EUROPEAN HEART RHYTHM ASSOCIATION (EHRA) 2023, BARCELONA

16.-18. APRIL 2023

Den europeiske rytmekongressen «EHRA 2023» fant sted i Barcelona midt i april måned. Med EHRA-president Jose Luis Merino i spissen var den 2,5 dager lange kongressen svært godt besøkt med nesten 5000 deltakere. Essensielle oppdateringer og anbefalinger for klinisk praksis i tillegg til ny forskning innen arytmi og elektrofysiologi-faget ble presentert. Kongressen tilbød også et bredt utvalg av praktisk gruppeundervisning.

Norske kardiologer og forskere deltok med presentasjoner/abstrakter og som besøkende. Norske bidrag følger under. EHRA ønsker alle velkommen til Tyskland for EHRA 2024 der kongressen er satt til Berlin 7.-9.april 2024.

Nina Eide Hasselberg
Kardiologisk avdeling,
Oslo universitetssykehus, Rikshospitalet

EHRA
European Heart
Rhythm Association

Sesjon: Non-ischemisk dilatert kardiomyopati: genotype-spesifikk behandling

Sesjonen bestod av fire foredrag som hver omtalte familiær dilatert kardiomyopati (DCM) forårsaket av henholdsvis fire ulike gener:

1. Lamin A/C (NE Hasselberg, Oslo)
Lamin *A/C (LMNA)*-assosiert DCM har alvorlig prognose med 100 % penetrans ved 60-års alder med høy forekomst av ventrikulær takykardi (VT), terminal hjertesvikt og hjertetransplantasjon. Hovedpunkter fra foredraget var at atrioventrikulært blokk er en risikomarkør for VT, og det er klar anbefaling om implanterbar hjertestarter (ICD) hvis pasientene har indikasjon for pacemaker pga. bradykardi. Både atrieflimmer- og VT-ablasjon har høy residivfrekvens og endrer ikke den alvorlige prognosen for pasientene. Høyintensitetstrening frarådes pga. raskere sykdomsprogresjon. Graviditet derimot, ser ikke ut til å medføre tilsvarende aksellerert sykdomsprogresjon eller å forverre prognosen, selv om noen kvinner får økt arytmitendens under selve svangerskapet.

2. Titin (L Mestroni, Aurora, USA)
Titin-gen *(TTN)*-mutasjon er årsak til 11-25 % av tilfellene av genetisk DCM og 18 % av sporadisk DCM og er således den vanligste familiære DCM. TTN er det største genet, og titin-proteinet er således det største proteinet i kroppen med essensiell strukturell rolle i kardiomycyttenes sarkomerer. Titin-kardiomyopati har høy penetrans over 40-års alder, og prognosen har vist seg være verre for menn enn kvinner. Det er høy forekomst av arytmier og hjertesvikt, men likevel er prognosen generelt bedre enn ved laminA/C-DCM og arytmogen kardiomyopati (AC), og ledningsforstyrrelser er sjelden. TTN genet kan også spille en rolle som modifiserende gen og være avgjørende for forløpet ved myokarditter og alkohol -og kjemoterapi-indusert kardiomyopati. Opptil 10 % av peripartum kardiomyopatiene har vist seg å ha bakenforliggende TTN-mutasjon. Hvis man er bærer av TTN-mutasjon, bør man derfor være forsiktig med alkoholoverforbruk og følges ekstra tett under potensiell kardiotoksisk cellegiftbehandling og svangerskap.

3. Fosfolamban (C Basso, Padua, Italia)
Fosfolamban-proteinet finnes i sarkoplasmastisk retikulum, spesielt i kardiomyocytter. Den patogene mekanismen ved fosfolamban-gen (PLN)-mutasjon forklares blant annet ved manglende inhibering av sarkoendoplasmatisk reticulum kalsium-ATPase (SERCA) og hemmet protein kinase A-funksjon.

PLN-genotype kan gi opphav til kardiomyopati med kliniske og histologiske karakteristika av både DCM og AC. *PLN*-mutasjonen *R14Del* er «grunnlegger»-mutasjon i Nederland og er også den *PLN*-mutasjonen vi ser i Norge, med klynge (cluster) på Nordvestlandet. Som eksempel på genetiske sykdommers geografiske clusteregenskap, viste Basso til at ved hennes senter i Padua har hun kun funnet én pasient med patologisk PLN-variant blant deres kohort av 530 AC pasienter.

Basso som er patolog, viste histologistudier som viste like stor grad av fibrøs-fett-erstatning (fibrofatty replacement) ved PLN-mutasjon som ved desmosomsykdommen AC. Hun understreket obduksjonens rolle ved genetiske kardiomyopatier der patologene kan både stille korrekt diagnose og veilede videre familiescreening.

4. SCN5A (CA Remme, Amsterdam, Nederland)
"Når ionekanalsykdom gir DCM – den mørke siden av natrium (Na)-kanalen", SCN5A-genet koder for kardial Na-kanal. Vi kjenner best til at varianter av genet kan føre til «tap av funksjon» (loss of function) av kanalen som er forbundet med Brugada syndrom og «oppnåelse av funksjon» (gain of function) som blant annet gir lang QT-tid-syndrom type 3. Men *SCN5A*-varianter kan også gi DCM og er årsak til 2-3 % av familliær DCM. Det er beskrevet 18 ulike patogene *SCN5A*-varianter som gir ulik funksjonell effekt på Na-kanalen.

Ikke overraskende er *SCN5A*-assosiert DCM forbundet med høy arytmi-byrde med blant annet multifokale ventrikulær ekstrasystoler (VES) (spesielt fra purkinjefibre) og ledningsforstyrrelser.

Den strukturelle DCM-fenotypen forklares ved at *SCN5A*-proteinet også har «ikke-ionekanal funksjon» og er involvert i celleadhesjon, cellekommunikasjon og signalisering, myokardarkitektur og utvikling. Musemodeller med *SCN5A*-genvarianter har vist økt myokardfibrose og høyre ventrikkeldilatasjon. Videre har *SCN5A*-varianter blitt funnet hos ellers genotype negative AC-pasienter. Pasienter med *SCN5A*-genotype må derfor følges for strukturelle forandringer med rutinemessig ekkokardiografi og ikke kun EKG og rytmeovervåkning. Studier har vist lovende effekter med både redusert arytmi-byrde og strukturelle DCM-funn ved behandling med Na-kanalblokkere som flekainid.

ABSTRAKTER MED NORSKE BIDRAG

Diagnostic gain of cardiac MRI in patents with premature ventricular complexes and structurally normal hearts on echocardiography

Tariq Ahmed MD[12], Stine Aaagaard-Nilsen[123], Ole-Gunnar Anfinsen MD, PhD[2], Finn Hegbom MD, PhD[2], Torbjørn Holm MD, PhD[2], Thor Edvardsen MD, PhD[12], Erik Kongsgård MD, PhD[2], Lars Andreas Dejgaard MD, PhD[12], Mathis Korseberg Stokke MD, PhD[123]

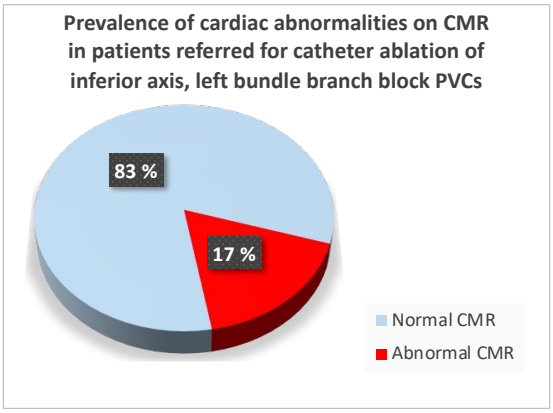
[1] KG Jebsen Centre for Cardiac Research, University of Oslo, Oslo, Norway. [2] Department of Cardiology, Oslo University Hospital Rikshospitalet, Oslo, Norway. [3] Institute for Experimental Medical Research, Oslo University Hospital and University of Oslo, Oslo, Norway

Background: An important part of the diagnostic evaluation of patients with premature ventricular complexes (PVCs) is to identify underlying cardiac disease. The majority of these patients referred to catheter ablation have PVCs with inferior axis and left bundle branch block morphology (I-LBBB). Although this is the most common morphology in patients with idiopathic PVCs, cardiac magnetic resonance (CMR) is recommended to exclude potential other underlying pathology. However, the diagnostic gain of CMR in patients with I-LBBB PVCs is uncertain.

Purpose: The purpose of this study was to explore the prevalence of cardiac abnormalities identified by CMR in patients with I-LBBB PVCs evaluated for catheter ablation without signs of underlying cardiac disease from resting ECG, stress test, or echocardiography.

Methods: We retrospectively collected data from consecutive patients with I-LBBB PVCs evaluated for catheter ablation at our tertiary referral centre from 2011 to 2022. We included patients with normal ECG and stress test, and no evidence of functional or structural heart disease by echocardiography. We categorized CMR examinations as normal or as having signs of functional or structural abnormalities.

Results: We identified a total of 63 patients with I-LBBB PVCs evaluated for catheter ablation, with no signs of underlying conditions from sinus rhythm ECG, stress test or echocardiography. All were studied by CMR at our institution. The median age was 49 years (IQR 36-61), and 39 were females (62 %). The maximum PVC burden recorded in each patient prior to referral was 20 % (IQR 11-29.5). Left ventricular (LV) ejection fraction by echocardiography was 56±4 %. CMR was normal in 52 patients (83 %), while functional or structural abnormalities were detected in 11 patients (17 %). These abnormalities comprised reduced LV systolic function (2 patients), dilated right ventricle (2 patients), dilated LV (1 patient), ventricular septal defect (2 patients), noncompaction cardiomyopathy (1 patient), mitral annular disjunction (2 patients), tricuspidal annular disjunction (1 patient), and myocardial



fibrosis by late contrast enhancement (3 patients).

Conclusions: In patients with I-LBBB PVCs evaluated for catheter ablation, and with no signs of underlying pathology from standard diagnostic work-up, CMR detected abnormalities in 17 %. These results support the routine use of CMR in the evaluation of patients with I-LBBB PVCs referred for catheter ablation.

Lamin A/C dilated cardiomyopathy in childhood

Marit Kristine Smedsrud[1], Monica Chivulescu[2], Christine Rootwelt-Norberg[2,3], Isotta Castrini[2,3], Eivind Westrum Aabel[2,3], Christian Kullmann Five[2,3], Nina Eide Hasselberg[2], Andreas Früh[1], Kristina H. Haugaa[2,3,1] ProCardio Center for Innovation, Department of Paediatric Cardiology, Oslo University Hospital, Rikshospitalet, Norway; [2] ProCardio Center for Innovation, Department of Cardiology, Oslo University Hospital, Rikshospitalet, Norway, [3]Faculty of Medicine, Institute of Clinical Medicine, University of Oslo, Norway, [4]Faculty of Medicine, Karolinska Institute and Cardiovascular Division, Karolinska University Hospital, Stockholm, Sweden

Background: Lamin A/C gene (LMNA) mutations cause familial dilated cardiomyopathy (DCM) with a malignant cardiac phenotype characterized by atrioventricular (AV) block and supraventricular and ventricular arrhythmias, often preceding cardiac dilatation and dysfunction. Current guidelines recommend genetic and clinical screening of family members, starting at 10-12 years of age. However, children with LMNA mutations are underrepresented in research publications and there is limited data on the onset of a cardiac phenotype in this population.

Purpose: We aimed to investigate the penetrance of LMNA phenotype during childhood and specifically the occurrence of cardiac events in LMNA genotype positive children.

Methods: We conducted a single-centre, longitudinal cohort study including genotype-positive LMNA patients and genotype positive relatives, all ≤18 years of age, followed between 2009 and 2022. The patients were examined by electrocardiography, Holter monitoring, cardiac magnetic resonance imaging, and echocardiography. A cardiac phenotype was defined as the presence of atrioventricular (AV) block, atrial fibrillation/ flutter (AF), ventricular tachycardia (VT), and/or echocardiographic DCM. Cardiac events were defined as AF, VT, sudden cardiac arrest (SCA) or heart transplantation (Htx).

Results: We clinically followed 25 LMNA genotype-positive children (5 probands with cardiac phenotype, 1 proband with neuromuscular phenotype only, 19 relatives, age 9.7 [IQR 6.8-13.1] years) of which 11 (44 %) were phenotype-positive at end of 9.7 years follow-up at a median age of 11.7 [IQR 7.2-15.1] years. Among the LMNA genotype-positive relatives, 32 % (6/19) became phenotype-positive at a median age of 13.4 [IQR 6.5-16.3] years (Figure).

New onset cardiac events occurred in 8 children (32 %) during follow-up,

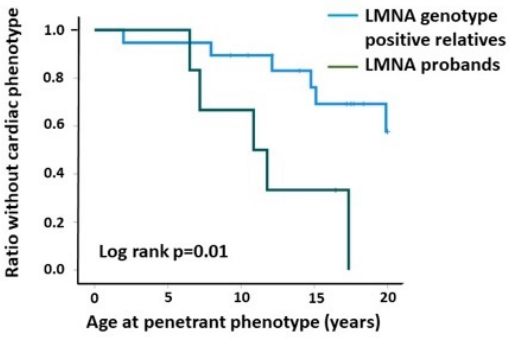
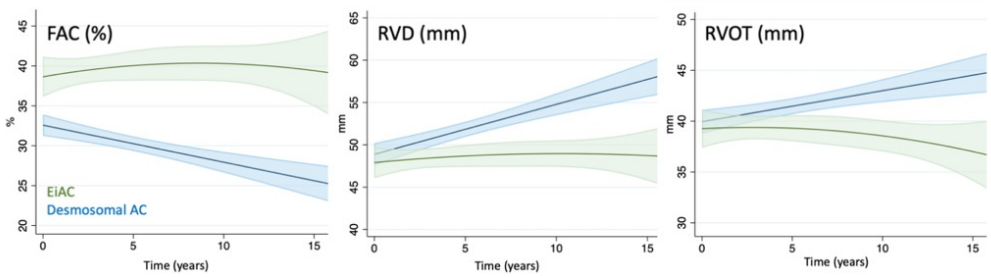


Figure: Comparison of RV disease progression in EiAC and desmosomal AC



RV disease progression during follow-up (years) in EiAC (green line with 95% CI) and desmosomal AC (blue line with 95% CI). AC = arrhythmogenic cardiomyopathy, CI = confidence interval, EiAC = exercise-induced arrhythmogenic cardiomyopathy, FAC = fractional area change, RV = right ventricular, RVD = right ventricular diameter, RVOT = right ventricular outflow tract

of which half of them in patients ≤12 years of age. Fifty % (4/8) of the cardiac events occurred in relatives. Two children had AF, 3 had non-sustained VT, and 1 underwent SCA. Htx was performed in 2 unrelated children, at 6 and 8 years of age, respectively.

Conclusions: In a paediatric cohort of LMNA genotype positive probands and relatives, we found a high occurrence of AF, VT and HTx. Half of the events occurred in children ≤12 years of age.

One third of the paediatric LMNA genotype-positive relatives had a cardiac phenotype during follow-up, highlighting the importance of early family screening and cardiological follow-up.

Disease progression in exercise-induced compared to desmosomal arrhythmogenic cardiomyopathy - a longitudinal cohort study

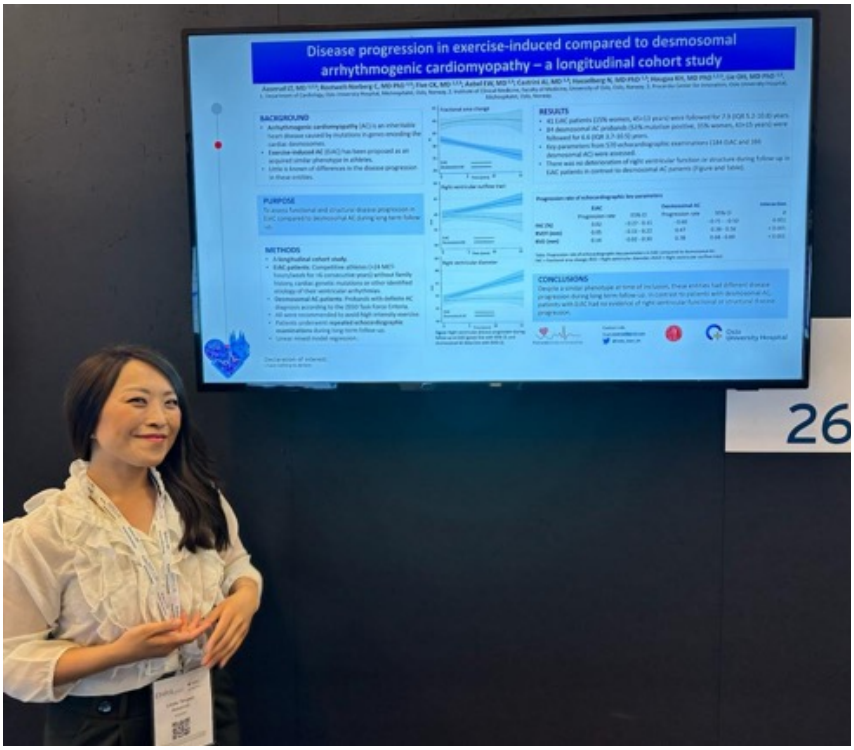
Linda Aaserud [1], Christine Rootwelt-Norberg [2], Eivind W Aabel [2], Christian K Five [1], Nina E Hasselberg [1], Anna I Castrini [2], Kristina H Haugaa [1], Øyvind H Lie [1],

[1] Oslo University Hospital Rikshospitalet, Oslo, Norway, [2] University of Oslo, Oslo, Norway

Introduction: Arrhythmogenic cardiomyopathy (AC) is an inheritable heart disease caused by mutations in genes encoding the cardiac desmosomes, while exercise-induced AC (EiAC) has been proposed as an acquired similar phenotype in athletes. Little is known about the progression of EiAC compared to AC.

Purpose: To assess functional and structural disease progression in EiAC compared to desmosomal AC during long-term follow-up.

Methods: We consecutively included probands with definite AC diagnosis according to the 2010 Task Force Criteria and patients with EiAC in a longitudinal cohort study. EiAC was diagnosed in competitive endurance athletes (>24 MET-hours/week for >6 consecutive years) referred with symptomatic ventricular arrhythmias who had no family history, no genetic mutations associated with heart disease, and no other identified etiology after through clinical work-up. All patients in both groups were recommended to avoid high intensity exercise. Progression of the structural phenotype was assessed by regular repeated echocardiographic examinations during long-term follow-up. Right ventricular (RV) function and size were assessed by RV fractional area change (FAC), RV basal diameter (RVD) and RV outflow tract (RVOT) diameter. Disease progression was evaluated and compared using linear mixed model regression.



Results: Forty-one EiAC patients (15% women, age 45 13 years) and 84 AC probands (51% mutation positive, 35% women, age 43 15) were followed for 6.6 (IQR 3.7-10.5) and 7.9 (IQR 5.2-10.8) years, respectively. Key parameters from 570 echocardiographic examinations (184 EiAC and 386 AC) were assessed. There was no deterioration of RV function during follow-up in EiAC patients, in contrast to AC patients (FAC yearly progression rate: EiAC +0.02% [95% CI -0.27 to 0.31] vs AC -0.60% [95% CI -0.71 to -0.50] per year, p=0.001, Figure left panel). RV size did not increase in EiAC patients in contrast to AC patients (RVD: EiAC +0.01 mm [95% CI -0.00 to 0.03] vs AC +0.78 mm [95% CI 0.68 to 0.89] per year, p<0.001, Figure mid panel, and RVOT: EiAC +0.01 mm [95% CI -0.01 to 0.02] vs AC +0.47 mm [95% CI 0.38 to 0.56] per year, p<0.001, Figure right panel).

Conclusion: Patients with exercise-induced AC had no evidence of disease progression during long-term follow-up. These patients had a more benign disease trajectory than patients with desmosomal AC. Despite the limited sample size, these results seem reassuring for patients diagnosed with exercise-induced AC.

Epicardial versus endocardial pacing in cardiac resynchronization therapy

M Marciniak [1], M Albatat [1], LE Hammersboen [2], E Finstad [1], M Stugaard [2], VC Frostelid [2], E Remme [2], H Odland [1]

[1] Pacertool AS, Oslo, Norway, Oslo, Norway, [2]Oslo University Hospital Rikshospitalet, Institute for Surgical Research, Oslo, Norway

Background/Introduction: The timing of left ventricular pressure rise (Td) relative

to QRS-onset is associated with dispersion of regional work distribution and prolongs with dyssynchrony and dyssynergistic contractions. Td is short in normal conduction and shortening of Td can be achieved with effective biventricular pacing (BIVP). The effect of endocardial compared to epicardial pacing on Td is unknown and could be important for the interpretation of Td when different pacing strategies are utilized for CRT.

Purpose: We wanted to analyze the measurement from QRS-onset to onset of LV pressure rise identified as the peak double derivative of LV pressure rise (Onset of Synergy, OoS) and to the peak pressure rise (Td), and test the effects of cardiac resynchronization therapy with endocardial vs epicardial pacing electrodes in a large animal model of LBBB.

Methods: 5 mongrel dogs were included in the study and handled according to ethics committee approved protocol/ GLP. Pacing electrodes were placed epicardial on the left ventricular (LVepi) and right ventricular (RVepi) free wall, and endocardial electrodes were positioned at the right ventricular septum (RVsept) and in the LV endocardial free wall (LVendo). The atrial electrode was placed on the left atrial appendage. Pressure was measured with a Micro-tip pressure sensor (Millar Inc.) in the LV and sampled at 1000Hz. LBBB was created with a retrograde placed 7F standard ablation catheter and confirmed by surface ECG and four endocardial electrodes. Td was measured from 10 consecutive beats. Mixed models were utilized for the repeated measurements.

Results: Td was measured to 115±2ms at baseline in LBBB. Td decreased by 5ms from RVepi (114±3ms) to RVendo (109±3ms) regardless of LV electrode position. We then compared the effects of using LV endocardial and epicardial pacing in CRT and found that Td was 6ms higher ($p<0.01$) in LVepi (115±3ms) vs LVendo (109±3ms) regardless of RV electrode position. The interaction between RV RV and LV revealed that RVepi/LVendo (105±3ms) was significant shorter than RVendo/ LVendo (110±3ms, p0.01) and RVepi/LVepi (115±3ms, $p<0.01$). OoS with RVepi/LVendo was 71±2ms, and a significant relationship between OoS and Td were found ($R=0.62$, $p<0.01$) to indicate that the myocardial contraction is affected by pacing already at 71ms after QRS-onset early during the pre-ejection period.

Conclusion(s): In this study we demonstrate how endocardial and epicardial pacing applied with CRT may affect contraction patterns of the heart differently. The different effects from pacing can be measured as early as 71ms after QRS-onset. Shortening of Td occurs to a larger extent with pacing from the endocardial LV and epicardial RV, while pacing at two endocardial sites did not result in synergistic effects on Td. This may indicate that there might be an interaction between endocardial pacing sites when applied in combination.

Effects on the timing of left ventricular pressure rise when pacing the right ventricular free wall in cardiac resynchronization therapy

M Marciniak [1], M Albatat [1], LE Hammersboen [2], M Stugaard [2], VC Frostelid [2], E Finstad [1], E Remme [2], H Odland [1]

[1] Pacertool AS, Oslo, Norway, Oslo, Norway, [2] Oslo University Hospital Rikshospitalet, Institute for Surgical Research, Oslo, Norway

Background/Introduction: The timing of left ventricular pressure rise (Td) is associated with dispersion of regional work distribution and prolongs with dyssynchrony and dyssynergistic contractions. Synergistic contractions shorten Td and result from effective biventricular pacing (BIVP). Attempts have been made to optimize right ventricular (RV) lead position with septal lead placement away from the apex. In this

study we attempted to study the effects from RV free wall (RVfw) compared to septal/ apical RV (RVsept) lead positioning on Td.

Purpose: RVfw pacing results in activation of RVfw before LV activation with a delay that may hamper the myocardial synergy resulting from biventricular pacing. This effect has not yet been demonstrated and may play an important role to understand non-response to CRT.

Methods: 9 mongrel dogs were included in the study and handled according to ethics committee approved protocol/GLP. Pacing electrodes were placed epicardial on the left atrial appendage, the RVfw and LV, and endocardial in the septum. Pressure was measured with a Micro-tip pressure sensor (Millar Inc.) in the LV. BIVP was performed from LV combined with RVsept or RVfw. Td was measured from 10 consecutive beats. Mixed models were utilized for the repeated measurements.

Results: The average Td with BiVP-RVfw, BIVP-RVsept and LV pacing only was 116ms (95% CI: 110, 122), 114ms (95% CI: 108, 120), and 118ms (95% CI: 112, 124) respectively ($p<0.001$). BiVP with RVsept shortened Td by 4.1 ms (95% confidence interval (CI): -5.3, -2.9, $p<0.001$), whereas BiVP with RVfw pacing location shorten Td by 1.8 ms (95% CI: -2.8, -0.8, $p<0.001$), compared to LVP. The SD from 10 beats was on average 0.8ms (range 0-1.6ms).

Conclusion(s) : Myocardial Synergy with shortening of Td compared to LV only pacing was demonstrated with BIVP regardless of RV position. The synergistic effect from BIVP is more pronounced with BIVP-RVsept than from BIVP-RVfw. RV lead position may play an important role in cardiac resynchronization therapy that can be revealed when measuring the time-course of LV pressure rise.

Analysis of the effects of atrial pacing on the timing of left ventricular pressure rise in normal conduction and left bundle branch block

M Marciniak [1], M Albatat [1], L Hammersboen [2], M Stugaard [2], E Finstad [1], VC Frostelid [2], E Remme [2], H Odland[1] ,

[1] Pacertool AS, Oslo, Norway, Oslo, Norway, 2 Oslo University Hospital Rikshospitalet, Institute for Surgical Research, Oslo, Norway

Background/Introduction: The timing of left ventricular pressure rise (Td) relative to QRS-onset is associated with dispersion of regional work distribution and prolongs with dyssynchrony and dyssynergistic contractions. Td is short in normal conduction and shortening of Td can be achieved with effective biventricular pacing (BIVP). The effect of atrial pacing on Td is unknown and could be important for the interpretation of Td when utilized for cardiac resynchronization therapy.

Purpose: We wanted to test the effects from atrial pacing (AP) compared to sinus rhythm (SR) on Td in animals with narrow QRS (nQRS) complexes and after the creation of LBBB.

Methods: 9 mongrel dogs were included in the study and handled according to ethics committee approved protocol/GLP. Pacing electrodes were placed epicardial on the left atrial appendage. Pressure was measured with a Micro-tip pressure sensor (Millar Inc.) in the LV and sampled at 1000Hz. LBBB was created with a retrograde placed 7F standard ablation catheter and confirmed by surface ECG and four endocardial electrodes. Td was measured from 10 consecutive beats. Mixed models were utilized for the repeated measurements.

Results: Analysis of the marginal means in pooled data showed that the average Td with AP was 96.7ms (95% CI: -195.7,

388.7), and in SR 96.5ms (95% CI: - 195.5, 389.0). The analysis with the Bonferroni correction for multiple comparisons revealed that the differences between pacing configurations were not statistically significant (p=0.80). The analysis revealed that AP on average lengthens Td by 0.3ms (95% confidence interval (CI): - 1.7, 2.2, p=0.8), compared to no pacing. The difference in Td in nQRS between AP and SR was 82.4ms (95% CI: 76.8, 88.1) and 82.1ms (95% CI: 76.4, 87.8) respectively (p=0.02) while the difference in Td in LBBB between AP and SR was 111.1ms (95% CI: 104.8, 117.4) and 110.9ms (95% CI: 104.581, 117.197) respectively (p=0.48). Standard deviation within 10 consecutive beats was 1.0ms (max 3.7ms, min 0.4ms, median 0.95ms), and AP did not influence Td measurement variability (p=0.53).

Conclusion(s) : We did not find any influence from atrial pacing in Td in this study. The significant difference between AP and SR in nQRS was extremely small and less than the sample interval of 1ms. The significance of this difference is attributed to the robustness of the Td measurement and does not represent a meaningful clinical significance. Td can be measured without being influenced by atrial pacing in both native conduction and with LBBB.

What determines who gets cardiac resynchronization therapy in europe?

P Gatti [1], T Thorvaldsen [1], L Benson [1], C Normand [2], G Savarese [1], U Dahlstrom [3], A Maggioni [4], L H Lund [1], C Linde [1], K Dickstein [2], [1] Karolinska Institute - Stockholm - Sweden, [2] University of Stavanger - Stavanger - Norway, [3] Linkoping University - Linkoping - Sweden, [4] ANMCO Research Center - Florence - Italy,

Background/Introduction: Cardiac resynchronization therapy (CRT) is a valuable treatment in selected patients with heart failure (HF) but is still underutilized.

Aim: We compared three informative data sources, which enrolled patients with HF at different organization setting and identified clinical, organizational, and level of care factors linked to CRT implantation in these cohorts.

Methods: Data from three large cohorts of patients with HF were compared. Patients with HF with reduced ejection fraction (HFrEF) in an ESC HF-Long Term Registry (ESC-HF-LT, n=25,621), a National HF Registry - Swede HF (n=156,621) and in the ESC-CRT Survey II (n=11088, all receiving CRT across 42 ESC countries), contributed data to the analysis. The ESC Survey II recruited patients at implanting centers, ESC-HF-LT at HF centers, whereas SwedeHF enrolled HF patients at different levels of care. Firstly, we compared patient characteristics, socio-economic and organizational factors between cohorts as well as between overlapping countries participating both in CRT Survey II and ESC HF LT. Secondly, we identified independent predictors of CRT use in the two registries using multivariable logistic regressions.

Results: Of the 1031 patients in ESC-HF-LT and the 5008 patients in Swede-HF, CRT was not used in 53-75 % of guideline-indicated patients. Women constituted 22% and median age ranged between 68-72 years. Guideline Directed Medical Therapy (GDMT), atrial fibrillation, previous myocardial infarction (SwedeHF) and HF hospitalization (ESC-HF-LT) was associated with more CRT use as was enrollment at university hospital and follow-up at HF center/Hospital. In Swede-HF above median income and higher education level were also independently associated with use of CRT. In the ESC-CRT Survey II (n=11.088) all patients received CRT with differences in the clinical indications between countries.

Conclusion(s): CRT is an important treatment option for eligible patients with HF, which is still largely underused. The findings reported demonstrate that awareness of CRT indications as well as demographics, organizational and economic factors play an important role in CRT utilization.