Cryoablation for curing reciprocating tachycardia: take the good and leave the bad

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The introduction into clinical practice, approximately 25 years ago, of catheter ablation for cardiac arrhythmias has dramatically changed our understanding of and treatment approach for arrhythmias [1]. The concept of catheter-based destruction of the arrhythmogenic substrate instead of simply trying to modify it using antiarrhythmic drugs has transformed a preventive palliative approach into a definitive curative treatment, thus explaining the dramatic and widespread rise in use of this technique.

The type of energy used to damage the myocardial tissue has been critical from the early days. The first - direct-current delivery - was associated with a high risk of acute complications and a low spatial accuracy [2]. These problems have been largely overcome by the use of Radiofrequency-energy [3]. Radiofrequency-induced resistive heating leads to lesion formation in the myocardial tissue. It is characterized by much better spatial resolution together with improved control of energy delivery compared with direct-current energy. As a consequence, the development of catheter ablation is closely related to the use of appropriated radiofrequency catheters in the electrophysiology (EP) lab. Important improvement in energy titration by power, temperature, and impedance control has been obtained, thus minimizing the risk of complications related to energy delivery [4] without hampering efficacy. Nevertheless, the inability to assess the electrophysiological effect of radiofrequency energy before it becomes irreversible represents its main drawback. Radiofrequency ablation is associated with a risk of damaging the physiological conduction pathway(s) between the atria and the ventricles, leading to potentially irreversible complete atrioventricular (AV) block when ablation is performed on parts or in the vicinity of the compact AV node. This was in fact the goal of initial procedures performed in the eighties [2, 3]. Although this risk has been minimized by improvement in target definition [5], it is still a potential complication when ablating or modulating the slow pathway for the cure of AV nodal re-entrant tachycardia (AVNRT). This complication leads to pacemaker implantation in approximately 1% of AVNRT-radiofrequency ablation [6]. The risk of AV block is also present during radiofrequency RF ablation of mid-septal accessory pathways [7]. Although uncommon, implantation of a pacemaker is a devastating complication in young healthy subjects, and this complication is difficult to accept for the treatment of benign arrhythmias such as AVNRT.

Cryothermal energy – long used during open chest cardiac surgery - has the main advantage of assessing the electrophysiological effect of energy delivery before definite lesion formation [8, 9]. As a consequence, one can “cryo-map” (at -30°C) any targeted spot to create reversible electrophysiological effects and then perform a full cryoablation (at -80°C) in safe regions, thus avoiding the risk of AV block. Others features of cryoablation, such as preservation of tissue architecture, may be used to prevent vein stenosis and/or cardiac perforation during left atria ablation [10].

Development of cryocatheter ablation first took place in the setting of slow pathways and mid-septal accessory pathways. The advantage of cryothermal energy for mid-septal accessory pathway ablation is clear since such a location would have represented a contraindication to radiofrequency ablation, with the exception of life-threatening Wolff-Parkinson-White syndrome. The advantage of cryoenergy for curing AVNRT is less obvious. Acute slow-pathway ablation or modulation using a cryocatheter has been shown to be almost as efficient as that with radio-
frequency [11, 12]. However, cryo catheters have a relatively poor maneuverability, the energy application times and hence the procedure times are longer than with radiofrequency catheter, the electrophysiological criteria to define the target and ablation efficacy are sometimes difficult to obtain, and cryocatheters are more expensive. Nonetheless, the main concern with cryoablation of the slow pathway is the high proportion of recurrences, reaching 20% in some reports [13, 14].

The decision to use a cryocatheter instead of a conventional radiofrequency catheter should involve thorough assessment of the advantages and disadvantages. On the one hand, ablating the slow pathways by cryo will improve the security of the procedure but at the cost of loss of efficiency, thus increasing the need for procedures with their associated potential complications. This “safe” approach can be easily explained to the patients and their referring cardiologist before the procedure, but explaining the need for a repeat procedure would be more gruesome in case of early recurrence... In addition, in some cases it is not possible to ablate with a cryocatheter, and it would then be difficult to switch to a conventional radiofrequency catheter when the patient has been told that the risk for AV block would be negligible. On the other hand, using only radiofrequency energy could be considered as taking an unjustified and/or unacceptable risk of AV block. The question is still the matter of debate, and some centers have decided to ablate all AVNRTs by cryo while others continue to use radiofrequency energy.

In the present issue of Archives of CardioVascular Diseases, Nadji et al. describe the pragmatic approach they use in Amiens University hospital [13]. In this non-randomized, real-life study, the authors compared the efficacy and complication rates of the two approaches - radiofrequency and cryo - when ablating AV nodal or AV-reciprocating tachycardia in 199 patients. The decision to use cryo energy instead of radiofrequency was based on predefined electrophysiological criteria of augmented risk of AV block, including transient AV block during previous radiofrequency application, a small Koch triangle with a narrow safety margin, mid-septal and para-Hisian accessory pathways, and clinical criteria such as patient age below 25 years or because of the referring physician’s request. Applying these criteria, cryo energy was used in 13% of patients (9% of those with an AVRT and 16% with an AVNRT).

Using this strategy, no permanent AV block was observed among the overall population of the study, thus suggesting the safety of such an approach. The only potential problem with the Amiens strategy is represented by the non-predictable AV blocks, i.e. those that develop despite ablating far from spots considered to be “dangerous”. Otherwise, this strategy is flexible, allowing the operator to switch between the two energies when needed. In the study by Nadji et al., 8 of 26 patients received cryo applications after radiofrequency and 4 of 26 radiofrequency after cryo applications, thus improving the acute success rates without complications. The recurrence rate with cryo was 50% for mid-septal and para-Hisian accessory pathway ablation, but it is important to keep in mind that such accessory pathways would probably not have been targeted with radiofrequency energy [7]. In line with a previous study [12, 14], Nadji et al. report a 22% recurrence rate after AVNRT cryoablation. But since cryo energy was used in only 16% of AVNRT ablations, the overall recurrence rate in their AVNRT ablation series was only 4%.

The strategy proposed by Nadji et al. appears safe, with an acceptable overall recurrence rate, and is cost effective. This smart approach is a first step to future studies aiming to validate better-defined patient-specific criteria for a rational choice of energy with which to perform the ablation. However, it is already clear that the two energies are complementary tools that should both be available in the EP lab to help the electrophysiologist ablate previously untouchable accessory pathways and to minimize the risk of complications without hampering the success rates for AVNRT ablation.

References