CASE REPORT

Intermittent fasciculoventricular pathway: ECG and electrophysiologic findings, clinical implications

Agustín Bortone*, Florence Leclercq, Robert Grolleau-Raoux, and Jean-Luc Pasqué

CHU Montpellier, Service de Cardiologie A, Clinique de Maladies du Cœur et des Vaisseaux, Hôpital Arnaud de Villeneuve, Centre Hospitalo-Universitaire, 371, avenue du Doyen Gaston Giraud, 34295 Montpellier Cedex 5, France

Received 6 November 2006; accepted after revision 3 March 2007; online publish-ahead-of-print 20 April 2007

Although fasciculoventricular (FV) pathways never participate into tachycardia circuits, they give rise to ventricular pre-excitation of variable magnitude which can be source of ECG misinterpretation when associated to other supraventricular rhythm disorders. We report an intermittent FV pathway coincidently unmasked during an electrophysiologic study performed for a symptomatic supraventricular tachycardia (atrial tachycardia). The clinical context, ECG and EP findings, and therapeutic options are described. Fasciculoventricular pathways need no medical or ablative treatment, thus their positive and differential diagnosis must be clearly assessed.

KEYWORDS
Ventricular pre-excitation; Mahaim fibres; Intermittent fasciculoventricular pathway; Atrial tachycardia

Introduction

Fasciculoventricular (FV) pathways are extremely rare and correspond to accessory connections taking off from the bundle of His or the fascicles and inserting into the ventricles. Fasciculoventricular pathways are commonly thought to play no active role in tachycardia circuits being bystanders bundles.1,2 However, FV pathways can be associated with other arrhythmogenic substrates causing ECG aspects that might be of difficult interpretation. It is then crucial to clearly identify FV pathways and distinguish them from other bypass tracts or arrhythmias in which substrate involves, in particular, the Hisian region before performing catheter ablation.2

We present the case of a young woman complaining of palpitations in whom a bystander intermittent conducting FV pathway was diagnosed. The diagnosis context, the ECG findings, the electrophysiologic study, and the clinical implications related to this FV pathway are described.

Case report

A 38-year-old female was referred to our institution for electrophysiologic study. She complained of recurrent, drug resistant palpitations. Her mother and her niece have both the Wolff–Parkinson–White syndrome. Twelve-lead ECG was unremarkable except for rest sinus tachycardia (Figure 1A). Clinical examination and transthoracic echocardiogram showed no abnormality. The patient had no anaemia or phlebitis and her thyroid function was normal. ECG Holter monitoring showed sustained episodes of sudden onset, regular narrow complex tachycardia, with a mean cycle of 370 ms and with a long PR interval > RP interval (Figure 1B).

Electrophysiologic study was performed after obtaining informed consent, in the fasting state, and free of medication. Under light sedation, diagnostic catheters were introduced through the right femoral vein. Two 6-French quadripolar catheters were placed in the high right atrium and the His bundle positions. A 6-French decapolar catheter was placed in the high right atrium and the His bundle positions. A 6-French quadripolar catheter was placed in the coronary sinus (CS). Twelve surface ECG leads and multiple intracardiac bipolar electrograms filtered at 30–500 Hz were recorded using a computerized EP recording system (EP MedSystems, West Berlin, NJ, USA). Rest sinus rate was 650 ms. Rest AH and HV intervals were, respectively, 110 and 35 ms. AH conduction during incremental atrial pacing showed AH prolongation with an AV node Wenckebach conduction pattern at an atrial pacing length of 300 ms. Dual anterograde nodal pathways were individuated but no AVNRT was inducible. HV interval remained unchanged and no manifest ventricular pre-excitation was observed during atrial stimulation manoeuvres. Ventricular pacing from the RV apex demonstrated concentric and decremental retrograde VA conduction. Right ventricular apical electrical stimulation with up to two extrastimuli following two different paced cycle lengths (600 and 400 ms) failed to induce atypical AVNRT, AVRT, or VT. Isoproterenol infusion induced an atrial tachycardia (AT) with a long PR interval consistent with records from the Holter tracing.

* Corresponding author: Tel: +33 467 33 62 17; Fax: +33 467 33 62 18. E-mail address: agubene@hotmail.com

© The European Society of Cardiology 2007. All rights reserved. For Permissions, please e-mail: journals.permissions@oxfordjournals.org
Atrial tachycardia originated from a region close to the sinus node and reproduced the patient’s symptoms. However, once the effects of the isoproterenol resumed, a clear but intermittent ventricular pre-excitation pattern (Figures 2 and 3) was repetitively observed. Twelve-lead ECG suggested a left-sided bypass tract (negative delta wave in aVL lead). However, stimulation from the CS catheter and from the RV base and apex failed to demonstrate the existence of any bypass tract. Furthermore, complete conduction block was observed after intravenous adenosine and no ventricular pre-excitation was unmasked. At this step of the electrophysiologic study, the decapolar catheter was placed at the His bundle position and the His bundle quadripolar catheter was placed within the CS. A fourth diagnostic catheter (5-French bipolar) was inserted through the right femoral vein and positioned at the high right atrium. The quadripolar catheter located previously at the high right atrium was positioned at the para-Hisian position. Para-Hisian pacing was not used to differentiate retrograde conduction from an accessory pathway from
conduction over the AV node as described by Hirao et al. In our case, para-Hisian pacing unmasked an anterograde unidirectional accessory pathway and reproduced exactly the ECG aspect of the intermittent ventricular pre-excitation observed previously (Figures 2 and 3).

Para-Hisian pacing with an incremental rate demonstrated a non-decremental conduction pattern of the accessory pathway in which effective refractory period (ERP) was 250 ms, suggesting a FV pathway connecting the His bundle to the left posterior side of the interventricular septum. The clinical AT of the patient was successfully managed with β-blocker therapy.

Discussion

Fasciculoventricular pathways are the most unusual variants of Mahaim fibres. They can be considered, according to Josephson, as an electrocardiographic curiosity. These pathways connect the His bundle or the fascicles to the...
right (most of the time) or the left ventricle (LV).\textsuperscript{1,2} Fasciculoventricular pathways permit only anterograde conduction and have, in general, non-decremental conducting properties.\textsuperscript{1,2} However, it had been recently shown that some FV fibres can exhibit decremental conduction properties.\textsuperscript{4} Fasciculoventricular pathways are never involved in reciprocating tachycardia circuits and should only be managed medically. However, they give rise to a ventricular pre-excitation pattern that may result in ECG aspects of difficult interpretation.\textsuperscript{1,2} Fasciculoventricular pathways are associated to other types of bypass tracts,\textsuperscript{5} typical\textsuperscript{6} and atypical AVNRT,\textsuperscript{7} and other SVT.\textsuperscript{8} Fasciculoventricular pathways identification is of major concern. They must be differentiated from other bypass tracts and arrhythmia mechanisms, which involves in particular the Hisian region, before any ablation is attempted. Although the magnitude of the ventricular pre-excitation is variable, FV are in general manifest. To the best of our knowledge, our case illustrates for the first time an intermittent FV fibre connected from the bundle of His to the LV.

Regarding the ventricular insertion of the FV pathway, the large initial positivity of the pre-excitation in lead V1 suggests an insertion high on the left posterior side of the interventricular septum. However, this assertion cannot be proved since we did not perform mapping within the LV.

The diagnosis of an intermittent FV bypass connecting the bundle of His to the LV was assessed by the following findings: (i) absence of another accessory pathway, in particular a midseptal accessory pathway, demonstrated by atrial test stimuli or atrial pacing at increasing rates and by ventricular pacing manoeuvres without and with isoproterenol concomitant infusion, (ii) nodal Wenckebach anterograde phenomenon and complete AV block after adenosine injection without any pre-excitation unmasked, (iii) spontaneous intermittent ventricular pre-excitation observed in the His bundle catheter without change in the ventricular activation pattern in the CS catheter, (iv) pacing from the para-Hisian region reproducing the pre-excitation syndrome without change in the ventricular activation pattern within the CS catheter. However, this finding did not exclude a paraseptal atrio-ventricular pathway, (v) the width of the QRS of only 110 ms, while a clear delta wave is present.

The reasons explaining the intermittent pattern of the FV fibre of our observation are not clear. One can speculate that, at rest, there might be electrotonic interactions between the FV fibre and the His bundle conduction system, which are favourable to the conduction through the His bundle system. Under stress conditions, mimicked by isoproterenol infusion, the electrotonic interactions may be modified by catecholamines unmasking the FV accessory bypass.

**Conclusion**

Fasciculoventricular fibres give rise to ventricular pre-excitation patterns which can cause misleading ECG aspects, particularly when associated to a supraventricular tachycardia. It is of major concern to recognize FV pathways, as they do not necessitate any treatment. In this setting, we describe for the first time an intermittent FV pathway connecting the His bundle to the LV associated to an AT.

**References**