Present Role and Future Perspectives of Radiofrequency Ablation of Atrial Fibrillation

M. SCAGLIONE, D. CAPONI, P. DI DONNA, M. BOCCHIARDO

Transcatheter ablation of atrial fibrillation has been recently developed and is part now of the armamentarium in the treatment of atrial fibrillation. The ablation of atrial fibrillation started out from the experience of the surgical maze procedure, which showed very encouraging results but at a high price because it required open chest surgery. In the following years the attempt has been made to produce similar results using transcatheter ablation. Different approaches have been used: linear lesions mimicking the surgical maze operation, linear lesions in the right or left atrium using different schemes, or a sequential approach ablating first in the right and then in the left atrium.

What we have learned from all this is that it is extremely difficult to obtain a complete transmural lesion with the transcatheter approach, and this reduces the chances of success of the procedure. In addition, it has been shown that right atrial linear ablation alone is less effective but safer, whereas linear lesions in the left atrium carry a higher success rate but with the disadvantage of an increased rate of complications (pericardial effusion, pericardial tamponade, and thromboembolism).

A major breakthrough has been the recognition of a focal mechanism in the initiation of many cases of idiopathic atrial fibrillation. The foci are mainly localized in the pulmonary veins (PVs). The exact mechanism of the focal activity is not clear, but it seems to be due to triggered activity. The presence of these foci can be suspected when Holter monitoring documents the presence of early atrial extrasystoles (“P on T” phenomenon) or evidence of high-frequency organized atrial activity in the initiation of atrial fibrillation or the presence of brief self-terminating episodes of atrial fibrillation.

Based on this evidence, Haïssaguerre proposed ablation of these foci located inside the PV involved in the initiation of atrial fibrillation, looking for the “PV spike” expression of the automatic activity. Using this approach it has been possible to eliminate the focal extrasystoles and atrial fibrillation in a...
high number of patients. Unfortunately, stenosis of the PVs occurred in a small percentage of patients, and very often more than one PV was involved in triggering atrial fibrillation, so that multiple procedure sessions were required. To eliminate these problems, a different technique has been developed: using special multipolar catheters it is possible to map the ostium of each PV and thus identify the electrical connections between the PV and the left atrium, which can then easily be targeted and ablated.

Using this technique with the application of radiofrequency energy at selected ostial sites, stenosis of the pulmonary vein has been almost eliminated. Moreover, using this technique it is also possible to electrically disconnect all the PVs in one session in the majority of cases, allowing the possibility of treating multiple PV foci in one session. Analyzing the clinical results of the centers that use this technique, it may be seen that the rate of success (elimination of atrial fibrillation) is about 65%-70%. The failure in the other 30%-35% of cases can be explained by the fact that in some cases the trigger points are located outside the PVs, and in other cases the substrate plays an important role in the genesis and maintenance of the arrhythmia. Alternative sites of initiation of atrial fibrillation may be the superior vena cava, Marshall's ligament, the posterior region of the left atrium, and the epicardial surface of the coronary sinus. It is sometimes difficult to localize them because this requires extensive electrical mapping of both the atria and, above all, the presence of the focal discharge during the ablation procedure.

As mentioned earlier, this approach has shown higher success rates in idiopathic atrial fibrillation, whereas in the case of persistent or chronic atrial fibrillation associated with organic heart disease, in which the substrate seems to play a more important role, it has demonstrated less efficacy.

Our experience in ablating atrial fibrillation dates to the mid-1990s. At that time we performed linear ablation in the right atrium in patients affected by "vagal" idiopathic atrial fibrillation. No complications occurred with this approach, but the success rate was 55% at 1-year follow-up and dropped to 25% at 3-year follow-up. For this reason we moved to PV foci ablation, and for the last two years we have performed electrical disconnection of the PVs. Our clinical results using electrical PV disconnection (Figs. 1, 2) show a 70% success rate with no major complications (pericardial tamponade, pulmonary vein stenosis) in patients with atrial fibrillation of focal origin.

Electrical disconnection of the PVs in patients affected by persistent atrial fibrillation or chronic atrial fibrillation associated with organic heart disease has a lower success rate in our experience, confirming the literature data. Since in this population the substrate plays a more important role in the genesis and maintenance of atrial fibrillation, as shown by the surgical experience, some centers have decided to perform left linear lesions in addition, improving the success rate at the expense of a higher rate of complications.

On the basis of this experience we have decided to reevaluate the safe right atrial linear approach to modify the substrate combined with PV disconnection in this group of patients.