Quantifying Anatomical Variation to Optimize Catheter Design for His Bundle Pacing

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Introduction: His Bundle (HB) pacing shows promise in physiological pacing but lead implant at the HB remains a challenge. Anecdotally, patients with large right atria are often challenging. A new delivery catheter is being developed to address this need. The use condition of a delivery catheter is critical toward development of an optimal design. The purpose of this work was to improve delivery catheter design based on quantified anatomy inputs.

Materials and Methods: The angle between the HB plane and the superior vena cava (SVC) ostium plane was calculated for 20 subjects using clinical CT scans, selected to include subjects with large right atria. The shortest distance between the HB plane, and the lateral wall of the SVC was also measured. These measures inform the design, specifically tip orientation and reach, of the catheter (Fig 1). A 3D printed model simulating HB location for the 20 subjects, was designed by registering all the right atria into the same co-ordinate system. This 3D printed model used to verify the improvements of the new design in comparison to market released catheters. Success was defined as the ability to fixate a lead at the target locations.

Results and Discussion: The wide-ranging angle and distance measurements, and virtual catheter implantations, were used to inform design for an optimal catheter tip orientation to the HB. The design resulted in improvements, with the new catheter covering 85% of the measurements, versus 65% for the market released catheters. Testing on the 3D printed model agreed with the results, with 40% higher success rate using the new catheter.

![Figure 1: A market released catheter (Medtronic, C315HIS) in a 3D printed model simulating His bundle location of an anatomy. Parameters ‘α’ and ‘D’ represent the measurements of interest.](image)

Translational Impact: Anatomical quantification enabled improvements to the design of a new delivery catheter intended to support HB implantation. A 3D printed model showed that the new catheter design performed better than current market-released catheters, including in larger right atria.

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