As catheter ablation to eliminate atrial fibrillation (AF) has evolved, new catheter technologies have become available to increase lesion size and improve safety. Pulmonary vein (PV) isolation was first performed with radiofrequency energy using a 4 mm tip electrode. Subsequently, 8–10 mm tip electrodes and irrigated-tip catheters became available. The premise of these systems is that as the catheter tip is cooled either by blood flow or by an irrigant, more energy can be delivered deep in the tissue without reaching the temperature ceiling at the catheter tip–tissue interface. Furthermore, the risk of thrombus or char formation is also reduced.² Besides radiofrequency energy, other types of energy such as cryo, microwave, ultrasound, and laser have been used for PV isolation or ablation of atrial myocardium.

The power and temperature settings for radiofrequency ablation using a variety of catheters often have been rather empirical. When energy is applied near critical structures such as the PVs or oesophagus, the energy output has been reduced based on anecdotal experience of adverse events.

However, there also have been efforts to identify a variety of parameters to titrate the duration and amount of radiofrequency energy application. A fall in impedance of ~10 ohm during energy application has been considered to indicate effective lesion development. Other endpoints for energy application have included voltage abatement (≥80%), elimination of PV potentials and/or electrical isolation of the PVs, or achieving conduction block. In one study, a decrease in electrochemical potentials between the distal and proximal electrode pairs was found to be the best predictor of lesion size, particularly during irrigated ablation.³ Because excessive heating of the tissue–electrode interface may increase the risk of char/thrombus formation and tissue pops, monitoring of microbubble formation under intracardiac echo guidance⁴ has also been proposed even in the face of lack of sensitivity.⁵ Despite these efforts, a recent animal study pointed out the difficulty in monitoring actual temperatures inside the tissue beyond the electrode–tissue interface. Of particular interest was the substantial mismatch between the temperatures at the electrode–tissue interface and within the myocardium. Furthermore, intramural temperatures continued to rise even after radiofrequency energy application was discontinued.

Nilsson et al.⁷ report the procedural outcomes of PV isolation by ostial radiofrequency energy ablation using low power for long duration and high power for short duration in patients with paroxysmal and persistent AF. In all patients, an irrigated tip catheter was used and flow rate was limited to 2 mL/min. In the low-power group, radiofrequency energy was applied at a power of 30 W and with a temperature ceiling of 50°C for 120 s. In the high-output group, energy was applied at 45 W and 55°C for 20 s. Complete PV isolation was achieved in a similar number of patients in both groups; however, more PVs per patient were isolated in the high-output group. The duration of radiofrequency energy application, procedure time, and fluoroscopy time were lower in the high-output group. At a mean follow-up of 15 months, ~75% of patients in each group were in sinus rhythm. However, ~45% of patients were still being treated with an antiarrhythmic drug in both groups. The authors concluded that 20 s radiofrequency energy applications at a high-power output are preferable to low power, 2 min applications for PV isolation.

Although this is the first study that compared radiofrequency energy applications at high and low-power outputs for PV isolation, several prior studies have used high output energy applications for short durations for ostial ablation⁸ and circumferential PV ablation.⁹,¹⁰ A limitation of this study is that it was not randomized and included a consecutive series of patients. Older patients and more patients with persistent AF were included in the second consecutive group. It appears that as the operators became more comfortable with the ablation technique, they were more liberal in selecting patients, suggesting the presence of a learning effect. A second limitation is that each application was required to be 120 s in the first group, regardless of whether the lesion was effective or not. Therefore, comparisons of the duration of the procedure or radiofrequency energy application may not be meaningful. A third limitation is that the flow rate at the tip of the irrigated catheter was only 2 mL/min. Because of this very low flow rate, it is likely...
that the catheter behaved like a conventional catheter, with little benefit from the irrigation. It is also not clear why more lesions per PV were required in the high-power group. Lastly, the sample sizes in this study were too small to assess safety.

This study, nevertheless, is useful because it demonstrates that there is no value in applying radiofrequency energy at low output for an extended duration. Instead, it may be more helpful to monitor for a fall in impedance, voltage abatement, conduction block, and move the catheter to a new target site when the desired endpoint is reached. However, to prevent collateral damage, high power settings for durations >10 s should be avoided near critical structures such as the oesophagus.

REFERENCES


