POSTER PO-643:
Posters: Heart Failure at Pod 15
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PO-643-01
ELECTRICAL DYSSYNCHRONY MAPPING IN CARDIAC RESYNCHRONIZATION THERAPY
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Background: There is no clinical method for measuring electrical dyssynchrony over a wide range of atrial-ventricular delays (AVD) and ventricular-ventricular delays (VVD) in cardiac resynchronization therapy (CRT) patients.

Objective: To describe a new methodology, based on wavefront fusion, for mapping electrical synchrony in CRT.

Methods: The area between combinations of 9 anterior/9 posterior electrograms (area under curve; AUC) was quantified and cardiac resynchronization index (CRI) was defined as %change in AUC compared to native AUC. CRI was measured in 20 ms steps over a wide range of atrial-RV pace (A-RVp) and atrial-LV pace (A-LVp) intervals in 90 patients 3.4±3.7 years post-CRT to generate electrical dyssynchrony maps (EDM). An optimal synchrony line (OSL) depicted the combination of AVD/VVD producing the highest CRIs.

Results: CRI at baseline programming was 54±39%. Patients with complete heart block (n=20) had an OSL parallel to the VV line with leftward shift showing LV preactivation (VVD) needed for optimal resynchronization. Patients with intact AV node conduction (n=64) had an OSL parallel to the VV line at short AVD (fusion of RVp and LVP wavefronts), upward curving at intermediate AVD (triple fusion), and vertical at long AVD (fusion of native and LVP wavefronts) except for the patients with poor LV lead position (n=6). On average, the LVP wavefront was 38±26 ms behind the RVp wavefront and 87±24 ms behind the native wavefront.

Conclusion: We describe a new methodology of EDM for quantifying and graphing electrical synchrony over a wide physiologic range of AVDs/VVDs. This methodology offers a noninvasive, practical, clinical approach for mapping electrical dyssynchrony and optimizing CRT programming.

PO-643-02
CARDIAC RESYNCHRONIZATION THERAPY OPTIMIZATION IN NON-RESPONDERS USING ELECTRICAL DYSSYNCHRONY MAPPING
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Background: Cardiac resynchronization therapy (CRT) non-response occurs in ~30% of patients. There are no well-accepted methods for optimizing CRT in non-responders.

Objective: To assess effects of CRT optimization using electrical dyssynchrony mapping (EDM) on left ventricular (LV) function in CRT non-responders.

Methods: We studied 33 patients with underlying LBBB/IVCD who had an EF <45%, 3.5+/−3.4 years after CRT. The area under the curves (AUC) between 9 anterior/9 posterior electrograms was measured at multiple combinations of atrial-ventricular and ventricular-ventricular delays (AVD, VVD). Electrical dyssynchrony was quantified by cardiac resynchronization index (CRI), calculated as % change in AUC compared to native. EDM depicted CRI over the wide range of settings tested. Patients were programmed to highest CRI setting with echos read blinded pre-optimization and ~6 months post-optimization.

Results: EDM (Figure) of nonresponder with LBBB, programmed simultaneous biventricular pacing at AVD 120 ms (CRI 47%) and optimized to LV-only pacing at AVD 110 ms (CRI 95%). EF improved from 21% to 28%. Table shows significant improvements in systolic function, LVESV, global and regional strain and interventricular mechanical dyssynchrony (AVO - PVO) in the study cohort.

Conclusion: CRT non-responders are 51% electrically resynchronized at baseline and improve to 90% with CRI-guided optimization. CRT optimization using a novel EDM technology results in significant improvements in LVEF, LVESV, LV global strain in multiple planes, anteroseptal/septal regional strain, and interventricular mechanical dyssynchrony. This methodology offers a non-invasive, practical clinical approach to treating CRT nonresponders.
PO-643-03

ENDOCARDIAL PACING, HIS BUNDLE PACING AND LEFT BUNDLE BRANCH AREA PACING ACHIEVE SUPERIOR LEFT VENTRICULAR ELECTRICAL RESYNCHRONIZATION COMPARED TO CONVENTIONAL CARDIAC RESYNCHRONIZATION THERAPY

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Background: Endocardial and conduction system pacing are novel methods to deliver CRT and may improve electrical resynchronization over conventional epicardial CRT (CRT-epi). A direct comparison of electrical resynchronization for all the methods of CRT delivery has not yet been performed.

Objective: To compare LV electrical resynchronization during CRT-epi, endocardial pacing (CRT-endo), His bundle pacing (HBP) and left bundle branch area pacing (LBBAP) using electrocardiographic imaging (ECGi).

Methods: 7 patients underwent a temporary CRT and ECGi study. Reconstructed epicardial electrograms from ECGi were used to calculate LV activation time (LVAT) and LV dyssynchrony index (LVDI) [Fig 1A]. Relative changes from baseline were compared using repeated measures ANOVA and post-hoc Tukey’s tests.

Results: Mean patient age was 71 ± 6.6 years and 57% were male. 2 patients had ischemic heart disease, 1 patient had AF and mean LV ejection fraction was 28.7 ± 6.0%. Baseline rhythm was LBBB (4 patients) or RV-pacing (3 patients) with mean QRS duration 157 ± 20 ms. Compared to CRT-epi, there were greater reductions in LVAT during CRT-endo (-48.1 ± 13.1% vs -23.6 ± 11.3%; P = 0.009) and LBBAP (-44.3 ± 12.6%; P = 0.025) and a non-significant trend towards greater LVAT reduction for HBP (-40.9 ± 13.0%; P = 0.088) [fig 1B]. There were greater reductions in LVDI versus CRT-endo during CRT-epi (-61.0 ± 15.5% vs -20.3 ± 20.0%; P = 0.002), HBP (-47.4 ± 17.7%; P = 0.045) and LBBAP (-58.3 ± 15.3%; P = 0.005) [fig 1C]. There were no differences in LVAT or LVDI between CRT-endo, HBP or LBBAP (P > 0.05).

Conclusion: CRT-endo, HBP and LBBAP provide superior LV electrical resynchronization compared to CRT-epi. Performance was comparable between the novel CRT techniques.

PO-643-04

MULTI-SITE PACING FOR CARDIAC RESYNCHRONIZATION THERAPY: A SYSTEMATIC REVIEW AND META-ANALYSIS OF RANDOMIZED CONTROLLED TRIALS

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Background: Multi-site pacing (MSP) may provide more rapid LV activation by employing two LV leads during CRT. Randomized studies of MSP have shown conflicting results.

Objective: To perform a systematic review and meta-analysis of RCTs comparing MSP with conventional CRT.

Methods: A literature search was performed up to October 2021 using keywords “multi site pacing”, “triventricular pacing” and “triple site pacing”. Exclusion criteria included observational trials, studies with acute response metrics only, and those where CRT was performed with 2 RV leads + 1 LV lead. 251 unique records were identified, of which 5 met inclusion criteria. Meta-analysis was performed using the Stata 16 software package.

Results: There was no difference between MSP and conventional biventricular CRT in LV end-systolic volumes at follow-up (mean difference [MD] -1.76 ml, p = 0.80, I² = 0.0%) [fig 1A]. Similarly there was no difference between groups in LV ejection fraction (MD 1.58%, p = 0.50, I² = 72.2%) [fig 1B], or in the proportion of patients in New York Heart Association Class III-IV at follow-up (log odds [OR] ratio 0.21, p = 0.67, I² = 64.4%) [fig 1C]. Mortality rates were comparable between groups (log OR 0.14, p = 0.71, I² = 0.0%) [fig 1D].

Conclusion: This meta-analysis does not support the use of MSP for CRT. However, sub-group analyses were not reported for all studies, and it is possible that MSP may provide benefit in specific patient cohorts.