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Atrial fibrillation ablation techniques

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We performed a survey on current atrial fibrillation (AF) ablation techniques used for catheter ablation of AF among the European Heart Rhythm Association Research Network. The focus of this questionnaire is on the ablation strategy, such as the use of different lesion sets or sites of ablation in the various forms of AF, and on the technical aspects of catheter ablation with respect to energy sources and imaging modalities.

Keywords Atrial fibrillation • Catheter ablation • Ablation techniques

Aims

As a result of limited antiarrhythmic drug efficacy and favourable results in catheter ablation, atrial fibrillation (AF) ablation is becoming more and more established in the field of AF treatment.[1,2] Atrial fibrillation ablation techniques and procedural strategies are on the one hand somehow standardized, like pulmonary vein isolation (PVI) as the desired endpoint in ablating paroxysmal AF,[1,3] on the other hand, clinical everyday practice is characterized by areas of large variations, respectively, among operators. To document the degree of standardization or variation in catheter ablation of AF in clinical routine, we performed the herewith presented survey.

Methods and results

Responses were received from 46 partners of the European Heart Rhythm Association Research Network, with the majority of centres being university hospitals (67.4%).

With respect to the pattern of AF in patients who undergo ablation in these centres, 33 or 82.5% of centres indicate that paroxysmal AF counts for >50% of their ablation indication. In 28 or 74% of the centres, persistent AF with a duration of <1 year exhibits 10–30% of their ablation indication. The vast majority (33 centres or 91.7%) estimate long-standing persistent AF as a minor ablation indication (<10% of ablated patients). Twenty-one centres or 54% do not perform AF ablation as a first-line therapy, whereas in 18% of the centres first-line therapy in drug-naïve patients is already forming a group of 10–20% in their ablation cohort.

Atrial fibrillation ablation, mapping, and imaging equipment

Regarding ablation and imaging equipment, 24 centres (63%) are using a Carto or NavX system in more than 70% of their ablation cases, whereas rotational angiography, intracardiac echocardiography, the Hansen Robotic System, and Magnetic Navigation systems are only used in a minority of cases and centres.

As expected, radiofrequency is the most frequently used energy source (15 centres use it in >70% of all cases), but cryoenergy is also used by 5 or 21% of centres in more than 70% of their AF ablations. Laser light is so far used only by two centres in 10–30% of AF ablation.

Oesophageal temperature monitoring is not performed by 23 centres or 59% because they believe, that this method is not necessary of helpful at all, whereas three centres (8%) use it for all cases, two centres (5%) only for radiofrequency ablations, and seven centres (18%) only in selected cases such as lines in the posterior wall. Four centres (10.3%) do not use oesophageal temperature monitoring because they only use cryoenergy and they believe that for this energy source temperature monitoring does not make sense.

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Table 1 Which catheter design do you use for paroxysmal atrial fibrillation ablation?

	<10%	10–30%	30–50%	50–70%	>70%	Response count
Cooled tip (= irrigated)	2.9% (1)	11.8% (4)	8.8% (3)	14.7% (5)	61.8% (21)	34
Solid tip (4 mm)	85.7% (6)	14.3% (1)	0.0% (0)	0.0% (0)	0.0% (0)	7
Solid tip (8 mm)	55.6% (5)	11.1% (1)	11.1% (1)	11.1% (1)	11.1% (1)	9
Cryo-balloon	27.3% (6)	22.7% (5)	13.6% (3)	4.5% (1)	31.8% (7)	22
Laser-balloon	75.0% (6)	25.0% (2)	0.0% (0)	0.0% (0)	0.0% (0)	8
Circular RF ablation catheter	64.3% (9)	7.1% (1)	21.4% (3)	7.1% (1)	0.0% (0)	14
Other	100.0% (9)	0.0% (0)	0.0% (0)	0.0% (0)	0.0% (0)	9

RF, radiofrequency.

Table 2 How do you estimate your success rate (Success-I = asymptomatic patients, AF free without antiarrhythmic drugs. Success-II = asymptomatic patients, AF free including those with antiarrhythmic drugs) for all forms of persistent AF including multiple procedures?

	<40%	40–50%	50–60%	60–70%	>70%	Response count
Success-I (without antiarrhythmic drugs)	29.4% (10)	35.3% (12)	29.4% (10)	5.9% (2)	0.0% (0)	34
Success-II (with antiarrhythmic drugs)	2.8% (1)	22.2% (8)	30.6% (11)	36.1% (13)	8.3% (3)	36

AF, atrial fibrillation.

Ablation strategy, success rate, and follow-up in paroxysmal atrial fibrillation

The vast majority of centres (32 or 82%) perform PVI as the preferred strategy in paroxysmal AF. Five centres (13%) do a priori PVI + lines or complex fractionated atrial electrogram (CFAE)-ablation as their primary ablation strategy. Looking specifically into catheter designs used for paroxysmal AF ablation, cooled tip ablation (in more than 70% of cases in 21 centres/62%) and the cryo-balloon [seven centres (32%) use it in more than 70% of their cases] are the most frequently used catheter designs (for details see *Table 1*).

The estimated ablation success (defined as percentage of patients free from symptomatic AF without antiarrhythmic drugs) after the first ablation procedure within 1 year is close to the published data: 18 centres (47%) indicate an ablation success as defined above 60–70% of their cases. Thirty-seven percent or 14 centres estimate their success in the 50–60% range; only one centre has a success rate of >70% and two centres state an ablation success rate of <40%.

To assess recurrence of paroxysmal AF episodes, nearly all centres use clinical evaluation (91%), resting electrocardiogram (ECG) (88%) and 24-h Holter (79%). More than 50% of all centres use stress ECG, 7-day Holter, yet external or implantable loop recorders only in <10% of their cases as a follow-up tool.

Ablation strategy, success rate, and follow-up in persistent atrial fibrillation

Interestingly, 17 centres (45%) perform AF ablation in persistent but not in long-standing persistent AF, whereas 19 centres (50%) perform ablation also in long-standing persistent AF. In persistent AF with <1 year of duration, PVI is the primary ablation strategy in 13 centres or 37.1%, whereas seven centres perform PVI + CFAE ablation and six centres PVI + left atrial lines and nine centres PVI + lines + CFAE ablation as the primary and first ablation strategy. In long-standing persistent AF with an AF duration of >1 year, 14 centres (47%) use the complete approach with PVI + lines + CFAE ablation as their primary strategy, whereas three centres (10%) use only PVI for the first procedure. For all forms of persistent AF ablation, using a three-dimensional (3D) guiding system with either the NavX (13 centres/37%) or the CARTO system (20 centres/57%) is the standard of care.

Regarding the estimated rate of success for all forms of persistent AF including multiple procedures, success rate I (=asymptomatic, AF free without antiarrhythmic drugs) is most frequently seen between 40 and 50%, whereas success rate II (with antiarrhythmic drugs) is at a level of 60–70% in the majority of centres (see details in *Table 2*, especially the distribution of estimated success rate without antiarrhythmic drugs with 10 centres <40% and 10 centres >50%).

Twenty-three centres (64%) experience recurrent atrial tachycardias at a rate of 5–15% following their ablation procedures, five centres observe this in more than 15% of their cases, and three centres see atrial regular tachycardias in >25% after ablation of persistent AF.

Conclusion

This survey about AF ablation techniques, strategy, and equipment reveals interesting real-world facts, which warrant further

investigation and scientific work: first of all, we have areas of common and standard practice in Europe: paroxysmal and persistent AF <1 year is the most frequent ablation indication. In paroxysmal AF, PVI is the endpoint of choice induced either with a cooled tip catheter in combination with a 3D navigation system or a cryo-balloon. With the first procedure, success rates are estimated to range between 50 and 70% with >70% including multiple procedures, and nearly 70% without using oesophageal temperature monitoring. But even in this well investigated field of paroxysmal AF, there are areas of variation: 54% of centres do not perform AF ablation as a first-line therapy, whereas the rest is doing so! Pulmonary vein isolation is the standard therapy, but nevertheless five of the interrogated centres do more than PVI in their first ablation for paroxymal AF.

In persistent AF, standardization is less well developed: ablation strategy ranging from PVI only to PVI + lines + CFAE is nearly equally distributed and should be a topic for multicentre investigations, which have the power to generate a standard. In addition, estimation of success and amount of post-ablation atrial tachycardias exhibits a wide range, emphasizing the need for more operator training, prospective and randomized data but also for more standardization in follow-up concepts.

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