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Case report

Left bundle branch pacing in diffuse electrical cardiac disease in a pediatric patient

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ABSTRACT

Left bundle branch pacing is a second-line strategy in patients where His bundle pacing is not optimal. Currently, no cases of left bundle branch pacing have been reported in patients with diffuse electrical cardiac disease or in pediatric population.

Keywords: Bundle of His; Cardiac Pacing, Artificial; Cardiac Arrhythmia; Sinus Node Dysfunction; Pediatrics (source: MeSH-NLM).

Introduction

Left bundle branch pacing was first described in 2017 by Huang *et al.* [1]. It is a useful technique in patients where physiological His bundle pacing is not feasible due to high capture thresholds, conduction blocks distal to His, or technical difficulties; moreover, it is safe and reproducible [2]. One indication for pacing is sinus node dysfunction, which may or may not be accompanied by other conduction system disturbances. When a patient has abnormalities in the electrical impulse propagation in both the specific conduction system and the atrial and ventricular myocardium, the patient has diffuse electrical cardiac disease [3]. Currently, no cases

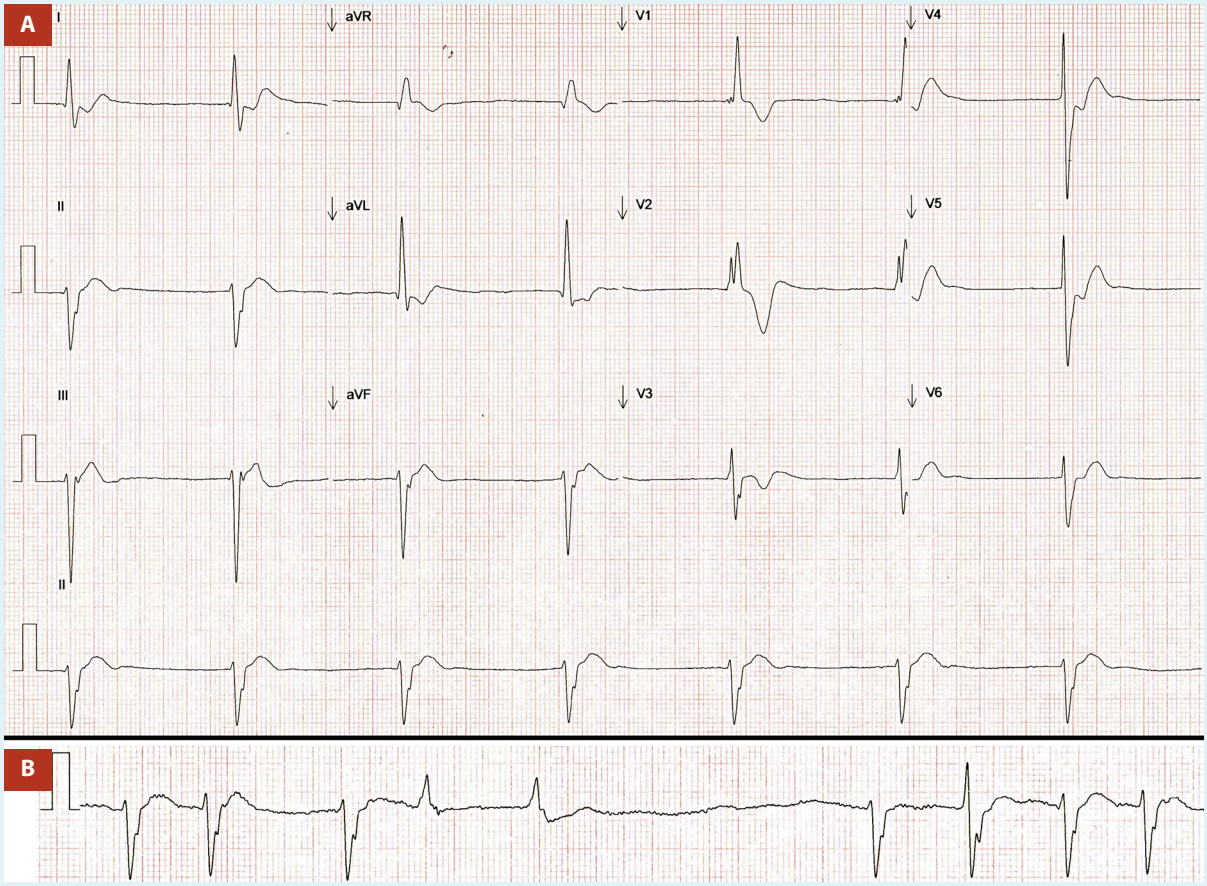

Figure 1. Twelve lead electrocardiogram at rest. **A.** AV-junctional rhythm at a rate of 42 beats per minute with QRS of 140 ms and bifascicular block, without evidence of atrial activity. **B.** Pause of 2.3 seconds during an episode of atrial fibrillation.

of left bundle branch pacing with diffuse cardiac electrical disease have been reported in pediatric population.

Case report

A 5-year-old female patient with no significant family history, was admitted to our institute with a history of three months of repetitive syncope. On admission, she presented bradycardia and hemodynamic compromise, in addition to Stokes-Adams crisis, the electrocardiogram (ECG) showed junctional rhythm and pauses **(Figure 1).** Therefore, a temporary pacemaker was implanted with an active fixation lead through the right jugular vein connected to external permanent pacemaker source, as previously reported [4]. The echocardiogram showed absence of structural heart disease, with monophasic ventricular filling.

It was decided to perform an electrophysiological study with the temporary pacemaker programmed in VVI 40, which showed absence of electrical activity in the right atrium, as well as failure of capture in different positions and with higher output **(Figure 2A)**; likewise, it presented very sporadic atrial depolarizations that allowed to document prolonged atrial-His (AH) and His-ventricle (HV) intervals **(Figure 2B).** A ventricular tachycardia induction protocol was performed due to the possibility of coexistence between diffuse electrical cardiac disease and ventricular arrhythmias, which was negative.

Subsequently, single-chamber pacemaker implantation with His bundle pacing was programmed using the Medtronic 3830 Select Secure lead (Medtronic, Minneapolis, MN, USA) and the C315 sheath (Medtronic, Minneapolis, MN, USA). During the procedure, high thresholds were obtained in the anatomical region of the His bundle, for which reason the lead

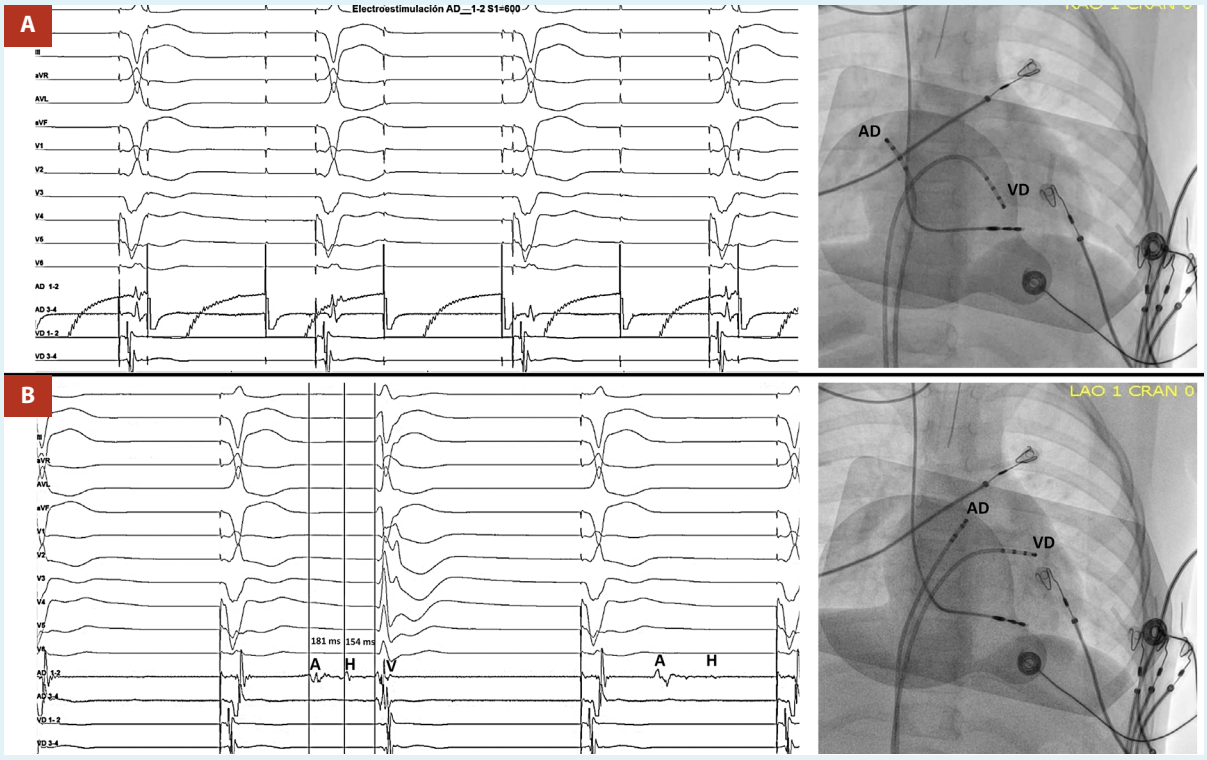

Figure 2. Electrophysiological study. Initially, a quadripolar catheter was positioned in the right atrium (RA) and another in the right ventricle (RV). **A.** Stimulation at multiple points of the RA without capture at maximum output. **B.** The RA catheter was intentionally positioned in the region of the His bundle and we documented an atrial beat that generated longer AH and HV intervals (AH 181 ms, HV 154 ms), as well as infra-Hisian block

was implanted 1 cm below, in the anatomical region of the left bundle branch; pacing in this location was able to capture and generate a QRS of 115 ms with a threshold of 0.7V/1.0 ms and impedance of 1200 ohms **(Figure 3A).** Contrast injection through the sheath showed adequate penetration of the electrode in the interventricular septum **(Figure 3B),** and the

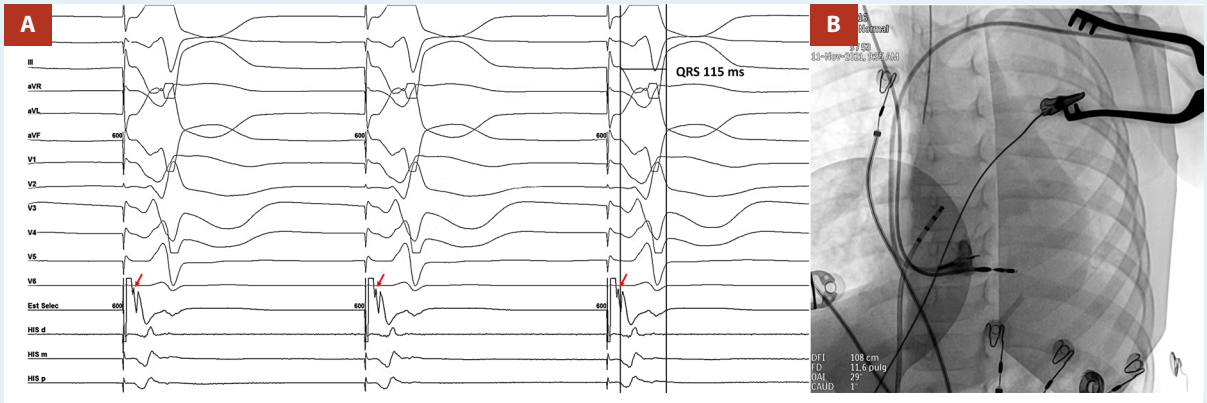

Figure 3. Left bundle branch area pacing. **A.** Subselective left bundle branch pacing that generated a QRS of 115 ms with right bundle branch block morphology in V2, left bundle branch potential is observed from the stimulation electrode. **B.** Contrast injection through the C315 sheath allowing adequate penetration of the 3038 lead into the interventricular septum.

procedure was completed without complications. At 6-month follow-up, the patient did not have syncope again.

Discussion

Implantation of cardiac electronic devices in pediatric population is challenging due to the smaller size of the patients, the limitations of vascular access and possible complications associated with future generator replacement [5]. In these patients physiological or His bundle pacing is ideal because it avoids deleterious effect of chronic right ventricular (RV) pacing [5]. Another option of physiological pacing is left bundle branch pacing or Huang's technique [1]. Recently, Ponnusamy *et al.* reported a case of left bundle branch pacing in a 13-year-old patient with complete atrioventricular (AV) block [6].

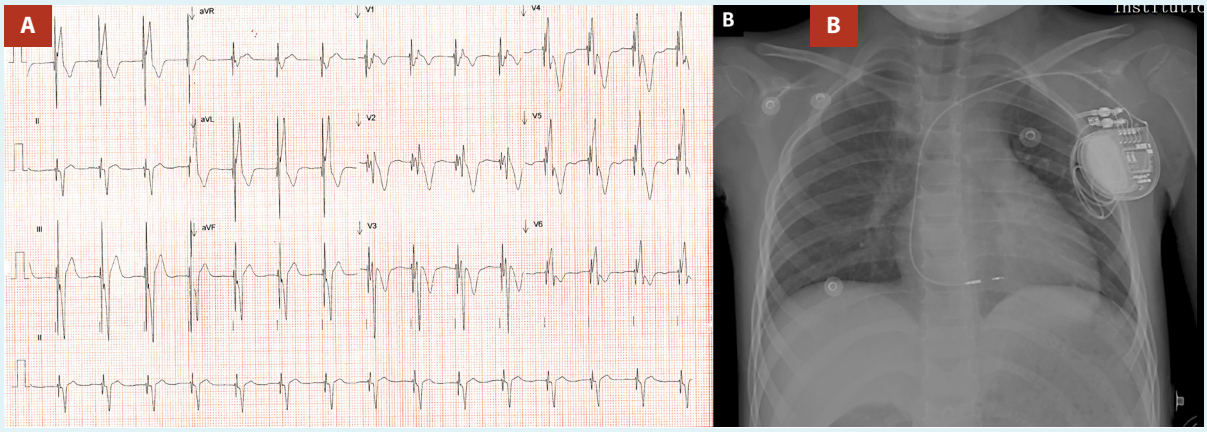

Figura 4. A. Twelve lead electrocardiogram with left bundle branch subselective pacing. **B.** Post-procedural chest X-ray.

Diffuse electrical cardiac disease is a rare cause of pacemaker implantation in children [3]. In this case, we opted for left bundle branch pacing with a single-chamber pacemaker in VVIR mode due to the age of the patient, the need for chronic ventricular pacing, electrical right atrial stand-still and the failure to obtain adequate thresholds in the His bundle region.

Currently, there are some criteria for left bundle branch pacing [2], In the case described, we obtained sub-selective capture of left bundle branch pacing with an adequate threshold, meeting the following criteria. 1) right bundle branch morphology in V2; 2) notch in the middle of the QRS in V1; 3) presence of S wave in V6; and 4) ventricular activation time (VIT) less than 90 ms in V5. In addition, this stimulation, reduced the QRS duration compared to the patient's baseline QRS (from 140 to 115 ms) with the same axis as the intrinsic rhythm **(Figure 4).** Likewise, during pacing, a left bundle branch potential was evidenced from the pacing electrode, this potential was documented in 25 to 30% of the cases **(Figure 4)** [2].

In conclusion, this type of pacing is an alternative to traditional His bundle pacing [1]. In the case presented, the indication was due to the presence of high capture thresholds in the anatomical region of the His bundle. Although the area to stimulate the left bundle branch is relatively wide, it is necessary to ensure adequate penetration of the electrode in the interventricular septum due to the anatomical conformation of this structure [2]. Therefore, a contrast injection was applied through the delivery system and the adequate fixation of the electrode was corroborated **(video 1, Figure 3)**. Ensuring adequate fixation reduces the risk of electrode displacement, as well as significant variations in the capture threshold.

Author Contributions: All authors participated in the preparation of the manuscript.

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