Focal Atrial Tachycardia

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Charles Dussault and Jean-Francois Roux

Focal atrial tachycardias, defined as a regular atrial arrhythmia not requiring the AV node or the ventricles, represent 5–15% of supraventricular tachycardia (SVT) cases. They therefore represent a relatively rare form of arrhythmia compared to reentrant SVTs. In the vast majority of cases, they arise in patients with structurally normal hearts. While evenly distributed between genders, younger patients are more commonly affected with these arrhythmias, increasing the interest in fluoro-reduction strategies. The potential sites of origin for these arrhythmias are diverse. Recognized mechanisms for focal atrial tachycardia include triggered activity, abnormal automaticity, and microreentry.

Hazards of radiation exposure have been specifically documented for patients undergoing RF ablation for supraventricular tachycardias, with an increased incidence of fatal malignancies most notably affecting the lungs. This particular risk appears to be increased in obese subjects [1].

To further describe the mechanism of a focal AT, response to various pacing and pharmacological maneuvers can be assessed (Table 9.1). Activation mapping is the cornerstone of focal atrial tachycardia localization. Technological advancements in the field of electroanatomical mapping now allow the localization of non-sustained atrial arrhythmia foci that would otherwise be impossible to map and successfully ablate. High-density mapping has also made possible the identification as well as definition of microreentrant arrhythmias. The three-dimensional display of the atria is of paramount importance in eliminating fluoroscopy. Electroanatomical mapping systems use a color-coded display showing the earliest site of activation as the red region with activation spreading in a radial (centrifugal) direction.

ECG Localization of Atrial Tachycardia

When a fluoroless approach is contemplated, surface ECG localization of the arrhythmia focus ahead of it is critically important. Although significant overlap exists, available algorithms are helpful in identifying the most likely site of origin of the arrhythmia. In order to fully delineate the potential risks of the procedure, it is particularly important to identify arrhythmias likely to originate from the left atrium or the parahisian region. Of note, an isoelectric p-wave in lead V1 suggests a focus near the AV node, while a positive p-wave in leads V1 to V5 is more suggestive of a left atrial origin [2].

Our standard approach consists of using the patches needed for a 3D mapping system on all

C. Dussault (✉) · J.-F. Roux
Cardiology Division, Department of Medicine, Université de Sherbrooke, Sherbrooke, QC, Canada
e-mail: Charles.dussault@usherbrooke.ca; Jean-Francois.Roux@usherbrooke.ca

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R. Proietti et al. (eds.), *Cardiac Electrophysiology Without Fluoroscopy*,
https://doi.org/10.1007/978-3-030-16992-3_9

Table 9.1 Atrial tachycardia mechanisms

	Initiation	Response to entrainment/overdrive	Other
Triggered	Rapid atrial pacing/ PES	Transient suppression or termination	Adenosine response
Increased automaticity	Isoproterenol	Transient suppression	Warm-up/cool-down
Microreentrant	Rapid atrial pacing/ PES	Entrainment possible	Adenosine response possible

suspected cases, as if an atrial tachycardia arises, all is already in place to perform a 3D mapping cartography, navigation, and ablation, thus reducing or eliminating the need of fluoroscopy.

Evidence Supporting Fluoroless Ablation of Focal Atrial Tachycardia

Razminia et al. [3] published their 5-year experience with fluoroless catheter ablation for various cardiac arrhythmias including ATs, demonstrating both the efficacy and the safety of this approach. One hundred and eleven patients underwent focal AT ablation with an acute success rate of 100%. They used either Carto 3 (Biosense Webster) or EnSite (Abbott) as their EA mapping system and used an intracardiac ultrasound probe for left side. Ablation catheters were either conventional or irrigated RF and contact force was not mandatory. The sites of origin of these arrhythmias were highly variable, with 39 coming from the right atrium, 42 from the left atrium, 4 from the noncoronary sinus, and 26 from within the coronary sinus. The median procedure duration was 146 min (range 54–371 min). Of note, procedure duration was shown to be highly operator dependent and significantly decreased over time, decreasing from a mean of 209.6 min during the first year of the study to 105.3 min 5 years later.

After an average follow-up of 18.4 months, the recurrence rate was 5.4%, which is comparable to what is expected following fluoroscopy-guided ablation procedures. As for safety, only one major complication occurred among the 60 patients who underwent ablation of a focal AT as the primary arrhythmia (tamponade requiring pericardiocentesis during left-sided AT ablation). This reported 1.7% complication rate compared to accepted complication rates for this type of procedure [4].

Technical Considerations

As for other EP procedures using 3D mapping, the diagnostic study for focal AT requires the use of a coronary sinus catheter that will serve as reference for the EA mapping system. In order to position the remaining diagnostic catheters, the ablation catheter is advanced in the right atrium and a geometry of the right atrium is created with precise delineation of the tricuspid annulus. A particular attention is devoted to mapping of the His region, where tags will be highlighted at sites demonstrating His bundle potentials. The remaining diagnostic catheters can then be safely positioned as required at the right ventricular apex, His bundle region, and high right atrium. Using this technique, successful catheter positioning without fluoroscopy has been reported to approach 100% (please refer to the chapter on catheter positioning for details on any of the available 3D mapping system utilization).

A standard EP study can then be performed to induce the clinical arrhythmia and diagnose the atrial tachycardia. Once the diagnosis is confirmed, activation sequences in the atrium based on diagnostic catheters should suggest a likely region of origin for the arrhythmia. The ablation catheter will then be used to delineate the exact focus of the arrhythmia by identifying the earliest activation point.

If the foci are localized in the right atrium, the only consideration before ablation is the distance to the His bundle; as all available His potentials are recorded in the 3D mapping system, it is easy

to safety ablate while visualizing at all times the catheter ablation in he 3D mapping system, with multiangled views as needed. We suggest a 1 cm distance from any His recorded in the atrial anatomy as a safety margin to ablate with radiofrequency; closer foci can be approached safely with cryoablation.

If the foci are localized in the left side, the complete elimination of fluoroscopy needs either a patent foramen ovale (present in as high as 20% of patients) or an intracardiac ultrasound (ICE) to perform a transseptal puncture; otherwise, minimal fluoroscopy can be used to achieve left access and the case can be continued without X-rays as in any right-sided approach (please refer to the atrial fibrillation ablation chapter for details on transseptal access).

In our series, with 37 atrial tachycardias approached initially without fluoroscopy, we were able to achieve (without ICE) a 83.8% success in eliminating completely the need of fluoroscopy (left-sided access requires fluoroscopy for the transseptal puncture and ablation proceeded then without X-rays even if these cases were counted as a "failure" to perform a 100% fluoroscopy-free procedure) [5].

Finally, we suggest also (unless the activation sequence shows a pulmonary vein foci as the clear origin of the arrhythmia) to map the coronary cusps as between 10 and 15% of septal localizations can be approached from the aortic cusps. Finally care on energy titration or source of energy is required for locations near the septal tricuspid annulus, as ablating form this region could occlude the right coronary artery or the AV node artery, ending in complete AV block in a region far from the His or the AV node [6].

Conclusion

Atrial tachycardia ablation either in the right of the left side is feasible and safe with a minimal or complete elimination of fluoroscopy, as all of these substrates need a 3D mapping system to perform the procedure. Left atrial access is also feasible without fluoroscopy using ICE, but minimal fluoroscopy can be used for transseptal puncture and then continuing without fluoroscopy for the rest of the procedure.

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