Underrecognized consequence of three-dimensional mapping tool selection for atrial fibrillation ablation: when the operators' decision determines the amount of silent micro-embolic burden

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Underrecognized consequence of three-dimensional mapping tool selection for atrial fibrillation ablation: when the operators' decision determines the amount of silent micro-embolic burden

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Endovascular cardiac interventions carry an inherent risk for thromboembolic events by different means. While retrograde aortic access to the heart contains an additional risk for the dislodgement of calcified vascular and valvular particles, sources of cerebral lesions during atrial transseptal procedures mainly comprise air and/or thrombus embolization. Catheter ablation of left atrial (and ventricular) arrhythmias with radiofrequency (RF) energy furthermore harbors the risk for the development of a distinct type of embolic material, that is coagulum-char formation at the heated ablation catheter tip. The incidence of clinically relevant symptomatic thromboembolic complications due to left atrial (LA) ablation is lower than 1% (1). However, it has been first demonstrated by Lickfett and co-workers already 15 years ago that LA catheter ablation can be associated with clinically silent embolic cerebral lesions (2). Since then, the major focus of

research investigating potential mechanisms causing these silent cerebral lesions was directed at different RF energy application techniques and energy sources, quality of intra- and peri-procedural anticoagulation, and sheath-flushing protocols, respectively. However, the thromboembolic potential of different three-dimensional electro-anatomical mapping (3D-EAM) systems with its respective mapping catheter designs has not been adequately addressed in clinical or experimental studies.

In the current issue of the Journal, Nakamura and co-workers (3) present a study that investigated the impact of two different mapping (and ablation) techniques on the occurrence of clinically silent cerebral events (SCEs) after RF ablation of atrial fibrillation (AF). The study population comprise a total of 211 consecutive patients undergoing AF ablation. Of these, 105 patients underwent the procedure with the use of the CARTO system (Biosense Webster, group C). In this group, two circular pulmonary vein mapping catheters were used and the ablation was performed with the 'Ablation-Index' technique (under contact-force guidance). The other 106 patients were treated with the Rhythmia system (R-group). In the R-group, 3D-EAM was obtained using a mini-basket catheter (Orion, Boston Scientific) and PV mapping was performed with a circular mapping catheter. Thus, a triple transseptal approach was used in both groups. Ablation in the R-group was performed under local-impedance guidance (IntellaNav catheter, Boston Scientific). One the day after ablation, all patients underwent brain magnetic resonance imaging (MRI) and all patients with SCEs underwent follow-up MRI at 3-4 weeks after ablation. In this cohort, a total of 78 (37%) patients demonstrated SCE at day-1, with 18% of patients in the CARTO group and 56% in the Rhythmia group. Out of this study cohort, 60 patients in each group were matched on the basis of a propensity score analysis. In this more specific patient cohort, the overall incidence of SCEs was 31%. More than half of the Rhythmia patient group demonstrated incident SCEs after ablation while this incidence was one-of-ten in the CARTO group patients (52 vs. 10%). Moreover, the number of lesions per patient detected in the early post-ablation MRI was 8 in 6 patients in the CARTO group and 98 in 31 patients. The follow-up MRI, available in more than 90% of patients with initially detected lesions, revealed that 89% of lesions disappeared and 11% developed into chronic cerebral infarcts; all lesions in the CARTO group and 88% of lesions in the Rhythmia group dissolved within 3-4 weeks after ablation.

Summarizing these data, the use of structurally complex mapping tools, such as the mini-basket Orion catheter, appears to harbor an increased risk for SCEs during an AF ablation procedure. Moreover, not only the incidence of SCEs was significantly higher, but also the cerebral embolic burden for the individual patient was markedly increased with the use of these structurally complex mapping catheters.

With this study, the authors provide an important contribution to the so far widely neglected issue of the thromboembolic potential of endovascular mapping catheters; hitherto neglected since the embolic profile of AF ablation procedures were mainly attributed to embolic material formations arising from ablation catheters and sheaths. It is the credit of the authors to bring the attention of interventional electrophysiologists to the role of mapping catheters with a complex structural arrangement in the development of SCEs. In a previous study by the same group, the 3D-EAM systems CARTO and Rhythmia were compared in the context of LA tachycardia ablation with a nearly identical result (4). The strengths of the current study are the large number of patients included, the propensity score matching comparison and the rigorous post-ablation work-up with brain MRI on the day after the procedure and again after around four weeks. The follow-up MRI was available in almost all patients (92%). And here, the good news is also the bad news: while almost 90% of lesions detected immediately after the procedure disappeared during a 4-week follow-up, more than 10% of lesions developed into chronic cerebral infarcts. All chronic infarcts were observed in patients treated with the Rhythmia system. Unfortunately, this study did not perform any cognitive or neuropsychological testing before and after ablation. Although SCEs are considered to remain clinically asymptomatic, it would be interesting to see whether sophisticated neurocognitive testing will reveal alterations between pre- and acute post-ablation performance as well as differences between patients with and without development of chronic cerebral infarcts at longer follow-up. Nevertheless, although catheter ablation of AF obviously is associated with incident cerebral embolic lesions in a substantial number of patients, a net clinical benefit in terms of preservation of cognitive function and prevention of dementia (both Alzheimer disease and vascular dementia) has been well-established for patients who underwent successful AF catheter ablation (5).

It is with this background that we have to consider this important new information for our daily routine clinical practice. The presented study revealed that non-paroxysmal AF (not influenceable) and being treated with the Rhythmia system were independent positive predictors of SCEs. Thus, when we decide to use the Rhythmia system for the AF (or AT) ablation procedure, we should evaluate the patient status for parameters that were observed in this study to be associated with an increased risk for SCEs:

- Is the left atrium significantly enlarged?
- Is the left atrial appendage emptying velocity markedly reduced?
- Does the patient have a history of TIA/stroke?

If all these questions receive a yes-answer, the use of the Rhythmia system is probably something best avoided. Thus, an appropriate and differentiated indication for the use of the Rhythmia system may decrease the number of SCEs. Likewise, although no data are provided in the current study, it is conceivable that a shorter catheter dwell time in the left atrium would reduce the risk for SCEs further.

Thus, even under consideration of all well-defined strategies to minimized the risk for (mainly small and clinically silent) cerebral lesions, we now should keep in mind that already only our choice of the 3D-EAM system to guide the ablation procedure may determine the risk independently.

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