

Pulmonary Vein Tachycardia: Is the Sinus Rhythm P-wave Useful?

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Focal atrial tachycardia (AT) accounts for up to 15% of patients referred for electrophysiologic study for supraventricular tachycardia SVT.¹ Tachycardia foci do not occur randomly throughout the atria but rather cluster at predefined anatomic locations. In the right atrium, the commonest site of origin is at the crista terminalis, with other locations at the tricuspid annulus, coronary sinus ostium, right atrial appendage and peri-nodal region.²⁻⁴ The most frequent site of origin in the left atrium is at the pulmonary vein ostia, with the mitral annulus and left atrial appendage less frequent.⁵⁻⁸

Focal AT is often refractory to medical therapy and catheter ablation has become the mainstay of therapy, with high long-term success. Much can be learned about the likely site of origin of the tachycardia from a careful analysis of the tachycardia P-wave.⁹ The responsible focus can usually be localised to 1 or 2 neighbouring sites, allowing a targeted approach to point mapping. In addition, the distinction between left and right atrial foci is useful in anticipating the requirement for left atrial access. Lead V₁ is the most useful in determining the likely site of origin, with a negative or positive-negative biphasic P-wave in V₁ highly predictive of a right atrial (RA) focus, whereas a positive or negative-positive morphology in V₁ suggests left atrial (LA) origin.^{9,10} The major limitation of P-wave morphology is the inability to identify a P-wave unencumbered by the preceding T-wave and in the setting of structural atrial

disease, which is now common following extensive catheterisation for atrial fibrillation (AF).

In this issue of *Revista Española de Cardiología*, Bazán et al report a series of 87 consecutive patients with focal AT undergoing electrophysiologic study using a 3D electroanatomic mapping system.¹¹ Four groups were defined: group 1 (n=25) with pulmonary vein (PV) AT alone; group 2 (n=18) with PV AT and coexistent AF; group 3 (n=7) with other forms of LA AT; and group 4 (n=37) with RA AT. Clinical and electrophysiologic characteristics including the sinus rhythm P-wave morphology were then evaluated across all 4 groups.

Groups 1 and 4 (PV AT and RA AT) had significantly less structural heart disease and left atrial dilatation compared with groups 2 and 3. There was a predominance of superior vein foci for PV AT and PV AF and the tachycardia cycle length was shorter compared with non-PV sites. The likely tachycardia mechanism was enhanced automaticity or triggered activity in the majority of PV foci (24/25 group 1, 17/18 group 2) compared with reentry in non-PV foci (4/7 group 3, 16/44 group 4) although only limited conclusions can be made regarding tachycardia mechanism from a clinical study. The authors report a higher incidence of sinus rhythm (SR) P-wave notching and a longer SR P-wave duration in left atrial foci compared with right atrial foci. The PV AT group achieved acute success in 24/26 with 2 recurrences of AT and 1 patient with paroxysmal AF (PAF) at 34 (10) months follow-up. The PV-AF group obtained acute success in 17/18 procedures; however, long-term success was limited, with recurrent AT in 4 and recurrent AF in 6.

SEE ARTICLE ON PAGES 149-55

Disclosure: Dr Kistler is the recipient of research support from the Cardiac Society of Australasia (CSANZ). Dr Teh is the recipient of a postgraduate research scholarship with the National Heart Foundation of Australia.

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Pulmonary Vein Atrial Tachycardia Versus Pulmonary Vein Atrial Fibrillation

This study confirms previous reports on the high success rate for ablation of focal AT originating from the PVs^{8,12} in the absence of AF. The present study also identifies an important clinical observation that PV ATs typically occur spontaneously or with isoproterenol but not programmed extrastimulation.⁸

However, although both PV AT and PV AF may be initiated by PV triggers, the current paper highlights the important question of whether PV AT results in long-term AF. The present series reports high success in patients with PV AT alone (92%) but limited success in patients with PV AT and AF with a single vein approach (44%). In our own series, we have not documented AF following a focal ablation approach in PV AT in patients without a prior history of AF during long-term follow-up (mean, 7.2 [2.1] years).¹² We therefore postulate that PV AT and PV AF represent 2 distinct clinical entities. Haissaguerre and coworkers identified PV foci initiating AF to be located 2-4 cm within the PV in contrast to a more ostial location for PV AT.^{8,13,14} Unfortunately, the current series provides no information regarding the differences in location of the foci responsible for PV AF and PV AT as empiric pulmonary vein isolation of the PV AT focus was performed rather than focal ablation. Haissaguerre and coworkers were also responsible for the landmark observation that PAF is commonly associated with multiple triggers from multiple veins. As such, empiric 4-vein isolation is the preferred technique for treating paroxysmal AF. The higher recurrence rate in the PV-AF compared with the PV AT group in this series is consistent with our understanding of a more diffuse process for PV AF compared with a localised focus for PV AT as for AT in other locations. Bazán et al have not provided information on whether the recurrences underwent repeat electrophysiology study and if so, whether recurrences were from the original site or new sites.¹¹

P-Wave Morphology

P-wave morphology is an important tool in the electrophysiology kit for the mapping and ablation of atrial arrhythmias.^{8,10} However, care must be taken in identifying the tachycardia P-wave unencumbered from the preceding T-wave. Although this may occur spontaneously, ventricular ectopic beats, ventricular pacing, vagal manoeuvres or the administration of adenosine may all assist in isolating the tachycardia P-wave. The sinus P-wave is an attractive proposition as it is more readily accessible; accurate assessment of the tachycardia P-wave is at times challenging. To date, analysis of the sinus rhythm P-wave has been considered of limited benefit. Bazán et al present interesting new information on the sinus P-wave duration and P-wave notching in left versus right ATs.¹¹ Seminal studies characterising the morphology of the P-wave were performed by Waldo et al more than 30 years ago.¹⁵ The major determinants of P-wave morphology both during sinus rhythm and tachycardia are septal and left atrial

interatrial conduction. The presence of notching and prolongation of the P-wave in the PV AF group and LA AT group in this series is consistent with an increase in left atrial size in these groups. Conclusions are limited with respect to the P-wave duration in patients under 50 years of age. Differences were modest, although achieving statistical significance.

In conclusion, Bazán et al have provided further evidence that ablation of PV AT alone is highly successful and that the arrhythmia mechanism is likely to be abnormal automaticity or triggered activity.¹¹ Limited success was demonstrated with a single vein approach in patients with PV AT and AF in keeping with our understanding of a more diffuse process involving multiple sites within multiple veins compared with the focal process of PV AT alone. Although the sinus P-wave is more readily accessible, an accurate assessment of the tachycardia P-wave provides a more accurate prediction of the likely site of origin.

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