9. Atrioventricular Reentrant Tachycardia *continued*

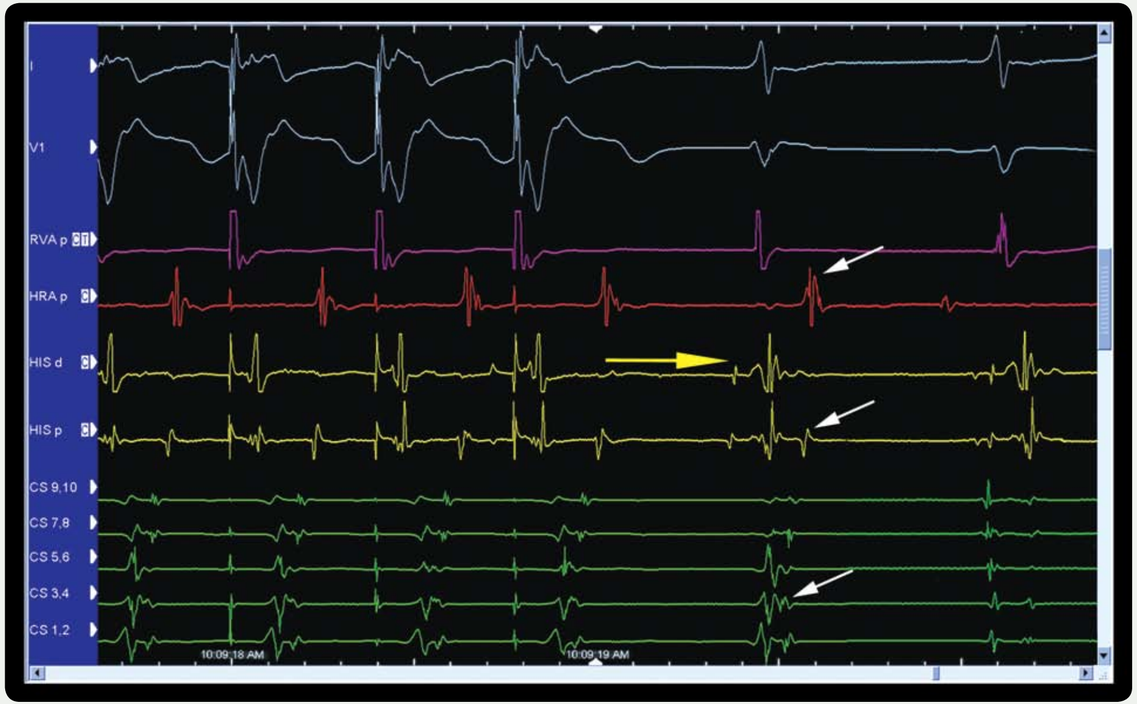
Accessory Pathway Echo

When delivering programmed extra-stimuli, we often see a single echo beat prior to initiating tachycardia. Recall that an echo beat is essentially one beat of reentrant tachycardia (see page 42 to review echo beats).

In this example, we are pacing in the ventricle. Notice how the atrial activation is eccentric, indicating a left lateral AP (CS 1-2 is the earliest AEGM). The S2 continues to be conducted to the atrium via the AP as diagnosed by the early atrial signal in CS 1-2.

After the AEGM (on the HIS channel), we then see a long A-H interval (*yellow arrow*) followed by a VEGM. This indicates that after conduction to the atrium using the AP, there is conduction back over the AV node to the ventricle, likely using a slow pathway. This is a single echo beat using the AP and the AV node as the circuit. In fact, there is conduction back to the atrium one more time using the AP (*white arrows*). So we really have one and a half cycles of AVRT before it stops by blocking in the AV node.

Commentary: **Why did the AP echo not initiate AVRT? To answer this, we simply need to consider what the weak link is in this reentrant circuit. The last activity was an AEGM received from the AP. The tachycardia was prevented because of blocking in the AV node. This makes the AV node the "weak link." Starting the patient on isoproterenol to improve AV nodal conduction may allow AVRT initiation.**



12. Atrial Fibrillation *continued*

Pulmonary Vein Fibrillation

This example reinforces the concept that successful ablation can "fence in" the electrical activity of the PVs and surrounding tissue, preventing exit into the atrium and initiation of AF. The blue Lasso signals here indicate that fibrillation is ongoing inside the PV. However, sinus rhythm continues (as seen on the surface ECG), unperturbed by the ongoing arrhythmia inside the vein.

In paroxysmal AF, the usual goal of ablation is electrical isolation of all four PVs to prevent ectopy in the veins from starting AF. In chronic AF, however, the ablation target is usually more complicated since the problem is not only the initiating beats from the veins but also the areas in the atrium that allow AF to persist.

In chronic AF, the first target is often isolation of the PVs. The second step is then some combination of ablating complex fractionated EGMs (CFEs), which are areas thought to contribute to sustaining the AF, as well as creating lines of conduction block in the left atrium across the roof and/or from mitral annulus to left PV (through the mitral isthmus). Another effect of creating these linear ablation lesion sets is to prevent flutter circuits from developing and the occurrence of left atrial flutter after the ablation. If a patient returns for a second ablation due to recurrent AF or left atrial flutter, the second procedure usually entails checking the veins for return of conduction, with further ablation applied to re-isolate them if necessary. If left atrial flutter is seen, then ablation is also directed at interrupting these circuits.

Commentary: **Extra lines and targeting complex fractionated EGMs are all part of substrate modification. However, incomplete lines may, paradoxically, increase the substrate for left atrial flutter. Incomplete lines are worse than no lines at all. It is often very difficult to ablate patients returning with left atrial flutter because of the challenge in identifying the circuit and its critical zone.**

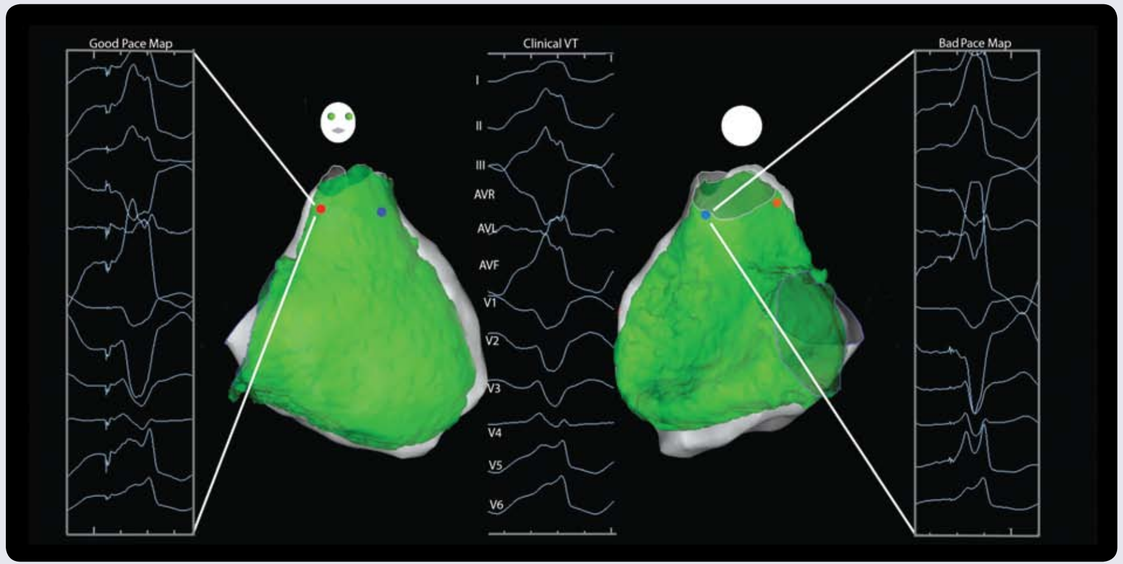
13. Ventricular Tachycardia *continued*

Pace Mapping

Pace mapping is a method that uses the QRS morphology on the ECG as a guide to locate the site of origin of the VT. This strategy is carried out using the catheter to pace several locations within the ventricle. The VT QRS morphology is studied, and there is an attempt to mimic the morphology of the clinical VT with that of the pacing morphology. This strategy is based on the concept that the QRS morphology of the VT will be reproduced by pacing the ventricle at the site of origin of the VT.

The ablation catheter is moved to different parts of the ventricle and pacing is performed. The closer the paced morphology matches the VT morphology, the closer the pacing site is to the origin or exit site of the VT. In this example, different locations in the right ventricular outflow tract were paced. The VT morphology is shown in the middle, and two different pacing sites are highlighted. One demonstrates a good morphology match, while the other shows a poor morphology match.

Commentary: **Like all strategies, pace mapping has its pitfalls. One important factor is lead placement. Remember that in the EP lab, the ECG electrodes are often placed in nonconventional positions because the R2 (defibrillating) pads and ground patches prevent conventional lead placement. This can lead to dramatic changes in the apparent ECG morphology.**



23. Why Does the A-H Interval Vary? *continued*

In this tracing, we tried inducing an SVT with a ventricular extra-stimulus (S2). It blocked in the left lateral AP as well as the AV node. However, a spontaneous PVC did successfully initiate AVRT. Each QRS during tachycardia is followed closely by eccentric atrial activation starting in the distal CS (1-2). This can only be AVRT over a left lateral AP (you may consider why). Interestingly, the TCL is irregular, which is related to a changing A-H interval. Why is the A-H interval changing?

Commentary: The concept of dual AV nodal pathways has been discussed, and the slow AV nodal pathway is usually the antegrade limb of the circuit in AVNRT. However, patients with A-V tachycardias may also have dual pathways.

In this example, antegrade conduction utilizes either the slow pathway or the fast pathway with some decrement. Since the right ventricular PVC takes much longer to travel to the AP, the A-H interval is shorter. Once the tachycardia is under way, the circuit is smaller, shortening the A-A time and thus lengthening the A-H interval.

In such patients, dual AV nodal pathways may also manifest AVNRT as well as AVRT.