRF) which is funded by the Ministry of Education, Science and Technology of the Republic of Korea.

REFERENCES

1) Wazni OM, Marrouche NF, Martin DO, et al. *Radiofrequency ablation vs antiarrhythmic drugs as first-line treatment of symptomatic atrial fibrillation: a randomized trial. JAMA 2005;293:2634-40.*
2) Jaïs P, Cauchemez B, Macle L, et al. *Catheter ablation versus antiarrhythmic drugs for atrial fibrillation: the A4 study. Circulation 2008;118:2498-505.*
3) Nair GM, Nery PB, Diwakaramenon S, Healey JS, Connolly SJ, Morillo CA. *A systematic review of randomized trials comparing radiofrequency ablation with antiarrhythmic medications in patients with atrial fibrillation. J Cardiovasc Electrophysiol 2009;20:138-44.*
4) Camm AJ, Kirchhof P, Lip GY, et al. *Guidelines for the management of atrial fibrillation: the Task Force for the Management of Atrial Fibrillation of the European Society of Cardiology (ESC). Eur Heart J 2010;31:2369-429.*
5) Haïssaguerre M, Jais P, Shah DC, et al. *Spontaneous initiation of atrial fibrillation by ectopic beats originating in the pulmonary veins. N Engl J Med 1998;339:659-66.*
6) Perez-Lugones A, McMahon JT, Ratliff NB, et al. *Evidence of specialized conduction cells in human pulmonary veins of patients with atrial fibrillation. J Cardiovasc Electrophysiol 2003;14:803-9.*
7) Pak HN, Hwang C, Lim HE, Kim JW, Lee HS, Kim YH. *Electroanatomic characteristics of atrial premature beats triggering atrial fibrillation in patients with persistent versus paroxysmal atrial fibrillation. J Cardiovasc Electrophysiol 2006;17:818-24.*
8) Tada H, Oral H, Greenstein R, et al. *Differentiation of atrial and pulmonary vein potentials recorded circumferentially within pulmonary veins. J Cardiovasc Electrophysiol 2002;13:118-23.*
9) Oral H, Scharf C, Chugh A, et al. *Catheter ablation for paroxysmal atrial fibrillation: segmental pulmonary vein ostial ablation versus left atrial ablation. Circulation 2003;108:2355-60.*
10) Pak HN, Kim JS, Shin SY, et al. *Is empirical four pulmonary vein isolation necessary for focally triggered paroxysmal atrial fibrillation? Comparison of selective pulmonary vein isolation versus empirical four pulmonary vein isolation. J Cardiovasc Electrophysiol 2008;19:473-9.*
11) Pappone C, Rosanio S, Oreto G, et al. *Circumferential radiofrequency ablation of pulmonary vein ostia: a new anatomic approach for curing atrial fibrillation. Circulation 2000;102:2619-28.*
12) Haïssaguerre M, Hocini M, Sanders P, et al. *Catheter ablation of long-lasting persistent atrial fibrillation: clinical outcome and mechanisms of subsequent arrhythmias. J Cardiovasc Electrophysiol 2005;16:1138-47.*
13) Oral H, Pappone C, Chugh A, et al. *Circumferential pulmonary-vein ablation for chronic atrial fibrillation. N Engl J Med 2006;354:934-41.*
14) Everett TH 4th, Wilson EE, Olgin JE. *Effects of atrial fibrillation sub-*

strate and spatiotemporal organization on atrial defibrillation thresholds. Heart Rhythm 2007;4:1048-56.

15) West TC, Landa JF. *Minimal mass required for induction of a sustained arrhythmia in isolated atrial segments. Am J Physiol 1962;202: 232-6.*

16) Jang SW, Shin WS, Kim JH, et al. *The feasibility and efficacy of large-seized Lasso catheter combined with 3 dimensional mapping system for catheter ablation of atrial fibrillation. Korean Circ J 2011;41: 447-52.*

17) Scharf C, Boersma L, Davies W, et al. *Ablation of persistent atrial fibrillation using multielectrode catheters and duty-cycled radiofrequency energy. J Am Coll Cardiol 2009;54:1450-6.*