

Zwolle, The Netherlands, Bologna University, Bologna, Italy and Sorin Group CRM, Saluggia, Italy.

**Background:** The optimization of cardiac resynchronization therapy (CRT) devices is time consuming not only at implant time but also during follow-up, when remodeling occurs, requiring re-programming. During AV delay (AVD) scanning, Peak Endocardial Acceleration (PEA), assessed using a microaccelerometer inserted in the tip of a right ventricle (RV) lead, depends both on contractility (Left Ventricle (LV)  $dP/dt_{max}$ ) and on A-wave transmitral flow, that is directly related to degree of mitral leaflets opening, giving indication of global LV function. A new CRT optimization algorithm is based on the assessment of the PEA values during AVD scanning for each pacing configuration (PEA<sub>area</sub> is estimated as the mean value of PEA values): a wider PEA<sub>area</sub> corresponds to a greater improvement of cardiac function. Aim of this study is the validation of the new PEA<sub>area</sub> method to optimize CRT, comparing it with the results obtained using LVdP/dt<sub>max</sub>.

**Methods:** a biventricular pacemaker (Living CHF, Sorin) connected to a PEA sensor RV lead was implanted in 10 patients (70 ± 5 years) with impaired LV function (NYHA class III or IV, QRS 168ms ± 19). At each pacing configuration (LV, BiV0, LR12, LR40, RL12, RL40), AVD scanning ranging from 60 to 220 ms was automatically performed. A pressure catheter (Millar) inserted in the LV was used to measure LVdP/dt<sub>max</sub> at each pacing configuration. Hemodynamic responders to CRT were defined by % change in LVdP/dt<sub>max</sub> ≥ 10%. For each patient the Student-Newman-Keuls test (at α=0.05) was performed on LVdP/dt<sub>max</sub> values to determine optimal CRT configurations.

**Results:** 7/10 pts were classified as responders to CRT. In 6/7 responders the optimal pacing configuration suggested by the PEA<sub>area</sub> index corresponded to the greatest hemodynamic improvement, as indicated by LVdP/dt<sub>max</sub>.

**Conclusions:** The consistent results of PEA<sub>area</sub> with indications given by a contractility index (LVdP/dt<sub>max</sub>) are the basis to introduce this new operator-independent and cost-effective method for optimization of CRT devices.

#### P4-92

##### OPTIMAL HAEMODYNAMIC AV DELAY DURING EXERCISE CAN BE PREDICTED BY PERFORMING OPTIMISATION AT REST WITH ELEVATED PACING RATE

Zachary I. Whinnett, MRCP, Justin E. Davies, MRCP, Catherine A. Briscoe, RN, Keith Willson, PhD, Manisty H. Charlotte, MRCP, D. Wyn Davies, MD, FRCP, Alun D. Hughes, MD, PhD, Jamil Mayet, MD, FRCP and Darrel P. Francis, MD, MBBS. Imperial College and St Mary's Hospital, London, United Kingdom, St. Mary's Hospital, London, United Kingdom, Royal Brompton Hospital, London, United Kingdom and St. Mary's Hospital London, London, United Kingdom.

**Background:** Ideally optimisation of atrioventricular (AV) delay of cardiac resynchronisation therapy would be performed during exercise, as this is when patients are most symptomatic. However, this can be technically difficult and inconvenient for the patient. It may be possible to use fast pacing at rest to simulate exercise, however, account has to be taken for the difference in optimal AV delay between atrial pacing and sensing. We test a pacing model for exercise, to determine whether it is possible at rest to predict the haemodynamic peak AV delay determined during exercise.

**Methods and Results:** We performed AV delay optimisation, using non-invasive haemodynamics by Finometer, in 12 biventricular pacemaker patients, using our system for maximising signal-to-noise ratio. We calculated the difference between the haemodynamic optimal AV delay for atrial paced and atrial sensed AV delay at resting rates (the "sensed-paced optimum difference"). We subtracted this from the optimal AV delay found with atrial pacing at 100bpm, in order to create a "predicted exercise AV optimum". Patients separately underwent haemodynamic optimisation during actual treadmill exercise (~100bpm), to test the validity of the resting prediction. All patients showed a clear optimum. The actual exercise

optimal AV delay was shorter than the 100 bpm pacing value and was closely predicted by our resting formula ( $r=0.87$ ,  $p<0.001$ ). The root-mean-square difference between predicted and actual was only 14ms.

**Conclusions:** Actual exercise haemodynamic optimisation is possible, in patients able to exercise for several minutes. The exercise optimum for AV delay can be determined from resting optimisation, if the sensed-paced difference is also measured. This may allow appropriate exercise AV delays to be selected without the need for optimisation during exercise.

#### P4-93

##### CARDIOVASCULAR SAFETY PROFILE OF ELECTRICAL STUN GUNS (TASER®): IMPACT OF POINT OF DELIVERY ON VENTRICULAR FIBRILLATION THRESHOLDS

Dhanunjaya R. Lakkireddy, MD, William Kowalewski, BA, Donald W. Wallick, PhD, Atul Verma, MD, David O. Martin, MD, MPH, Kay Ryschon, MS, Jagdish Butany, MBBS, Andrea Natale, MD and Patrick J. Tchou, MD. Cleveland Clinic Foundation, Cleveland, OH and Toronto General Hospital, Toronto, Ontario, Canada.

**Context:** Stun guns gained popularity with law enforcement authorities in subduing violent subjects and have raised serious safety concerns. However, the cardiovascular safety profile of these devices and the effect of point of delivery have not been well established.

**Methods:** We tested 13 adult pigs using a custom device built to deliver multiples of standard stun gun discharge that matched the waveform of a commercially available device (TASER® X-26, TASER International, Scottsdale, AZ). Stun gun discharges were applied in a step-up and step-down fashion, using two tethered darts at five locations: Sternal notch to cardiac apex (position-1), sternal notch to supra-umbilical (position-2), sternal notch to infra-umbilical (position-3), side to side on chest (position-4) and upper to lower mid posterior torso (position-5). End points included determination of maximum safety multiple (MSM), minimum VF inducing multiple (MVFIM) and VF threshold (VFT)

**Results:** Standard stun gun discharges (x1) did not cause VF at any of the 5 locations. The MSM, MVFIM and VFT of the stun gun were much lower when applied in the axis of the heart (position-1) ( $4.31 \pm 1.11$  vs.  $40.77 \pm 9.54$ ,  $8.31 \pm 2.69$  vs.  $50.77 \pm 9.54$  and  $6.31 \pm 1.9$  vs.  $46.54 \pm 8.99$  respectively) than when applied away from the heart on the dorsum (position-5). The values of the end points at position-1, position-3 and position-4 were progressively higher and ranged in between position-1 and position-5. There was no evidence of myocardial damage based on serum cardiac markers, electrocardiography and echocardiography. No significant metabolic and hemodynamic changes were seen after standard stun gun discharge.

**Conclusions:** Standard stun gun discharge doesn't cause VF at any paired dart locations. Applications away from the cardiac axis and cardiac apex have higher VF safety margin than those close to it.

Figure 2: Body charts of the pig model constructed based on human experience into various segments for paired dart application shown on the front and the back

