Several different approaches have been proposed for targeting the pulmonary veins (PVs) or atria in catheter ablation for atrial fibrillation (AF). It was initially focal radiofrequency (RF) application inside the PV, then PV ostial isolation by segmental RF applications guided by a circular mapping catheter was developed (EP-guided method). Another standard method, circumferential PV isolation, was used to disconnect the ipsilateral PVs en bloc by linear RF applications all around the ipsilateral PVs (anatomical method). In both the EP-guided and anatomical methods, the endpoint of the procedure is the electrical isolation of the 4 PVs from the left atrium, which subsequently revealed the limitations of these procedures. The application of RF at the PV ostia can cause PV ostial stenosis or obstruction, which sometimes requires additional angioplastic procedures. Ectopic firing from the myocardium around the PV isolation area often induces postoperative recurrence of AF. Furthermore, perpetuation of AF is induced by reentrant conduction between the PV and the surrounding atrial tissues (venous wave hypothesis). Today, the goal of either method is to isolate all the PVs, not at the ostium but outside the tubular portion (ie, PV antrum) to avoid the risk of venous stenosis and improve the procedural efficacy. That change in the endpoint resulted in an increased rate of cure for the paroxysmal form of AF, ranging from 85% to 95% after approximately 1.5 ablation procedures without antiarrhythmic drugs (AADs). The success rate for chronic AF is generally lower than that (70–85%).

More recently, other approaches that mainly target the substrates of AF in the atria have been developed to reduce the perpetuation mechanism of AF. Linear lesions are commonly made in the roof between the contralateral superior PVs (roof line) and also at the isthmus between the mitral valve and the left inferior PV (mitral isthmus line). Another popular method for AF-substrate modification in the atria, evolved by Nademanee et al, is to apply RF energy and create lesions targeting the areas with complex fractionated atrial electrograms (CFAEs). CFAEs are believed to represent slow conduction or pivot points where wavelets turn around at the end of arcs of functional blocks, defined by atrial electrograms with fractionations, and show continuous activity or rapid firing with a very short cycle length ≤120 ms averaged over a 10-s recording period. It has been reported that CFAE ablation terminated AF in 86% and 63% of paroxysmal and chronic AF, respectively, and that the AF-free rate at 1 year was 91%. Subsequently, Haïssaguerre et al8 used this concept in their combined strategy for modifying the AF-substrate in long-lasting persistent AF. A combination of PV isolation, electrogram-based CFAE-ablation, and linear ablation terminated chronic AF in 84% of the patients, resulting in an AF-free rate of 95% in patients with AF-termination.

In this issue of the Journal, Kumagai et al report the efficiency of an alternative approach for treating AF (Box-isolation), involving complete isolation of the posterior LA, including all the PVs, guided by a non-contact mapping (NCM) system. In a recent report, they described the high efficiency of Box-isolation for suppressing AF; continuous lesions were created in the anterior portions of the ipsilateral superior and inferior PVs, guided by a circular mapping catheter, without making lesions in the posterior portions of the PVs. Two horizontal lines were created in the roof and the floor of the LA by a contiguous line of ablation lesions joining the contralateral superior PVs and inferior PVs, respectively. Although this procedure was technically challenging, the technical difficulty was addressed by the use of the NCM system (Ensite), which enabled fast recognition of the earliest depolarization sites, propagation patterns and conduction gaps. Among a total of 188 patients (116 paroxysmal, 48 persistent, 24 long-standing persistent AF), 87%, 69% and 42% of the paroxysmal, persistent and long-standing persistent AF cases, respectively, were arrhythmia-free without any AADs after the initial procedure. After the final procedure, including 8 patients requiring a second procedure, 91%, 73% and 46% of the paroxysmal, persistent and long-standing persistent AF cases became arrhythmia-free without medications. The authors strongly emphasized the usefulness of the NCM, especially in identifying focal triggers, confirming the conduction block of the linear lesions and analyzing the mechanism of atrial flutter associated with the procedure. Furthermore, the use of NCM decreased the fluoroscopy time.

It is important to consider this study in the context of the earlier literature on AF ablation. The principal advantages of this method include the expansion of the isolation area with a minimal requirement to increase the RF lesions. The posterior LA wall plays an important role in both the trig-
gearing and maintenance of AF. The isolation of the posterior LA, including all PVs, may increase the efficiency of catheter ablation for AF in comparison with the standard methods described earlier. On the other hand, the roles and indications of the Box-isolation method in AF ablation must be considered. Paroxysmal AF can be cured in nearly 90% of cases by expanded PV isolation around their antrums and there is no need to further expand the isolation area, which can limit the contractility of the posterior LA wall. In contrast, Box-isolation that targets isolation of the posterior LA wall and PVs seems to be insufficient for catheter ablation of permanent or long-persistent AF. Because AF substrates scattered throughout the atria play a role in the maintenance of persistent AF, it is necessary to apply adjunctive ablation targeting these substrates (CFAE) outside the posterior LA. It is important to consider the necessary and sufficient endpoint of ablation (with both the highest efficiency and the lowest complications) in each type of AF. The efficiency, safety and the role of the new approach of Box-isolation for curing AF must be thoroughly evaluated in many centers around the world.

There have been several recent publications describing procedures similar to Box-isolation. Thomas et al. described the efficiency of the “single-ring approach” for the electrical isolation of the posterior LA wall and PVs for AF in a comparison with the “double-ring approach (2 by 2 approach)”. They showed that the number of times the procedure is performed, the number of ablation sites and the rhythm outcomes at 6 months were similar for both approaches. Sanders et al. evaluated the efficiency of complete isolation of the PVs and posterior LA in chronic AF. In their method, each PV and the posterior LA were individually isolated by ablation joining the right and left PVs by both the roof and inferior lines. AF persisted in all 27 cases after PV isolation and terminated in 5 (19%) during posterior LA isolation, and at 2 years of follow-up, 63% of cases remained in sinus rhythm, which was not comparable with the stepwise procedures used in the same institution. Although it is difficult to simply compare these published results with Box-isolation, the excellent outcome reported in the article in this issue is inconsistent with previous findings. The patient population, including the stage and degree of AF type, methods of RF application, accuracy of mapping with guidance by the NMS etc may have caused the discrepancies between the procedures.

References