Images in cardiovascular medicine

Evidence of a concealed accessory pathway during a tachycardia with three QRS morphologies and cycle length variations related to functional bundle branch block

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A healthy 21-year-old male athlete with recurrent episodes of sustained palpitations was referred to our laboratory for arrhythmia investigation. After written consent, a transesophageal electrophysiological study was performed. Premature atrial stimulation induced a wide complex tachycardia with left bundle branch block (LBBB) morphology. After a few beats, the QRS morphology narrowed for two beats and then a right bundle branch block (RBBB) morphology with occasional normal QRS complexes appeared (Fig. 1). The tachycardia persisted until sinus rhythm was restored by three atrial extrastimuli. The induction, interruption and the pattern of ventricular activation were all highly reproducible. The tachycardia R-R intervals, although at first glance fairly identical, were prolonged during LBBB (320 ms) when compared to RBBB and normal morphology (270-280 ms). During tachycardia, the esophageal recording showed a stable 1:1 atrioventricular ratio. The longest ventriculo-atrial interval was associated with LBBB (160 ms), and the shortest (120 ms) with normal morphology and RBBB. The atrioventricular interval varied only slightly and was shorter with RBBB than with LBBB and normal morphology (150 vs 160 ms).

Induction and interruption of a tachycardia by programmed stimulation strongly suggest a reentry mechanism. During a wide complex tachycardia, a transient narrowing of the QRS that is not due to capture or fusion of a supraventricular beat strongly suggests a supraventricular tachycardia with aberrant conduction. During tachycardia, esophageal recording clearly demonstrated a stable 1:1 atrioventricular ratio, excluding fusion or capture phenomena and consequently a ventricular origin of the

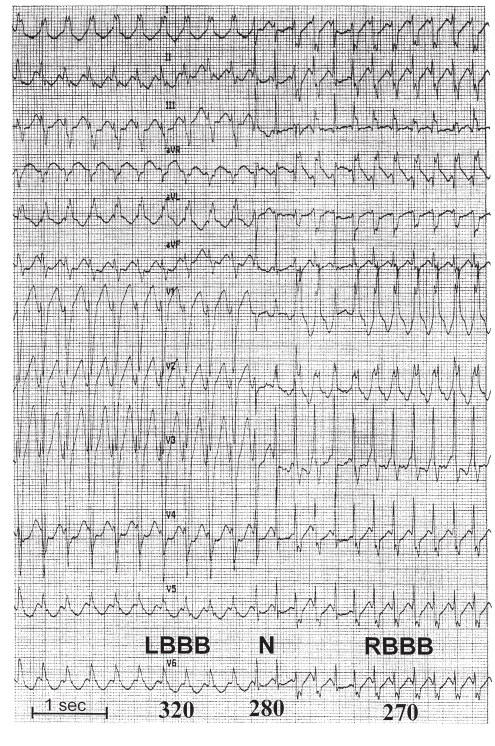

Figure 1. *A tachycardia with three QRS morphologies. A 12-lead ECG of a wide complex tachycardia showing, at the beginning, a left bundle branch block (LBBB) morphology, narrowing (N) of the QRS complexes for two beats and then a right bundle branch block (RBBB) morphology. Typically LBBB is associated with a longer R-R interval (320 ms). Upon QRS normalization, the R-R interval shortens (280 ms) and remains almost unchanged (270 ms) during RBBB morphology.*

rhythm. Furthermore, a normalization of the conduction in the left bundle branch is able to shorten the cycle of the tachycardia as in case of direct involvement of the left bundle branch in the circuit of the tachycardia: an atrioventricular reentrant tachycardia using a left accessory pathway was diagnosed[1].

An intracavitary electrophysiological investigation was subsequently performed. Three diagnostic catheters were used: a decapolar catheter was introduced via the left subclavian vein and placed into the coronary sinus to obtain five bipolar recordings, a quadripolar steerable catheter was introduced via the right femoral vein and placed into the high right atrium, and a quadripolar catheter introduced via the right femoral vein was placed into the Hisian region. Supraventricular tachycardia was induced by programmed atrial stimulation and during the tachycardia the earliest atrial activation was recorded in the distal coronary sinus (Fig. 2). During tachycardia, a ventricular premature beat during His bundle refractoriness was able to anticipate the subsequent atrial deflection. This confirmed the diagnosis of an atrioventricular reentrant tachycardia retrogradely involving a concealed left free-wall accessory pathway. The steerable ablation catheter inserted through the right femoral vein was then advanced into the left atrium by transseptal catheterization as previously described[2]. A single radiofrequency energy pulse along the mitral annulus, where the shortest interval of ventriculoatrial activation was recorded during tachycardia (tracing SITE in figure 2) terminated the tachycardia and completely interrupted the conduction over the accessory pathway. Subsequently, no arrhythmia was inducible. No recurrences of tachycardia were reported during 2 years of follow-up.

This case shows that a detailed analysis of the surface ECG may enable recognition of both the tachycardia mechanism and the location of a concealed accessory pathway.

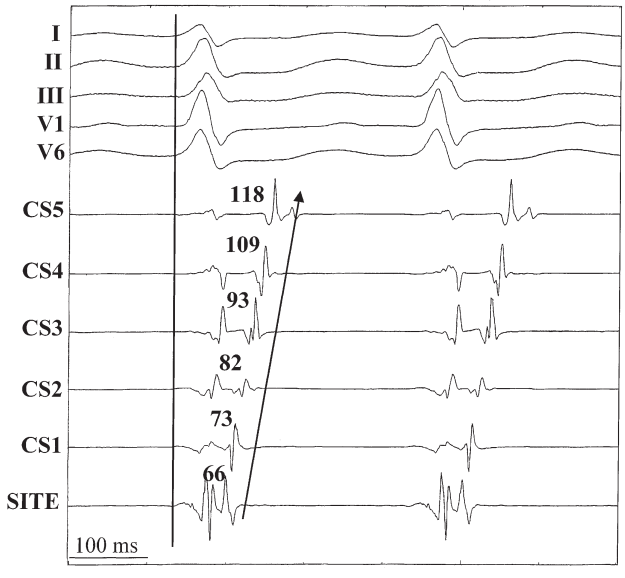

Figure 2. *Surface and endocavitary recordings during tachycardia.* From top to bottom *leads I, II, III, V_1, V_6, bipolar recordings from the proximal (CS5) to the distal (CS1) electrode pairs of the decapolar catheter in the coronary sinus and bipolar recordings from the distal electrode pair of the ablation catheter (SITE) are shown. The shortest interval of ventriculo-atrial activation was recorded at the site of successful ablation in the lateral region of the mitral annulus, close to the distal electrode pair of the coronary sinus catheter. The* vertical line *identifies the QRS onset, whereas* numbers *refer to the value (in ms) of the interval between the QRS onset and the atrial deflections in the different tracings. The* arrow *indicates the direction of atrial propagation.*

References

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2. De Ponti R, Zardini M, Storti C, Longobardi M, Salerno-Uriarte JA. Trans-septal catheterization for radiofrequency catheter ablation of cardiac arrhythmias: results and safety of a simplified method. Eur Heart J 1998; 19: 943-50.