EP Rounds: Para-Hisian pacing: Beware what you capture

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Abstract

A 78 year old lady sought medical attention for palpitations with documented regular wide complex tachycardia with a left bundle branch block (figure [1](#fig-cap-0001)) as well as atrial fibrillation. She presented for a catheter ablation for atrial fibrillation and presumed CTI-dependent atrial flutter. As a part of the procedure, we performed an electrophysiology study. We performed pacing manoeuvres to evaluate for the presence of a concealed accessory pathway. She had an underlying left bundle branch block observed in sinus rhythm. Results of para-Hisian pacing maneuver are displayed in figure [2](#fig-cap-0002) with intracardiac electrograms and corresponding 12-lead ECG. Para-Hisian pacing is performed at a constant pacing interval through the distal electrode of the His bundle catheter. There is a decapolar catheter in the coronary sinus with the proximal electrode positioned at the Os. Here are some questions to consider: There are 4 different paced morphologies observed. What does each one of these represent? How can we interpret the findings of this maneuver? What role does pre-existing left bundle branch block play in our interpretation?

EP Rounds: Para-Hisian pacing: Beware what you capture

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Background

A 78 year old lady sought medical attention for palpitations with documented regular wide complex tachycardia with a left bundle branch block (figure 1) as well as atrial fibrillation. She presented for a catheter ablation for atrial fibrillation and presumed CTI-dependent atrial flutter. As a part of the procedure, we performed an electrophysiology study.

We performed pacing manoeuvres to evaluate for the presence of a concealed accessory pathway. She had an underlying left bundle branch block observed in sinus rhythm. Results of para-Hisian pacing maneuver are displayed in figure 2 with intracardiac electrograms and corresponding 12-lead ECG. Para-Hisian pacing is performed at a constant pacing interval through the distal electrode of the His bundle catheter. There is a decapolar catheter in the coronary sinus with the proximal electrode positioned at the Os.

Here are some questions to consider:

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How can we interpret the findings of this maneuver? What role does pre-existing left bundle branch block play in our interpretation?

Considerations

In this example, para-Hisian pacing is performed through the distal electrode of the ablation catheter. The retrograde atrial activation sequence is eccentric and identical in all beats. The shortest V-A interval, to the earliest atrial signal is constant in all beats displayed. However, the paced QRS morphologies are different. There are four differing QRS morphologies with ventricular pacing via the distal His electrode. Paced beats 1, 2, 3 and 5 have different morphologies while paced beats 3 and 4 are identical. The Stim-QRS interval and the initial component of the QRS complex varies between the beats. Depolarisation of ventricular myocardium via the conduction system results in rapid initial deflections of the QRS due to the rapid conduction velocity, direction of activation and mass of myocardium activated concurrently. Direct capture of ventricular myocardium results in shorter Stim-QRS intervals with a slurred onset representing slower cell to cell conduction. Typically, the para-Hisian pacing maneuver involves capture of the His bundle and the ventricular myocardium, comparing this to a situation when there is only ventricular myocardial capture (without His bundle capture). When this occurs, the pattern of atrial activation is evaluated and the V-A interval is compared. Changes in atrial activation pattern suggest more than one pathway of electrical conduction from ventricle to atrium. Changes in V-A interval suggests conduction from ventricle to atrium is reliant on the AV node and conduction system (1).

A typical nodal response, with retrograde conduction exclusively through the AV node, is one where the retrograde atrial activation sequence is preserved and the VA interval is longer in the absence of His bundle or conduction system capture, than it is with His bundle or conduction system capture.

When performing this manoeuvre it is important to confirm what is being captured by the pacing electrode. Below is our explanation of the four paced QRS morphologies:

- QRS 1: Capture of His bundle only
- QRS 2: Capture of His bundle only and correction of left bundle branch block
- QRS 3 and 4: Capture of His bundle and local ventricular myocardium
- QRS 5: Capture of His bundle with correction of left bundle branch block and capture of local ventricular myocardium

Our His catheter shows evidence of local ventricular myocardial signals which are seen in the initial 2 beats, as distinct from the pacing stimulus. This occurs as the local ventricular myocardium has not been captured by the pacing stimulus.

Interpretation

Given the above explanations, we can then interpret the findings. In this instance we have conduction system capture in all beats. Therefore, this response is in fact nodal as there is no change in the VA interval. The presence of a septal accessory pathway would allow for quicker activation of the atrium, or shorter VA interval, when there was direct ventricular myocardial capture alongside His bundle capture. We would also expect a shift in retrograde atrial activation sequence.

Additionally, overcoming typical left bundle branch block with His bundle capture is a phenomenon that has been observed with His bundle pacing (2). There are multiple mechanisms proposed to explain this with the seminal concept that fibers within the His bundle itself are predestined for the left or right bundle branch (3). Therefore, bundle branch block can be overcome by pacing distal to the block within the His bundle, or by using pacing outputs to improve the source-sink mismatch that would otherwise render the left bundle fibres inactive (4).

Conclusion

This case highlights an example of attempted para-Hisian pacing with responses contrary to what is typically described due to the capture of tissue in an unusual manner. Therefore, it is in fact exactly what is to be observed with conduction through the atrioventricular node, despite the apparent eccentric retrograde atrial activation sequence.

Disclosure

The authors of this manuscript have no conflicts of interest to disclose.

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Figures

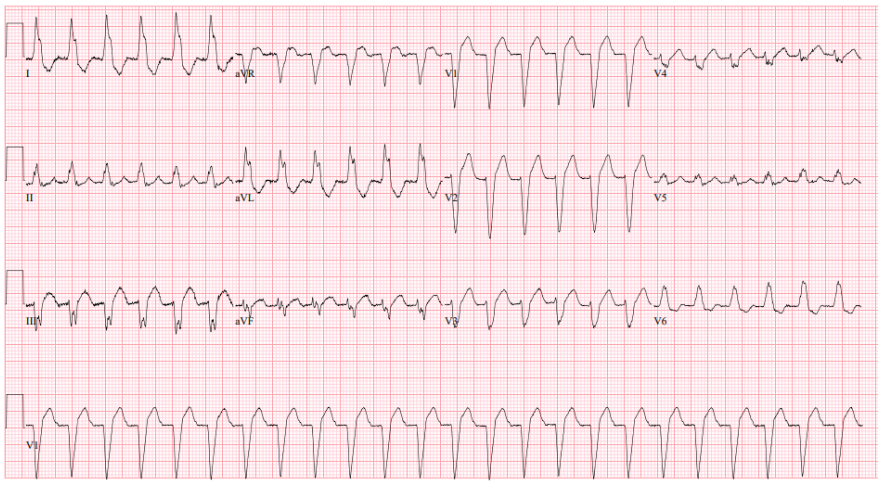

Figure 12-lead ECG showing a regular wide complex tachycardia with LBBB ventricular morphology, similar to her QRS morphology in sinus rhythm.