CASE REPORT

An old myocardial infarction unmasked by upgrade to His bundle pacing: a case report

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Abstract: Right ventricular pacing is considered a non-physiological modality; the wavefront of depolarization slowly spreads from the lead tip to the rest of the myocardium, creating morphological alterations of the QRS complexes that make it difficult an electrocardiographic diagnosis of myocardial infarction. During His bundle pacing the electrical impulse travels through the normal conduction system, as a result, paced ventricular complexes show morphological features that are completely superimposable to basal ECG. This peculiarity allows to appreciate the electrocardiographic alterations consequent to a previous heart attack or to an acute coronary syndrome. Below, we introduce a clinical case of PMK recipient in which the upgrade to HB pacing unmasked a previous infero-lateral myocardial infarction.

Keywords: His bundle pacing, conduction system pacing, myocardial infarction, upgrade, acute coronary syndrome

INTRODUCTION

Resting 12-lead ECG is the first-line diagnostic tool in the evaluation of patients with suspected acute coronary syndrome (ACS) and old myocardial infarction (Collet, J.P. et al., 2020); however, in pacemaker (PMK) recipients, ECG morphological changes related to right ventricular (RV) pacing, even in intermittent paced forms, make it difficult to correctly diagnose myocardial ischaemia, also due to the phenomenon known as cardiac memory (Shvilkin, A. et al., 2015; & Abraham, A. S. et al., 2019), delaying medical therapy.

In recent years we have witnessed a progressive interest of the scientific community in His bundle (HB) pacing as an alternative to RV pacing (Vetta, F. et al., 2020). HB pacing is rightly considered physiological, since, unlike RV pacing, the electrical impulse travels through the normal conduction system and, therefore, does not result in ventricular electrical dyssynchrony. As a result, paced ventricular complexes show morphological features that are completely superimposable to those evident in the baseline ECG in the absence of pacing (Abraham, A. S. et al., 2019; Vetta, F. et al., 2020; Vijayaraman, P. et al., 2018; & Catanzariti, D. et al., 2013). Although HB pacing, in contrast to RV pacing, should not affect the ventricular repolarisation phase, there are only few cases in the literature about electrocardiographic diagnosis of myocardial ischaemia during HB pacing.

Therefore, below, we introduce a clinical case of PMK recipient in which the upgrade to HB pacing unmasked a previous infero-lateral myocardial infarction.

CASE REPORT

We report the clinical case of a 71-year-old man who was implanted with a dual-chamber PMK for complete atrioventricular block in 2012. Suffering from chronic ischemic heart disease, in 2013 he was treated with two percutaneous coronary intervention (PCI) and stenting of the left anterior descending coronary artery (LAD) and right coronary artery (RCA); in 2014 he underwent, successfully, atrioventricular node ablation for the appearance of a high ventricular frequency atrial fibrillation despite optimal medical therapy for rate control. In March 2021, he was referred to our hospital for acute heart failure. Medical therapy included acetylsalicylic acid, bisoprolol, furosemide, mineralocorticoid receptor antagonist and sacubitril/valsartan. On admission he presented dyspnoeic, with peripheral edema, pulmonary congestion on clinical examination and chest radiography; transthoracic echocardiography showed diffuse hypokinesis, with a left ventricular ejection fraction (LVEF) of 28% (46% six months earlier). ECG showed atrial flutter and paced ventricular rhythm with notch of the QRS complex in all 12 leads (Figure A). After achieving good clinical compensation with intravenous diuretics, the patient underwent coronary angiography with evidence of an unchanged coronary situation compared with 2013. Given the constant right ventricular apical pacing, we considered the LVFE decline as a consequence of pacemaker-induced cardiomyopathy (PICM) (Khurshid, S. et al., 2014) then, after obtaining the patient’s informed consent, a successful upgrade to HB pacing was performed (Figure B). The surface ECG showed selective HB pacing with QRS width comparable to the native ECG (Figure C) but different morphology, because of evidence of QS complexes in V3-V6 and II,III,aVF (Figure D); physiological pacing obtained with selective HBP had made evident electrocardiographic signs of a previous myocardial infarction (MI).
**DISCUSSION**

RV pacing typically produces a left bundle-branch block (LBBB)-like pattern in septal and anterior precordial leads, with a predominantly negative QRS complex followed by ST elevation and positive T-waves (Khurshid, S. *et al.*, 2014; & Browning, A. C., & Schaefer, S. 2013). Sgarbossa criteria can help identify myocardial infarction with ST-segment elevation (STEMI) in LBBB patients, allowing at least in some cases, timely access to reperfusion therapy. However, the low sensitivity of these criteria (between 18% and 55%) results in a low negative predictive value to exclude an acute coronary event (Khurshid, S. *et al.*, 2014; Browning, A. C., & Schaefer, S. 2013; Barold, S. S. *et al.*, 2006; & Nestelberger, T. *et al.*, 2019).

Even more difficult is the diagnosis of a previous MI during RV pacing (3,8-10); to date, although considered questionable, we have only the criteria of Kochiadakis and colleagues (9) (Figure A):
- Notch of 0.04-second duration on the ascending limb of the S-wave of leads V3, V4, or V5 (Cabrera's sign).
- Notching of the ascending stroke of the R wave in leads I, aVL, or V6 (Chapman's sign).
- Q waves of 0.03 second duration in leads I, aVL, or V6.
- Notch of the first 0.04 seconds of the QRS complex in leads II, III, and aVF.
- Q wave of 0.03 seconds duration in leads II, III, and aVF.

Occurring through the normal conduction system, HB pacing should generate in addition to a depolarization also a physiological myocardial repolarization resulting in a paced QRS complex with morphology and duration equal to the basal ECG, without alterations in the ventricular repolarization phase. As proof of the above, it was possible to appreciate that the transition from RV pacing to selective HB pacing allowed to unmask the signs of a previous infero-lateral IMA, showing clear QS complexes in II, III, aVF, V3-V6. There are only 2 similar cases in the literature, the first case described how, in a patient with left bundlebranch (LBB) block and old inferior infarction, LBB pacing corrected the conduction defect and made evident pathological Q waves in the inferior leads (Ponnusamy, S. S., & Vijayaraman, P. 2021); the second one described how the paraHissian area pacing made evident a Brugada pattern in a patient with left bundle branch block (Guandalini, G. S., & Marchlinski, F. E. 2021). In our case, for the first time, the upgrade from RV pacing to selective HB pacing has made the conduction physiological in all the surface ECG leads, unmasking a previous infero-lateral myocardial infarction. Finally, in a recent case report Marinaccio *et al.*, described for the first time how physiological stimulation allows to appreciate even minimal electrocardiographic alterations during non-ST elevation myocardial infarction (NSTEMI), speeding up the diagnosis and therapy (Marinaccio, L. *et al.*, ).

**CONCLUSIONS**

This clinical case reinforces the limited evidence in the literature that the restoration of cardiac physiological conduction by HB pacing can unmask ECG abnormalities, not evident during RV pacing, such as signs of a previous myocardial infarction.

Therefore, in light of the current data and evidence on the feasibility and safety of HBP, it seems reasonable to consider HB pacing also in patients at high risk of ischemic heart disease who require pacing.
Figure A) Post dual chambre PMK, surface 12 leads ECG: it shows atrial flutter, ventricular paced QRS morphology from apical site (explanation in the text). B) Chest X-Ray post upgrade to His bundle pacing; yellow arrow: His lead. C) Basal surface 12 leads ECG: it shows sinus rhythm, left anterior fascicular block. D) Post upgrade to His Bundle pacing, surface 12 leads ECG: it shows atrial flutter and selective His bundle pacing; note, highlighted in red, the QS complexes as for previous inferior and anterolateral transmural necrosis (leads V3-V6, II, III,aVF). Red arrow: PMK spike; HBP: His bundle pacing.

REFERENCES