New Technology for Complete & Permanent PV Isolation

Hyoung-Seob Park, MD
Clinical Cardiac Electrophysiology
Division of Cardiology, Department of Internal medicine,
College of Medicine, Keimyung University, Dongsan Medical Center
Daegu, Republic of Korea

1. Contact-force sensing catheters

One of the most important things to consider when performing catheter ablation is how closely the tissue and catheter come in contact with each other. Previously, the contact between the tissue and catheter during radiofrequency (RF) catheter ablation could be identified by the sense of touching, seeing the size and shape of the local electrogram and the movement at the tip of catheter as shown by fluoroscopy. Another indirect way to see the level of contact is to observe the change in the impedance that appears when RF energy is delivered. Recently, contact-force(CF) sensing catheters have allowed the direct measurement and continuous monitoring of the CF during catheter ablation procedures.

Ablation of atrial fibrillation (AF) using CF catheters has led to less acute pulmonary vein (PV) reconnections and fewer gaps in the ablation lines. Good CF during PV isolation correlates with a better clinical outcomes and shorter procedure time. The lower CF has been associated with acute and chronic PV reconnections.

2. Phased RF ablation technology

Duty-cycled phased RF is a new ablation technology combining uni- and bi-polar RF ablation delivered via specifically designed ablation catheters. This catheter has multiple electrodes and ablation using synchronous uni- and bi-polar RF energy can be performed. The PV ablation catheter (PVAC GOLD™, Medtronic, Minneapolis, Minnesota, USA) is a circular-shaped nine-pole steerable over-the-wire catheter used for PV mapping and ablation. The PVAC produces contiguous arcs around the PVs, each with a length of up to approximately 60 mm. Multiple overlapping RF ablations are needed for PV isolation. RF energy is usually applied over all ten electrodes for 60 seconds.

This approach has an advantage of simultaneous circumferential energy delivery instead of requiring the operator to move the catheter point by point around the PV.

However, maintaining adequate contact between PV antrum and each ablation electrodes simultaneously is not always possible.

3. Balloon-based technology (Cryoballoon)

Balloon-based technologies are another method to deliver energy around the PVs to perform PV isolation. The most widely used balloon-based technology is the cryoballoon catheter (Arctic Front Advance, Medtronic, Minneapolis, Minnesota, USA). The catheter delivers nitrous oxide to an inner balloon, where it undergoes phase change from liquid to gas resulting in a temperature near – 80°C. The balloon catheter has a central lumen for a spiral mapping catheter to guide balloon position, reduce perforation risk and record PV potentials during ablation. The STOP AF (North American Arctic Front) trial demonstrated that cryoballoon ablation is effective in preventing paroxysmal AF in patients who are resistant to at least one antiarrhythmic drug. PV isolation could be achieved in most patients using the cryoballoon alone.

References

1. Buch E, Shivkumar K. Catheter Ablation of Atrial Fibrillation: Advent of Second-Generation Technologies. J Am Coll Cardiol. 2015;66:1361-3.
2. Hoffmayer KS, Gerstenfeld EP, Contact force-sensing catheters. Curr Opin Cardiol. 2015 Jan;30(1):74-80.
3. Bittner A, Monnig G, Zellerhoff S et al. Randomized study comparing duty-cycled bipolar and unipolar radiofrequency with point-by-point ablation in pulmonary vein isolation. Heart Rhythm. 2011;8:1383-90.
4. Packer DL, Kowal RC, Wheelan KR et al. Cryoballoon ablation of pulmonary veins for paroxysmal atrial fibrillation: first results of the North American Arctic Front (STOP AF) pivotal trial. J Am Coll Cardiol. 2013;61:1713-23.