Validation and Utility of a Novel Mapping System in Ablation of Complex Arrhythmias in Adult Congenital Heart Disease: A Multicenter UK Study

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Introduction: Multiple tachycardia circuits in adults with congenital heart disease (ACHD) pose a challenge in identification of the critical isthmus. We sought to validate a novel wavefront mapping system using the High-density (HD) Grid catheter (Abbott Medical). The system was validated for mapping complex wavefront patterns in atria tachycardia (AT) and defining a critical isthmus in areas of scar.

Methods: ACHD patients undergoing catheter ablation for ATs across 3 centres were included. Wavefront propagation maps were made using the HD Grid (Fig 1). Critical isthmuses of ATs were identified using HD wave solutions and conventional bipolar mapping (independently) and confirmed with entrainment and response to ablation. The mean voltage amplitude within the critical isthmus was determined for HD wave and conventional bipole maps. These analyses were done by two independent observers blinded to the clinical case. Only LAT maps were available for review to ensure point selection for voltage amplitude within the critical isthmus.

Result: 50 patients with ACHD underwent mapping using the HD grid. Of these, 19 were excluded (VT ablation, n=2; SVT, n=2; unable to induce or sustain AT, n=15). In the remaining 31 patients, underlying CHD diagnosis was repaired ASD/AVSD (n=9), Percutaneous ASD closure (n=1), AP Fontan (n=3), AVR/Root replacement (n=3), Mustard TGA (n=4), repaired ToF (n=3), repaired VSD (n=2) and pulmonary atresia/MAPCAs/PVR (n=3), ccTGA (n=1), Ebstein (n=2). The mean procedure and fluoroscopy times were 180±69 and 7±5 min respectively. 58% cases were performed without using any fluoroscopy. HD wave accurately mapped 15 CTI-dependent flutters and 16 micro re-entrant ATs. 472,072 points were collected in an average time of 15 min with HD and 92,026 with conventional bipoles. Within the critical isthmus, the mean voltage amplitude and number of points using HD wave was higher than conventional bipoles (1.21mV, 92 versus 0.86mV, 76). Critical isthmus sites were missed in 4 micro re-entrant ATs cases (13) using conventional bipoles alone. Ablation at the identified critical isthmus led to arrhythmia termination in all cases. There were no procedural complications.
Conclusion: This novel mapping approach was able to accurately define the critical isthmus by mapping complex wavefronts using multiple orthogonal bipoles. HD mapping enabled identification of critical channels in areas of scar, which were missed on conventional mapping due to limitations in bipolar density and single bipole orientation resulting in a wavefront propagation that was not fully defined. This is particularly relevant for multiple micro re-entrant ATs in ACHD patients.