ATRIAL FIBRILLATION

The Use of Cryoballoon Technology in Catheter Ablation of Atrial Fibrillation: the State of the Art

Drs. Perna and Mansour provide an outstanding review of cryoballoon ablation for treatment of atrial fibrillation. This new technique has been available for several years in Europe and was approved for use in the United States in January 2011. It is rapidly being adopted by electrophysiology physicians due to its efficacy, safety, and a rapid learning curve for its use. A thorough read of their paper is highly recommended.

Point-to-point radiofrequency (RF) ablation has been the only realistic tool available for AF ablation for over the past decade. We are familiar with multiple strategies of mapping and energy application and the complications that can be associated with RF ablation. Shortly after developing techniques for pulmonary vein (PV) isolation using RF energy, it was discovered that PV stenosis can occur; usually due to ablation inside the tubular portion of the PV. Our ablation strategies were modified to reduce this complication. Similarly, we learned that ablation on the posterior wall near the esophagus can cause life-threatening erosion. Avoidance or markedly reduced energy delivery with temperature monitoring can reduce this disastrous complication, but may leave important areas inadequately ablated. Worldwide estimates of cryoballoon ablation are approaching 20,000 cases and esophageal fistula has never been reported. PV stenosis has been rare with cryoablation but did occur in the Stop-AF US trial of the cryoballoon. It has not occurred or has been very rare in subsequent publications, supporting the need to attempt an antral delivery of cryoablation and favoring use of a larger 28 mm cryoballoon as the preferred strategy. I believe that any energy source delivered too deep within a PV can cause injury. Care and diligence are important in the performance of all ablation procedures. RF ablation is also associated with the creation of substrate modification and ablation-induced atypical macro-reentrant atrial tachycardias. These arrhythmias can be very difficult to map and eliminate on subsequent ablations. Cryoballoon ablation is very rarely associated with these new atypical flutters. Rare with RF and infrequent (<3%) with balloon-based PV isolation is the potential for phrenic nerve injury, especially during applications in the RSPV and to a lesser extent the RIPV. The power of the cryoballoon to effectively create a transmural lesion explains its high effectiveness, but also allows for potential collateral damage to the right phrenic vein as it courses extrapericardially. Careful monitoring of diaphragmatic contraction during pacing of the right phrenic nerve from a superior vena cava site can almost eliminate this problem by discontinuing the freeze as soon as any diminution of muscle contraction is detected. Fortunately, when phrenic injury occurs, it almost always rapidly resolves, although sometimes it may take months.

Reported efficacy rates with cryoballoon ablation for elimination of PAF are excellent, averaging in the 70–80% range at 1 year with aggressive follow up. Direct comparison to RF ablation has been limited but there are trends toward higher success with cryoballoon ablation. We await results of FreezeAF and other trials. There is also a growing body of literature supporting the use of cryoballon PV isolation in combination with RF techniques for persistent AF. The future is indeed very exciting.

We are only using an early version of the cryoballoon. Enhancements in design and compliance will allow for even better initial permanent PV isolation. Most important is which ablation technique will allow the electrophysiologist to consistently achieve a satisfactory outcome in AF ablation. Cryoballoon ablation is the beginning of a new era, with a safe and highly effective procedure that can technically be mastered by a physician with experience of 10 or fewer cases who is already familiar with transseptal techniques and left atrial anatomy. What additional marvels will the continued advance of medical technology bring to us and our patients?