P1126

LGE-CMR methods for scar identification in a patient with non-ischemic cardiomyopathy: validation by whole heart histology

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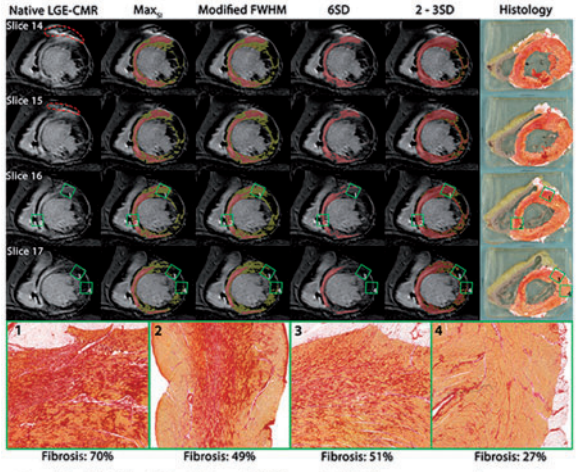
Background: Ventricular tachycardias (VTs) in non-ischemic cardiomyopathy (NICM) are related to fibrosis. Late gadolinium enhancement (LGE) cardiac magnetic resonance (CMR) is the imaging reference method for the non-invasive detection of fibrosis in NICM. Several methods for fibrosis detection requiring either bright areas with dense fibrosis or normal reference myocardium have been suggested but have never been validated by whole heart histology in humans with NICM.
Methods: LGE-CMR data (1.5T Phillips Intera, Phillips Medical Systems, in-plane voxel resolution of 1.25 x 1.25 mm, slice thickness of 5mm) of a 67 year old male with NICM was obtained prior to VT ablation. Death occurred 133 days after CMR images were acquired. The intact, fixed heart was sliced along the short axis in 5mm slices and photographed. 3D reconstructions of both the CMR and pathology images were created and merged using the Amira software package (ThermoFisher Scientific, USA). Histology was obtained and stained with Pico-Sirius Red to visualize fibrosis. CMR image analysis was performed with the MASS software package (Leiden, The Netherlands). In the short-axis image series, LV endocardial and epicardial contours were manually traced. Scar was defined using 4 previously described
methods: 1.) MaxSI: scar core = tissue with an signal intensity (SI) value of ≥50% of the MaxSI, scar borderzone = SI between 35-50% of MaxSI. 2.) Modified Full-Width Half Maximum method scar core = SI >50% of the MaxSI, borderzone = SI>peak remote SI but <50% of MaxSI. 3.) 6 SD method scar ≥6SD above the mean SI of a remote region. 4.) 2-3SD method Scar core ≥3SD above the mean SI of a remote region, scar borderzone ≥2SD but <3SD above the mean.
Results: Areas of dense mid-septal fibrosis surrounded by viable myocardium corresponded well with areas of LGE on CMR (Figure, histology insert 2). Despite a high quantity (70% fibrosis), less well delineated fibrosis (insert 1) was only identified as core scar when using the 2-3SD method, and as borderzone when using the MaxSI or modified FWHM method; but was not identified at all when using the 6SD method. Despite consisting of more than 50% fibrosis, a diffuse fibrosis architecture was not detected on LGE-CMR irrespective of which method used (insert 3).
Conclusion: Depending on the LGE-CMR method applied, delineation of the scar and estimation of scar density can vary significantly. Currently applied methods may be inaccurate for patients with NICM and VT considering the different architecture of fibrosis.



Legend: Red dotted line: ICD artefact – excluded from analysis. Red areas: scar core, yellow areas: scar borderzone according to 4 methods. Green squares: locations corresponding to high resolution histology inserts (bottom row). Areas of dense mid-septal fibrosis surrounded by viable myocardium corresponded well with areas of LGE on CMR (histology insert 2). Despite a high quantity (70% fibrosis), less well delineated fibrosis (insert 1) was only identified as core scar when using the 2-3SD method, and as borderzone when using the MaxSI or modified FWHX method; and was not identified at all when using the 6SD method. Despite consisting of more than 50% fibrosis, a diffuse pattern was not detected on LGE-CMR irrespective of which method used (insert 3).

Abstract P1126 Figure.

P1127

Usability of single lead ECG from smartphones: the USELESS pilot?

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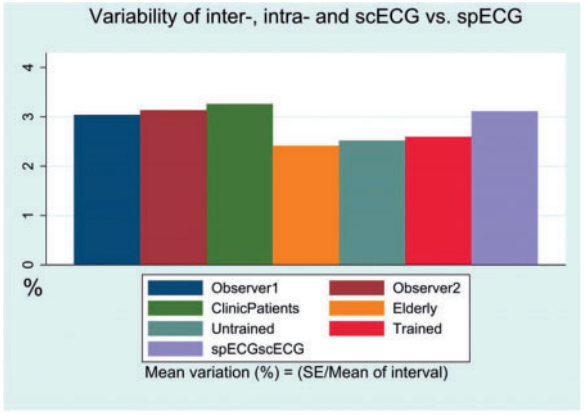
Funding Acknowledgements: University of Bergen, Faculty of Medicine, Bergen, Norway
Background: Different wireless, single-lead real-time ECG devices are commercially available for electrocardiogram (ECG) screening, monitoring and possible on-demand diagnosis. Some devices have demonstrated acceptable detection of intervals and rhythms, and are increasingly available.
Objective: We wanted to evaluate the accuracy and usability of Smartphone ECG (spECG) in both healthy controls and clinic patients. Our hypothesis was that the device would prove to be of poor clinical value.
Methods: We used a commercially available spECG device, connected wirelessly to a tablet, to record 30-second lead I ECG waveforms, which were interpreted by two observers. We examined the inter- and intraobserver variability of five standard intervals (PQ, QRS, QT, QTc), frequency and rhythm (sinus, atrial fibrillation, SVES, VES etc.). In clinic patients, we compared variability between standard calculated 12-lead ECG (scECG) and spECG.
We have currently studied intervariability in four groups: Young healthy individuals at rest (n=20) and immediately after vigorous exercise (n=20), healthy individuals over 50 years (n=20) and clinic patients (n=20). For evaluation of the spECG we studied clinic patients (n=27), and acquired scECG for comparison shortly after. The ECGs were anonymized, and the data handled in Stata/IC.
Results: In 1068 measured intervals (PQ, QT, QRS, frequency), 9,2% were unreadable, whereas 23,2% of the spECGs had one or more unreadable interval. The PQ measurements accounted for 65,3% of the disturbance.
We calculated intraobserver variability to be: Observer 1: 3,0%, Observer 2: 3,1%.
We calculated interobserver variability for each of the four groups to be: Untrained: 2,5%, Trained: 2,6%, Elderly: 2,4% Clinic Patients: 3,2%. Ultimately this represents a standard error for all measured intervals of less than 10 ms or 3 beats/min. Inter- and intraobserver variability was comparable. These were also comparable to spECG and scECG- variation (3,1%), see Figure 1.
After vigorous exercise the readability decreased slightly in PQ intervals: from 95,0% to 87,5%. All other intervals remained fully interpretable. By defining true positive as abnormality seen in both modalities we found the specificity to be 62,5% and the sensitivity to be 90,9%.
Bland Altman plotting of the five intervals indicated that spECG and scECG were comparable in lead I. In the groups over 50 years old, 22,7% needed assistance in handling the device.
Conclusion: The examined wireless, single-lead real-time ECG device is not useless. It accurately measures intervals and frequencies as well as detects abnormal rhythms, although specificity is suboptimal and inconclusive recordings occur. Vigorous activity has a minor influence on the readability of the recorded intervals, primarily the PQ interval. Elderly might have challenges recording a spECG correctly without assistance.



Abstract P1127 Figure.

P1128

Catheter ablation of idiopathic premature ventricular contractions and idiopathic ventricular tachycardia - origin determines success

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Introduction: Catheter ablation of frequent idiopathic premature ventricular contractions (PVCs) and idiopathic ventricular tachycardia (VT) is used to eliminate symptoms and to prevent or treat PVC-induced cardiomyopathy in patients refractory to antiarrhythmic pharmacological therapy. While the right ventricular outflow tract (RVOT) traditionally has been the most frequent ablation site, mapping and ablation is now increasingly performed also for PVCs and VTs originating from the left ventricular outflow tract (LVOT) including the aortic cusps and from non-outflow tract locations (non-OT). We aimed to assess the impact of the origin on the success rates of catheter ablation.
Methods: This is a prospective observational cohort study of consecutive patients undergoing a first catheter ablation for symptomatic idiopathic PVCs or idiopathic VTs. All procedures were performed using an electroanatomical mapping system. Structural heart disease as the underlying cause for the PVCs or VTs was ruled out using echocardiography or cardiac MRI at the discretion of the physicians. Patients in

whom ablation was not performed due to insufficient or non-inducible arrhythmias were excluded from analysis. Ablation success was assessed after a median FU of 2.7 months (IQR 1.3-3.5 months) using 24h Holter ECG.

Results: A total of 70 patients were enrolled. Median age was 48 years (IQR 39-58) and 50% of the patients were female. Median PVC burden before ablation was 19% (IQR 7-26%). The origin of the arrhythmias was mapped and ablated in the RVOT in 43 (61%), in the LVOT in 18 (26%) and in non-OT sites in 9 (13%) patients. Baseline characteristics of the patients according to these 3 groups are shown in Table 1. Overall, the success rate after catheter ablation was 79%. While the success rate was similarly high for arrhythmias originating from the RVOT or LVOT (81% vs. 83%, p=0.86), the success rate for arrhythmias originating from non-OT sites was remarkably lower (56%, p=0.07 for comparison with outflow tract sites). Complications occurred in 2/70 patients (2.8%): Pericardial tamponade in one patient with an RVOT site, and pericarditis requiring treatment in one patient with an LVOT site.

Conclusion: The origin of idiopathic PVCs and VTs determines the success of catheter ablation. While the success rates are favorable and similarly high in the RVOT and LVOT, failure is much more frequent for non-outflow tract sites.

Table: Baseline characteristics of the patients according to the origin of the idiopathic PVC/VT

	RVOT (n=43)	LVOT (n=18)	Non-OT (n=9)	p-value
General characteristics				
Age – years	46 (39-55)	56 (50-69)	36 (28-57)	0.005
Male sex	20 (47%)	10 (57%)	5 (56%)	0.45
PVC burden pre-ablation (%)	18 (5-27)	24 (15-36)	11 (7-17)	0.14
LVEF pre-ablation (%)	61 (59-67)	55 (48-61)	56 (50-65)	0.01
Hypertension	11 (26%)	9 (50%)	3 (33%)	0.18
Diabetes	2 (5%)	3 (17%)	1 (11%)	0.30
Coronary artery disease	3 (7%)	1 (6%)	0 (0%)	0.71
Previous Medication				
Beta blocker	19 (56%)	11 (32%)	4 (44%)	0.47
Ca-Channel blocker	9 (21%)	4 (22%)	3 (33%)	0.72
Amiodaron	0 (0%)	0 (0)	2 (22%)	0.001

Data are presented as n (%) or median (IQR)

Abstract P1128 Figure.

P1129

Comparison of Ventricular Tachyarrhythmia Recurrence Between Ischemic Cardiomyopathy and Dilated Cardiomyopathy in Implantable Cardioverter-Defibrillator Recipients for Secondary Prevention

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Background: Implantable cardioverter-defibrillator (ICD) has been established as an effective secondary prevention strategy for ventricular tachycardia (VT)/ventricular fibrillation (VF). However, there are limited reports regarding the difference in clinical predictors for recurrent VT/VF between patients with ischemic cardiomyopathy (ICM) and patients with dilated cardiomyopathy (DCM).

Purpose: This study aimed to investigate the difference in predictors for recurrent VT/VF between patients with ICM and patients with non-ischemic DCM receiving ICD for secondary prevention.

Methods: From May of 2004 to December of 2015, 132 consecutive patients who had ICM (n=94) or DCM (n=38) receiving ICD implantation for secondary prevention were enrolled in this study. All anti-tachycardia events during follow-up were validated. The clinical characteristics and echocardiographic parameters were obtained for comparison.

Results: At a mean follow-up of 1322.6 $\pm$ 1070.8 days, 34 patients (36.2%) in the ICM group and 22 patients (57.9%) in the DCM group had recurrence of VT/VF episodes ($p = 0.032$). The DCM group had lower left ventricular (LV) ejection fraction ($p = 0.019$), larger LV end diastolic volume (LVEDV) ($p = 0.001$), more prevalence of LVEDV $>$ 163.5 mL ($p = 0.005$), and larger LV end systolic volume ($p = 0.006$) compared to the ICM group. LVEDV $>$ 163.5 mL and no use of angiotensin-converting-enzyme inhibitor/angiotensin receptor blocker were independent predictors of recurrent of VT/VF in ICM patients, but not in DCM patients. There was no difference in cardiovascular mortality and all-cause mortality between the ICM and DCM patients.

Conclusion: DCM patients had a higher recurrent rate of VT/VF compared to ICM patients during long-term follow-up. Enlarged LV is an independent predictor of recurrence of VT/VF in ICM patients receiving ICD for secondary prevention.

P1130

Induction of ventricular fibrillation during electrophysiological study. specificity and prognostic value

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Introduction: Induction of Ventricular Fibrillation (VF) is a common finding during electrophysiological study (EPS) with programmed ventricular stimulation (PVS). Whereas current guidelines consider this as an indication for implantable cardioverter-defibrillators (ICDs) in specific scenarios, its specificity remains controversial and incidence of malignant ventricular arrhythmias during follow up is less established.

Methods: We conducted a retrospective analysis of 259 consecutive patients who underwent an EPS with PVS. During follow up, events were considered as: appropriate ICD therapies, cardiac arrest and documented monomorphic sustained ventricular tachycardia (MSVT). Depending on the result of the EPS, three groups were analyzed: No induction (NIG, N: 162), MSVT induction (VTG, N 55) and VF induction (VFG, N 42).

Results: Mean age was 59 years with 190 males, with a mean follow up of 30 months. Compared to the VFG and VTG, which had no significant differences, patients in the NIG had fewer structural heart disease and less devices implanted. During follow up, 18 events were found in the VTG (32.7%), significantly higher than the VFG (9.5%, $p < 0,04$) and the NIG 7 (6.33%, $p < 0,04$). No differences were observed between the VFG and NIG ($p > 0,3$).

Conclusions: Despite lacking randomized trials involving patients with VF induction during EPS, this finding is considered in current recommendations for ICD implantation. According to our results, the induction of VF during EPS does not imply higher incidence of hard events during follow up. Larger studies are needed in order to further support these results.

CRT

P1131

CRT in heart failure patients with mitral regurgitation

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Purpose: Mitral regurgitation (MR) is common in patients (pts) with heart failure (HF) with severely reduced LV systolic function. Due to their high-risk profile, these pts are rarely indicated for valvular surgery but frequently undergo cardiac resynchronization therapy (CRT). This retrospective single-centre analysis focuses mid-term outcome of CRT in heart failure patients with moderate to severe MR .

Patients and Methods: We retrospectively analysed a cohort of 192 consecutive pts successfully implanted with a CRT system during 2 years (2015-2016). Moderate and severe MR was present in 53 pts (28%). Twenty three patients (20 men, mean age 65 $\pm$ 13.4 years at the time of implantation) with a follow-up (F-U) $\geq$ 1 year were analysed. MR was moderate in 20 and severe in 3 pts.The mean post-implant F-U was 17.5 $\pm$ 5.4 months. Thirteen pts had ischemic HF etiology of HF, 7 pts had previously implanted PM /ICD, 1 pt had temporary pacing. Fifteen pts were in NYHA class III, mean LVEF at the time of implantation was 26 $\pm$ 7%. Mean QRS duration was 165 $\pm$ 32 ms, 13 pts had typical LBBB, 4 pts were PM-dependent due to AV block, permanent atrial fibrillation was present in 13 pts.

Results: We implanted 15 CRT-D systems and 8 CRT-P systems, 6 pts suffered early complications and 3 required reoperations. Based on clinical and echo evaluation, 12 (52%) pts were CRT responders (NYHA improvement $\geq$ 1 class and LVEF improvement of $\geq$ 5%). In 10 responders MR has improved by $\geq$ 1 grade. Five pts (22%) died during F-U. In a univariate analysis by Fisher's test absence of renal failure (serum creatinine below 140 μmol / l) was significantly more frequent in CRT responders ($p<0.005$).

Conclusion: Moderate to severe MR occurred in more than 1/4 of HF patients indicated for CRT. More than half of these patients were CRT responders. However, mortality and CRT complication rate in MR patients from our cohort was high. Renal failure is a strong risk factor for non-responding to CRT.

P1132

LV lead apical placement could be the best option in selected patients candidate to CRT

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Background: Pursuing the optimal LV pacing site may be crucial to increase the percentage of patients responder to cardiac resynchronization therapy. Purely anatomically defined regions do not seem to predict CRT response, although indications in the literature suggest to avoid apical regions.

Purpose: In our study, we evaluated the correlation between acute improvement in contractility and LV lead anatomical position.

Methods: In 102 patients, mean age 72$\pm$9 years, LV EF of 31$\pm$7 %, LV electrical delay and contractility response (during biventricular pacing) were systematically measured at each available pacing site. Data about contractility was collected as variations of dP/dtmax by means of a RADI pressure wire. The LV anatomy was divided into 15 portions. In the right anterior oblique (RAO) view, the long axis of the heart was divided into basal, mid, and apical ventricular segments. In the left anterior oblique (LAO) view, the short axis of the heart was divided into anterior, antero-lateral, lateral, postero-lateral and posterior segments.

Results: A total number of 294 veins and 616 sites were tested. On average, the basal portion of the lateral vein showed the largest delay (Q-LV= 124.9$\pm$34.2ms) and the highest hemodynamic response (increase in LVdP/dtmax=+24.8$\pm$15.5% vs baseline). In 38/102 patients (37%) the basal lateral was the optimal site for LV lead. In 8/102 patients (8%) the apical region (4/102 lateral, 4/102 postero-lateral) was classified as the optimal site.

Conclusions: We have described the observed LV electrical delay and the hemodynamic response to biventricular pacing into 15 sites in the LV wall. In 8% of cases,