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EDITORIAL

Catheter ablation of supraventricular tachycardias—a success story

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This editorial refers to 'In-hospital mortality and major complications related to radiofrequency catheter ablations of over 10000 supraventricular arrhythmias from 2005 to 2020: Individualized case analysis of multicentric administrative data', by F. Doldi *et al.*, on pages 130–136.

Catheter ablation of supraventricular tachycardias (SVT) clearly constitutes the groundwork of modern interventional electrophysiology. Already in the early 1970s Hein Wellens, Douglas Zipes, Pablo Denes, and others performed diagnostic catheterizations to demonstrate dual atrioventricular (AV) nodal conduction properties and accessory pathways implicating the mechanistic discovery of AV nodal reentry tachycardias (AVNRTs) and Wolf-Parkinson-White syndrome, respectively.[1,2] While those findings paved the way, it took two decades until the establishment of radiofrequency (RF)-based catheter ablation for the treatment of SVTs by Warren Jackman, Fred Morady, and Karl-Heinz Kuck (among others) marked the birth of interventional electrophysiology as a new subspecialty.[3,4]

Treatment of accessory pathways by surgical ablation and percutaneous catheter ablation applying high-energy direct-current shocks was already being performed in the 1970s and 1980s, respectively. However, it was the introduction of RF energy, pioneered by Stephen Huang, Martin Borggrefe, Günther Breithardt, and others that turned catheter ablation into a safe and effective treatment option.[5,6] Application of RF energy virtually eliminated the risks associated with high-energy direct current ablation, including cardiac perforation, cardiogenic shock, coronary-artery spasm, AV-block as well as late occurrence of ventricular fibrillation, and it obviated the need for general anesthesia.

In a setting where antiarrhythmic drugs consistently failed to demonstrate any benefit, RF catheter ablation literally offered a cure to patients, rendering SVTs one of the few cardiovascular disease conditions for which a curative treatment is readily available. Since then, the field of interventional electrophysiology has seen a fast-paced evolution. Manifold technological and conceptual advancements that have been achieved within the framework of SVT ablation not only made it an even more efficacious and safer therapy but also laid the foundation and were a prerequisite for the understanding and treatment of more complex arrhythmias like atrial fibrillation (AF) and ventricular tachycardias.

Today, catheter ablation may be considered as first-line therapy for most tachycardias, but the risk–benefit ratio of SVT ablation remains unparalleled. In fact, reported long-term arrhythmia-free survival rates are highest for AVNRT (98%) and AV reentrant tachycardias (92%), followed by typical flutter (90%), being only slightly lower for focal atrial tachycardias (80%).[7]

While those success rates are impressive, the safety profile of SVT ablation, for which Doldi *et al.*[8] provide yet another proof in this issue, is at least as compelling—a cardiac intervention with an almost negligible risk of severe complications is truly unique. Obviously, reporting a favourable safety profile of SVT ablation is nothing novel; in fact, this has been confirmed repeatedly by numerous studies, including large analyses of administrative data accumulating more than 300 000 patients.[9–11] However, safety of SVT ablation is not a fixed value, but rather a fragile achievement that is not to be taken for granted. Although, after so many years and convincing, reassuring evidence, we have gained a lot of confidence, we should not settle back, but stay alert. Therefore, Doldi *et al.*,[8] who report the incidence of in-hospital death and major complications in over 10 000 patients that underwent catheter ablation for SVT based on administrative data, must be congratulated for their continued efforts in quality control and safety monitoring.

Moreover, their approach of individualized case analyses offers an important advantage compared with previous studies. Due to the

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very low incidence, risk estimates of severe complications associated with SVT ablation require very large patient cohorts and are therefore mostly derived from administrative health care data linking coded complications to ablation procedures. However, it must be considered that such mere association studies are prone to bias and potentially misleading. In fact, in-hospital mortality rates are particularly prone to such bias. First, because these are very rare events, and second, a causal relationship with catheter ablation or the treated arrhythmia is unlikely.

The excess mortality that has been consistently reported for (right atrial) catheter ablation of typical flutter compared with left atrial AF ablation is a good example as it most likely reflects such bias.[9,11] These seemingly paradoxical data sparked a search for possible explanations and an ongoing discussion questioning the safety of right atrial ablations and reconsidering the intrinsic risk of typical flutter. Of note, based on one of these reports of administrative data, the current guidelines for the management of patients with SVT of the European Society of Cardiology even assume a procedure-related mortality for the ablation of cavotricuspid-dependent right atrial flutter of as high as 0.3%![7,9] And that, regardless of the fact that the putative paradox may be easily resolved: As left atrial ablation for AF is far more invasive with a much less favourable risk-benefit-ratio, it tends to be avoided in patients with limited prognosis or severe comorbidities. In contrast, right atrial SVT ablations (e.g. for typical flutter) are such safe, quick and well-tolerated procedures with exceptional success rates, that they are considered even in severely ill patients with end-stage disease and very limited life expectancy. It is tempting to speculate that those kind of patients account for the rare events of in-hospital death. However, those very few patients at true risk for in-hospital death will always be diluted by the vast majority of patients in the cohort without relevant comorbidities, and their risk profile is not going to be reflected by any statistics.

These confounding factors can only be detected by individual case analyses, as performed by Doldi *et al.*[8] Based on an in-depth review of cases with endpoint-relevant events, they concluded that the two in-hospital deaths associated with SVT ablation procedures in their cohort were highly unlikely to reflect a causal relationship. Taken together, their study indicates that SVT ablation may be even safer than suggested by previous analyses, although it has to be taken into account that the data was acquired from three highly experienced ablation centers.

From today's perspective, we can say without exaggeration that the curative treatment of SVTs by catheter ablation is a true success story in medical history—a success story that probably not even the pioneers of catheter ablation could have imagined at the time. With ongoing progress like fluoro-less SVT ablation and novel, non-thermal energy sources as well as the promise of non-invasive radio-ablation on the horizon, we have no doubt that the story is to be continued.

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