Impact of energy titration in endoscopic pulmonary vein isolation

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This editorial refers to ‘Energy titration strategies with the endoscopic ablation system: lessons from the high-dose vs. low-dose laser ablation study’ by S. Bordignon et al., on page 685

Electrical isolation of the pulmonary veins (PVS) is the cornerstone in ablation of atrial fibrillation (AF). Radiofrequency current applied in a point-by-point fashion in combination with a three-dimensional anatomical mapping system is the most frequent approach. The limitations of radiofrequency-based PV isolation (PVI) kindled interest in investigating the alternative energy sources and developing new catheter designs. Balloon-based ablation systems utilizing energy sources such as cryothermal energy (Cryo), or high-intensity focused ultrasound (HIFU) have been introduced. Both the Cryo- and the HIFU-balloon are single-shot devices. However, their energy delivery-mode is binary (on/off) and neither balloon is compliant, but available in different sizes. Following reports on the occurrence of atrioesophageal fistula, the HIFU-balloon is no longer used in clinical practice. By contrast, the Cryoballoon is an established and widely spread ablation tool with a favourable efficacy and safety profile.

As a novel balloon-based ablation tool, the endoscopic ablation system (EAS) was introduced. It is the first device offering a spectacular, direct view into the left atrium and the respective PV and thus allowing for visually guided PVI. It combines favourable characteristics of both, the radiofrequency-based ablation approach and the balloon-based ablation systems. It contains a titratable energy source allowing for energy delivery in an individual point-by-point fashion and the energy source is integrated into a compliant balloon catheter.

The first EAS generation consisted of a non-compliant balloon available in three different sizes (20, 25, and 30 mm diameter), which was filled and flushed with deuterium (D₂O). The central balloon shaft contained a miniature endoscope as well as a laser source whose energy delivery was titratable from 6.3 to 7.6 W/cm. Energy was applied via two different laser arcs of 90° or 150°. In the initial studies, acute PVI was achieved in 91% of targeted PVS combined with a reasonable safety profile. The recurrence rate of AF was 40% at 1 year. However, the laser arc, having a width of at least 90°, required an optimal balloon-to-PV contact to ensure safe and effective energy application and limited the freedom to perform an individual ablation line design. In addition, optional ostial sealing was often hampered by the non-compliant balloon which was not adjustable to different PV diameters.

The current EAS generation consists of a compliant balloon, adjustable in nine steps from a minimum of 9 mm to a maximum of 35 mm in diameter. Laser energy is titratable from 5.5 to 12 W and the width of the laser arc was reduced to 30°, allowing for discrete lesions and an individual ablation line design according to individual PV anatomy. Feasibility, acute and mid-term clinical efficacy and a favourable safety profile have been demonstrated. The durability of endoscopic PVI was assessed by Dukkipati et al. at remapping 3–4 months, PVI was achieved in 86%. However, the applied energy levels (5.5 W–16 W, 20–30 s) were dependent on operator’s choice, which was mainly affected by parameters such as balloon-to-tissue contact, the targeted portion of the PV, or by adjacent anatomical structures, e.g. the esophagus or the phrenic nerve.

In this issue of the Journal, Bordignon et al. reported the effect of energy titration on acute and chronic success of endoscopic PVI in a cohort of 60 patients with AF. The authors compared a low-dose (LD) energy group (30 patients, 5.5–8.5 W) with a high-dose (HD) energy group (30 patients, >8.5 W) with regard to procedure parameters such as acute PVI success, applied energy amount until complete PVI, procedure- and fluoroscopy-times as well as median follow-up results. They found that (i) the rate of electrical PVI after completion of a purely visually guided ablation circle was higher in the HD group compared with the LD group (89 vs. 69%); (ii) the proportion of patients in whom all PVS were isolated after a single ablation circle per PV was higher in the HD group (70% vs. 39%); (iii) procedure times were shorter in the HD group (128 ± 17 min vs 154 ± 38 min); and (iv) the recurrence rate of AF was lower in the HD group during the median follow-up period.
follow-up of 311 (261–346) days (17 vs. 40%). No stroke or atrioesophageal fistula occurred in any group. These results are in line with previously published data assessing the effect of three different energy settings (posterior 5.5 W/ anterior 7 vs. 7 W/8.5 vs. 8.5 W/10 W) on acute and mid-term efficacy and safety in a cohort of 30 patients. Consequently, the application of higher energy levels was more effective. The current study contributes to a better understanding of this fascinating ablation tool and has a potential impact on future clinical practice in endoscopic AF ablation. Procedure times may be reduced since the application of higher energy levels will increase the acute success rate after visually guided ablation. Based on that, the need for remapping and reablation of non-isolated PVs eventually requiring multiple manipulations of EAS will be reduced. That may minimize manipulation-related complications. The superior clinical outcome in the HD group might be explained by an improved durability of PVI, which needs to be assessed in future studies. Importantly, catheter ablation of AF is still a therapeutic approach aiming at symptom relief and improvement of quality of life with only limited information regarding mortality and stroke. Therefore, safety is the most important issue in AF ablation. In this non-randomized study, the authors measured the esophageal temperature during energy application. However, it is underreported whether intraluminal temperature rise is associated with increased risk of esophageal thermal lesions since no post-procedural endoscopy has been performed. No atrioesophageal fistula, transient ischaemic attack (TIA), or stroke was observed. However, as recently described, the overall rate of major complications of ablation for AF is 4.54% with a rate of TIA, stroke, or atrioesophageal fistula being 0.71, 0.23, and 0.04%, respectively. 11 The ‘single big cryoballoon’ technique for acute pulmonary vein isolation in patients with paroxysmal atrial fibrillation: a prospective observational single centre study. Eur Heart J 2009;30:699–709. 2. Chun KR, Schmidt B, Kuck KH et al. Cryoablation of the pulmonary veins using a novel balloon catheter. J Interv Card Electrophysiol 2006;15:79–81. 3. Schmidt B, Chun KR, Kuck KH, Antz M. Pulmonary vein isolation by high intensity focused ultrasound. Indian Pacing Electrophysiol J 2007;7:126–33. 4. Neven K, Schmidt B, Kuck KH et al. Fatal end of a safety algorithm for pulmonary vein isolation with use of high-intensity focused ultrasound. Circ Arrhythm Electrophysiol 2010;3:260–5. 6. Reddy VY, Neuzil P, Themistoclakis S, Danik SB, Bonso A, Rossillo A et al. Visually-guided balloon catheter ablation of atrial fibrillation: experimental feasibility and first-in-human multicenter clinical outcome. Circulation 2009;120:12–20. The dur- ability of pulmonary vein isolation using the visually guided laser balloon catheter: Multicenter results of pulmonary vein remapping studies. Heart Rhythm 2012;9: 919–25. 8. Dukkipati SR, Neuzil P, Kautner J, Petru J, Wichterle D, Skoda J et al. The durability of pulmonary vein isolation using the visually guided laser balloon catheter: Multicenter results of pulmonary vein remapping studies. Heart Rhythm 2012;9: 919–25.

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