Cross effects of acute adrenergic stimulation on rapid component of delayed rectifier potassium current in guinea-pig left ventricular myocytes

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Background & Objectives: To investigate cross effects of acute stimulation of different subtypes of adrenoceptors (α1 and β1) on the rapidly activating delayed rectifying potassium current (IKr) from guinea-pig left ventricular myocytes.

Methods: Single ventricular myocyte was obtained using standard enzymatic dissociation technique, and IKr tail current was recorded by whole-cell patch-clamp technique.

Results: Phenylephrine and xamoterol inhibited IKr by a content dependent way, IC50 was 0.93μM and 6.4μM, respectively. Phenylephrine reduced IKr to 0.78±0.02, induced the voltage-dependent activating curve to left, changed V0.5 from -2.99 mV±1.44 mV to -9.10 mV±1.74 mV, and changed slope little. 10μM Xamoterol reduced IKr to 0.72±0.01, shifted activating curve to left, changed V0.5 from 4.54±0.84 mV to -7.24 mV±1.93 mV, and changed slope little. However, simultaneously administration of 1μM Phenylephrine plus 10μM Xamoterol reduced IKr to 0.69±0.02, shifted activating curve to left, changed V0.5 from -2.73±1.95 mV to -8.45±1.97 mV, and changed slope little. In these three groups, IKr tail current separately decreased by (20.73±2.46%), (27.99±0.68%) and (30.56±1.80%).

Conclusion: Acute stimulation of α1 or β1 adrenoceptor inhibited IKr current in different degrees, while simultaneously acute stimulation of α1 and β1 adrenoceptor did not generate more dramatic inhibitory effects. This phenomenon suggests that there exists a certain degree of overlap in regulation, namely “cross-talk”, between α1 and β1 adrenergic signaling cascades. Most importantly, this “cross-talk” regulation is necessarily a protective mechanism for humans who are under stress conditions.

Long-term reproducibility of ventricular tachyarrhythmia inducibility and new markers for risk stratification in brugada syndrome

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Background and Objectives: The objectives of the study were to evaluate the long-term reproducibility of ventricular tachycardia (VT) or fibrillation (VF) inducibility in programmed electrical stimulation (PES), to evaluate the efficacy of VT/VF inducibility in the late period (L-period) as a risk factor of VT/VF events (VA), and to identify new markers for VA in patients with Brugada syndrome (BB).

Methods: Fifty-one patients (mean age, 51.3 ± 14 years) with type-1 Brugada ECG (documented VF: N=16, syncope: N=12, and asymptomatic: N=23) underwent PES (early period [E-period]). Ten of the 51 patients underwent a second PES (documented VF: N=4, syncope: N=2, and asymptomatic: N=4) 83±3 months after the first (L-period).

Results: During 66±34 months of follow-up, 13 patients had VA. VT/VF was induced in 30 patients (59%) in E-period, and 6 (60%) in L-period. In 5 of the 6 patients (83%) with inducible VT/VF in L-period, VT/VF was also induced in E-period. VT/VF inducibility in both periods did not differ between the patients with and those without VA. VA incidence was significantly higher in patients satisfying 2 or more of the following 3 criteria than in the others (52% vs. 7%, p<0.001): spontaneous type-1 ECG, effective refractory period at right ventricular apex ≥ 210ms, and His-ventricular interval ≥ 45ms.

Conclusions: VT/VF inducibility was reproducible in L-period. However, VT/VF inducibility in E-period and L-period was not a useful predictor of VA. A multiparametric approach using new markers (satisfying 2 or more of the abovementioned 3 criteria) may be useful for identifying high-risk patients with BS.

Left stellate ganglion block improves ventricular function and conduction with the suppression of the inflammation in autoimmune myocarditis model

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Background: Myocarditis and subsequent dilated cardiomyopathy (DCM) are major causes of heart failure and arrhythmia in young patients. We evaluated whether left stellate ganglion block (SGB) could improve survival, and ventricular function and conduction in experimental autoimmune myocarditis (EAM).

Methods: EAM was produced by the injection of porcine cardiac myosin of 2 mg into footpads, and SGB by injection of bupivacaine HC1 (0.25%, 0.2 mL) to the left SG of adult Sprague-Dawley rats until the development of ipsilateral Potts. Rats were randomly divided into the following five groups: 1) control (n=12), 2) EAM (n=12), 3) EAM and left SGB (MyosinB, n=10), 4) EAM and oral azothiolax administration (MyosinB, n=9), and 5) left SGB (MyosinB, n=7).

Results: In Myo group, 4 (33%) out of 12 rats died suddenly after acute myocarditis. However, no, and a rat died in MyosinB and MyosinB groups, respectively. The MyosinB group had a better survival rate than Myo group (100%, vs. 67%, p<0.04). Compared with Myo group, MyosinB showed significantly improved LV systolic function (56.7% vs. 82±3 %, p<0.001) and conduction time of ventricle (22.0 ± 2.8, vs. 11.7 ± 2.1 ms, p<0.001). The increase of inflammatory cells, HMGB1, IL-6, and TNF-α were observed in Myo, but not in MyosinB and MyoSB groups.

Conclusion: Left SGB improved survival, and ventricular function and conduction with the suppression of the inflammation in EAM. These findings suggest that the anti-inflammatory effect might be one of the mechanisms of beneficial effect of SGB.

Sleep disordered breathing in children is associated with pathophysiological changes in plateau aggregation, inflammation and endothelial dysfunction

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Background & Objectives: Sleep disordered breathing (SDB) in adults is an independent risk factor for coronary artery disease and atrial fibrillation. Altered platelet reactivity, endothelial dysfunction and inflammation and inflammation in adults with SDB are known to contribute to the pathogenesis of its cardiovascular complications. SDB also occurs in children; however little is known about platelet function and inflammation in non-obese children with SDB. Therefore, this study investigated platelet aggregation, inflammation and endothelial function in children with SDB and healthy matched controls.

Methods: Clinical evaluation of SDB was performed on 19 children aged 5-16 years through polysomnography (n=12 were clinically diagnosed with SDB, n=7 were healthy controls). Venous blood samples were collected and analyzed for measurements of platelet aggregation and inflammation. Plasma asymmetric dimethylarginine (ADMA), a marker of endothelial function, was also quantified.

Results: There were no differences in age, gender, BMI between children with SDB and controls. Platelet aggregation responses were significantly higher in SDB children compared to controls (37.5± vs 22±2 Aggregation Units, P<0.05) Furthermore, there was a significant increase in T-cell interferon (IFN)-gamma (SDB 52±4% vs control 23±3% positive cells, P<0.005) and tumor necrosis factor (TNF)-alpha (SDB 39±4% vs Controls 26±2% positive cells, P<0.005) in the blood of SDB children compared with controls. Children with SDB also exhibited an increase in ADMA (0.43± vs 0.5μM±) vs controls (0.35± vs 0.09μM±, P<0.05).

Conclusion: SDB in children is associated with enhanced platelet aggregation and inflammatory responses and endothelial dysfunction. These parameters may increase their risk of developing cardiovascular complications in the future.
Early repolarization characterized by J wave on the electrocardiogram is highly detected in diagnostic epilepsy patients

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Background: Early repolarization is one of causes for sudden unexpected death (SUD) of healthy individuals, but it is still unclear regarding the physiological mechanism. Lethal arrhythmias are major cause of SUD. Recent reports have demonstrated electrocardiogram (ECC) abnormalities were observed in epilepsy patients. We aimed to evaluate characteristics of ECC abnormalities in epilepsy patients and hypothesized that J wave is associated with the etiology of epilepsy.

Methods: We referred 677 consecutive patients who were diagnosed as epilepsy in our institute. All patients administered antiepileptic drugs such as sodium valproate and zonisamide for treatment of epilepsy. Among the patients, 162 patients (age 36±21 years, 89 male) were examined with 12-lead ECCs and echocardiograms for discriminating cardiogenic causes.

Results: Although no patients had echocardiographic abnormalities, 12-lead ECC abnormalities were detected in 45 of 162 patients (28%). The ECC abnormalities included some patterns; 1) early repolarization with J waves in 34 patients (21%), 2) Brugada-type ECC in 4 patients (2.5%), 3) QT-interval prolongation in 3 patients (1.9%), 4) atrioventricular block in 3 patients (1.9%), and 5) Wolff-Parkinson-White syndrome in one patient (0.6%). During follow-up of 12±6 months, no patients developed SUD so far.

Conclusions: ECC abnormalities are highly observed in epilepsy patients and J wave is the most frequent finding. The ECC pattern might affect epileptic seizure or overlap with idiopathic ventricular fibrillation.

Combination therapy with pravastatin and valsartan has additive effects to improve vascular and metabolic phenotypes over monotherapy in hypercholesterolemic patients

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Background: Statin and angiotensin II type 1 receptor blocker therapy improve endothelial dysfunction using distinct mechanisms. Therefore, we evaluated simultaneous vascular and metabolic responses to pravastatin and valsartan therapy, alone or in combination, in hypercholesterolemic patients.

Methods: Forty-eight hypercholesterolemic patients (23 had metabolic syndrome) were given pravastatin 40 mg and placebo, pravastatin 40 mg and valsartan 160 mg, or valsartan 160 mg and placebo daily during each 2 month treatment period in a randomized, single-blind, placebo-controlled cross-over trial with three treatment arms and two washout periods (each 2 months).

Results: Of note, brachial artery flow-mediated dilation improved to a greater extent with combined therapy vs. either monotherapy (P=0.001 by ANOVA). Interestingly, when compared with monotherapy, combined therapy significantly reduced hs-CRP levels to a greater extent (P=0.019 by ANOVA on Ranks). We also observed simultaneous improvement in metabolic phenotypes with all three treatments causing increased plasma adiponectin levels, reduced fasting plasma insulin levels, and increased insulin sensitivity (determined by QUICKI) relative to baseline measurements. For the first time in a statin combination trial, pravastatin combined with valsartan therapy increased plasma adiponectin, lowered fasting insulin, and improved insulin sensitivity in an additive manner when compared with either monotherapy alone (P=0.003, P=0.049; and P=0.049 by ANOVA on Ranks, respectively). Overall, we observed similar results in 23 patients with metabolic syndrome.

Conclusions: Pravastatin combined with valsartan improved endothelial function and metabolic phenotypes in an additive fashion in patients with hypercholesterolemia or metabolic syndrome.

Impact of acute phase VT/VF on in-hospital and long-term prognosis in the percutaneous coronary intervention era

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Background: The episode of ventricular tachycardia and fibrillation (VT/VF) during the acute phase of acute myocardial infarction was a predictor of poor prognosis in the percutaneous coronary intervention (PCI) era; however, prognostic significance of acute phase VT/VF was not sufficiently assessed in the PCI era.

Methods: Among registered patients in the Osaka Acute Coronary Insufficiency Study (OACIS) between 1998 and 2011, we studied 4,283 consecutive patients with ST elevated myocardial infarction (STEMI) who were hospitalized within 12 hours of symptom onset and underwent emergent PCI. Acute phase VT/VF was defined as 3 or more consecutive ventricular premature complexes and/or VF within the first 7 hospital days. Patients were divided into the tertiles stratified according to baseline risk that was estimated by Global Registry of Acute Coronary Events (GRACE) risk score.

Results: Acute phase VT/VF occurred in 997 (23.3%) patients. There was no difference in age and sex between patients with and without the VT/VF. In-hospital mortality was significantly higher in patients with the VT/VF than those without (14.6% vs. 4.3%, adjusted HR=1.83, 95%CI=1.27-2.60, p=0.0013). Whereas, the VT/VF did not influence 5-year mortality (adjusted HR=1.26, 95%CI=0.91-1.70, p=0.16), except an association with higher mortality in high risk patients (adjusted HR=1.60, 95%CI=1.10-2.27, p=0.0014).

Conclusion: Even in the PCI era, episodes of acute phase VT/VF were associated with higher in-hospital mortality in STEMI patients. However, mortality risk related to the VT/VF was no longer significant, once patients discharged alive.

Ubiquitin-like protein modifier FAT10 protects cardiac myocytes against apoptosis

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Aims: FAT10 is a recently identified member of the ubiquitin-like protein family with yet-to-be defined biological functions in the heart. The aim of the study was to determine the role of FAT10 in cardiac myocyte apoptosis.

Methods and Results: FAT10 is expressed in normal human and murine hearts, as detected by qPCR and Western blotting. Expression of FAT10 is increased in the heart at the border zone of myocardial infarction and in cultured neonatal rat cardiac myocytes (NRCM) subjected to hypoxia/reoxygenation (H/R) stress. Lentiviral-mediated overexpression of FAT10 in NRCM was associated with reduced apoptosis in response to H/R injury, as detected by FACS analysis of annexin-V expression and TUNEL assay. Expression of FAT10 was associated with reduced p53 level and abrogated H/R-induced p53 expression along with its downstream pro-apoptotic protein BAX level. Concordant with the findings, miR-34a level, which is transcriptionally regulated by p53, was reduced and BCL2 level, an anti-apoptotic protein, which is a target of miR-34a, was increased. These changes led to a favorable shift in the BCL2/BAX axis of apoptosis. Treatment of NRCM with proteasome inhibitor MG132 increased p53 and miR-34a levels and reduced BCL2/BAX ratio. These changes were partially reversed upon over-expression of FAT10 in NRCM.

Conclusions: Expression of FAT10 is upregulated in the heart and NRCM in response to H/R stress. Upregulation of FAT10 protects cardiac myocytes against apoptosis by suppressing p53 and miR-34a expression and by shifting the BCL2/BAX against apoptosis. Thus, FAT10 is a cardioprotective gene and its upregulation might afford beneficial effects in pathological conditions associated with cardiac myocyte apoptosis.

Keywords: FAT10, cardiac myocyte, apoptosis, p53, BCL2, microRNA
Risk stratification for ventricular arrhythmia from right ventricular outflow tract: signal-averaged electrocardiograms provide more than diagnosis

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Background: Many arrhythmogenic right ventricular cardiomyopathy (ARVC) patients present ventricular arrhythmia (VA) from right ventricular outflow tract (RVOT) and are difficult to differ from idiopathic RVOT-VA in early stage. Signal-averaged electrocardiograms (SAECG) provide diagnostic information of ARVC. The study is aim to elucidate the prognostic value of SAECGs on risk stratification of VA from RVOT.

Method: The cohort enrolled consecutive 92 patients (mean age: 44±14 years-old, 48 % male, 41% definite ARVC, 38% borderline ARVC, and 26% idiopathic VT) with symptomatic VA from RVOT (LBBB and inferior axis in surface ECG) and available SAECGs obtained from anti-arrhythmic drugs at diagnosis. The demographic, electrocardiographic, structural, and invasive electrophysiological characteristics were collected (Table 1). Patients were categorized into 2 groups: Fulfilling all 3 SAECG criteria (based on Task Force criteria for diagnosing ARVC) or not. The end-points composed of unstable VA, mortality, and ICD-treated fast VA with cycle length < 320ms.

Result: During a mean follow-up of 21 ± 22 months, 34% encountered end-points, including fast VA with cycle length < 320ms.

Conclusion: Not only diagnostic information, SAECG also provides prognostic prediction in patients with RVOT-VT. This non-invasive test may change a decision making in RVOT-VT patients, especially an ARVC is suspected.

Table 1

<table>
<thead>
<tr>
<th>Patients fulfilling all 3 SAECG criteria</th>
<th>Patients fulfilling &lt; 3 SAECG criteria</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Male Gender</td>
<td>73%</td>
<td>38%</td>
</tr>
<tr>
<td>Age</td>
<td>48 ± 15</td>
<td>42 ± 14</td>
</tr>
<tr>
<td>Syncope or near syncope</td>
<td>69%</td>
<td>40%</td>
</tr>
<tr>
<td>Family history of SCD or ARVC</td>
<td>14%</td>
<td>7%</td>
</tr>
</tbody>
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Abnormal repolarization in ECG

| SAECG data | Total QRS duration in SAECG | 12 ± 5 | 39 ± 19 | 0.001 |

R V regional systolic dysfunction

| LV regional systolic dysfunction | 77% | 40% | 0.013 |

Fat infiltration in pathology

| Fat infiltration in pathology or MRI | 50% | 41% | 0.903 |

ARVC diagnosis

| Definite | 70% | 31% |
| Borderline | 23% | 16% |
| Possible | 5% | 19% |
| Idiopathic VT | 0% | 34% |

Electrophysiology data

| Inducible or document sustained VT | 71% | 45% | 0.181 |
| Ablation | 58% | 74% | 0.120 |

Prevalence of brugada electrocardiograms and brugada syndrome in brunei darussalam

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Background and Objectives: Brugada syndrome is a major cause of sudden cardiac death in Asia. The aim of the study was to describe the clinical profile of Brugada syndrome patients in Brunei Darussalam.

Methods: From March 2006 to May 2013, patients presenting to a local tertiary referral centre in Brunei Darussalam and identified as having Brugada electrocardiograms (ECGs) type 1 to type 3 were included in the study. Patients with type 2 or type 3 ECGs underwent provocative testing with up to 400mg of oral flecainide. Patient data was obtained through review of medical records.

Results: 40 patients were identified having Brugada ECGs (mean age 40.7±19.9 years, 77.5% male). At baseline, 12 patients showed spontaneous type 1 ECGs, 13 patients showed type 2 ECGs, and 13 patients showed type 3 ECGs. 1 patient’s baseline electrocardiogram (ECG) could not be commented on owing to missing data however limited record showed patient had positive flecainide challenge. 1 patient who has a family history of Brugada syndrome had normal baseline ECG but screening flecainide challenge was positive.

16 patients fulfilled the diagnostic criteria of having Brugada syndrome (mean age 36.4±10.0 years, 62.5% male). Out of the 16 patients, 10 patients had spontaneous type 1 ECGs, and 6 patients had flecainide-induced type 1 ECGs. 1 patient whose baseline ECG could not be commented on, and who had a positive flecainide challenge died 3 years after the flecainide test from unknown causes. 3 patients had syncope, 1 patient survived cardiac arrest, 6 patients had non-specific cardiac symptoms, and 5 patients were asymptomatic. 7 patients had a positive family history of sudden death. Spontaneous type 1 ECGs were observed in the 3 patients who had syncope, and the 1 patient who was a survivor of cardiac arrest.

An electrophysiological (EP) study was performed in 17 patients, and 10 patients had a positive EP study. Out of the 10 patients, 9 patients had spontaneous type 1 ECGs, 7 patients who had a positive EP study received an implantable cardioverter-defibrillator (ICD), one of whom was a survivor of out-of-hospital cardiac arrest. 3 patients with a positive EP study did not receive ICD due to clinical reasons and financial constraints. 1 patient had a positive flecainide test, and a negative EP study but received an ICD due to a strong family history of premature sudden death.

During a mean follow-up of 51.9±33.1 months, 1 patient with asymptomatic spontaneous type 1 ECG, and without a family history of sudden death developed an out-of-hospital cardiac arrest with subsequent hypoxic brain damage, and died two years later. None of the patients with an ICD had appropriate therapy for ventricular tachyarrhythmias. 1 patient had multiple inappropriate shocks from his ICD due to atrial tachyarrhythmias. One patient had an ICD lead fracture leading to lead extraction six years following initial ICD implant.

Conclusions: In this hospital-based study, Brugada electrocardiograms and the Brugada syndrome were found to be prevalent at a tertiary referral centre in Brunei Darussalam. There were two deaths in the patients with Brugada syndrome. Patients having spontaneous type 1 ECGs were prone to syncopal attacks, positive programmed electrical stimulations, and fatal arrhythmic events. The rate of appropriate therapy in patients with ICD appeared to be low suggesting the need for improved risk stratification.
**P3-064**

**Relationship between sleep apnea syndrome with normal cardiac function and T-wave alternans during sleep: analysis using a newly developed holter electrocardiogram system**

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**Background:** A previous study reported that sleep apnea syndrome (SAS) patients complicated with congestive heart failure have cardiac electrical instability manifested as T-wave alternans (TWA). However it is unknown whether TWA is associated with obstructive SAS (OSAS) with normal cardiac function. To examine the relationship between OSAS and TWA, we assessed TWA and polysonograph (PSG) during their nocturnal sleep in such patients.

**Methods:** A total of 21 suspected OSAS patients (14 years old, 15 men) with a left ventricular ejection fraction >60% were enrolled. All patients underwent both PSG and TWA assessments. For PSG assessment, an apnea hypopnea index (AHI) was used. TWA was analyzed using a newly developed Holter electrocardiogram (ECG) system (SCM-8000) that can analyze TWA phenomenon with the spectral method. The definition of positive outcome of TWA in this study is as follows; the TWA level >1.9 kμV with the alternans signal-to-noise ratio >5 sustained for &gt;1 min. We assessed the prevalence of TWA and the correlation between TWA and PSG.

**Results:** Of the 21 patients, 20 were definitely diagnosed as OSAS. Unfortunately, we could not analyze TWA in eight patients because of arrhythmia during recordings. Eventually, ten (83%) out of the 12 patients had TWA phenomenon. However, there was no significant correlation between the TWA level and AHI.

**Conclusions:** TWA was highly detected during sleep in OSAS patients with normal cardiac function. However, no significant correlation was observed between their values. An additional research might be needed for exact investigation.

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**P3-065**

**Difference in leave hospital mortality of ventricular fibrillation between ACS and non-ACS**

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**Objectives:** Ventricular fibrillation (VF) is responsible for various heart diseases. The purpose of this study is to evaluate relationship between VF and heart disease.

**Methods and Results:** From April 2012 to March 2013, 31 patients (male is 20 patients (65%), mean age is 65.5±11.5 years old) with newly diagnosed VF were admitted to our hospital after successful resuscitation. These patients were divided to two groups according to the etiology: acute coronary syndrome (ACS) (15 patients, 48%) or non-ACS (16 patients, 52%). In non-ACS group, causes of VF were cardiomyopathy (4 patients, 13%), complete atrioventricular block (3 patients, 10%), Brugada syndrome (1 patient, 3%), and dilapathic ventricular fibrillation (1 patients, 3%). 24 Patients (77%) were discharged alive from our hospital (77%). The cause of death is circulatory insufficiency2 ACS itself, 1 ventricular septal rupture, 1 aortic dissection, 1 hemorrhagic shock, and 1 aortic valve stenosis). Leave hospital mortality in ACS group tended to be higher than that in non-ACS group but there were no significant differences in them (31% vs 6.7%, P<0.08). Twelve patients had irreversible cause of VF and we underwent implantable cardioverter defibrillator implantation in nine of them.

**Conclusion:** In this study, VF due to ACS tended to have poorer outcome compared with non ACS group.

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**P3-066**

**A novel synonymous mutation in lamin A/C gene causes aberrant splicing in patients with familial dilated cardiomyopathy and conduction diseases**

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Mutations in Lamin A/C gene (LMNA) are the most common cause of familial dilated cardiomyopathy (DCM) with cardiac conduction disease system (CCD). DNA sequence data have revealed that many types of mutations in the LMNA gene lead the haplosufficiency of A-type lamin and the DCM phenotype. But the defects of splicing are not always easy to identify from DNA sequence data alone. Here we report a 63-year-old Japanese male patient, who has been diagnosed as developing DCM and CCD. The proband's mother, sister and two sons also suffered from DCM and/or CCD. We performed genetic analysis, and identified a novel synonymous mutation, c.1131C>T (p.R377R), on the exon 6 in the LMNA gene. The results of genetic analysis with his family members were completely correlated with their clinical phenotypes. In order to analyze the association of the synonymous mutation with splicing, we used the web-based splicing site analysis tool (Berkeley Drosophila Genome Project at http://www.fruitfly.org). As a result, it was calculated that the R377R mutation generated the abnormal boundary of splicing donor site adjacent to the mutated base in the exon 6 (score for 3’ splice site: 0.91). The occurrence of splicing abnormality would invoke the frameshift at codon 377 and the change of the following first stop codon encountered in the sequence. These findings indicate that the R377R synonymous mutation in the LMNA gene causes the splicing abnormality and the frameshift that could be the factor of development of LMNA related cardiomyopathy phenotype.

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**P3-067**

**Coronary artery reperfusion for ST elevation myocardial infarction results in shorter cycle length VT and fewer spontaneous arrhythmias**

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**Background and Objectives:** Ventricular tachycardia (VT) induction at electrophysiological (EP) study early after ST elevation myocardial infarction (STEMI) has been a predictor of spontaneous ventricular arrhythmia. Reperfusion therapy for STEMI may have resulted in altered VT character. We attempted to determine differences in VT cycle length (CL) and VT recurrence rates, in patients with and without reperfusion treatment for STEMI.

**Methods:** Of 180 consecutive patients with LVEF < 40%, 77 patients had positive EP studies. Forty nine patients receiving early reperfusion treatment (Group 1, n=49) were compared with 28 patients who were not reperfused (Group 2, n=28). Seventy five patients had defibrillators implanted for primary prevention of sudden death. Patients were followed for up to 8 years to assess long term rates of spontaneous ventricular tachycardia.

**Results:** Patients who received reperfusion demonstrated shorter CL inducible VT (231±43ms vs 252±56ms; P=0.015). They also had fewer spontaneous arrhythmias (Adjusted Hazard Ratio (AHR) of 0.28, 95% CI: 0.105 to 0.747; P=0.011) with shorter CL spontaneous VT (266±54ms vs 252±56ms; P=0.015). They also had fewer spontaneous arrhythmias (Adjusted Hazard Ratio (AHR) of 0.28, 95% CI: 0.105 to 0.747; P=0.01). They also had fewer spontaneous arrhythmias (Adjusted Hazard Ratio (AHR) of 0.28, 95% CI: 0.105 to 0.747; P=0.01).

**Conclusions:** Patients who received reperfusion therapy following STEMI had faster inducible VT, with fewer spontaneous recurrences. This may be due to changes in the myocardial substrate as a result of coronary artery reperfusion.
Conclusions: The generation of disease-specific induced pluripotent stem (iPS) cells which can be differentiated into cardiomyocytes using a cardiac specific promoter lentiviral vector can be used to model inherited cardiomyopathies.

Methods: We generated iPS cells from healthy subjects and from patients with various cardiomyopathies. The iPS cells were differentiated into cardiomyocytes using a cardiac specific promoter lentiviral vector. The differentiated cardiomyocytes were analyzed for their contractile function and for their response to various pharmacological agents.

Results: The differentiated cardiomyocytes from healthy subjects showed normal contractile function and were not affected by the pharmacological agents. The differentiated cardiomyocytes from patients with cardiomyopathies showed decreased contractile function and were sensitive to the pharmacological agents.

Conclusions: Our results demonstrate the ability of the cardiac specific promoter lentiviral vector to generate disease-specific cardiomyocytes from iPS cells. These cardiomyocytes can be used to model inherited cardiomyopathies and to test the efficacy of new drugs.

Keywords: iPS cells, cardiac specific promoter, lentiviral vector, cardiomyocytes, cardiomyopathies.
Rotational anisotropy prevents transition of tachycardia to fibrillation in the ventricular wall model: a simulation study

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We have recently demonstrated in computer simulations that rotational anisotropy of ventricular fiber orientation decreases the sustainability of ventricular fibrillation (VF) even under the large transmural dispersion of repolarization (TDR). However, the detailed mechanism is unclear.

To clarify this issue, we repeated simulations of scroll wave (SW) reentries in ventricular wall slab models, incorporating various degrees of rotational anisotropy. Transmural gradient (electrical heterogeneity through the wall; epi-, midmyo-, and endo-cardial layers) was achieved by modifications of potassium channel currents. Then, we analyzed the dynamics of both SWs and filaments (3-dimensional organizing center of SW).

In the model without rotational anisotropy, the increase in TDR enhanced the difference of SW cycle lengths among the layers. Such twist of the SW’s destabilized the transmural I-shaped filament, causing VF via wavefront fragmentation. On the other hand, in the model with rotational anisotropy, the I-shaped filament was relatively stable, preventing the degeneration into VF. The degrees of filament bending in the models with various types of rotational anisotropy were almost the same.

TDR and rotational anisotropy independently increase the SW complexity; however, combinations of the two might prevent the transition of stable ventricular tachycardia to chaotic VF via the control of SW filament. Twist of the SWs might be an important mechanism for the inhibitory effect on VF. Our finding might contribute to clarify the physiological significance of rotational anisotropy in ventricles.

Heart rate variability measurement with detrended fluctuation analysis as a predictor of death among patients undergoing peritoneal dialysis

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Objectives: The prognostic value of heart rate variability (HRV) has been widely studied in various diseases. This study is designed to disclose the predicting value of HRV measured with different methods on death among patients undergoing peritoneal dialysis

Methods: We enrolled patients who had received PD for more than six months in National Taiwan University Hospital. HRV measurements with time-domain (SDNN, PNN50, RMSSD), frequency-domain (VLF, LF, HF) and DFA alpha1 were assessed from 24-hour Holter recording of our study subjects.

Results: A total of 134 subjects were included in our study from July 2007 to March 2009. During the follow-up period of 28.9±10.6 (Mean±SD) months, 14 patients died. DFA alpha1 is significantly lower in the mortality group (P<0.001), while other HRV parameters are not. After multivariate regression analysis, DFA alpha1 (§ 0.95) remained a strong predictor of total mortality among our study subjects (HR: 0.185; 95%CI: 0.053-0.642; P<0.008). On the other hand, HRV assessed by conventional methods (SDNN, PNN50, RMSSD, VLF, LF, HF) could not provide any prognostic information.

Conclusions: In comparison with traditional cardiovascular risk factors and conventional HRV parameters, DFA alpha1 was a more powerful predictor of death among patients undergoing peritoneal dialysis.
Clinical significance of increased variability of the coupling interval of premature ventricular contractions: validations in ICD recipients due to heart failure

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The predictive usefulness of the variability or dispersion of coupling interval (CI) of premature ventricular contractions (PVC) for the propensity toward occurrence of malignant arrhythmia is not known yet.

Thirty-two patients (22 men, 62±10 years-old) were enrolled who implanted ICD due to heart failure (secondary prevention in 16, ischemic origin in 17 patients) and had 24-hr ambulatory ECG at the time of implantation. Heart rate turbulence onset (To) and slope (Ts) and T-wave alternans (TWA) were analyzed from 24-hr ambulatory ECG. The CI of PVCs (MEANNN), standard deviation of the CI of PVCs (SDNN), their ratio with preceding N-N intervals (SDNN/SDNN) and mean of preceding N-N intervals (MEANNN) were calculated from constructed Poincaré plot using annotated QRS data of 24-hr ambulatory ECG.

Among 32 patients, appropriate shock due to VT or VF, and VT terminated by antitachycardia pacing occurred in 20 patients (group 2), but not in 12 patients (group 1) during 45±37 months follow-up period (median, 35 months). No differences of total counts of PVCs, incidence of NSVT, TWA and To and Ts between 2 groups were found. LV ejection fraction was higher in group 2 (21±6 vs. 30±11%, P=0.023). MEANNN (78±14 vs. 91±14.6ms, P=0.038), SDNN (66±22 vs.101±44ms, P=0.025), and SDNN (50±15 vs. 94±37ms, P=0.001) were significantly larger in group 2 patients by Mann-Whitney test. However, SDNN was the only variable which can predict the occurrence of VT and/or VF in this population (B=0.090, Wals 5.709, P=0.017, Exp(B)=1.094, 95% CI 1.016-1.179). Thus, the variability of the CI of PVCs (SDNN) would be an adjunctive parameter to prognosticate the occurrence of malignant ventricular arrhythmia in patients with heart failure.

Increased variability of the coupling interval of premature ventricular contractions as an adjunctive predictor of cardiac mortality in mild to moderate heart failure

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The characteristics and predictive value of the variability of coupling interval (CI) of premature ventricular contractions (PVC) for cardiac mortality is not decisive yet. In 133 consecutive patients (58±1.4 year-old, 53 men) who presented with frequent PVCs (>10/hr) and underwent 12-channel ambulatory electrocardiography (AECG) simultaneously, early and delayed heart/mediastinum (H/M) ratio and wash-out ratio were calculated from 123-MIBG SPECT. Heart rate turbulence onset (To) and slope (Ts), and T-wave alternans (TWA) from 24-hr AECG were analyzed. The CI of PVCs (MEANNN), standard deviation of the CI of PVCs (SDNN), their ratio with preceding N-N intervals (SDNN/SDNN) were calculated from constructed Poincaré plot using annotated QRS data of 24-hr ambulatory ECG. Cardiac mortality was the primary end-point of this retrospective study. Mean follow-up was 69 months. Among 133 patients, 114 patients were alive (group1) and 19 patients (14%, group 2) died during the follow-up period. Age was higher (56±14 vs. 66±9, P<0.001), LV ejection fraction (42±17 vs. 35±13%, P=0.013), early and delayed H/M ratio were significantly lower in group 2 patients (2.04±0.33 vs. 1.8±1.05, 2.08±0.42 vs. 1.72±0.25, P<0.001 for both, respectively). The MEANNN and SDNN were higher in group 2 patients (539±104 vs. 559±114ms, P=0.024, 64±34 vs. 83±37ms, P=0.031, respectively). Determinants of SDNN were the numbers of PVC morphology, PVC counts and MEANNN. However, SDNN, PVC counts, and delayed H/M were remained as a significant predictor of cardiac mortality on binary logistic regression analysis. These results suggest that the variability of the CI of PVCs (SDNN) would be another adjunctive parameter to predict the cardiac mortality in this patient population.

Phenotypic characterization of two patients with lethal arrhythmia related to KCNH2-R148W variant

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Background & Objectives: KCNH2 encodes Kvl.1 channel which produces the rapid component of delayed rectifier potassium current (IKr). The mutations of KCNH2 have been reported to cause long or short QT and Brugada syndrome. We recently identified a KCNH2 variant, R148W, in two patients who suffered ventricular arrhythmias. In silico model, the variant was classified as pathogenic but it was identified in 16 from 13008 alleles (MAF 0.0012) in ESP database and reported as rs13594414 in SNP database. The objective of this study is to clarify the relationship between KCNH2-R148W and the phenotypic characteristic of the mutant carriers with lethal arrhythmias.

Methods: In two patients with a KCNH2-R148W variant, we performed clinical evaluation including ECG measurement.

Results: The first patient was a 43-year-old female who had repeated syncope at rest. At Holter recording, torsade de pointe (TdP) was recorded though QTc interval immediately prior to the TdP was within normal limit (428 ms). Another patient was a 27-year-old male who was resuscitated at the speedboat racecourse. The ECG on arrival to the emergency hospital showed polymorphic premature ventricular contractions. His QTc interval was 428 ms at rest and was not changed by exercise (455 ms). His father died at the age of 44 while sleeping, and his sister died when she was junior high school student while swimming.

Conclusions: Both patients with KCNH2-R148W variant suffered severe arrhythmic events. Although the variant has been reported in normal controls, we may need careful attention to the carriers of this specific mutation.

Sudden cardiac death and the use of ICDs in the Singapore Brugada syndrome registry

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Background and Objectives: Brugada syndrome (BrS) is a heritable cause of sudden cardiac death (SCD). ICD is the only effective treatment for SCD in BrS. This study explores the outcomes, ICD implantation practices, and ICD therapy rates from the Singapore Brugada registry.

Methods: The population consists of 66 unrelated individuals (62 males, 94%) from the Singapore Brugada Registry, with either spontaneous (44 patients, 67%) or drug induced type 1 Brugada ECG pattern. Clinical, ICD interrogation and follow-up data were collected.

Results: Median follow up duration was 35 months (2-92 years). The median age of symptom onset and median age of diagnosis was 41 and 42 years respectively. 53 patients were asymptomatic, with syncope (27.3%) as the most common presenting complaint. 8 (27.3%) had a family history of SCD. Six patients were diagnosed during a febrile illness. 13 (19.7%) patients were asymptomatic, and were found to be at risk due to a family history of SCD. Among symptomatic patients, the cardiac event rate averaged 1.4% per annum. Fragmented QRS is associated with an increase risk of SCD in BrS.
A loss-of-function mutation in SCN5A associated with monomorphic ventricular tachycardia in brugada syndrome

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Background & Objectives: Mutations in SCN5A are associated with lethal arhythmia syndromes including long QT syndrome and Brugada syndrome, both of which are associated with increased risk of sudden cardiac death caused by ventricular fibrillation and polymorphic ventricular tachycardia. However, a role of SCN5A mutations in pathogenesis of monomorphic ventricular tachycardia is not well known. Here, we present the association of an SCN5A mutation with monomorphic ventricular tachycardia and conduction disease in Brugada syndrome.

Methods: We screened for mutations in SCN5A in patients with Brugada syndrome who were referred to our hospital. Identified mutations were functionally characterized using heterologous expression system.

Results: We identified a novel missense mutation in SCN5A (p.R893H) in a male patient with Brugada syndrome. He had cardiac conduction disease and multiple episodes of monomorphic ventricular tachycardia and ventricular fibrillation. Two cousins died suddenly in their 20s. Alignment of the amino acid sequences from multiple species demonstrated that R893 is highly conserved, supporting the importance of the amino acid. In functional analysis using conventional whole-cell patch-clamp techniques, R893H failed to generate any currents indicating that the mutant channel is non-functional.

Conclusion: We identified a loss-of-function mutation in SCN5A associated with Brugada syndrome, monomorphic ventricular tachycardia, and conduction disease. Our findings indicate that sodium channel dysfunction has an important role in the pathogenesis of monomorphic ventricular tachycardia.

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Epinephrine/exercise-triggered QT prolongation without KCNQ1 mutations


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Background: Epinephrine/exercise stress test is used for the diagnostic evaluation of long QT syndrome (LQTS). LQT1 is always caused by the mutations in KCNQ1 and episodic or usually episodic/exercise-triggered. In this report, we described two cases presenting epinephrine/exercise-triggered QT prolongation without KCNQ1 mutations.

Methods & Results: We carried out genetic analyses in the potassium channel genes (KCNQ1, KCNHI2, KCNE1-5 and KCNJ2) and the sodium channel gene (SCN5A) in two probands: (A) a 24-year-old male with sinus bradycardia who experienced syncope during swimming, (B) a 16-year-old female with progressive cardiac conduction defect and her brother died during swimming. The both probands showed the normal QTc interval at rest (423ms and 419ms, respectively), but the intervals were prolonged after epinephrine administration or exercise stress (581ms and 563ms, respectively). As a result of genetic analyses, we identified a missense mutation, V2016M in the SCN5A gene in the proband A, and three mutations, V905M in the KCNHI2 gene, IVS5+1G>A and P2006L in the SCN5A, P2006L in the KCNHI2 but not IVS5+1G>A. These results suggest that SCN5A IVS5+1G>A might be responsible for cardiac conduction defect.

Both SCN5A V2016M and P2006L in the KCNHI2 are located in the C-terminus of the sodium channel. Our data raised the possibility that these C-terminal mutations may lead to epinephrine/exercise-triggered QT prolongation.

Conclusion: Mutations, which were identified in the SCN5A gene, might be associated with epinephrine/exercise-triggered QT prolongation. The underlying mechanisms are needed to be elucidated.

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Gap junction modifier rotigaptide increases ventricular conduction velocity and prevents pacing-induced ventricular fibrillation during therapeutic hypothermia in isolated rabbit hearts

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Background: Hypothermia decreases ventricular conduction velocity (CV) and increases the vulnerability of pacing-induced ventricular fibrillation (PVF). Gap junction (GJ) coupling plays a pivotal role for CV in cardiac tissue. Rotigaptide is a GJ conductance-enhancing peptide that has been shown to improve cell-to-cell coupling and increase CV. We hypothesize that rotigaptide can increase ventricular CV during therapeutic hypothermia and decrease the vulnerability of PVF.

Methods: Langendorff-perfused isolated rabbit hearts were subjected to 30-min hypothermia (30°C) followed by 20-min treatment with rotigaptide (300 nM, n=7) or vehicle (n=5) during hypothermia. Using an optical mapping system, epicardial CV was evaluated by S1 pacing before and after treatment during hypothermia. VF inducibility test was done by burst S1 pacing for 30 s at the shortest pacing cycle length (PCL) that achieves 1:1 ventricular capture.

Results: Before treatment at PCL of 350 ms, epicardial CV was similar between rotigaptide (64.3±7.2 cm/s) and vehicle (64.1±14.1 cm/s) group (p=0.95). At PCL of 350 ms, rotigaptide increased ventricular CV from 64.3±7.2 cm/s to 67.1±8.2 cm/s during hypothermia (p=0.014). The ventricular CV was not changed before (64.1±14.1 cm/s) and after (64.3±17.3 cm/s) vehicle treatment at PCL of 350 ms (p=0.06). VF inducibility was decreased by 29%±40% with rotigaptide treatment, while increased by 27%±34% with vehicle treatment during hypothermia (p=0.03).

Conclusion: GJ modifier rotigaptide increased ventricular CV and decreased the vulnerability of PVF during hypothermia (30°C). By enhancing GJ coupling and increasing CV, GJ modulation with rotigaptide might be a novel approach to prevent VF during therapeutic hypothermia.

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Arrhythmic events of elderly patients with brugada syndrome

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Background: Little is known about the lethal arrhythmic events of elderly patients with Brugada syndrome (BRS).

Methods & Results: This study included 33 patients (mean age 74 [range 47–94] years, 32 males) with type-1 Brugada-pattern electrocardiogram (ECC) who were more than 70 years old at the last follow-up visit. At the time of admission, 4 patients had a history of ventricular fibrillation (VF) (VF group), 3 had experienced a syncope (Syncope group), and 15 were asymptomatic (Asymptomatic group). An implantable cardioverter defibrillator (ICD) was implanted in 16 patients. During a mean follow-up of 107±100 months, 4 patients in the Syncope group received an appropriate ICD shock due to VF. No patients experienced sudden cardiac death (SCD). The age at the first attack was less than 70 years (range 55–69 years) in all 8 patients who experienced VF. VF occurred in only 1 patient in the Syncope group after 70 years of age. No patients in the Asymptomatic group including 3 patients with positive electrophysiological study or a family history of SCD developed VF. Seven of 16 patients (43.8%) experienced ICD complications including inappropriate shocks due to supraventricular tachycardia which occurred in 4 patients.

Conclusions: In this cohort of elderly BRS patients, the first attack as well as the recurrence of VF seldom occurred after the age of 70 years. Considering a significant number of ICD complications, the implantation of ICD should involve risk/benefit considerations, especially in asymptomatic elderly patients with Brugada-pattern ECC.
**Study on the cardiac ventricular myocytes electrophysiology by the patch-clamp technique**

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**Objective:** In order to observe the electrophysiological effects in Ventricular myocytes when malignant arrhythmia occurs by patch clamp technique.

**Method:** Using rats as the experimental animals (by the Experimental Animal Center of Jilin University). Make ischemic malignant arrhythmia in rats and malignant reperfusion arrhythmias in rats to observe their heart rate changes and blood pressure. Isolate myocardial cells using the conventional method for isolation of adult cardiac myocytes methods. With the patch-clamp technique and whole-cell channel current observed record method to observe the changes in action potential of ventricular muscle cells, sodium channels, calcium channels, and potassium channels.

**Result:** The sodium channel currents of both the ischemic group and the after reperfusion group/g.4/g53/g52/g55/g53/g3/g65/g51/g.1/g3/g5./g.3/g.2/g3/g65/g.3/g5./g.2/g53/g3/g53/g.2/g53/g.3/g55/g56/g.6/g52/g51/g .../g56/g.6/g.4/g51/g.6/g141/g.0/g65/g51/g5./g3/g.1/g.6/g.3/g.3/g.2/g53/g.2/g5 ...1/g.1/g3/g.3/g42/g53/g.2/g53/g.0/g.3/g52/g.4/g.2/g56/g5./g.2/g53/g52/g.4/g.2/g50/g.6/g65/g3/g64/g.2/g5./g40/g.2/g.2/g51/g3

Calcium channel currents of both the ischemic group and the after reperfusion group of malignant arrhythmia were significantly increased. The potassium channel currents of both the ischemic group and the after reperfusion group of malignant arrhythmia were significantly increased. Action Potential: Compared to the control group, both the ischemic group and the after reperfusion group have higher Vmax, APA, APD20, APD50 and APD90 (P<0.05).

**Conclusion:** When malignant ventricular arrhythmia occurs in rat, the influx of sodium channels, calcium ion channels and potassium channels in ventricular myocytes increased. Compared with the control group, their Vmax, APA, APD20, APD50 and APD90 were increased.

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**Fragmented QRS after acute inferior MI and future risk of sudden cardiac death**

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**Background:** Fragmented QRS has been proposed to be predictive of sudden cardiac death in patients with preexisting cardiac conditions. Data in post-MI patients is relatively limited.

**Methods:** We studied the impact of fragmented QRS on the long-term risk of the occurrence of sudden cardiac death, cardiac death, and hospitalization due to cardiac events in 412 consecutive patients (64±13 years; 75% men). All patients had experienced an acute inferior ST-segment-elevation MI and survived the first 30 days.

**Results:** All patients were in sinus rhythm on hospital admission and fragmented QRS was observed in 75 patients (18.2%) after the index acute inferior myocardial infarction. There were no statistical significant differences in sex, age, hypertension, DM, and hypercholesterolemia between patients with and without fragmented QRS. In addition, there were no statistical significant difference in term of the use of primary percutaneous coronary intervention, and thrombolytic, nor the post-MI medications such as beta-blocker, angiotensin converting enzyme inhibitors, and statin. At a mean follow-up of 92 months, there were 32 sudden cardiac deaths. The incidences of sudden cardiac death in patients with and without fragmented QRS were 1.35% vs. 1.00% respectively, p=0.05. Kaplan Meier analysis reviews no difference in sudden cardiac death free survival between the 2 groups.

**Conclusion:** Fragmented QRS after acute inferior MI is not associated with an increased future risk of sudden cardiac death in patients.
Long-term follow up of closed loop cardiac pacing in patients with refractory neurocardiogenic syncope

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Background: Cardiac pacing in patients with neurocardiogenic syncope (NCS) has been controversial. Our group earlier reported on the efficacy of closed loop (CLS) cardiac pacing in pacing suffering from recurrent episodes of NCS. In this report we present our centres experience with a long term results of CLS in a larger population (N=117) patients suffering from recurrent NCS.

Methods and Results: Patients were included in the study if they suffered from recurrent neurocardiogenic syncope and met all of the following criteria:
1. Had suffered at least two syncopal episodes in the preceding 6 months.
2. Patients were refractory to (or intolerant of) all conventional, non-pharmacological or pharmacological treatments.
3. Had an evidence of asystole (> 10 sec) or severe bradycardia (heart rate< 30bpm.) on implantable loop recorder or during head-up tilt test (HUTT).

Results: A total of 117 patients meeting the above criterion were identified to be included in this analysis. 17 patients were excluded because of the follow-up less than 9 months. The mean age was 51±11 and 80(85%) were females. The mean follow-up was 18±8 month (10-32 months). The pacemaker therapy was termed successful if there was no recurrence of syncope, if the syncope burden decreased by >50%, if only presyncope occurred, or if the syncope occurred but with significant warning symptoms (in those who had no prodrome previously). Thirty four patients (34%) demonstrated total elimination of syncope, 30(30%) continued to have syncope but with burden decreased by >50%, if only presyncope occurred, or if the syncope occurred but with significant warning symptoms. Thirty-six (36%) patients continued to have recurrent syncope.

Conclusion: CLS pacing may be promising therapy in a subgroup of patients suffering from refractory recurrent episodes of NCS. The results of this study support conducting a prospectively designed randomized controlled trial evaluating the role of this potentially promising therapy in patients with refractory NCS.

Electrocardiographic features during cardioinhibitory tilt-induced syncpe in children

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Aim: To assess electrocardiographic features during tilt-test (TT) in children with cardioinhibitory (CI) syncope reactions.

Methods: We examined the continuous ECG during medication-free 60°TT in 16 children aged 8-18 years who developed CI syncope reactions and had history recurrent syncope.

Results: During supine period fourteen children had sinus and two supraventricular rhythm. After tilt heart rate increased by 17.7-50.8% in all children and all of them had sinus rhythm. By the moment of syncope, heart rate had being significantly higher in comparison with values of orthostasis start (p = 0.001). Syncope has started since heart rate had decelerated. Cardioinhibition could developed acutely (n = 11) or after sinoatrial blocks (n = 5). Nine children had shown one ventricular pause (3078-22800 msec) and six children had 2-4 consecutive pauses due to absence or depression of escape rhythm in all patients. Impairment of AV conduction during the syncope was observed in 3 children. Recovery period was characterized by significantly lower heart rate in comparison with baseline values (p = 0.0006) and high frequency recorded vagus-associated arrhythmias.

Conclusion: ECG pattern of CI syncope in children is characterized by increasing sympathetic activation followed by sharp shift regulatory control toward parasympathetic with depression of both junctional and sinoventricular pacemakers. Vagal activation determines ECG pattern during syncope development and in the recovery period too.

Effectiveness of patient’s symptoms based protocol of head up tilt table test for evaluation of vasovagal syncope

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Background and Objectives: Head up tilt table test (HUTT) is commonly used for diagnosis of Vasovagal Syncope (VVS). Medications used and results of the tests have varied. Symptom tailored HUTT has not been described prior. Our aim was to evaluate the sensitivity of HUTT test when drugs used were tailored based on the individual precipitating factors, associated conditions and symptoms in patients having typical VVS symptoms.

Method: 124 patients who had recurrent typical VVS symptoms were included in the study. All patients underwent a HUTT test with a protocol of 30 minute basal study and 15 minutes of drug protocol (isoprenaline and/or Glycerine-trinitrate (GTN)) which was pre-selected based on precipitating events, presenting circumstances and associated conditions. Parameters during test were recorded and results analyzed.

Results: Of the 124 patients, 43 patients had a positive HUTT, without the need to administer a drug. 81 patients further required drug at the end of 30 minutes. 30 out of 32 patients given isoprenaline and 34 out of 38 patients given GTN had a positive test. Of 6 patients, who were given isoprenaline followed by GTN, 5 had a positive HUTT. Of 5 patients who were given isoprenaline after GTN, 3 had a positive HUTT test. Overall sensitivity of symptom tailored HUTT test was 90% and correlated well with patients symptoms.

Conclusion: Symptom tailored HUTT test can be an effective tool in diagnosing VVS symptoms and correlates well with the patient’s symptoms.

Recurrent Vasovagal syncope: - is it manifestation of nutritional/endoocrinal deficiency or subtle autonomic dysfunction?

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Background and Objectives: Vasovagal Syncope (VVS) is the most common cause of syncope. Aim of the study was to evaluate, whether recurrent VVS is associated with deficiency disease or autonomic dysfunction.

Method: Of 172 patients with VVS, who presented to our clinic, 83 patients had recurrent symptoms and had a complete hemogram, VoH12 levels and TSH levels done. Further investigations were done on a case to case basis. All reports were recorded and results analyzed.

Results: Of the 83 patients who were included in the study, 46 were female. All patients underwent a Head Up Tilt Table Test (HUTT) of which 80 had positive HUTT. 12 patients had anemia with iron deficiency anemia in 10 and megaloblastic anemia in 2 of them. 39 of the 83 patients had evidence of VoB12 deficiency. 5 patients had sub-clinical hypothyroidism and 1 patient had overt hypothyroidism. 4 patients had diabetes of which one patient having retinopathy and nephropathy, but none had other clinical signs of neuropathy. 7 patients (8.4%) had associated Postural Orthostatic Tachycardia on HUTT. 1 patient each had early parkinsonism, irritable bowel syndrome and rheumatoid arthritis. 5 patients were on drugs having adverse effect of neuropathy. Overall 52 (63%) patients had either one or more condition of deficiency or autonomic dysfunction.

Conclusion: Recurrent VVS can be a manifestation of nutritional or hormonal deficiency or of subtle autonomic dysfunction and should be investigated in patients who presents with recurrent VVS.
Paroxysmal tachycardia recorded on a smartphone

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Background & Objectives: Smartphones now have applications which allow them to be used as heart-rate monitors using photoplethysmograph (PPG) with the LED flash as the transmitter and the camera lens as the receiver of infrared light which fluctuates depending on blood flow. We highlight a case study where use of this helped increase the index of suspicion and hasted diagnosis of a supraventricular tachycardia (SVT), amongst a demographically with a high incidence of syncope.

Methods: A 24 year old female with no past medical history or family history of note presented with 3 episodes of near-syncpe, which were not related to exertion or postural change. These were sometimes preceded by palpitations.

Although vasovagal syncope could be a possible cause, she had a smartphone application which recorded her heart rate pre-syncpe, as shown in Figure 1. As shown the PPG signal shows a regular tachycardia running at 185 bpm.

This recording focused our investigations to further diagnose this tachycardia, instead of tests for vasovagal syncope (e.g. tilt-table testing). It proceeded to have a transtelephonic ECG

Results: The transtelephonic ECG captured a long RP tachycardia with pre-excitation, cycle length 280ms, as shown in Figure 2. EP study showed an orthodromic reentrant tachycardia of cycle length 262ms via a concealed left posterior accessory pathway (AP). This was ablated and the patient has been asymptomatic since.

Conclusion: Heart rate monitor recording applications on smartphones could assist in raising the index of suspicion of incidences of paroxysmal tachycardia in young females.

Risk factors predicting the future presence of long QT syndrome-related symptoms in pediatric patients diagnosed by screening programs in Japan

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Background and Objectives: A school-based electrocardiographic screening program has been developed for 1st, 7th, and 10th graders in Japan. However, there are few data regarding risk factors predicting the future presence of long QT syndrome (LQTS)-related symptoms in pediatric patients diagnosed by screening programs.

Subjects: Subjects were 257 children and adolescents (M/F=133/124; age at diagnosis, 10.9±3.1 years; observation period, 4.3±4.2 years) who were screened by the program. LQTS-related symptoms were defined as syncope, sudden death, and aborted cardiac arrest. Risk factors were determined using regression analysis.

Results: Of 257 subjects, 41 (16%) had past history of symptoms. Triggers were exercise in 9 and swimming in 10 subjects. After diagnosis, 29 subjects (11%) developed symptoms; triggers were exercise in 12 and swimming in 1. The prevalence of exercise as a trigger was not different (p=0.11) between before and after diagnosis. However, swimming as a trigger significantly decreased (p=0.02) after diagnosis compared with before diagnosis. One child died during sleep. Multivariate logistic regression analysis showed that observation period was a sole risk factor to predict the future presence of symptoms, and that among patients who were treated (48 patients), drug incompatibility was also a predictive factor for the presence of symptoms.

Conclusions: Pediatric LQTS patients who were screened by programs should be monitored for long periods of time, in addition to individuals who were visited and diagnosed by the presence of LQTS-related symptoms. New strategies are needed to prevent exercise-triggered symptoms after diagnosis in these patients.

Single-center experience of implantable loop recorders in patients with unexplained syncope

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Background & Objectives: Syncope is a common problem, and prolonged electrocardiographic monitoring, especially implantable loop recorder (ILR), is a useful tool in the diagnosis of syncope. The purpose was to investigate the effectiveness of ILR in the diagnosis of unexplained recurrent syncope.

Methods: This single-center retrospective study sought to assess the role of ILR in the diagnosis of unexplained recurrent syncope.

We implanted 22 ILR devices in unexplained syncope patients from August 2010 to September 2012. Clinical data and interrogation reports were collected in all patients. The indications for ILR were unexplained syncope (77%), and unexplained presyncope or dizziness (23%).

Results: During a median follow-up period of 382 days, 12 patients (55%) had recurrent symptoms after ILR placement with the mean time to recurrence of 406 days. Of these, an arrhythmic diagnosis was established in 6 patients (50%). Every arrhythmia was bradycardia, and 3 patients underwent implantation of pacemaker. 6 patients (50%) did not have any arrhythmia during their symptoms. Most of these patients were discharged from the electrophysiology clinic. 10 patients (38%) did not have any symptoms following ILR placement and they are still being followed.

Conclusion: In patients with unexplained syncope, ILR plays an important role in diagnosis of an arrhythmia, and also to rule out an arrhythmic cause.

Syncopy due to complete atrioventricular block

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Background: Complete atrioventricular block (CAVB) is known to be one of the most important cause of Adams-Stokes syndrome. But there is variety between with and without syncope in patients with CAVB, its mechanism is unknown. So, we investigate the difference between with and without syncope in patients with CAVB.

Methods and Results: We studied consecutive ninety eight patients that were documented CAVB and underwent pacemaker implantation between January 2008 and February 2013. They were distinguished between the presence and absence of syncope. Patients with syncope due to reversible cause, such as drug or electrolyte disturbance.Patients were examined the twelve lead electrocardiogram (ECG) on the onset and during follow up. There were 54 men and 53 females, mean age 77±9.2 years. Twenty six of 107 patients (24%) had history of syncope. The QRS duration in patients with syncope was significant longer than that in patients without syncope (140±32.3ms vs 126.1±26.1ms p<0.05). But, there was no significant difference on other ECG parameters such as heart rate of escape rhythm. Patients with syncope had a lower rate of cumulative percent of ventricular pacing after permanent pacemaker implantation significantly (72.7±42.6% vs 95.3±22.1% p<0.05).

It is speculated that their atrioventricular conduction are injured lower than asymptomatic patients.

Conclusion: In patients with CAVB, QRS duration of escape rhythm on onset will be predictor to future syncope.
Poster Presentation - Syncope

P2-105

Predictor of presyncope and syncopal recurrence in neurally mediated and unexplained syncope

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Background: Predictors for recurrence of syncope are unclear in syncope patients. We investigated whether there was any significant clinical factor in the recurrent presyncope or syncopal patients.

Methods: Two hundred and sixteen patients with more than one episode of neurally mediated and unexplained syncope were enrolled. We evaluated the incidence of pre-syncope or syncope in all patients using telephone interviews for 1 year.

Results: There were 172 neurally mediated and 44 unexplained syncope patients. During 12 months follow up, 23 (10.6%) patients experienced the recurrence of syncope and pre-syncope. The recurrence rate was higher in female (68.9% vs. 39.1%; p=0.82), neurally mediated than unexplained syncope (69.6% vs. 30.4%; p=0.27) but that did statistically insignificant. However, age (43±18 vs. 40±15 ; p=0.60), prodromal symptoms (78.3% vs. 78.2%; p=0.99), previous syncope episodes (3.2±2.9 vs. 3.2±2.7; p=0.97), syncope related injury (52.2% vs. 48.2%; p=0.37), head up tilt test response (65.0% vs. 71.2%; p=0.68) were not statistically significant predictors of syncopal recurrence.

Conclusions: Female gender were more common and there were more recurrence rate in neurally mediated than unexplained syncope. No definite clinical factors were observed for predictors of presyncope and syncopal recurrence during follow up.

Keywords: recurrence, vasovagal syncope, unexplained syncope

P2-106

Prognosis after tilt training in patients with recurrent vasovagal syncope

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Background: The efficacy of tilt training in vasovagal syncope (VVS) is controversial. There are few studies that have evaluated the prognosis of patients with VVS after tilt training in the clinical realm. We performed a study to evaluate the prognosis after tilt training during hospital admission in recurrent VVS patients.

Methods: A total of 119 patients (57 men and 62 women, mean age 32.3 years, range 12-66 years) with recurrent VVS and positive head-up tilt test results (HUT) who had taken a tilt training program in the hospital were enrolled. The tilt training program consisted of twice daily sessions until 3 consecutive negative HUT results were achieved during hospital admission. The patients were followed-up and we questioned patients about the recurrence of syncope, pre-syncope, and other symptoms.

Results: The mean follow-up duration was 22.5 months. Recurrence of syncope occurred in 31 of the 119 VVS patients (26.1%). The recurrence rate of syncope was 12.6% at 1 year, 21.0% at 3 years, and 24.4% at 5 years. There were no significant differences in baseline clinical characteristics in the recurrence group and non-recurrence group, except for age. Syncope occurrence during the first or second phase of HUT, the total number of tilt training sessions, and the total duration of tilt training time were also not different in the two groups. The times-to-syncpe during HUT were different, with the recurrence group having a longer parameter compared to the non-recurrence group.

Conclusions: Tilt training may provide an initial alternative to the recurrent and refractory VVS patients who are young.

Keywords: recurrent, vasovagal syncope, unexplained syncope

P2-107

Syncope clinic: what are problems in Japan?


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Background: We would like to report the experience and problems of The Syncope Unit in Japan.

Methods: We enrolled consecutive patients referred to our Syncope Clinic for one year.

Results: 54 patients (35 males, 59) referred due to syncope unknown origins. Their median number of syncope was two. During 30±27 days, 63% of all (34 patients) were diagnosed. The most common origin is reflex syncope (11 patients). Nine patients (17%) rejected further examinations. The others were in process. We performed specialized examination to selected patients as follow: electrophysiological studies for 11 patients (20%), tilt table tests for 15 (27%) and coronary angiography for 9 (17%). The most common origin of syncope is reflex syncope (11 patients, 33%). The other causes of syncope were 10 bradycardia, 7 orthostatic hypotension, 3 tachycardia and 3 other structural cardiovascular diseases. One patient has a non-syncope seizure. Nine patients rejected further management before their certain diagnosis. Finally, 5 patients (9%) were not diagnosed syncope origins. Indications of implantable loop recorders in 11 (20%) for recurrence syncope episodes at high risk. However, 72 % of them were rejected for the implantations. About treatments, we performed 9 pacemaker implantations, 1 implantable cardioverter-defibrillator implantation and 2 radiofrequency catheter ablation procedures.

Conclusions: We documented the current practice of syncope management in a specialized facility in Japan. Several major problems were detected. The most common problem is rejections of future managements.

P2-108

Association between traumatic injury and history of syncope in patients with reflex syncope

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Background: Reflex syncope is one of the most common mechanisms in transient loss of consciousness. Clinical course of reflex syncope is usually benign, however it could be complicated with injury or even traffic accident. Therefore, it remains as a clinical challenge to prevent these complications in patients with reflex syncope.

Aim: The aim of this study was to assess relationship between traumatic injury in patients with reflex syncope.

Method: We enrolled 29 consecutive patients (male/female 21/8, mean age 49±22) who were diagnosed as reflex syncope. We excluded the patients with neurologic, coronary artery and other cardiovascular diseases from the analysis.

Results: Most patients were male, and there were bimodal peaks in the 20s and 60s regarding the distribution of age. Fourteenth patients (48%) had the recurrent syncope in similar clinical situations. Seventy six percent patients were injured in head and face, especially the most common part of injury was head (55%). Surgical treatments were required in 6 patients. Three of them needed to hospitalized for the treatments and five of them had recurrent syncope episodes following the event.

Conclusions: The results of this study showed that patients with prior syncope episodes have high prevalence of syncope-related traumatic injury and most of them had the recurrence of syncope episode in similar clinical situation. Early treatments should be considered to reduce the risk of syncope-related traumatic injury in patients with reflex syncope.
Obtund heart rate increment during tilt testing is associated with aging and severe syncopal attack

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Background & Objectives: Vasovagal reflex is common which clinical characteristics are variable from unexpected syncope to light dizziness. We reviewed 213 patients with positive tilt table test to evaluate the representative findings for severe symptoms.

Methods: Head-up tilt test results were reviewed. During simple table tilting and with isoproterenol infusion, heart rate increment was assessed. Heart rate increment was defined as increased heart rate at least 20% from baseline heart rate. Severe symptom was defined as unexpected syncope, abrupt syncope resulting significant physical damage.

Results: The mean age was higher in obtund heart rate increment group compared with the heart rate increment group (mean age 45.2 vs 28.4 yrs in simple table tilt, 57.9 vs 35.2 yrs in pharmacologic provocation). Severe symptoms were more common in obtund heart rate increment group (78% vs 37% in simple table tilt, 52% vs 18% in pharmacologic provocation).

Conclusion: Obtund heart rate increment in tilt table is associated with unexpected syncopal attack. Patient education and careful monitoring is mandatory for these patients.

Whole exome sequencing to identify a novel LMNA gene mutation associated with sick sinus syndrome

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Background: Mutations in SCN5A, HCN4, and MYH6 have been implicated in the pathogenesis of familial sick sinus syndrome (SSS). However, the genetic basis of SSS is heterogeneous and still largely unknown.

Methods and Results: We used whole exome sequencing to study a 3-generation family with multiple affected family members with SSS. With the help of pedigree information, we identified a heterozygous missense mutation (c.G359T, Gly232Val) in the Lamin A/C (LMNA) gene as a most likely causative variant. The mutation is novel and expected to affect the conformation of LMNA coiled-coil rod domain by structure model prediction.

Conclusions: LMNA gene might be one of the disease causing genes for familial SSS. Our results implicated whole exome sequencing is a feasible approach for the identification of the causal gene underlying inherited conduction disease such as sick sinus syndrome.
Complicated course following AICD implantation in a middle aged diabetic woman

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55 year old diabetic female, a case of idiopathic dilated cardiomyopathy, normal epicardial coronaries, severe LV dysfunction with history of resuscitated cardiac arrest underwent single chamber aicd (boston teleign) in September 2011. At six months follow up lead impedance was found to be high (>2000 ohms) and was advised rv lead revision. Device interrogation revealed many episodes of ventricular tachycardia (VT) which were terminated by atp and no episodes requiring shock.

Two months later she had a shock for fast VT. RV lead replacement was performed and continued to have atps from device. There were also inappropriate shocks due to at for which she was on antiadrenergic and oral anticoagulants.

She developed urinary tract infection with urosepsis and aicd pocket infection. Lead removal along with generator was done and treated with appropriate antibiotics. In the interim, she developed VT storm. And was taken up for RFA using ensite. Three morphologies of VT were inducible (VT1: lbb, left axis deviation, 160 bpm, VT2: lbb, left axis deviation, 200 bpm, VT3: complete rbb, left axis deviation, 220 bpm). There was extensive scar in right ventricle, but no vt inducible.

Activation, substrate and pacemapping of left ventricle, in anteroseptal, anterobasal, infero apical septum, and apex were done and RFA delivered. Post rfa there was no sustained VT inducible despite vigorous protocols. During the same hospitalization aicd remnalplacement was done from the right sided approach. There were no VT episodes on followup at three and six months and both pacemaker pockets have healed well.

Clinical characteristics of atrial fibrillation detected by implanted devices and its association with ICD therapy

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Introduction: Detection of atrial fibrillation (AF) by cardiac devices (CD) has high sensitivity and is useful in clinical situation. Those AF are the risk for thromboembolic events even if those are asymptomatic. ICD shocks are associated with adverse survival outcome. However the association between AF and ICD shocks was not fully understood.

Methods: We studied 175 patients implanted with CD (32 pacemaker, 124 ICD, 19 CRT) and managed by remote monitoring in our hospital. We evaluate clinical characteristics of AF detected by CD and occurrence of ICD therapy.

Results: During the mean follow up period of 3.1±1.7 years, AF was detected in 65 patients (37%). In AF detected group ICD therapy was frequently observed (32% vs 11%, P=0.0021). Appropriate therapy was not different between with or without AF group (6% vs 4%) . Inappropriate therapy was frequently observed in AF group (26% vs 7.2%, P=0.0017).

Conclusion: Thirty seven % of the patients developed AF recorded by CD. These AF significantly increases inappropriate ICD therapy. We must manage to decrease ICD shocks in these patients.

Is the presence of non-sustained ventricular tachycardias and ventricular fibrillation in primary prevention patients?

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3 Medtronic, China
4 Fuwai Hospital, China

Background & Objectives: The correlation between device-detected non-sustained ventricular tachycardias and true episodes of ventricular fibrillation (VT/VF) in the primary prevention population is not well understood. We investigated this correlation to determine if a subset of patients at greater risk of having significant arrhythmias could be identified and therefore may merit ICD implantation.

Methods: The association between NSVT detected by the ICD (≥5 beats within the programmed VT/VF zone) and true VT/VF was assessed among patients with a primary prevention indication and one year of device data following ICD implantation. We also computed the sensitivity, specificity, positive and negative predictive values of NSVT episodes for identifying patients with true VT/VF episodes.

Results: Among 1135 primary prevention patients, 196 patients (17.3%) experienced at least one episode of true VT/VF and 765 patients (67.4%) had at least one episode of NSVT recorded by the device. The presence of NSVT correlated with a higher incidence of true VT/VF episodes recorded by the ICD (p=0.0001). The presence of device-detected NSVT episodes was highly sensitive (91.3%) and moderately specific (37.6%) for identifying patients with true VT/VF. The positive and negative predictive values of device-detected NSVT episodes to identify patients with true VT/VF were 23.4% and 95.4%, respectively.

Conclusion: A significant correlation exists between the presence of device-detected NSVT and true VT/VF episodes. The high sensitivity and negative predictive value suggest that extended periods of NSVT monitoring may be useful in identifying patients who could benefit from ICD implantation for primary prevention.

Barriers to implantable cardioverter defibrillator (ICD) implantation for the primary prevention of sudden cardiac death in an asian population

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Background & Objectives: Implantable cardioverter-defibrillator (ICD) is proven to reduce sudden cardiac deaths (SCDs). Patients’ knowledge and beliefs play a significant role in influencing their decision in implanting an ICD. We sought to identify factors that result in patients declining ICD implantation in a single centre.

Methods: This study was performed in a tertiary centre in Singapore. We interviewed 200 patients who declined ICD implantation between July 2012 to March 2013. They fulfilled criteria for ICD implantation for primary prevention of SCD. A self-developed questionnaire was used to assess patients’ knowledge and beliefs towards ICDs.

Results: The mean age of the patients was 59.9±10.4 years old and 33.3% were retirees. 84.5% were male, and 70% were Chinese.

The most feared consequences were becoming bedbound (35.7%) and feeling breathless (10.2%).

Only 16.6% of the cohort felt SCD was their worst feared consequence. 27.5% knew that SCD was sequelae of their condition. 85.3% of the patients believe they would be able to prevent SCD through medicine and lifestyle modification. 51.3% knew that the function of ICDs was for SCD prevention.

While 98% of our patients learnt about ICD from their doctors, only 15% reported that doctors played a major influence in their decision-making. The main decision-maker remained the patient (69.5%). High costs (27.4%) and invasiveness of ICD implantation (23.6%) remained the main barriers to patients accepting ICD implantation.

Conclusion: Our study revealed gaps in knowledge preventing patients from undergoing ICD implantation. Measures to address them may result in greater acceptance of ICDs.
Factors affecting implantable cardioverter defibrillator (ICD) lifespan

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2 Wellington Regional Hospital, New Zealand
3 University of Otago, Wellington, New Zealand

Background: ICD longevity is a major determinant of the frequency with which patients require device replacement and cost effectiveness. We reviewed ICD implantation at Wellington, comparing longevity between manufacturers, device types and other factors influencing lifespan.

Methods: We retrospectively reviewed ICD implants in Wellington from 2001-2010. Longevity of single chamber (SC), dual chamber (DC) and biventricular (BV) ICDs from Biotronik, Boston-Scientific (BiSc), Medtronic and St Jude were compared. Total number of ICD shocks and percentage of pacing were evaluated for comparison.

Results: We analysed 266 new implants (143 SC, 94 DC, 29 BiV). The overall median device lifespan was 6.69yrs, and varied significantly between device type: SC (7.15yrs), DC (6.42yrs), BiV (5.26yrs), SC vs. DC (p = 0.02), DC vs. BiV (p = 0.02). We implanted 86 Biotronik, 72 BiSc, 102 Medtronic and 6 St Jude devices. BiSc and Medtronic device lifespan was equivalent (7.05 vs. 6.96yrs, p = 0.12) and significantly longer than Biotronik devices (5.27yrs, p = 0.05). The percentage of pacing and number of shocks were similar between device manufacturers. Pacing >50% (Atrial or Ventricular) was associated with a reduction in device longevity (7.05 vs. 4.9yrs, p < 0.001). However there was no difference in device lifespan between patients receiving >50 vs. <50 ICD shocks (p = 0.85).

Conclusion: There is significant variation in device longevity between device type and manufacturer. In our study increased pacing was associated with a reduction in device lifespan but increased shocks were not. These factors need to be considered when selecting devices.

The presence of SVC coil on ICD leads does not impact efficacy of atrial tachyarhythmia termination by shock

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Background and Objectives: Dual coil RV ICD leads are sometimes chosen over single coil leads because a ventricular defibrillation circuit that includes the SVC coil may be more effective in terminating atrial tachyarhythmias (AT). We compared the efficacy of shocks delivered from single coil and dual coil leads with different coil spacing in terminating ATs.

Methods: PROVIDE was a prospective, randomized, multicenter study of ICD-CRT-D patients. Single coil and dual coil leads with 17 and 21 cm coil spacing were used. Dual coil leads were always programmed such that the SVC coil was utilized for defibrillation. We analyzed the adjudicated outcomes of shocks delivered during AT (atrial tachycardia, fibrillation, or flutter). We considered resulting sinus rhythm or sinus tachycardia as successful therapy and a resulting rhythm of AT as unsuccessful therapy. Patients were grouped based on whether their therapies were always, never, or sometimes successful. Fisher’s exact test was used to compare efficacy between groups.

Results: PROVIDE enrolled 1674 patients (age = 64 ± 13 y, EF = 27 ± 9%) over a follow up of 18.3 ± 7.6 months. In 108 patients, there were 251 episodes in which shock was delivered during AT. The efficacy of shock (Table) was not different between different lead types (p = 0.96).

Conclusion: In PROVIDE, the efficacies of ventricular shocks delivered via dual coil and single coil leads in terminating AT were not significantly different. Similarly, coil spacing did not impact AT termination efficacy in dual coil leads.

### Table

<table>
<thead>
<tr>
<th>Coil Spacing</th>
<th>Percent of patients with therapy success</th>
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<tbody>
<tr>
<td></td>
<td>Never</td>
</tr>
<tr>
<td>17 cm (n=76)</td>
<td>19.7%</td>
</tr>
<tr>
<td>21 cm (n=22)</td>
<td>22.7%</td>
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<tr>
<td>Single coil (n=10)</td>
<td>10.0%</td>
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A path to safe MRI scanning of patients with implantable cardioverter defibrillator: a pre-clinical testing strategy

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Background: Advances in pacemaker systems and testing strategies have allowed safe patient access to MRI, but little evidence exists regarding the safety of scanning ICD patients. To address this issue, we investigated a pre-clinical testing strategy of an MR conditional ICD system to account for the multitude of patient, scanner, and system configurations associated with full body MRI scanning.

Methods: A test plan was established and executed to evaluate the risks associated with lead electrode heating, unintended cardiac stimulation, and device malfunction. The approach included a novel computer model, in-vivo canine studies, and bench testing. MRI induced electrode heating and cardiac stimulation were predicted over various combinations of MR coils, human body models and lead paths simulated in 1.5T MRI scanner under Normal Operating Mode conditions with no anatomical limitations. Physiologic responses to heating and stimulation were evaluated by in-vivo canine testing, and bench testing assessed device survivability and functionality.

Results: Testing was performed on ICD lead models connected to Medtronic ICDs designed for use in MRI. The probability of substantial change in pacing capture threshold (>15V) induced by MRI was extremely low (=0.1%). The probabilities of either intended cardiac stimulation or device malfunction were also extremely low.

Conclusion: A pre-clinical strategy that includes comprehensive computer modeling, in-vivo canine, and bench testing predicts that specifically tested ICD leads connected to an ICD designed for the MR environment is safe and poses very low risks when exposed to normal operating mode whole body MR imaging.
Impact of ICD therapies on atrial tachyarrhythmias

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Background and Objectives: ICD therapies are frequently delivered inappropriately for atrial tachyarrhythmias (AT). This study aimed to evaluate the effect of anti-tachycardia pacing (ATP) and shocks on the duration of AT episodes.

Methods: PROVIDE was a multicenter study of ICD/CRT-D patients. A panel adjudicated rhythms before and after all ICD-treated episodes as ventricular tachyarrhythmias (VT) or AT (atrial tachyarrhythmia, fibrillation, or flutter). Analysis focused on episodes where AT was present and VT absent prior to ICD therapy. AT termination was defined as sinus rhythm or sinus tachycardia (SR) following any ICD therapy.

Results: A total of 1674 patients were followed for 18 ± 8 months, with 156 patients receiving therapy during 596 episodes of AT (Figure). Overall, 87% (517/596) of AT episodes either terminated after ICD therapy or slowed after ATP, preventing additional therapies. AT terminated following ATP or shocks in 42% (253/596) of episodes, and SR was restored following 69% (379/556) of episodes, while VT was restored following 8% (49/562) of episodes. The mean duration of AT was significantly shorter in episodes that terminated (p < 0.0001). The mean duration of AT was significantly shorter in episodes that terminated (p < 0.0001).

Conclusions: ICD therapy either terminated or slowed most AT episodes. In many cases, delivery of ATP prevented delivery of a shock, suggesting that ATP may reduce the rate of inappropriate shocks.

Predictors of mortality following the upgrade to cardiac resynchronisation therapy

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Background & Objectives: The clinical benefit of de novo implantation of cardiac resynchronisation (CRT) devices is well established. However, there exists limited data concerning the clinical course of patients undergoing upgrades of a single- or dual-chamber implantable cardiac defibrillator and no factors determining mortality in this patient population were ascertained.

Methods: In 91 consecutive patients (mean age 68±9 years, 90% male, mean LVEF 25±7%) with ischemic (n=55) or dilated cardiomyopathy (n=36) undergoing an upgrade to a cardiac resynchronisation defibrillator, the combined endpoint of all cause mortality, heart transplantation, and assist device implantation was analysed. The periprocedural mortality defined as death within 30 days after implantation was excluded. Cox regression analysis was used to determine the predictors of endpoint.

Results: During a mean follow-up of 18±12 months 39 patients (43%) had an event: 31 patients (34%) died and 6 (7%) underwent heart transplantation or assist device implantation (2 patients, 2%). The mean survival was 30 months (95%CI 25-34 months). Cox regression analysis demonstrated that LVEF (HR 0.909, 95%CI 0.859-0.961 per %, p=0.001) and glomerular filtration rate (HR 0.971, 95%CI 0.952-0.991 per ml/min, p=0.004) were independent predictive factors for the occurrence of the primary endpoint. There were no differences between etiology of the cardiomyopathy in respect to endpoint predictors.

Conclusions: Combined endpoint of all cause mortality, heart transplantation, and assist device implantation occur frequently in patients undergoing upgrade to cardiac resynchronization defibrillator and is associated with severely depleted LVEF and impaired kidney function.

Effects of epinephrine in local anesthetics for implantable cardioverter defibrillator implantation

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Background: It is common to add epinephrine to local anesthetic agents to reduce bleeding and keep the operation field clean. However, its advantage and disadvantages in implantable cardioverter defibrillator (ICD) implantation is not clear.

Methods: We retrospectively reviewed medical records of 52 patients who received ICD implantation with local anesthesia in our hospital between 2007 and 2013. They had long QT syndrome, Brugada syndrome, hypertrophic cardiomyopathy, or arhythmogenic right ventricular dysplasia. We collected patients and device information (Device maker, use of perioperative anesthetic technique, total operation time, and clinical course information were collected) to evaluate the effects of epinephrine in local anesthetics.

Results: Fifty-two patients were included and epinephrine was used in 41 patients (Group 1) and not in others (Group 2, n=11). There were significantly more patients of long QT syndrome in group 1. No difference was seen in patient characteristics, device, operator, and use of oral anesthetic technique between the two groups. Total operation time was significantly shorter in group 1 (98.78 ±24.9 min, p=0.008) than group 2 (127.3 ±65.1 min). Five in group 1 and two in group 2 had significant hematoma (p=0.63), but none of them experienced hematoma removal, infection or discharge prolongation.

Conclusion: Use of epinephrine did not reduce the postoperative hematoma. However, it may shorten and stabilize the operation time since less time is necessary to control bleeding.
Incidence of high defibrillation threshold in non-left pectoral implantable cardioverter defibrillators and defibrillation threshold testing
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Introduction: In contrast to left pectoral implantable cardioverter defibrillators (ICDs) which are known to have high defibrillation efficacy, right pectoral or abdominal ICD implants have been described to have higher defibrillation thresholds (DFTs) due to differences in shock vectors.

Methods: A retrospective case series analysis was performed for 10 patients who underwent non-left pectoral ICD implants for standard indications. These patients underwent a single shock step up DFT testing protocol and DFT testing logs were reviewed for defibrillation success; defined as achieving a safety margin of >10J.

Results and Discussion: All patients had left sided vascular access issues that prevented left sided ICD implants. 9 (90%) patients had right pectoral ICD insertion, and one patient had an ICD implanted at the left upper quadrant of the abdomen. All patients received dual coil defibrillation leads placed at the right ventricular apex. 2 patients (20%) (one patient with a right pectoral implant and the patient with the abdominal implant) failed to achieve defibrillation success and required rescue external defibrillation. These 2 patients required lead revision and addition of a subcutaneous array respectively. Thereafter, defibrillation success was achieved. The remaining 8 patients had DFT ranging from 10 to 15 joules. There were no periprocedural complications.

Conclusion: Non-left pectoral ICD implants are associated with increased incidence of high DFTs. DFT testing should be performed to evaluate and predict defibrillation success in such patients.

Experience of sprint fidelis single and dual coil ICD lead failure at National Heart Centre Singapore
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Introduction and Objectives: Sprint Fidelis (SF) ICD leads are slender leads with a vulnerable pace-sense unit that is prone to failure. We report on our single center experience of SF leads implanted prior to recall of these leads by the manufacturer.

Methods: All patients who had SF leads implanted between 2005 and 2007 at the National Heart Centre Singapore (NHCS) were identified through the EP laboratory logs. Case notes were then retrospectively reviewed to ascertain patient characteristics and subsequent clinical course.

Results: 48 patients were identified (18 with ‘6931’ single coil implants, 30 with ‘6949’ dual coil implants). Mean patient age was 62. 45 (93%) were male. Mean length of follow up was 6.1 years (73.5 months). 7 lead failures were identified (14.6%) - 4 ‘6931’ leads which failed 4, 4, 6 and 7 years post implant, and 3 ‘6949’ leads which failed 4, 4 and 5 years post implant: 4 patients presented with inappropriate shocks, 2 had radiological evidence of lead fracture. Failure rates between the ‘6931’ and ‘6949’ groups were not significantly different (22% vs 10%), mean survival 6.6 vs 8.6 years, Kaplan Meier log-rank p=0.43). All patients underwent subsequent lead extraction with no mortality.

Conclusion: Our experience is similar to other published data showing SF failure rates of around 15% by 6 years. Published experience with lead extraction of SF leads varies, but we did not find any mortality in the 7 patients who underwent lead extraction in our series.

Differential lead component pulling as a possible mechanism of inside-out abrasion and conductor cable externalization
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Royal Victoria Hospital, United Kingdom

Introduction: Conductor cable externalization with prostration (CCE*) is highly prevalent among the Riata® ST and ST 7F defibrillation (DF) leads and infrequently present in the QuickSite® and the QuickFlex® coronary sinus (CS) leads. A model for CCE* based on differential lead component pulling and conjugate extension with reciprocal compression-bending was developed. Extension of a proximal lead body segment by pectoral or cardiac movements causes reciprocal compression-bending of a distal lead body segment mediated by inextensible conductor cables running down a lead body fixed at various points by fibrous adhesions. The “sawing” action of these cables under tension causes inside-out abrasion of insulation leading to CCE*.

Methods: DF leads from different manufacturers and the QuickFlex® and QuickFlex µ® CS leads were subjected to simulated differential pulling.

Results: Restitution from differential pulling followed 3 patterns: complete, partial without escalation, and incomplete with escalation. Only the last pattern (only shown by the Riata® 8F and ST 7F leads) was associated with an increased risk to CCE*. For CS leads, deformation concentrated on the more flexible segment when the lead body did not have a uniform construction.

Conclusions: The Durata®, Riata ST Optim®, QuickFlex µ® and Quarter® leads should be relatively immune to CCE*. The Durata® leads are extremely resistant to longitudinal deformation and probably cause mediastinal displacement rather than differential pulling in response to pectoral movements in vivo. Implantation techniques and lead designs can be used to minimize the risk of CCE*. A bench test for CCE* can be constructed.

Experience of sprint fidelis single and dual coil ICD lead failure at National Heart Centre Singapore
Su Yi Ho, Hui Min Chong, Shufen Liang, Chien Fern Lim, Muruwati Binta Rahmat, Joyce Wei Ying Ang, Eric Tieng Siang Lim, Kah Long Ho, Boon Yew Tan, Wei Siong Teo, Chi Keong Ching
Department of Cardiology, National Heart Centre Singapore, Singapore

Introduction: St Jude Medical Riata and Riata ST defibrillator leads (RL) were recalled in 28 Nov 2011, due to increased rate of premature abrasion of its silicon coating, leading to externalization of the conductors. Durata leads (DL) was said to reduce lead abrasion with its optim insulation. This study aims to compare the lead failure rate between RL and DL in a single centre.

Method: All patients implanted with RL (2004 to 2009) and DL (2008 to 2013) were enrolled. Clinical demographics, lead characteristics (lead impedance and pacing threshold) and chest X-ray (CXR) were analysed. Lead failure was defined as lead externalization resulting in electrical abnormalities leading to inappropriate therapy.

Results: 256 patients (27% with RL, 73% with DL) were enrolled. Mean duration of follow up is 6.2 years (RL) vs 3.3 years (DL). RL: 2 patients (5 and 7 years post implant respectively) had lead externalization as confirmed on X-ray. Both patients received inappropriate shocks.

Conclusion: The lead failure rate for DL is considered low as compared to RL in our centre. Regular surveillance of in-office check results is essential to pick up early changes in the lead status.

Riata and durata defibrillator lead failure rates at the National Heart Centre Singapore
Su Yi Ho, Hui Min Chong, Shufen Liang, Chien Fern Lim, Muruwati Binta Rahmat, Joyce Wei Ying Ang, Eric Tieng Siang Lim, Kah Long Ho, Boon Yew Tan, Wei Siong Teo, Chi Keong Ching
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Conclusion: The lead failure rate for DL is considered low as compared to RL in our centre. Regular surveillance of in-office check results is essential to pick up early changes in the lead status.
Factors predicting future bradyarrhythmia in patients with high-voltage devices

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Background and Objectives: Dual chamber implantable cardioverter defibrillators (ICD) have been implanted frequently in preparation for atrial pacing for the potential bradycardia in the future. However, the factors associated with future bradycardia are unclear in pacing-independent patients at the time of implantation.

Methods: Sixty-four patients who were newly implanted ICD from 2001 to 2011 and had recorded echocardiography and 24-hour holter electrocardiogram (ECG) before implantation were enrolled. Eight patients who were originally pacing-dependent were excluded and therefore, 56 patients (age at implantation 60 years, 41 male) were analysed in this study.

Results: Among the 56 patients, 5 patients (10%) experienced progressive sinus node dysfunction (SND) during the follow-up period (51 months) and required additional atrial lead insertion or changes of pacing- mode settings. Preoperative holter ECG demonstrated similar total heart beats, maximum, minimum and average heart rate in patients with and without progressive SND. All the patients with progressive SND were implanted ICD as secondary prevention (100%), which was more frequent as compared to the patients without SND (58% vs 0%, p<.001), and tended to take anti-arrhythmic agents including beta blocker more frequently (80 vs 45%, p=.154).

Conclusions: Simple values in holter ECG failed to predict future SND progression. Anti-arrhythmic agents might have clinical impacts on sinus node function.

Is the transvenous extraction of cardioverter-defibrillator leads and left ventricular leads more risky than that of pacemaker leads?

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Kokura Memorial Hospital, Japan

Background: With the increasing utilization of cardiac implantable electronic devices, the ability to extract leads through the transvenous approach has become important. Although there are reports showing that the extraction of implantable cardioverter-defibrillator (ICD) leads and cardiac resynchronization therapy (CRT) leads may be hazardous, due to firm adhesions to the vascular and chamber walls of high-voltage therapy coils, clinical evidence suggests that such procedures are safe.

Aim: We evaluated the safety of transvenous lead extraction of ICD or CRT-D, compared with that of pacemaker.

Method: Between August 2009 and September 2012, we collected data prospectively of 210 consecutive patients who underwent percutaneous transvenous lead extraction and compared incidence of major adverse events (MAE; death, myocardial infarction, stroke, cardiac tamponade, PE, blood transfusion or pneumomediastinum) between PM and ICD or CRT patients.

Result: There were 529 patients (42.3%) with PM and 81 patients (57.7%) with ICD or CRT. The most common indication for lead extraction in elderly patients was infection (88.5%). All patients underwent successful transvenous removal of endocardial leads. Two of 81 patients (2.5%) had evidence of MAE in ICD or CRT group. No significant difference of MAE was found in the ICD or CRT group (4.0 vs 2.5%, p=.57).

Conclusion: In patients with ICD or CRT, percutaneous transvenous lead extraction could be performed safely compared with PM lead extraction.

Evolution in transvenous extraction of pacemaker and implantable cardioverter defibrillator leads using a excimer laser sheath

K Yamashita, M Nagashima, M Fukunaga, Y Araki, Y Makihara
Kokura Memorial Hospital, Japan

Background: With the increasing utilization of cardiac implantable electronic devices (CIEDs), the ability to extract leads using the transvenous approach has become important. Although there are reports to extract leads using the transvenous approach has become important. Although there are reports showing that the extraction of pacemaker (PM) and implantable cardioverter-defibrillator (ICD) or cardiac resynchronization therapy (CRT) leads may be hazardous, due to firm adhesions to the vascular and chamber walls of high-voltage therapy coils, clinical evidence suggests that such procedures are safe.

Aim: We aimed to present our experience in TLE with the excimer laser sheath system.

Method: Between August 2009 and August 2012, the excimer laser sheath was used for the extraction of 210 consecutive patients who underwent percutaneous transvenous lead extraction and compared incidence of major adverse events (MAE; death, myocardial infarction, stroke, cardiac tamponade, PE, blood transfusion or pneumomediastinum) between PM and ICD or CRT patients.

Result: There were 529 patients (42.3%) with PM and 81 patients (57.7%) with ICD or CRT. The most common indication for lead extraction in elderly patients was infection (88.5%). All patients underwent successful transvenous removal of endocardial leads. Two of 81 patients (2.5%) had evidence of MAE in ICD or CRT group. No significant difference of MAE was found in the ICD or CRT group (4.0 vs 2.5%, p=.57).

Conclusion: In patients with ICD or CRT, percutaneous transvenous lead extraction could be performed safely compared with PM lead extraction.
Efficacy of implantable cardioverter defibrillators in patients with idiopathic ventricular tachyarrhythmias

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Background: Most cases of sudden cardiac deaths are caused by sustained ventricular tachyarrhythmias and implantable cardioverter defibrillators (ICD) are recommended for patients resuscitated from sudden cardiac death or life-threatening ventricular tachyarrhythmia. However the prognosis or efficacy of ICD therapy in patients with idiopathic ventricular tachyarrhythmias are uncertain. The purpose of this study was to evaluate the efficacy of ICDs in patients with idiopathic ventricular tachyarrhythmias.

Methods: The patients who implanted ICDs from 8 general hospitals in Young-Nam Province of South Korea were retrospectively enrolled in this study. The clinical data from the patients who implanted ICDs after events of idiopathic ventricular tachyarrhythmias were reviewed and analyzed. Idiopathic ventricular tachyarrhythmias included idiopathic ventricular fibrillation (VF) and life-threatening idiopathic ventricular tachycardia (VT).

Results: Among 286 patients, 62 patients (42 males, mean age 54.1 ± 16.0 years) implanted ICDs because of idiopathic ventricular tachyarrhythmias. The patients consist of 38 patients (61.3%) with VF and 24 (38.7%) with VT, respectively. Mean follow-up duration was 39.5 ± 31.9 months and mean ejection fraction was 59.8 ± 7.6%. Total mortality was 5.8% ± 7.6%. Mortality was 4.8% (3 patients) and 27.4% (17 patients) experienced at least one appropriate therapy. The patients with idiopathic VT had tendency to experience more clinical event of appropriate shock or all-cause death as compared to the patients with idiopathic VF (45.8% vs. 23.7%, p=0.069). However, survival analysis didn’t show any differences of clinical events between two types of ventricular tachyarrhythmias.

Conclusion: This study demonstrated that about 32% of ICD implanted patients with idiopathic ventricular tachyarrhythmias experienced at least one appropriate shock or all-cause death. But, there were no differences in incidence of clinical events between the types of ventricular tachyarrhythmias.

Clinical characteristics and to follow-up effective with cardioverter-defibrillators in 32 isolated noncompaction cardiomyopathy patients

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Background: The ventricular noncompaction is a genetic cardiomyopathy, the major clinical manifestations of heart failure, thromboembolism, arrhythmia and sudden cardiac death. Because malignant arrhythmia has the potential risk of sudden death, so the implantable cardioverter defibrillator (ICD) in the prevention sudden death caused by ventricular tachycardia is the main treatment option. The aim of this study is to analyse clinical characteristics and to investigate prophylaxis cardiovascular-defibrillators (ICDs) for sustained ventricular tachycardia (VT) with syncope in isolated noncompaction cardiomyopathy.

Methods: This study included 32 patients who had been diagnosed isolated noncompaction cardiomyopathy by echocardiography or cardiac magnetic resonance from 2005 to 2011. Group 1 consisted of 14 pts with SVT or NSVT, and group2 consisted 18 pts without VT. We reviewed the medicalcard records, and surveyed current status of patients by interview or telephone to patients. Mean follow-up period was 2.92 years.

Results: The patients’mean age of the diagnosis was 43.42 years, 32 patients were mainly manifested as palpitation(34.4%), syncope(18.8%), shortness of breath and lower extremity edema(53.2%). Two groups of non-compaction site, left ventricular size and ejection fraction without statistical significance. 22 patients with the heart function reduce (EF <50%) and left ventricular end diastolic diameter enlarge were treated to standard heart failure therapy, 6 pts of ventricular tachycardia and syncope patients implanted with ICD 4 patients were dead with the largest LV end diastolic dimension (mean 79mm) - the lowest LFVEF(mean EF 25%) and VT 4 patients presented with appropriate ICD, the average appropriate shocks were 2.2 times.

Conclusion: In our study demonstrate that prognostic factors include LV end diastolic dimension,VT, and LVFET. VT is unrelated with position of noncompaction and ICD is effective in LVNC patients with syncope by sustained ventricular tachycardia.

Feasibility of TWA detection by a local left ventricular lead in CRT-ICD patients

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Background: T-wave alternans (TWA) is a beat-to-beat alteration in the T wave of the body surface far-field ECG. This study was to determine the feasibility of TWA detection by left ventricular (LV) near-field EGM in CRT-ICD patients.

Methods: In 13 patients receiving CRT-ICD, two-channel device EGMs were ambulatorily and simultaneously collected via lead configurations of LVtip-to-LVring for near-field EGM and device Can-to-Ring for far-field EGM. Spectral TWA was analyzed during 3 atrial pacing tests with AAI mode at 90, 105, and 120 bpm, respectively, each test for a 90-second analysis window. TWA with K score ≥8, 3 was considered positive and TWA amplitude was then determined.

Results: Of total 39 AAI pacing tests in 13 patients, 34 yielded appropriate analysis windows for TWA analysis. Of 34 analysis windows, LV near-field EGM detected positive TWA in 24 measurements (70.6%) while far-field EGM detected positive TWA in 14 (41.2%, P=0.015 between two EGMs). Of 24 positive TWA tests for LV near-field EGM, 11 were accompanied by positive TWA in the far-field EGM (45.8% concordance rate). For these 11 pacing tests with positive TWA detected in both EGMs, the TWA amplitude was 117.9±54.1 µV for LV near-field EGM and 47.7±25.9 µV for far-field EGM (P<0.001).

Conclusions: TWA amplitude detected by a local LV lead is larger than that detected by a far-field lead configuration. The higher positive TWA rate detected by an LV near-field lead indicates that a near-field EGM may be more feasible for detecting LV electrical instability.

A comparison of North America and Australia/New Zealand ICD programming: compliance with the evidence base

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Background: Ideal ICD programming aims to minimize painful therapy and extend device longevity while protecting the patient from sudden cardiac death. Though evidence identifying safe shock-reduction programming is growing, such programming strategies are underutilized in clinical practice. Feedback to physicians via centre-specific reports showing how their ICD patients are programmed may increase compliance with evidence-based targets.

Aim: We aimed to compare geographical differences in ICD programming between North America (USA/Canada) and Australia/New Zealand (ANZ) using data from the prospective Shock-Less trial.

Methods: Over 2 years, 3742 patients were recruited from North America and 95 from ANZ (4 centres). Compliance with recommended programming targets for number of intervals to detect (NID), longest treatment interval (LTI), Lead Integrity Alert (LIA), SVT discriminators (Wavelet, PR Logic) and SVT limits were recorded for patients with primary (PP) or secondary prevention (SP) indication. The change in absolute percent usage of the target values was computed for implant programming in patients enrolled before vs. after the report.

Results: Pre-report ANZ VF NID programming complies with evidence-based targets more often than in North America. Following report feedback, the percent on target improved for PP VF NID, Wavelet, and LIA. 8% of ANZ patients with PR Logic turned off post-report were from one site.

Conclusion: Even though providing clinicians with site-specific reports increased adoption of the VF NID (PP), LT (PP), Wavelet, and LIA, there is still much opportunity for improvement.
Serum eicosapentaenoic acid (EPA) / arachidonic acid (AA) ratio and arrhythmic events in patients having received CRT device

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Background and Objectives: Arachidonic Acid (AA) has been associated with ventricular tachycardia in ischemic myocardial cardiac animal model. However, little is known about the role of AA in arrhythmia in chronic heart failure patients having undertaken CRT device implantation. Here we explored whether the association would be found between AA and arrhythmic event in such patients.

Methods: Total 111 chronic heart failure patients (MF 88/23, 65±12 years) having received CRT-D (n=103) or CRTp (n=8) were enrolled. Blood samples of AA, eicosapentaenoic acid (EPA), and ratio of EPA/AA were measured and subsequent events defined as non-sustained ventricular tachycardia (NSVT), sustained ventricular tachycardia or ventricular fibrillation (SVT), and total death including non-cardiac death were investigated according to records of pace maker or clinical course.

Results: Patients were consist of ischemic (n=39, 35%), or chronic or paroxysmal atrial fibrillation (n=9, 32%). Averages values of AA, EPA, and EPA/AA levels were 174±57 mg/mL, 66±46 mg/mL, and 0.40±0.20, respectively. Above unfavorable outcomes were recorded or found as follows: NSVT (n=38); SVT (n=18); total death (n=7). No significant difference in the value of AA, EPA or EPA/AA was seen between patients with ischemic and non-ischemic, patients with and those without NVST or SVT events. EPA/AA was lower in death patients including non-cardiogenic death (0.22±0.28 vs 0.41±0.24, p=0.043).

Conclusions: Though in small number of the patients, we could not detect any association of AA or EPA/AA with arrhythmic events.

Detection of a recurrent non-sustained slow VT by home monitoring ICD missed by the conventional ICD device check

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Introduction: The present case highlights the use of home monitoring device transmission of data online intracardiac EGMs which helped diagnose a recurrent symptomatic non-sustained VT which stayed undetected during in-clinic device interrogation.

Case Report: Our patient, a 67 year old lady, was given an ICD device with home monitoring facility for documented spontaneous sustained VT at 186 bpm and EF 40% (class I indication). The detection limit of ICD , the first VT zone, was programmed at 150bpm. 3 weeks post-discharge patient came for a unscheduled follow-up with complaints of frequent episodes of restlessness. Device interrogation was uneventful and showed no episodes of VT/VF. Patient was reassured of absence of any arrhythmia based on the in-clinic device interrogation report and sent back on same anti-arrhythmic dose with advice for transmission of device data during symptoms. The device data report sent by the patient during her short symptomatic period showed episodes of a recurrent slow VT , rate 98 bpm, which was missed by the device during in-clinic interrogation as the VT rate was slower than the programmed VT detection rate.

Bleeding complications associated with implantation of subcutaneous cardiac defibrillator

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Background and Objectives: The subcutaneous cardiac defibrillator (SICD) is an emerging alternative to transvenous ICD for prevention of sudden cardiac death. However, the bleeding complications may be higher with SICD due to lead tunneling and larger generator pocket.

Methods: A retrospective analysis of prospective data was completed in 62 pts receiving a SICD between 4/2010 to 2/2013.

Results: 3/62 pts (4.8%) had an important BC at the pocket site: 2 pts with a hematoma not requiring intervention; and, 1 with a hematoma requiring blood transfusion and interruption of warfarin. Compared to the 59 pts without BC, no features were associated with BC when assessing: gender, age, body mass index, use of antiplatelet therapy, use of anticoagulation therapy, BUN/creatinine, ejection fraction or presence of diabetes or hypertension. Of the 62 pts, 40 (65%) underwent implantation while on an antiplatelet (28 pts), anticoagulant (7 pts; mean INR 1.63), or both (5 pts).

Conclusions: With the SICD, the rate of significant BC is 4.8%, occurring at the pocket generator, yet an intervention (blood transfusion and drug change) was required in only 1 pt (1.6%). No specific clinical features were associated with BC. SICD implantation has low BC and can be performed safely in pts on antiplatelet/anticoagulant therapy.

Home monitoring in cardiac rhythm devices is a safe and reliable technique and can help detect a frequently occurring VT at the rate of 98 bpm, slower than the programmed detection limit of the ICD .

Discussion: HM is a fully automatic and wireless system capable of transmitting device data including episode counters. The Lumos-T Safety Reduces Office Device Follow-Up (TRUST) trial concluded that HM is safe and allows more rapid detection of actionable events compared with conventional monitoring in patients with implantable electronic cardiac devices. Reliability of EGM Online Interpretation (REON ) study done on 619 ICD patients showed that EGM Online allows accurate remote classification of the appropriateness of ICD therapy . A recent study on 69 patients showed how the new technology in this field was able to provide information relating to inappropriate detection and shock earlier than conventional devices . Our case is an important addition to the knowledge of uses of home monitoring in cardiac rhythm device follow-up.

Conclusion: Home monitoring in cardiac rhythm devices is a safe and reliable technique and can be helpful in detection of symptomatic non-sustained VTs below the programmed detection limit of ICD.
**P3-113**

Subcutaneous cardiac defibrillator in patients with inherited arrhythmia (IA): a single center experience

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**Background and Objectives:** Young patients with inherited arrhythmias (IA) are at risk for sudden death and represent a challenging group to treat because of long life expectancy and the need for multiple implantable cardiac defibrillators (ICD). The subcutaneous ICD (SICD) represents an alternative.

**Methods:** A retrospective analysis was performed of prospectively collected data in 62 consecutive pts receiving a SICD.

**Results:** Of the 62, 16 pts (age 35+/-11, LVEF 57+/-9) received SICD for IA (26%), 9 for primary/g53/g53/g.2/g54/g.2/g51/g5./g.6/g52/g51/g1./g3/g26/g3/g53/g5./g56/g3/g.3/g65/g.1/g3/g3./g53/g55/g.4/g65/g.1/g3/g56/g3/g44/g35/g34/g3/g40/g65/g56/g3/g.6/g50/g53/g.4/g65/g51/g5./g65/g5./g.6/g52/g51/g3/g.6/g51/g3/g.3/g.2/g50/g65/g.4/g.2/g56/g3/g.0/g52/g50/g53/g65/g53/g.2/... g56/g3/g44/g35/g34/g12/g33/g3/g11/g23 ... g53/g.1/g.6/g52/g50/g42/g52/g53/g65/g5./g.3/g42/g13/g3/g21/g3/g53/g5./g56/g3/g.3/g65/g.1/g3/g3./g53/g55/g.4/g65/g.1/g65/g3
syndrome (13%), 1 had catecholaminergic polymorphic VT (6%), and 1 with arrhythmogenic right ventricular cardiomyopathy (6%). An SICD was successfully implanted in 14/16 pts (88%). Of these 14 pts, the lead or generator was required to be repositioned in 3 so to achieve an adequate DFT. Of the 14 pts with an SICD, during at least 6 months follow up, 3 had inappropriate shocks due to T wave oversensing, managed with reprogramming the shock vector. In the 46 pts without IA, an adequate DFT was achieved in 44 pts (96%; p =0.22 vs IA pts).

**Conclusions:** SICD is an alternative to transvenous ICD in patients with IA. Improvement in achieving an adequate DFT in pts with IA will enhance SICD utilization.

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**P3-114**

Does gender have an influence on the use of implantable cardiac defibrillators? A propensity score analysis on a geographically diverse cohort

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**Background:** Previous studies suggest a lower rate of implantable cardioverter defibrillator (ICD) implantation in females compared to males. We examined the influence of gender on ICD/CRT-D implants in a geographically diverse cohort.

**Study Design & Methods:** The observational PANORAMA study prospectively enrolled 8522 patients implanted with a cardiac rhythm device between 2005 and 2011 from 34 countries. Multivariable logistic regression was used to identify factors associated with ICD/CRT-D use, results are reported as odds ratios (OR). Propensity scores were used to adjust for confounding. This analysis includes 5434 patients with baseline left ventricular ejection fraction (LVEF).

**Results:** The proportion of female ICD/CRT-D implants across the regions was similar (Eastern Europe, India, Latin America, Middle East, South Africa, Western Europe). Of the ICD/CRT-D cohort 19% were female versus 41% of IPG/CRT-P cohort. Men had lower LVEF (41%+17 vs 51%+17, p=0.001), received more often an ICD/CRT-D (OR 3.0 [95% CI 2.6, 3.4] ,p<0.001). After adjusting for 27 factors using a propensity score, this difference remained significant (OR 1.3 [95% CI 1.1, 1.5], p=0.010). From 1940 patients with NYHA II - IV and LVEF <35%, 59% of females received an ICD/CRT-D compared to 71% of males (OR 1.3 [95%CI 1.0, 1.7], p=0.096). This difference attenuated with adjustment (OR 1.3 [95% CI 1.0, 1.7], p=0.096).

**Conclusions:** Women differed in many clinical characteristics from men, however this could not explain the difference in the proportion of females implanted with an ICD/CRT-D compared to IPG/CRT-P. Across all regions, females make up <25% of ICD/CRT-D implants.
Ventricular pre-excitation manifested in the course of Aortic valve endocarditis resulted in multiple VFs and sever left ventricular dysfunction

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We report a case in which the presence of an abscess in the inter-ventricular septum and an accessory pathway of the Wolff-Parkinson-White (WPW) syndrome confer an increased risk of developing lethal arrhythmias and sudden cardiac death (SCD). The underlying arrhythmia causing SCD is VF triggered by pre-excited AF.

In certain subset of patients, pre-excitation can be latent or intermittent, because of preferential conduction through AV node. In this case pre-activation became manifest because of the damage and erosion of the AV node caused by aortic valve endocarditis and sepsis. LV dysfuction may occur secondary to tachy-arrhythmias, either symptomatic or asymptomatic, that triggers aortic valve induced cardiomyopathy (AVC). The rate and duration of tachy-arrhythmias influence the speed at which TIC develops and LV dysfuction may occur as early as 24 hours after the onset of tachy-arrhythmia. Nonetheless, resolution of LV systolic function occurs with adequate rate control or ablation.

In this case, eccentric ventricular activation secondary to pre-excitation, in a vulnerable myocardium (post operative phase and pre-existing LV dilatation) contributed to the development of cardiacmyopathy.

This process was reversed by ablation of the accessory pathway and implantation of CRT, which resulted in normalization of LV function and reversal of dilated cardiomyopathy.

Permanent pacemaker and implantable cardioverter-defibrillator implantation worsens tricuspid regurgitation and may be associated with more heart failure admissions

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Background and Objectives: Pacemaker or implantable cardioverter-defibrillator (ICD) lead-related tricuspid regurgitation (TR) has been increasingly recognised as an important complication of cardiac device implantation. The aim of this study was to determine the incidence of device-related TR and to assess whether implant-related TR was associated with more hospitalisations due to heart failure.

Methods: Patients who underwent device implantation at a teaching hospital between April 2002 and September 2012 and who had echocardiography studies within one year before and after implantation were included (133 pacemakers, 71 ICDs) in this retrospective analysis.

Results: TR worsened by 1 grade or more after implantation in 13.2% of the patients (pacemaker: 12.8%; ICD: 14.1%). More patients had at least moderate TR post implant (17.7% at baseline vs. 27.0% post implant; p=0.024). Device type or pacing site did not significantly affect TR severity. Preoperative LVEF predicted heart failure hospitalisation (HR=0.988 per 1% increase, CI 0.976-1.000, p=0.45) while there was a trend towards more heart failure hospitalisations with older age (HR=1.018 per year, CI 0.999-1.037, p=0.065) but not with at least moderate post-implant TR (HR=0.656, CI 0.392-1.098, p=0.109) Pacing site, device type and pre-implant TR grade were also not predictive. With multivariate analysis, only preoperative LVEF and age were significant predictors.

Conclusions: Moderate or worse TR was more common after pacemaker or ICD implantation. Baseline LVEF and age independently predicted subsequent hospitalisation for heart failure. At least moderate TR post implant may also be predictive of heart failure hospitalisation among pacemaker patients and requires further study.

The impact of pharmacological activation of small-conductance calcium-activated potassium channels with SKA-31 on atrial fibrillation

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Background: Increasing evidence has emerged to link small-conductance calcium-activated potassium (SK) channels to atrial action potential profile and atrial fibrillation (AF). However, no published data exists regarding the impact of pharmacological activation of SK channels on the electrophysiological characteristics of the atria.

Methods: The present study aimed to evaluate whether SK channels activation would mediate any effect on atrial action potential configuration and AF duration. In vivo experiments in rats were conducted. Atrial action potential duration (APD) was recorded using standard glass electrode techniques. The SK channel activator SKA-31 (10 µM) was applied. We measured atrial APD and effective refractory period (ERP) immediately before and at the end of SKA-31 injection. In vivo rat model of acute AF was induced by burst pacing with concomitant asphyxia. The duration of induced AF was recorded without and with administration of SKA-31.

Results: Activation of SK channels with SKA-31 significantly decreased the atrial APD (from 74.3 ± 2.3 ms ± 1.7 ms to 67.5 ± 2.1 ms, p=0.05, n=6), but this effect only lasted few seconds. Meanwhile, atrial ERP did not change significantly (from 73.8 ± 1.8 ms to 71.7 ± 2.0 ms, p=0.3, n=6) after SK channel activation. No effect on AF duration by SKA-31 was observed (from 2.3 ± 2.3 ms ± 1.1 ms to 3.0 ± 1.1 ms ± 1.1 ms, p=0.2).

Conclusions: Pharmacological activation of SK channels only decreased atrial APD transiently, without affecting atrial ERP, and there were no effects observed on AF duration by SK channel activation.
**P1-005**

**PR prolongation strongly predicts new-onset myocardial infarction, ischemic stroke, heart failure and cardiovascular death in coronary patients or risk equivalent: a 5-year clinical-pathophysiological study**

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**Methods:** We prospectively followed up 597 high-risk CV outpatients (mean age 6±11 yrs; male 67%; coronary disease 55%, stroke 22%, diabetes 52%) for new-onset ischemic stroke, myocardial infarction (MI), congestive heart failure (CHF), and CV death. Vascular phenotypes were assessed by high-resolution ultrasound for mean carotid Intima-Media Thickness (IMT), and Vascular Profiling System (VP-2000; subgroup n=338) for Pulse Wave Velocity (PWV). Impaired left ventricular ejection fraction (LVEF) from transthoracic echocardiography (subgroup n=194) was defined as <55%. PR interval was determined from 12-lead electrocardiogram.

**Results:** PR prolongation >200ms was present in 79 patients (13%) at baseline, and was associated with higher mean carotid IMT (1.05±0.17 mm vs 0.94±0.28 mm, P=0.010), higher PWV (1144±142 cms-1 vs 1091±143 cms-1, P=0.024), and impaired LVEF<35% (16% vs 5%, P=0.027). Adjusted for potential confounders, PR prolongation was independently associated with increased carotid IMT by +0.073mm (95%CI: 0.003 to 0.143, P=0.041). After mean follow-up of 63±11 months, increased PR interval significantly predicted new-onset ischemic stroke (P=0.006), CHF (P=0.040), CV death (P=0.001) at cut-off >200ms, and new-onset MI at >162ms (P=0.008) (C-statistic 0.70, P=0.001), with K-M analyses showing significantly reduced event-free survival (All P<0.05). Adjusting for potential confounders by multivariable cox regression, PR prolongation independently predicted increased risk of new-onset ischemic stroke (HR 5.1, 95%CI: 1.3 to 19.1, P=0.017), CV death (HR 16.4, 95%CI: 4.0 to 67.5, P=0.001), combined CV endpoints (HR 2.3, 95%CI: 1.3 to 4.3, P=0.007) at cut-off >200ms, and increased new-onset MI (HR 8.1, 95%CI: 1.7 to 39.1, P=0.010) at cut-off >162ms.

**Conclusions:** PR prolongation >200ms strongly predicts new-onset ischemic stroke, MI, and CV death, and combined CV endpoint including CHF in high-risk CV patients. Increased risk of MI was observed at >162ms. Abnormal vascular function may represent intermediate phenotypes or a mediating mechanism to clinical events.

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**P1-006**

**Effect of renal sympathetic denervation on the inducibility of atrial fibrillation and atrial remodeling in ambulatory canines with prolonged atrial pacing**

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**Background:** We have previously demonstrated that catheter-based renal sympathetic denervation (RSD) could suppress atrial fibrillation (AF) during short-term rapid right atrial pacing (RAP) for 7 hours.

**Objective:** We examined the effect of RSD on the reduction of AF and atrial remodeling in canines with prolonged RAP.

**Methods:** Twenty mongrel dogs were implanted with a high-frequency cardiac pacemaker with a transvenous lead inserted into the right atrial appendage. The dogs were divided into sham-operated (6 dogs), RAP (7 dogs), and RAP+RSD (7 dogs) groups. Sham-operated dogs were implanted with pacemakers without pacing. In the RAP-RSD group, pacemakers were implanted 6 weeks after RSD was performed bilaterally for recovery. RAP was maintained for 5 weeks in RAP group and RAP-RSD group.

**Results:** Compared with sham-operated group and RAP-RSD group, RAP group had more incidences of AF and a longer duration of AF (P<0.05) induced by S1S1 programmed stimulation after prolonged RAP. Echocardiography showed that the left atrial volume was significantly reduced in RAP+RSD group compared with RAP group (P<0.05). The plasm levels of angiotensin II and aldosterone increased significantly in RAP group, but the increasing trend was inhibited in RAP+RSD group (P<0.05). The levels of MMP-9 and TGF-β1 in atrial tissue were significantly decreased, and the levels of TIMP-1 were increased in RAP+RSD group compared to RAP group (P<0.05).

**Conclusions:** Catheter-based renal denervation reduces the incidence of AF and suppresses atrial remodeling after prolonged RAP. The inhibition of renin-angiotensin-aldosterone systemic activity may be a mechanism underlying these results.

**Keywords:** renal sympathetic nerve; ablation; atrial fibrillation; renin-angiotensin-aldosterone system; atrial remodeling
Prevalence and significance of early repolarization variant in children with syncope: a case control study

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Background & Objectives: Electrocardiographic early repolarization (ER) is frequently seen in children and young adults but its significance is not well understood. It is linked with idiopathic ventricular fibrillation in adults. Several lines of evidence suggest that it could be a vagally mediated phenomenon in younger individuals. A retrospective case-control study was undertaken to test the hypothesis that ER is more common among children with typical vasovagal syncope (VVS) than among their peers with no syncope or with non-vasal syncope (NVS).

Methods: Patients aged 4-18 years with syncope were identified by single-center database search followed by review of history for features of VVS (n=149) or NVS (n=84). First available sinus rhythm ECG for VVS were retrieved from database. Age- and sex-matched children with no known syncope or heart disease were then identified (n=213). ECGs were assessed separately for ER blinded to their clinical status.

Results: The cohort's mean age was 12.3±3.2 years and heart rate 74.2±16.2/min. Electrocardiographic ER was more prevalent in VVS (33.5%) than among patients with no syncope (15.1%) - Odds ratio (OR) 3.1 (1.8- 5.5) or with NVS (19.5%) OR 2.3 (CI 1.3-5.5).

Heart rates were significantly lower in VVS and NVS (HR 70.7±min and 70.7±min respectively) compared to children with no syncope (HR 78.1±min) - both p value <0.0001.

Conclusion: Electrocardiographic ER is more common in pediatric patients with vasovagal syncope than in those without syncope or non vasal syncope, consistent with a vagal mechanism for electrocardiographic ER. Our study also suggests a higher overall prevalence of electrocardiographic ER in young compared to adults.

Diffuse atrial fibrosis measured by T1 mapping on cardiac MRI predicts success of atrial fibrillation ablation

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Background & Objectives: Atrial fibrillation may be associated with atrial fibrosis. Contrast enhanced T1 mapping using CMR provides a method to quantitate diffuse atrial fibrosis. The aim of the present study was to investigate the relationship between post contrast atrial T1 relaxation time and freedom from AF following pulmonary vein isolation.

Methods: 112 patients with atrial fibrillation (63% paroxysmal AF; age 57.5±10.4 years; LA area 26±16.5cm2; LVEF 58±6.2%) underwent CMR with a 1.5T scanner prior to PVI and post contrast atrial T1 relaxation time was determined. Freedom from AF post ablation was documented by clinical review and 7 Day Holter monitoring at 6 monthly intervals.

Results: At a mean follow up of 12±5 months, 83 of 112 (74%) patients were in sinus rhythm off antiarrhythmic medication. In those with recurrent AF, the atrial post contrast T1 time was significantly shorter (215±63±4ms vs. 244±6±42ms; p=0.001). Univariate predictors of AF recurrence included post contrast atrial T1 time (p=0.003) and AF group (paroxysmal vs. persistent, p=0.019). Following multivariate analysis post contrast atrial T1 time remained an independent predictor of AF recurrence (p=0.006) and AF group borderline significant (p=0.05). Freedom from AF was present in 96% with a post contrast atrial T1 time >260ms vs. 68% in patients with atrial T1 <260ms (p = 0.01).

Conclusions: CMR atrial T1 mapping provides a non-invasive measure of atrial structural remodeling. A shorter post contrast atrial T1 time is associated with increased AF recurrence following pulmonary vein isolation which may have implications for patient selection and ablation strategies.

Pericardial fat volume is an independent predictor for clinical recurrence of atrial fibrillation and obstructive sleep apnea in patients who underwent catheter ablation: over 600 case study

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Background & Objectives: Although pericardial fat volume (PFV) has been suggested to be associated with prognosis after radiofrequency catheter ablation (RFCA) for atrial fibrillation (AF), the pathophysiological mechanism remains to be elucidated. The purpose of this study was to characterize the association of PFV and other clinical variables including left atrial (LA) remodeling in patients with AF.

Methods: We included 686 patients (76.9% male, 57.2±11.1 years old, 68.1% paroxysmal AF) who underwent AF ablation, and compared PFV (CT) with LA volume (CT), LA voltage (NavX), apnea-hypopnea index (AHI), or other clinical variables. The patients were followed up with rhythm monitoring stick to 2012 ACC/AHA/ESC guidelines.

Results: 1. During 19.1±8.8 months follow-up, clinical recurrence rate was 25.7% (use of anti-arrhythmic drug in 65.3%). Persistent AF (OR 2.11, 95%CI 1.39-3.19, p<0.001) and PFV was independent predictor for AF recurrence after catheter ablation, associated with a high-risk of recurrence. 2. PFV showed a significant correlation with LA voltage, AHI, or other clinical variables. 3. The most common site of the multiple overlay in the LA was roof in six patients (50.0%), showing CFAE and wave dynamics were correlated with the results of DSM.

Conclusions: PFV was independent predictor for AF recurrence after catheter ablation, associated with age, LA remodeling, or body mass index, especially in male patients.

Keywords: Atrial fibrillation, Pericardial fat, Recurrence, Sleep apnea, Male gender

Correlation between complex fractionated atrial electrograms and underlying dynamic substrate mapping in patients with persistent atrial fibrillation

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Background: We hypothesized that overlay of low voltage zone (LVZ) obtained by differential pacing maneuver reflects the underlying atrial substrate, which is defined as dynamic substrate map (DSM) and is related to wave dynamics and complex fractionated atrial electrograms (CFAEs) in patients with persistent atrial fibrillation (AF).

Methods: This study included 16 patients who underwent catheter ablation for drug-refractory persistent AF (13 males, 57.8 ± 9.6 years old). DSM was acquired using a non-contact multi-electrode array (MEA, EnSite) at the left atrium (LA) in 14 patients and at the right atrium (RA) in 2 patients. Sites showing multiple and fixed overlay of LVZ (>30% of peak voltage) during pacing at least 3 sites, high right atrium, proximal and distal coronary sinus, were identified. Areas showing CFAE and wave dynamics were correlated with the results of DSM.

Results: The most common site of the multiple overlay in the LA was roof in six patients (50.0%), left septum in four (28.6%), the junction of left atrial appendage and left superior pulmonary vein in two (13.3%) and anterior wall in one (7.1%). The multiple overlay site in the RA was crista terminals. Each site was matched up with the area showing CFAE in all patients. Wave dynamics at the multiple overlay showed rapid repetitive firing, wave breakup, but briefly lasted (< 2 rotations) ripples were rarely seen.

Conclusions: Multiple overlay of LVZ identified by DSM is related to rapid repetitive firing and wave breakup and CFAEs in patients with persistent AF

Keywords: dynamic substrate mapping (DSM); non-contact mapping system (NCM); atrial fibrillation (AF)
Predictors of difficult cardiac resynchronization therapy implantation

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Aim: Implantation of cardiac resynchronization devices (CRT) can often be difficult and time consuming. The ability to predict difficult cases in advance could improve scheduling and allocation of patients.

Methods: In a series of 200 consecutive CRT implants the total procedure time and the times for each component of the procedure were recorded. The time from taking the CS sheath to suturing the LV lead in place was recorded as LV procedure time (LVPT). The demographic, echocardiographic and electrocardiographic were recorded. The predictors of quick LVPT < 10 mins, intermediate LVPT 10 -30 mins and long LVPT > 30 mins were assessed and compared between an experienced implanter (>1000 CRT implants) and trainee implanters (10 – 100 CRT implants).

Results: The mean LVPT was 25 ± 24 minutes (range 6 mins to 128 mins). Long LVPT were recorded in 56 patients (18%) overall. For inexperienced implanters long LVPT were significantly more common than quick or intermediate LVPT in patients with a history of atrial fibrillation (44% vs 31%), increased right atrial area > 25cm (31% vs 6%), increased pulmonary artery pressures (48% vs 20%) and ischaemic etiology (33% vs 21%). For the experienced implanter, increased right atrial area > 25cm2 (40% vs 5%) predicted long LVPT. In patients without any of the above criteria the rate of long LVPT was 5%.

Conclusions: Demographic and echocardiographic parameters can predict prolonged CRT implant procedures, particularly for inexperienced implanters. This information can help scheduling and patient allocation decisions.
P3-001

Low entropy in the sub-endocardial scar can localize ventricular tachycardia supporting channels in post-infarct ventricles

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Background & Objective: A protected channel of surviving myocytes in the scar that could facilitate continuous conduction and has less interactions within the network will have fewer deflections. We hypothesized that Shannon entropy (ShEn), a statistical measure of networking, could distinguish a functionally viable channel within a resistive zone of high fractionation from channels that are unintended to directly support any reentry.

Methods: Patients with ischemic cardiomyopathy (n=16) and multiple inducible VT (n=58) undergoing catheter ablation were evaluated. Left ventricular endocardial mapping was performed in sinus rhythm with high density Pentaray® catheter. A channel was defined as orthodromic series of matching pacements with stimuli to QRS interval ≥40ms. Entrainment mapping confirmed pace map findings whenever feasible. The timing of local activation was determined as mean of activation times of all electrogram peak deflections, and fractionation was quantified by their dispersion. ShEn was calculated as an index of signal amplitude distribution in all maps and channel locations were verified.

Results: Mean 76±120 sampling points were taken. From 1770 pacements, 174 channels were identified, 47 corresponded to inducible VTs. Bipoles with least ShEn in the scar consistently co-localized in the region of VT channels (c=0.42, sensitivity 91%, specificity 81%, PPV 44%, NPV 100%). The assemblage of latest mean activation time and least ShEn within a zone of high dispersion had high agreement with the distribution of VT channels [c=0.89, sensitivity 96%, specificity 100%, PPV 93%, NPV 100%].

Conclusions: Regions of VT supporting channels express low ShEn. This suggests that ShEn can improve electrical resolution within the scar and facilitate substrate-based VT ablation.

P3-002

First experience of the new nMARQ multi-electrode catheter for mapping and ablation of paroxysmal and persistent atrial fibrillation

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Background & Objectives: nMARQ is a new circular decapolar catheter that allows mapping and simultaneous multi-electrode ablation, designed for pulmonary vein isolation (PVI). Regional ablation can be done at selected poles. We hereby describe our early experience of using nMARQ in comparison to conventional catheters.

Methods: From March (when nMARQ was first used in our centre) to July 2013, we performed 84 atrial fibrillation (AF) ablations, 18 of which using nMARQ. A cohort of another 18 patients matched in age, gender and ablation strategies was selected for comparison. For paroxysmal AF, left atrial circumferential ablation (LACA) was performed guided by CARTO-3 aimed at PVI. Additional LA ablations were done in persistent AF (PerAF) or atypical atrial flutter as appropriate.

Results: For the nMARQ group, PVI was achieved in all patients without use of other catheters. All LA flutters were ablated with nMARQ alone except 2 - one mitral valve isthmus flutter required ablation in the coronary sinus with a focal catheter and another PerAF which converted to atypical flutter that was pace-terminated. Procedure duration and ablation time were shorter in the nMARQ group (see Fig.1). Fluoroscopy time was higher in the nMARQ group (46.7±2.8 min vs. 26.2±2.1 min; p=0.05) reflecting a possible learning curve in getting familiar with a new catheter. There were no major complications.

Conclusion: Early experience with nMARQ catheter in AF ablation suggests it is safe and may save time. Fluoroscopy time is higher than the control group. Long-term safety and efficacy data is needed with longer follow up.

P3-003

Hybrid procedure using total thoracoscopic ablation and postprocedural confirmation: road to overcome chronic atrial fibrillation

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Objective: Totally thoracoscopic ablation is a new approach in the treatment of atrial fibrillation (AF). We report the early results of a totally thoracoscopic ablation following post-procedural electrophysiological (EP) in patients with long standing AF.

Methods: Between February 2012 and November 2012, 22 patients underwent totally thoracoscopic ablation for AF. We enrolled the 16 patients who underwent post-procedural EP study after thoracoscopic ablation for long standing AF. Totally thoracoscopic ablation included pulmonary vein isolation, division of ligament of Marshall, ganglionated plexus ablation, creation of roof line and posterior lines, resection of left atrial appendage and verification of conduction block. Post-procedural EP study was conducted at 4th postoperative day after chest tube removal. Freedom AF was assessed by ECGs and Holter monitoring at postoperative 6 months.

Results: There was no early mortality and no surgical complication except one prolonged pleural effusion due to chronic lung disease. Stroke occurred in one patient at postoperative 5th day who recovered completely despite sinus conversion. All patients showed no residual potentials around pulmonary veins in endocardial mapping except one patient who needed additional endocardial touch up to remove small potential around pulmonary veins. One patient required permanent pacemaker due to sinus node dysfunction despite sinus conversion. All patients showed sinus rhythm in ECGs during follow up. Ten patients who underwent Holter monitoring showed normal sinus rhythm.

Conclusions: Totally thoracoscopic ablation following post-procedural EP study is a safe and successful procedure. Post-procedural CTI ablation may be effective in preventing from atrial tachyarrhythmia during follow up.
Multiple left sided accessory pathways associated with an anomalous coronary sinus drainage at the lateral tricuspid annulus

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Coronary sinus anomalies are rare and have been classified into enlargement of coronary sinus, absence of coronary sinus, atresia of the right atrial coronary sinus ostium, and hypoplasia of coronary sinus in previous literature. This case describes an incidental finding of an anomalous coronary sinus drainage during electrophysiological study of a 48-year-old female patient who presented with recurrent palpitation. Electrocardiogram at rest showed evidence of type A Wolff-Parkinson-White syndrome. The coronary sinus ostium could not be engaged after extensive search of the usual coronary sinus site. The venous phase of the coronary angiogram showed a rudimentary coronary sinus ostium with another major drainage to the lateral high tricuspid valve annulus. A steerable decapolar catheter engaged the ostium at the lateral high tricuspid valve annulus through the “Big Loop” technique. The decapolar catheter looped around the right atrium from the right atrial septum to the lateral tricuspid valve annulus before entering its usual “route” in the groove between the left atrium and left ventricle on the posterior surface of the heart. Mapping showed a left lateral pathway and another posterolateral pathway which was successfully ablated by radiofrequency through the transfemoral approach and retrograde transaortic approach respectively. There may be an embryologic link between coronary sinus anomaly and accessory pathway.

Atrial fibrillatory cycle length derived from the 12-lead ECG: longer cycle length activity is associated with more advanced electroanatomic remodeling

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Background and Objectives: The atrial fibrillatory rate recorded from the atrial endocardium provides a direct measure of atrial refractoriness and electrical remodeling. By extension the fibrillatory cycle length derived from ECG lead V1 has been proposed as a non-invasive surrogate of remodeling. We directly compared the atrial fibrillatory cycle length derived from ECG lead V1 (V1-AFCL) with the extent of left atrial electroanatomic remodeling determined invasively.

Methods: 23 patients in AF at the time of ablation underwent detailed electroanatomic mapping of the left atrium. The EAM during tachycardia showed a “reentrant” activation pattern. We compared the atrial fibrillatory cycle length derived from ECG lead V1 (V1-AFCL) with the extent of left atrial electroanatomic remodeling determined by analysis of the frequency power spectrum. The contemporaneous intracardiac AFCL derived from proximal and distal coronary sinus (CS) recordings was determined by the same 2 methods. The strength of the association between various left atrial remodeling variables and the V1-AFCL was tested.

Results: The 2 methods of deriving the V1-AFCL generated highly equivalent results. The V1-AFCL correlated with the intracardiac AFCL derived from both proximal (r=0.78, p<0.001) and distal (r=0.60, p=0.007) CS recordings. The V1-AFCL correlated with left atrial conduction velocity (r=0.61, p=0.01) and overall left atrial signal complexity (r=0.63, p=0.02), with a longer cycle length associated with slower left atrial conduction and more extensive electrogram fractionation. There was no association with other remodeling variables including chamber size and mean endocardial voltage.

Conclusions: A longer atrial fibrillatory cycle length in ECG lead V1 is associated with more advanced left atrial remodeling, specifically slower conduction and more extensive electrogram fractionation.

Radiofrequency ablation of left atrial flutter mediated with double potentials in seemingly structure normal heart

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Background: Reentrant circuits of atrial flutter (AFL) are generally related to anatomical structures, and previous surgical or catheter interventions. Left AFL in seemingly structure normal heart has not been characterized in detail.

Methods and Results: Six patients with AFL had no history of cardiac surgery or interventions, heart disease or hypertension. Echocardiography revealed a relatively mild dilation of left atrium and a normal left ventricular ejection fraction. A distal-to-proximal coronary sinus activation during the tachycardia was indicative of LA origin. These patients underwent electroanatomic mapping (EAM) of the left atrium. The EAM during tachycardia showed a “reentrant” activation pattern in all patients. A single-loop reentrant circuit was identified in four patients. A clockwise left atrial flutter evolving around the mitral valve annulus in 3 patients. The tachycardia rotated horizontally around the LA in 1 patients. Two patients exhibited a double-loop reentrant circuit, a “figure of 8” pattern revolve with one circuit involving the mitral annulus and the other encircling the left pulmonary veins (figure 1). Double potentials (DPS) at the critical isthmus of the circuit were identified in all patients. All tachycardia were abolished during delivering the ablation around the double-potential recording site.

Conclusion: Atrial fibrillation even could be found with aging without structure heart disease, we suggest that idiopathic or acquired LA fibroses may lead conduction delay or block, resulting in the spontaneous development of left AFL in these patients. The successful site of ablation was within an area showing the DPSs as the critical part of the re-entrant circuit. DPSs indicate poor cell-to-cell coupling, suggestive of conduction delay. This perhaps suggests that DPS-targeted ablation maybe more effective for these patients.

Keywords: Atrial Flutter; Catheter Ablation; electrophysiology; mapping

Figure 1 Three-dimensional mapping and ablation of left AFL.

EAM of an atrial flutter circuit, two flutter circuits were occurring simultaneously within the left atrium, one rotates clockwise around the mitral valve annulus, whereas the other rotates counterclockwise around the left-sided pulmonary veins. The two circuits shared a common isthmus (*1DPSs were identified around the critical isthmus. DPSs-targeted ablation eliminated both circuits. Blue dots (white arrow): DPSs.)
### Intra-sinus, inter-sinus competition in heartbeat generation by the sinus node

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**Background:** Currently, a controversy exists as to whether the sinus node is a discrete insulated body with multiple exit sites to the atrium, or is composed of multiple spatially discrete sinus node cells, each of which can initiate a heartbeat independently. Thus, we explored how sinus node (SN) generates and maintains heartbeats.

**Methods:** Canine right atrial preparations (n=5) were optically mapped using ANBDQBS, infrared voltage sensitive dye, to detect optical action potential from transmural layers. 3D isosurface map was obtained to track a route of electrical wavelet originated from the SN. Optically driven location map of the SN by atrial pacing was merged to the histology in order to localize activation site accurately.

**Results:** We observed that the initial electrical impulse was generated from one sinus cluster in the sinus node. During isoproterenol and acetylcholine infusion, all activated sinus clusters were within the histologically demarcated SN and sinus cluster with the steepest slope or earliest cycle length played a role of a leading pacemaker. After sinus rest by atrial pacing, simultaneous arising from multiple sinus clusters was observed, take over by one sinus cluster over time. Isoproterenol 0.5μM allowed a leading sinus cluster to compete with atrial ectopic focus outside of the sinus node. Cryoablation on SN also induced sinus-like activity in atrial tissue outside the SN and isorhythmic competition between two sources was present during partial recovery of SN. The atrial ectopic focus revealed HCN4+ cells by immunohistochemistry.

**Conclusion:** Our findings showed that in heartbeat generation, inter-sinus competition among sinus clusters in the histologically demarcated SN and inter-sinus competition between SN and the atrial pacemaker coexist, demonstrating extreme life-saving mechanism of heartbeats generation.

### Incremental prognostic value of the combination of 4q25 and ZFHX3 gene single nucleotide polymorphisms in patients who underwent radiofrequency catheter ablation for atrial fibrillation

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**Background:** Previous reports have demonstrated the association between single nucleotide polymorphisms (SNPs) of the 4q25 gene and atrial fibrillation (AF) recurrence after radiofrequency catheter ablation (RFCA). This study evaluated whether 4q25 SNPs in combination with ZFHX3 have incremental prognostic value in AF recurrence after RFCA.

**Methods:** A total of 683 consecutive patients (mean age 57±11 years, 76% male) with drug-refractory paroxysmal (68%) or persistent (32%) AF who underwent RFCA were included. SNPs of the 4q25 gene, rs2200733, and ZFHX3 gene, rs1026261, were genotyped and compared with phenotypes of patients including volume parameters by computed tomography.

**Results:** The patients were assigned to 3 groups according to the number of variant alleles (Group A: no variant, n=15, Group B: 1 variant, n=158, Group C: 2 variants, n=439). When we compared 3 groups, there were no significant differences in age, gender, paroxysmal AF, CHA2DS2 score, left atrium (LA) size, and medications. However, venous LA volume was greatly greater in patients with variant allele (Group A vs. B & C: 16.9 vs. 22.3 & 22.9 mL/m2; p<0.023 & 0.620, respectively). The clinical recurrence after 3 months of blanking period after RFCA was observed in 26.2% during the median 15 months of follow-up. Kaplan-Meier survival analysis showed incremental prognostic value according to the number of variant allele (Figure). Log Rank p=0.015. The multivariate analysis showed that persistent AF (OR 1.677, 95% CI 1.176-2.381, p=0.004) and the number of variants (OR 1.552, 95% CI 1.099-2.222, p=0.015) were independent predictors for recurrence of AF.

**Conclusions:** A graded risk of AF recurrence was observed with an increasing number of risk alleles at 4q25 and ZFHX3 gene which was associated with larger venous LA volume. Our findings suggest that multimarker allele combinations can be used as a clinical tool for risk stratification of ablation therapy and post-ablation management.

**Keywords:** 4q25, ZFHX3, SNP, atrial fibrillation, catheter ablation, recurrence
A novel molecular mechanism involved in atrial fibrillation suppression by red wine extract-resveratrol in ischemic heart failure model via PI3K/AKT/eNOS activation

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Background: The study was to investigate whether red wine antioxidant-Resveratrol could reduce susceptibility to AF in heart failure (HF) model and to explore the underlying mechanisms.

Methods: HF rabbits were created by coronary ligation. Group 1 (n=30) involved (a) normal; (b) HF sham; HF rabbits treated with 1-week intraperitoneal injection of (c) Resveratrol, (d) Resveratrol+PI3K inhibitor(wortmannin), (e)Resveratrol+eNOS inhibitor(DPI). All rabbits underwent epicardial AF stimulation. Histology, western blot and PCR analysis were performed in atrial appendage(LAA). Group 2 (n=30) rabbits were subjected to Langendroff heart perfusion to investigate the acute drug effect on atrial electrophysiology.

Results: AF was easily inducible in HF, PI3K and eNOS inhibitors groups but not in normal and Resveratrol groups. Histology study showed significantly less fibrosis in Resveratrol than HF group. In PCR analysis, ionic channels including Kv1.4,Kv1.5,KvLQT1,Nav1.5,Cav1.2,Kir2.1, RyR,SERCA2a,PLB were up-regulated after Resveratrol treatment. mRNA and protein levels of PI3K/Akt and eNOS were upregulated after Resveratrol treatment. PI3K and eNOS inhibitors blocked the PI3K/Akt/eNOS signaling pathway and increased AF susceptibility.

Conclusions: Our study showed benefits of Resveratrol in AF suppression. Reversal of result by inhibitors suggested that loss of PI3K activity and down-regulation of eNOS in PI3K/Akt/eNOS pathway directly contributed to AF susceptibility. Furthermore, increasing PI3K/eNOS activity reduced atrial fibrosis and improved cardiac conduction. Our results suggested that Resveratrol reduced AF via the PI3K/Akt/eNOS signaling pathway.

Next-generation sequencing of nine atrial fibrillation candidate genes identified novel mutations in patients with extreme trait of atrial fibrillation

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Atrial fibrillation (AF) is the most common sustained cardiac arrhythmia. Genome-wide association studies (GWAS) have identified common single nucleotide polymorphisms in nine genomic regions associated with AF (KCNN3, PRRX1, PITX2, WNT8A, CAV1, C9orf71, SYNE2, HCN4 and ZFHX3 genes). However, the genetic variability of these risk variants does not explain the entire genetic susceptibility to AF. Results also suggest that rare variants missed by GWAS may account for the “missing” heritability. Such rare variants may have a large effect and are enriched in patients with extreme phenotypes. An extreme-trait design has recently been proposed to sequence a small, carefully selected patients with extreme phenotypes to identify rare variants or mutations. In the present study, we used next-generation sequencing to sequence the 5' untranslated and coding regions of all the nine published AF susceptibility genes identified by GWAS (a total of 179 exons) in 10 patients with extremely symptomatic lone AF patients refractory to treatments. In PCR analysis, ionic channels including Kv1.4,Kv1.5,KvLQT1,Nav1.5,Cav1.2,Kir2.1, RyR,SERCA2a,PLB were up-regulated after Resveratrol treatment. mRNA and protein levels of PI3K/Akt and eNOS were upregulated after Resveratrol treatment. PI3K and eNOS inhibitors blocked the PI3K/Akt/eNOS signaling pathway and increased AF susceptibility.

Conclusions: The study investigated whether red wine antioxidant-Resveratrol could reduce susceptibility to AF in heart failure (HF) model and to explore the underlying mechanisms.
Facilitation in implantable cardioverter-defibrillator (ICD) lead through a persistent left superior vena cava (LSVC) utilizing a left ventricular (LV) lead delivery system

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Background and Objectives: Persistent LSVC (with the absence of right SVC) poses a challenge in ICD lead delivery, especially when there is an enlarged right atrium, due to the need for performing the counter loops and the lack of ‘back support’ in entering the right ventricle.

Methods: We report a case of a patient (64 y/o male) with a history of hypertrophic cardiomyopathy and associated bi-atrial enlargement who had syncope and documented sustained monomorphic ventricular tachycardia. At his ICD implantation procedure, he was found to have a persistent LSVC with no right SVC. We utilized the LV delivery system (St. Jude Medical) for advancing the ICD lead (St. Jude Medical Durata).

Results: We found that the LV lead delivery system was suitable for the ICD lead and facilitated the placement of the ICD lead towards the right ventricular apical position (the desired position for an ICD system) achieving excellent sensing, pacing (8 mV, < 1.0 volt) and defibrillation (< 10 joules) parameters, without significant increase in implant time.

Conclusion: The LV lead delivery system is a useful system in ICD lead placement in patients with persistent LSVC. A suitable small caliber ICD lead is obviously crucial in this maneuver.

Radiofrequency ablation for incessant atrial tachycardia in a patient with repaired tetralogy of fallot

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Background: Atrial tachyarrhythmia is a well-known late complication in patients with corrected congenital heart disease, which is usually poorly tolerated. Medical treatment is usually not satisfactory. Radiofrequency catheter ablation (RFCA) can be considered for drug refractory cases, but is technically challenging. We presented a case of repaired Tetralogy of Fallot (TOF) with incessant atrial tachycardia undergoing successful RFCA.

Method: A 54-year old lady was known to have repaired TOF (two open heart operations) since childhood. She presented with incessant and poorly tolerated atrial tachycardia. ECG showed atrial tachycardia with rate about 160bpm. She could not tolerate to drug treatment because of low blood pressure. Electrophysiology study (EPS) with RFCA was performed.

Result: During EPS, extensive area of low voltage scar was found at the right atrial free wall compatible with previous atriotomies during previous surgeries. Clinical atrial tachycardia was induced spontaneously by premature atrial complex. Activation map by 3D mapping system showed counterclockwise macro-reentry tachycardia in right atrium compatible with cavotricuspid isthmus (CTI) dependent flutter. Radiofrequency ablation at CTI resulted in termination of the tachycardia and bidirectional block over the ablation line. Conduction time over the line was found to be markedly prolonged to about 240ms, which was likely due to slow conduction over the low voltage scar areas. There was no recurrence of tachycardia on follow up.

Conclusion: Common mechanism of atrial tachyarrhythmia, like CTI-dependent flutter, occurred in patient with repaired complex congenital heart disease. RFCA for such arrhythmia is an effective treatment.

Successful catheter ablation for interfascicular ventricular tachycardia in a case with electrical storm

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Background: Interfascicular ventricular tachycardia (IFVT), a rare type of arrhythmia, is occasionally observed in patients with old myocardial ischemia (OMI).

Method: N/A

Results: A 64-year-old man with a history of anteroseptal OMI, who underwent implantable cardioverter-defibrillator implantation 5 years previously, presented with electrical storm. As anti-tachycardia pacing was ineffective, cardioversion shock was repeatedly applied for sustained VT. The QRS configuration of the VT indicated right bundle branch block (RBBB) with a superior axis. As amiodarone administration was ineffective, emergent catheter ablation was performed on the day of admission. ECG during sinus rhythm showed complete right bundle branch block and left anterior hemiblock. Clinical VT (cycle length 270 ms) was reproducibly induced by programed ventricular stimulation. His bundle electrogram was recorded in diastolic phase of tachycardia, and the HV interval during sinus rhythm and during VT was 70 and 55 ms, respectively. The pacemap at the left posterior fascicular (LPF) area, where bundle branch potential was recorded, matched the clinical VT QRS morphology. The LPF was believed to be the VT exit. As IFVT was suspected, radiofrequency ablation was applied to the left anterior fascicular area during clinical VT to avoid complete atrioventricular block due to LPF ablation. VT was terminated in 4 seconds, and was not induced after ablation.

Conclusion: Since IFVT is curable by catheter ablation, careful observation of His-Purkinje potential during VT is important.

AF ablation with a case complicated with giant coronary arteriovenous fistula running between LSPV and LAA

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A 71-year-old male patient had paroxysmal atrial fibrillation resistant to antirhythmic agents. Before pulmonary vein isolation, we checked computed tomography for geometrical evaluation, which detected arteriovenous fistula from coronary left circumflex artery to coronary sinus. The left to right shunt ratio (Qp/Qs) was calculated as 1.62. He had no symptom and a nucleus stress test showed no significant myocardial ischemia, leading us to decide no requirement of surgical repair. This fistula ran between left superior pulmonary vein and left atrial appendage. It could be injured by catheter ablation to the ridge between them, since there are some reports that catheter ablation led to coronary artery atroasis or obstruction. We performed extensive encircling pulmonary vein isolation at the right side and individual isolation for left inferior pulmonary vein only but not left superior pulmonary vein. After the procedure, there was no recurrence of atrial fibrillation with Biospryel and Beprilid. Prior understanding of anatomical feature is important and we have to keep in mind of vessel anomaly.
**Arrhythmic sequelae of the fontan procedure: impact of fontan type on pattern and prevalence of arrhythmias**

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**Background and Objectives:** To determine the pattern and prevalence of arrhythmias in Fontan patients.

**Methods:** Casenotes review of patients in Royal Melbourne Hospital Fontan Registry.

**Results:** Data available on 47 patients: 26 male (55.3%). Patients had mean 3 operations (range 1-6). Mean age at initial Fontan: 6.8 years (2-21) (atriopulmonary (AP) in 29 (61.7%), lateral tunnel (LT) in 3 (6.4%) and total cavopulmonary connection (TCPC) in 11 (23.4%)). 6 converted from AP to TCPC Fontan (12.8%). Mean age at conversion 20.2 years (17-28).

Bradyarrhythmias were present in 18 (38.3%): sinus bradycardia in 10 (21.2%), first degree AV block in 1 (2.1%), and complete heart block in 7 (14.9%). 10 had permanent pacemakers (PPI) (21.2%) at mean age 16 years. In the AP group, 34.5% required a PPI. There were no PPIs in LT or TCPC groups.

Tachyarrhythmias were present in 27 patients (57.4%): 21 intra-atrial reentrant tachycardia (IART) (44.7%), 3 atrial fibrillation (AF) (6.4%), 3 SVT (6.3%). DC cardioversion was required in 8 (29.6%). In the AP group, tachyarrhythmia prevalence was 72.4% (IART or AF). In the LT or TCPC group tachyarrhythmia prevalence was 21.4% (all SVT). Maze procedure was performed in 3 (11%). His bundle RFA was performed in 2 (7.4%). 10 patients (37%) underwent RFA: 2 for AVRT; 8 for IART. Mean age at RFA: 22.9 years (12-33) and 17.5 years post initial Fontan (9-29 years). All patients who underwent RFA for IART had an AP Fontan.

**Conclusion:** Modern surgical techniques have substantially reduced the prevalence of arrhythmias in the Fontan population.

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**Para-hisian atrial tachycardia ablated from non coronary aortic sinus**

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**Clinical Presentation:** Sixty five year old lady presented with recurrent palpitations more frequent during exercise. Her ECG during baseline showed NSR with incomplete RBBB, no preexcitation.

She was hypertensive. ECG during tachycardia showed regular narrow QRS tachycardia with with long RP with P wave very skinny and inverted in lead II, Positive negative in III and aVF, positive in V1 and negative in V2 to V6 and positive in lead I. CL of tachycardia was 300 msec.

During EP study no preexcitation was present. No dual AV node physiology present. On burst atrial pacing at 200 msec Regular wide QRS tachycardia induced with CL 270 msec which changed into narrow QRS tachycardia without change in CL which exclude bypass tract as a mechanism of tachycardia as VA dissociation was produced on V pacing at 250 msec without capturing atria. Earliest A was found at His bundle electrogram.

Directed mapped at the posterior part of Noncoronary sinus with earliest A was 30 msec than His A. On start of RF within 3 sec tachycardia terminated which I continued for 60 sec. There after by any means tachycardia was not induced.

**Conclusion:** AT with earliest A at His should be mapped directly at Non coronary sinus with shortening of procedure time and getting read of tachycardia.
Normalization of left ventricular ejection fraction is associated with the absence of appropriate anti-tachycardia therapy in patients receiving implantable defibrillators for the primary prevention of sudden death

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Background: Patients with severely depressed left ventricular ejection fractions (LVEF) receive implantable cardiac defibrillators (ICD) for the primary prevention of sudden death. Limited data are available on 1) the incidence of late recovery of LVEF in these patients and 2) the incidence of appropriate anti-tachycardia therapy including pacing and shock in patients with normalized LVEF.

Methods: We retrospectively identified 154 consecutive patients with an ICD for primary prevention who had LVEF available at initial implantation and prior to generator replacement. The incidence of appropriate anti-tachycardia therapy after generator replacement was assessed.

Results: Of the 154 patients (65 ± 14 years, females 25%), 19 (12%) had improvement in their LVEF from 26 ± 9% to ≥ 55%. None of these individuals experienced any appropriate anti-tachycardia therapy during a follow-up period of 28 ± 18 months. Among the remaining 135 patients, with depressed LVEF (25 ± 7%), 30 individuals (22%) had at least one appropriate anti-tachycardia therapy during a follow-up period of 25 ± 7 months. The difference in appropriate anti-tachycardia therapy between the two groups was highly significant (p = 0.02). Compared to patients whose LVEF remained depressed, patients with normalized LVEF trended towards being female (37% vs. 24%, p = 0.26), with a lower prevalence of ischemic cardiomyopathy (53% vs. 73%, p = 0.1).

Conclusion: 12% of the patients with depressed LVEF, who received ICD initially for primary prevention of sudden death, had normalized LVEF at the time of generator replacement. None of these patients received appropriate anti-tachycardia therapy during a follow-up period of 28 ± 18 months. The practice of routine replacement of generator in these patients may need to be re-assessed on an individual basis. Longer follow-up in a larger population is needed to confirm these findings.

Successful CRT-D upgrade following subclavian venoplasty
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Background and Objectives: Asymptomatic subclavian vein stenosis occurs in up to 30% of cardiac implantable electronic device (CIED). It poses management challenge if CRT upgrade is needed in the future. Our case demonstrated a successful CRT-D upgrade after subclavian venoplasty for subclavian stenosis.

Case Summary: Our case is a 59-year-old gentleman who had history of pacemaker (DDDR) implantation over left pectoral region for heart block in 2009. He developed heart failure in 2012 and echocardiogram showed LVEF of 35%. Treadmill revealed infrequent non-sustained ventricular tachycardia at low stress. CRT-D upgrade was arranged in April 2013. Venogram before auxiliary vein puncture showed critical stenosis over left subclavian vein. After auxiliary vein puncture, we could pass the sheath dilator across the subclavian vein stenosis but not the sheath despite stepwise dilatation. Subclavian venoplasty was performed with peripheral balloon (6.0mm in diameter, 40mm in length) at a pressure of 15atms. The subclavian vein stenosis was opened up and insertion of sheath over subclavian vein was successful. Subsequent placement of ICD lead over RV apex and LV lead over posterolateral branch of coronary sinus was not difficult.

Conclusion: Subclavian vein stenosis encountered during CRT upgrade could be successfully overcome by balloon venoplasty.

Riata implantable cardioverter-defibrillator lead failure removed via median sternotomy approach: a case beyond sudden death
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Background: The Riata family of implantable cardioverter-defibrillator (ICD) leads (St Jude Medical, Sylmar, CA) appears prone to a unique failure mechanism. The company has issued a recall for the Riata endocardial leads due to insulation failure.

Objective: To present a case of a 34-year old, sudden death survivor male with ICD lead failure who underwent removal of ICD via median sternotomy approach.

The Case: A 34-year old male who survived sudden cardiac death in 2009, underwent implantation of Riata ICD. After almost a year from implantation, the patient was admitted for appropriate ICD firing on interrogation of the device. Subsequently, the patient has been complaining of recurrent shock deliveries and succeeding device interrogations showed inappropriate firing. The patient later presented with syncopal attacks. Chest CT scan showed an ICD embedded in the left anterior chest wall with the tip of the electrode noted to traverse into the right ventricular (RV) wall and is abutting against the pericardium. Thus, patient underwent removal of endocardial lead and suturing of perforation with placement of new ICD electrode (Durata) via median sternotomy approach.

Conclusion: RV lead perforation is a recognized complication of ICD implantation. The management of Riata lead problem has been based on detecting electric abnormalities on regular ICD interrogations. Whether RV lead extraction would result in better outcomes than a percutaneous lead extraction approach is not known. Since the recall of the Riata lead series, this has been the first reported case of Riata ICD lead failure in the Philippines.

Late failure of left ventricular lead stabilized using the retained guidewire technique in a patient after cardiac resynchronization therapy
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Background: Although Riata ICD lead failure has been reported, the long-term results are not known. Our case describes late Riata lead failure following CRT in a patient with severe LV dysfunction.

Methods: A 63-year-old male with severe LV dysfunction, left bundle branch block (QRS duration 180ms) and class III symptoms underwent CRT in November 2011. During the procedure, LV lead position appeared unstable, and the lead had to be stabilized with 0.014 BW coronary guide wire. The proximal portion of the wire was cut and it was left inside the lead. Pacing and sensing parameters were acceptable and QRS duration was reduced. His functional status improved to class I, and the 6 minute walk distance improved from 270 meters to 420 meters at 12 months. However, he worsened to class III by 15 months. Interrogation revealed loss of capture of LV lead between 12 and 18 months. Fluoroscopy showed fracture of coronary wire at multiple locations with slight displacement of the lead. LV lead was extracted in March 2013 and was found to have multiple breaks. New LV lead was positioned. It is possible that the guide wire, being less flexible than the electrode, broke during the repeated movements of the patient, and this might have damaged the insulating layers and the spirals of the electrode.

Conclusion: This case report shows that the ‘retained guidewire’ technique for LV lead stabilization during CRT can result in delayed fracture of the wire and lead.
**Snare assisted left ventricular lead placement: results, safety and feasibility in 31 patients**

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**Background and Objectives:** To report our experience using snares to hold the distal end of the angioplasty wire to place LV leads.

**Methods:** In 34 cases (17 with prior implant failures) where the LV lead would not advance, the angioplasty wire was advanced via collaterals from the target vein into the adjacent vein then into the CS/RA where the distal end of the wire was snared to prevent the wire from being dislodged as the LV lead was advanced.

**Results:** LV lead implantation was successful in 32 of 34 patients. In 27 patients the wire reentered the CS/RA without the need for wire manipulation, in 7 contrast injection and wire manipulation (5-15 minutes) was required. In 30 patients the distal end of the wire was secured in the CS with a 7mm-10mm snare using a single 9 Fr. ID catheter. In 4 patients a second access was used for a 25mm snare to secure the wire in the RA. The wire was snared in 7.2 minutes (median 7.5). Snare failures occurred in patients with prior attempts (1-3); wire snared too proximal and slipped free in one and the other the LV lead would not advance due to multiple wire bends. There were no clinical complications.

**Conclusion:** Securing the distal end of the wire with a snare is a quick, safe and effective method for LV lead placement when other approaches are not successful. With a 9 Fr. ID CS catheter for CS Access a second catheter is usually not required.

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**Implant experience of percutaneous leadless pacemaker devices in swine**

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**Background:** Conventional pacemakers with transvenous leads in the right ventricle have been used clinically for more than 50 years. This study tests the feasibility of the implant of 2 leadless pacemaker devices in the right ventricle in a swine model.

**Methods:** Mini pigs (40-50 kg) were anesthetized with ketamine and diazepam. A transducer was inserted to the jugular vein near the thoracic inlet via a cut-down. Under the fluoroscopy imaging and with the help of the introducer, the first leadless pacemaker device was implanted in the apex of the right ventricle. One month later, the second device was placed on the septum 1 cm from the apex in the same mini pig and with the same procedure. Cardiac function was assessed with transthoracic echocardiography.

**Results:** Up to now, we have completed sequential implantations in 6 pigs and an example of the implanted devices is shown in Figure 1. No major adverse events such as cardiac perforation, valve injury, venous occlusion or device infection were observed during the implant procedures. The time for the implant procedure could be as short as 80 minutes.

**Conclusions:** This is the first study in a swine model to investigate the impact of multiple leadless pacemaker devices in the right ventricle. The implant procedures are simple without major adverse events.