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EDITORIAL COMMENT

Inadvertent LBBB Pacing

Landing on the Right (Left) Spot*

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In children with atrioventricular block, chronic right ventricular (RV) apical pacing provides an adequate ventricular heart rate at the expense of altered cardiac activation and mechanical dyssynchrony. Efforts to reduce potential ventricular dyssynchrony and myocardial dysfunction have centered on alternative pacing sites, including the RV septum and RV outflow tract, although there remains a lack of randomized pediatric studies between these approaches. Cardiac resynchronization therapy, with left ventricular (LV) pacing, shortens the QRS duration and improves ventricular function and quality of life, yet is unable to take advantage of the native His-Purkinje system and advantageous ventricular myocyte orientation for optimal electrical signal transduction (1,2). Permanent His-bundle pacing (HBP), although even more physiologic, tends to have higher pacing thresholds and lead dislodgements, necessitating a proclivity for operative revisions (3). Although technical and experiential improvements with HBP were recently described in a cohort of 17 adolescents and young adults with congenital complete atrioventricular block, it remains unclear which patients remain at risk for distal conduction disease (4). Left bundle branch pacing (LBBP) has recently emerged as a pacing modality that can preserve LV function by directly stimulating the cardiac conduction system, although little data exist in this technology in children.

In this very interesting case report in this issue of *JACC: Case Reports*, Vinocur (5) describes a fortuitous case of LBBP achieved in a young girl (approximately age 3 years, 14 kg) while attempting to place an RV septal lead. Although many pediatric electrophysiologists would have considered epicardial pacing at this very young age, given the likely concerns of vascular obstruction and somatic growth on long-term lead viability, the family preferred an endocardial system. After several attempts and lead dislodgements using a Medtronic 3830 "Select Secure" lead through a Medtronic C315-S4 delivery system, the lead was secured midseptum with stable impedance and excellent pacing thresholds. The paced QRS interval was narrow (95 ms) with "right bundle branch block morphology" and unipolar electrograms affirmed small left bundle branch (LBB) potentials. Achieving left bundle capture from an attempted RV septal deployment is incredibly unusual but, when one considers the anatomy of the region and the potential differences between a 2-year-old and a 40-year-old, it is quite feasible.

In contrast to HBP, which can be achieved in either the atrial or ventricular side of the tricuspid valve annulus, LBBP is performed in the ventricle as the entirety of the LBB is endocardial on the left side of the ventricular septum surrounded by myocardial tissue (6). As a result, the lead is generally placed deep in the interventricular septum. This location tends to provide excellent thresholds and stability. However, in young children, the septum is certainly not fully developed from a thickness vantage and the deployment of a 1.8-mm helix when the septum is no more than 2-3 times that thickness (3-6 mm) is uniquely different than adults where a normal septum can be 12 mm. Although this patient did well postprocedure, individuals contemplating such an approach should be very mindful of a real risk of perforation given the fact that the difference between full screw advancement and the wrong end of the septum could be as little as 1.5 mm. Careful attention

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to the paced QRS morphology and lead impedances both at implantation and at follow-up is critical to minimize the risk of septal perforation (7). Perforation places the patient at risk for thromboembolism and/or stroke. Consideration for lead extraction if and when the lead fails may also prove to be technically challenging.

It is interesting to note that the patient no longer demonstrated LBB capture at 1 year of follow-up. This has not been the experience in adults who have been shown to demonstrate reliable LBB capture beyond 1 year of follow-up (8). The mechanism of loss of capture is unknown but may be a result of the natural thickening of the septum during growth that could result in greater distance from the lead tip to the left bundle. Long-term follow-up of LBBP in pediatric patients is needed before this approach can be generalized to this unique population. Future prospective randomized controlled trials in children with physiologic pacing (HBP or LBBP) are needed to assess the long-term viability of these leads and in the cohort with congenital heart block whether such an early proactive strategy has long-term functional and quality of life benefits.

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