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ORIGINAL PAPER

Is image integration with preprocedural CT a necessity?

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The advent of 3D electroanatomical mapping of the heart in 1998, brought about a revolution in the field of electrophysiology [1]. Physicians, used to mapping with the aid of 2D fluoroscopic projections, were suddenly exposed to a new environment where detailed electrophysiological information superimposed on the 3D anatomy combined with precise catheter navigation capabilities enabled gaining patient-specific insights into arrhythmia mechanisms, accurately guiding the delivery of radiofrequency lesions, generating continuous ablation lesions [2] and consequentially performing procedures that were previously unthinkable. Pappone [3] was the first to utilize the novel electroanatomical mapping approach to perform circumferential radiofrequency ablations around the pulmonary vein ostia to treat atrial fibrillation (AF). This emphasized the need for accurate 3D geometry for successful ablation. However, the early generations of mapping systems were cumbersome, requiring point by point mapping, and the resulting anatomical maps were often incomplete.

The development of multislice computed tomography (CT) in the early 2000's saw the introduction of dedicated gated cardiac scans. This enable merging accurate 3D anatomic maps from CT or magnetic resonance imaging, with the less detailed electroanatomical scans [4] which went on to bring about improved clinical outcomes [5].

More recently, new multielectrode mapping catheters have enabled obtaining more rapid and complete electroanatomical maps [6], with the potential to allay the need for CT image integration. In the published MICRO-AF study, Shin et al. [7] have examined whether the use of image integration possesses procedural or clinical benefits over high-density multielectrode mapping catheters without CT merging for ablation of AF. One hundred patients were randomized into two groups with similar baseline characteristics. No significant differences were found in procedural data including ablation time, fluoroscopy time, and contact force. During 12-month follow-up, no significant difference in AF recurrence was observed between the two groups.

So, does this interesting and thoroughly performed study irrevocably prove that CT image integration is obsolete for AF ablation? To answer this, we need to answer the following questions: Firstly, is the study design adequate to meet its predefined goals? Secondly, are the parameters studied optimal? Thirdly, what are the additional potential benefits of pre-acquired CT?

Firstly, regarding the design, 100 patient probably suffices regarding procedural data, however it seems unlikely that one year follow up of 100 patients has sufficient statistical power to examine AF recurrence. No power analysis was provided by the authors.

Secondly, the parameters most related to procedural success and efficiency are probably contact force; the percentage of cases with a gap following the initial circumferential ablation; total procedure/fluoroscopy/ablation time, and procedure-related complications rate. All of these issues were studied thoroughly.

Lastly, regarding potential benefits of the CT scan itself: CT provides highly detailed anatomical details, not all of which are consistently captured by the catheter, which requires contact by the electrodes to build the 3D anatomy. In many cases left atrial anatomy includes atypical features, such as additional pulmonary veins and accessory appendages and diverticles [8], which are potential arrhythmogenic sources. CT enables planning trans-septal puncture and allows precise calculation of atrial volume, which is an important parameter in clinical success [9]. In patients who have undergone previous ablation procedures it is imperative to rule out pulmonary vein stenosis. CT also enables ruling out the presence of atrial thrombus [10], potentially saving the need for preprocedural transesophageal echo. The precise location of the esophagus relative to the atrium can be seen, which may help prevent the rare complication of

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atrial-esophageal fistula. There may be other important findings, which may have value in therapeutic decision making, such as the presence of coronary artery disease, and myocardial scars.

Finally, it is important to note that the all procedures in the present study were performed by experienced operators. Since catheter mapping requires extensive experience, image integration may provide an advantage for less-experienced operators.

In conclusion, the study by Shin et al. is an important step in answering the question regarding the need for preprocedural imaging, and gives some reassurance for sites where preprocedural CT is not a routine. However, given the question marks which still remain, further larger studies are required before the controversy can be entirely settled.

Declarations

Conflict of interest The author declares that there is no conflict of interest.

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