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# Poster Walk: Ablation, Pacing and Defibrillation II

## P42–P49

### Joint Annual Meeting 2019 of the Swiss Society of Cardiology and the Swiss Society of Cardiac Surgery

## P42

### Identification and characterization of suitable S-ICD sensing vectors for patients with ajmaline-induced Brugada syndrome

*G. Conte[1], M. Namdar[2], C. De Asmundis[3], A. Vicentini[4], F. Salghetti[5], G. De Ferrari[6], P. Berne[7], V. Allavatam[8], A. Auricchio[9]*

*[1]Cardiocentro Ticino, lugano, [2]University Hospital of Geneva, Geneve, Switzerland, [3]Free University of Brussel, Brussels, Belgium, [4]University Hospital of Pavia, Pavia, Italy, [5]Free University of Brussel, Brussels, Belgium [6]University Hospital of Berne, Switzerland, [7]Hospital of Nuoro, Nuoro, Italy, [8]Boston Scientific - CRM R&D, Arden Hills, MN, United States, [9]Cardiocentro Ticino, Lugano, Switzerland*

**Background:** Patients with Brugada syndrome (BrS) present a higher rate of eligibility failure for subcutaneous implantable cardioverter-defibrillators (S-ICD) compared with patients with a different cardiac channelopathy. Ajmaline challenge can be a valuable tool in BrS patients to unmask variations in ECGs that may challenge S-ICD. Aim of this multicenter study is to assess S-ICD dynamic sensing vector features during ajmaline infusion.

**Methods:** S-ICD screening was performed during ajmaline infusion in consecutive patients with suspected BrS. ECGs were collected in 3 stages of ajmaline test (1-Baseline, 2-Ajmaline Infusion and 3-Recovery) using the automated screening tool (AST 1.0). The attributes of QRS and T-wave amplitudes, QRS/T-wave ratio were available for analysis.

**Results:** S-ICD screening ECGs from 44 patients (negative ajmaline test: 27, positive ajmaline test: 17) were collected in 3 stages of ajmaline test. A total of 2040 vectors (680 per sense vector, negative: 1212, positive: 828) were available for this analysis. The QRS/T-wave measurements per phase were measured (Baseline: 0.70-0.90/0.11-0.12, Ajmaline infusion: 0.65-0.80/0.11-0.13 and Recovery: 0.67-0.80/0.13-0.14). The QRS amplitudes in positive ajmaline patients were significantly lower than negative ajmaline test patients (Negative/Positive: Primary - 0.76/0.46, Secondary - 0.98/0.86 and Alternate - 0.79/0.71 millivolts).

**Conclusion:** Patients with drug-induced BrS ECG have lower-QRS amplitude on S-ICD primary vector. The Secondary sense vector appears to be appropriate for sensing in Brugada patients testing positive for ajmaline. The impact of these findings on real-life S-ICD sensing in patients with BrS needs to be further assessed.

## P43

### QTc prolongation in connective tissue disorders - prevalence and correlation with ventricular tachycardia

*B. Ibrahimi[1], N. Molitor[2], D. Despotovic[1], J. Voegele[3], A. Oxenius[4], F. Duru[5], C. Scharf[6], M. Greutmann[1], E. Valsangiacomo Buechel[4], F. Bonassin[7], M. Rohrbach[8], G. Matyas[9], R. Weber[10], C. Attenhofer Jost[11]*

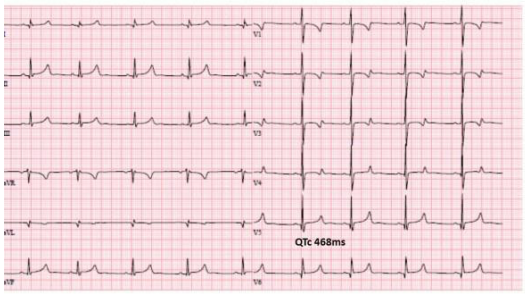
*[1]Adult Congenital Heart Disease Center, University Heart Center Zurich, University Hospital Zurich, [2]Adult Congenital Heart Disease Center, University Heart Center, Cardiology, University Hospital Zurich, [3]HerzGefässZentrum Zürich Klinik Im Park, [4]Cardiology, University Children's Hospital Zurich, [5]Electrophysiology, University Heart Center Zurich, University Hospital Zurich, [6]Rhythmologie Zürich AG, Klinik Im Park, Zurich, [7]University Heart Center Zurich, University Hospital Zurich, [8]Endocrinology and metabolism, University Children's Hospital Zurich, Zurich, [9]Genetikzentrum Schlieren, Schlieren, [10]Cardiology, University Children's Hospital Zurich, [11]HerzgefässZentrum Zürich Klinik Im Park, Zurich, Switzerland*

**Introduction:** Sudden cardiac death (SCD) has been described in Marfan syndrome (MFS), TGFBetaR2 mutations, and SMAD 3 mutations as well as generally in mitral valve prolapse (MVP). The etiology of SCD in this patient group of connective tissue disorders (CTD) is unknown, although increased ventricular arrhythmias and ventricular repolarization abnormalities have been described.

**Methods:** The CTD population of 3 referral centers was analyzed for ECG findings, history of ventricular tachycardia (VT) and syncope. The findings were correlated with results of genetic testing if available.

**Results:** There were 123 patients, age at examination was 36 ±18 years (range 2 to 79 years). In 68 patients, results of genetic testing was available (47 had FBN1, 2 FBN1 and another mutation, 6 SMAD 3 mutation etc.). Average heart rate was 69 (14)bpm, PR interval 172 (151), QRS 107 (26), QTc 421 (30ms). None of the patients was taking QTc

**Figure:** P43-1.




prolonging drugs. QTc prolongation defined as >460ms in children< 16 years, respectively 480ms in men, and 490ms in women was present in 6 of 121 patients (5%). QTc was significantly predicted by age. QTc prolongation could not be predicted by the genetic results. There was a correlation of QTc with a history of ventricular tachycardia, however. One of these 6 patients with QTc prolongation and SMAD3 mutation had SCD at 12 years of age with no previous detected ventricular tachycardia (he had no Holter ECG), ECG at rest see Figure P43-1.

**Conclusion:** QTc prolongation may occasionally be observed in CTD, in the absence of drugs affecting cardiac repolarization and independent of the underlying genetic mutation, putting the pts at risk for life threatening arrhythmias, and thus, necessitating careful ECG analysis of these pts.

## P44

### Right atrial electrogram complexity predicts acute outcome of extra-pulmonary vein substrate modification in atrial fibrillation ablation

*N. Johner, M. Namdar, D.C. Shah*

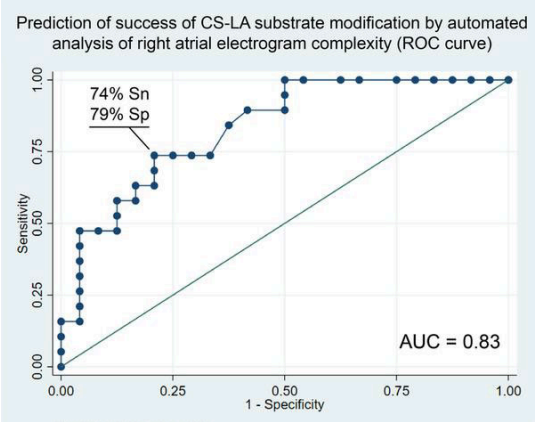
*Geneva University Hospitals, Geneva, Switzerland*

**Introduction:** While pulmonary vein isolation (PVI) is the cornerstone of atrial fibrillation (AF) ablation, extra-PV substrate modification remains a major challenge. We sought to identify electrophysiological predictors of successful coronary sinus (CS)-left atrium (LA) substrate modification, based on custom-made computerized electrogram (EGM) annotation.

**Method:** We studied 66 patients (age 59±11, 77% men) undergoing de novo catheter ablation of paroxysmal (N=43) or persistent AF (N=23). Following PVI, AF was induced by LA burst-pacing. Multi-site RA and CS EGMs within the first 30 seconds of induced AF were annotated beat-to-beat by a custom-made algorithm and Sample Entropy (SE) was computed (higher values indicating increasing AF complexity). In case of post-PVI sustained AF (>5 min), fractionated EGMs were ablated in the CS and LA and inducibility was retested. Primary outcome was AF non-inducibility.

**Results:** After PVI, 43 patients exhibited sustained induced AF and underwent CS-LA defragmentation, resulting in AF non-inducibility in 19/43 (44%). Patients responding positively to CS-LA ablation exhibited beforehand (during induced AF immediately after PVI) smaller RA SE (0.20±0.09 vs 0.29±0.08, p=0.001), fewer

**Figure:** P44-1. ROC curve: acute ablation outcome prediction by right atrial AF electrograms.




RA activation pattern changes (3.5±1.2 vs 4.4±0.9/sec, p=0.0004), fewer non-uniform RA wavefronts (3.1±1.3 vs 4.4±0.9/sec, p=0.001), more cranio-caudal RA activations (2.3±1.7 vs 0.7±0.8/sec, p=0.0002), and fewer caudo-cranial RA activations (0.09±0.13 vs 0.25±0.25/sec, p=0.02), compared to patients who did not respond. The derived parsimonious model predicted the primary outcome of CS-LA ablation with 74% sensitivity, 79% specificity (Figure P44-1), area under the ROC curve after 10-fold cross-validation = 0.80 (95% CI 0.67-0.94). In contrast, CS EGM complexity was not associated with outcome. The secondary composite outcome of AF termination or non-inducibility showed similar results; so did stratifying by persistent/paroxysmal AF. In patients with failed CS-LA ablation, RA defragmentation resulted in sustained AF termination or non-inducibility in 57%.

**Conclusion:** RA EGM complexity during the first 30 seconds of post-PVI induced AF reliably predicts acute outcome of CS-LA defragmentation. When CS-LA ablation failed to render AF non-inducible, subsequent RA defragmentation was successful in the majority of patients. These results indicate RA contribution to post-PVI AF maintenance in patients unresponsive to PVI followed by CS-LA ablation.

## P45

### Short QT phenotype in a family with genetic variants in the *KCNH2* and *SLC4A3* genes - the role of prediction tools, whole exome sequencing and genetic cascade screening

*B. Kovacs[1], U. Graf[2], I. Magyar[2], L. Baer[2], A. Maspoli[2], F. Duru[1], W. Berger[2], A.M. Saguner[1]*

*[1]Cardiology, University Hospital Zürich, [2]Institute of Molecular Genetics, University of Zurich, Zurich, Switzerland*

**Introduction:** Short QT syndrome (SQTS) is a rare, autosomal dominant disease causing sudden cardiac death. Genetic testing is recommended according to current guidelines. Mutations in *KCNQ1*, *KCNH2*, *KCNJ2* and *SLC4A3* genes have been implicated in SQTS. These genes encode potassium channel subunits and a bicarbonate transporter regulating intracellular pH. A dominant mutation in this transporter can lead to increased intracellular pH and shortened action potential.

**Method:** We performed a thorough work-up of the index patient including medical history, physical examination, 12-lead ECG, echocardiography, stress testing, coronary angiography, flecainide challenge, and genetic testing with NGS. QTc was determined using Bazett's formula. CS of all 1° relatives was performed.

**Results:** The ECG of the index patientshowed a QTc of 340ms and characteristics compatible with a SQTS. Clinical work-up was unremarkable. A first genetic search with NGS focusing on genes that have been previously involved in the pathogenesis of channelopathies detected a rare known heterozygous missense variant in the *KCNH2* gene (Arg328Cys, frequency 0.053%), which was predicted to be pathogenic according to various prediction algorithms (Polyphen, SIFT, Align GVGD, mutation taster). ECG screening of all asymptomatic first-degree family members identified a SQT phenotype in the mother (QTc 355ms), but not in the father (QTc 380ms) and sister (410ms). The *KCNH2* variant was found in the father and sister but not the affected mother, which excludes this variant as the causative mutation in this family. Therefore, reanalysis of whole-exome sequencing data was performed and revealed a novel heterozygous missense variant (Arg370Cys) in the recently identified *SLC4A3* gene, which was also predicted to be pathogenic. A mutation in this gene at the same position has been previously associated with the SQTS. The Arg370Cys mutation was found in the mother but not in the father or sister, supporting the assumption that this was the causative mutation in this family. However, we can not exclude a modifying effect of the *KCNH2* variant in the affected family members.

**Conclusions:** Predictive bioinformatic algorithms to assess the pathogenicity of missense variants are of limited relevance and whole-exome sequencing, co-segregation analysis and a thorough clinical work-up are crucial to interpret novel mutations causing the SQTS.

## P46

### The timing of new left bundle branch block predicts the need for permanent pacemaker implantation in patients undergoing transcatheter aortic valve implantation

*L.D. Loretz[1,2], M. Brinkert[2], F. Moccetti[2], M. Bossard[2], F. Cuculi[2], R. Kobza[2], S. Toggweiler[2]*

*[1]Universität Zürich, Zurich, [2]Cardiology, Heart Center Lucerne, Luzerner Kantonsspital, Lucerne, Switzerland*

**Background:** New left bundle branch block (LBBB) frequently occurs during transcatheter aortic valve implantation (TAVI). Little is known about the relevance of its timing. We sought to determine if the timing of new LBBB during TAVI influences the need for permanent pacemaker implantation.

**Methods:** Consecutive patients with normal QRS at baseline and new LBBB during TAVI were analyzed. Patients with new LBBB before valve deployment (insertion of the stiff wire or predilatation) were compared to patients with new LBBB after valve deployment (valve deployment or postdilatation).

**Results:** A total of 126 patients (mean age 81 ± 7 years, 51% female) were enrolled. New LBBB occurred before valve deployment in 67 (53%) patients and after valve deployment in 59 (47%) patients. Resolution of LBBB until discharge was observed in 47 (70%) of patients with LBBB before valve deployment and in 33 (56%) of patients after valve deployment (p= 0.15). Implantation of a new permanent pacemaker in patients with LBBB occurring before valve deployment was required in 1 (2%) compared to 7 (12%) of patients with LBBB after valve deployment (p= 0.03). One-year mortality did not differ.

**Conclusion:** Patients with new LBBB during insertion of the stiff wire or predilatation required less often implantation of a permanent pacemaker than patients with new LBBB with valve deployment or postdilatation. This may indicate that trauma occurring before valve deployment may be reversible and may have important implications for postprocedural management.

## P47

### Correlation between $CHA_2DS_2$-VASc score and P-wave duration as an indicator for atrial cardiomyopathy

*N. Nozica, E.G. Elchinova, A. Lam, E. Goulouti, A. Haeberlin, H.S. Servatius, J. Seiler, F. Noti, S.H. Baldinger, R. Sweda, B. Asatryan, H. Tanner, T. Reichlin, L. Roten*

*Department of Cardiology, Inselspital, Bern University Hospital, University of Bern, Berne, Switzerland*

**Introduction:** Atrial cardiomyopathy is associated with atrial fibrillation (AF) and thromboembolic events. Atrial remodeling predisposes to prolonged atrial electrical activation time as quantified by P-wave duration. Clinically, $CHA_2DS_2$-VASc score and the majority of its components have been implicated in the pathway leading to advanced atrial disease. Markers of atrial remodeling may be clinically useful and clear association with clinical sequelae including arrhythmia and stroke has been shown. We therefore investigated the correlation of $CHA_2DS_2$-VASc score and its components with the filtered P-wave duration.

**Methods:** The STAR-FIB study is a hospital-based, prospective, cohort study, which aims to examine indicators associated with atrial cardiomyopathy and the prevalence of subclinical AF. This cohort included subjects without a previous diagnosis of AF, aged 65 to 85, evenly distributed for age and gender. The filtered P-wave duration was measured by signal-averaged ECG.

**Results:** The cohort included 583 participants (52% men, mean age 75± 5.5 years, median $CHA_2DS_2$-VASc score 3; and 48% women, mean age 74 ± 5.4 years, median $CHA_2DS_2$-VASc score 4). 37 (6%) participants had a $CHA_2DS_2$-VASc score of 1, 130 (22%) of 2, 171 (29%) of 3, 139 (24%) of 4 and 106 (18%) of >4. Participants with a high $CHA_2DS_2$-VASc (≥3, 416, 71.4%) compared with a low $CHA_2DS_2$-VASc (≤2, 167, 28.6%) had a significantly longer p-Wave duration (mean 141 ms vs 137 ms, p 0.033, see Figure). Male gender, history of hypertension and of coronary artery disease (CAD) correlated independently with increased P-wave duration in multivariate analysis. A history of CAD, although not an individual category in the $CHA_2DS_2$-VASc score, correlated with a longer P-wave duration while myocardial infarction, included in $CHA_2DS_2$-VASc score, did not. Women had a significantly shorter P-wave duration compared to men (mean 137 ms vs 143 ms, p < 0.0001).

**Figure:** P47-1. High and Low Chads2Vasc Scores vs Filtered P-wave duration.

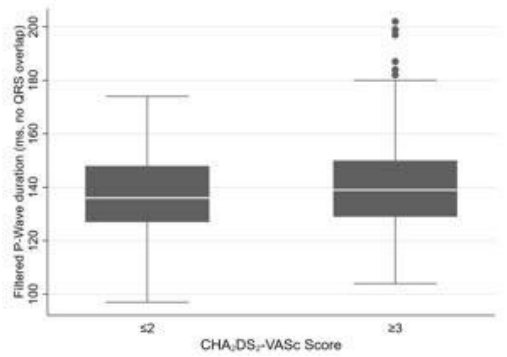



**Figure:** P47-2. Filtered P-wave duration vs components of Chads2Vasc Score (multivariate analysis).

| Variables | Filtered P-Wave duration | |
|---|---|---|
| | coeff. (95%-CI) | p-value |
| Gender (female) | -4.53 (-7.19;-1.88) | <0.001 |
| Age | 2.02 (-0.59;4.63) | 0.129 |
| Hypertension | 5.33 (2.38;8.27) | <0.001 |
| Diabetes | -1.05 (-4.58;2.48) | 0.560 |
| Coronary artery disease | 3.98 (1.06;6.90) | 0.008 |
| Peripheral artery disease | 1.95 (-3.38;7.28) | 0.472 |
| Heart Failure | -7.08 (-16.99;2.82) | 0.161 |
| Previous stroke/TIA/peripheral thromboembolism | -2.26 (-6.12;1.58) | 0.248 |

**Conclusion:** Our results show that there is a significant difference in filtered P-wave duration when comparing subjects without previously documented AF, stratified into low and high $CHA_2DS_2$-VASc score categories. This may be useful as a potential marker of atrial disease, influence risk stratification and secure the indication for further diagnostic work-up. Interestingly, although female gender increases thromboembolic risk according to $CHA_2DS_2$-VASc score, our results showed a shorter P-wave duration in women.

## P48

### Recurring patterns of ventricular response during persistent atrial fibrillation correlate with the ablation outcomes

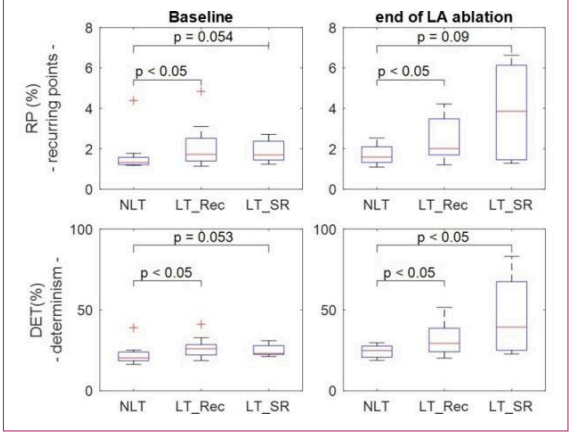
*Y. Prudat[1], A. Luca[2], E. Pruvot[2], R. Vinals Terres[1], A. Buttu[1], P. Pascale[2], M. Le Bloa[2], C.-I. Park[3], L. Roten[4], M. Kühne[5], F. Spies[5], S. Knecht[5], C. Sticherling[5], J.-M. Vesin[1]*

*[1]Swiss Federal Institute of Technology, [2]Lausanne University Hospital, Lausanne, [3]La Tour Hospital, Genève, [4]University Hospital of Bern, Berne, [5]University Hospital Basel, Basel, Switzerland*

**Introduction**: The ventricular response during atrial fibrillation (AF) has been shown to be modulated by the atrial rate. We hypothesized that the dynamics of ventricular response during persistent AF (pAF) correlates with the outcomes of catheter ablation.

**Method**: In 40 consecutive pts (61±8 y, sustained AF 19±11 m), pulmonary vein isolation, defragmentation and linear ablations were performed within the left atrium (LA) until pAF termination or cardioversion. Recurrence quantification analysis (RQA) was performed on RR-interval time series extracted from 5-min ECG recorded before ablation (BL) and at the end of LA ablation (end_ABL). Percentage of recurring points (RP) and percentage of determinism (DET) were computed as measures of the temporal regularity of RR-intervals. AF recurrence during follow-up (FU) was defined as any atrial arrhythmia > 30 sec.

**Figure:** P48-1.




**Results**: pAF was terminated within the LA in 70% (28/40, LT) of the pts, while 30% (12/40, NLT) were not. Over a mean FU of 34±14 months, recurrence occurred in 100% of NLT pts and in 71% of LT pts (20/28, LT_Rec), while 28% of LT pts (8/28, LT_SR) remained in sinus rhythm after a single procedure. The figure P 48-1 shows that: (1) NLT pts, all with recurrence at FU, displayed significantly lower RP and DET values, indicative of a higher complexity of RR-intervals both at BL and at end_ABL than pts with a successful procedure; (2) higher DET and RP values indicative of decreased complexity of RR-intervals at end_ABL are associated with AF termination and reduced AF recurrence at FU.

**Conclusion**: Complexity measures of ventricular response in pAF appear as promising parameters of catheter ablation outcomes.

## P49

### Predictors of atrial fibrosis in patients with atrial fibrillation referred for catheter ablation

*V.A. Rossi, I. Krizovic-Grgic, A. Breitenstein, T. Wolber, D. Hofer, S. Dougoud, M. Mohsen, C.B. Bruncknorst, F. Ruschitzka, J. Steffel, F. Duru, A.M. Saguner*

*Universitätsspital Zürich, Zurich, Switzerland*

**Introduction:** Left atrial (LA) fibrosis has been associated with an increased risk of atrial fibrillation (AF). Female gender and APPLE score have been suggested as independent risk factors. We aimed to validate parameters potentially associated with LA fibrosis assessed by low voltage areas (LVA) during invasive electroanatomical voltage mapping (EAM) in patients with AF. LVA seems more reliable to quantify LA fibrosis than MRI with late gadolinium enhancement.

**Methods:** 81 patients undergoing EAM-guided ablation for AF in 2016-18 were included. LVA were defined as confluent endocardial areas< 0.5mV on bipolar electrograms during sinus rhythm (CARTO3 mapping system). The total area of LA fibrosis was indexed for LA volumes measured by CT and expressed as%. Blood tests were

drawn the morning before the ablation. Left ventricular function was analyzed by echocardiography. The APPLE score was calculated as: 1point each for age>65 years, persistent AF, eGFR< 60ml/min/m2, LA diameter≥4.3cm, LVEF< 50%.

**Results:** Mean patient age was 62.5±11; 37% had paroxysmal AF; 19% had a LVEF< 50%. LA fibrosis was present in 63% patients, of whom 35% were female (p=0.266). In patients with persistent AF, LA fibrosis was frequently localized in the anterior and posterior LA (both p=0.004); a positive correlation was found for LA fibrosis and indexed aortic sinus diameters (p=0.004). No differences were found with respect to gender.

Patients with more LA fibrosis had lower BMI (p=0.013), larger indexed LA (p< 0.001), higher E/e' ratio (p=0.057) and higher NT-proBNP (p=0.031). LA fibrosis positively correlated with female gender, increasing age, NT-proBNP, indexed LA volume (all p< 0.001), $CHA_2DS_2VASc$ score (p=0.011), APPLEscore (p=0.012), hypertension (p=0.041), mean E/e'(p=0.016). A positive trend was found for persistent AF (p=0.056), no correlation was found for AF duration (p=0.76). NT-proBNP positively correlated with APPLEscore (p=0.003).

After correction for gender, age, type of AF, indexed LA volume, hypertension, BMI, renal function and APPLEscore, only higher NT-proBNP independently predicted LA fibrosis.

**Conclusion:** In patients with AF, NT-proBNP independently predicted LA fibrosis, while female gender and APPLE score did not. Since most of patients had preserved systolic LV function and LVEF was not predictive of LA fibrosis, elevated NT-proBNP as a marker of diastolic dysfunction and increased left-sided filling pressures seem to represent an important cause of LA fibrosis.