Image integration in 3D catheter mapping systems: proof of the pudding

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This editorial refers to ‘The impact of image integration on catheter ablation of atrial fibrillation using electro-anatomic mapping: a prospective randomized study’ by P.M. Kistler et al. on page 3029

Pulmonary vein (PV) isolation can be performed at different levels in the ostium. Initially, segmental isolation, targeting individual strands of atrial myocardial tissue in PV ostia, was performed using the combination of a circular mapping catheter and a standard ablation catheter.1 In most centres, clinical success rates were moderate. Soon, however, it was recognized that wider encircling improved success and reduced complications.2 Additional ablation lines and substrate modification may further increase success, but may also create a substrate for left atrial flutters.3–5

The creation of a long continuous ablation line around a PV antrum using a single ablation electrode is technically challenging. Kistler et al. described a prospective randomized study to investigate the contribution of image integration to catheter ablation of atrial fibrillation.5 The value of Cartomerge6 was investigated on the basis of an incomplete Carto map. It is highly remarkable that even then, image integration did not affect the quality of the procedure. The study suggests that an anatomically correct geometry does not facilitate the creation of continuous transmural lesions. Such geometry definitively helps to outline the desired course of the ablation lines, but apparently it does not improve the continuity of that line. Use it if you like it, but don’t expect any miracles.

The ablation procedure was performed using an irrigated ablation electrode to create the long ablation lines around both pairs of PV ostia.6 Wall contact during ablation, precise catheter manipulation, and the delivery of sufficient radiofrequency (RF) power are the most important determinants of successful electrical isolation. While irrigated catheters are highly advisable to reduce the risk of blood clot formation during RF ablation, electrode cooling greatly eliminates the electrode temperature increase as feedback for tissue contact. This may have been the reason for the investigators using a remarkable irrigation protocol: the flow rate was maintained at 2 mL/min unless the 50°C target temperature was reached with <20 W. One should remember that a flow rate of 2 mL/min may only be sufficient to keep the irrigation holes open, not to prevent blood clot formation on the heated tissue surface.7 Even with standard non-irrigated electrodes, detection of wall contact and lesion formation on the basis of electrode temperature response remains difficult. A high electrode temperature increase at low power may be caused not only by intimate electrode–tissue contact, but also by low blood flow. Local electrogram characteristics and amplitude, impedance drop during ablation, fluoroscopic imaging, and intracardiac echocardiography (ICE) are alternative ways to judge wall contact, but they all have important limitations or add significant complexity. A combination of these methods and 3D mapping systems are used in most labs, but even then, multiple acute gaps in the lines are more the rule than the exception. Moreover, a large number of patients experience a recurrence after a first procedure because of resumed conduction through the antrum lines despite the fact that the observation time after isolation often is lengthened by additional ablations.8 Persistent continuity of ablation lines should be our main goal for future developments. A 30 W/50°C setting was originally used for segmental PV isolation where myocardial sleeves may be relatively thin. To prevent collateral damage, one should always try to limit RF power, but with low power it may sometimes be very difficult to achieve complete electrical isolation of the PV antrum that includes sections with thicker myocardium and the appendix ridge where catheter stability is a major challenge.9

Kistler et al. used an electrogram amplitude <0.1 mV or amplitude reduction >80% as endpoint during ablation.10 Reduction of the local unipolar electrogram clearly is an indicator for lesion formation. Often, however, electrograms <0.1 mV still can be found inside the PV ostia and some of these can be proven to be true local activations. Conversely, an electrogram >0.1 mV within PVs can be a remote signal from the bulk of the left or right atrium, left atrial appendage, or superior caval vein. The latter signals, very misleadingly, sometimes also show decremental properties with atrial extrastimuli. Consequently, a simple amplitude...
criterion is not sufficient to declare PVs electrically silent. If the goal is complete electrical isolation then one should meticulously investigate the origin of all electrograms distal from the ablation line and continue the search for leaks until all local signals have disappeared. Adenosine may reveal latent leaks, but mapping of those leaks can be very difficult.11

Kistler et al. speculate that image fusion in NavX could result in more reduction in fluoroscopy time than with Carto. With NavX, an accurate geometry can be created in 15 min, with only a few minutes of fluoroscopy. With image fusion, only these few minutes are at stake and it is unlikely that image fusion will reduce fluoroscopy time more than CartoMerge. Reductions in radiation exposure, however, always remain a valid argument to investigate new technologies. Many electrophysiology (EP) labs are equipped with fluoroscopy systems that were originally designed to visualize tiny arteries and stents. EP procedures, however, do not require that image quality; we mainly have to see the contrasting catheters. Fluoroscopy systems in EP labs can therefore use extra primary beam filtration and lower pulse rates. In addition, one is obliged to use standard measures such as lower body-protecting lead flaps and an upper body-protecting glass screen. With a badge on the collar above the apron, the total annual dose of all operators performing catheter ablation procedures in a single EP lab can then stay below 5 mSv. Any team with a significantly higher total operator badge dose for catheter ablation procedures alone should seek advice from the fluoroscopy system manufacturer. Most modern systems have three different dose rate settings that are individually programmable by the manufacturer. Both electrophysiologists and interventional cardiologists can then be satisfied when they have to share the lab, and often operator and patient dose rates can be reduced by a factor of 5 or more without any impact on the quality of EP procedures. As a method for reducing fluoroscopy exposure, the application of advanced technologies, such as ICE, robotic or magnetic catheter navigation, image integration, and even 3D mapping systems alone, only makes sense when basic measures such as optimized fluoroscopy settings have been put in operation.

Conflict of interest: F.H.M.W. is a consultant for St Jude Medical.

References