Direct His Bundle Pacing in a Patient with Complete Heart Block Requiring Implantable Defibrillator

SARAH A. WORSNICK, PA-C, BARBARA CAMPAGNA, NP, GERALD LACEY, PA-C, GOPI DANDAMUDI, MD, FHRS and PUGAZHENDHI VIJAYARAMAN, MD, FHRS

Cardiac Electrophysiology, Geisinger Wyoming Valley Medical Center, Wilkes-Barre, PA

ABSTRACT. A 66-year-old female underwent mitral and tricuspid valve repair. Following a postoperative myocardial infarction, she developed atrioventricular nodal conduction block and atrial fibrillation. Because of recurrent non-sustained ventricular tachycardia, persistent atrial fibrillation, complete heart block, and left ventricular ejection fraction of 35–39% at 4 weeks, she underwent risk-stratifying electrophysiology study, which was positive for inducible sustained ventricular tachycardia. Direct His bundle pacing was performed and the lead connected to the left ventricular port of a biventricular implantable cardioverter-defibrillator. By directly pacing the His bundle, native His–Purkinje conduction was utilized and ventricular dyssynchrony from right ventricular pacing was avoided. His bundle pacing could be achieved despite a tricuspid valve annuloplasty ring.

KEYWORDS. His bundle pacing, ICD, ventricular tachycardia.

Case report

A 66-year-old female with a past medical history of severe mitral regurgitation secondary to anterior leaflet mitral valve prolapse, and moderate to severe tricuspid regurgitation, underwent mitral valve repair with a pericardial Edwards’s mitral ring, and tricuspid valve repair with Edward’s annuloplasty ring. Postoperatively she developed posterolateral myocardial infarction. She underwent emergent stenting of the proximal left circumflex artery inadvertently compressed by mitral annular sutures. She developed atrioventricular (AV) nodal dysfunction on the third day, and then developed atrial fibrillation with slow but regular ventricular response at 60 bpm. She remained hemodynamically stable without need for temporary pacing. Oral anticoagulation was initiated. Because the AV nodal block was thought to be infarct related and expected to improve, she was discharged home on a mobile cardiac outpatient telemetry (MCOT) monitor.

During MCOT monitoring for 4 weeks, she was noted to have recurrent episodes of monomorphic non-sustained ventricular tachycardia of 8–20 beats and also episodes of non-sustained torsades de pointes, which appeared to be preceded by a PVC induced pause (Figure 1). She continued to remain in atrial fibrillation, complete heart block with ventricular rates of 50–70 bpm, and minimal or no arrhythmic symptoms. A repeat echocardiogram revealed large lateral and posterior wall akinesis with moderately reduced left ventricular (LV) function and an ejection fraction of 35–39%.

Because of persistent complete heart block and episodes of torsades de pointes, she clearly needed permanent pacemaker implantation. However, recurrent monomorphic non-sustained ventricular tachycardia and LV ejection fraction of <40% puts her at high risk for sudden cardiac death. She underwent a transesophageal echocardiogram to exclude left atrial thrombus (subtherapeutic INRs). A diagnostic risk-stratifying electrophysiology study was positive for easily inducible sustained monomorphic ventricular tachycardia at cycle length of 350–500 ms. Direct His bundle pacing was performed with the lead connected to the left ventricular port of a biventricular implantable cardioverter-defibrillator. By directly pacing the His bundle, native His–Purkinje conduction was utilized and ventricular dyssynchrony from right ventricular pacing was avoided. His bundle pacing could be achieved despite a tricuspid valve annuloplasty ring.
250 ms that required cardioversion. Both ventricular tachycardia and atrial fibrillation were terminated by the shock and converted to sinus rhythm. She persisted in complete heart block with a junctional escape rhythm. She subsequently underwent implantable cardioverter-defibrillator (ICD) implantation with a right atrial and right ventricle (RV) defibrillator lead placement. An additional active fixation (Medtronic Inc, St. Paul, MN, Select Secure 3830) lead was placed in the His bundle region delivered via a fixed curve (Medtronic, C315 His) sheath. A significant current of injury was noted on the His bundle electrogram obtained from the lead (Figure 2c). The His bundle pacing threshold was 1.25 V @ 0.5 ms with pacing impedance of 420 ohms and R-wave sensing of 1.2 mV. The His bundle pacing lead was connected to the LV port of the biventricular (BiV) ICD (Medtronic, Concerto D204TRN). The ICD was programmed to DDD mode with LV–RV delay of 80 ms. LV–RV delay was set at 80 ms to provide back-up RV pacing, in case the His bundle pacing lead (LV) fails to capture RV. Electrocardiograms at baseline and following His bundle pacing (BiV pacing mode) are shown in Figure 2a,b. Chest radiography shows the location of the His bundle pacing lead in the posterior–anterior and lateral projections (Figure 3).

Discussion

Direct His bundle pacing has been shown to preserve ventricular synchrony. By utilizing the native His–Purkinje conduction system, QRS morphology during direct His bundle pacing is identical to the baseline QRS. The need for ICD therapy in this patient with underlying complete heart block and moderate LV dysfunction would normally lead to placing a dual-chamber ICD. However, RV pacing would have resulted in significant ventricular dyssynchrony and worsening of congestive heart failure symptoms. RV pacing has been shown to increase the risk for atrial fibrillation, heart failure, and mortality in pacemaker and ICD trials. In addition, prevention of RV pacing by prolonging the AV delay has been shown to reduce the adverse outcomes in patients with LV dysfunction and intrinsic AV conduction. We felt that direct His bundle pacing would preserve intrinsic conduction and prevent pacing-induced dyssynchrony, thereby obviating the need for biventricular pacing. Initial experiences with His bundle pacing involved stylet-driven pacing leads and was fraught with technical challenges. The availability of special leads (Medtronic, Select SecureTM) deliverable through specifically designed sheaths has significantly improved the success of His bundle pacing. In our experience, His bundle pacing in patients with tricuspid valve annuloplasty can be challenging because of distortion of the valve anatomy. However, in this particular patient, the His bundle lead was placed within 7 min, with a fluoroscopy duration of only 3 min. A biventricular ICD with LV lead placement would have been a reasonable choice in this patient, even though it may not be superior to native His–Purkinje conduction. Permanent Direct His bundle pacing is a feasible, physiological alternative to RV or BiV pacing in patients with narrow QRS requiring ICD therapy and ventricular pacing.
Figure 2: (a) Twelve-lead electrocardiogram showing atrial fibrillation, complete heart block, and junctional escape rhythm at 60 bpm. (b) Electrocardiogram showing normal sinus rhythm, atrial sensed His bundle pacing and QRS morphology similar to baseline. Note the isoelectric interval between pacing spike and QRS onset suggesting direct His bundle capture. (c) Intracardiac electrogram from His bundle pacing lead showing large His electrogram with local current of injury followed by near-field ventricular electrogram.

Figure 3: Chest radiographs in posterior–anterior and lateral projections showing the location of atrial, right ventricular and His bundle pacing leads.
References


