Abstracts of the Scientific Spring Congress of the Netherlands Society of Cardiology 7-8 November 2019

Conference Center Papendal - Arnhem
Session 1: Atrial fibrillation

EFFICACY AND SAFETY OF ADDITIONAL NON PULMONARY VEIN TRIGGER ABLATION IN TREATMENT OF PERSISTENT ATRIAL FIBRILLATION

A. Adiyaman (Isala, Zwolle); M. Rehman (Isala, Zwolle); A.R. Ramdat Misier (Isala, Zwolle); J.J.J. Smit (Isala, Zwolle); P.P.H.M. Delnoy (Isala, Zwolle); A. Elvan (Isala, Zwolle)

Purpose:
Success rates of ablation in patients with persistent atrial fibrillation (AF) remains modest. A strategy of additional non-pulmonary vein trigger ablation improved success rates in randomized trials, mostly published by a single research group in the United States of America. We therefore investigated long term results of this approach in our centre.

Methods:
Consecutive patients with persistent (87%) and/or longstanding persistent AF (13%), underwent RF catheter ablation in our centre. Pulmonary vein isolation, posterior left atrial isolation and isoproterenol guided non-pv trigger ablation was performed. Post ablation atrial burst pacing was performed with a CL of 300-200 (or refractory) ms, and inducible stable atrial tachycardias were ablated. Success was defined as freedom of atrial tachyarrhythmias, after a blanking period of 3 months.

Results:
A total of 91 patients were treated, and 63 patients with at least 1 year follow-up were analyzed. Mean age was 62±10 (34% females) and mean left atrial volume was 43Â±7 cc/m2. Success at 12 months was 81%, after a mean of 1.13 procedures, with 3.2% still on anti-arrhythmic drugs. Major and minor complications occurred in 1.4% and 4.3% of procedures. After a mean of 24Â±13 months, 75% of patients were free of atrial tachyarrhythmia. No recurrences occurred between 24-48 months of follow-up.

Conclusion:
A strategy of pulmonary vein isolation, posterior left atrial isolation and isoproterenol guided non-pv trigger ablation, in patients with persistent and/or longstanding persistent AF, results in excellent success rates.
Figures:
INTEGRATED MANAGEMENT OF ATRIAL FIBRILLATION IN PRIMARY CARE –
RESULTS OF THE ALL-IN CLUSTER RANDOMISED TRIAL

C.J. van den Dries (UMC Utrecht, Utrecht); S. van Doorn (UMCU, Utrecht); F.H. Rutten (UMCU, Utrecht); R. Oudega (UMCU, Utrecht); J.J.C.M. van de Leur (UMCU, Utrecht); A. Elvan (Isala, Zolle); L. Oude Grave (UMCU, Utrecht); H.J.G. Bilo (UMCG, Groningen); K.G.M. Moons (UMCU, Utrecht); A.W. Hoes (UMCU, Utrecht); G.J. Geersing (UMCE, Utrecht)

Purpose:
Integrated care for atrial fibrillation (AF) patients reduced mortality in an outpatient tertiary care setting. Elderly AF patients often suffer from cardiac and non-cardiac comorbidities, some of which already managed in primary care. This makes it potentially attractive to orchestrate integrated AF-care in primary care, yet only if proven safe.

Methods:
The ALL-IN trial was a cluster randomised, pragmatic non-inferiority trial performed in primary care practices in the Netherlands. Practices were randomised to either integrated AF-care or usual care, for AF patients aged ≥ 65 years. The integrated care intervention consisted of (i) quarterly check-ups by trained nurses in primary care, (ii) monitoring of anticoagulation therapy in primary care, and finally (iii) close collaboration with cardiologists and anticoagulation clinics. The primary endpoint was all-cause mortality during 2 years of follow-up. Secondary endpoints were cardiovascular and non-cardiovascular adverse events.

Results:
26 practices were randomised (15 intervention, 11 control). In the intervention arm, 527 out of 941 eligible AF patients provided informed consent to undergo the intervention. These 527 patients were compared with 713 AF patients in the control arm. Median age was 77 years (interquartile range 72-83). The all-cause mortality rate was 3.5 per 100 patient-years in the intervention arm versus 6.7 per 100 patient-years in the control arm (adjusted hazard ratio 0.55; 95% confidence interval 0.37-0.82). For other adverse events no statistically significant differences were observed.

Conclusion:
In this cluster randomised trial, integrated care for elderly AF patients in primary care showed a 45% reduction in all-cause mortality when compared to usual care.
Figures:

* Adjusted for age, sex and frailty index

<table>
<thead>
<tr>
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<th>Intervention rate (events)</th>
<th>Control rate (events)</th>
<th>Relative risk (95% CI)</th>
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<td><strong>Primary Outcome:</strong></td>
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<tr>
<td>All-cause mortality</td>
<td>3.45 (39)</td>
<td>6.72 (96)</td>
<td>0.55 (0.37 - 0.82)</td>
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<td><strong>Secondary Outcomes:</strong></td>
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<tr>
<td>Cardiovascular mortality</td>
<td>1.86 (21)</td>
<td>3.22 (46)</td>
<td>0.63 (0.37 - 1.06)</td>
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<td>Non-cardiovascular mortality</td>
<td>1.59 (18)</td>
<td>3.50 (50)</td>
<td>0.47 (0.27 - 0.82)</td>
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<td>MACE</td>
<td>4.76 (50)</td>
<td>4.59 (62)</td>
<td>0.90 (0.62 - 1.32)</td>
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<td>Ischaemic stroke</td>
<td>1.35 (15)</td>
<td>1.28 (18)</td>
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<td>Major bleeding</td>
<td>2.54 (28)</td>
<td>2.01 (28)</td>
<td>1.36 (0.70 - 2.62)</td>
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<tr>
<td>All-cause hospitalisation</td>
<td>28.72 (323)</td>
<td>32.91 (466)</td>
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<td>CV hospitalisation</td>
<td>9.25 (104)</td>
<td>10.95 (155)</td>
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<td>Non-CV hospitalisation</td>
<td>19.48 (219)</td>
<td>21.97 (311)</td>
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<td>Non-major bleeding</td>
<td>16.90 (190)</td>
<td>17.37 (245)</td>
<td>0.99 (0.80 - 1.23)</td>
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ISCAN: IMPLEMENTING SELF MANAGEMENT USING EHEALTH FOR MONITORING AND MANAGEMENT AFTER CATHETER ABLATION IN THE TREATMENT OF ATRIAL FIBRILLATION; A STUDY ON THE DIAGNOSTIC ACCURACY OF AN EHEALTH SOLUTION

M.N. Klaver (St. Antonius ziekenhuis, Nieuwegein); M. Maarse (St. Antonius ziekenhuis, Nieuwegein); J. Peper (St. Antonius ziekenhuis, Nieuwegein); V.F. van Dijk (St. Antonius ziekenhuis, Nieuwegein); M.C.E.F. Wijffels (St. Antonius ziekenhuis, Nieuwegein); M. Liebregts (St. Antonius ziekenhuis, Nieuwegein); J. van de Swaluw (Jeroen Bosch ziekenhuis, ’s-Hertogenbosch); S. Blok (Cardiologie Centra Nederland, Amsterdam); G.A. Somsen (Cardiologie Centra Nederland, Amsterdam); I.I. Tulevski (Cardiologie Centra Nederland, Amsterdam); J.C. Balt (St. Antonius ziekenhuis, Nieuwegein); L.V.A. Boersma (St. Antonius ziekenhuis, Nieuwegein)

Purpose:
In recent years many mobile devices and applications claim to be able to detect cardiac arrhythmias have emerged. Limited data and resources are available for the clinician to assess the diagnostic performance and clinical value of such technologies. The aim of this study is to assess the diagnostic performance of a smartphone-based single-lead EKG device and automated algorithm in detecting atrial fibrillation in patients undergoing pulmonary vein isolation (PVI).

Methods:
The iSCAN study (NL6956) is a prospective single-centre cohort study including patients scheduled for pulmonary vein isolation (PVI) for atrial fibrillation (AF). Patients underwent a 7-day Holter with concomitant daily and symptom-driven EKG recordings with the telemonitoring device prior to PVI. The primary analysis was to compare the diagnostic performance of the automated algorithm with two references; (1) the cardiologists’ interpretation of the single-lead EKG recording and (2) the Holter monitoring result.

Results:
102 patients scheduled for PVI were included between August 2018 and May 2019 (73% male, 61±10 years old and CHA2DS2-VASC 1 [0 – 2]). At inclusion, 63% of the patients were diagnosed with paroxysmal AF, 31% persistent AF and 6% long-standing persistent AF. A total of 1101 EKGs were recorded and analyzed (11 [8-16] EKGs per patient). The algorithm categorised these as; 55% sinus rhythm (SR), 31% AF, 14% not classified and 1% unreadable. After cardiologists review, 98% of the recordings were deemed interpretable and classified as SR in 66% and AF in 31% of cases. The quality was scored as “good” in 87%, “moderate” in 11% and “uninterpretable” in 2%. Of note, 13% of the recordings showed PAC and/or PVC. Using the cardiologists’ interpretation as the reference standard for AF, sensitivity, specificity, negative predicting value, positive predicting value and accuracy were determined: 0.98, 0.82, 0.99, 0.73 and 0.87. Using the Holter as the reference standard for AF, the diagnostic performance was comparable: 0.98, 0.81, 0.99, 0.72 and 0.87. Patients reported the device and application to be easy to use (9.3/10) and helpful to address their symptoms and monitor their treatment (9.3/10).

Conclusion:
The present study shows the performance of a patient-driven single lead EKG eHealth monitoring solution. As a standalone, the algorithm has a decent performance, but remains inferior to Holter monitoring and might cause concerns or anxiety in patients. Supported by a cardiologists’ review, the accuracy becomes viable for clinical use and might be an attractive alternative for rhythm monitoring.
TREATMENT AND OUTCOME OF ATRIAL FIBRILLATION AND ITS ASSOCIATION WITH CLOSURE IN PATIENTS WITH AN ATRIAL SEPTAL DEFECT

M. Reinders (Radboud University Medical Center, Nijmegen); R. Evertz (RadboudUMC, Nijmegen); C.A. Houck (RadboudUMC, Nijmegen); T.J.F. ten Cate (RadboudUMC, Nijmegen); A.L. Duijnhouwer (RadboudUMC, Nijmegen); R.H. Beukema (RadboudUMC, Nijmegen); S.W. Westra (RadboudUMC, Nijmegen); K. Vernooy (RadboudUMC, Nijmegen; Maastricht UMC+, Maastricht); N.M.S. de Groot (Erasmus MC, Rotterdam)

Purpose:
Despite the fact that atrial fibrillation (AF) is a known complication in atrial septal defect (ASD) patients, there is no consensus on the relation between closure of an ASD and the incidence of AF. More importantly studies reporting on the treatment applied for AF in ASD patients are missing. The aims of this study were (a) to assess the incidence of AF in ASD patients, (b) to study the relation between closure and AF and (c) to evaluate applied treatment strategies including rhythm control and rate control.

Methods:
A single centre retrospective and descriptive study in patients with an ASD, extracted from a clinical outpatient database containing follow-up data between 2004 and 2015. We compared ASD patients on two levels, first on the development of new-onset AF yes or no, and second a comparison based on closure of the defect, yes or no. Adjustments on the association with AF or closure were made with logistic regression analysis.

Results:
Of the total 173 patients, 34 (19.7%) developed new-onset AF during a median follow-up time of 43 years, which resulted in an incidence rate of 4.45 per 1000 patients years. Mean (SD) age at new-onset AF was 59 (±14) years. Of those 34 patients, 12 were never closed, 8 developed new-onset AF pre-closure and 14 had new-onset AF after closure. Hypertension (P < .001), obstructive sleep apnoea (P = .049) and a dilated left atrium (P < .001) were more prevalent in patients who developed AF. Older age (OR: 1.072; P < .001) and a dilated left atrium (OR: 3.727; P = .009) were independently associated with new-onset AF. After adjustments, closure itself was not independently associated with AF. First applied treatment strategy was rhythm control in 77% (24/31), among whom 6 (19%) switched to rate control during follow-up period. 18 patients were treated with antiarrhythmic drugs. 50% of these patients had at least 1 recurrence of AF with median 2 recurrences per patient. Five patients had additional rhythm control interventions, taking into account a blanking period of 3 months, 3 of the 5 patients were recurrence free.

Conclusion:
The risk of developing AF in ASD patients is high and occurs at a relatively young age, nevertheless aging is still an important risk factor in these patients. Closure of the defect was not associated with a higher incidence of AF, and no clear preventive or therapeutic relation was found between closure and AF in ASD patients. This is the first study describing applied therapy for AF in ASD patients, where rhythm control might be the preferred strategy, though with disappointing results in our cohort.
FEASIBILITY OF A MULTIDISCIPLINARY LIFESTYLE PROGRAM FOR OBESE PATIENTS WITH ATRIAL FIBRILLATION

N.C.C.W. Tenbült van Limpt (Máxima MC, Eindhoven); J.J. Kraal (Faculteit Industrial Design Engineering, Delft); R.W.M. Brouwers (Máxima MC, Eindhoven); R.F. Spee (Máxima MC, Eindhoven); S.C.M. Eijsbouts (Máxima MC, Eindhoven); H.M.C. Kemps (Máxima MC & Department of Industrial Design, University of Technology, Eindhoven)

Purpose:
Obesity in cardiac patients results in a higher risk of atrial fibrillation (AF) and more frequent and severe AF complains. A healthy lifestyle consisting of frequent exercise and healthy nutrition result in weight loss, consequently decreasing burden of AF and improving the effect of pulmonary vein ablation isolation (PVAI). However, traditional lifestyle programs often lack focus on behavioural change management, resulting in a decreased outcome after termination of the program. Aim of this pilot is to study the feasibility of a multidisciplinary cardiac rehabilitation (CR) program focusing on behavioural change in AF patients with obesity.

Methods:
We included 10 patients with AF and a BMI > 29.0. Patients received CR for three months including exercise training, lifestyle counselling by an Advanced Nursing Specialist, dietary advice and psychosocial therapy when deemed necessary. Main endpoints were weight loss and burden of AF (AFSS questionnaire). Secondary endpoints were physical fitness (6MWT), depression (PHQ9) and anxiety (GAD7). Measurements were performed at baseline and post-CR. Weight and 6MWT were also assessed at 1-year follow-up. Analyses were performed using paired sample t-tests.

Results:
Patients were predominantly men (8/2), had a mean age of 57.2±9.0, and a BMI of 32.4±3.5. Two patients dropped out during the trial. After CR patients improved their weight and 6MWT significantly (-4.7±4.7kg, (p=0.01) and 50.1±34.9m (p=0.01) respectively, table 1). Although the absolute differences were maintained at 1-year follow-up, the differences were not significant due to substantial inter-subject variation. Although differences in AF burden, depression and anxiety before and after CR were not significant, all showed a trend towards reduced complaints.

Conclusion:
A multidisciplinary lifestyle program in obese patients with AF appears feasible to reduce weight and physical fitness. Consequently, it appears to decrease burden of AF, although sample size was too small to detect significant differences. Currently a multicenter RCT is performed to study clinical effectiveness of a tailored CR program for obese AF and non-AF patients. Results of this study are expected in 2020.
Figures:

Table 1: Results of the CR program

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Post CR</th>
<th>1-year follow-up</th>
<th>p-value</th>
</tr>
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<tbody>
<tr>
<td>Weight (kg)</td>
<td>107.2 ± 11.8</td>
<td>102.5 ± 13.7</td>
<td>105.1 ± 16.1</td>
<td>0.01 &amp; 0.09</td>
</tr>
<tr>
<td>6MWT (m)</td>
<td>538.9 ± 70.6</td>
<td>595.3 ± 72.8</td>
<td>600.8 ± 94.0</td>
<td>0.01 &amp; 0.10</td>
</tr>
<tr>
<td>AFSS - Burden</td>
<td>17.4 ± 3.5</td>
<td>16.3 ± 2.0</td>
<td>-</td>
<td>0.16</td>
</tr>
<tr>
<td>PHQ9</td>
<td>6.8 ± 4.3</td>
<td>4.6 ± 4.3</td>
<td>-</td>
<td>0.16</td>
</tr>
<tr>
<td>GAD7</td>
<td>4.4 ± 5.3</td>
<td>2.7 ± 2.9</td>
<td>-</td>
<td>0.39</td>
</tr>
</tbody>
</table>

Data are provided as mean ± SD
Purpose:
Studies on routine use of direct-acting oral anticoagulants (DOACs) for stroke prevention in patients with atrial fibrillation (AF) show that patient characteristics and dosing practices differ per region. However, as edoxaban is the most recently approved DOAC, data on this anticoagulant is scarce.

Methods:
We described characteristics and prescription patterns for patients prescribed edoxaban in Belgium and the Netherlands (BeNe), and compared these with those from other European countries (OEC) using results from the ETNA-AF-Europe study, a post authorization study on edoxaban conducted in 10 European countries.

Results:
Of all 13,639 patients included in our analyses, 2,579 were from BeNe: 1,316 from Belgium and 1,263 from the Netherlands. BeNe-patients were similar to those from OEC respecting age (mean: 72.3 vs. 73.9 years), weight (mean: 82.3 vs. 80.7 kg), CHAD2DS2-VASc (mean: 2.8 vs. 3.2), and HAS-BLED (mean: 2.4 vs. 2.6). However, relatively fewer patients in BeNe were prescribed 30 mg edoxaban (14.8%) than in OEC (25.4%), and of all patients in BeNe, 5.5% were prescribed 30 mg and had no dose reduction criterion, relative to 9.0% in OEC. Moreover, compared with OEC-patients, BeNe-patients had higher creatinine clearances (mean: 78.4 vs. 73.5 mL/min), and were less frequently previously diagnosed with hypertension (61.6% vs. 80.4%), congestive heart failure (4.2% vs. 6.2%), and/or diabetes mellitus (17.3% vs. 23.1%). Conversely, a prior transient ischaemic attack was more prevalent in BeNe (5.0%) compared with in OEC (3.3%).

Conclusion:
Overall, characteristics and prescription patterns of AF-patients prescribed edoxaban were similar in BeNe and OEC, yet there were several notable differences.
**Figures:**

Characteristics of patients prescribed edoxaban in Belgium and the Netherlands compared with those in other European countries.

<table>
<thead>
<tr>
<th>Characteristics</th>
<th>Belgium and the Netherlands (N=2,579)</th>
<th>Other European countries (N=11,060)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reduced dose users - N (%)</td>
<td>382 (14.8)</td>
<td>2,612 (25.4)</td>
</tr>
<tr>
<td>Male - N (%)</td>
<td>1,514 (58.8)</td>
<td>3,219 (56.2%)</td>
</tr>
<tr>
<td>Age - years</td>
<td>72.3 ± 9.1</td>
<td>73.9 ± 9.6</td>
</tr>
<tr>
<td>Body weight - kg</td>
<td>82.3 ± 17.4</td>
<td>80.7 ± 17.3</td>
</tr>
<tr>
<td>Creatinine clearance† - mL/min</td>
<td>78.4 ± 29.7</td>
<td>73.5 ± 30.6</td>
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<tr>
<td>CHA₂DS₂-VASc†</td>
<td>2.8 ± 1.4</td>
<td>3.2 ± 1.4</td>
</tr>
<tr>
<td>HAS-BLED†</td>
<td>2.4 ± 1.2</td>
<td>2.6 ± 1.1</td>
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<tr>
<td>Off-label use of edoxaban*</td>
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<tr>
<td>Reduced dose - N (%)</td>
<td>141 (5.5)</td>
<td>998 (9.0)</td>
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<tr>
<td>Standard dose - N (%)</td>
<td>211 (8.2)</td>
<td>953 (8.6)</td>
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CATHETER ABLATION AFFECTS EFFICACY OF THORACOSCOPIC SURGERY

R. Wesselink (Amsterdam UMC locatie AMC, Amsterdam); M. Vroomen (Maastricht UMC+, Maastricht); J. Neefs (Amsterdam UMC locatie AMC, Amsterdam); N.W.E. van den Berg (Amsterdam UMC locatie AMC, Amsterdam); E.R. Meulendijks (Amsterdam UMC locatie AMC, Amsterdam); S.W.E. Baalman (Amsterdam UMC locatie AMC, Amsterdam); W.R. Berger (OLVG, Amsterdam); S.P.J. Krul (Amsterdam UMC locatie AMC, Amsterdam); F. Piersma (Amsterdam UMC locatie AMC, Amsterdam); A.H. Zwinderman (Amsterdam UMC locatie AMC, Amsterdam); L.A.F.G. Pison (Ziekenhuis Oost-Limburg, Genk); M. la Meir (UZ Brussel, Brussel); W.J.P. van Boven (Amsterdam UMC locatie AMC, Amsterdam); A.H.G. Driessen (Amsterdam UMC locatie AMC, Amsterdam); J.R. de Groot (Amsterdam UMC locatie AMC, Amsterdam);

Purpose:
To determine the effect of a previous catheter ablation on the efficacy of thoracoscopic surgical ablation

Methods:
Patients from the Amsterdam UMC location AMC and Maastricht UMC+ underwent thoracoscopic surgical ablation for treatment of AF. The primary endpoint was freedom of any atrial tachyarrhythmia >30s without the use of antiarrhythmic drugs. We used conditional logistic regression (LR), conditional logistic regression with inverse propensity weighting (LR IPW) and 1:1 propensity score matching (PSM)

Results:
601 patients were included. 495 from Amsterdam UMC location AMC and 106 from Maastricht UMC+. On baseline characteristics from the Amsterdam UMC cohort, patients with a previous catheter ablation had lower LAVI (34.2, 38.7 ml/m2 p<0.001), tendency to lower RAVI (26.4, 28.9 ml, p=0.06), longer AF duration (6[4-10], 4[2-7], p<0.001), less persistent AF (49.5, 64.1%, p=0.01) and less congestive heart disease (0, 7.3%, p=0.01). All three models consistently show increased AF recurrence for thoracoscopic surgical ablation after earlier catheter ablation. The odds ratio for LR was 1.40 (p=0.14), for LR IPW 1.58 (p<0.001) and for PSM 2.06 (p=0.02).

Conclusion:
Patients with a previously failed catheter ablation undergoing thoracoscopic surgical ablation have more recurrence of AF despite having less risk factors for recurrence. Our data are consistent with a causal relation between previous CA and worse outcome of VATS.
Figures:

Figure: Kaplan-meier of 1:1 propensity score matched groups. P value calculated with log rank test.

Survival probability

$p = 0.017$

Patients at risk

<table>
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NURSE-LED VS. USUAL-CARE FOR ATRIAL FIBRILLATION

E.P.J. Wijtvliet (Maastricht University Medical Centre, Maastricht; Cardiovascular Research Institute Maastricht (CARIM), Maastricht; Martini Hospital, Groningen); R.G. Tieleman (Martini Hospital, Groningen); I.C. van Gelder (University of Groningen, Groningen); N.A.H.A. Pluymaekers (Maastricht University Medical Centre, Cardiovascular Research Institute Maastricht (CARIM), Maastricht); M. Rienstra (University of Groningen, Groningen); R.J. Folkeringa (Medical Centre Leeuwarden, Leeuwarden); P. Bronzwaer (Zaans Medical Centre, Zaandam); A. Elvan (Isala Hospital, Zwolle); J. Elders (Canisius Wilhelmina Hospital, Nijmegen); R. Tukkie (Spaarne Hospital, Haarlem); J.G.L.M. Luermans (Maastricht University Medical Centre, Cardiovascular Research Institute Maastricht (CARIM), Maastricht); A.D.I. Van Asselt (University of Groningen, Groningen); S.M.J. Van Kuijk (Maastricht University Medical Centre, Maastricht); J.G. Tijssen (Amsterdam University Medical Centre, Amsterdam); H.J.G.M. Crijns (Maastricht University Medical Centre, Cardiovascular Research Institute Maastricht (CARIM), Maastricht)

Purpose:
We conducted a multicenter, randomized trial, RACE 4 (Nurse-led Care vs. Usual-care), to find out whether in patients newly referred for management of atrial fibrillation, nurse-led care would be superior to usual-care provided by a cardiologist in reducing cardiovascular mortality and cardiovascular hospitalization. The article is 'in press' with the European Heart Journal.

Methods:
We randomized 1375 patients with atrial fibrillation (64 ± 10 years, 44% women, 57% had CHA2DS2-VASc ≥ 2) to receive nurse-led care or usual-care. Nurse-led care was provided by specialized nurses using a decision-tool, in consultation with the cardiologist. The primary endpoint was a composite of cardiovascular death and cardiovascular hospital admissions.

Results:
Of 671 nurse-led care patients, 543 (81%) received anticoagulation in full accordance with the guidelines against 559 of 683 (82%) usual-care patients. The cumulative adherence to guidelines-based recommendations was 61% under nurse-led care and 26% under usual-care. Over 37 months of follow-up, the primary endpoint occurred in 164 of 671 patients (9.7% per year) under nurse-led care and in 192 of 683 patients (11.6% per year) under usual-care [hazard ratio (HR) 0.85, 95% confidence interval (CI) 0.69 to 1.04, P = 0.12]. There were 124 vs. 161 hospitalizations for arrhythmia events (7.0% and 9.4% per year), and 14 vs. 22 for heart failure (0.7% and 1.1% per year), respectively. Results were not consistent in a pre-specified subgroup analysis by centre experience, with a HR of 0.52 (95% CI 0.37–0.71) in four experienced centres and of 1.24 (95% CI 0.94–1.63) in four less experienced centres (P for interaction <0.001).

Conclusion:
Our trial failed to show that nurse-led care was superior to usual-care. The data suggest that nurse-led care by an experienced team could be clinically beneficial.
Figures:
(A) Primary endpoint of the trial. (B) The incidence of the primary endpoint over time in experienced (B1) and less-experienced centres (B2).
MEASURING THE ACTIVATED CLOTTING TIME IN PATIENTS RECEIVING UNFRACTIONATED HEPARIN PRIOR TO CORONARY ANGIOGRAPHY AND INTERVENTION

J.C. Heemelaar (Noordwest Ziekenhuisgroep, Alkmaar); A.C.M. Heestermans (Noordwest Ziekenhuisgroep, Alkmaar), M.T. Dirksen (Noordwest Ziekenhuisgroep, Alkmaar), J.H. Cornel (Noordwest Ziekenhuisgroep, Alkmaar), E. ten Boekel (Noordwest Ziekenhuisgroep, Alkmaar), J. van Ramshorst (Noordwest Ziekenhuisgroep, Alkmaar)

Purpose:
Activated clotting time (ACT) has been used for decades in cardiac surgery and interventional cardiology to assess unfractionated heparin activity. However, standardised protocols for the use of ACT measurement in the catheterisation laboratory are lacking. We aimed to investigate the influence of sampling site on the variability of ACT measurement.

Methods:
We conducted a cross-sectional single center study comparing ACT measurements in simultaneously obtained blood samples from three different sample sites (arterial catheter, arterial sheath, and peripheral intravenous line) after diagnostic angiography or elective PCI. Measurements were performed using the i-Stat® device (Abbott, Princeton, NJ, United States of America).

Results:
Between April 2018 and August 2018 110 consecutive patients included, of whom 100 (mean age 67.1, 65% male) were included in per-protocol analysis. There were no significant differences in ACT measurements obtained from the guiding catheter and arterial sheath (mean difference (MD) -18.3 s; standard deviation (SD) 96 s; P=0.067). On the contrary, ACT measurements obtained from the intravenous line were significantly shorter as compared to measurements obtained from the guiding catheter (MD 25.7 s; SD 75.5; P=0.003) and arterial sheath (MD 39 s; SD 102.8; P< 0.001). A Bland-Altman plot revealed statistically significant proportional bias between measurements from the arterial sheath and the other sample sites (sheath vs catheter, r = 0.761, P = 0.001; sheath vs IVL , r = 1.013, P < 0.001).

Conclusion:
The present study shows that ACT measurements from different sample sites are grossly comparable, but not interchangeable. ACT values obtained from intravenous line were structurally lower, although this difference was of limited clinical significance. Furthermore, ACT values obtained from the arterial sheath are subject to larger deviations at higher ACT values. Bias in ACT measurements may be minimized by taking into account some practical considerations and using uniform protocols for of ACT measurement during cardiac catheterisation.
Purpose:
Absorb bioresorbable vascular scaffold (BVS) related events have been reported between 1 and 3 years – the period of active scaffold bioresorption. This resulted in the recommendation to continue DAPT up to 3 years after implantation. We evaluated the safety and efficacy of the Absorb BVS compared to Xience everolimus-eluting stent (EES) in routine PCI at 3 years follow-up in the AIDA all comers trial.

Methods:
AIDA was a single-blind, multicentre, investigator-initiated, non-inferiority trial, in which 1,845 patients were randomly assigned to either Absorb BVS (924) or Xience EES (921). The primary endpoint was target-vessel failure, a composite of cardiac death, target-vessel myocardial infarction (TV-MI) or target-vessel revascularisation.

Results:
At three-years, TVF occurred in 123 Absorb BVS-treated patients (13.5%) versus 110 Xience EES-treated patients (12.1%) (HR 1.13; p=0.364). Absorb BVS was associated with an increased rate of TV-MI and definite device thrombosis (HR 1.55, p=0.041 and HR 6.02, p<0.001, respectively).

Conclusion:
Device-related events continued to accrue through 3 years following PCI in both Absorb BVS and Xience EES. Yet, Absorb BVS had overall higher rate of target-vessel myocardial infarction and definite device thrombosis compared to Xience EES. Of note, there was only one very late device thrombosis in Absorb BVS-treated patients who continued DAPT up to three years.
Figures:
Time-to-first event curves of target lesion failure through 3 years

Hazard Ratio 1.13 (95% CI 0.87 - 1.46)
p=0.364

<table>
<thead>
<tr>
<th>No. at risk</th>
<th>Absorb BVS</th>
<th>Xience EES</th>
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DETERMINING FACTORS ASSOCIATED WITH HIGHER INCIDENCE OF DISCREPANCY BETWEEN, FRACTIONAL FLOW RESERVE AND INSTANTANEOUS WAVE-FREE RATIO IN AN ALL-COMER, POPULATION

J.J.P. Luijkx (Zuyderland Medisch Centrum, Heerlen); T. Pustjens (Zuyderland Medisch Centrum, Heerlen); S. Rasoul (Zuyderland Medisch Centrum, Heerlen)

Purpose:
Fractional Flow Reserve (FFR) has been widely used to assess intermediate coronary stenoses. Recently, instantaneous wave-Free ratio (iFR) has been shown to have similar diagnostic accuracy and long-term outcomes. iFR is performed without adenosine administration and may thus reduce procedural time, costs and chest discomfort. However, discrepant values between FFR and iFR occur regularly and form a dilemma in clinical decision-making as the cause of discrepancies remains unclear. In this study, we sought to identify factors that may cause discrepant measurements.

Methods:
All patients from the Zuyderland Medical Centre in Heerlen, The Netherlands, requiring functional assessment of intermediate coronary stenoses, received both FFR and iFR subsequently for each stenosis. Of these patients, multiple demographics, procedural data and echocardiographic data were collected. All data were analysed in order to find associations between collected variables and the occurrence of discrepant measurements.

Results:
From January 2017 through December 2017, 731 stenoses measured in 502 patients were included. In 116 (15.9%) stenoses, discrepancy between FFR and iFR occurred. A maximal aortic valve velocity of >3 m/s and maximal aortic valve pressure gradient of >50 mmHg, showed higher incidence of discrepant measurements (odds ratio (OR) 3.30, 95% confidence interval (CI), 1.60-6.83) and (OR 2.79 95% CI 1.20-6.47) respectively. FFR values approximating the cut-off value of 0.80, were also associated with higher incidence of discrepancies (FFR 0.77-0.83 OR 4.00 95% CI 2.61-6.12 and FFR 0.79-0.81 OR 4.74 95% CI 2.68-8.43).

Conclusion:
Aortic valve stenosis has shown to be associated with a higher chance of discrepancy between FFR and iFR.
Figures:

**Fig. 1a. Proportion of discrepancy categorized by AV Vmax**

Percentual incidence of discrepancy categorized by AV max velocity

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<td>3.1-4.0 m/s</td>
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<tr>
<td>&gt;4.0 m/s</td>
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</table>

**Fig. 1b. Proportion of discrepancy categorized by AV maxPG**

Percentual incidences of discrepancy for multiple groups

<table>
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<th>Maximum AV pressure gradient</th>
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<tr>
<td>&lt;30 mmHg</td>
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<td>&gt;50 mmHg</td>
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POSITIVE PREDICTIVE VALUE OF CORONARY COMPUTED TOMOGRAPHY ANGIOGRAPHY FOR DETECTING SIGNIFICANT CORONARY ARTERY DISEASE

A.J. Paes (OLVG, Amsterdam); J.M. Schroeder-Tanka (OLVG, Amsterdam); R.G.E.J. Groutars (OLVG, Amsterdam); H.M. Suliman (OLVG, Amsterdam)

Purpose:
Coronary computed tomography angiography (CCTA) is a non-invasive imaging modality that has become increasingly valuable due to technical improvements of modern computed tomography (CT) scanners. Its applicability for ruling-out coronary artery disease has been thoroughly established due to a high sensitivity. However, the role and performance of CCTA for detecting significant coronary artery stenosis remains largely unclear. The aim of this study is to assess the positive predictive value of CCTA in daily clinical practice.

Methods:
A retrospective, single center, 'real world' study was performed. Inclusion criteria were defined as: adult patients with suspected significant stenosis at CCTA who subsequently underwent invasive coronary angiography (ICA). Exclusion criteria: previous revascularization. The CT images were acquired using a Revolution™ CT (GE Healthcare, Waukesha, WI, USA) 256-slice scanner. CCTA reports and ICA results were compared regarding stenosis severity.

Results:
In total 103 patients were included. Mean age was 63 (± 9) years, 57% female, a median Agatston-score of 401. Cardiovascular risk-factors were prevalent. Among these, 100 (97.1%) patients had coronary artery disease of any kind and 51 (49.5%) had a significant stenosis at ICA. The positive predictive value was 25.2%, 38.8% and 49.5% in a per segment, per vessel and patient-based analysis respectively.

Conclusion:
This 'real world' study using CCTA for detecting significant coronary artery stenosis revealed a positive predictive value of 49.5%, compared with ICA. The primary indication for CCTA remains ruling-out coronary artery disease in low to intermediate risk patients. Identifying significant stenoses correctly by CCTA using a newest generation CT-scanner remains challenging.
Figures:
Significant stenosis of the Right Coronary Artery (RCA) on Multiplanar Reconstruction (MPR) of a Coronary Computed Tomography Angiography (CCTA) scan compared with invasive coronary angiography within one patient.
PROGNOSIS AND OUTCOME IN PATIENTS WITH NON ST-ELEVATION MYOCARDIAL INFARCTION AND MULTIVESSEL CORONARY ARTERY DISEASE

T.F.S. Pustjens (Zuyderland Medisch Centrum, Heerlen); S. Rasoul (Maastricht UMC+, Maastricht); A.W.J. van ‘t Hof (Maastricht UMC+, Maastricht)

Purpose:
Patients presenting with non-ST-segment elevation acute coronary syndromes (NSTE-ACS) and multivessel disease (MVD) have worse prognosis compared to those with single vessel or non-obstructive coronary artery disease. There is uncertainty whether multivessel or culprit-only coronary revascularization should be the first treatment of choice in patients with NSTE-ACS and MVD. Using data from the nationwide percutaneous coronary intervention (PCI) registry, we aimed to evaluate 1-year mortality in this group of patients.

Methods:
This was a multicentre observational registry study among Dutch patients presenting with NSTE-ACS and MVD between 2013 and 2016 who underwent PCI. Data were extracted from the Netherlands Heart Registry (NHR). Patients were grouped according to their revascularization strategy (multivessel or culprit-only PCI). Patients presenting with an out-of-hospital cardiac arrest or cardiogenic shock were excluded. Primary endpoint was all-cause mortality at 1-year.

Results:
Data from 2,731 patients with NSTE-ACS and MVD were available for analysis. A total of 1,269 (46.5%) patients underwent multivessel PCI and 1,462 (53.5%) culprit-only PCI. Those undergoing multivessel PCI were more likely to have a chronic total occlusion (5.5% vs. 2.5%; p<0.001), but less likely to have a previous myocardial infarction (19.6% vs 24.5%; p=0.002) and previous PCI (18.9% vs 26.8%; p<0.001). There was no difference between both groups in 1-year mortality (6.0% vs. 5.7%; p=0.55). Kaplan-Meier analysis for all cause mortality at long-term follow-up (2.8 ±1.4 years) (log-rank p = 0.96) was not significantly different.

Conclusion:
In NSTE-ACS patients with MVD, 1-year all-cause mortality and at long-term follow-up were not significantly different between multivessel and culprit-only PCI.
Figures:
Kaplan-Meier curve showing all-cause mortality at 1 year follow-up

![Kaplan-Meier curve](image)
EFFICACY AND SAFETY OF GLYCOPROTEIN IIB/IIIa INHIBITORS IN ADDITION TO P2Y12 INHIBITORS IN STEMI: A SUB-ANALYSIS OF THE POPULAR GENETICS TRIAL

A.H. Tavenier (Isala, Zwolle); D.M.F. Claassens (St. Antonius hospital, Nieuwegein); R.S. Hermanides (Isala hospital, Zwolle), G.J.A. Vos (St. Antonius hospital, Nieuwegein); T.O. Bergmeijer (St. Antonius hospital, Nieuwegein); P. van der Harst (University Medical Center Groningen, Groningen); E. Barbato (University of Naples Federico II, Naples; Onze Lieve Vrouwe Hospital, Aalst); C. Morisco (University of Naples Federico II, Naples); R.M. Tjon Joe Gin (Rijnstate hospital, Arnhem); F.W. Asselbergs (University Medical Center Utrecht, Utrecht; University College London, London); A. Mosterd (Meander Medical Center, Amersfoort); J.P.R. Herman (Onze Lieve Vrouwe Gasthuis, Amsterdam); W.J.M. Dewilde (Amphia hospital Breda; Imelda hospital, Bonheiden); J.C. Kelder (St. Antonius hospital, Nieuwegein); V.H.M. Deneer (St. Antonius hospital, Nieuwegein; University Medical Center Utrecht, Utrecht); A.W.J. van ‘t Hof (Isala hospital, Zwolle; Zuyderland Medical Center, Heerlen; Maastricht University Medical Center, Maastricht); J.M. ten Berg (St. Antonius Hospital, Nieuwegein; University Medical Center Groningen, Groningen).

Purpose:
Glycoprotein IIb/IIIa inhibitors (GPI) are widely used in clinical practice in patients with ST-segment elevation myocardial infarction (STEMI) undergoing primary percutaneous coronary intervention (PCI), though discussion is ongoing about its clinical benefit.

Methods:
The use of GPI was analyzed in this sub-analysis of the POPular Genetics trial that randomized STEMI patients to genetic CYP2C19 guided treatment (clopidogrel or ticagrelor) or standard treatment with ticagrelor/prasugrel. Primary thrombotic outcome of this sub-analysis was a composite of vascular death, myocardial infarction (MI), definite stent thrombosis and stroke at 30-days. The primary safety outcome was PLATO major and minor bleeding at 30-days.

Results:
2378 patients, of which 1033 with GPI and 1345 without GPI, were analyzed. Administration of GPI was associated with a reduction of the primary thrombotic outcome at 30 days (hazard ratio (HR) 0.32, 95% confidence interval (CI); 0.15-0.70) and a significant reduction in myocardial infarction at 30 days (p=0.002). Furthermore, administration of GPI was associated with an increase in bleedings at 30 days (HR 1.91, 95% CI: 1.22-2.98) driven by minor bleedings (HR 2.19, 95% CI: 1.37-3.50), without a difference in major bleedings (HR 0.71, 95% CI: 0.22-2.28).

Conclusion:
In STEMI patients undergoing primary PCI, GPI administration was associated with a reduction in the composite endpoint of vascular death, MI, definite stent thrombosis and stroke at an cost of an increase minor bleedings at 30 days. GPI administration was also associated with a reduction in MI after 30 days.
Purpose:
The results of chronic total occlusion percutaneous coronary intervention (CTO PCI) trials are inconclusive. Therefore, we aggregated all randomized data to determine whether CTO PCI leads to better improvement of clinical endpoints and patient complaints than optimal medical therapy (OMT) alone.

Methods:
We searched MEDLINE, Embase and the Cochrane Library until March 2019, using the search terms 'Chronic total coronary occlusion', 'Percutaneous coronary intervention' and 'Random'. All randomized trials comparing CTO PCI to OMT were included. The primary endpoint was all-cause mortality. Secondary endpoints included major adverse cardiac events (MACE) and its individual components separately (including target lesion revascularization [TLR]), improvement of angina and left ventricular function.

Results:
Five randomized trials were identified, comprising 1790 CTO-patients (mean age 63 ±10 years, 83% male), 964 in the PCI-group and 826 in the OMT-group. There was no difference between PCI versus OMT in all-cause mortality at 1 year (RR 1.70, 95% CI 0.50-5.80 p=0.40) and 4 years follow-up (RR 1.14, 95% CI 0.38-3.40 p=0.81), nor MACE at 1 year (RR 0.69, 95% CI 0.36-1.33, p=0.27) and 4 years (RR 1.00, 95% CI 0.79-1.27, p=0.98). However, patients in the PCI-group had lower frequency of TLR (RR 0.28, 95% CI 0.15-0.52, p<0.001) and reported fewer anginal symptoms at 1 year follow-up (RR 0.65, 95% CI 0.50-0.84, p=0.001). No differences were found in ventricular function, but a trend was found in the PCI-group towards improvement of segmental wall thickening in CTO-segments that were dysfunctional at baseline (mean difference 5.19 95% CI -0.47-10.84, p=0.07).

Conclusion:
In this meta-analysis of 1790 CTO patients randomized to CTO PCI or OMT, CTO PCI resulted in less angina and less TLR, but did not improve survival or MACE until 4 years follow-up, compared to OMT. The trend towards improvement of segmental wall thickening in dysfunctional CTO segments could indicate that proper patient selection prior to PCI might contribute to better results.
Figures:
Forest plots displaying all-cause mortality at 12 months, freedom of angina at 12 months and left ventricular ejection fraction at 4 months. MD = mean difference; RR = risk ratio.
LONG-TERM OUTCOME AFTER DEFERRED REVASCULARIZATION DUE TO NEGATIVE FRACTIONAL FLOW RESERVE IN INTERMEDIATE CORONARY LESIONS

J. Weerts (Maastricht University Medical Center, Maastricht); T. Pustjens (Zuyderland Medical Centre, Heerlen); E. Amin (Maastricht University Medical Center, Maastricht); M. Ilhan (Maastricht University Medical Center, Maastricht); L.F. Veenstra (Maastricht University Medical Center, Maastricht); R.A.L.J. Theunissen (Maastricht University Medical Center, Maastricht); J. Vainer (Maastricht University Medical Center, Maastricht); M. Stein (Zuyderland Medical Centre, Heerlen); A.W. Ruiters (Maastricht University Medical Center, Maastricht); B.C.G. Gho (Zuyderland Medical Centre, Heerlen); A.W.J. Van ’t Hof (Maastricht University Medical Center, Maastricht); S. Rasoul (Maastricht University Medical Center, Maastricht)

Purpose:
To assess long-term outcome after deferring intervention of coronary lesions with a fractional flow reserve (FFR) value >0.80 in a real-world patient population. Secondly, to identify factors associated with deferred target lesion failure (DTLF).

Methods:
A retrospective analysis was conducted of patients with deferred coronary intervention based on FFR value >0.80. Primary endpoint was DTLF, a composite of acute coronary syndrome (ACS) and any coronary revascularization, related to the initially deferred stenosis.

Results:
A total of 600 patients, mean age 66±10 years, and 751 coronary lesions with negative FFR values (mean 0.88±0.04) were included. Mean follow-up was 27±15 months. DTLF occurred in 44 patients (7.3%); revascularization in 42 (7%), ACS without revascularization in 2 (0.3%). Patients with DTLF more often had diabetes mellitus, previous CABG, multivessel disease (MVD) and lower FFR at inclusion. Multivariable regression analysis showed that lower deferred FFR values [FFR 0.81-0.85: HR 2.79 (95%CI; 1.46-5.32), p 0.002], MVD [HR 1.98 (95%CI; 1.05-3.75), p 0.036], distal lesions [HR 2.43 (95%CI; 1.29-4.57), p 0.006], and lesions located in a saphenous vein graft (SVG) [HR 6.35 (95%CI; 1.81-22.28), p 0.004] were independent predictors for DTLF.

Conclusion:
Long-term rate of DTLF of initially deferred coronary lesions was 7.3%. Independent predictors for DTLF are lower deferred FFR value, presence of MVD, distal lesions and lesions in SVG.
Figures:
Kaplan-Meier curves for patient-level outcome compared for (A) fractional flow reserve (FFR) values, (B) multivessel disease (MVD), (C) distal lesions, and (D) saphenous vein graft lesions. DTLF, deferred target lesion failure; CAD, coronary artery disease.
Session 3: General electrophysiology

EFFICIENCY AND COMPLICATIONS OF DIFFERENT ENDOVASCULAR PACEMAKER AND DEFIBRILLATOR LEAD EXTRACTION TECHNIQUES

F.A.L.E. Bracke (Catharina Ziekenhuis, Eindhoven); N. Verberkmoes (Catharina Ziekenhuis, Eindhoven); L.M. Rademakers (Catharina Ziekenhuis, Eindhoven); L.M. van Gelder (Catharina Ziekenhuis, Eindhoven)

Purpose:
Efficiency and safety are competing interests in lead extraction. We compared different endovascular extraction techniques regarding these outcomes.

Methods:
Consecutive lead extractions from 1997 till 2019. Endovascular techniques: first traction (T), if not successful laser sheath (LS), femoral approach (FA) or mechanical rotational sheaths (MRT). Outcomes: procedural success (PS): lead completely removed without backup technique; PS-MC: PS without major complication (MC); endovascular clinical success (ECS): lead completely removed or only lead fragment < 4cm left behind, including the use of endovascular backup techniques and without MC. Assessment per lead for each technique and stratified for implant time (IT).

Results:
Leads were extracted in 775 patients, in 96.3% of patients all leads were removed with ECS without surgery or MC. A total of 1725 leads (222 ICD leads) were extracted, with primary endovascular attempts in 1703 leads (the remainder removed surgically). Median implant time was 6.0 yrs [IQR 2.7-10.2], ECS for the 1703 leads was 94.8%. The table shows the PS and PS-MC of the initially used technique without backup technique. MC occurred in 0.5% of FA, 7.4% of LS and 1.2% of MRT leads.

Conclusion:
LS is less effective than FA or MRT, especially for older leads and this is largely due to more MC. FA and MRT are equally efficient, but FA is not suited for many ICD leads and technically more demanding. The combination of FA and MRT yields optimal results.

Figures:
IT: in yrs, median [IQR; na: not applicable

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<th>Procedural success individual endovascular technique as stand alone</th>
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PERCUTANEOUS CERVICAL STELLATE GANGLION BLOCK IN VENTRICULAR ARRHYTHMIA AS A BRIDGE TO DEFINITIVE THERAPY: A CASE SERIES

N. Kabašaj (Medisch Spectrum Twente, Enschede); M.F. Scholten (Medisch Spectrum Twente, Enschede); N.P. Monteiro de Oliveira (Medisch Spectrum Twente, Enschede); R.G.H. Speekenbrink (Medisch Spectrum Twente, Enschede); R. Coronel (Amsterdam UMC, locatie AMC, Amsterdam); Y.S. Stevenhagen (Medisch Spectrum Twente, Enschede); J.M. van Opstal (Medisch Spectrum Twente, Enschede); P.F.H.M. van Dessel (Medisch Spectrum Twente, Enschede)

Purpose:
Ventricular storm (VS) is defined as three or more appropriate ICD shocks or three or more episodes of sustained ventricular arrhythmia (VA) –either ventricular tachycardia or fibrillation- within 24 hours and constitutes a medical emergency. We hypothesize that percutaneous cervical stellate ganglion block (PCSGB) can be used to suppress VA, when catheter ablation and/or pharmacological antiarrhythmic treatment fail.

Methods:
Six patients (male, age 69.5 ±4 years, median left ventricular ejection fraction of 35.5 (15-60) %), who presented with ventricular storm or frequent ventricular arrhythmias despite optimal medical treatment and/or previous catheter ablation, underwent PCSGB between 11 April 2018 and 23 June 2019. Ultrasound-guided left-sided PCSGB was performed by an anaesthesiologist using a long-acting, amide anaesthetic agent. If a positive clinical response was observed, combined with a high recurrence rate of VA following pharmacokinetic elimination of the anaesthetic, left cardiac sympathetic denervation (LCSD) was performed using video-assisted thoracoscopic surgery.

Results:
The number of episodes of ventricular arrhythmia decreased in the two-week observation period compared to baseline values (figure 1). In one patient, a transient ipsilateral Horner syndrome was observed. Four patients underwent elective LCSD at a later stage. Median number of days to LCSD was 27 [range 22-64 days]. No serious complications were observed after LCSD.

Conclusion:
Left-sided PCSGB is a safe and easy to perform treatment in patients with ventricular arrhythmia as a bridge to LCSD, catheter ablation or optimal medical therapy.
Figures:
Figure 1. Total number of ventricular arrhythmia 14 days prior to PCSGB and after PCSGB.
SIMULTANEOUS ENDO-EPICARDIAL MAPPING OF THE HUMAN RIGHT ATRIUM:
EXPLORING 3-DIMENSIONAL EXCITATION

R.K. Kharbanda (Erasmus MC, Rotterdam); P. Knops (Erasmus MC, Rotterdam), M. Roos-Serote (Erasmus MC, Rotterdam), C. Kik (Erasmus MC, Rotterdam), Y.J.H.J. Taverne (Erasmus MC, Rotterdam), A.J.J.C. Bogers (Erasmus MC, Rotterdam), N.M.S. de Groot (Erasmus MC, Rotterdam)

Purpose:
Mapping studies demonstrated that endo-epicardial asynchrony (EEA) plays an important role in the pathophysiology of atrial fibrillation (AF). Our objective was to investigate the nature and clinical relevance of EEA during SR by investigating the relation between conduction block (CB) in the 2D endo- and epicardial layers and degree of EEA.

Methods:
In 80 patients (63 male (79%), age 66±9 years, 31 history of AF (39%)) undergoing cardiac surgery, simultaneous endo-epicardial mapping (256 electrodes, interelectrode distance:2mm) of the inferior, middle and superior right atrium (RA) was performed during SR. Areas of CB were defined as conduction delays of ≥12ms, EEA as activation time differences of opposite electrodes of ≥15ms and transmural CB as CB at similar endo-epicardial sites (depicted in Figure 1).

Results:
Amount of CB was highest at the endocardium (endo median:1.9% [0-21.6] vs. epi median:1.1% [0-19.2], all locations p<0.025) and was more pronounced at the superior RA. In patients with hypertension, CB at the superior RA endo-epicardium was more pronounced (p=0.046). Similar as for CB, prevalence of transmural CB and EEA, up to 84 ms, significantly increased from inferior to superior RA (all p<0.001). Transmural CB at the inferior RA appeared to be associated with a higher incidence of post-operative AF (p=0.03). Median endo-epicardial delay (EEA degree) was also highest at superior RA (superior:17.5ms[16-21.75] vs mid:17ms[0-20] and inferior:0ms[0-17], p<0.001). Prevalence of CB was strongly correlated with prevalence EEA (r=0.644-0.825; all locations p<0.001). In patients with hypertension (p=0.009), diabetes (p=0.015) and hypercholesterolemia (p=0.015), EEA degree was higher at inferior RA. Significant more CB (p=0.007) and EEA (p=0.037) during SR are present in patients with a history of persistent AF compared to patients without AF history.

Conclusion:
This study provides important insights into the complex relations between 3-dimensional endo-epicardial excitation, arrhythmogenesis and the association with clinical profiles. Knowledge on the 3-dimensional substrate underlying AF is essential to individualize and stage future therapy of AF.
Figures:
Fig 1. Simultaneous endo-epicardial mapping of the right atrium
PREDICTING VENTRICULAR ARRHYTHMIAS IN PATIENTS WITH ISCHEMIC CARDIOMYOPATHY AND IMPLANTABLE CARDIOVERTER-DEFIBRILLATORS USING CMR AND PET

A.C.J. van der Lingen (Amsterdam UMC, Amsterdam); M.T. Rijnierse (Amsterdam UMC, Amsterdam); S. de Haan (Amsterdam UMC, Amsterdam); M.A.J. Becker (Amsterdam UMC, Amsterdam); H.J. Harms (Amsterdam UMC, Amsterdam); M.C. Huisman (Amsterdam UMC, Amsterdam); A.A. Lammertsma (Amsterdam UMC, Amsterdam); A.C. van Rossum (Amsterdam UMC, Amsterdam); P. Knaapen (Amsterdam UMC, Amsterdam); C.P. Allaart (Amsterdam UMC, Amsterdam)

Purpose:
Improved risk stratification of ventricular arrhythmia (VA) is important to identify patients who should benefit of prophylactic implantable cardioverter-defibrillator (ICD) implantation. This study presents a head-to-head comparison of the value of cardiac magnetic resonance imaging (CMR) derived left ventricular function and scar burden and positron emission tomography (PET) derived perfusion and innervation in predicting VA.

Methods:
74 patients with ischemic cardiomyopathy and left ventricular ejection fraction (LVEF) ≤35%, referred for primary prevention ICD implantation were enrolled prospectively. Late gadolinium enhanced (LGE)-CMR was performed to assess cardiac function and scar characteristics. [15O]H2O and [11C]hydroxyephedrine PET were performed to quantify resting and hyperemic myocardial blood flow (MBF), coronary flow reserve (CFR) and sympathetic innervation. During follow-up of 5.4±1.9 years, the occurrence of sustained VA and appropriate ICD therapy was evaluated.

Results:
In total, 20 (26%) patients experienced VA. Univariable analyses showed that LVEF (HR 0.92, P=0.03), left ventricular end-diastolic volume index (LVEDVi) (HR 1.02, P<0.01) and scar border zone (HR 1.11, P=0.03) were related to VA, although in multivariable analyses LVEDVi was the only independent predictor. No differences were observed in scar core size, resting MBF, hyperemic MBF, perfusion defect size, innervation defect size or the innervationperfusion mismatch.

Conclusion:
In patients with ischemic cardiomyopathy, LVEF, LVEDVi and scar border zone were related to VA, although LVEDVi was the only independent predictor. PET derived perfusion and sympathetic innervation, as well as CMR derived scar core size did not predict VA. These results suggest that improved prediction of VA by advanced imaging remains challenging for the individual patient.
DIFFERENCES BETWEEN GAP-RELATED PERSISTENT CONDUCTION AND CARINA-RELATED PERSISTENT CONDUCTION DURING RADIOFREQUENCY PULMONARY VEIN ISOLATION

M.J. Mulder (Amsterdam UMC, locatie VU, Amsterdam); M.J.B. Kemme (Amsterdam UMC, locatie VU, Amsterdam); M.J.W. Götte (Amsterdam UMC, locatie VU, Amsterdam); P.M. van de Ven (Amsterdam UMC, locatie VU, Amsterdam); H.A. Hauer (Cardiology Centers of the Netherlands, Amsterdam); G.J.M. Tahapary (North West Clinics, Alkmaar); A.C. van Rossum (Amsterdam UMC, locatie VU, Amsterdam); C.P. Allaart (Amsterdam UMC, locatie VU, Amsterdam)

Purpose:
During pulmonary vein isolation (PVI), non-isolation after initial encircling of the pulmonary veins (PVs) may be due to gaps in the initial ablation line. Alternatively, earliest PV activation may occur on the intervenous carina and ablation within the WACA (wide-area circumferential ablation) circle is needed to eliminate residual conduction. This study investigates prognostic implications and determinants of gap-related persistent conduction (gap-RPC) and carina-related persistent conduction (carina-RPC).

Methods:
Two hundred fourteen atrial fibrillation (AF) patients (57% paroxysmal, 61% male, mean age 62±9 years) undergoing first contact force-guided radiofrequency pulmonary vein isolation were studied. Non-isolation after initial encircling of the PVs was targeted for additional ablation and classified as gap-RPC or carina-RPC, depending on the site of earliest activation.

Results:
Gap-RPC was observed in the left WACA in 37 patients (17%) and in the right WACA in 52 patients (23%). Carina-RPC was noted in the left PVs in 47 patients (22%) and in the right PVs in 78 patients (36%). Kaplan–Meier survival analyses demonstrated a significantly higher rate of recurrence in patients with gap-RPC (47% vs. 28%, p=0.003), whereas no significant difference between patients with and without carina-RPC was found (37% and 31%, respectively; p=0.379). Multivariate analyses identified paroxysmal AF and WACA circumference as independent predictors of gap-RPC, whereas carina width and WACA circumference correlated with carina-RPC.

Conclusion:
Gap-RPC is associated with increased AF recurrence risk after PVI, whereas carina-RPC does not predict AF recurrence. Moreover, gap-RPC and carina-RPC have different determinants and may thus have different underlying mechanisms.
Figures:
Kaplan-Meier survival analyses for freedom of atrial tachyarrhythmias divided by occurrence of (A) gap-related persistent conduction (gap-RPC) and (B) carina-related persistent conduction (carina-RPC).
A COMPARISON BETWEEN THE TWO DIFFERENT LEADLESS PACEMAKERS, NANOSTIM LP VERSUS MICRA TPS

F.J. Oosterwerff (Isala, Zwolle); A. Adiyaman (Isala, Zwolle); M. Lenssen (Isala, Zwolle); A. Ghani (Isala, Zwolle); J.J.J. Smit (Isala, Zwolle); A.R. Ramdat Misier (Isala, Zwolle); A. Elvan (Isala, Zwolle); P.P.H.M. Delnoy (Isala, Zwolle)

Purpose:
Several studies have demonstrated the safety and efficacy of two different leadless pacemaker (LP) systems, namely Nanostim LP and Micra TPS. Comparative data regarding acute and chronic electrical performance and safety is scarce however. We therefore performed a comparative analysis between these LP systems.

Methods:
From 2013 to present, 96 consecutive patients undergoing LP implantation in our center were analyzed. We assessed acute and 90 day complications and acute and late (12 months post-implantation) electrical performance.

Results:
Nanostim LP was implanted in 51 patients and Micra TPS in 45 patients. Main indication (47%) was chronic atrial fibrillation with high-grade AV-block or slow ventricular response. Baseline characteristics were similar with a mean age of 79 years and 63% male in the Nanostim LP and 81 years and 67 % male in the Micra TPS. Implant success rate was 94% in Nanostim LP versus 100% in Micra TPS. Complications occurred in 9 % Nanostim LP vs 4 % Micra TPS (P= 0,07). Per-procedural revision/extraction occurred more often in Nanostim LP than in Micra TPS (24% vs 9%, P<0,05). At 90 days post-implantation, no device related or cardiac deaths were observed. Nanostim LP R-wave amplitude/capture at implant was 9 mVolt/1,75Volt and 9,1mVolt/1,5Volt after 12 months. For the Micra TP the R-wave amplitude/capture at implant was 11,9 mVolt/0,65Volt and 11,1mVolt/0,68Volt after 12 months.

Conclusion:
Implantation of the Micra TPS seems to have a superior success rate and safety at short-term when compared to Nanostim LP. Both leadless pacemakers showed an excellent electrical performance at 12 months.
### Figures:

<table>
<thead>
<tr>
<th>Procedure outcomes</th>
<th>Nanostim LP (n = 54)</th>
<th>Micra TPS (n = 45)</th>
<th>P-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Implant success rate</td>
<td>51 (94%)</td>
<td>45 (100%)</td>
<td>NS</td>
</tr>
<tr>
<td>Duration of implantation (min)</td>
<td>97 (+/-33)</td>
<td>95 (+/-42)</td>
<td>0.76</td>
</tr>
<tr>
<td>Duration of fluoroscopy (sec)</td>
<td>682 (+/-532)</td>
<td>528 (+/-500)</td>
<td>0.17</td>
</tr>
<tr>
<td>Device-related revision/extraction Per-procedural</td>
<td>11 (22%)</td>
<td>3 (7%)</td>
<td>&lt;0.05</td>
</tr>
<tr>
<td><strong>Complications in the first 90 days</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Cardiac perforation requiring intervention</td>
<td>1 (2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Device dislodgement</td>
<td>2 (4%)</td>
<td>1 (2%)</td>
<td></td>
</tr>
<tr>
<td>Vascular complication</td>
<td>0</td>
<td>1 (2%)</td>
<td></td>
</tr>
<tr>
<td>Infection</td>
<td>0</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Device dysfunction or damage requiring replacement of the pacemaker</td>
<td>1 (2%)</td>
<td>0</td>
<td></td>
</tr>
<tr>
<td>Ventricular arrhythmia</td>
<td>1 (2%)</td>
<td>0</td>
<td></td>
</tr>
</tbody>
</table>
PREDICTING MORTALITY IN PATIENTS WITH TETRALOGY OF FALLOT USING MACHINE LEARNING

M.D. Oudkerk Pool (Amsterdam UMC, Locatie AMC, Amsterdam); J.P. Bokma (Amsterdam UMC, locatie AMC, Amsterdam); R.R. Lopes (Amsterdam UMC, locatie AMC, Amsterdam); Y. Pinto (Amsterdam UMC, locatie AMC, Amsterdam); M.M. Winter (Amsterdam UMC, locatie AMC, Amsterdam)

Purpose:
Fragmentation of QRS (fQRS) has been revealed as strongly related with right ventricle dysfunction and myocardial fibrosis in adult TOF patients. Myocardial fibrosis means the contractility of the myocardium is decreased and could be the cause of arrhythmias. In recent studies the effect of fQRS on patients with TOF was assessed, in which fQRS was found to be a predictor of all-cause mortality and ventricular arrhythmia in these patients. In this article the same database is analyzed with multiple machine learning techniques to build prediction models to predict all-cause mortality and ventricular arrhythmia.

Methods:
For every patient the first standard 12-lead electrocardiogram (ECG) (25 mm/s, 10mm/mV) after inclusion in CONCOR was retrieved. All ECGs were analyzed by a single observer (JPB), and 40 randomly selected ECGs were assessed by a second independent observer (JV). Of each ECG the heart rate, rhythm, QRS morphology, Rmax, Pmax, RR interval, and duration of QRS, PR, QT were determined. QRS fragmentation (fQRS) could be a predictor of cardiac events, which is why on each lead the QRS complex was assessed on the presence of fragmentation. In patients with right bundle branch block (RBBB) fQRS was defined as ≥3 R-waves/notches in the R/S complex in ≥2 contiguous leads (right sided/septal: aVR, V1, V2; anterior: V2-V5; lateral: I, aVL, V5, V6; or inferior: II, aVF, III). In patients with paced QRS and premature ventricular complexes, fQRS was characterized as ≥3 notches in the R/S. If the QRS <120ms, fQRS is characterized as an additional R wave (R’) or notch in the nadir of the S wave.

All-cause mortality was the primary outcome, which was obtained from hospital databases. This data was verified by linking CONCOR with the Dutch Central Bureau of Statistics. The secondary outcome was ventricular arrhythmia (VA). VA was defined as: (1) documented as asymptomatic and/or recurrent non-sustained ventricular tachycardia (VT), for which intervention is required (2) documented sustained VT, lasting >30s or requiring cardioversion (3) ventricular fibrillation or out of hospital cardiac arrest, with successful resuscitation.

In order to analyze the data, several machine learning techniques will be used; logistic regression (LR), random forest (RF), support vector machine (SVM), and K-nearest neighbor (KNN). The accuracy, sensitivity and specificity were determined for each technique and for both the all-cause mortality and VA.

Results:
The logistic regression technique showed an accuracy of 96.3%, a sensitivity of 96.5%, and a specificity of 0% in predicting all-cause mortality. When predicting ventricular arrhythmia it showed 100% in accuracy as well as sensitivity and specificity. The Random Forest technique showed an accuracy of 96.1%, a sensitivity of 96.6%, and a specificity of 18.2% in predicting all-cause mortality. When predicting ventricular arrhythmia it showed 100% in accuracy as well as sensitivity and specificity. The Support Vector machine technique showed an accuracy of 96.5%, a sensitivity of 96.5%, and a specificity of 0% in predicting all-cause mortality. When predicting ventricular arrhythmia it showed 100% in accuracy as well as sensitivity and specificity. The K-Nearest Neighbor technique showed an accuracy of 96.2%, a sensitivity of 96.5%, and a specificity of 0% in predicting all-cause mortality. When predicting ventricular arrhythmia it showed 94.5% in accuracy, 100% sensitivity, and 94.2% specificity.
**Conclusion:**
When predicting all-cause mortality, the proposed techniques showed a high accuracy and sensitivity, however they had no specificity or very low. This implicates that these techniques are bad at correctly diagnosing the patients who died. Out of all 806 patients, only 26 died. This might not be enough to build a good prediction model. The follow up control was performed in 2015, when repeated more mortality could be found and a better prediction model could be made.
The techniques were perfect in predicting the ventricular arrhythmia. One or more of the input variables perfectly corresponds with ventricular arrhythmia, which makes it easy for the techniques to perfectly predict if the patients will get arrhythmia or not. A next step might be to predict what kind of arrhythmia the patient has, and to find out which feature or combination of features is responsible for this perfect correlation.

**Figures:**
Results of the machine learning techniques

<table>
<thead>
<tr>
<th>Technique</th>
<th>Mortality Accuracy</th>
<th>Mortality Sensitivity</th>
<th>Ventr Arrhythmia Specificity</th>
</tr>
</thead>
<tbody>
<tr>
<td>Logistic Regression</td>
<td>96.3%</td>
<td>96.5%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Random Forest</td>
<td>96.1%</td>
<td>96.6%</td>
<td>18.2%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>Support Vector Machine</td>
<td>96.5%</td>
<td>96.5%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>100%</td>
<td>100%</td>
<td>100%</td>
</tr>
<tr>
<td>K-Nearest Neighbor</td>
<td>96.2%</td>
<td>96.5%</td>
<td>0%</td>
</tr>
<tr>
<td></td>
<td>94.5%</td>
<td>100%</td>
<td>94.2%</td>
</tr>
</tbody>
</table>
DUTCH OUTCOME IN ICD THERAPY (DO-IT); A PROSPECTIVE COHORT STUDY FOR PREDICTION OF APPROPRIATE ICD INDICATION IN PRIMARY PREVENTION OF SUDDEN CARDIAC DEATH

T.E. Verstraelen (Amsterdam UMC, Locatie AMC, Amsterdam); M. van Barreveld (Amsterdam AMC, locatie AMC, Amsterdam); M.G.W. Dijkgraaf (Amsterdam UMC, locatie AMC, Amsterdam); L.V.A. Boersma (St. Antonius, Nieuwegein); P.P.H.M. Delnoy (Isala, Zwolle); M. Meine (UMCU, Utrecht); A.E. Tuinenburg (UMCU, Utrecht); D.A.M.J. Theuns (Erasmus MC, Rotterdam); P.H. van der Voort (Catharina, Eindhoven); G.P. Kimman (Noordwest ziekenhuisgroep, Alkmaar); E. Buskens (Universiteit Groningen, Groningen); P.H.F.M. van Dessel (Medisch spectrum Twente, Enschede); A.H. Zwinderman (Amsterdam UMC, locatie UMC, Amsterdam); A.A.M. Wilde (Amsterdam UMC, locatie UMC, Amsterdam)

On behalf of the DO-IT investigators

Purpose:
This contemporary prospective primary prevention ICD cohort study was performed to develop prediction models for appropriate ICD therapy and mortality to identify subgroups who do not (sufficiently) benefit from primary prevention ICD implantation.

Methods:
Between 2014 and 2016 we included 1442 consecutive patients, from all 28 Dutch ICD implanting hospitals, with reduced left ventricular function in a setting of structural heart disease and scheduled for primary prevention ICD implantation. Primary endpoints appropriate ICD therapy and mortality will be adjudicated by a clinical endpoint committee. Bootstrapping-based Cox proportional hazards and Fine and Gray competing risk models with likely candidate predictors were developed for all-cause mortality and appropriate ICD therapy respectively. Stepwise backwards selected variables were gender, NSVT, NYHA class, Prior PCI, aldosteron antagonist use, heart rate, potassium and ACE or AT2 use for prediction of appropriate ICD therapy and age, COPD, diuretic use, sodium, NTproBNP for prediction of mortality.

Results:
During a median follow-up of 2.4 years (IQR 2.0-2.6), 162 (7.4%) patients received appropriate ICD therapy and 187 (13.0%) patients died. Patients with and without events could be accurately distinguished with these models, with an optimism corrected c statistic of 0.75 for mortality and 0.62 for appropriate ICD therapy. Figure 1 shows the Kaplan Meier curve of observed mortality and appropriate ICD therapy events when stratified by predicted risk quintiles. The appropriate therapy model can be used to defer from ICD implantation in a predicted low risk subset. When deferring ICD implantation in patients with a hypothetical cutoff of less than 2.6% 2 year ICD therapy risk, 144 (10%) will receive no ICD, with false-negative predictions for 2 patients. A cutoff of 3.9% results in 288 (20%) less ICD implants and false-negative predictions for 7 patients. However not all 'missed' ICD therapies will lead to sudden cardiac death and furthermore complications (14% any, 8% major) and inappropriate shocks (3.8%) will be prevented in the deferred group. These factors need to be considered when deciding on a cutoff point for the ICD therapy model.

Conclusion:
Based on a contemporary, nationwide cohort with strict data quality checks we present new prediction models for death and appropriate ICD therapy in primary prevention ICD recipients which may be used to defer ICD implantation in a subset of patients.
Figures:

Kaplan meier curve survival

Kaplan meier curve appropriate ICD therapy

Follow-up time (Months)
FREQUENCY AND PREDICTORS OF UNSUCCESSFUL EECOMPENSATION AT HOME FOR DETERIORATED HEART FAILURE

E.M. Boukema-Nieuwenhuis (Isala, Zwolle); J.P. Ottervanger (Isala, Zwolle) ; E.P. de Kluiver (Isala, Zwolle); A. Ghani (Isala, Zwolle)

Purpose:
Recompensation at home, including intensive intravenous treatment, is an attractive alternative for hospital admission for deteriorated heart failure, avoiding hospital admission related complications as delirium, falls and hospital infections. However, it is yet unclear what the frequency and predictors are for unsuccessful recompensation at home. Our aim was to assess frequency and predictors of unsuccessful recompensation at home.

Methods:
It concerns a retrospective cohort study of consecutive patients referred for deteriorated heart failure who were recompensated at home. Unsuccessful recompensation at home was defined as either all-cause mortality or hospital admission for heart failure within 30 days after inclusion. Multivariable analyses were performed to assess independent predictors of unsuccessful recompensation at home.

Results:
During the study period (2004-2017), 423 patients were included. Average age was 80 ±9 years, 40.4% was female. A total of 108 patients (25.5%) had unsuccessful recompensation at home, of which 86 had a hospital admission (20%), whereas 37 patients (8.7%) died. Younger age, chronic lung disease, female gender, diabetes mellitus, lower systolic blood pressure, creatinine levels, not using ACE-Inhibitors or ARB and not using beta-blockers were independent predictors for unsuccessful recompensation at home.

Conclusion:
Recompensation at home for deteriorated heart failure is unsuccessful in 25.5%. Younger age, female gender, chronic lung disease, diabetes mellitus, low systolic blood pressure, higher creatinine levels, not using ACE-I, ARB or beta-blockers at inclusion predict unsuccessful recompensation at home.

Figures:

<table>
<thead>
<tr>
<th>Predictors for unsuccessful recompensation at home</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Younger age</td>
<td>0.97 (0.95-0.99)</td>
</tr>
<tr>
<td>Chronic lung disease</td>
<td>2.1 (1.3-3.4)</td>
</tr>
<tr>
<td>Female gender</td>
<td>2.3 (1.4-3.8)</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>2.0 (1.1-3.5)</td>
</tr>
<tr>
<td>Lower systolic blood pressure</td>
<td>0.98 (0.97-0.99)</td>
</tr>
<tr>
<td>Creatinine levels at inclusion</td>
<td>1.007 (1.001-1.01)</td>
</tr>
<tr>
<td>Not using ACE-inhibitors or ARB at inclusion</td>
<td>1.6 (1.1-2.5)</td>
</tr>
<tr>
<td>Not using beta-blockers at inclusion</td>
<td>2.0 (1.23-3.3)</td>
</tr>
</tbody>
</table>
PULMONARY ARTERY PULSATILITY INDEX (PAPI) AS A PREDICTOR OF EARLY RIGHT VENTRICULAR FAILURE AFTER LEFT VENTRICULAR ASSIST DEVICE (LVAD) IMPLANTATION

F. Brouwer (LUMC, Leiden); E. Janssen (LUMC, Leiden); M. C. den Haan (LUMC, Leiden); M.L. Antoni (LUMC, Leiden); J. Montero (LUMC, Leiden); M. Palmen (LUMC, Leiden); M.J. Schalij (LUMC, Leiden); L.F. Tops (LUMC, Leiden); S.L.M.A. Beeres (LUMC, Leiden)

Purpose:
Right ventricular (RV) failure is a major cause of morbidity and mortality after left ventricular assist device (LVAD) implantation. Identifying patients at risk of RV failure is paramount for patient selection and peri-operative management. This study evaluates if Pulmonary Artery Pulsatility index (PAPI) can predict RV failure early after LVAD implantation.

Methods:
Heart catheterization was performed in patients scheduled for LVAD implantation as destination therapy. PAPI was calculated as systolic minus diastolic pulmonary artery pressure divided by right atrial pressure. Early postoperative RV failure was defined as the need of inotropic support >14 days after LVAD implantation or death due to RV failure within 14 days. The association between PAPI and early postoperative RV failure was assessed with multivariate regression analysis.

Results:
In 69 patients (64±1 years, 82% male), mean PAPI was 2.7±0.2. Early postoperative RV failure occurred in 40 patients (58%). PAPI was 2.1±0.2 in patients with vs. 3.4±0.5 in patients without RV failure (P=0.02). The table displays the results of the univariate analysis. Multivariate analysis revealed that a lower PAPI associated with increased risk of RV failure (OR 0.602;95%CI 0.374-0.969;P=0.04).

Conclusion:
In patients scheduled for LVAD implantation, PAPI independently associated with the occurrence of early postoperative RV failure.

Figures:
Data are presented as percentage or as mean ± standard error. BUN = blood urea nitrogen; PAPI = Pulmonary Artery Pulsatility index.

<table>
<thead>
<tr>
<th></th>
<th>All patients N=69</th>
<th>Early post-operative RV failure N=40</th>
<th>No early post-operative RV failure N=29</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age (years)</td>
<td>64±1</td>
<td>64±1</td>
<td>65±1</td>
<td>NS</td>
</tr>
<tr>
<td>Male sex (%)</td>
<td>82</td>
<td>85</td>
<td>79</td>
<td>NS</td>
</tr>
<tr>
<td>Ischemic etiology (%)</td>
<td>63</td>
<td>65</td>
<td>62</td>
<td>NS</td>
</tr>
<tr>
<td>Creatinine (μmol/L)</td>
<td>125.0±6.1</td>
<td>134.6±9.8</td>
<td>111.7±4.6</td>
<td>0.02</td>
</tr>
<tr>
<td>BUN (mmol/L)</td>
<td>12.8±0.9</td>
<td>14.6±1.3</td>
<td>10.2±0.8</td>
<td>0.01</td>
</tr>
<tr>
<td>PAPI</td>
<td>2.7±0.2</td>
<td>2.1±0.2</td>
<td>3.4±0.5</td>
<td>0.02</td>
</tr>
</tbody>
</table>
DO YOU HAVE ANY PHYSICAL COMPLAINTS? INSIGHTS IN TELECARE FOR HEART PATIENTS.

A.M. van Hout (Windesheim University, Zwolle); M. Buls (Saxion, Enschede); M. Hettinga (Windesheim, Zwolle); M.E. den Ouden (Saxion, Enschede); R. Steenkamp (Liberaux, Zwolle); W.P. Koch (HC@Home, Zwolle); E.P. de Kluiver (Isala, Zwolle)

Purpose:
Telemonitoring is gaining attention as a way to improve care for patients with chronic heart diseases. In Zwolle, the Netherlands, a successful project on monitoring heart patients at home has turned into a regular service. In our research project, the objective was to gain insight in patients’ and professionals’ experiences when using telemonitoring. Our results can both add to the quality of the service as to education of professionals.

Methods:
We used different qualitative methods to gathering patients’ (8) and care professionals’ (5) experiences. We observed care practices, used cultural probes and interviewed patients and care professionals (Bowen, 2006; Mol 2002). We also used dialogues as a way of discussing our analysis with the care professionals (Abma and Widdershoven, 2006).

Results:
Patients gather data at home (blood pressure and weight). In some cases, discussing the data during a consult is sufficient, in other cases patients are phoned: Do you have physical complaints? Firstly, we map how care professionals make their decisions. Secondly, we aim to explain the discrepancy between data from the patient journey, professional skills profiles and actual behavior of professionals in the telemonitoring practice.

Conclusion:
Our preliminary results show how we can use our data to refine the patient journey and to renew competence profiles of the care professionals. We will also show that new knowledge that care professionals develop when caring at a distance is quite difficult to describe and has a strong intertwining with the patients’ knowledge and experience. Final conclusions will be available in November 2019.
Figures:
Screenshot monitor heart patients at home
PREDICTORS OF RIGHT VENTRICULAR DYSFUNCTION IN PATIENTS WITH LEFT CORONARY ARTERY DISEASE

R.S. Joosen (Amsterdam UMC, location Vumc, Amsterdam); L.H.F.J. Robbers (Amsterdam UMC, locatie VUmc, Amsterdam); A.C. van Rossum (Amsterdam UMC, locatie VUmc, Amsterdam); M.J.W. Götte (Amsterdam UMC, locatie VUmc, Amsterdam); M.C. van de Veerendonk (Amsterdam UMC, locatie VUmc, Amsterdam)

Purpose:
Right ventricular (RV) dysfunction is an independent predictor of mortality in patients with ischemic heart disease (IHD). RV dysfunction does not only occur after right coronary artery (RCA) related myocardial infarctions, but is also observed after left coronary artery (LCA) disease. The etiology of the latter, however, remains incompletely understood. The study aim is to assess the predictors of RV dysfunction in patients with LCA stenosis.

Methods:
This is a retrospective analysis of 184 patients whom underwent percutaneous coronary intervention of the LCA, cardiac magnetic resonance imaging and echocardiography. Patients with significant RCA stenosis were excluded. 84 patients had a left ventricular ejection fraction (LVEF) below 50% and were divided into a group of patients with low RV ejection fraction (RVEF) (<50%) and preserved RVEF (≥50%). 100 matched patients with LVEF≥50% served as control group.

Results:
In 27% of patients with LVEF≤50%, RV dysfunction was present in contrast to 2% of patients with preserved LV function. In patients with RV dysfunction, RV remodeling was limited. In case of low LVEF, RVEF was related to LVEF (R=0.65; p<0.001). RV function was similar in patients with septal and lateral infarctions. RV dysfunction was not associated with mitral regurgitation, tricuspid regurgitation or bundle branch blocks. After correction for age, gender and systolic pulmonary artery pressure, RV dysfunction was independently predicted by LVEF<50%.

Conclusion:
RV dysfunction in patients with IHD due to LCA stenosis is independently predicted by low LVEF. Our results suggest that RV dysfunction may be related to interventricular mechanical dependency.
Purpose:
Recent reports demonstrated that patients with heart failure (HF) might have an increased risk to develop malignancies, due to tumor growth by circulating factors. Patients with end-stage HF undergoing heart transplantation (HTx) also have an increased risk to develop malignancies due to immunosuppression. The aim of this study was to determine the interaction of HF duration pre-HTx and the risk of malignancy development post-HTx.

Methods:
We included all adult HTx recipients transplanted between January, 2000 and November, 2017 in our center. Patients were excluded if they died or were retransplanted within the first 3 months post-HTx. Clinical characteristics were retrospectively collected.

Results:
Sixty out of 250 patients (24.0%) developed a malignancy at a median time of 66 months [33-108] post-HTx. HF duration was not a significant risk factor for all malignancies or specifically solid organ malignancies post-HTx in multivariable Cox regression analysis (HR 1.037 per year [95% CI 0.979-1.098], p=0.219 and HR 1.028 per year [0.948-1.114], p=0.503, respectively). However, age (HR 1.059 [1.023-1.095], p=0.001) and chronic kidney disease (CKD) pre-HTx (HR 1.942 [1.105-3.413], p=0.021) were independent risk factors for malignancies post-HTx. EBV primary infection (HR 4.956 [1.372-17.907], p=0.015), malignancy pre-HTx (HR 3.071 [1.018-9.266], p=0.046) and CKD pre-HTx (HR 2.668 [1.171-6.076], p=0.019) were risk factors for solid organ malignancies.

Conclusion:
Duration of HF pre-HTx was not associated with malignancy risk post-HTx. However, CKD was an independent risk factor for malignancy development, especially solid organ malignancies post-HTx. More research is needed to further explore the relationship between HF, CKD and malignancies.
Differences in treatment of chronic heart failure patients with reduced ejection fraction according to blood pressure: data from Check-HF

J.F. Veenis (Erasmus MC, Rotterdam); G.C.M. Linssen (ZGT, Twente); H.P. Brunner-La Rocca (Maastricht UMC+); A.W. Hoes (UMCU, Utrecht), J.J. Brugts (Erasmus MC, Rotterdam)

Purpose:
Prescribed dosages remain lower than guideline-recommended. It remains unclear whether systolic BP influences prescription behavior in a European setting. The aim of this study was to investigate the role of systolic blood pressure (BP) on the prescription rate and actual dose of guideline-recommended heart failure (HF) therapy.

Methods:
A total of 8,246 patients with chronic HF with reduced ejection fraction (HFrEF) from 34 Dutch outpatient HF clinics were included in this analysis. Detailed information on prescription rates and dosages of HF drugs were assessed according to systolic BP categories (<95 mmHg, 95-109 mmHg, 110-129 mmHg, and ≥130 mmHg).

Results:
Patients with systolic BP <95 mmHg receive more often triple therapy (beta-blocker, RAS inhibitor, and MRA) (40.3% vs. 30.4%, resp., p<0.01) compared to ≥130 mmHg. Patients with systolic BP <95 mmHg received significantly more often MRA (64.5% vs. 43.8%), ivabradine (8.3% vs. 3.6%) and diuretics (94.2% vs. 78.6%) and less often RAS-inhibitors (75.4% vs. 82.8%) compared to ≥130 mmHg (p for all trends <0.01). The prescribed dosages as % of the guideline-recommended target dose of beta-blockers and RAS-inhibitors were significantly lower in patients with systolic BP <95 mmHg compared to ≥130 mmHg (p for all trends <0.01).

Conclusion:
In this large cross-sectional cohort of HFrEF patients, patients with lower systolic BP receive more HF drugs, but at lower dose relative to the target dose recommended in HF guidelines. The discussion is warranted which target BP is acceptable and what should be limiting factors in up-titration to adequate levels of HF medication.
Figures:
* Figure A: Prescription rates of guideline-recommended HF therapy; B: prescribed dosages expressed as a percentage of recommended target dose; C: triple therapy (beta-blocker, RAS-inhibitor and/or MRA); D: triple therapy of at least ≥50% of the recommended.
CONTEMPORARY COMPLICATIONS IN ADULTS WITH TRANSPOSITION OF THE GREAT ARTERIES AFTER ATRIAL SWITCH


Purpose:
Patients after atrial switch surgery for transposition of the great arteries (TGA-AtrSO) face various sequelae during adulthood. Studies identified these problems, but no clear data on absolute risks and risk factors exist. We aimed to provide insight in the current status of TGA-AtrSO patients and assess risk for complications.

Methods:
We reviewed medical records of TGA-AtrSO patients included in the prospective CONCOR registry from four medical centers. Endpoints of interest were (1) all-cause mortality, (2) heart failure (HF), defined as hospital admissions, listing for transplantation, or HF as cause of death, (3) ventricular arrhythmias (VA), including sudden death, non-sustained, and sustained VA, and (4) surgical and percutaneous baffle reinterventions. Kaplan Meier analysis using a delayed entry method for left-truncated data was conducted to provide survival estimates and 5-year incidence rates.

Results:
In total, 120 patients (age 27[IQR 22-32] years, 64% Mustard) were followed for 13[IQR 8-16] years. Eleven patients died, 20 had HF (5 died of HF, 3 were listed for transplantation, 18 were hospitalized), 16 patients had VA, and 17 had baffle reinterventions. Cumulative survival was 72% at age 50. Median heart failure-free, VA-free, and reintervention-free survival were all 50 years. At age 45, 5-year risk of death, VA, baffle reintervention, and HF were 7%, 11%, 13% and 22%, respectively.

Conclusion:
Incidence of serious events steadily grows over the lifetime of TGA atrial switch patients, with the largest gain in heart failure. As these patients increasingly reach older age, the need for expert counselling and management solutions will keep expanding.
Figures:
A. Cumulative event-free survival of adults with transposition of the great arteries after atrial switch. B. Risk of events during 5-year periods during adulthood.

A. Cumulative (event-free) survival

B. 5-year incidence of events
EHEALTH-GUIDED TITRATION OF SACUBITRIL/VALSARTAN IN SYSTEMIC RIGHT VENTRICULAR HEART FAILURE PATIENTS

T.E. Zandstra (LUMC, Leiden); R.W. Treskes (LUMC, Leiden); M.R.M. Jongbloed (LUMC, Leiden); P. Kiës (LUMC, Leiden); H.W. Vliegen (LUMC, Leiden); M.J. Schalij (LUMC, Leiden); A.D. Egorova (LUMC, Leiden)

Purpose:
Treatment with sacubitril/valsartan is indicated for patients with heart failure and an ejection fraction ≤35%. We aimed to assess the effects of sacubitril/valsartan in the subgroup of congenital heart failure patients with a systemic RV and to evaluate the potential of eHealth telemonitoring in initiation and dose titration of sacubitril/valsartan in this patient group.

Methods:
Data of patients with systemic RV failure who were treated with sacubitril/valsartan was analyzed. Telemonitoring of blood pressure, heart rate and body weight was used to guide titration to the highest tolerated dose. Patients evaluated the eHealth guided titration using a questionnaire.

Results:
Data of the first 9 systemic RV patients who received treatment with sacubitril/valsartan, in our center, for at least three months are described. Six patients used the target dose of 2×97/103mg and 3 patients used 2×49/51mg. Median NT-pro-BNP dropped from 1039 to 649 ng/L after 3 months (p=0.038) Median systolic blood pressure dropped from 104 to 95 mmHg (p=0.026). NYHA class was stable (median of II). The eHealth modalities were reported to be of added value (Table 1).

Conclusion:
Treatment of systemic RV failure with sacubitril/valsartan was well tolerated and lead to a reduction in NT-pro-BNP. The eHealth guided titration was successfully implemented in this group.

Table 1: Results of eHealth questionnaire.

<table>
<thead>
<tr>
<th>Questionnaire item</th>
<th>Agree (N, %)</th>
<th>Disagree (N, %)</th>
<th>No answer (N, %)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Telemonitoring is of added value to usual care</td>
<td>5 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Telemonitoring makes me nervous</td>
<td>1 (20%)</td>
<td>4 (60%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Telemonitoring makes me feel more secure</td>
<td>4 (80%)</td>
<td>1 (20%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Telemonitoring improved communication with my cardiologist</td>
<td>4 (80%)</td>
<td>0 (0%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>My cardiologist reached out unnecessarily</td>
<td>0 (0%)</td>
<td>5 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>Telemonitoring costs me more time than I gain from it</td>
<td>0 (0%)</td>
<td>4 (80%)</td>
<td>1 (20%)</td>
</tr>
<tr>
<td>I don’t pay attention to changes in my measurements myself</td>
<td>0 (0%)</td>
<td>5 (100%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>I would continue even if the cardiologist doesn’t look at my measurements anymore</td>
<td>5 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
<tr>
<td>I am satisfied with this system of telemonitoring</td>
<td>5 (100%)</td>
<td>0 (0%)</td>
<td>0 (0%)</td>
</tr>
</tbody>
</table>
Session 5: General cardiology

EXTRACELLULAR VESICLE PROTEIN LEVELS TO DETECT STRESS INDUCED ISCHEMIA IN WOMEN PRESENTING WITH STABLE CHEST PAIN

M.D. Dekker (UMC Utrecht, Utrecht); F. Waissi; J. Bennekom; M.J.M. Klein-Avink; I.E.M. Bank; A.M. Scholtens; G. Pasterkamp; A. Mosterd; L. Timmers; D.P.V. De Kleijn

Purpose:
Diagnosis of stable ischemic heart disease (IHD) is complicated, especially in females. Currently, no blood test is available. We assessed if plasma Extracellular Vesicle (EV) protein biomarkers could identify stress induced ischemia as surrogate marker of stable ischemic heart disease in patients presenting with chest pain in the outpatient clinic.

Methods:
We analyzed 281 patients with stable chest pain referred for 82Rb PET/CT. Myocardial perfusion was evaluated semi quantitatively according to the 17 segment model of the AHA. Blood samples were collected before PET/CT and Plasma EVs were isolated in 3 plasma sub-fractions (LDL, HDL, TEX) and proteins, identified by proteomics, were quantified in each of these sub-fractions using immuno-bead assays. We used a model (determined with backward selection) to determine the best combination of EV proteins on top of clinical parameters to detect stable IHD.

Results:
SerpinG1 and Cystatin C in the HDL fraction showed a significant association with stress-induced ischemia. These biomarkers significantly increased the AUC of the clinical model consisted of history of coronary artery disease from 0.73 to 0.78, P-value. Stratified analysis on gender showed that the added value of the biomarkers is completely adjudicated to the effect in females with an AUC increase from 0.73 to 0.87 (P value < 0.001, p value males 0.128).

Conclusion:
Conclusion: We identified an EV based biomarker signature that on top of clinical history of CAD is able to diagnose stable ischemic heart disease in females presenting with chest pain.

Figures:
ROC Curves with corresponding AUC values for both clinical as well as biomarker model predicting stress-induced ischemia in patients with stable chest pain. Clinical model contains: history of coronary artery disease. Biomarker model contains: history of coronary artery disease, Serpin G1 HDL and Cystatin C HDL.
REFINING THE EUROPEAN GUIDELINES RISK ASSESSMENT FOR PULMONARY ARTERIAL HYPERTENSION IN ADULT CONGENITAL HEART DISEASE

A.C. van Dissel (Amsterdam UMC, locatie AMC, Amsterdam); A.P.J. Van Dijk (RadboudUMC, Nijmegen); A.L. Duijnhouwer (RadboudUMC, Nijmegen); B.J.M. Mulder (AmsterdamUMC-AMC, Amsterdam); B.J. Bouma (AmsterdamUMC-AMC, Amsterdam)

Purpose:
Guidelines recommend a goal-oriented treatment approach in pulmonary arterial hypertension (PAH), based on a comprehensive risk assessment. However, this approach has not been validated for PAH associated with congenital heart disease (CHD). We aimed to investigate the discriminatory ability of such risk assessment and explore the prognostic advantage of other cut-offs or parameters in PAH-CHD.

Methods:
PAH-CHD adults seen between 2004-2016 at two Dutch expert centres were eligible. Patients were classified as ‘Low’, ‘Intermediate’, or ‘High’ risk based on N-terminal pro-brain natriuretic peptide (NT-proBNP), 6-minute walk distance, functional class and imaging parameters.

Results:
One hundred and twelve patients (age 42.1±16 years, 70% Eisenmenger, 38% Down) were included. At baseline, 25% (28) of patients were classified as ‘Low’, 69% (77) as ‘Intermediate’, and 6% (7) as ‘High risk’. Although survival was better (P=0.012) for patients with higher proportions of ‘Low risk’ variables, this method did not discriminate well between the three risk groups (Figure 1A, P=0.371). One-year survival estimates corresponded moderately to those proposed by the guidelines, 96.4% in the ‘Low risk’ (vs. >95%), 94.8% in the ‘Intermediate risk’ (vs. 90-95%), and 85.7% in the ‘High risk’ (vs. 1400 ng/l, respectively) and use of tricuspid annular plane systolic excursion (TAPSE) measurements (‘Low’, ‘Intermediate’, ‘High’ as 2.7 cm, respectively) as imaging parameter improved discrimination substantially (P<0.001, Figure 1B).

Conclusion:
An modified version of the guidelines risk assessment—with different NT-proBNP cut-offs and use of TAPSE—discriminates more accurately in PAH-CHD. Further analysis will be performed to estimate the benefit of reaching a ‘Low risk’ profile.
Figures:
Figure 1. Five-year survival following (A) the current guidelines and (B) proposed modification of the risk assessment.
PULMONARY ARTERIAL HYPERTENSION AND PULMONARY VENOUS HYPERTENSION IN THE AGING CONGENITAL HEART DISEASE POPULATION

T.C. Hankel (Amsterdam UMC, Locatie AMC, amsterdam); S.G.L.H. Nijbroek (Amsterdam UMC, locatie AMC, Amsterdam); B.J. Bouma (Amsterdam UMC, locatie AMC, Amsterdam); B.J.M. Mulder (Amsterdam UMC, locatie AMC, Amsterdam)

Purpose:
Prevalence estimates of pulmonary arterial hypertension (PAH) in the congenital heart disease (CHD) population vary greatly, while prevalence of pulmonary venous hypertension (PVH) is unknown. In clinical practice, recognition and differentiation between PAH and PVH is important since therapy and prognosis are different. The objectives were to investigate prevalence rates and prognosis of CHD-PAH and PVH in adult CHD-patients.

Methods:
From the prospective Dutch CONgenital CORvita registry, we enrolled 2253 adult CHD patients from a single tertiary center. All echocardiographic reports were carefully reviewed for the presence of PH defined as systolic pulmonary arterial pressure ≥40 mmHg measured by Doppler-echocardiography at two independent moments during follow-up between 2002-2019. PVH was defined as PH with signs of left heart failure on echocardiography.

Results:
In total, 2166 patients could be included. The prevalence of CHD-PAH was 4.8% (n=103, 69% female), 1.4% for PVH (n=30, 43% female) and 0.2% for a mixed variant (n=5, 80% female). CHD-PAH was diagnosed at younger age compared to PVH (43.7±16.5 vs 50.7±17.3, p<0.000), however no differences in age of death (54.0±14.4 vs 53.7±19.0, p=0.814) were observed. PH was significantly associated with lower 10-year survival rates of 70.0% for CHD-PAH and 52.4% for PVH (p<0.001 versus 95.3% for CHD patients without PH). After adjusting for age, no significant differences were observed in prognosis between CHD-PAH and PVH patients.

Conclusion:
Mortality for CHD patients with PH is significantly increased compared to CHD patients without PH. PAH and PVH are associated with a similar age of death, but PAH usually starts at a significantly younger age. Early recognition of elevated pulmonary pressures is necessary to provide optimal therapeutic and clinical care.
**INCREASED LEFT VENTRICULAR OUTFLOW TRACT ACCELERATION TIME IS ASSOCIATED WITH SYMPTOMS IN PATIENTS WITH HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY**

*R. Huurman (Erasmus University Medical Center, Rotterdam); M. Michels (Erasmus University Medical Center, Rotterdam); D.J. Bowen (Erasmus University Medical Center, Rotterdam); M. van Slegtenhorst (Erasmus University Medical Center, Rotterdam); A. Hirsch (Erasmus University Medical Center, Rotterdam); A.F.L. Schinkel (Erasmus University Medical Center, Rotterdam)*

**Purpose:**
Not all hypertrophic obstructive cardiomyopathy (HOCM) patients are symptomatic. The relation between HOCM and symptoms is not well understood. The hypothesis of this study is that LVOT acceleration time (AT) is associated with symptomatic status.

**Methods:**
This study included 187 patients (61% men, mean age 55 ± 14 years) with HOCM, defined as a maximal wall thickness ≥15 mm and an LVOT peak gradient ≥30 mmHg. Continuous wave Doppler tracings from 3 beats were used to assess peak velocity (PV), left ventricular ejection time (LVET) and AT (the time interval between onset of flow over the LVOT and the moment of PV). Logistic and Cox proportional hazard regression analyses were used to evaluate the relation between symptoms and echocardiographic measurements including AT. Reproducibility was assessed using the intraclass correlation coefficient (ICC).

**Results:**
Symptomatic patients were more often female and had significantly higher mean AT values. Logistic regression demonstrated a significant association of AT and symptoms, after correction for gender, use of medical therapy, PV, LVOT diameter and diastolic dysfunction (odds ratio 1.04 per 10 ms, p<0.001). AT was independently associated with symptoms and septal reduction during follow-up (hazard ratio 1.09 per 10 ms, p<0.05). The ICC was 0.99 with a mean difference of 0.18 ± 5.5 ms.

**Conclusion:**
In HOCM patients, increased AT is significantly related to symptoms, also after adjustment for gender, use of medical therapy, PV, LVOT diameter and diastolic dysfunction, and is predictive of symptomatic status during follow-up. AT represents an easily measured echocardiographic variable with excellent inter-reader reproducibility.
Figures:
Boxplot illustrating mean acceleration time for each New York Heart Association class subgroup

Anova: p<0.001
IMPACT OF 9-MONTHS INCREASED TRAINING VOLUME ON CARDIAC REMODELLING IN ELITE MALE AND FEMALE ELITE ROWERS: DISTINCT EFFECTS BETWEEN CARDIAC SIDES AND SEXES

G. Kleinnibbelink Radboudumc, Nijmegen); N.M. Panhuyzen-Goedkoop (Radboudumc, Nijmegen); H.G. Hulshof (Radboudumc, Nijmegen); A.P.J. van Dijk (Radboudumc, Nijmegen); K.P. George (Liverpool John Moores University, Liverpool); J.D. Somauroo (Liverpool John Moores University, Liverpool); D.L. Oxborough (Liverpool John Moores University, Liverpool); D.H.J. Thijssen (Radboudumc, Nijmegen; Liverpool John Moores University, Liverpool)

Purpose:
Whilst the athlete’s heart has been extensively described, little work has focused on the potential for elite athletes to demonstrate further cardiac remodelling. Moreover, work in this field is limited by focusing on the left-side only, predominantly in male athletes. To examine the impact of an increase in training volume across 9-months in elite rowers on left- and right-sided cardiac structure, function and mechanics, and explore potential sex differences.

Methods:
As part of the preparations to the 2012 Olympic Games, twenty-seven elite rowers (26.4±3.7 years, 19 male) underwent baseline echocardiography prior to and post (9-months) an increase in training volume. Echocardiography, including structure, function and mechanics of all cardiac chambers were assessed prior to (i.e. after the 2011 World Championship) and following 9-months (i.e. before the 2012 Olympic games).

Results:
Training increased left ventricular (LV) structure, including wall thickness, diameter, volume and mass, concomitant with an increase in LV twist (all p<0.05). Female rowers showed a significantly larger adaptation in LV diameter and mass compared to male rowers (both p<0.05). No changes were found in other measures of LV function (all p>0.05). Left atrial volume increased (p=0.01), which did not differ between sexes. No changes in right ventricular or atrial structure or function were found (all P<0.05).

Conclusion:
Our data revealed that 9-months increased training volume in elite rowers induced side- and sex-specific cardiac remodelling. Specifically, left-sided (but not right-sided) adaptation and concomitant increase in LV twist were present, with significantly larger adaptation in women compared to men.
Figures:
Left and right heart structural, functional and mechanical echocardiographic parameters observed in male and female elite rowers prior and post a 9-month increase in training volume

|                         | All rowers (n=27) |                         |                         |                         |                         |                         |                         |                         |
|-------------------------|-------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|-------------------------|
|                         | Pre               | Post                   | T-test                  | ANOVA (Male n=19,       | Time* Gender            | Time* Gender            | Time* Gender            |
|                         | Mean±SD           | Mean±SD                | P-value                 | Female n=8)             |                         |                         |                         |
| Septal wall thickness, mm | 9.2±1.2          | 9.7±1.1                | <0.001                  | 0.01                    | 0.01                    | 0.04                    | 0.34                    |
| Posterior wall thickness, mm | 8.3±1.3          | 8.7±1.4                |                         |                         |                         |                         |                         |
| LV internal diameter, mm | 56.5±4.6         | 57.9±4.2               | 0.001                   | <0.001                  | 0.002                   | <0.05                   |
| LV mass, g              | 190.6±50.5       | 212.2±48.2             | <0.001                  | <0.001                  | 0.002                   | 0.11                    |
| LV mass index           | 90.2±17.8        | 100.8±17.1             | <0.001                  | <0.001                  | 0.04                    | 0.03                    |
| RWT, ratio              | 0.29±0.04        | 0.3±0.05               |                         |                         |                         |                         |                         |
| LV end-diastolic volume, ml | 146.5±33.7      | 151.7±27.5             | 0.04                    | 0.03                    | 0.03                    | 0.32                    |
| LV ejection fraction, % | 58.2±6.0         | 57.6±4.1               | 0.66                    | 0.77                    | 1.00                    | 0.32                    |
| E/A ratio               | 1.9±0.4          | 1.8±0.3                | 0.33                    | 0.33                    | 0.68                    | 0.83                    |
| TDI E, m/s              | 0.171±0.02       | 0.17±0.02              | 0.97                    | 0.93                    | 0.81                    | 0.15                    |
| TDI A, m/s              | 0.081±0.01       | 0.08±0.01              | 0.74                    | 0.24                    | 0.62                    | 0.86                    |
| TDI S, m/s              | 0.11±0.01        | 0.12±0.02              | 0.48                    | 0.16                    | 0.39                    | 0.35                    |
| LV Longitudinal Peak Strain, % | -18.6±1.7     | -18.6±2.0              | 0.98                    | 0.49                    | 0.10                    | 0.14                    |
| LV Basal Circumferential Peak Strain, % | -18.4±3.9    | -17.7±3.8              | 0.36                    | 0.66                    | 0.21                    | 0.73                    |
| LV Apical Circumferential Strain, % | -17.1±3.9    | -17.7±3.9              | 0.55                    | 0.77                    | 0.01                    | 0.58                    |
| LV Basal Radial Peak Strain, % | 32.6±15.0    | 29.5±9.5               | 0.42                    | 0.43                    | 0.72                    | 0.75                    |
| LV Apical Radial Peak Strain, % | 55.4±22.1    | 56.7±16.7              | 0.83                    | 0.73                    | 0.05                    | 0.23                    |
| Peak Systolic Basal Rotation, ° | -4.4±3.1      | -4.5±2.4               | 0.84                    | 0.89                    | 0.36                    | 0.67                    |
| Peak Systolic Apical Rotation, ° | 5.8±3.4       | 7.1±3.7                | 0.01                    | 0.36                    | 0.02                    | 0.07                    |
| Peak Twist, °           | 9.2±4.5         | 11.7±4.7               | 0.04                    | 0.24                    | 0.20                    | 0.46                    |
| LA diameter, mm         | 34.9±5.1         | 37.3±4.8               | 0.001                   | <0.001                  | 0.02                    | 0.07                    |
| LA volume, ml           | 58.8±15.2        | 65.3±17.6              | 0.03                    | 0.03                    | 0.34                    | 0.61                    |
| LA Longitudinal Peak Strain, % | 57.3±19.3     | 53.4±12.2              | 0.19                    | 0.23                    | 0.41                    | 0.92                    |
| RVOT PLAX, mm           | 33.6±4.4         | 34.0±3.8               | 0.42                    | 0.66                    | 0.53                    | 0.49                    |
| RV Basal Diameter, mm   | 43.7±4.9         | 42.8±5.6               | 0.28                    | 0.33                    | 0.05                    | 0.99                    |
| RV Mtd-Cavity Diameter, mm | 33.1±5.4       | 32.5±5.5               | 0.32                    | 0.74                    | 0.07                    | 0.14                    |
| RV end-diastolic area, cm² | 29.1±4.7       | 28.6±4.7               | 0.33                    | 0.39                    | 0.001                   | 0.89                    |
| RV fractional area change, % | 42.2±4.4      | 41.6±3.5               | 0.47                    | 0.32                    | 0.94                    | 0.31                    |
| TAPSE, cm               | 29.7±4.4         | 31.0±4.9               | 0.05                    | 0.23                    | 0.02                    | 0.30                    |
| TDI E', m/s             | 0.17±0.02        | 0.17±0.03              | 0.24                    | 0.14                    | 0.70                    | 0.28                    |
| TDI A', m/s             | 0.12±0.03        | 0.12±0.03              | 0.59                    | 0.60                    | 0.40                    | 0.90                    |
| TDI S', m/s             | 0.16±0.02        | 0.16±0.02              | 0.82                    | 0.91                    | 0.91                    | 0.53                    |
| RV Longitudinal Peak Strain, % | -23.2±2.2    | -22.6±1.7              | 0.05                    | 0.03                    | 0.09                    | 0.10                    |
| RA Area, cm²            | 18.6±4.1         | 19.4±4.3               | 0.10                    | 0.24                    | <0.001                  | 0.41                    |
| RA Longitudinal Peak Strain, % | 56.7±11.3     | 56.6±12.3              | 0.97                    | 0.83                    | 0.13                    | 0.62                    |
A META-ANALYSIS OF SEX AND GENDER STRATIFIED RISK OF PSYCHOLOGICAL FACTORS FOR ISCHEMIC HEART DISEASE.

P.M.C. Mommersteeg (Tilburg University, Tilburg); V. Smaardijk (Tilburg University, Tilburg; Radboudumc, Nijmegen) A.H.E.M. Maas (Radboudumc, Nijmegen); P. Lodder (Tilburg University, Tilburg); W.J. Kop (Tilburg University, Tilburg);

Purpose:
We assessed sex & gender (S&G) related risks of psychological factors for the development (incidence) and progression (prognosis) of ischemic heart disease (IHD) in a meta-analysis. Psychological factors such as depression and anxiety are related to IHD development and progression. Depression and anxiety are more prevalent in patients with IHD, and they are more prevalent in women compared to men. However, it is unknown if these psychological factors pose an increased risk in women, and whether gender differences can be detected.

Methods:
Literature was searched using PubMed, EMBASE, and PsycINFO. Screening and data-extraction were performed in duplicate. Studies were included when examining depression, anxiety, social support, anger/hostility, personality, post-traumatic stress disorder, and psychological distress for the incidence or prognosis of IHD. When no S&G stratified data were present, authors were contacted to provide additional S&G-stratified analysis. Random-effect analyses were performed using Comprehensive Meta-Analysis.

Results:
We included 290 papers regarding IHD incidence or prognosis, of which 64% did not report S&G-stratified results. After contacting 187 authors, 36% provided S&G-stratified results. Depression was the most examined psychological factor, followed by anxiety. Pooled effect estimates showed that psychological factors were associated with incident IHD and adverse outcomes after IHD in both women and men, with a stronger association in men. Studies from Europe and Northern-America are overrepresented, as are groups of European descent. Findings of the incidence meta-analysis are published as J Am Heart Assoc. 2019 May 7;8(9):e010859 https://doi.org/10.1161/JAHA.118.010859.

Conclusion:
Most studies do not report S&G-stratified findings of psychosocial factors with IHD incidence or prognosis. Studies comprise more male than female participants, and mainly focus on obstructive coronary artery disease as well as groups of European descent. Our findings aim to contribute to increase awareness of the risk of psychological factors for S&G-sensitive risks for IHD, improve prevention and healthcare, and guide S&G-sensitive interventions for incident IHD and adverse progression.
IMPROVEMENT IN QUALITY OF LIFE AND ANGINA PECTORIS SYMPTOMS: ONE-YEAR FOLLOW-UP OF PATIENTS WITH REFRACTORY ANGINA PECTORIS AND SPINAL CORD STIMULATION TREATMENT

F.E. Vervaat (Catharina Ziekenhuis, Eindhoven); A. van der Gaag (Catharina Ziekenhuis, Eindhoven); H. van Suijlekom (Catharina Ziekenhuis, Eindhoven); C.J. Botma (Catharina Ziekenhuis, Eindhoven); K. Teeuwen (Catharina Ziekenhuis, Eindhoven); I. Wijnbergen (Catharina Ziekenhuis, Eindhoven)

Purpose:
Spinal cord stimulation (SCS) is a treatment for patients with refractory angina pectoris (RAP) remaining symptomatic despite optimal medical therapy and without revascularisation options. Previous studies have shown that SCS improves the quality of life in this patient group and reduces the severity of the angina pectoris. The aim of this prospective observational study is to show this effect in a single-centre cohort, with a follow-up period of one year.

Methods:
Between July 2010 and March 2017, 87 patients with RAP referred to our centre received SCS. The Seattle Angina Questionnaire (SAQ) and RAND-36 were completed at baseline, prior to implantation, and one year post implantation.

Results:
After one-year follow-up there was a statistically significant decrease in the frequency of angina pectoris attacks from more than four times a day to one to two times a week (p<0.001). The SAQ showed statistically significant improvement in four of the five dimensions: physical limitation (p<0.001), angina frequency (p<0.001), angina stability (p<0.001), and quality of life (p<0.001). The RAND-36 showed statistically significant improvement in all nine dimensions: physical functioning (p=0.001), role physical (p<0.001), social function (p=0.03), role emotional (p<0.05), bodily pain (p<0.001), general health (p<0.001), vitality (p<0.001), mental health (p=0.02) and health change (p<0.001).

Conclusion:
This study showed a significant improvement in quality of life and reduction of angina pectoris severity after one-year follow-up in patients treated with spinal cord stimulation for refractory angina pectoris.
FOLLOW YOUR HEART: OPTIMIZING THE DELIVERY OF CARE FOR REFERRAL AND PARTICIPATION TO CARDIAC REHABILITATION FOR PATIENTS AFTER AN ACUTE CORONARY SYNDROME.

A. de Vries (Tergooi hospital, Blaricum); S. Brinckman (Tergooi hospital Blaricum); P.W. Westgeest (Tergooi hospital Blaricum); G. Holleman (Universiteit of applied sciences, Utrecht)

Purpose:
Participation in outpatient cardiac rehabilitation for patients after an Acute Coronary Syndrome (ACS) has been shown to reduce mortality, morbidity and improve quality of life. Despite the proven benefits this secondary prevention program is (inter)nationally underused. A problem that also occurs at Tergooi hospital. Analyses at Tergooi shows a suboptimal referral rate and a lack of a well-structured referral. Optimizing this referral to fit patients' needs is necessary for an appropriate and motivated participation in cardiac rehabilitation. The objective of this study is to examine the optimal delivery of care for referral and participation to cardiac rehabilitation that leads to an enhanced quality of life and optimization of secondary prevention.

Methods:
An explorative, descriptive mixed-method study was conducted. The study was performed in two parts. First a literature review, semi-structured interviews with national experts, a benchmark and a patients survey. Secondly the study results and a proposal for innovation were presented to a focus group-interview at Tergooi to choose an appropriate innovation to ‘fit’ the organization of Tergooi.

Results:
The optimal delivery of care to promote referral and participation to cardiac rehabilitation includes multiple interventions. All indicated patients after an ACS need to be automatically referred to cardiac rehabilitation as a standard of care. Referral has to be supported with optimal information provision, coordinated care and personalized care tailored to the patient’s needs, values and preferences. Survey respondents 91% (N=75) find it important to make a shared decision about their recovery and options to improve their cardiovascular risk profile with the healthcare provider.

Conclusion:
To enhance quality of life and secondary prevention after an ACS an optimal delivery of cardiac rehabilitation care is necessary. Utilizing an advanced nurse practitioner coordinated and managed person-centered pathway in the delivery of cardiac rehabilitation will give the patient more control in recovery and secondary prevention. And last but not at least a responsibility in own health and healthy behavior.
Figures:
Influence of central themes on decision making for participation in cardiac rehabilitation
LONG-TERM CLINICAL OUTCOMES OF LOSARTAN IN PATIENTS WITH MARFAN SYNDROME - FOLLOW-UP OF THE MULTICENTER RANDOMIZED CONTROLLED COMPARE TRIAL.

M.M. van Andel (Amsterdam UMC - locatie AMC, Amsterdam); R. Indrakusuma, (Department of Vascular Surgery, Amsterdam UMC, University of Amsterdam, Amsterdam); H. Jalalzadeh, (Department of Vascular Surgery, Amsterdam UMC, University of Amsterdam, Amsterdam); R. Balm, (Department of Vascular Surgery, Amsterdam UMC, University of Amsterdam, Amsterdam); J. Timmermans, (Department of Cardiology, St. Radboud University Medical Center, Nijmegen); A.J.H.A. Scholte, (Department of Cardiology, Leiden University Medical Center, Leiden); M.P. van den Berg, (Department of Cardiology, University Medical Center Groningen, Groningen); A.H. Zwinderman, (Department of Clinical Epidemiology, Biostatistics and Bioinformatics, Amsterdam UMC, University of Amsterdam, Amsterdam); B.J.M. Mulder, (Department of Cardiology, Amsterdam UMC, University of Amsterdam, Amsterdam); V. de Waard, (Department of Medical Biochemistry, Amsterdam UMC, University of Amsterdam); M. Groenink, (Department of Cardiology and Radiology, Amsterdam UMC, University of Amsterdam, Amsterdam, the Netherlands)

Purpose:
The COMPARE trial showed a small but significant beneficial effect of three year losartan treatment on aortic root dilatation rate in adults with Marfan syndrome (MFS). Yet, this was not reproduced by other trials. The aim of the current study was to investigate the long-term clinical outcomes after losartan treatment.

Methods:
Adult patients with MFS (n=233) were randomly allocated to either losartan or no additional medication on top of regular treatment (β-blockers 68% in the losartan group and 76% in the control group) in the original COMPARE study.
Follow-up data were available from 207 patients. The clinical endpoints were defined as elective aortic root replacement, aortic dissection or rupture (aortic complications) and all-cause mortality. These endpoints and a composite endpoint consisting of all three clinical endpoints were subsequently compared between the group originally allocated to losartan and the group with no additional treatment after a median follow-up of 8 years.

Results:
Five deaths, two aortic ruptures, 14 dissections (13 type B, 1 unknown origin) and 48 aortic root replacements occurred in 207 patients. Patients who used losartan in the original COMPARE study showed a significantly reduced number of events (death: 0 vs 5, p = 0.028; aortic complications: 3 vs 12, p = 0.025; elective aortic root replacement: 17 vs 31, p = 0.161 and composite endpoint: 20 vs 41, p = 0.020) (Figure 1).

Conclusion:
These results show that treatment with losartan is associated with an overall improved clinical outcome in patients with MFS after >8 years follow-up. Until more prospective long-term data becomes available, losartan treatment should therefore be considered as a suitable treatment option for MFS patients.
Figures:
Figure 1. Event free survival

![Event free survival graph]

- **Event-Free Survival (%)**
  - Losartan
  - Control

- **Time in Years**
  - 0, 3, 6, 9

- **No. at risk**
  - **Losartan**
    - 92 at 0 years
    - 82 at 3 years
    - 67 at 6 years
    - 15 at 9 years
  - **Controls**
    - 115 at 0 years
    - 98 at 3 years
    - 64 at 6 years
    - 6 at 9 years

- **HR 0.535 (95% CI 0.313 - 0.914)**
- **p = 0.020 (Log-Rank)**
DELAYED DIAGNOSIS OF ARRHYTHMOGENIC CARDIAC SARCOIDOSIS: A CASE SERIES

J.C. Hoogendoorn (LUMC, Leiden); M.K. Ninaber (LUMC, Leiden); M. de Riva Silva (LUMC, Leiden); R. Grauss (HMC, Den Haag); K. Zeppenfeld (LUMC, Leiden)

Purpose:
Cardiac sarcoidosis (CS) can be challenging to diagnose. Extracardiac symptoms are often absent and cardiac manifestations may mimic other diseases. Occurrence of monomorphic ventricular tachycardia (VT) may be associated with high morbidity and mortality. Early diagnosis allows intervention which may impact prognosis. We assessed the diagnostic- and disease course of patients referred for VT ablation.

Methods:
Patients who underwent VT ablation in our (referral) center with CS as underlying aetiology (according to Japanese- or HRS criteria) were retrospectively included. Data on first presentation related to CS, date of diagnosis of (extra)CS, cardiac function on echocardiogram, sustained VTs, heart failure admissions, VT ablations and death were collected.

Results:
Fifteen patients (60% male, 51±8 years at first presentation) were included. Early cardiac manifestation was VT in 10/15, AV-block in 3/15 and heart failure in 2/15 (figure). The median time between first cardiac presentation and diagnosis of CS was 15 (IQR: 1-37) months; common early misdiagnosis was ischemic cardiomyopathy despite normal angiogram (n=4) and ARVC (n=3). Only 2/11 patients with extracardiac sarcoidosis had related complaints. Isolated CS was present in 4/15 patients. Median follow-up from first presentation was 55 (IQR: 23-88) months. Six patients died; 5/6 had a delayed diagnosis (1/5 at autopsy). 7/15 patients had progressive cardiac dysfunction (all with delayed diagnosis).

Conclusion:
Patients with arrhythmogenic cardiac sarcoidosis (ACS) are initially frequently misdiagnosed. Considering the severe disease course of ACS, awareness of this potential diagnosis, comprehensive evaluation and early treatment is urgently needed.

Figures:
USE OF CARDIAC CT IN THE ROUTINE ASSESSMENT OF CARDIAC ALLOGRAFT VASCULOPATHY IN HEART TRANSPLANT PATIENTS: RESULTS FROM THE FIRST 100 CONSECUTIVE PATIENTS.

F.M.A. Nous (Erasmus MC, Rotterdam); R.P.J. Budde (Erasmus Medical Center, Rotterdam); S. Roest (Erasmus Medical Center, Rotterdam); E.D. van Dijkman (Erasmus Medical Center, Rotterdam); M. Attrach (Erasmus Medical Center, Rotterdam); K. Caliskan (Erasmus Medical Center, Rotterdam); J.J. Brugts (Erasmus Medical Center, Rotterdam); K. Nieman (Stanford University, Palo Alto); A. Hirsch (Erasmus Medical Center, Rotterdam); A.A. Constantinescu (Erasmus Medical Center, Rotterdam); O.C. Manintveld (Erasmus Medical Center, Rotterdam)

Purpose:
Cardiac allograft vasculopathy (CAV) is an accelerated form of coronary disease that affects heart transplant patients (HTX). Routine screening for CAV is warranted. We evaluated the feasibility and utility of cardiac CT to screen for CAV in 100 consecutive heart transplant patients at our center.

Methods:
From Feb 2018 to Jan 2019 all consecutive HTXs who were more than five-years post-transplant were converted from using stress myocardial perfusion imaging to cardiac CT for the annual assessment of CAV. CAV was scored (0 (absent), 1 (mild), 2 (moderate), 3 (severe)) based on coronary CT angiography (CCTA) findings and compared with the most recently known CAV score before CCTA.

Results:
CCTA was performed in 99 out of 100 patients who were planned for cardiac CT (56 (42-63) years, 65% men, and 11 (8-16) years post-transplant), 1 patient underwent only a calcium scan due to IV access problems. The median Agatston calcium score was 6 (0-85), and 37 patients had no detectable calcium. CCTA showed new obstructive coronary disease (>50% stenosis) in 20 patients. The CAV score was reclassified based on CCTA findings in 42 patients. There were 53 CAV0, 22 CAV1, 11 CAV2 and 13 CAV3 patients. Mean heart rate during scanning was 75±11 beats per minute and beta-blockers were required in 63 patients. Median radiation dose was 2.5 (1.9–3.5) mSv.

Conclusion:
Cardiac CT can be successfully performed in HTXs with a low radiation dose. CCTA detects patients with significant coronary disease which leads to substantial reclassification of CAV grades.
USE OF EITHER CARILLON DEVICE OR MITRACLIP FOR THE TREATMENT OF SEVERE SECONDARY MITRAL REGURGITATION: A PROPENSITY SCORE MATCHED COHORT.

T.H. Pinxterhuis (Medisch Centrum Leeuwarden, Leeuwarden; Medisch Spectrum Twente, Enschede); T. Vossenberg (Medisch Centrum Leeuwarden, Leeuwarden); C.A. da Fonseca (Medisch Centrum Leeuwarden, Leeuwarden); S.H. Hofma (Medisch Centrum Leeuwarden, Leeuwarden); A.J. van Boven (Medisch Centrum Leeuwarden, Leeuwarden); F.S. van den Brink (Medisch Centrum Leeuwarden, Leeuwarden).

Purpose:
In inoperable patients percutaneous treatment of severe secondary mitral regurgitation is possible through edge to edge repair or annuloplasty. Little head to head comparison between the two techniques exists.

Methods:
A propensity score matched cohort study was performed on patients who underwent Carillon device implantation and were subsequently matched with a patient who underwent MitraClip implantation. Patients were matched on sex, age, left ventricular function (LVF), diabetes, severity of mitral regurgitation, atrial fibrillation, coronary artery disease, hypertension and peripheral vascular disease.

Results:
A total of 8 patients in the Carillon group were matched to 8 patients in the MitraClip group. Half of the patients was male with a median age of 74.50±4.70 years (MitraClip) vs 74.63±4.70 years (Carillon) (p=0.92). Previous CABG (MitraClip 62.5% vs Carillon 12.5%, p=0.28) was the only significant difference between the groups. The mean NYHA class before implantation was 3.25±0.46 versus 2.88±0.35 for Carillon patients and MitraClip patients (p=0.09). After implantation the NYHA class improved significantly to 2.25±1.03 for the Carillon (p=0.026) and 1.57±0.79 for the MitraClip (p=0.001) group. There was no significant change in left ventricular function between the groups (pre-Carillon: 17.5%±10.00 and pre-MitraClip: 23.7%±16.85 (p=0.39)). LVF after implantation was 15.0%±4.63 and 17.8%±13.35 (Carillon: p=0.53; MitraClip p=0.32). After 1-year a mortality rate of 25% was observed in both groups.

Conclusion:
In this small single centre observational study in patients undergoing Carillon or MitraClip a significant improvement NYHA class was observed in both groups, in spite of severe heart failure at baseline and no improvement in LVF.
EARLY DETECTION OF MECHANICAL DYSFUNCTION IN PLN R14DEL MUTATION CARRIERS

K. Taha (UMCU, Utrecht); W.P. Te Rijdt (UMCG, Groningen), H.A.C.M. De Bruin-Bon (AUMC/AMC, Amsterdam), M.J.M. Cramer (UMCU, Utrecht), F.W. Asselbergs (UMCU, Utrecht), B.J. Bouma (AUMC/AMC, Amsterdam), M.P. Van Den Berg (UMCG, Groningen), A.J. Teske (UMCU, Utrecht)

Purpose:
Carriers of the Dutch phospholamban (PLN) R14del founder mutation may develop arrhythmogenic and/or dilated cardiomyopathy. Overt disease is preceded by a pre-symptomatic phase of variable length in which structural abnormalities seem to be absent. We aimed to explore echocardiographic characteristics of PLN R14del mutation carriers, particularly in early disease stages.

Methods:
We included 188 PLN R14del mutation carriers and classified them to the pre-symptomatic stage (no symptoms and no structural disease, n=93), the arrhythmic stage (arrhythmic symptoms and left ventricular ejection fraction (LVEF) ≥50%, n=50) or the structural stage (LVEF <50%, n=45). We included 89 healthy control subjects who were age- and gender matched with pre-symptomatic mutation carriers. All subjects underwent comprehensive echocardiographic analysis, including deformation imaging. Follow-up data was collected from 149 PLN R14del carriers.

Results:
By design, patients in the structural stage had significantly impaired left ventricular (LV) function and increased LV size when compared to the other mutation carriers (p<0.001). In the pre-symptomatic and arrhythmic stage, LV function and volumes did not differ significantly from controls by conventional measurements. However, LV global longitudinal strain (GLS) and LV mechanical dispersion (MD) were already significantly impaired in the pre-symptomatic and arrhythmic stage when compared to controls (p<0.001). LV MD had the highest area under the curve for predicting sustained ventricular arrhythmia during follow-up (optimal cut-off 47ms; sensitivity 94%, specificity 77%).

Conclusion:
Echocardiographic deformation imaging reveals mechanical alterations in PLN R14del mutation carriers before arrhythmic symptoms and overt structural disease. The predictive value of these measurements should be investigated in a multivariate model.
**Figures:**
Echocardiographic characteristics in PLN R14del mutation carriers

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<thead>
<tr>
<th>Concealed stage</th>
<th>Subclinical stage</th>
<th>Arrhythmic stage</th>
<th>Structural stage</th>
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MID-TERM FOLLOW UP AND RATE OF REINTERVENTION AFTER BIOLOGICAL AORTIC VALVE REPLACEMENT: A SINGLE-CENTRE EXPERIENCE WITH THREE DIFFERENT TYPES OF BIOPROSTHESSES.

N.M.A.J. Timmermans (Catharina Ziekenhuis, Eindhoven); K.Y. Lam (Catharina Ziekenhuis, Eindhoven); B.M.J. Koene (Catharina Ziekenhuis, Eindhoven; M.A. Soliman-Hamad (Catharina Ziekenhuis, Eindhoven); A.H.M. van Straten (Catharina Ziekenhuis, Eindhoven)

Purpose:
The choice to implant biological valve prosthesis is influenced by the issue of durability. We investigated the rate and cause or reintervention of three different aortic valve bioprostheses.

Methods:
All patients who underwent aortic valve replacement (AVR) with the use of biological valve prosthesis between October 2009 and December 2018 were included in the study. Three different bioprostheses were used and compared: Carpentier-Edwards (CE), Trifecta (TRI) and Mitroflow (MIT). The primary end point was the rate of explants. The event-free survival and possible predictors for reintervention were also analyzed.

Results:
In total, 2004 biological aortic valve prostheses were implanted, including 923 CE, 719 TRI and 362 MIT bioprostheses. The CE group had a significantly higher event-free survival (n=917; 99.3%) compared to the TRI (n=685; 95.3%) and MIT (n=340; 93.9%) group; p=0.0001. The main cause of reintervention in the CE group was endocarditis (n=6; 100%), while structural valve deterioration (SVD) was the most common reason for reintervention in the TRI (n=14; 41.2%) and MIT (n=14; 63.6%) group. Cox analysis revealed that only age (HR 0.942, 95% CI 0.914-0.971, P = 0.000) and type of prosthesis (TRI: HR 6.335, 95% CI 2.638-15.213, P < 0.0001; MIT: HR 6.037, 95% CI 2.403-15.167, P < 0.0001) were associated with lower event-free survival.

Conclusion:
According to this single-center analysis, the rate of reintervention after implantation of the Carpentier-Edwards bioprosthesis is lower than that of both Trifecta and Mitroflow bioprostheses. Further investigations with larger patient populations and longer follow-up are needed to verify our findings.
Figures:
AVR, Aortic Valve Replacement; NSVD, Nonstructural Valve Deterioration; SVD, Structural Valve Deterioration
IMAGING FINDINGS AFTER AORTIC VALVE IMPLANTATION ON 18F-FLUORODEOXYGLUCOSE POSITRON EMISSION TOMOGRAPHY WITH COMPUTED TOMOGRAPHY

A.R. Wahadat (Erasmus MC, Rotterdam); W. Tanis (Haga Ziekenhuis, Den Haag); A.M. Scholtens (Meander Medisch Centrum, Amersfoort); M. Bekker (Erasmus MC, Rotterdam); L.H. Graven (Erasmus MC, Rotterdam); L.E. Swart (Erasmus MC, Rotterdam); A.M. den Harder (Universitair Medisch Centrum Utrecht, Utrecht); M.G.E.H. Lam (Universitair Medisch Centrum Utrecht, Utrecht); L.M. de Heer (Universitair Medisch Centrum Utrecht, Utrecht); J.W. Roos-Hesselink (Erasmus MC, Rotterdam); R.P.J. Budde (Erasmus MC, Rotterdam)

Purpose:
Although 18F-Fluorodeoxyglucose (18F-FDG) Positron Emission Tomography (PET) with computed tomography (CT) is an essential tool in diagnosing prosthetic heart valve (PHV) endocarditis, the normal uptake patterns after PHV-implantation have not been studied prospectively. We prospectively assessed perivalvular FDG-uptake at different time points after aortic PHV-implantation.

Methods:
Patients who had undergone aortic PHV-implantation were included and underwent PET/CT at 5(±1) weeks (group 1), 12(±2) weeks (group 2) or 52(±8) weeks (group 3) after implantation. FDG-uptake around the PHV was scored using Qualification Visual Score for Hypermetabolism (QVSH) as “none” (<mediastinum), “mild” (>mediastinum but <liver), “moderate” (>liver), or “severe” (intense uptake). Quantitative analysis was performed with maximum Standardized Uptake Value (SUVmax) and target to background ratio (SUVratio) on standardized European Association of Nuclear Medicine Research Ltd. (EARL) reconstructions.

Results:
In total 37 patients (group 1: n=12, group 2: n=12, group 3: n=13) (age 66±8 years) were included. QVSH around the PHV was 8/12(67%) mild and 4/12(33%) moderate in group 1, 7/12(58%) mild and 5/12(42%) moderate in group 2 and 8/13(62%) mild and 5/13(38%) moderate in group 3 (p=0.91). SUVmax was 3.6±0.5, 3.8±0.5 and 3.3±0.6 (mean±SD, p=0.14), and SUVratio was 1.8±0.2, 1.8±0.3 and 1.7±0.3 (mean±SD, p=0.41) for groups 1, 2 and 3, respectively.

Conclusion:
Baseline FDG-uptake around aortic PHV at 5, 12 and 52 weeks after implantation is similar on qualitative and quantitative measurements. This provides further evidence that PET/CT can be used as a diagnostic tool for the detection of endocarditis even shortly after aortic PHV implantation.
EARLY ECHOCARDIOGRAPHIC RESULTS AFTER MITRACLIP® INTERVENTION AT HAGA HOSPITAL, THE HAGUE.

T.E. Walton-van der Sar; G.B. Bleeker (Haga Teaching Hospital, The Hague); I.A.C. van der Bilt (Haga Teaching Hospital, The Hague)

Purpose:
Percutaneous mitral valve repair using the MitraClip® system is a minimal-invasive treatment for patients with severe mitral regurgitation who don't qualify for mitral valve replacement surgery. The aim of the study was to evaluate whether or not MitraClip® intervention would reduce hemodynamic significance of mitral regurgitation

Methods:
In this retrospective study medical record data of all 49 consecutive patients who underwent MitraClip® intervention at Haga Teaching Hospital, The Hague between January 1st 2016 and December 31st 2018 were collected. The following echocardiographic parameters were analyzed: mitral regurgitation severity (MR), left atrial volume index (LAVi), semi-quantitative grading of left systolic ventricular function (LVF) and systolic pulmonary artery pressure (sPAP). The outcomes of the parameters collected during transthoracic echocardiogram (TTE) before MitraClip® intervention (baseline TTE) and between one and six months after MitraClip® intervention (follow-up TTE) were analyzed.

Results:
Comparison of the echocardiographic outcomes at baseline TTE and follow-up TTE, respectively, revealed a reduction of MR severity from 2.8 ± 0.4 to 1.8 ± 0.7 (P =<0.0001). Changes in LAVi (75.0 ± 23.6 ml/m2, and 75.3 ± 25.2 ml/m2); LVF (2.5 ± 1.2, and 2.2 ± 1.1); and sPAP (41.2 ± 10.8 mmHg, and 39.7 ± 9.7 mmHg) were not significant.

Conclusion:
Although a significant reduction of MR severity after MitraClip® based on echocardiographic parameters was established, changes in LAVi, LVF and sPAP were not statistically significant. Evaluation of echocardiographic parameters considering MitraClip® intervention including more patients and over a longer period of time is required to validate the outcomes of this study.