Will the blooming of artificial intelligence modify our approach to atrial fibrillation cure?

LUIGI SCIARRA[1] and Antonio Scarà[2]

[1]University of L'Aquila Faculty of Medicine and Surgery
[2]San Carlo di Nancy Hospital - GVM care and research

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Abstract

Catheter ablation represents nowadays a cornerstone for the treatment of atrial fibrillation. However, the benefit-risk ratio of this procedure still needs to be significantly improved. Many strategies have been proposed for this goal. Increased experience of operators and technological advances appear to be crucial points. Very important in this scenario is improving patients selection for ablation, as well. The blooming of artificial intelligence and machine learning represents a solid promise in many fields of medicine. Even in the field of atrial fibrillation cure they could prove to have a strong impact. Further prospective studies will surely help to define the real role of these techonologies in the treatment of atrial fibrillation.

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Luigi Sciarra MD(1), Antonio Scarà MD(2)

1 University of L'Aquila – Department of Cardiovascular disease

2 San Carlo di Nancy Hospital, GVM care and research – Electrophysiology Unit

Catheter ablation represents nowadays a cornerstone for the treatment of atrial fibrillation (AF) (1).

Technological advances have led to significant progress in terms of procedural safety and acute efficacy (2). Our group has also worked in this direction evaluating different types of ablative solutions (3-4).

However, in spite of the consistent technological progresses and the increasing experience of the electrophysiologists, the medium-long term results of this type of intervention still appear far from success rates close to 100% (5). Moreover, the price that we pay in terms of procedural-related complications is still not negligible(6).

Possible explanation for these improvable results could be searched in the difficulties of characterizing the various forms of AF and precisely defining the substrate that induce and maintain the arrhythmia in the single patients.

To this goal, we tried to evaluate whether an ablative approach, tailored on the patho-physiological mechanisms of the arrhythmia could provide optimal results, minimizing the procedural risks for patients. We demonstrated that some forms of paroxysmal atrial fibrillation can be triggered by other kind of arrhythmias with focal (atrial tachycardia) or reentrant mechanism (WPW syndrome or nodal reentrant tachycardia)(7-8). On the other hand, in patients with vagally-mediated AF we also investigated the possibility of using right atrial ganglion ablation to modify the influence of the autonomic nervous system on the heart, in order to prevent atrial fibrillation episodes (9).

Moreover, technological progress has recently made it possible to carry out very high-density mapping of the cardiac chambers, and therefore also of the atria, to try to characterize the underlying arrhythmic substrate [(10)]. However, the enormous amount of information generated is often difficult to interpret, particularly during the ablative procedure, since the importance of searching for both structural and functional substrates appears evident[(11)]. For this reason, the use of a form of artificial intelligence (AI), capable of rapidly acquiring and analyzing data from various sources, seems to be a promising scenario in order to simplify this issue [(12)].

Razeghi and co-authors have explored the possibility of using machine learning (ML) to personalize AF management strategies and develop customized ablative approaches, integrating atrial geometry data derived from CT scans and patient-specific clinical data. Authors should be commended for exploring such an important and current topic. Obviously, the routine use of ionizing radiations to develop the anatomical model by CT-scan (while cardiac MRI or intracardiac echocardiograms were not considered) could seem questionable, since ALARA (as low as reasonably achievable) principle could be not applied. However, the horizon that it opens appears extremely fascinating for many reasons. For example, to date technology developers are providing efforts to achieve transmural and efficient lesions (regardless of energy source used) in order to have a definitive pulmonary veins (PV) isolation. This mainly depends on ostial/antral PV thickness. So, it could be extremely interesting to have a predictive model, based on left atrium thickness, and analysed by artificial intelligence, and to evaluate its impact on the outcomes of ablation treatment.

Moreover, moving from the paroxysmal to persistent AF, reproducible ablative strategies that are suitable for all patients are still lacking. This probably depends on the different structural or functional substrates in every patient, that today we are often unable to precisely define. The possibility to analyse an enormous amount of electrical information, derived from electro-anatomical maps, and to combine them with additional anatomical features in a predictive model using an AI could be a desirable option.

We strongly believe that AF catheter ablation can be proposed as a curative solution for many patients. However, the way to achieve excellent benefit-risk ratios seems to be long, even nowadays. In this scenario, the role of ML anf AI seems very promising, particularly in patients selection and in personalizing treatment strategies.

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