KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
June 4(Fri.) - 5(Sat.), 2021
MISSION

심장의 건강한 리듬을 지키기 위해 꾸준히 도전하고 헌신한다

VISION

부정맥 극복을 위한 창의적 연구, 인재교육 및 국민인식개선을 통해 의료의 선진화를 주도해 나가는 학회
### PROGRAM AT A GLANCE

#### DAY 1 | JUNE 4 (FRI.)

<table>
<thead>
<tr>
<th>Time/Room</th>
<th>Room 1</th>
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<th>Room 4</th>
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<tbody>
<tr>
<td>08:30-10:00</td>
<td>Atrial Fibrillation 1: Non-Interventional Management of AF</td>
<td>Basic 1: Translating Basic Research Discoveries into Clinical Practice</td>
<td>Ventricular Tachycardia 1: VT in Structural Heart Disease</td>
<td>Noninvasive 1: Clinical Implication of Wearable Device for the Management of Atrial Fibrillation</td>
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<tr>
<td>10:00-10:15</td>
<td>Break</td>
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<tr>
<td>10:15-11:45</td>
<td>Atrial Fibrillation 2: Tailored Approach in AF</td>
<td>PSVT 1: Treatment of Atrial Tachycardia</td>
<td>SPAF 1: Management for Subclinical AF</td>
<td>Cross Specialty 1: Joint Symposium with Heart Failure</td>
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<td>11:45-12:00</td>
<td>Break</td>
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<tr>
<td>12:00-13:00</td>
<td>Scientific Session (Pfizer Korea &amp; BMS Korea)</td>
<td>Lighten the Load: AF Patients with Renal Dysfunction in Focus</td>
<td>Scientific Session (Chong Kun Dang Pharm)</td>
<td>Scientific Session (Abbott)</td>
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<td>13:00-13:15</td>
<td>Break</td>
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<tr>
<td>13:15-14:45</td>
<td>Ventricular Tachycardia 2: VT without Structural Heart Disease</td>
<td>CIED 2: ICD and CRT</td>
<td>Noninvasive 2: Artificial Intelligence and Signal Data Analysis</td>
<td>PSVT 2: Unusual Situations</td>
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<td>14:45-15:00</td>
<td>Break</td>
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<tr>
<td>15:00-16:30</td>
<td>Atrial Fibrillation 3: Anatomy, Imaging and Mapping for AF</td>
<td>Life Saving Device Therapies in Cardiology</td>
<td>SPAF 2: Anticoagulation and Stroke Prevention</td>
<td>Atrial Fibrillation 4: Rhythm Control of AF</td>
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<th>Time/Room</th>
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<tbody>
<tr>
<td>08:30-10:00</td>
<td>SCD 1: Challenging Decision in SCD Related to J Wave &amp; Sports</td>
<td>CIED 1: Monitoring of CIED Patients</td>
<td>Oral 1 (AF)</td>
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<td>10:00-10:15</td>
<td>Break</td>
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<tr>
<td>10:15-11:15</td>
<td>Basic 2: From Mechanism to Therapy: Update in Genetics for Arrhythmia</td>
<td>MR Education</td>
<td>Oral 2 (AF)</td>
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<td>11:15-11:45</td>
<td>Break</td>
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<tr>
<td>12:00-13:00</td>
<td>Oral 3 (Other)</td>
<td>Oral 4 (Basic &amp; CIED)</td>
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<td>Break</td>
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<tr>
<td>13:15-14:15</td>
<td>Policy &amp; New Technology</td>
<td>YIA Competition</td>
<td>Oral 5 (AF)</td>
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<td>14:45-15:00</td>
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<tr>
<td>15:00-16:00</td>
<td>Ventricular Tachycardia 3: Sudden Cardiac Death</td>
<td>Imaging and New Procedure</td>
<td>Oral 6 (AF)</td>
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| 15:00-16:30 | Industry Session (Bayer Korea) | }
## PROGRAM AT A GLANCE

### DAY 2 | JUNE 5 (SAT.)

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<tbody>
<tr>
<td>08:30-10:00</td>
<td>LAA Occluder and Others</td>
<td>Cross Specialty 2: Current Update of Surgical Treatments for Arrhythmias and LAA</td>
<td>CIED 5: CIED Infection and Others</td>
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<tr>
<td>10:00-10:15</td>
<td>Break</td>
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<tr>
<td>12:00-13:00</td>
<td>Scientific Session (DaichiiSankyo-Daewoong) Anti-thrombotic Management with Atrial Fibrillation</td>
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<td>13:00-13:15</td>
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<td>16:30-16:40</td>
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<tr>
<td>16:40</td>
<td>General Assembly for KHRS 2021</td>
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### ROOM 5

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<tbody>
<tr>
<td>08:30-10:00</td>
<td>EGM Tracing 1: Atrial Tachycardia; De Novo &amp; Post-Procedures</td>
<td>Allied Professional 1: Clinical Electrophysiology</td>
<td>Arrhythmia Review Course 1: Basic Interpretation of Arrhythmia</td>
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<td>10:00-10:15</td>
<td>Break</td>
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<tr>
<td>10:15-11:45</td>
<td>EGM Tracing 2: Interesting ECG Tracing</td>
<td>Allied Professional 2: Cardiovascular Implantable Electronic Devices</td>
<td>Arrhythmia Review Course 2: Narrow QRS Tachycardia</td>
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<td>11:45-12:00</td>
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<tr>
<td>12:00-13:00</td>
<td>Oral 7 (Other)</td>
<td>Oral 8 (SCD &amp; Other)</td>
<td>Oral 9 (CIED)</td>
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<tr>
<td>13:15-14:45</td>
<td>Joint Symposium with Overseas Society 1</td>
<td>개최의 및 전공의를 위한 부정맥 치료법 1</td>
<td>EKG Educational Course 1</td>
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<tr>
<td>15:00-16:30</td>
<td>Joint Symposium with Overseas Society 2</td>
<td>개최의 및 전공의를 위한 부정맥 치료법 2</td>
<td>EKG Educational Course 2</td>
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PROGRAM DETAILS

ATRIAL FIBRILLATION 1:
NON-INTERVENTIONAL MANAGEMENT OF AF

**08:30-10:00 | ROOM 1 | ENG**

**CHAIRS**
Kee-Joon Choi (University of Ulsan College of Medicine)
Eun Sun Jin (School of Medicine, Kyung Hee University)

**SPEAKERS**
- Implication of Sleep Apnea in the Management of Atrial Fibrillation
  Younghoon Kwon (University of Washington, United States)
- Role for Genetic Profiling in AF Screening and Predicting Outcomes
  Jung Myung Lee (School of Medicine, Kyung Hee University)
- Lifestyle Modification in AF
  Jin-Kyu Park (Hanyang University College of Medicine)
- Sex Differences in AF Outcomes: Ablation, Stroke, and Anticoagulation
  Hye Young Lee (Inje University College of Medicine)
- Role of Artificial Intelligence in the Prediction and Management of AF
  Khong Lee (Chonnam National University Medical School)

BASIC 1:
TRANSLATING BASIC RESEARCH DISCOVERIES INTO CLINICAL PRACTICE

**08:30-10:00 | Room 2 | ENG**

**CHAIRS**
Jeong-Wook Seo (Incheon Sejong Hospital)
Dong-Gu Shin (Yeungnam University College of Medicine)

**SPEAKERS**
- Calcium Sensitizer Levosimendan on VF Vulnerability during Therapeutic Hypothermia
  Yu-Cheng Hsieh (Taichung Veterans General Hospital, Taiwan)
- Autonomic Modulation in Acute Myocardial Infarction
  Wei-Chung Tsai (Kochsung Medical University, Taiwan)
- The Fluoroscopic Anatomy of Outflow Tract for GVT Ablation
  Ju Youn Kim (School of Medicine, Sungkyunkwan University)
- ICE for AF Ablation
  Myung-Jin Cha (University of Ulsan College of Medicine)
- Anatomic Consideration of Atrium for Ablation of Persistent AF
  Ligang Ding (Fuwei Hospital, China)

VENTRICULAR TACHYCARDIA 1:
VT IN STRUCTURAL HEART DISEASE

**08:30-10:00 | Room 3 | ENG**

**CHAIRS**
Daewoo Hyun (Andong Medical Group Hospital)
Chang Hee Kwon (Konkuk University Professional Graduate School of Medicine)

**SPEAKERS**
- Multifaceted Management of VT in Cardiac Sarcoidosis
  Konstantinos Siontis (Mayo Clinic, United States)
- Arrhythmogenic Substrates in ARVC
  Fa-Po Chung (Taipei Veterans General Hospital, Taiwan)
- Application of Noninvasive Signal-Averaged Electrocardiogram Analysis in Predicting the Requirement of Epicardial Ablation in Patients with Arrhythmogenic Right Ventricular Cardiomyopathy
  Chin-Yu Lin (Taipei Veterans General Hospital, Taiwan)
- Alcohol Induced VT Ablation
  Le Uyen Phuong Tran (Cho Ray Hospital, Vietnam)
- Scar-Related Ventricular Tachycardia in Postoperative Congenital Heart Disease
  June Huh (School of Medicine, Sungkyunkwan University)

NONINVASIVE 1:
CLINICAL IMPLICATION OF WEARABLE DEVICE FOR THE MANAGEMENT OF ATRIAL FIBRILLATION

**08:30-10:00 | Room 4 | ENG**

**CHAIRS**
June Soo Kim (School of Medicine, Sungkyunkwan University)
Daehyeok Kim (Inha University School of Medicine)

**SPEAKERS**
- Improving Care for Patients with Atrial Fibrillation through Use of Personal Electrocardiogram
  Teresa Praus (Southwest Medical, OptumCare Nevada, United States)
- The Use of AI for Atrial Fibrillation Detection
  Yong-Soo Bask (Inha University School of Medicine)
- Clinical Update for AF Screening
  Nam-Ho Kim (Wonkwang University School of Medicine)
- Advanced Deep Learning Algorithm for Acute Ischemic Stroke Classification Based on Brain MR
  Dae-In Lee (Chungbuk National University College of Medicine)
- Clinical Implication of Wearable Devices for Cryptogenic Stroke Evaluation
  Seung-Young Roh (Korea University College of Medicine)
PROGRAM DETAILS

SCD 1:
CHALLENGING DECISION IN SCD RELATED TO J WAVE & SPORTS
08:30-10:00 | Room 5 | ENG

CHAIRS
Tae-Joon Cha (Kosin University College of Medicine)
Sung-Won Jang (College of Medicine, The Catholic University of Korea)

SPEAKERS
Do We Need to Treat Athletes with J Wave?
Nam-Sik Yoon (Chonnam National University Medical School)
Genetic Basis of J Wave Syndrome
Dan Hu (Renmin Hospital of Wuhan University, China)
Should We Screen Athletes before Sports Participation?
Jin-Bae Kim (School of Medicine, Kyung Hee University)
Iatrogenic & Preventable Cardiac Arrest in Hospitalized Patients
Jong Sung Park (Dong-A University College of Medicine)

CIED 1:
MONITORING OF CIED PATIENTS
08:30-10:00 | Room 6 | ENG

CHAIRS
Choong Hwan Kwak (Gyeongsang National University College of Medicine)
Jung Hoon Sung (CHA University)

SPEAKERS
Current Status of Remote Monitoring of Patients with CIEDs - Pacemakers to CRTDs
Niraj Varma (Cleveland Clinic, United States)
Predictors for Pacing Induced Cardiomyopathy in Patients with Pacemaker
Ki-Woon Kang (Chung-Ang University College of Medicine)
Remote Monitoring: Drive Efficiency to Manage CIED Patients – Special Role of Remote Monitoring in Device Advisories and Recalls
Jumsuk Ko (Wonkwang University School of Medicine)
Sensing and Detection with Cardiac Implantable Electronic Devices - Stroke and AF: Diagnosis and Management
Dong-Hyeok Kim (Ewha Womans University School of Medicine)
Insecurity by Obscurity: A Cybersecurity Risk Assessment of Cardiac Implantable Electronic Devices
Sang Weon Park (Bucheon Sejong Hospital)

ORAL 1 (AF)
08:30-10:00 | Room 7 | ENG

CHAIR
Jae-Sun Uhm (Yonsei University College of Medicine)

PRESENTERS
Totally Thoracoscopic Ablation in Patients with Atrial Fibrillation and Left Ventricular Dysfunction
Hye Ree Kim (Samsung Medical Center (Samsung Seoul Hospital))
Risk Factors for Stiff Left Atrial Physiology after Catheter Ablation of Atrial Fibrillation
Jae-Hyuk Lee (Severance Hospital)
Spatial Changes of Fibrillatory Wave-Dynamics after Using Antiarrhythmic Drugs in Atrial Fibrillation: A Computational Modeling Study
Inseok Hwang (Yonsei University Health System)
Longitudinal Patterns in Antithrombotic Therapy in Patients with Atrial Fibrillation after Percutaneous Coronary Intervention in the Non-Vitamin K Oral Anticoagulant Era: A Nationwide Study
Jiesuck Park (Seoul National University Hospital)
Mitral Isthmus Ablation with Moderate-Power (40 Watts) Radiofrequency Energy Is Associated with High Success Rate of Bidirectional Conduction Block
Jun Kim (University of Ulsan College of Medicine)
Impact of Cumulative Burden of Body Mass Index and Waist Circumference on Risk of Atrial Fibrillation: An Analysis of 3,700,000 Participants Who Underwent 4-Year Consecutive Annual Health Examination
Tae-Min Rhee (Seoul National University Hospital)
Electrical Remodeling of Left Atrium can Better Predict Recurrence after Radiofrequency Catheter Ablation of Atrial Fibrillation than Structural Remodeling
Yun Gi Kim (Korea University Anam Hospital)

INDUSTRY SESSION (SAMJIN PHARM.):
UPDATE ON DIAGNOSIS AND TREATMENT OF ATRIAL FIBRILLATION
08:30-09:30 | Room 8 | KOR

CHAIRS
Boyoung Joung (Yonsei University College of Medicine)
Jong-II Choi (Korea University College of Medicine)

SPEAKERS
The Diagnosis of AF Using the Wearable ECG Monitoring Device; S-PATCH EX
Jumsuk Ko (Wonkwang University School of Medicine)
The Review of Current Treatment Strategies in Patients with Atrial Fibrillation
Se-Ryoung Lee (Seoul National University College of Medicine)
## PROGRAM DETAILS

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<th>SPEAKERS</th>
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| **INDUSTRY SESSION (BOSTON SCIENTIFIC):**  
CASE SHARING – ULTRA HIGH DENSITY MAPPING | Room 8 | 09:30-10:00 | Ultra High Density Mapping – [Case Sharing] | Jaemin Shim (Korea University College of Medicine) |
| **ATRIAL FIBRILLATION 2:**  
TAILORED APPROACH IN AF | Room 1 | 10:15-11:45 | Young-Hoon Kim (Korea University College of Medicine)  
Kee-Joon Choi (University of Ulsan College of Medicine) | Fluoroscopy Catheter Ablation of AFib  
Mansour Razmini (AMITA Health Care, United States)  
Short & Long-Term Endpoint of My AF Ablation Procedure  
Young-Hoon Kim (Korea University College of Medicine)  
My Approach to Patients with Persistent AF  
Yong Seog Oh (College of Medicine, The Catholic University of Korea)  
New Developments in Atrial Fibrillation Ablation  
Sung Woo Lee (MedStar Heart and Vascular Institute, United States) |
| **PSVT 1:**  
TREATMENT OF ATRIAL TACHYCARDIA | Room 2 | 10:15-11:45 | Dong-Su Shin (Yeungnam University College of Medicine)  
June Huh (School of Medicine, Sungkyunkwan University) | Ablation of Focal Atrial Tachycardia  
Nwe Nwe (Yangon General Hospital, Myanmar)  
Cryofreezing Catheter Ablation of Supraventricular Tachycardia  
Kaoru Okishige (Yokohama Minato Heart Clinic, Japan)  
Supraventricular Tachycardia in Patients with Persistent Left Superior Vena Cava  
Jae-Sun Uhm (Yonsei University College of Medicine)  
Atrial Tachycardia in Structural Heart Disease  
Myung Hwan Bae (Kyungpook National University School of Medicine)  
Catheter Ablation of Recurrent PSVT Using Ultra High Density Mapping System  
Jaemin Shim (Korea University College of Medicine) |
| **CROSS SPECIALTY 1:**  
JOINT SYMPOSIUM WITH HEART FAILURE | Room 4 | 10:15-11:45 | Dong-Ju Choi (Seoul National University College of Medicine)  
Eun-Jung Bae (Seoul National University College of Medicine) | Atrial Dysfunction in Patient with AF and HF  
Dae-In Lee (Chungbuk National University College of Medicine)  
Benefit of CRT for Non-Ambulatory Class IV HF Patients  
JiHyun Lee (Seoul National University College of Medicine)  
Preventing HF and AF with Treatments for Diabetes Mellitus  
Mi-Seung Shin (Gachon University School of Medicine)  
Management of Arrhythmias after Heart Transplantation  
Jong-Chan Youn (College of Medicine, The Catholic University of Korea)  
Management of HF in AF Patients: HFpEF vs HFpEF  
Jin-Oh Choi (School of Medicine, Sungkyunkwan University) |
| **PSAF 1:**  
MANAGEMENT FOR SUBCLINICAL AF | Room 3 | 10:15-11:45 | Myung Yong Lee (Dankook University College of Medicine)  
Hong Euy Lim (College of Medicine, Hallym University) | Managing Patients with CIED Detected Atrial Fibrillation  
Chi-Keong Ching (National Heart Centre Singapore, Singapore)  
Atrial Remodeling in Patients with Device Detected AF (AHRE)  
Hsu-Ming Tao (National Yang Ming Chiao Tung University Hospital, Taiwan)  
Tailored Anticoagulation in Atrial Fibrillation: Current Trends and Future Perspective  
Marcellus Francis L. Ramirez (University of Santo Tomas, Philippines)  
How Much AF Matters?: AF Burden and Stroke Risk  
Min Soo Cho (University of Ulsan College of Medicine)  
Risk Factors for AF – Who, When and How to Intervene  
Pil-Sung Yang (CHA University) |
### PROGRAM DETAILS

#### BASIC 2:
**FROM MECHANISM TO THERAPY: UPDATE IN GENETICS FOR ARRHYTHMIA**

**CHAIRS**
- Tae-Joon Cha (Kosin University College of Medicine)
- Hyung Wook Park (Chonnam National University Medical School)

**SPEAKERS**
- Biological Pacing by Non-Viral TBX18 Gene Transfer and TGFβ Inhibition
  - Kihong Lee (Chonnam National University Medical School)
- Transmembrane Action Potential in Failing Ventricular Cardiomyocyte
  - Namisk Yoon (Chonnam National University Medical School)
- Gene Therapy for Heart Rate Control
  - Hee Cheol Cho (Emory University, United States)
- The Role of SCN5A in J Wave Syndrome
  - Dan Hu (Renmin Hospital of Wuhan University, China)
- Role of Genetics in AF
  - Hye Tae Yu (Yonsei University College of Medicine)

#### ORAL 2 (AF)

**CHAIR**
- Eue-Keun Choi (Seoul National University College of Medicine)

**PRESENTERS**
- Characteristics of the Unipolar Electrograms in the Pulmonary Vein Antrum during Radiofrequency Pulmonary Vein Antral Isolation
  - Ungjeong Do (Dongguk University Ilsan Hospital)
- Malnutrition and Risk of Procedural Complications in Patients with Atrial Fibrillation Undergoing Catheter Ablation
  - Daehoon Kim (Yonsei University College of Medicine)
- Association of Rhythm Control with Incident Dementia among Patients with Atrial Fibrillation: Nationwide Cohort Study
  - Do Young Kim (Yonsei University College of Medicine)
- Sex Differences in the Left Atrial Low Voltage Areas according to CHA2DS2-VA Score among Patients with Atrial Fibrillation
  - Jiesuck Park (Seoul National University Hospital)
- A Healthy Lifestyle Combination is Associated with a Lower Risk of Dementia in Patients Newly Diagnosed with Atrial Fibrillation after Percutaneous Coronary Intervention: A Nationwide Study in the Era of NOAC
  - Ki-Hun Kim (Inje University College of Medicine)

#### MR EDUCATION

**CHAIRS**
- Myungchul Hyun (Kyungpook National University School of Medicine)
- Byung-Chun Jung (Daegu Fatima Hospital)

**SPEAKERS**
- 부정맥 치료 방법
  - Jun Hyung Kim (Chungnam National University College of Medicine)
- 심장세동이란 (심장, 치료)
  - Sung Ho Lee (School of Medicine, Sungkyunkwan University)
- 부정맥 치료의 삼각상
  - Who Seok Lee (Yeosu Jeil Hospital)
- 심장세동 치료요법
  - Ki-Hun Kim (Inje University College of Medicine)

#### INDUSTRY SESSION (ABBOTT):
**AF MANAGEMENT WITH ABBOTT’S TECHNOLOGY**

**SPEAKERS**
- Why I Use Confirm Rx for My Atrial Fibrillation Patients
  - Asim Yunus (Michigan Cardio-Vascular Institute, United States)
- The Magic of Using HD Grid and ICE in Treatment of Cardiac Arrhythmias
  - Mansour Razmnia (AMITA Health Care, United States)
INDUSTRY SESSION (BORYUNG PHARMACEUTICAL):
OUTCOMES AFTER USE OF 110MG DABIGATRAN IN PATIENTS WITH AF
11:15-11:45 | Room 8 | ENG

SPEAKER
Outcomes after Use of 110mg Dabigatran in Patients with AF
In-Soo Kim (Yonsei University College of Medicine)

SCIENTIFIC SESSION (PFIZER KOREA & BMS KOREA):
LIGHTEN THE LOAD: AF PATIENTS WITH RENAL DYSFUNCTION IN FOCUS
12:00-13:00 | Room 1 | ENG

CHAIR
Kee-Joon Choi (University of Ulsan College of Medicine)

SPEAKERS
Tailored Oral Anticoagulation Strategies with Eliquis in AF patients with Renal Impairment
Charles Herzog (Hennepin Healthcare / University of Minnesota, United States)
AF Patients with CKD: A Room for Improvement with Eliquis
Junbeom Park (Ewha Womans University School of Medicine)

SCIENTIFIC SESSION (ABBOTT):
ARRHYTHMIA MANAGEMENT SESSION: BREAKTHROUGH TECHNOLOGIES AND APPROACHES
12:00-13:00 | Room 3 | ENG

SPEAKERS
Advance Ablation and Mapping Technologies – How It Has Change My Technique
HCA Healthcare Northwest U.S. Hospitals
HF Management with CRT
Justin Mariani (Heart Centre Alfred Hospial, Australia)

SCIENTIFIC SESSION (CHONG KUN DANG PHARM)
12:00-13:00 | Room 2 | KOR

CHAIR
Tai Ho Roh (Dr. Rho’s Heart Clinic)

SPEAKERS
Beta-Blocker in Patients with Cardiac Arrhythmias
Jong-II Choi (Korea University College of Medicine)
Recent Update on OAC Therapy
Tae-Hoon Kim (Yonsei University College of Medicine)

ORAL 3 (OTHER)
12:00-13:00 | Room 5 | ENG

CHAIR
Il-Young Oh (Seoul National University College of Medicine)

PRESENTERS
A Comparison of Atrial Fibrillation Incidence among Physician and the General Population: The Good, the Bad and the Ugly
Wei-Syun Hu (China Medical University Hospital, Taiwan)
Adhesive Single-Lead ECG Device versus Holter Monitoring for Non-Atrial Fibrillation Patients
Soonil Kwon (Seoul National University Hospital)
An Artificial Intelligence-Enabled ECG Algorithm for the Identification of Patients with Heart Failure Reduced Ejection Fraction
Young Jun Park (Yonsei University Wonju College of Medicine)
Association between Body Mass Index and the Risk of Atrial Fibrillation and Ischemic Stroke According to Age: A Nationwide Population-Based Cohort Study
Hy-Jeong Ahn (Seoul National University Hospital)
## PROGRAM DETAILS

### ORAL 4 (BASIC & CIED)

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<tr>
<td>12:00-13:00</td>
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**CHAIR**
Hyoung-Seob Park (Keimyung University School of Medicine)

**PRESENTERS**
- The First Survey on Patients’ Needs for Remote Monitoring of Cardiac Implantable Electronic Devices in South Korea
  - Youmi Hwang (The Catholic University of Korea, St. Vincent’s Hospital)
  - Comparison of Apical Pacing and Septal Pacing in Patients with Atrioventricular Block Undergoing Pacemaker: 3 Year Follow up
  - Sung Soo Kim (Chosun University College of Medicine)
  - Feasibility Study on Stereotactic Radiotherapy for Total Pulmonary Vein Isolation in a Canine Model
  - Myung-Jin Cha (ASAN Medical Center)
  - Comparison between Centroid Defuzzification and Maximum Defuzzifier Model Mean of Maxima (MOM) For the Diagnosis of Coronary Artery Disease (CAD)
  - Rifaldy Fajar (Yogyakarta State University, Indonesia)

### CIED 2: ICD AND CRT

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**CHAIRS**
Jae-Jin Kwak (Inje University College of Medicine)
Jun Hyung Kim (Chungnam National University College of Medicine)

**SPEAKERS**
- New Approaches in CRT Optimization or Possible Solutions for CRT Non-Response
  - Niraj Varma (Cleveland Clinic, United States)
  - Prognosis of Pacing Associated Heart Failure and the Role of CRT - Nationwide Data Analysis
  - Seung-Jung Park (School of Medicine, Sungkyunkwan University)
  - Advancing S-ICD through Clinical Evidence & Contemporary Implant Management
  - Myung Hwan Bae (Kyungpook National University School of Medicine)
  - ICD Shocks-Related Heart Failure Worsening
  - Yukimi Tsuchi (Nagasaki University, Japan)
  - Conduction System Pacing for Cardiac Resynchronization Therapy - Electrical Characteristics of Deep Septal vs. Left Bundle Branch (area) Pacing vs. His-Bundle Pacing
  - Tae-Hoon Kim (Yonsei University College of Medicine)

### VENTRICULAR TACHYCARDIA 2: VT WITHOUT STRUCTURAL HEART DISEASE

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**CHAIRS**
Yongkeun Cho (Kyungpook National University School of Medicine)
Gi-Byoung Nam (University of Ulsan College of Medicine)

**SPEAKERS**
- Periarotic VT/PVC Ablation
  - Kyoko Soejima (Kyoto University, Japan)
  - Idiopathic VT Ablation Is Not Always Simple: My Experience
  - Gi-Byoung Nam (University of Ulsan College of Medicine)
  - My Tip for VT Ablation
  - Chun Hwang (Revere Health, United States)
  - Papillary Muscle PVC Ablation
  - Yoori Kim (Dongguk University School of Medicine)

### NONINVASIVE 2: ARTIFICIAL INTELLIGENCE AND SIGNAL DATA ANALYSIS

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**CHAIRS**
Choon Hwan Kwak (Gyeongsang National University College of Medicine)
Joong-Wha Chung (Chosun University College of Medicine)

**SPEAKERS**
- Artificial Intelligence in EP: Current State and Future Promise
  - Konstantinos Siontis (Mayo Clinic, United States)
  - Basic Concept of Artificial Intelligence Algorithm
  - Hyeonseung Im (Kangwon National University)
  - Current Status of Artificial Intelligence in Cardiology
  - Junbeom Park (Ewha Womans University School of Medicine)
  - The Impact and the Development of Technology on Future Management of Arrhythmia
  - Joong-Wha Chung (Chosun University College of Medicine)
PSVT 2: UNUSUAL SITUATIONS
13:15-14:45 | Room 4 | ENG

CHAIRS
Eun-Jung Bae (Seoul National University College of Medicine)
Sanghee Lee (Pohang SeMyeong Christianity Hospital)

SPEAKERS
Extremely Late Recurrences of AVNRT: Electrophysiological Characteristics of the Index and Repeat Ablation Procedures
Ming-Hsiung Hsieh (Wan-Fang Hospital, Taipei Medical University, Taiwan)
The Variants of Slow Pathway
Yoshiaki Kaneko (Gunma University Graduate School of Medicine, Japan)
The Variants of Long RP Tachycardia
Yoshiaki Kaneko (Gunma University Graduate School of Medicine, Japan)
To Ablate or Not to Ablate Asymptomatic Preexcitation
Jae-Young Jung (Chonbuk National University Medical School)
Difficult PSVT Cases
Youngjin Cho (Seoul National University College of Medicine)

POLICY & NEW TECHNOLOGY
13:15-14:45 | Room 5 | ENG

CHAIRS
Sang Weon Park (Bucheon Sejong Hospital)
Daewoo Hyun (Andong Medical Group Hospital)

SPEAKERS
Community CPR Policy and Education to Improve Survival in Sudden Cardiac Death
YiH Yng Ng (Tan Tock Seng Hospital, Singapore)
What Is the Best Policy for AF Ablation in Korea?
Jin-Kyu Park (Hanyang University College of Medicine)
Pacemaker and CRT
Sang Weon Park (Bucheon Sejong Hospital)
New CIED Technologies Not Available in Korea
Jung Hoon Sung (CHA University)
New Technology for Ablation of Arrhythmias
Eun Sun Jin (School of Medicine, Kyung Hee University)

YIA COMPETITION
13:15-14:45 | Room 6 | ENG

CHAIR
Boyoung Joung (Yonsei University College of Medicine)

JUDGES
Hyoung-Seob Park (Keimyung University School of Medicine)
Il-Young Oh (Seoul National University College of Medicine)
Jun Kim (University of Ulsan College of Medicine)
Jaemin Shim (Korea University College of Medicine)
Dae-In Lee (Chungbuk National University College of Medicine)

PRESENTERS
Fully Automated GPU-Based Framework for 3D Left Atrial Wall Thickness Measurement
Oh-Seok Kwon (Yonsei University Health System)
Left Atrial Wall Stress and the Outcome of Catheter Ablation for Atrial Fibrillation: Artificial Intelligence-Based Prediction of Clinical Outcome
Jae-Hyuk Lee (Severance Hospital)
Treatment Timing and the Effects of Rhythm-Control Strategy in Patients with Atrial Fibrillation: A Nationwide Cohort Study
Daehoon Kim (Yonsei University College of Medicine)
Efficacy and Safety of Cryoballoon Pulmonary Vein Isolation for Paroxysmal and Persistent Atrial Fibrillation: A Comparison with Radiofrequency Ablation
Ji-Heon Choi (Samsung Medical Center (Samsung Seoul Hospital))
Inhibition of Late Sodium Current via pI3K/Akt Signaling Prevents Cellular Remodeling in Tachypacing-Induced HIf-1 Myocyte for Atrial Fibrillation
Tae Hee Ko (Korea University College of Medicine)
Antiarrhythmic Effect of Artemisinin in Canine Experimental Model of Brugada Syndrome
Hyungki Jeong (Wonkwang University School of Medicine)
Intracardiac Echocardiographically Guided Permanent Pacemaker Implantation is a Feasible Imaging Tool with Comparable Procedural Efficacy and Safety
Moonki Jung (Chung-Ang University Hospital)
PROGRAM DETAILS

ORAL 5 (AF)  13:15-14:45  |  Room 7  |  ENG

CHAIR  |  Kihong Lee (Chonnam National University Medical School)

PRESENTERS
One-Year Change in the H2FPEF Score after Catheter Ablation of Atrial Fibrillation in Patients with a Normal Left Ventricular Systolic Function
Min Kim (Chungbuk National University College of Medicine)
Ventricular Diastolic Dysfunction Contributes to Ischemic Stroke in Low CHA2DS2-VASc Atrial Fibrillation
Min Kim (Chungbuk National University College of Medicine)
Artificial Intelligence for Atrial Fibrillation Prediction - Where Are We and Where Are We Going?
Wei-Syun Hu (China Medical University Hospital, Taiwan)
Association of Proteinuria and Hypertension with Incident Atrial Fibrillation in an Elderly Population: Nationwide Data from a Community-Based Elderly Cohort
Yoon Jung Park (Severance Hospital)
The Impact of Experiencing Socioeconomic Deprivation on the Risk of Atrial Fibrillation in Patients with Diabetes Mellitus: A Nationwide Population-Based Study
Minju Han (Seoul National University Hospital)
Effect of Physical Activity in Patients with Atrial Fibrillation: A Single Center Study in Korea
Mos-Nyung Jin (Inje University Sanggye Paik Hospital)
Risk of Sick Sinus Syndrome in Patients Diagnosed with Atrial Fibrillation: a Population-Based Cohort
Pil-Sung Yang (CHAU University)

INDUSTRY SESSION (DAIICHISANKYO-DAEWOONG):
NOAC GUIDE UPDATE AND NOAC IN ELDERLY PATIENTS  13:15-14:15  |  Room 8  |  KOR

CHAIRS  |  Hui-Nam Pak (Yonsei University College of Medicine)
Hyung Wook Park (Chonnam National University Medical School)

SPEAKERS
2021 EHRA NOAC Practical Guide Update
Hee Tate Yu (Yonsei University College of Medicine)
NOACs in Advanced Age and Special Considerations with AF
Ju Youn Kim (School of Medicine, Sungkyunkwan University)

ATRIAL FIBRILLATION 3:
ANATOMY, IMAGING AND MAPPING FOR AF  15:00-16:30  |  Room 1  |  ENG

CHAIRS  |  Kee-Joon Choi (University of Ulsan College of Medicine)
Seil Oh (Seoul National University College of Medicine)

SPEAKERS
Ablation in Asymptomatic AF: What is Evidence?
Kelvin Chua (National Heart Centre Singapore, Singapore)
New Technology in AF Ablation: High-Power & Short Duration
Jun Kim (University of Ulsan College of Medicine)
Anatomic Consideration for Avoiding Complications in AF Ablation
Jae-Sun Uhm (Yonsei University College of Medicine)
Atrial Structural & Functional Imaging for Predicting Outcomes in AF
Jin-Bae Kim (School of Medicine, Kyung Hee University)
Omnipolar Mapping Technology: To Address the Limitation of Bipolar Mapping
Li-Wei Lo (Taipei Veterans General Hospital, Taiwan)

CIED 3:
LIFE SAVING DEVICE THERAPIES IN CARDIOLOGY  15:00-16:30  |  Room 2  |  KOR

CHAIRS  |  Dong-Gu Shin (Yeungnam University College of Medicine)
Moon-Hyung Lee (Yonsei University College of Medicine)

SPEAKERS
Which Heart Failure Patients Should Receive CRT and How Should They Be Followed?
Jongmin Hwang (Keimyung University School of Medicine)
The Patient with Bradiacrdia - New and Conventional (External+Endocardial) to Pace the Heart
Young Soo Lee (Daegu Catholic University College of Medicine)
What Does One Need to Know about Sports and Driving in ICD Patients?
Laee-Young Jung (Chonbuk National University Medical School)
When Is the Timing of the Pacemaker in Case of Abnormal Rhythm after Surgery or Intervention?
Woo Hyun Lim (SNU-Boramae Medical Center)
When Should I Consider a Patient for a Primary Preventive ICD?
Kwang-No Lee (Ajou University School of Medicine)
### SPAF 2: ANTICOAGULATION AND STROKE PREVENTION

**15:00-16:30 | Room 3 | ENG**

**CHAIRS**
- June Soo Kim (School of Medicine, Sungkyunkwan University)
- Yong Seog Oh (College of Medicine, The Catholic University of Korea)

**SPEAKERS**
- Real-World Data of the Anticoagulant Management in Nonvalvular Atrial Fibrillation (NVAF) Patients
  - Takanori Ikeda (Toho University Medical Center, Japan)
- Anticoagulation during Perioperative Period of Catheter Ablation for Atrial Fibrillation
  - Kaoru Okishige (Yokohama Minato Heart Clinic, Japan)
- Anticoagulation Strategy in Special Circumstances: Fragile Patient, Renal Failure, and Post-Bleeding
  - Eue-Keun Choi (Seoul National University College of Medicine)
- Effectiveness and Safety of NOAC: Focused on Reduced and Off-Label Dosing
  - So-Ryoung Lee (Seoul National University College of Medicine)
- Antithrombotic Treatment after LAAD: Aspirin or Low Dose NOAC?
  - Seung-Young Roh (Korea University College of Medicine)

### VENTRICULAR TACHYCARDIA 3: SUDDEN CARDIAC DEATH

**15:00-16:30 | Room 5 | ENG**

**CHAIRS**
- Kyoung-Suk Rhee (Chonbuk National University Medical School)
- Seongwook Han (Keimyung University School of Medicine)

**SPEAKERS**
- Catheter Ablation of J-Wave Syndrome
  - Akihiko Nogami (University of Tsukuba, Japan)
- Use of Deep Learning Technique in Analyzing ECG Pattern for Prevention of Sudden Cardiac Death
  - Yu-Feng Hu (Taipei Veterans General Hospital, Taiwan)
- Ablation of PVC Triggering VF
  - Kyoung-Min Park (School of Medicine, Sungkyunkwan University)
- New Mapping and Ablation Tools
  - Haris Happoni (University of Queensland, Australia)
- Substrate for VT in NICM: Two Decades of Progress
  - Haris Happoni (University of Queensland, Australia)

### ATRIAL FIBRILLATION 4:

**RHYTHM CONTROL OF AF**

**15:00-16:30 | Room 4 | ENG**

**CHAIRS**
- Jae-Jin Kwak (Inje University College of Medicine)
- Jong-II Choi (Korea University College of Medicine)

**SPEAKERS**
- Does Early Rhythm Control of Atrial Fibrillation Improve Prognosis?
  - Isabelle Van Gelder (University Medical Center Groningen, Netherlands)
- New Drugs for Atrial Fibrillation
  - PI-Sung Yang (CHA University)
- Treatment of AF: ADD First
  - Yun G. Kim (Korea University College of Medicine)
- Debate: Treat AF Early with Catheter Ablation as First-Line Therapy
  - Hyeong-Seob Park (Keimyung University School of Medicine)

### IMAGING AND NEW PROCEDURE

**15:00-16:30 | Room 6 | ENG**

**CHAIRS**
- Byung-Chun Jung (Danggu Fatima Hospital)
- Jieun Ban (Ewha Womans University School of Medicine)

**SPEAKERS**
- Efficacy and Safety of His Bundle Pacing
  - Kieu Ngoc Dung (Cho Ray Hospital, Vietnam)
- Atrial Imaging Using Cardiac MRI
  - Jung Myung Lee (School of Medicine, Kyung Hee University)
- Zero-Fluoroscopy VT Ablation
  - Hong Euy Lim (College of Medicine, Hallym University)
- Anatomy for ICE-Guided LAA Closure Implantation
  - Il-Young Oh (Seoul National University College of Medicine)
## PROGRAM DETAILS

### ORAL 6 (AF)

**15:00-16:30 | Room 7 | ENG**

**CHAIR |** Junbeom Park (Ewha Womans University School of Medicine)

**PRESENTERS |**

- Vagal Denervation after High-Power Short Duration versus Conventional Radiofrequency Catheter Ablation in Paroxysmal Atrial Fibrillation
  - Ungejong Do (Dongguk University Ilsan Hospital)
- An Open-Label Randomized Non-Inferior Study of Generic-Name and Brand-Name of Propafenone for Rhythm Control in Taiwan Patients with Paroxysmal Atrial Fibrillation: the Preliminary Results
  - Ming-Hsiung Hsieh (Wan Fang Hospital, Taipei Medical University, Taiwan)
- The Association between Cumulative Exposure to Elevated Serum γ-Glutamyltransferase Level and Risk of Atrial Fibrillation: A Large Population-Based Cohort Study
  - Won Kyeong Jeon (Seoul National University Hospital)
- Sex Difference in Antiarrhythmic Drug Response among Patients Who Recurred Atrial Fibrillation after Catheter Ablation
  - Yeon Jung Park (Severance Hospital)
- Nonalcoholic Fatty Liver Disease in Young Adults and the Risk of Atrial Fibrillation: A Nationwide Population-Based Study
  - Jungmin Choi (Seoul National University Hospital)
- Safety and Long-Term Outcomes of Catheter Ablation according to Sex in Patients with Atrial Fibrillation: A Nationwide Cohort Study
  - Minsoo Yun (Yonsei University College of Medicine)
- Clinical Outcomes of Computational Virtual Mapping-Guided Catheter Ablation in Patients with Persistent Atrial Fibrillation: A Multicenter Prospective Randomized Study
  - Yong-Soo Baek (Inha University Hospital)

### INDUSTRY SESSION (BAYER KOREA):

**XARELTO, PROTECTION NEVER RESTS**

**15:00-16:00 | Room 8 | KOR**

**CHAIR |** Nam-Ho Kim (Wonkwang University School of Medicine)

**SPEAKERS |**

- Concomitant Diabetes with AF and Anticoagulation Management Considerations
  - Dong-Hyeok Kim (Ewha Womans University School of Medicine)
- What Dose Safety Means for Elderly AF Patients?
  - Myung-Jin Cha (ASAN Medical Center)
PROGRAM DETAILS

LAA OCCLUDER AND OTHERS  
08:30-10:00 | Room 1 | ENG

**CHAIRS**  
Yong Seog Oh (College of Medicine, The Catholic University of Korea)  
June Namgung (Inje University College of Medicine)

**SPEAKERS**  
LAA: Anatomy, Image and Clinical Significance  
Jung Myung Lee (School of Medicine, Kyung Hee University)  
LAAO with Minimalist Approach: Integrated Procedural Imaging Strategy with 3DP and ICE  
Seung Yong Shin (Chung-Ang University College of Medicine)  
Ablation of Atypical Atrial Flutter  
Cheng-Hung Li (Taiichung Veterans General Hospital, Taiwan)  
Treatment for Inappropriate Sinus Tachycardia  
Sarual Tseveende (Third State Hospital Mongolia, Mongolia)  
Do We Need LAAO in the Era of NOAC?: Comparison between LAAO and NOAC  
Hee Tae Yu (Yonsei University College of Medicine)

CIED 4: NEW TECHNOLOGY  
08:30-10:00 | Room 2 | ENG

**CHAIRS**  
Moon-Hyoung Lee (Yonsei University College of Medicine)  
Gyo-Seung Hwang (Ajou University School of Medicine)

**SPEAKERS**  
Leadless Pacemakers for Atrial Synchronous or Ventricular Pacing  
Chu-Pak Lau (The University of Hong Kong, Hong Kong)  
Update on Subcutaneous ICD  
Hung-Fat Tse (The University of Hong Kong, Hong Kong)  
His Bundle Pacing  
Joseph YS Chan (Prince of Wales Hospital, Chinese University of Hong Kong, Hong Kong)  
Interventional Approaches to Cardiac Resynchronization  
Sung Woo Lee (MersStar Heart and Vascular Institute, United States)  
Improving ICD/CRT Patient Outcomes through New Technology - Device-Detected Sleep-Disordered Breathing and Arrhythmic Events, etc.  
Hye Bin Gwag (School of Medicine, Sungkyunkwan University)

CROSS SPECIALTY 2:  
CURRENT UPDATE OF SURGICAL TREATMENTS FOR ARRHYTHMIAS AND LAA  
08:30-10:00 | Room 3 | KOR

**CHAIRS**  
Young Keun On (School of Medicine, Sungkyunkwan University)  
Doosang Kim (Veterans Health Service Medical Center)

**SPEAKERS**  
Amiodarone after MAZE Operation for AF: Is it Essential?  
Hyung Gun Je (Pusan National University School of Medicine)  
MultiCenter Registry Results of Concomitant Cox Maze with Mitral Valve Surgery  
Seung Hyun Lee (Yonsei University College of Medicine)  
Updates in Totally Thoracoscopic Ablation: Korean Experiences  
Dong Seop Jeong (School of Medicine, Sungkyunkwan University)  
Concomitant Surgical Ablation for AF in Patients with Significant Atrial Dilation  
Jae Suk Yoo (Bucheon Sejong Hospital)

CIED 5: CIED INFECTION AND OTHERS  
08:30-10:00 | Room 4 | ENG

**CHAIRS**  
Sang-Jin Han (College of Medicine, Hallym University)  
Jin-Seok Kim (Korea University College of Medicine)

**SPEAKERS**  
CIED Infection Incidence and Prevention  
Bruce Wilkoff (Cleveland Clinic, United States)  
Transvenous Lead Extraction and Improving Outcomes  
Bruce Wilkoff (Cleveland Clinic, United States)  
How to Reduce Inappropriate Shock?  
Boyoung Joung (Yonsei University College of Medicine)  
Anesthesia, Sedation, and Pain Relief for Cardioversion and Electrophysiologic Procedures  
Dong-Hyeok Kim (Ewha Womans University School of Medicine)  
How to Manage Patients after Extraction of Infected CIED Systems - Cardiac Contractile Modulation  
Seung-Jung Park (School of Medicine, Sungkyunkwan University)
## PROGRAM DETAILS

### EGM TRACING 1
**ATRIAL TACHYCARDIA; DE NOVO & POST-PROCEDURE**  
**08:30-10:00 | Room 5 | ENG**

**CHAIRS**  
Seongwook Han (Keimyung University School of Medicine)  
Chun Hwang (Revere Health, United States)

**SPEAKERS**  
**Case 1. Focal AT**  
Woohyun Lim (SMG-SNU Boramae Medical Center)  
Ju Youn Kim (School of Medicine, Sungkyunkwan University)  
Jongmin Hwang (Keimyung University School of Medicine)  
Chun Hwang (Revere Health, United States)

**Case 2. Atrial Tachycardia - De Novo Case**  
Min Kim (Chungbuk National University College of Medicine)  
Do Young Kim (College of Medicine, Hallym University)

**Case 3. Induced AT after PVI+CTI**  
Yongkeun Cho (Kyungpook National University School of Medicine)

**Case 4~5**

### ARRHYTHMIA REVIEW COURSE 1:  
**BASIC INTERPRETATION OF ARRHYTHMIA**  
**08:30-09:15 | Room 7 | KOR**

**CHAIR**  
Yongkeun Cho (Kyungpook National University School of Medicine)

**SPEAKERS**  
Sungil Im (Kosin University College of Medicine)  
Min Kim (Chungbuk National University College of Medicine)  
Do Young Kim (College of Medicine, Hallym University)

**ARRHYTHMIA REVIEW COURSE 2:  
BASIC BRADYCARDIA AND PACEMAKER**  
**09:15-10:00 | Room 7 | KOR**

**CHAIR**  
Nam-Ho Kim (Wonkwang University School of Medicine)

**Speakers**  
Dong Geum Shin (College of Medicine, Hallym University)  
Young-Ah Park (Inje University College of Medicine)

### ALLIED PROFESSIONAL 1:  
**CLINICAL ELECTROPHYSIOLOGY**  
**08:30-10:00 | Room 6 | KOR**

**CHAIRS**  
Chunja Yoo (Chonbuk National University Hospital)  
Chang Hee Lee (Samsung Medical Center)

**SPEAKERS**  
EP Recording System Setting for Best EGM Signals  
Hyeon Jun Kim (Ewha Womans University Mokdong Hospital)  
Clinical Utility of Unipolar and Bipolar Mapping  
Hyunwoo Shin (Korea University Anam Hospital)  
Tip and Tricks for Interpretation of Retrograde Conduction Pathway  
Woo Young Jung (Samsung Medical Center)  
Basic Principle of Entrainment Mapping  
Jeong Wook Park (The Catholic University of Korea, Seoul St. Mary’s Hospital)

### INDUSTRY SESSION (MEDTRONIC KOREA LTD.)
**08:30-09:30 | Room 8 | ENG**

**SPEAKERS**  
iAPT Introduction by Medtronic Scientist  
Troy Jackson (Medtronic, United States)  
How to Care Cryptogenic Stroke Patients with Reveal LINQ from EP Side  
Ki Yung Boo (Jeju National University School of Medicine)  
How to Care Cryptogenic Stroke Patients with Reveal LINQ from NL Side  
Joong-Goo Kim (Jeju National University School of Medicine)

### INDUSTRY SESSION  
**JOHNSON & JOHNSON MEDICAL KOREA**
**09:30-10:00 | Room 8 | ENG**

**SPEAKER**  
Systematic Approach to Persistent Atrial Fibrillation  
Matthew Hyman (Medicine at the Hospital of the University of Pennsylvania, United States)
**PROGRAM DETAILS**

**ATRIAL FIBRILLATION 5:**
CATHETER ABLATION FOR ATRIAL FIBRILLATION

*10:15-11:45 | Room 1 | ENG*

**CHAIRS**
Daehyeok Kim (Inha University School of Medicine)
Jung Hoon Sung (CHA University)

**SPEAKERS**
- How Do I Approach Re-Do AF Ablation?
  Hui-Nam Pak (Yonsei University College of Medicine)
- New Technology in AF Ablation: Pulsed Field Ablation
  Eue-Keun Choi (Seoul National University College of Medicine)
- First-Line Therapy for AF: Cryoballoon or RFCA?
  Young Keun On (School of Medicine, Sungkyunkwan University)
- Additional Ablation Beyond PV Isolation in Patients with Persistent AF
  Hyoung-Seob Park (Keimyung University School of Medicine)
- My Tip for Catheter Ablation of AF
  Chun Hwang (Revere Health, United States)

**SPAF 3:**
SCREENING AND MONITORING FOR SUBCLINICAL AF

*10:15-11:45 | Room 2 | ENG*

**CHAIRS**
Choong Hwan Kwak (Gyeongsang National University College of Medicine)
Nam-Ho Kim (Wonkwang University School of Medicine)

**SPEAKERS**
- AF Screening in Asia-Pacific Region: The Approach of the APHRS Practice Guidelines
  Ngai-Yin Chan (Princess Margaret Hospital, Hong Kong)
- Association between Subclinical AF and Heart Failure
  Mitsuhiro Kawamura (Makita General Hospital, Japan)
- Cryptogenic Stroke Evaluation – Wearable Device or Loop Recorder
  Yung-Lung Chen (Kaohsiung Chang Gung Memorial Hospital, Taiwan)
- Monitoring after AF Ablation - Optimizing Outcomes and Efficiency
  Yun Gi Kim (Korea University College of Medicine)
- When and How to Monitor for Subclinical AF
  Tae-Hoon Kim (Yonsei University College of Medicine)

**BASIC 3:**
DEEP DIVE IN BASIC SCIENCE FOR AF

*10:15-11:45 | Room 3 | ENG*

**CHAIRS**
Tae-Joon Cha (Kosin University College of Medicine)
Namkoo Yoon (Chonnam National University Medical School)

**SPEAKERS**
- Role of SK Current in Metabolic Syndrome Related Atrial Myopathy
  Wei-Chung Tsai (Kaohsiung Medical University, Taiwan)
- Insulin Resistance and Atrial Fibrillation
  Jung-Hee Yeh (Chang-Gung Memorial Hospital, Taiwan)
- Role of Autonomic Nervous System in Pathophysiology of AF
  Seil Oh (Seoul National University College of Medicine)
- Proarrhythmic Atrial Calcium Signaling in Failed Heart
  Sung-Ho Woo (Chungnam National University College of Pharmacy)
- Neural Control of Arrhythmia
  Hyung Wook Park (Chonnam National University Medical School)

**PEDIATRIC:**
APPROACH TO COMPLEX ARRHYTHMIAS IN PED & CHD

*10:15-11:45 | Room 4 | ENG*

**CHAIRS**
JaeKon Ko (University of Ulsan College of Medicine)
Myungchul Hyun (Kyungpook National University School of Medicine)

**SPEAKERS**
- Current Topics of Brugada Syndrome in Children
  Naokata Sumimoto (Saitama Medical University International Medical Center, Japan)
- Twin AV Nodes in Heterotaxy Syndrome: Right, Left and Indeterminate Isomerism
  Mei-Hwan Wu (National Taiwan University Children’s Hospital, Taiwan)
- How to Manage a Neonate with Symptomatic Long QT Syndrome
  June Huh (School of Medicine, Sungkyunkwan University)
- Role of Genetic Testing in Primary Electrical Disease
  Mi Kyung Song (Seoul National University College of Medicine)
- NOAC in Adult Congenital Heart Disease
  Jeun Ban (Ewha Womans University School of Medicine)
## PROGRAM DETAILS

### EGM TRACING 2
**INTERESTING ECG TRACING**

**10:15-11:45 | Room 5 | ENG**

**CHAIRS**
Sung-Won Jang (College of Medicine, The Catholic University of Korea)
Young Soo Lee (Daegu Catholic University College of Medicine)
Akihiko Nogami (University of Tsukuba, Japan)

**SPEAKERS**
Case 1–4
Akihiko Nogami (University of Tsukuba, Japan)
Case 5–7
Sung-Won Jang (College of Medicine, The Catholic University of Korea)

### ALLIED PROFESSIONAL 2:
**CARDIOVASCULAR IMPLANTABLE ELECTRONIC DEVICES**

**10:15-11:45 | Room 6 | ENG**

**CHAIRS**
Hyun Soo Lee (Korea University Anam Hospital)
Mi Sook Cha (Gachon University Gill Medical Center)

**SPEAKERS**
All About the Leadless Pacemaker
Hye Ree Kim (Samsung Medical Center)
Tips and Tricks in Extracting a Difficult Lead and Complication Prevention Strategies
Jae-Hyuk Lee (Severance Hospital)
Understanding of Pacemaker Timing Cycles
Hannah Kim (Asan Medical Center)
Single Center Experience in Lead Extraction in Thailand
Natcha Soontornmanokai (Mahidol University, Thailand)
Cases Troubleshooting for CRM
Nayun Kang (Dankook University Hospital)

### ARRHYTHMIA REVIEW COURSE 3:
**NARROW QRS TACHYCARDIA**

**10:15-11:00 | Room 7 | KOR**

**CHAIR**
Gyo-Seung Hwang (Ajou University School of Medicine)

**SPEAKERS**
In-Soo Kim (Yonsei University College of Medicine)
Won-Seok Choe (Bucheon Sejong Hospital)
In Geol Song (Baekje General Hospital)

### ARRHYTHMIA REVIEW COURSE 4:
**WIDE QRS TACHYCARDIA**

**11:00-11:45 | Room 7 | KOR**

**CHAIR**
Myung Yong Lee (Dankook University College of Medicine)

**SPEAKERS**
Euijae Lee (Bucheon Sejong Hospital)
Young Jun Park (Yonsei University College of Medicine)
Ungjeong Do (Dongguk University School of Medicine)

### INDUSTRY SESSION
**(PFIZER KOREA & BMS KOREA):**
**PRACTICAL CONSIDERATIONS FOR ELDERLY NVAF PATIENTS**

**10:15-11:15 | Room 8 | ENG**

**CHAIR**
June Soo Kim (School of Medicine, Sungkyunkwan University)

**SPEAKERS**
The Risks of Switching to Another OAC and Discontinuation of DOACs
Amol Dhamane (Bristol-Myers Squibb, India)
Treatment & Guideline for Asian Patients
Min Soo Cho (University of Ulsan College of Medicine)
Adherence Issue and Optimal Dosing
Jae-Sun Uhm (Yonsei University College of Medicine)
PROGRAM DETAILS

INDUSTRY SESSION (NOVARTIS):
ARNI: THE ESSENTIAL STANDARD OF CARE FOR HEART FAILURE
11:15-11:45 | Room 8 | KOR

CHAIRS | Kee-Joon Choi (University of Ulsan College of Medicine)
        | Sang Weon Park (Bucheon Sejong Hospital)

SPEAKERS | How to Reduce Sudden Cardiac Death of My Heart Failure Patient
        | Seong Yong Shin (Chung-Ang University College of Medicine)
        | The Opportunity to Optimize Treatment in ADHF Patients
        | Seung-Young Roh (Korea University College of Medicine)

SCIENTIFIC SESSION (DAIICHISANKYO-DAEWONG):
ANTITHROMBOTIC MANAGEMENT WITH ATRIAL FIBRILLATION
12:00-13:00 | Room 1 | KOR

CHAIRS | Myung Yong Lee (Dankook University College of Medicine)
        | Seongwook Han (Keimyung University School of Medicine)

        | Kihong Lee (Chonnam National University Medical School)
        | Anticoagulation Strategy in Special Population: Fragile Patients, Renal Failure, and Post-Bleeding
        | So-Ryoung Lee (Seoul National University College of Medicine)

ORAL 7 (OTHER)
12:00-13:00 | Room 5 | ENG

CHAIR | Tae-Hoon Kim (Yonsei University College of Medicine)

SPEAKERS | Artificial Intelligence Based Watch-Type Electrocardiography Monitoring Device Is Superior Than Holter Monitoring in Detecting Cardiac Arrhythmias
        | Yun Gi Kim (Korea University Anam Hospital)
        | Association between Physical Activity and the Risk of Sudden Cardiac Death in Older Patients
        | Moon Hyun Kim (Yonsei University College of Medicine)
        | Obstructive Sleep Apnea (OSA) Detection System Based on Fast Fourier Transform (FFT) Algorithm on Electrocardiogram
        | Rifaidy Fajar (Yogyakarta State University, Indonesia)
        | Acupuncture Decreases Risk of Stroke among Patients with Atrial Fibrillation - Novel Link between Traditional and Modern Science
        | Wei-Syun Hu (China Medical University Hospital, Taiwan)
        | Atrial Fibrillation in Patients with Congenital Heart Disease: Therapeutic Implications and Strategic Mapping
        | Wei-Syun Hu (China Medical University Hospital, Taiwan)

ORAL 8 (SCD & OTHER)
12:00-13:00 | Room 6 | ENG

CHAIR | Yae Min Park (Gachon University School of Medicine)

PRESENTERS | Electrocardiographic Manifestations in Patients with COVID-19; Daegu in South Korea
            | Han Joon Bae (Daegu Catholic University Medical Center)
            | Quality Assessment of Timeliness in the Delivery of Electrocardiography Service in the Critical Areas of a Tertiary Hospital Using Time and Motion Analysis: A Systems Analysis
            | Aiza-Meriam Tahil (UP-Philippine General Hospital-University of the Philippines)
            | Impact of de Novo Tachyarrhythmias in Patients with Prior Acute Coronary Syndrome Patients
            | Youmi Hwang (The Catholic University of Korea, St. Vincent’s Hospital)
            | The 10-Year Trend of Out-of-Hospital Cardiac Arrests: A Korean Nationwide Population-Based Study
            | Seung-Young Roh (Korea University Guro Hospital)
            | Early Antiarrhythmic Efficacy of Noninvasive Cardiac Radioablation for Ventricular Tachycardia
            | Myung-Jin Cha (ASAN Medical Center)
PROGRAM DETAILS

ORAL 9 (CIED)  12:00-13:00  Room 7  ENG

CHAIR  | Seung-Jung Park (School of Medicine, Sungkyunkwan University)

PRESENTERS
Artificial Intelligence Predicts Clinically Relevant Atrial High-Rate Episodes in Patients with Cardiac Implantable Electronic Devices
Min Kim (Chungbuk National University College of Medicine)

Hye Bin Gwag (Samsung Changwon Hospital)

Survival among Ischemic and Non-Ischemic Heart Failure Patients with Primary Implantable Cardiac Defibrillator Therapy in Korea: A Nationwide Cohort Study
Pil-Sung Yang (CHA University)

Risk Factor, Prognosis of Pacemaker Associated Heart Failure: PS-Matched Cohort Study
Young Jun Park (Yonsei University Wonju College of Medicine)

VENTRICULAR TACHYCARDIA 4: VT IN GENETIC DISEASE  13:15-14:45  Room 1  ENG

CHAIRS  | Hui-Nam Pak (Yonsei University College of Medicine)
Jun Kim (University of Ulsan College of Medicine)

SPEAKERS
Tips for Successful Ablation of Brugada Syndrome
Tachapong Ngarmukos (Ramathibodi Hospital of Mahidol University, Thailand)

An Update on the Diagnosis and Management of Catecholaminergic Polymorphic Ventricular Tachycardia
Seiko Ohno (National Cerebral and Cardiovascular Center, Japan)

Update on Long QT Syndrome
Yongkeun Cho (Kyungpook National University School of Medicine)

Useful Tips for Successful Ablation of ARVC
Hyung Wook Park (Chonnam National University Medical School)

Challenging Cases of J Wave Syndrome
Jaemin Shim (Korea University College of Medicine)

CROSS SPECIALTY 3: JOINT SYMPOSIUM WITH NEUROLOGY  13:15-14:45  Room 2  KOR

CHAIRS  | Byung-Chul Lee (College of Medicine, Hallym University)
Seil Oh (Seoul National University College of Medicine)

SPEAKERS
Management of ESUS: From Subclinical Atrial Fibrillation Detection to Secondary Prevention - Neurologist Perspectives
Jeong-Min Kim (Seoul National University College of Medicine)

Update of Clinical Trials and Future Direction for Left Atrial Appendage Occlusion in Neurologist Perspective
Bum Joon Kim (University of Ulsan College of Medicine)

Minimalist Approach to Percutaneous Left Atrial Appendage Occlusion
Seung Yong Shin (Chung-Ang University College of Medicine)

The Role of Cardiologists in Stroke Prevention and Treatment
Se-Ryoung Lee (Seoul National University College of Medicine)

Management of ESUS: From Subclinical Atrial Fibrillation Detection to Secondary Prevention - Cardiologist Perspectives
Yae Min Park (Gachon University School of Medicine)

ATRIAL FIBRILLATION 6: OUTCOMES AFTER AF ABLATION  13:15-14:45  Room 3  ENG

CHAIRS  | Gyo-Seung Hwang (Ajou University School of Medicine)
Jin-Bae Kim (School of Medicine, Kyung Hee University)

SPEAKERS
Reverse Remodeling of AF Substrate
Jonathan Kalman (Royal Melbourne Hospital and University of Melbourne, Australia)

Epicardial Fat and Atrial Fibrillation
Jonathan Kalman (Royal Melbourne Hospital and University of Melbourne, Australia)

Impact of Catheter Ablation and Early Rhythm Control Therapy on Cognitive Decline and Dementia
Boyoung Jung (Yonsei University College of Medicine)

AF Detection: Implantable Monitors vs Wearables vs Pulse Checks
Chang Hee Kwon (Konkuk University Professional Graduate School of Medicine)

Atrial Fibrillation in HFrEF vs HFpEF
Minsoo Ahn (Yonsei University College of Medicine)
PROGRAM DETAILS

NONINVASIVE 3:
IN Volving TECHNOLOGY FOR ARRHYTHMIA DETECTION
13:15-14:45 | Room 4 | KOR

CHAIRS
Eun-Jung Bae (Seoul National University College of Medicine)
Sang-Jin Han (College of Medicine, Hallym University)

SPEAKERS
The Use of Wearable Devices for Arrhythmia Detection in General Practice
Junboom Park (Ewha Womans University School of Medicine)
Prediction of Arrhythmic Risk Using Exercise-/Holter-Based ECG Data
Young Soo Lee (Daegu Catholic University College of Medicine)
How to Acquire an Appropriate Signal with a Single-Lead ECG?
Il-Young Oh (Seoul National University College of Medicine)
New Technology for Predicting CV Events
Kyoungh-Min Park (School of Medicine, Sungkyunkwan University)
How to Apply Mobile Application and Remote Medicine in Korea?
Yoori Kim (Dongguk University School of Medicine)

JOINT SYMPOSIUM WITH OVERSEAS SOCIETY 1
13:15-14:45 | Room 5 | ENG

CHAIR
June Soo Kim (School of Medicine, Sungkyunkwan University)
Jong Sung Park (Dong-A University College of Medicine)

SPEAKERS
In-Soo Kim (Yonsei University College of Medicine)
Sungil Im (Kosin University College of Medicine)
Moo-Nyun Jin (Inje University College of Medicine)
Sang Hoon Na (Seoul National University College of Medicine)

EKG EDUCATIONAL COURSE 1
13:15-14:45 | Room 7 | KOR

CHAIRS
Moon-Hyung Lee (Yonsei University College of Medicine)
Jin-Seok Kim (Korea University College of Medicine)

SPEAKERS
ECG Basics (Basic Physiology, ECG Leads and Axis)
Young Choi (College of Medicine, The Catholic University of Korea)
P Wave and Sinus Node Dysfunction
Tae-Seok Kim (College of Medicine, The Catholic University of Korea)
Cardiac Conduction System and Atrioventricular Block
Jinhee Choi (Pusan National University School of Medicine)
Physiology and Abnormality of Repolarization on ECG
Kwang-No Lee (Apu University School of Medicine)
ECG Detection of Acute Coronary Syndrome
Jumsuk Ko (Wonkwang University School of Medicine)
## PROGRAM DETAILS

### INDUSTRY SESSION (CHONG KUN DANG PHARM)
**13:15-14:15 | Room 8 | KOR**

**CHAIRS**
Seongwook Han (Keimyung University School of Medicine)

**SPEAKERS**
- Anti-Arrhythmic Effect of Carvedilol on Suppressing PVC/VT from OT
  Jongmin Hwang (Keimyung University School of Medicine)
- Wearable Devices in Cardiology; CART-I
  Eue-Keun Choi (Seoul National University College of Medicine)

### INDUSTRY SESSION (YUHAN)
**14:15-14:45 | Room 8 | KOR**

**SPEAKER**
AF Burden and Stroke Risk in the Era of Wearable ECG Monitor
Pil-Sung Yang (CHA University)

### SCD 2:
**NOVEL INSIGHTS INTO SCD: WHAT IS NEW IN INHERITED ARRHYTHMIA**
**15:00-16:30 | Room 1 | ENG**

**CHAIRS**
Hui-Nam Pak (Yonsei University College of Medicine)
Young Keun On (School of Medicine, Sungkyunkwan University)

**SPEAKERS**
- Impact of Genomics in Clinical Cardiology Practice
  Christopher Semsarian (University of Sydney, Australia)
- “Concealed Cardiomyopathies” in Young People with Sudden Cardiac Arrest
  Christopher Semsarian (University of Sydney, Australia)
- Inherited Cardiac Disorders: Beyond Monogenic Inheritance
  Connie Bezina (Amsterdam UMC, Netherlands)
- Genetic Basis Sudden Cardiac Death in Japan
  Takeshi Aiba (National Cerebral and Cardiovascular Center, Japan)
- Sudden Cardiac Death and Inherited Arrythmia in Korea
  Jong-Il Choi (Korea University College of Medicine)

### CROSS SPECIALTY 4:
**JOINT SYMPOSIUM WITH KOREAN INTERVENTION SOCIETY**
**15:00-16:30 | Room 2 | KOR**

**CHAIRS**
Myung Yong Lee (Dankook University College of Medicine)
Jang-Whan Bae (Chungbuk National University College of Medicine)

**SPEAKERS**
- Antithrombotic Therapy in AF Patients Undergoing PCI: Overview
  Jin Bae Lee (Daegu Catholic University College of Medicine)
- When to Stop Aspirin in AF Patients after PCI
  Young-Hoon Jeong (Gyeongsang National University College of Medicine)
- Atrial Fibrillation Patients Undergoing PCI: Complex Case and Clinical Tip
  Youmi Hwang (College of Medicine, The Catholic University of Korea)
- Antithrombotic Therapy after TAVR in Atrial Fibrillation Patients
  Ju Youn Kim (School of Medicine, Sungkyunkwan University)
- Management of Conduction Disturbances Associated with TAVR
  Myung-Jin Cha (University of Ulsan College of Medicine)

### ATRIAL FIBRILLATION 7:
**AF ABLATION WITH BALLOON**
**15:00-16:30 | Room 3 | ENG**

**CHAIRS**
Kee-Joon Choi (University of Ulsan College of Medicine)
Daehyeok Kim (Inha University School of Medicine)

**SPEAKERS**
- Update Novel Balloon Devices and PFA in AF Ablation
  Julian Chui (CCB Frankfurt, Germany)
- What is Next after Durable PVI-ASTRO AF Study
  Julian Chui (CCB Frankfurt, Germany)
- Hot Balloons for Pulmonary Vein Isolation
  Hiro Yamasaki (University of Tsukuba, Japan)
- Cryoballoon Ablation of Persistent AF
  Hong Eui Lim (College of Medicine, Hallym University)
- Tips and Tricks for Optimizing the Safety of CryoAblation
  Sanghee Lee (Pohang SeMyeong Christianity Hospital)
VENTRICULAR TACHYCARDIA 5:
PRACTICAL TIP IN ABLATION FOR VT
15:00-16:30 | Room 4 | ENG

CHAIRS
Kyoung-Min Park (School of Medicine, Sungkyunkwan University)
Eue-Keun Choi (Seoul National University College of Medicine)

SPKERS
Direct Epicardial Ablation Supplemented by Intramural Ethanol Injection via Surgical Approach for VTs Refractory to Combined Epi/Endocardial Ablation
Minglong Chen (The First Affiliated Hospital of Nanjing Medical University, China)
Substrate Mapping during Sinus Rhythm in VT Ablation: How to Improve Clinical Outcomes
Gi-Byoung Nam (University of Ulsan College of Medicine)
Determining VT Circuit and Successful Ablation Site: Entrainment Pacing and Pace-mapping
Seongwook Han (Keimyung University School of Medicine)
Inducing PVCs and VTs during EP Study: Tips and Pitfalls
Ki-Hun Kim (Inje University College of Medicine)
Yae Min Park (Gachon University School of Medicine)

JOINT SYMPOSIUM WITH OVERSEAS SOCIETY 2
15:00-16:30 | Room 5 | ENG

CHAIR
Eun Sun Jin (School of Medicine, Kyung Hee University)

PRESENTERS
Recurrent Syncope following Heart Transplantation: A Case Report and Literature Review
Hye Ree Kim (Samsung Medical Center (Samsung Seoul Hospital))
Evaluation of the Pattern Use of Anti-Thrombotic in Stroke Patients with Atrial Fibrillation
Niyata Hananta Karunawan (Tugurejo General Hospital, Indonesia)
A Case of AWRT Pediatric with Recurrent Three-Time Hospitalized: What Should We Do to Acute and Long Term Management of Pediatric Arrhythmia?
Niyata Hananta Karunawan (Tugurejo General Hospital, Indonesia)
Bradyarrhythmia-Related Atrial Noncapture during Dual-Chamber Pacemaker Implantation
Sze Man Fona Yuen (North District Hospital, Hong Kong)
Catheter Ablation of Ventricular Tachycardia in a Case of Arrhythmogenic Right Ventricular Tachycardia with Multiple ICD Shocks
Anupam Jena (Kalinga Institute of Medical Sciences, India)
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Dear Friends and Colleagues,

It is our great pleasure to invite you to our upcoming KHRS 2021–VIRTUAL: The 13th Annual Scientific Session of the Korean Heart Rhythm Society, which will be held virtually from June 4 (Fri.) to 5 (Sat.).

KHRS 2021–VIRTUAL is the one and only conference in South Korea that deals with all about arrhythmia from basic research to clinical content related to diagnosis and treatment. You will be able to meet up with globally renowned invited speakers online, which will be a meaningful chance to share knowledge including the latest research trends in this field.

Due to the global spread of COVID–19, the meeting will be held online as we consider the safety of our participants a top priority. Despite the fact that it will be a virtual event, it is expected to serve as a fruitful online platform for participants to discuss various topics with outstanding speakers.

Especially, this year’s KHRS will feature diverse lectures and discussions with world–renowned scholars such as Dr. Bruce Wilkoff, Dr. Jonathan Kalman, Dr. Isabelle C. Van Gelder, Dr. Mansour Razminia and Dr. Kyoko Soejima. “EGM Tracing Course” will be led by Dr. Chun Hwang and Dr. Akihiko Nogami, and the Scientific Session will include a diverse array of lectures about AF, SPAF, VT, SCD, CIED, etc.

Indeed, KHRS 2021–VIRTUAL will continue to act as a significant venue to promote academic development even under limited conditions caused by COVID–19. To that end, the Organizing Committee of KHRS 2021–VIRTUAL has tried its best to provide an online platform for you to gain practical knowledge. Therefore, we cordially invite all of you to participate actively in the upcoming conference. We strongly believe that your active participation will make our 13th conference even more vibrant and productive.

Thank you.

Moon-Hyoung Lee
President
Korean Heart Rhythm Society (KHRS)

Kee-Joon Choi
Chairman, Board of Trustees
Korean Heart Rhythm Society (KHRS)

Boyoung Joung
Scientific Committee Chair
Korean Heart Rhythm Society (KHRS)
### ORGANIZING COMMITTEE

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<th>Vice President</th>
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<th>General Secretary</th>
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<td>Jin-Bae Kim</td>
<td>School of Medicine, Kyung Hee University</td>
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<td>Jun Kim</td>
<td>University of Ulsan College of Medicine</td>
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<td>Allied Professional Committee Chair</td>
<td>Kyoung-Min Park</td>
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<td>Pediatrics Committee Chair</td>
<td>June Huh</td>
<td>School of Medicine, Sungkyunkwan University</td>
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<td>Audit Committee Chair</td>
<td>Gi-Byoung Nam</td>
<td>University of Ulsan College of Medicine</td>
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<td>Audit Committee Chair</td>
<td>Nam-Ho Kim</td>
<td>Wonkwang University School of Medicine</td>
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<td>Guideline Committee Chair</td>
<td>Eun-Sun Jin</td>
<td>School of Medicine, Kyung Hee University</td>
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<td>Hye Bin Gwag</td>
<td>School of Medicine, Sungkyunkwan University</td>
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<td>Interventional Electrophysiology Specialist Qualification Committee Chair</td>
<td>Myung Yong Lee</td>
<td>Dankook University College of Medicine</td>
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# PROGRAM AT A GLANCE

## Day 1 | June 4 (Fri.)

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<tr>
<td>08:30-10:00</td>
<td>Atrial Fibrillation 1: Non-Interventional Management of AF</td>
<td>Basic 1: Translating Basic Research Discoveries into Clinical Practice</td>
<td>Ventricular Tachycardia 1: VT in Structural Heart Disease</td>
<td>Noninvasive 1: Clinical Implication of Wearable Device for the Management of Atrial Fibrillation</td>
<td>SCD 1: Challenging Decision in SCD Related to J Wave &amp; Sports</td>
<td>CIED 1: Monitoring of CIED Patients</td>
<td>Oral 1 (AF)</td>
<td>Industry Session (SAMJIN PHARM.) 08:30-09:30</td>
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<tr>
<td>12:00-13:00</td>
<td>Scientific Session (Pfizer Korea &amp; BMS Korea)</td>
<td>Scientific Session (Chong Kun Dang Pharm)</td>
<td>Scientific Session (Abbott)</td>
<td>Scientific Session (Medtronic Korea Ltd.)</td>
<td>Oral 3 (Other)</td>
<td>Oral 4 (Basic &amp; CIED)</td>
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<td>Industry Session (Boryung Pharmaceutical) 11:15-11:45</td>
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<tr>
<td>15:00-16:30</td>
<td>Atrial Fibrillation 3: Anatomy, Imaging and Mapping for AF</td>
<td>CIED 3: Life Saving Device Therapies in Cardiology</td>
<td>SPAF 2: Anticoagulation and Stroke Prevention</td>
<td>Atrial Fibrillation 4: Rhythm Control of AF</td>
<td>Ventricular Tachycardia 3: Sudden Cardiac Death</td>
<td>Imaging and New Procedure</td>
<td>Oral 6 (AF)</td>
<td>Industry Session (Bayer Korea) 15:00-16:00</td>
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### PROGRAM AT A GLANCE

#### Day 2 | June 5 (Sat.)

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<tr>
<td>08:30-10:00</td>
<td>LAA Occluder and Others</td>
<td>CIED 4: New Technology</td>
<td>Cross Specialty 2: Current Update of Surgical Treatments for Arrhythmias and LAA</td>
<td>CIED 5: CIED Infection and Others</td>
<td>EGM Tracing 1: Atrial Tachycardia: De Novo &amp; Post-Procedural</td>
<td>Allied Professional 1: Clinical Electrophysiology</td>
<td>Arrhythmia Review Course 1: Basic Interpretation of Arrhythmia</td>
<td>Industry Session (Medtronic Korea Ltd.) 08:30-09:30</td>
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<tr>
<td>12:00-13:00</td>
<td>Scientific Session (DaichiSankyo-Daewoong)</td>
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<td>Industry Session (Yuhan) 13:15-14:15</td>
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<tr>
<td>15:00-16:30</td>
<td>SCD 2: Novel Insights into SCD: What is New in Inherited Arrhythmia</td>
<td>Cross Specialty 4: Joint Symposium with Korean Intervention Society</td>
<td>Atrial Fibrillation 7: AF Ablation with Balloon</td>
<td>Ventricular Tachycardia 5: Practical Tip in Ablation for VT</td>
<td>Joint Symposium with Overseas Society 2</td>
<td>EKG Educational Course 2</td>
<td>Industry Session (SANOFI) 15:00-15:30</td>
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<tr>
<td>16:40-</td>
<td>General Assembly of KHRS 2021</td>
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ORAL 1 (AF)
Oral 1 (AF)

**OR1-01**

**Totally Thoracoscopic Ablation in Patients with Atrial Fibrillation and Left Ventricular Dysfunction**

Hye Ree Kim, Dong-Seop Jeong, Hee-Jin Kwon, Seung-Jung Park, Kyoung-Min Park, June Soo Kim, Young Keun On

Samsung Medical Center (Samsung Seoul Hospital), Republic of Korea

**Background:** The purpose of this study is to evaluate the effectiveness and safety of totally thoracoscopic ablation (TTA) in patients with left ventricular (LV) dysfunction for treatment of Atrial fibrillation (AF) refractory to drug.

**Methods:** From January 2012 to December 2018, 31 patients underwent TTA with drug refractory AF and preoperative left ventricular ejection fraction (LVEF) < 50% were included. Of the 31 patients, 8 received additional catheter ablation with an electrophysiologic study within 3 months after TTA. Rhythm outcome was obtained by 12-lead electrocardiogram or 24-hour-Holter monitoring.

**Result:** Patients were a mean age of 54.9 ± 9.0 years and consisted of 51.6% persistent AF (n = 16), 45.2% long-standing persistent AF (n = 14) and 3.2% paroxysmal AF (n = 1). During the follow-up period, no patients died. Compared with the baseline, postoperative LVEF at 3 months (interquartile range [IQR], 2-6 months) significantly increased (from 39.7 ± 6.1% to 53.6 ± 9.3%; P < .001). At 25 months (IQR, 14-45 months), LVEF have sustained or further improved (from 39.7 ± 6.1% to 58.1 ± 7.5%; P < .001). Sinus rhythm state was 93.5% (29 of 31), and freedom from arrhythmias off-anti-arrhythmic drugs after final procedure was 61.3% (19 of 31) at the median follow-up period of 32 months (IQR, 24-54 months).

**Conclusions:** TTA is a safe and effective procedure that improves LV function and restores sinus rhythm in AF patients with LV dysfunction.

**Effect of Totally Thoracoscopic Ablation on LVEF**

**Conclusion:** TTA is an effective procedure that improves LVEF in AF patients with left ventricular dysfunction.

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TTA, totally thoracoscopic ablation; LVEF, left ventricular ejection fraction; AF, atrial fibrillation; LAA, left atrial appendage; LUPV, left upper pulmonary vein; LLPV, left lower pulmonary vein; RUPV, right upper pulmonary vein; RLPV, right lower pulmonary vein; PVI, pulmonary vein isolation; LoM, ligament of Marshall; GP, ganglionated plexus; SVC, superior vena cava; IVC, inferior vena cava; CS, coronary sinus.
Risk Factors for Stiff Left Atrial Physiology after Catheter Ablation of Atrial Fibrillation

Jae-Hyuk Lee, Hee Tae Yu, Tae-Hoon Kim, Jae-Sun Uhm, Boyoung Joung, Moon-Hyoung Lee, Hui-Nam Pak
Severance Hospital, Republic of Korea

Background: We previously reported that atrial fibrillation (AF) catheter ablation (AFCA) increases left atrial (LA) pressure without significant change of symptom score. We hypothesized that extensive LA ablation increases the risk of stiff LA physiology.

Methods: We included 1780 patients (69.3% male, 60.0 [53.0-68.0] years old, 65.8% with paroxysmal AF) who underwent de novo AFCA with LA pressure (LAP) measurement and echocardiography follow-up before and a year after the procedure. We defined stiff LA physiology as echocardiographic estimated right ventricular systolic pressure (RVSP) >35mmHg and pulmonary artery pressure (PAP) elevation >10mmHg. We explore the proportion and the risk factors for stiff LA physiology and the association with rhythm outcome of AFCA.

Result: Among 1780 patients, 70 patients (4.1%) showed stiff LA physiology a year after AFCA. Stiff LA physiology was independently associated with diabetes (OR 2.79 [1.36-5.72], p=0.005), E/Em (OR 1.06 [1.00-1.11], p=0.038), low LA voltage (OR 0.46 [0.23-0.91], p=0.025), empirical extra-pulmonary vein (PV) LA ablation (OR 2.69 [1.20-6.02], p=0.016), and radiofrequency (RF) ablation duration (Model 2: OR 1.02 [1.00-1.03], p=0.013). Furthermore, sustaining AF after recurrence within a year was independently associated with stiff LA physiology (OR 4.36 [2.04-9.31], p<0.001). Additionally, rhythm outcome was worse in patients with stiff LA physiology (log-rank p=0.002).

Conclusions: Occurrence of stiff LA physiology was about 4% after de novo AFCA, and associated with diabetes, empirical extra-PV ablation, and sustaining AF after recurrence within a year.

Table. Logistic regression analysis for stiff LA physiology

<table>
<thead>
<tr>
<th>Univariate</th>
<th>Multi variate model 1</th>
<th>Multi variate model 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>OR (95% CI)</td>
<td>P OR (95% CI)</td>
<td>P OR (95% CI)</td>
</tr>
<tr>
<td>Persistent AF</td>
<td>2.11 (1.30-3.40)</td>
<td>0.002</td>
</tr>
<tr>
<td>AF duration</td>
<td>1.00 (0.99-1.01)</td>
<td>0.795</td>
</tr>
<tr>
<td>Male</td>
<td>0.69 (0.42-1.14)</td>
<td>0.146</td>
</tr>
<tr>
<td>Age</td>
<td>1.05 (1.02-1.07)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Body surface area</td>
<td>0.34 (0.09-1.27)</td>
<td>0.107</td>
</tr>
<tr>
<td>Body mass index</td>
<td>1.04 (0.96-1.12)</td>
<td>0.335</td>
</tr>
<tr>
<td>Concomitancy</td>
<td></td>
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</tr>
<tr>
<td>Hypertension</td>
<td>1.37 (0.83-2.22)</td>
<td>0.198</td>
</tr>
<tr>
<td>Diabetes mellitus</td>
<td>1.96 (1.13-3.40)</td>
<td>0.017</td>
</tr>
<tr>
<td>Stroke-TIA</td>
<td>1.02 (0.50-2.08)</td>
<td>0.956</td>
</tr>
<tr>
<td>Heart failure</td>
<td>1.59 (0.87-2.91)</td>
<td>0.130</td>
</tr>
<tr>
<td>Vascular disease</td>
<td>1.70 (0.93-3.11)</td>
<td>0.084</td>
</tr>
<tr>
<td>Echocardiography</td>
<td></td>
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<tr>
<td>LA dimension</td>
<td>1.08 (1.04-1.12)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LV ejection fraction</td>
<td>0.99 (0.97-1.02)</td>
<td>0.474</td>
</tr>
<tr>
<td>E/Em</td>
<td>1.07 (1.03-1.11)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>TR jet</td>
<td>0.90 (0.91-0.99)</td>
<td>0.881</td>
</tr>
<tr>
<td>RVSP</td>
<td>1.02 (0.99-1.05)</td>
<td>0.263</td>
</tr>
<tr>
<td>LAP, peak</td>
<td>1.04 (1.00-1.07)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LAP, nadir</td>
<td>1.04 (1.00-1.09)</td>
<td>0.032</td>
</tr>
<tr>
<td>LA pulse pressure</td>
<td>1.04 (1.00-1.07)</td>
<td>0.003</td>
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<tr>
<td>Ablation time (min)</td>
<td>1.02 (1.01-1.03)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Procedure time (min)</td>
<td>1.01 (1.00-1.01)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Empirical extra-PV LA ablation</td>
<td>2.32 (1.43-3.76)</td>
<td>0.001</td>
</tr>
<tr>
<td>Extra PV foci</td>
<td>0.69 (0.24-1.94)</td>
<td>0.478</td>
</tr>
<tr>
<td>Post-procedural medication</td>
<td></td>
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</tr>
<tr>
<td>ACEI/ARB</td>
<td>1.57 (0.97-2.54)</td>
<td>0.065</td>
</tr>
<tr>
<td>Beta-blocker</td>
<td>0.99 (0.60-1.64)</td>
<td>0.984</td>
</tr>
<tr>
<td>Anti-arrhythmic drug</td>
<td>1.17 (0.62-2.21)</td>
<td>0.628</td>
</tr>
<tr>
<td>Mean LA voltage</td>
<td>0.34 (0.20-0.58)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>LA wall thickness</td>
<td>0.77 (0.38-1.57)</td>
<td>0.471</td>
</tr>
<tr>
<td>LA/m-LV</td>
<td>1.00 (1.00-1.01)</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Sustaining AF within 1 year</td>
<td>2.44 (2.00-5.92)</td>
<td>&lt;0.001</td>
</tr>
</tbody>
</table>
Spatial Changes of Fibrillatory Wave-Dynamics after Using Antiarrhythmic Drugs in Atrial Fibrillation: A Computational Modeling Study

Inseok Hwang, Je-Wook Park, Byounghyun Lim, Ji-Soo Lee, Oh-Seok Kwon, Hee Tae Yu, Tae-Hoon Kim, Boyoung Joung, Hui-Nam Pak
Yonsei University Health System, Republic of Korea

Background: We previously reported that the computational modeling-guided anti-arrhythmic drug (AAD) test was feasible for evaluating multipleAADs in patients with atrial fibrillation (AF). In this study, we explored the anti-fibrillatory mechanisms of AADs in the realistic computational model of AF.

Methods: We used realistic computational modeling of 25 AF patients (68% male, 59.8±9.8 years old, 13.0% persistent AF) reflecting anatomy, histology, and electrophysiology of left atrium (LA) to characterize the effects of 5 different AADs (amiodarone, sotalol, dronedarone, flecainide, and propafenone). The action potential duration (APD90), conduction velocity (CV), maximal slope of the restitution curves (Smax), dominant frequency (DF), and PRR (persistent rotational reentry; phase singularities maintaining > 2sec within 10mm diameter) were evaluated and compared in 10 regions of LA and pulmonary veins (PVs), respectively. The coefficient of variation (COV) of each parameter was evaluated to compare the spatial changes of AF wave-dynamics responding to AADs.

Result: Overall, extra-PV especially LAA indicated high DF (p<0.001, Table 1, Table 2), and the significant change was observed in PV after AADs (p=0.022, Table 1). DF was significantly changed after AADs in PV (p=0.022, Table 1) especially LSPV (p<0.001, Table 2). Smax was higher in posterior inferior (p<0.001, Table 2). Smax was changed severely after AADs in posterior (p<0.001, Table 2). The incidence of PRR was higher in LLI (p<0.001, Table 2). DF was concentrated in extra-PV areas in baseline groups compared with defragmentation group (p=0.008). Smax was located in extra-PV in both baseline (p=0.001) and termination group (p<0.001). PRR incidences were also concentrated in extra-PV areas in baseline (p=0.013) and defragmentation group (p=0.024, Table 3).

Conclusions: Overall, Smax has spatial stability and homogeneity after AADs compared with DF. DF has shown instability especially in PV regions. Heterogeneity of DF was observed in AF wave-dynamics and defragmentation analysis.

| Table 1. High DF, high Smax, and PRR coefficient of variation (Overall) |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| Overall | Extra-PV | PV | p-value |
|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|--------------------------|
| DF (ms) | High | Low | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| Smax (ms) | High | Low | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |
| PRR (Hz) | High | Low | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 | 0.001 |

Figure 1: Regional Proportion of High DF, High Smax, and Incidence of PRR Area
Longitudinal Patterns in Antithrombotic Therapy in Patients with Atrial Fibrillation after Percutaneous Coronary Intervention in the Non-Vitamin K Oral Anticoagulant Era: A Nationwide Study

Jiesuck Park¹, Jin-Hyung Jung², Eue-Keun Choi¹, Seung-Woo Lee³, Soonil Kwon¹, So-Ryoung Lee¹, Jeehoon Kang¹, Kyung-Do Han⁴, Kyung Woo Park¹, Seil Oh¹, Gregory Lip⁴

¹Seoul National University Hospital, Republic of Korea, ²The Catholic University of Korea, Republic of Korea, ³Soongsil University, Republic of Korea, ⁴University of Liverpool and Liverpool Chest & Heart Hospital, United Kingdom

Background: Since non-vitamin K oral anticoagulants (NOACs) have been the major choice for stroke prevention in atrial fibrillation (AF), a growing body of evidence has reported outcome benefit of combination regimen based on NOACs for patients with AF undergoing percutaneous coronary intervention (PCI). We investigated whether longitudinal patterns in antithrombotic therapy have changed in real-world clinical practice after the introduction of NOACs among patients with AF who underwent PCI.

Methods: Using the claims database of the Korean AF population who underwent PCI between 2012 and 2016 (n=18,691), we analyzed prescription records for antithrombotic therapy, including oral anticoagulants (OACs) and antiplatelet agents at 3-month intervals over 2 years after PCI. The study population was stratified into the pre-NOAC, transition, and the NOAC era based on the time periods of NOAC introduction in Korea and expansion of reimbursement criteria for NOACs in AF.

Result: The overall baseline OAC rates in the pre-NOAC, transition, and NOAC era were low at 24.9%, 26.9%, and 35.2%, respectively, in contrast to high rates of dual antiplatelet therapy (DAPT) (73.3%, 71.4%, and 63.6%, respectively). However, the OAC rates increased at the 1-year (18.5%, 22.5%, and 31.6%, respectively) and 2-year follow-up (17.8%, 24.2%, and 31.8%, respectively) between the pre-NOAC and the NOAC eras. In the NOAC era, 63.5% of baseline OAC therapy comprised NOACs, of which 96.4% included triple therapy with DAPT. Over 2 years, we observed increasing rates of double therapy combined with a single antiplatelet drug (18.3% and 20.0% at the 1- and 2-year follow-up, respectively) and OAC monotherapy (2.7% and 8.9% at 1- and 2-year follow-up, respectively).

Conclusions: We observed low OAC rates in Asian patients with AF who underwent PCI, even after the introduction of NOACs. Although the NOAC-based antithrombotic therapy rates have increased, most patients continued to receive antiplatelet therapy without OACs over 2-year post-PCI follow-up.
Clinical factors associated with OAC use 1 year after PCI in the NOAC era

<table>
<thead>
<tr>
<th>Factor</th>
<th>OR (95% CI)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Age ≥65</td>
<td>1.69 (1.42-2.01)</td>
</tr>
<tr>
<td>CHA₂DS-VAS score ≥2</td>
<td>1.37 (1.08-1.73)</td>
</tr>
<tr>
<td>Stroke or Systemic Thromboembolism</td>
<td>1.36 (1.16-1.58)</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>1.22 (1.08-1.38)</td>
</tr>
<tr>
<td>Modified HAS-BLED score ≥3</td>
<td>1.20 (0.94-1.53)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>1.12 (0.99-1.27)</td>
</tr>
<tr>
<td>Hypertension</td>
<td>1.04 (0.81-1.32)</td>
</tr>
<tr>
<td>Gastrointestinal Bleeding</td>
<td>0.91 (0.72-1.15)</td>
</tr>
<tr>
<td>Peripheral Arterial Disease</td>
<td>0.85 (0.74-0.97)</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>0.81 (0.68-0.96)</td>
</tr>
<tr>
<td>Female</td>
<td>0.77 (0.67-0.87)</td>
</tr>
<tr>
<td>Chronic Renal Disease</td>
<td>0.76 (0.65-0.89)</td>
</tr>
<tr>
<td>Chronic Liver Disease</td>
<td>0.74 (0.65-0.85)</td>
</tr>
<tr>
<td>Myocardial Infarction</td>
<td>0.70 (0.62-0.79)</td>
</tr>
<tr>
<td>Intracranial Hemorrhage</td>
<td>0.58 (0.46-0.73)</td>
</tr>
</tbody>
</table>

Clinical factors associated with OAC monotherapy 1 year after PCI in the NOAC era

<table>
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<tr>
<th>Factor</th>
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<tr>
<td>Gastrointestinal Bleeding</td>
<td>2.40 (1.26-4.58)</td>
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<tr>
<td>Intracranial Hemorrhage</td>
<td>1.68 (0.62-3.37)</td>
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<tr>
<td>Modified HAS-BLED score ≥3</td>
<td>1.46 (0.76-3.46)</td>
</tr>
<tr>
<td>Female</td>
<td>1.18 (0.59-2.41)</td>
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<tr>
<td>Peripheral Arterial Disease</td>
<td>1.30 (0.76-1.88)</td>
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<tr>
<td>CHA₂DS-VAS score ≥2</td>
<td>1.18 (0.46-3.05)</td>
</tr>
<tr>
<td>Congestive Heart Failure</td>
<td>1.08 (0.71-1.65)</td>
</tr>
<tr>
<td>Stroke or Systemic Thromboembolism</td>
<td>1.02 (0.61-1.37)</td>
</tr>
<tr>
<td>Liver Disease</td>
<td>0.98 (0.62-1.54)</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>0.91 (0.52-1.56)</td>
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<tr>
<td>Diabetes Mellitus</td>
<td>0.90 (0.58-1.38)</td>
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<tr>
<td>Hypertension</td>
<td>0.90 (0.36-2.73)</td>
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<tr>
<td>Myocardial Infarction</td>
<td>0.78 (0.50-1.22)</td>
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<tr>
<td>Age ≥65</td>
<td>0.74 (0.41-1.36)</td>
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<tr>
<td>Dyslipidemia</td>
<td>0.57 (0.34-0.96)</td>
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<tr>
<td>Modified HAS-BLED score ≥3</td>
<td>1.80 (0.73-4.41)</td>
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<td>CHA₂DS-VAS score ≥2</td>
<td>1.78 (0.71-4.31)</td>
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<td>Stroke or Systemic Thromboembolism</td>
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<tr>
<td>Congestive Heart Failure</td>
<td>1.37 (0.90-2.07)</td>
</tr>
<tr>
<td>Age ≥65</td>
<td>1.19 (0.65-2.18)</td>
</tr>
<tr>
<td>Female</td>
<td>1.09 (0.71-1.67)</td>
</tr>
<tr>
<td>Diabetes Mellitus</td>
<td>0.98 (0.64-1.49)</td>
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<tr>
<td>Peripheral Arterial Disease</td>
<td>0.96 (0.62-1.50)</td>
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<tr>
<td>Hypertension</td>
<td>0.85 (0.35-2.08)</td>
</tr>
<tr>
<td>Renal Disease</td>
<td>0.73 (0.42-1.29)</td>
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<tr>
<td>Liver Disease</td>
<td>0.71 (0.46-1.10)</td>
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<tr>
<td>Intracranial Hemorrhage</td>
<td>0.60 (0.35-1.07)</td>
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<tr>
<td>Myocardial Infarction</td>
<td>0.58 (0.37-0.90)</td>
</tr>
<tr>
<td>Dyslipidemia</td>
<td>0.42 (0.27-0.67)</td>
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</table>
Mitral Isthmus Ablation with Moderate-Power (40 Watts) Radiofrequency Energy is Associated with High Success Rate of Bidirectional Conduction Block

Jun Kim, Minsoo Cho, Gi-Byoung Nam, Kee-Joon Choi
University of Ulsan College of Medicine, Republic of Korea

Background: Creating conduction block in the mitral isthmus with radiofrequency catheter ablation is challenging. We hypothesize that moderate power and technologic advancement of catheter and mapping system are associated with acute procedural outcome of mitral isthmus ablation.

Methods: This single-center, retrospective study included 299 patients who underwent de novo mitral isthmus ablation from January 2010 to January 2020. Patients were stratified according to use of contact-force sensing catheter, level of power (<or =35 W or 40 W), and use of automated annotation system. Success rate of bidirectional conduction block across the mitral isthmus was calculated for each parameter and then analyzed for differences among groups.

Result: Mitral isthmus block was achieved in 230 of 299 patients (76.9%). With adoption of contact-force sensing catheter and automated annotation system (group 2), success rate of mitral isthmus ablation did not improved compared with conventional ablation (group 1) (69.2% vs 66.3%). With adoption of moderate power (40 W) (group 3), success rate of mitral isthmus ablation improved compared with group 2 (66.3% vs 92.7%, p<0.001). RF time (minutes, median, IQR) was shorter in group 3 compared with group 1 and 2 (19.8 [17.7-26.6] vs 13.8 [10.2-21.2] vs 8.9 [5.8-12.1], P<0.001). Procedure related complication was similar among 3 groups (4.5% vs 6.2% vs 0.9%, p=0.143).

Conclusions: Mitral isthmus ablation at 40 W power using contact force sensing catheter and automated annotation system was associated with higher acute success rate compared with usual power ablation without increasing complication rate.
Impact of Cumulative Burden of Body Mass Index and Waist Circumference on Risk of Atrial Fibrillation: An Analysis of 3,700,000 Participants Who Underwent 4-Year Consecutive Annual Health Examination

Tae-Min Rhee, Eue-Keun Choi, Kyung-Do Han, So-Ryoung Lee, Seil Oh

1Seoul National University Hospital, Republic of Korea, 2Soongsil University, Republic of Korea

**Background:** There is limited evidence regarding the significance of the combination of waist circumference (WC), as a surrogate marker of central obesity, with body mass index (BMI) for predicting the future risk of atrial fibrillation (AF). Furthermore, additive value of BMI and WC burden on AF risk has not been reported.

**Methods:** This study included subjects aged >20 years who underwent four times of annual national health check-up serially during 2009-2013, excluding those with previous history of AF. The 4-year cumulative burden of BMI and WC was represented as burden-score calculated by the summation of BMI score at each year of health check-up. Newly developed non-valvular AF was identified using claims data from Korean National Health Insurance Service during median follow-up of 5.2 years.

**Result:** A total of 3,726,172 subjects (mean age 44.5 ± 11.1, men 69.5%) were analyzed. Compared to the zero burden-score, maximal burden-score of BMI mildly increased the risk of AF with incidence rate (IR) of 1.56 per 1,000 person-year (adjusted hazard ratio [HR] 1.32, 95% confidence interval [CI] 1.27-1.37), whereas the risk of AF predominantly increased in the group of maximal burden-score of WC (IR 2.26 per 1,000 person-year, adjusted HR 1.52, 95% CI 1.46-1.58). Different burden of BMI in the same WC burden group did not affect the risk of AF, while increase of WC burden in the same BMI burden group significantly increased AF risk. Risk of AF was particularly high in groups with moderate burden of BMI with concomitant high burden of WC.

**Conclusions:** Cumulative burden of WC was a stronger determinant of AF risk than BMI burden. Active surveillance for AF and early intervention for risk factors should focus on high risk population determined by the burden of WC.
Background: Recurrence rates after radiofrequency catheter ablation (RFCA) in atrial fibrillation (AF) patients are not low especially in non-paroxysmal AF. The diameter of left atrium (LA) has been widely used to predict the recurrence after RFCA for decades. However, LA diameter represents structural remodeling of LA and does not reflect electrical remodeling. We aimed to determine the predictive value of electrical remodeling of LA which is represented by low voltage zone (LVZ).

Methods: We performed a retrospective cohort analysis of AF patients who underwent de-novo RFCA in a single-center.

Result: A total of 3,120 AF patients with de-novo RFCA were analyzed. Among these patients, 537 patients underwent an electroanatomic mapping with bipolar voltage measurement of LA. Mean age and CHA2DS2-VASc score were 55.71 ± 11.02 and 1.33 ± 1.30, respectively. Non-paroxysmal AF was observed in 211 (39.3%) patients. The diameter of LA and flow velocity of LA appendage differed significantly according to LVZ area and percentage quartile group: patients with high LVZ had large diameter and low flow velocity (p < 0.001). Freedom from late recurrence was significantly lower in patients with high LVZ area and percentage (p < 0.001). The diameter and surface area of LA had area under curve (AUC) of 0.592 and 0.593, respectively (p = 0.002 for both). The predictive value of LVZ area (AUC = 0.676) and percentage (AUC = 0.671) were both superior compared with LA diameter (p = 0.011 and 0.027 for each comparison).

Conclusions: Low voltage zone can predict freedom from late recurrence after RFCA in AF patients. Predictive value was higher in parameters reflecting electrical rather than structural remodeling.
ORAL 2 (AF)
Characteristics of the Unipolar Electrograms in the Pulmonary Vein Antrum during Radiofrequency Pulmonary Vein Antral Isolation

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Background: Several studies have shown the usefulness of unipolar electrogram (EGM) in evaluating transmural lesion during pulmonary vein (PV) isolation.

Methods: We recorded unipolar EGM (0.5-150 Hz) at PV antrum in patients (n=18) undergoing radiofrequency (RF) ablation for atrial fibrillation (AF). EGM characteristics were evaluated during sinus rhythm (SR) and distal coronary sinus (CS) pacing before and after RF delivery.

Result: Unipolar EGMs showed several site-specific characteristics. In the right PV anterior antrum, sluggish far-field (FF) S wave preceded local RS EGM during SR, and distal CS pacing advanced local RS EGM, obscuring the FF S wave. In the left PV anterior antrum, broad FF r wave preceded local RS EGMs during SR, which were more separated with distal CS pacing. In the posterior PV antrum, the amplitude of the negative S wave deflection became smaller when the recording electrode approached the lower antrum. As a result, nearly monophasic R wave was observed in both PV posterior antrum and bottoms. During RF application, local injury potential occurred at the point of local EGM and the negative FF deflection preceding local signal frequently remained in the anterior antrum of the PVs. In contrast, S waves in the low posterior antral regions were too small to identify. The local S waves were instantaneously obscured by marked injury potential and completely disappeared usually within 5 seconds after RF onset.

Conclusions: Unipolar EGM along the PV antral region showed site-specific variations. S wave may remain after sufficient RF energy, while disappearance of S wave may not represent transmural necrosis.

A) Representative EGMs according to PV antral sites
B)-C) EGMs during SR and distal CS pacing, which were recorded at antrum of RSPV and LSPV, respectively.
D) Changes of EGMs during RF application at RSPV antrum (from left to right, baseline, 5 seconds after RF initiation and immediate after finish of the RF application, respectively).
ORAL 2 (AF)

OR2-02
Malnutrition and Risk of Procedural Complications in Patients with Atrial Fibrillation Undergoing Catheter Ablation

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Background: We investigated the prevalence and prognostic value of malnutrition among patients undergoing catheter ablation of atrial fibrillation (AF), a type of metabolic disease.

Methods: We included 3,239 patients undergoing de novo AF catheter ablation (AFCA) between 2009 and 2020. Nutritional status was assessed using the controlling nutritional status (CONUT) score. The association between malnutrition and the risk of AFCA complications or long-term rhythm outcomes was evaluated. We validated the effects of malnutrition using an external cohort of 360 patients undergoing AFCA between 2013 and 2016.

Result: In the study population (26.8% women, median age: 58 years), 1,005 (31.0%) had malnutrition (CONUT scores ≥2); 991 (30.6%) had mild (CONUT scores 2-4) and 14 (0.4%) had moderate-to-severe (CONUT scores ≥5) malnutrition. The overall complication rates after AFCA were 3.3% for normal nutrition, 4.2% for mild malnutrition, and 21.4% for moderate-to-severe malnutrition. Moderate-to-severe malnutrition (odds ratio [OR] 8.215, 95% confidence interval [CI] 2.199-30.691, compared with normal nutrition), older age (OR 1.024 per 1-year increase, 95% CI 1.005-1.044), and female sex (OR 1.938, 95% CI 1.321-2.842) were independent predictors for the occurrence of AFCA complications. In the validation cohort, malnutrition (CONUT scores ≥2) was associated with a 2.87-fold higher risk of AFCA complications (95% CI 1.174-7.033). Malnutrition did not affect the long-term rhythm outcomes during the median follow-up of 40 months (clinical recurrence: 37.0% in normal nutrition versus 36.5% in malnutrition; log-rank P=0.763).

Conclusions: Malnutrition, which is common in patients undergoing AFCA, was associated with a substantially higher risk for complications after AFCA.

Figure. Rates of the overall and major complications according to the CONUT score.
Figure. Kaplan–Meier analyses of the atrial fibrillation (AF) recurrence-free survival rate in the cohort 1 (the main cohort) (n=3,239; panels A and B) and in the cohort 2 (the external validation cohort) (n=360, panels C and D).
**Background:** Atrial fibrillation (AF) increases the risk of dementia, and catheter ablation for AF has been reported to be associated with a lower risk of dementia. We aimed to investigate the association of a rhythm-control strategy for AF with the risk of dementia, compared with a rate-control strategy.

**Methods:** This population-based cohort study included 41,135 patients with AF on anticoagulation who were newly treated with rhythm-control (antiarrhythmic drugs or ablation) or rate-control strategies between January 1, 2005, and December 31, 2015 from the Korean National Health Insurance Service database. All-cause dementia including Alzheimer's disease and vascular dementia was compared using propensity score overlap weighting.

**Result:** In the study population (46.7% female; median age: 68 years), a total of 4,039 patients were diagnosed with dementia during a median follow-up of 51.7 months. Rhythm control, compared with rate control, was associated with a lower risk of dementia (weighted incidence rate, 21.2 vs. 25.2 per 1000 person-years; hazard ratio [HR] 0.86, 95% confidence interval [CI] 0.80-0.93). The associations between rhythm control and decreased dementia risk were consistently observed even after censoring for incident stroke (HR 0.89, 95% CI 0.82-0.97) and were more pronounced in patients relatively younger (<80 years) and those with lower CHA2DS2-VASc scores. Among the subtypes of dementia, rhythm control was associated with a lower risk of Alzheimer's disease (HR 0.86, 95% CI 0.79-0.95).

**Conclusions:** In this nationwide cohort of patients with AF taking oral anticoagulants, rhythm control was associated with a lower risk of dementia, compared with rate control. Early initiation of rhythm control in AF patients with fewer stroke risk factors might help prevent subsequent dementia.

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**Figure.** Weighted cumulative incidence curves for all-cause dementia in (A) overall and (B) after censoring stroke.
Figure. Relation between age at treatment initiation and risk of dementia for rhythm control or rate control.
Sex Differences in the Left Atrial Low Voltage Areas according to CHA2DS2-VA Score among Patients with Atrial Fibrillation

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Background: The effect of female sex on the risk of stroke varies depending on the presence of CHA2DS2-VA (non-sex category risk factors). We hypothesized that female sex would have a differential impact on left atrial low voltage areas (LVAs) according to the CHA2DS2-VA score.

Methods: This study included 556 patients who underwent first-time radiofrequency catheter ablation (RFCA) for paroxysmal AF. Left atrial LVAs was evaluated before RFCA using a 3D-mapping system. LVAs were defined as regions with a bipolar peak-to-peak voltage of <0.5 mV. The proportion of LVAs was calculated by dividing the total LVA by LA surface area.

Result: There was no sex difference in LA LVAs among patients with a CHA2DS2-VA score ≤2. The proportion of LVAs was significantly higher in female among patients with a CHA2DS2-VA score of 3 (9.7[4.6-15.1]% vs. 16.8[6.9-32.1]%; p=0.044) and the female sex was significantly associated with a high burden of LVAs (LVA ≥20%) in patients with a CHA2DS2-VA score ≥3. In the multivariate regression model, female sex with a CHA2DS2-VA ≥3 was significantly associated with a higher proportion of LVAs after adjustment of age (as a continuous variable), reduced renal function (estimated glomerular filtration rate < 60mL/min/1.73m³), comorbidities, LA diameter ≥4.5 cm, type of AF and duration of AF.

Conclusions: Female sex is significantly associated with higher LVA burden, particularly female patients with a CHA2DS2-VA score ≥3.
Dual Antithrombotic Therapy on Early Clinical Outcomes in Patients with Atrial Fibrillation after Percutaneous Coronary Intervention: A Nationwide Study in the Era of NOAC

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Background: Among the Asian atrial fibrillation (AF) population undergoing percutaneous coronary intervention (PCI), most of the patients received dual antiplatelet therapy (DAPT) without oral anticoagulants (OACs). The current nationwide study assessed 3-month ischemic and bleeding risks of DAPT against triple therapy among the Korean AF population undergoing PCI.

Methods: We analyzed the claims records of 11,039 patients (mean age 70 years, 66.3% male, and mean CHA2DS2-VASc score 3.2) between 2013 to 2018. Patients were categorized into triple therapy group with vitamin K antagonists (VKAs-TT) (n=1,786), or non-vitamin K oral anticoagulants (NOACs-TT) (n=1,997), and DAPT group (n=7,256) according to the antithrombotic therapy after PCI. Three-month risks of ischemic stroke, non-fatal myocardial infarction, any in-hospital death, and major bleeding were compared after baseline adjustment using inverse probability weighting.

Result: The DAPT group had a higher prevalence of prior MI and coronary revascularization, but had lower thromboembolic and bleeding risks than the triple therapy groups at baseline. The NOACs-TT group was associated with a lower risk of ischemic stroke (hazard ratio [HR] 0.38, 95% confidence interval [CI] 0.20-0.70) and any in-hospital death than the VKAs-TT group. The DAPT group showed a lower risk of ischemic stroke (HR 0.41, 95% CI 0.27-0.63) and major bleeding (HR 0.55, 95% CI 0.37-0.84) than the VKAs-TT group. The DAPT group showed a comparable ischemic risk against the NOACs-TT group, although the risk of major bleeding was lower in the DAPT group, especially among old age (HR 0.47, 95% CI 0.29-0.78) or OACs-naive patients (HR 0.50, 95% CI 0.29-0.86).

Conclusions: Among the Asian AF population, using short-term DAPT for 3-month after PCI was associated with a lower bleeding risk without increasing ischemic risk compared to triple therapy. This may be a therapeutic option in high bleeding risk patients undergoing complex PCI necessitating focus on DAPT in the initial 3-month period.
Estimated hazard ratios for 3-months risk of clinical outcomes according to antithrombotic therapy

Months from index PCI

*P < 0.05 compared with VKAs-based triple therapy

- VKAs-based Triple therapy
- NOAC-based Triple therapy
- DAPT
A Healthy Lifestyle Combination is Associated with a Lower Risk of Dementia in Patients Newly Diagnosed with Atrial Fibrillation: A Nationwide Cohort Study

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Background: Atrial fibrillation (AF) increases the risk of dementia. A new paradigm for AF management should include a new pillar targeting lifestyle modification. There are limited data on the clinical impact of healthy lifestyle behaviors on the risk of dementia in patients with newly diagnosed AF.

Methods: Using the Korean National Health Insurance database between 2009 and 2016, we identified adult patients who were newly diagnosed as AF without dementia. Patients were categorized into 4 groups according to a healthy lifestyle-behavior score (HLS) 0, 1, 2, and 3 by assigning 1 point each for no current smoking, abstaining alcohol, and performing regular exercise. For the comparison, each group was balanced using the inverse probability of treatment weighting (IPTW). The primary outcome was incident dementia during follow-up.

Result: Among a total of 199,952 patients were included, the number of patients within the HLS 0, 1, 2, and 3 groups were 8709 (4.4%), 34839 (17.4%), 106796 (53.4%) and 49608 (24.8%), respectively. Using weighted COX proportional hazards regression model with IPTW, HLS 1, 2, and 3 groups were associated with a lower risk of dementia compared to HLS 0 group: Hazard Ratio [HR] 0.769, 95% confidence interval [CI] 0.704-0.842 for score 1; HR 0.770, 95% CI 0.709-0.836 for score 2; HR 0.622, 95% CI 0.569-0.679 for score 3. The effect of healthy lifestyle was similar for Alzheimer's dementia and vascular dementia. There was consistency in subgroup analyses stratified by age, sex, CHA2DS2-VASc score, oral anticoagulation use and prior stroke history.

Conclusions: A combination of a healthy lifestyle, including quitting smoking, abstaining from alcohol consumption, and performing regular physical activity, was associated with a significantly lower risk of dementia in patients with new-onset AF. These findings support the promotion of a healthy lifestyle within an integrated care approach to AF patient management, which could reduce the risk of dementia.
Background: Prognostic significance of resting heart rate and its therapeutic target in atrial fibrillation (AF) is still uncertain. The aim of this study was to investigate the relationship between resting heart rate and cardiovascular outcomes in patients with AF.

Methods: A total of 8,886 patients were included from the COmparison study of Drugs for symptom control and complication prEvention of AF (CODE-AF). Patients were categorized according to baseline heart rate and cardiovascular outcomes were accessed during a median follow-up of 30 months. The primary outcome was a composite of cardiovascular death, heart failure hospitalization, and myocardial infarction/critical limb ischemia.

Result: Compared to heart rate ≥100 beats per minute (bpm), heart rate 80-99 bpm was associated with the lowest risk of primary outcomes (adjusted hazard ratio [HR] 0.561, 95% confidence interval [CI] 0.399-0.789, p=0.001). In patients with concomitant HF with preserved ejection fraction (HFP EF), heart rate 80-99 bpm was associated with reduced risk of primary outcome compared to heart rate ≥100 bpm (HR 0.398 95%, 95%CI 0.162-0.980, p=0.045). However, in patients with HF with reduced ejection fraction (HFrEF), there was no association between resting heart rate and cardiovascular outcomes (P for interaction 0.001).

Conclusions: Resting heart rate was associated with cardiovascular outcomes in patients with AF, and heart rate 80-99 bpm had the lowest risk of adverse events. Impact of resting heart rate on adverse events remained in patients with concomitant HFP EF, but did not in those with concomitant HFr EF.
ORAL 3 (OTHER)

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
ORAL 3 (OTHER)

OR3-01

A Comparison of Atrial Fibrillation Incidence among Physician and the General Population: The Good, the Bad and the Ugly

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Background: To explore the association of atrial fibrillation (AF) among physician specialist.

Methods: We used Cox proportional hazards models to estimate the incidence rate and the adjusted hazard ratios (aHR) with 95% confidence intervals (CIs) to determine the risk of atrial fibrillation in the physician study cohort relative to the comparison cohort, and further analyzed stratified by age and comorbidities.

Result: The Cox proportional hazard regression model revealed that male physician was significantly associated with an increased risk of AF than non-physician after adjusting for potential confounders (adjusted HR, 1.05; 95% CI: 1.00–1.11). In age-specific analysis, male physician age less than 35 years old showed the strongest association with AF (adjusted HR, 3.70; 95% CI: 3.01–4.55). When stratified by comorbidity, the male physician cohort exhibited a significantly higher risk of AF than controls (adjusted HR, 1.45; 95% CI: 1.34–1.57).

Conclusions: Association of AF among physicians was shown.
Background: Less studies have been reported on the direct comparisons of electrocardiogram (ECG) monitoring between an adhesive single-lead device and Holter monitoring among patients with cardiac arrhythmias other than atrial fibrillation (AF). We aimed to compare 24-hour ECG monitoring between the adhesive single-lead device and Holter monitoring in general arrhythmia patients.

Methods: This was a prospective single-center cohort study. The individuals indicated for Holter monitoring for a work-up of pre-diagnosed arrhythmias or suspicious arrhythmic episodes were included in the study. Each participant wore an adhesive single-lead device and Holter monitoring simultaneously and monitored cardiac rhythm for 24 hours (Figure 1). Selective ECG parameters were measured in both monitoring methods. The parameters included the number of total QRS complexes and the numbers and burdens of ventricular ectopic beats (VEBs)/supraventricular ectopic beats (SVEBs) and heart rates. Diagnoses made with each device were compared by two cardiologists independently.

Result: A total of 29 participants were included in this study. The two most frequent ECG monitoring indications were work-up of premature atrial contractions (41.4%) and suspicious arrhythmia-related symptoms (37.9%). The single-lead device had a higher noise burden than the Holter monitoring (0.04±0.05% versus 0.01±0.01%, p-value =0.024). The number of total QRS complexes/VEBs/SVEBs, and the burdens of VEB/SVEBs showed an excellent degree of agreement between the two monitoring methods (intraclass correlation coefficients [ICC] =0.991, 1.000, 0.987, 1.000, 0.986, respectively) (Figure 2). Also, minimum/average/maximum heart rates showed an excellent degree of agreement (ICC =0.999, 0.994, and 0.994, respectively) (Figure 2). The two cardiologists made coherent diagnoses for all 29 participants between both monitoring methods.

Conclusions: For selective ECG parameters, both monitoring methods achieved an excellent agreement. Compared to Holter monitoring, the single-lead adhesive device could be an acceptable alternative for ambulatory ECG monitoring in general arrhythmia patients.

Figure 1. The measurement setting for ECG monitoring of a study participant. The left panel shows a participant wearing a Holter monitoring and an adhesive single-lead ECG monitoring device (mobiCARE-MC100) simultaneously.
Figure 2. The Bland-Altman plots for ECG parameters, including total QRS complexes/VEBs/ SVEBs, and burdens of VEBs/ SVEBs. The plots drew with 95% CI of limits of agreement and 95% CI of mean difference. The mobiCARE-MC100 served as a reference. Abbreviations: CI, confidence interval; ECG, electrocardiogram; ICC, intraclass correlation coefficient; SD, standard deviation; SVEB, supraventricular ectopic beat; VEB, ventricular ectopic beat.
An Artificial Intelligence-Enabled ECG Algorithm for the Identification of Patients with Heart Failure Reduced Ejection Fraction

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**Background:** Early diagnosis and treatment of patients with systolic heart failure (HF) can improve the prognosis. To diagnose heart failure, echocardiography and BNP tests are required, but it takes time and cost. The objective of this study was to assess the accuracy of an artificial intelligence-enabled ECG to identify left ventricular systolic dysfunction (LVSD).

**Methods:** Patients who underwent standard 12-lead ECG acquired on the date and an echocardiogram performed within 30 days of presentation. We divided into 3 groups: normal LV ejection fraction (LVEF $\geq$ 50%), HF mid-range (HF) 40$\leq$LVEF<50%, HF reduced EF HF<40%. We assessed the model performance using area under the receiver operating characteristic curve, accuracy, sensitivity, and specificity.

**Result:** A total of 42303 patients were included. The artificial intelligence-enabled ECG algorithm identified normal LV ejection fraction (LVEF$\geq$50%) with an area under the receiver operating characteristic curve of 0.86 (95% CI, 0.80-0.92) and accuracy of 83.9%. To identify an Heart failure reduced EF (LVEF<40%), the area under the receiver operating characteristic curve of 0.84 (95% CI, 0.80-0.88) and accuracy of 81.9%

**Conclusions:** Systolic heart failure can be predicted using an electrocardiogram, which is widely used in clinical practice.
**Background:** A limited study comprehensively evaluated the association between full ranges of body mass index (BMI), including underweight, and atrial fibrillation (AF) or ischemic stroke (IS) risks, especially in the different age subgroups. We investigated the association between BMI and AF and IS incidence according to the age groups.

**Methods:** We included 9,194,477 healthy adults who underwent a medical examination in 2009 from the National Health Insurance Service. Study population was stratified into three age subgroups: age 20-39 (33.1%), age 40-64 (56.3%), and age over 65 years (10.6%). In each age group, the individuals were categorized based on BMI (kg/m²) into underweight (<18.5), normal (18.5 to <23), overweight (23 to <25), obese I (25 to <30), and obese II (≥30). The first occurrences of AF and IS were followed up until December 31, 2018.

**Result:** Both underweight and higher BMI were associated with an increased risk of AF across all age groups. However, for underweight individuals, the increased risk of AF became more prominent in the elderly: HR and 95% CI was 1.12 (1.07-1.17) in the age over 65 years old, and 1.05 (0.94-1.16) in the age 20-39. Regarding IS, the association between the BMI and stroke risk became attenuated in the elderly: HRs and 95% CI in underweight and obese II individuals were 1.10 (0.93-1.30) and 2.23 (1.99-2.49) in the age 20-39 group, whereas 0.97 (0.93-1.01) and 1.03 (0.98-1.08) in the age over 65 years old.

**Conclusions:** Underweight as well as obesity was associated with increased risks of AF and IS in the general population. In both AF and IS, the gradient of risks according to BMI was apparent at young ages. An interplay of several factors other than BMI may contribute to ischemic stroke in the old ages, requiring integrated risk management in older patients.
ORAL 4
(BASIC & CIED)

KHRS 2021
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ORAL 4 (BASIC & CIED)

OR4-01
The First Survey on Patients’ Needs for Remote Monitoring of Cardiac Implantable Electronic Devices in South Korea

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Background: There have been studies showing remote device monitoring is performed to reduce unnecessary outpatient visits and increase patient satisfaction. As there was no research on remote monitoring in Korea, there was a lack of evidence for policy or insurance standards due to lack of domestic data despite the needs from domestic arrhythmia experts. Accordingly, in order to establish the basis for patient satisfaction, economic efficiency, and safety of wireless monitoring, survey-based study was planned.

Methods: This was a single university hospital survey study. Satisfaction index was evaluated using a questionnaire to investigate patient satisfaction in outpatient clinic, economic efficiency (measured as home to clinic time, waiting time, and actual clinic time), and demand for remote monitoring in patients with implantable cardiac devices. The questionnaire was adopted and modified from Survey on telehealth patient experience by Bas-Villalobos, 2006 (modified Korean version2.0 by You Mi Hwang,2020).

Result: Surveys were taken from 171 patients. Mean age of the patients were 71.2 ± 12.4 years. Based on survey, home to clinic time was usually less than 1 hour, mean waiting time in the hospital until clinic time was 42.6 ± 24.5 minutes, and mean clinic time was 3.1 ± 1.7 minutes. Based on survey, patients favored remote monitoring over hospital visit with cardiac implantable electronic device follow-up mainly because of time consuming from home to clinic.

Conclusions: Based on the survey, there is a clear need for remote monitoring in patients who have cardiac implantable electronic device.
Comparison of Apical Pacing and Septal Pacing in Patients with Atrioventricular Block Undergoing Pacemaker: 3 Year Follow up

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Background: Left ventricular function can be affected by chronic ventricular pacing. Different right ventricular (RV) pacing sites have shown heterogeneous clinical outcomes. We investigated these factors in patients receiving permanent pacemaker (PPM) implants.

Methods: This multicenter, retrospective analysis of PPM use from tertiary centers in South Korea, included all patients undergoing de novo transvenous PPM implantation for atrioventricular block from 2017 to 2019. Clinical characteristics, 12-lead electrocardiograms, echocardiography, and laboratory parameters were evaluated. Follow up included hospitalizations and deaths caused by heart failure.

Result: There were 167 patients (66 male; overall mean age 75.3 ± 11.9 y), divided into two groups according to the pacing site: 83 apical RV (RVA) vs 84 septal RV (RVS). There were no significant baseline differences between the groups. Paced QRS duration (pQRSd) increased with RVA placement compared with RVS (168.5 ± 20.1 vs 159.1 ± 16.3 ms; P < 0.001). Over a median 31-month follow up, there were 15 hospitalizations and 2 deaths. More patients with RVA placement were hospitalized or died (16% vs 5%, respectively; P = 0.049). In Cox proportional regression analysis, pQRSd (hazard ratio [HR] 1.046; 95% confidence interval [CI] 1.0041.091; P = 0.033), and diastolic dysfunction (HR 7.343; 95% CI 2.03526.494; P = 0.002) were independent predictors of outcome.

Conclusions: RVS placement shortened the pQRSd and improved clinical outcomes. However, the determinants of these were pQRSd and diastolic dysfunction rather than pacing site. Therefore, clinicians should try to shorten the pQRSd when implanting a PPM, and patients with diastolic dysfunction should be monitored intensively.
Feasibility Study on Stereotactic Radiotherapy for Total Pulmonary Vein Isolation in a Canine Model

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Background: We tested the feasibility of pulmonary vein (PV) and left atrial (LA) posterior wall isolation using non-invasive stereotactic ablative body radiotherapy (SABR) and investigated pathological changes in irradiated lesions in a canine model.

Methods: Seven male Mongrel dogs received single-fraction 33-Gy SABR. We designed the en-bloc circular target of total PVs and LA posterior wall to avoid the esophagus. The circular box lesion included the LA roof and ridge, low posterior wall, and posterior interatrial septum. At 6 weeks or 4 months post-SABR, electrical isolation of the SABR lesion was confirmed using LA posterior wall pacing, and histopathological review was performed.

Result: Electrical isolation of all PVs and the LA posterior wall was achieved in three of five dogs in the 4-month group. There was one target failure and one sudden death at 15 weeks. Although two dogs in the 6-week group failed to achieve electrical lesion isolation, the irradiated atrial myocardium showed diffuse hemorrhage with inflammatory cell infiltration. In successfully isolated 4-month model dogs, we observed transmural fibrotic scarring with extensive fibrosis on irradiated atrial tissue. The histologic changes after irradiation observed at 4 months are demonstrated in the figure. Compared to the normal atrial myocardium near the irradiated lesion (a), irradiated atrial myocardium (b) shows massive hemorrhage with anucleated wavy fibers with extensive interstitial fibrosis.

Conclusions: The findings suggest that this novel circular box-design radiotherapy technique using SABR could be applied to humans after further studies are conducted to confirm safety.
Background: MicroRNAs (miRNAs) are small noncoding RNAs that control patterns of gene expression by inducing the degradation of mRNA. Although several miRNAs have been shown to control important processes that contribute to the pathophysiological consequences of atrial fibrillation (AF), they have not been established clinically. This study evaluated whether the specific miRNA could control AF through inhibition of calcium handling protein phosphorylation in fibrosis model.

Methods: Human urine was obtained from 10 patients without serious or progressive cardiac disease at Ewha Womans University (Seoul, Korea) from August 2019 to February 2020. To identify valuable targets for atrial fibrillation, microarray were used to obtain miRNA expression profiles from PSVT and AF group.

Result: By performing microarray analysis of the transcriptome in human urine of PSVT and AF group, we found that these differentially expressed miRNAs in AF patient group was significantly down-regulated (miR-3613, 6763, 423, 3162, 1180, 6511, 3197). Also, the qRT-PCR results validated that Collagen 1, Collagen 3, Fibronectin 1, TGF-B, which are the fibrosis related genes, were significantly up-regulated in the AF group. Moreover, we found that calcium related genes was increased in Angiotensin II induced atrial myocyte cells, and further confirmed that calcium related gene is a target of miRNA-423. In the atrial fibrillation HL-1 cell model transfected with miR-423, the expression of a calcium handling protein including phosphorylated CaMKII was reduced. Transfection of miR-423 attenuated damage to cardiac cells caused by calcium handling proteins.

Conclusions: This study reveals that miR-423 regulates calcium handling protein and intracellular calcium signaling is involved in the development of cardiac arrhythmias. These data highlight the importance of calcium handling protein phosphorylation changes in fibrosis-induced atrial fibrillation and support miR-423 as a potential novel approach to disease diagnosis.
Comparison between Centroid Defuzzification and Maximum Defuzzifier Model Mean of Maxima (MOM) For the Diagnosis of Coronary Artery Disease (CAD)

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Yogyakarta State University, Indonesia

Background: Cardiovascular, especially coronary artery disease, is the number one cause of death globally. Every year, more people die from cardiovascular disease than any other disease. There are several factors and symptoms of coronary artery disease (CAD) that are easily recognized. To find out the severity of CAD, a diagnosis of CAD is needed to facilitate medical treatment. This study aims to explain the diagnostic process for CAD using a fuzzy system and to determine the accuracy of the fuzzy system.

Methods: This study uses a fuzzy system to diagnose the severity of coronary artery disease. Input variables used in the study were gender, age, pulse, systolic blood pressure, cholesterol, blood sugar, triglycerides, electrocardiogram (ECG), chest pain, shortness of breath, and cough. In making the system, 90 data were used which were then divided into two types of data, namely 70 training data and 20 testing data. The fuzzy inference system used in this study is the Mamdani inference system that uses centroid defuzzification and MOM. This defuzzification process is used to diagnose types of coronary artery disease, namely: CAD level 1 (Asymptomatic), CAD level 2 (Angina Pectoris), and CAD level 3 (Acute Myocardial Infarction).

Result: The results of the research on the application of the fuzzy system for diagnosing coronary artery disease were the accuracy of the defuzzification centroid method of 98.5% for training data and 95% for testing data, while for the MOM defuzzification method, the accuracy level of training data was 98.5% and 90% for testing data.

Conclusions: Based on the research results, it can be concluded that the centroid defuzzification method is better than the MOM defuzzification system for the coronary artery disease diagnosis system, so, it can be said that by using a fuzzy system with centroid defuzzification, the probability of correctly diagnosing one patient is 95%.
ORAL 5 (AF)

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
Background: It is unclear whether atrial fibrillation (AF) catheter ablation (AFCA) improves the left ventricular (LV) diastolic function. We evaluated the 1-year change in the H2FPEF score, which reflects the degree of LV diastolic function, after AFCA among patients with a normal LV systolic function.

Methods: We included 1,471 patients (30.7% female, median age 60 years, paroxysmal-type AF 68.6%) who had available H2FPEF scores at baseline and at 1-year after AFCA to evaluate the 1-year change in the H2FPEF score (H2FPEF score[1-yr]) after AFCA.

Result: Baseline high H2FPEF scores (≥6) were independently associated with the female sex, left atrium (LA) diameter, LV mass index, pericardial fat volume, and a low estimated glomerular filtration rate. One-year after AFCA, decreased H2FPEF scores [1-yr] were associated with baseline H2FPEF scores of 6 (OR, 4.19 [95% CI, 2.88-6.11], p<0.001), no diabetes (OR, 0.60 [95% CI, 0.37-0.98], p=0.04), and lower pericardial fat volume (OR, 0.99 [95% CI, 0.99-1.00], p=0.003). Increased H2FPEF scores [1-yr] were associated with a baseline H2FPEF score of <6 (OR, 3.54 [95% CI, 2.08-6.04], p<0.001) and sustained AF after a recurrence within one year (SustainAF [1-yr]; OR, 1.89 [95% CI, 1.01-3.54], p=0.048). Throughout a 56-month median follow-up, an increased H2FPEF score [1-yr] resulted in a poorer rhythm outcome of AFCA (at 1-year, log-rank p=0.003; long-term, log-rank p=0.010).

Conclusions: AFCA appears to improve LV diastolic dysfunction. However, SustainAF [1-yr] may contribute to worsening LV diastolic dysfunction and it was shown by increased H2FPEF scores [1-yr] which was independently associated with higher risk of AF recurrence rate after AFCA.
**Background:** Sometimes, ischemic strokes (ISs) can appear even in low CHA2DS2-VASc scores atrial fibrillation (AF) patients. We explored the potential risk factors related to ISs that appear in these individuals (0-1 point in men or 1-2 points in women).

**Methods:** Among 3,648 patients who underwent AF catheter ablation (AFCA), 1,668 AF patients (25.0% female, median age 56 years, paroxysmal AF 71.6%) had low CHA2DS2-VASc scores at either the enrollment (n=1,528) or IS event (n=140). We evaluated the clinical, imaging, hemodynamic, and electrophysiological parameters related to ISs among AF patients with low CHA2DS2-VASc scores.

**Result:** Patients with ISs in this study were older (p<0.001), had a lower eGFR (p<0.001), larger left atrial (LA) diameter (p<0.001) and volume (p=0.001), higher EEm (p<0.001), and reduced anterior LA voltage level (p=0.002) relative to those without ISs. Among AF patients with low CHA2DS2-VASc scores, the age (OR 1.07 [1.04-1.11], p<0.001), LA diameter*EEm >400 mm (OR 1.93 [1.20-3.08], p=0.006) and anterior LA voltage (OR 0.56 [0.32-0.96], p=0.036) were independently associated with ISs. During a median 36-month of follow-up, patients with low CHA2DS2-VASc scores-ISs (Log rank p=0.001) and with the highest-quartiles of LA diameter*EEm (Long rank p<0.001) demonstrated a significantly higher AF recurrence after catheter ablation.

**Conclusions:** Among the AF patients with low CHA2DS2-VASc scores, an old age, left ventricular diastolic dysfunction, and atrial myopathy as estimated by a low LA voltage contributed to the development of ISs.
Artificial Intelligence for Atrial Fibrillation Prediction - Where Are We and Where Are We Going?
Wei-Syun Hu

China Medical University Hospital, Taiwan

**Background:** We aim to construct a random forest model to predict atrial fibrillation (AF) in Chinese population.

**Methods:** This study is comprised of 682,237 subjects with or without AF. Each subject has 20 features that include the subjects’ age, gender, underlying diseases, and CHA2DS2-VASc score. The data is split into train and test sets at an approximate 9:1 ratio: 614,013 data points are placed into the train set and 68,224 data points are placed into the test set. This study uses the weighted average F1, precision, and recall values were used to measure prediction model performance. The F1F1, precision, and recall values were calculated across the train set, the test set and all data. The area under receiving operating characteristic (ROC) curve was also used to evaluate the performance of the prediction model.

**Result:** The prediction model achieved a k-fold cross-validation accuracy of 0.9792 (k = 10). In the test set, the prediction achieved an F1 F1 value of 0.968, precision value of 0.958, and recall value of 0.979. Table 2 shows the weighted average F1F1, precision, and recall values across all data. The area under ROC curve of the model is 0.9483 (95% confidence interval: 0.9473 - 0.944949). This model was validated with a separate dataset.

**Conclusions:** This study shows a novel AF risk prediction scheme for Chinese individuals with a random forest model technique.
Background: Hypertension is an independent risk factor for atrial fibrillation (AF). The excess risk in relation to the presence of proteinuria associated with hypertension has not been well elucidated. Our aim was to determine the effect of hypertension and/or proteinuria on the incidence of AF. Second, we evaluated whether the associations with temporal changes in proteinuria status.

Methods: A total of 85,434 participants with hypertension and 125,912 participants without hypertension with age ≥ 60 years from the Korea National Health Insurance Service-Senior cohort were included. Inverse probability of treatment weighting (IPTW) was used to adjust baseline characteristics of multiple groups.

Result: Overall, 4.4% of individuals with hypertension and 3.2% of individuals without hypertension were diagnosed with AF during a median follow-up period of 7.2 years (IQR 5.1-8.1). Amongst control (participants without proteinuria and hypertension), hypertension only, proteinuria only, and hypertension with proteinuria groups, the adjusted incidences of AF were 0.51, 0.69, 0.78 and 0.99 per 100 person-years respectively. Compared with controls, the weighted risks of AF in the hypertension only, proteinuria only, and hypertension with proteinuria groups were increased by 37% (Hazard Ratios, HR 1.37, 95% CI: 1.30-1.44, P=0.001), 55% (HR 1.55, 95% CI: 1.28-1.88, P<0.001), and 98% (HR 1.98, 95% CI 1.62-2.43, P<0.001), respectively. The presence of proteinuria was associated with increased risk of stroke, heart failure admission and cardiovascular (CV) death in both patients without and with hypertension. Populations who had proteinuria in the first exam had an increased risk of AF even in the group whereby the proteinuria was resolved on the second exam (HR 1.36, 95% CI: 1.12-2.31, p<0.001).

Conclusions: Hypertension and/or proteinuria were associated with increased risk of AF, stroke, heart failure admissions and CV death, with the greatest risks when both are present. Proteinuria could be a useful factor for predicting AF development, and as a prognostic marker.
The Impact of Experiencing Socioeconomic Deprivation on the Risk of Atrial Fibrillation in Patients with Diabetes Mellitus: A Nationwide Population-Based Study

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¹Seoul National University Hospital, Republic of Korea, ²Department of Statistics and Actuarial Science, Soongsil University, Seoul, Republic of Korea, ³Liverpool Centre for Cardiovascular Science, University of Liverpool and Liverpool Chest and Heart Hospital, United Kingdom

Background: Amid active studies on atrial fibrillation (AF) worldwide, whether socioeconomic status (SES) affects the disease is still under debate. This study aimed to examine the association between SES and the risk of AF in Korean patients with diabetes mellitus.

Methods: We studied 2,429,610 diabetic patients (mean age 56.9 years, female 40%) who underwent health check-ups from 2009 to 2012, using the National Health Insurance Service (NHIS) database of Korea. Subjects were categorized into 6 groups according to the number of times (0 through 5) entitled for medical aid (MA) recipient, within the past 5 years from the date of check-up. Among the study population, 64,818 were classified into the MA groups, and the remaining patients never entitled to MA recipients were assigned to the non-MA group (Figure 1). The incidence rate and hazard ratio of AF were then calculated for each group.

Result: 80,257 patients had been newly diagnosed with AF over the past 5 years. All the MA groups were found to be at higher risk of AF than the non-MA group: hazard ratio (95% confidence interval [CI]) for each group, 1.44 (1.32-1.58) in MA 1, 1.58 (1.45-1.73) in MA 2, 1.52 (1.39-1.65) in MA 3, 1.53 (1.40-1.68) in MA 4, and 1.35 (1.24-1.45) in MA 5. Adjusted with multi-variables, the MA 5 group showed 54% increased risk of AF compared to the non-MA group (HR, 1.54, [95% CI, 1.42-1.67]) (Figure 2).

Conclusions: The risk of AF increased more than 50% in patients who needed medical aid 5 years consecutively, compared to those who did not need aid for the same period. Also, the risk of AF also rose greatly in patients with only a short experience of socioeconomic hardship. Based on the findings, we need more attention to individuals with recent socioeconomic deprivation to provide timely management for AF and its complications.
## ORAL 5 (AF)

<table>
<thead>
<tr>
<th></th>
<th>Total number</th>
<th>AF</th>
<th>IR (1000 PY)</th>
<th>*Hazard Ratio (95% CI)</th>
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</thead>
<tbody>
<tr>
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<td>19,996</td>
<td>633</td>
<td>5.78</td>
<td>1.54 (1.42-1.67)</td>
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<tr>
<td>MA 4</td>
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<td>452</td>
<td>6.80</td>
<td>1.28 (1.17-1.41)</td>
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<td>MA 3</td>
<td>12,431</td>
<td>526</td>
<td>6.74</td>
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<td>non-MA</td>
<td>2,364,792</td>
<td>77,695</td>
<td>4.56</td>
<td>1 (Reference)</td>
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</table>

* The model is adjusted for age, sex, body mass index, fasting glucose, smoking, alcohol use, physical activity, hypertension, dyslipidemia and income. MA indicates medical aid (recipients); AF, atrial fibrillation; IR, incidence rate; PY, person-year; and HR, hazard ratio.
Effect of Physical Activity in Patients with Atrial Fibrillation: A Single Center Study in Korea

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Background: Impact of physical activity on outcomes in patients with preexisting atrial fibrillation (AF) is unknown. This study aimed to evaluate the impact of physical activity on clinical outcomes in patients with AF.

Methods: We assessed 486 patients with AF (mean age, 64 ± 11 years; 210 women [43%]) who completed self-reported questionnaire for physical activity from 2010 through 2020. Physical activity levels were converted into metabolic equivalent of task (MET) per week and categorized to correspond with multiples of guideline recommendation. We examined the associations of physical activity with all-cause mortality and stroke.

Result: All-cause mortality was inversely associated with greater level of physical activity. Compared with inactive patients, patients with AF who met the guideline recommended target range of physical activity (500 to 1,000 MET-minutes/week) had 52% lower risk (adjusted hazard ratio [HR]: 0.48, 95% confidence interval [CI]: 0.25-0.92) and highly active patients who exceed the minimum recommended level (≥1,000 MET-minutes/week) had 54% lower risk (HR: 0.46, 95% CI: 0.22-0.94) of all-cause mortality. The risk of stroke was revealed to be correlated with physical activity level, with a decreasing trend in stroke with ascending physical activity level (p for trend = 0.043).

Conclusions: Patients with existing AF may mortality benefit from physical activity. Our findings motivate inactive patients with AF to begin participation in exercise and refrain from discouraging patients who exceed the guideline recommended physical activity.
Risk of Sick Sinus Syndrome in Patients Diagnosed with Atrial Fibrillation: A Population-Based Cohort

Pil-Sung Yang¹, Daehoon Kim², Eunsun Jang², Hee Tae Yu², Tae-Hoon Kim², Jung-Hoon Sung¹, Hui-Nam Pak², Moon-Hyoung Lee², Boyoung Joung²

¹CHA University, Republic of Korea, ²Yonsei University College of Medicine, Republic of Korea

Background: Sinoatrial node dysfunction and atrial fibrillation (AF) frequently coexist and interact with each other, often to initiate and perpetuate each other. To determine the effect of AF on the incidence and risk of sick sinus syndrome (SSS).

Methods: The association of incident AF with the development of incident SSS was assessed from 2004 to 2013 in 302,229 SSS- and pacemaker-free subjects aged ≥60 years in the Korea National Health Insurance Service-Senior cohort.

Result: During an observation period of 1,854,800 person-years, incident AF was observed in a total of 12,797 subjects (0.69%/year). The incidence of SSS was 3.4 and 0.2 per 1000 person-years in the incident AF and the propensity score-matched no-AF groups, respectively. After adjustment, the risk of SSS observed after incident AF was significantly increased, with a hazard ratio (HR) of 13.4 (95% confidence interval [CI]: 8.4-21.4). This finding was consistently observed after censoring for heart failure (HR, 16.0; 95% CI: 9.2-28.0) or heart failure/myocardial infarction (HR, 16.6; 95% CI: 9.3-29.7). Incident AF also was associated with an increased risk of pacemaker implantation related with both SSS (HR, 21.8; 95% CI: 8.7-18.4) and atrioventricular (AV) block (HR, 9.5; 95% CI: 4.9-18.4). These results were consistent regardless of sex and comorbidities.

Conclusions: Incident AF was associated with more than ten times increased risk of SSS in an elderly population regardless of comorbidities. Risk of pacemaker implantations related with both sinus node dysfunction and AV block were increased in elderly population with incident AF.
ORAL 5 (AF)

A. Probable SSS by AF Before PS matching

- AF
- No-AF

HR (95% CI) = 8.2 (6.5–14.9)
P < 0.001

B. Probable SSS by AF After PS matching

- AF
- No-AF

HR (95% CI) = 13.4 (9.4–21.4)
P < 0.001

C. Probable SSS by AF Censor for HF

- AF
- No-AF

HR (95% CI) = 11.4 (8.7–14.9)
P < 0.001

D. Probable SSS by AF Censor for HF

- AF
- No-AF

HR (95% CI) = 16.0 (9.2–28.0)
P < 0.001
ORAL 6 (AF)

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
Vagal Denervation after High-Power Short Duration versus Conventional Radiofrequency Catheter Ablation in Paroxysmal Atrial Fibrillation

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1Dongguk University Ilsan Hospital, Republic of Korea, 2ASAN Medical Center, Republic of Korea

Background: The efficacy and safety of high power, short duration (HPSD) radiofrequency catheter ablation (RFCA) for atrial fibrillation (AF) have been demonstrated in several studies. We aimed to compare effect on vagal denervation between conventional versus HPSD RFCA in paroxysmal AF patients.

Methods: From the prospective AF ablation registry, paroxysmal AF patients who underwent pulmonary vein isolation (PVI) were analyzed. HPSD group (n=67) is distinguished from conventional ablation group (n=256) in terms of power (50 Watts versus 3040 Watts) and duration (5-10 seconds versus 2030 seconds) during PVI. Vagal denervation was assessed using change of sinus cycle length (SCL), block cycle length (BCL) and effective refractory period of the atrioventricular node (AVN). One-year clinical outcomes were also compared after adjustment for inverse probability of treatment weighting (IPTW).

Result: HPSD ablation was associated with shorter ablation time (P<0.001) and fluoroscopy time (P=0.018) compared to conventional method. Significant shortening of SCL after ablation was observed in both groups (P<0.001) and there was no difference between groups (P=0.670). BCL and ERP of AVN significantly shortened after ablation (P<0.001 for both). After adjustment with IPTW, one-year recurrence of AF/AFL (20.0% vs 23.9%; P=0.077) and AF (15.9% vs 15.4%; P=0.837) were not different between conventional group and HPSD group. AFL recurrence at 1-year was higher in the HPSD group (HR 2.44, P=0.006).

Conclusions: HPSD as well as conventional AF ablation showed vagal denervation effects evidenced by shortening of SCL, BCL and ERP of the AVN. Overall recurrence after AF RFCA was not different between the two groups.

<table>
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<tr>
<th>Outcomes</th>
<th>Conventional</th>
<th>HPSD</th>
<th>Univariable</th>
<th>Multivariable</th>
<th>IPTW</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>(n=256)</td>
<td>(n=67)</td>
<td>95% CI</td>
<td>95% CI</td>
<td>95% CI</td>
</tr>
<tr>
<td>1-year AF/AFL recurrence</td>
<td>20.0 (49/253)</td>
<td>23.9 (15/65)</td>
<td>1.34 (0.75-2.38)</td>
<td>1.20 (0.65-2.21)</td>
<td>1.36 (0.97-1.92)</td>
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<td>1-year AF recurrence</td>
<td>15.9 (38/253)</td>
<td>15.4 (9/65)</td>
<td>1.03 (0.50-2.14)</td>
<td>0.88 (0.41-1.90)</td>
<td>1.05 (0.69-1.59)</td>
</tr>
<tr>
<td>1-year AFL recurrence</td>
<td>4.4 (11/253)</td>
<td>9.2 (6/65)</td>
<td>2.38 (0.88-6.44)</td>
<td>2.37 (0.79-7.10)</td>
<td>2.44 (1.29-4.61)</td>
</tr>
</tbody>
</table>
An Open-Label Randomized Non-Inferior Study of Generic-Name and Brand-Name of Propafenone for Rhythm Control in Taiwan Patients with Paroxysmal Atrial Fibrillation: the Preliminary Results

Ming-Hsiung Hsieh¹, Wei-Shiang Lin², Yu-Cheng Hsieh³, Yenn-Jiang Lin⁴, Chuen-Wang Chio⁵, Tsung-Hsien Lin⁶, Chien-Lung Huang⁷, Wen-Ter Lai⁶

¹Wan Fang Hospital, Taipei Medical University, Taiwan, ²Tri-Service General Hospital, Taiwan, ³Taichung Veterans General Hospital, Taiwan, ⁴Taipei Veterans General Hospital, Taiwan, ⁵Kaohsiung Veterans General Hospital, Taiwan, ⁶Kaohsiung Medical University Hospital, Taiwan, ⁷Cheng Hsin General Hospital, Taiwan

Background: Propafenone is a class IC antiarrhythmic agent, commonly used as the first-line therapy for patients with paroxysmal atrial fibrillation (AF) in Taiwan. This study aimed to compare the efficacy and safety of generic-name (Rhynorm) and brand-name (Rytmonorm) propafenone for treatment of paroxysmal AF in Taiwan.

Methods: This is an open-label, randomized, multi-center, non-inferior study conducted in Taiwan. A total of 60 evaluable subjects is planned to be enrolled. For investigating the efficacy of propafenone, we used a wearable ECG event recorder to evaluate the frequency of paroxysmal AF episodes every day for 24 weeks. A complete study analysis is expected to be completed by the end of 2021.

Result: The interim analysis result in total 50 completed patients, Rhynorm (n=27) and Rytmonorm (n=23) over 24 weeks of treatment, were enrolled to efficacy analysis. The baseline patient characteristics were similar between two groups except the Rhynorm group was older. The change from baseline in frequency of clinically significant recurrence of AF (i.e., AF ≥ 30 sec) at Week 24 was decreased by 7.0%±20.1% (from 22.8 %±33.9% to 16.0 %±25.1%) in the Rhynorm group and 4.5%±18.5% (from 19.0%±27.5% to 14.4%±16.7%) in the Rytmonorm group. The intergroup difference was 2.4% (95% confidence interval =-13.5 to 8.6), indicating non-inferiority of Rhynorm to Rytmonorm. There are only three severe adverse events reported, one in Rhynorm group and two in Rytmonorm group.

Conclusions: The preliminary results verified that Rhynorm was not inferior to Rytmonorm in the efficacy and safety for the treatment of paroxysmal AF in Taiwan.

Figure 1. The Kaplan–Meier curve of freedom from atrial fibrillation recurrence with symptoms for PP population patients. (Interim analysis)
The Association between Cumulative Exposure to Elevated Serum γ-Glutamyltransferase Level and Risk of Atrial Fibrillation: A Large Population-Based Cohort Study

Won Kyeong Jeon¹, So-Ryoung Lee¹, Eue-Keun Choi¹, Kyung-Do Han², Seil Oh¹

¹Seoul National University Hospital, Republic of Korea, ²Soongsil University, Republic of Korea

Background: Oxidative stress is important in the pathogenesis of atrial fibrillation (AF). γ-Glutamyltransferase (GGT) showed a relationship with systemic oxidative stress. GGT level correlates with cardiac arrhythmia, including AF, but cumulative exposure to a high level of GGT was not evaluated.

Methods: Using the Korean national health insurance service database, we enrolled subjects without AF who underwent four annual health examinations from 2009 to 2012. The cumulative number of the highest GGT quartile diagnosed at each health examination was calculated. Multivariable Cox proportional hazards regression analysis was performed to assess the risk of AF according to the burden of GGT.

Result: Among 3,500,847 subjects, 27,752 incident AF was developed during a median of 8.0 years of follow-up. The incidence rate of AF and adjusted hazard ratio were increased by stepwise manner in higher quartile group [compared to Q1, adjusted HR (95% CI) in Q2 = 1.078 (1.039, 1.119), Q3 = 1.148 (1.106, 1.191), and Q4 = 1.332 (1.283, 1.383)] and cumulative GGT score group [compared to score 0, adjusted HR (95% CI) in score 1 = 1.092 (1.050, 1.135), score 2 = 1.180 (1.129, 1.233), score 3 = 1.244 (1.191, 1.298), and score 4 = 1.265 (1.223, 1.309)] (Figure A). In subgroup analysis, this trend was more prominent in the elderly, people without hypertension, non-obese people, and people without any four comorbidities (diabetes mellitus, hypertension, dyslipidemia, and obesity) (Figure B).

Conclusions: This study demonstrated the independent association of cumulative GGT score and AF incidence with a dose-response relationship. The cumulative GGT score was more correlated in specific subgroups, such as the elderly, people without hypertension, non-obese people, and especially the healthy population without comorbidities. Our results suggest multiple exposures to high GGT levels would have a relationship with the risk of AF development, especially in the elderly and healthy population.
Adjusted for age, sex, smoking, alcohol consumption, physical activity, income, hypertension, diabetes mellitus, dyslipidemia, body mass index, and heart failure.

Comorbidities include diabetes mellitus, hypertension, dyslipidemia, and obesity.

GGT, γ-Glutamyltransferase.
Sex Difference in Antiarrhythmic Drug Response among Patients Who Recurred Atrial Fibrillation after Catheter Ablation

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Severance Hospital, Republic of Korea

Background: We recently reported that the risk of atrial fibrillation (AF) recurrence after catheter ablation (AFCA) is higher in women. However, it is unknown whether there is a sex-difference in the antiarrhythmic drug (AAD) responsiveness among the patients who recurred AF after AFCA.

Methods: Among 2999 consecutive patients who underwent a de novo AFCA, 788 patients (28.9% women, 61.2 ± 10.5 years old, 70.2% paroxysmal AF) used AAD after AF recurrence. After propensity score matching for age and AF type, we compared AAD responsiveness between 200 women and 354 men.

Result: In female patients using AAD after AF recurrence, the time to recurrence after AFCA was longer (25.6 ± 22.7 vs 20.4 ± 22.3 months, p=0.009), E/Em was higher (12.0±4.9 vs 10.1±3.9, p<0.001), the proportions of extra-pulmonary vein (PV) LA ablation was lower (27.0 vs. 36.4%, p=0.030), and ablation time was shorter (4528.8 ± 1506.9 vs. 4944.1 ± 1797.2 seconds, p=0.004) than men. In contrast risk of recurrence after AFCA was significantly higher in women (Log rank p=0.041), AF recurrence was significantly lower after using AAD in women than in men (Log rank p=0.024). In the multivariate Cox regression analyses, older age (Hazard ratio (HR) 0.98 [0.97-0.99], p<0.001), women (HR 0.70 [0.56-0.89], p=0.003), LA volume (HR 1.01 [1.00-1.01], p=0.001) and class IC AAD (HR 0.76, CI 0.60-0.96, p=0.020) were independently associated with AAD response. Among the recurred patients after AFCA, AAD responsiveness was significantly better in women older than 65 years (Log rank p=0.013). There was no significant difference in adverse effects of AADs between women and men (13.5% vs. 13.0%, p=0.969).

Conclusions: Among the patients with AAD use after AF recurrence, elderly women have significantly lower rate of AF recurrence than men. This finding supports the extra-PV triggers commonly found in women might be the main mechanism of AF recurrence after AFCA.
Nonalcoholic Fatty Liver Disease in Young Adults and the Risk of Atrial Fibrillation: A Nationwide Population-Based Study

Jungmin Choi¹, So-Ryoung Lee¹, Kyung-Do Han², Eue-Keun Choi¹, Seil Oh¹
¹Seoul National University Hospital, Republic of Korea, ²Soongsil University, Republic of Korea

Background: Non-alcoholic fatty liver disease (NAFLD) is associated with multiple comorbidities, including cardiovascular diseases. This study aimed to evaluate the association between NAFLD assessed by fatty liver index (FLI) and the risk of atrial fibrillation (AF) in young adults (age 20 to 40 years) in a large population-based cohort.

Methods: We evaluated 5,850,736 young adults (30.8 ± 5.0 years, male 59.4%) without significant liver disease from the Korean National Health Insurance Service between 2009 and 2012. Study subjects were grouped based on FLI: FLI <30, 30 to 60, and ≥60. The incident AF was identified during follow-up.

Result: During a mean follow-up duration of 7.4 ± 1.1 years, 13,920 were newly diagnosed with AF (incidence rate [IR] 0.32 per 1000 person-years). After multivariate adjustment, subjects with FLI 30 to 60 and FLI ≥60 showed a higher risk of AF compared to those with FLI <30 (hazard ratio [HR] 1.22, 95% confidence interval [CI, 1.16 to 1.27] and HR 1.49, 95% CI [1.41 to 1.56], both p<0.001, respectively). In subgroup analyses, females had a higher risk of AF than males in every FLI subgroup (figure, p for interaction 0.032), whereas other subgroups, including obesity, central obesity, and drinking, showed similar risks of increasing the risk of AF according to FLI.

Conclusions: Among young adults, subjects with NAFLD assessed by FLI have a positive correlation with the risk of AF. These findings would support the evidence of screening of AF in young adults with high FLI scores.
Background: Catheter ablation is more effective than antiarrhythmic drug therapy alone in patients with atrial fibrillation (AF). However, there are limited data on the outcomes of AF ablation according to sex. The purpose of this study was to evaluate gender differences in the actual outcomes after catheter ablation for atrial fibrillation.

Methods: Of 801,710 patients with AF in the Korean National Health Insurance Service database, we identified 9,175 patients without valvular heart disease who underwent AF ablation between 2006 and 2015 and assessed 30-day safety and one-year effectiveness outcomes.

Result: Of the 9,175 patients who underwent AF ablation, 2,206 (24%) were female. Women, compared to men, were older (60.8 ± 10.2 vs. 56.0 ± 10.5 years), had higher CHA2DS2-VASc (3.5 ± 1.7 vs. 2.0 ± 1.6), higher HAS-BLED (2.6 ± 1.3 vs. 2.4 ± 1.2), and higher Charlson comorbidity index scores (3.8 ± 2.6 vs. 3.1 ± 2.5) (p < 0.001 for all). Following ablation, there was no significant difference in the risk of 30-day complications, including hemorrhage and tamponade, between women and men. In multivariable analyses, there were no significant differences in all-cause hospitalization (adjusted hazard ratio [HR] 1.05, 95% confidence interval [CI] 0.91-1.22, p = 0.489) and AF rehospitalization (adjusted HR 1.16, 95% CI 0.96-1.40, p = 0.135). Women were less likely to undergo cardioversion (adjusted HR 0.72, 95% CI 0.62-0.84, p < 0.001) but were more likely to be re-hospitalized for heart failure (adjusted HR 1.86, 95% CI 1.11-3.11, p = 0.019).

Conclusions: Women who underwent AF ablation did not differ from men in terms of the risk of complications and all-cause hospitalization in this study. The small increased risk in women reported in previous studies may be related to residual confounding, particularly from insufficient control for age and comorbidities.
Clinical Outcomes of Computational Virtual Mapping-Guided Catheter Ablation in Patients with Persistent Atrial Fibrillation: A Multicenter Prospective Randomized Study

Yong-Soo Baek¹, Oh-Seok Kwon², Byoungyun Lim², Song-Yi Yang², Hee Tae Yu², Tae-Hoon Kim², Jae-Sun Uhm², Boyoung Joung², Dae-Hyeok Kim¹, Moon-Hyoung Lee⁶, Junbeom Park³, Hui-Nam Pak²

¹Inha University Hospital, Republic of Korea, ²Yonsei University Health System, Republic of Korea, ³Ewha Womans University Medical Center, Republic of Korea

Background: Although the recurrence rate of atrial fibrillation (AF) is significant after catheter ablation (AFCA) of persistent AF (PeAF), an empirical extrapulmonary vein (extra-PV) isolation (PVI) does not improve the rhythm outcome. We previously reported that extra-PV linear ablation guided by computational modeling improves the AFCA outcomes. We investigated whether an extra-PV ablation targeting the dominant frequency (DF) extracted from electroanatomical map-integrated AF modeling improves the AFCA rhythm outcome in patients with PeAF.

Methods: We prospectively randomized 170 patients with PeAF (70.6% men; age: 59.2 ± 11.3 years) to a virtual-DF map-guided ablation (V-DF) group (n = 87 patients) and empirical PVI (E-PVI) group (83 patients). V-DF maps were generated during the PVI in all participants. The primary endpoint was AF recurrence after a single procedure, while the secondary endpoints included the recurrence pattern, cardioversion rate, and response to antiarrhythmic drugs.

Result: After a mean follow-up period of 16.3 ± 5.3 months, the clinical recurrence rate was significantly lower in the V-DF than with E-PVI group (p = 0.018, log-rank). Recurrences appearing as atrial tachycardias (9.1% vs. 0%; p = 0.145) and the cardioversion rates (19.5% vs. 26.5%; p = 0.362) did not significantly differ between the groups. At the final follow-up, sinus rhythm was maintained without any antiarrhythmic drugs in 74.7% in the V-DF group and 48.2% in the E-PVI group (p < 0.001). No significant difference was found in the major complication rates (3.4% vs. 6.0%; p = 0.489) or total procedure time (p = 0.513) between the groups. The V-DF ablation was independently associated with a reduced AF recurrence after AFCA (hazard ratio: 0.51 [95% confidence interval: 0.30-0.88]; p = 0.016).

Conclusions: The computational modeling-guided V-DF ablation improved the rhythm outcome of AFCA in patients with PeAF.
Figure. A) KM curve for AF recurrence in overall subjects.  B) KM curve for AF recurrence in AAD-free subjects

<table>
<thead>
<tr>
<th></th>
<th>Follow up Months</th>
<th>E-PVI group</th>
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<tbody>
<tr>
<td>Overall</td>
<td></td>
<td>83 65 43 19 2</td>
</tr>
<tr>
<td>V-DF group</td>
<td></td>
<td>87 74 51 22 5</td>
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</table>
ORAL 7 (OTHER)
Artificial Intelligence based Watch-Type Electrocardiography Monitoring Device is Superior than Holter Monitoring in Detecting Cardiac Arrhythmias

Yun Gi Kim, Jong-Il Choi, Hee-Jung Kim, Jaemin Shim, Ho Sung Son, Young-Hoon Kim
Korea University Anam Hospital, Republic of Korea

Background: Substantial proportion of cardiac arrhythmias are paroxysmal in nature. Traditional 12-lead electrocardiography (ECG) and Holter monitoring often fails to detect these paroxysmal arrhythmias. We designed a watch-type ECG recording wearable device, the Memowatch (HUINNO; Seoul; Republic of Korea), to overcome limitations of 12-lead ECG and Holter monitoring.

Methods: We enrolled 96 patients with symptoms assumed to be related with cardiac arrhythmias. Recording of ECG was performed with both the Memowatch and Holter monitoring. Detection of any arrhythmia was the primary outcome endpoint of this study and was compared between the Memowatch and Holter monitoring.

Result: Any arrhythmia was detected in 51 (53.1%) and 27 (28.1%) patients in the Memowatch and Holter monitoring, respectively (odds ratio [OR] = 2.9; p < 0.001. The Memowatch was superior than Holter monitoring for the detection of major arrhythmia (excluding atrial premature contraction, ventricular premature contraction, and non-sustained atrial tachyarrhythmia) than Holter monitoring (OR = 2.34; p = 0.018). In 27 (28.1%) patients, cardiac arrhythmias were only detected by the Memowatch and the most frequent arrhythmia only detected by the Memowatch was AF (13 patients). Based on ECG recorded by the Memowatch, 17 patients (17.7%) had therapeutic intervention.

Conclusions: The Memowatch was capable of recording ECG of good quality with discernable P wave and distinguishable QRS morphology. Ability to detect cardiac arrhythmias was significantly superior in the Memowatch compared with Holter monitoring and significant proportion of patients received therapeutic intervention based on ECG recorded by the Memowatch.
Background: Physical activity is associated with a reduction risk of cardiovascular events. However, the relationship between sudden cardiac death (SCD) and physical activity is unclear. The purpose of this study was to evaluate associations between physical activity and the risk of SCD and non-SCD in older patients.

Methods: We used data from the Korean National Health Insurance Service-Senior cohort database (2005-2012). Of the 312,736 patients, we included 68,223 patients. The patients were classified into 4 groups according to physical activity: (1) Inactive; (2) Insufficiency active; (3) Active; (4) Highly active.

Result: Inactive patients was older, had higher hospitality frailty risk score and higher Charlson comorbidity index score. The proportion of male, smoking history, alcohol consumption history was higher in highly active patients than other groups (p<0.001 for all). During follow up, highly active patients had a lower risk for SCD compared with inactive patients (1.14/100PYR, adjusted hazard ratio [HR] 0.45, 95% confidence interval [CI] 0.32-0.64, p<0.001). Also, highly active patients had a lower risk for non-SCD compared with inactive patients (14.7/100PYR, adjusted HR 0.59, 95% CI 0.54-0.65, p<0.001). The analysis was performed according to previous cardiovascular disease. Highly active patients with previous cardiovascular disease had a decreased risk for SCD (1.73/100PYR, adjusted HR 0.50, 95% CI 0.294-0.88, p=0.016) and non-SCD (0.94/100PYR, adjusted HR 0.43, 95% CI 0.28-0.66, p<0.001) compared with inactive patients.

Conclusions: Highly active patients had decreased risk for SCD and non-SCD than other physical activity patients. In subgroup analysis, regardless of previous cardiovascular disease, the results were consistent with primary finding.
ORAL 7 (OTHER)

OR7-03

Obstructive Sleep Apnea (OSA) Detection System Based on Fast Fourier Transform (FFT) Algorithm on Electrocardiogram

Rifaldy Fajar, Titik Wulandari, Nana Indri, Prihantini Jupri
Yogyakarta State University, Indonesia

Background: In this study, an Obstructive Sleep Apnea (OSA) disease detection system was created using the RR interval parameter. The design of this detection system uses backpropagation Artificial Neural Network (ANN) which is implemented using MATLAB software as a method in the classification of OSA determination.

Methods: The steps taken to design an OSA disease detection system in this study include data collection, feature extraction, ANN training, ANN testing, and performance determination. The feature extraction stage is performed using the Fast Fourier Transform (FFT) mathematical algorithm process. The result of feature extraction is then carried out ANN training using 10% of the entire data and ANN testing using 90% of the total data. To get the best performance results, variations in segment length features, variations in OSA definition features, and variations in frequency composition features are performed.

Result: The best performance results in this OSA disease detection system design are features that use a combination of frequency components 2, 5, and 6 with an OSA definition of 5% in the 90-segment length. This is shown from the results of ANN performance in the form of specialization, sensitivity, and best accuracy, with successive values of 79.3%, 84.6%, and 81.6%.

Conclusions: In this research, a system design has been made to detect OSA which is implemented in MATLAB software. The feature used in this detection system is the RR interval feature that has been transformed using the Fast Fourier Transform (FFT) operation. Based on the results of performance calculations, all values indicate a number exceeding 75% so that a system that can be said to be good in detecting is obtained.
Acupuncture Decreases Risk of Stroke among Patients with Atrial Fibrillation - Novel Link between Traditional and Modern Science

Wei-Syun Hu
China Medical University Hospital, Taiwan

**Background:** The authors aim to investigate retrospectively the association between acupuncture and risk of stroke in patients with atrial fibrillation (AF).

**Methods:** Using Taiwan National Health Research Institute database, AF patients without any acupuncture treatment record were classified as non-acupuncture cohort and 1:1 matching with acupuncture cohorts by age, gender, and all comorbidities. To calculate the risk of stroke in case and control group, cox proportional hazard models were used and presented by hazard ratios (HR), adjusted hazard ratios (aHR) and 95% confidence intervals (CIs).

**Result:** Two equally distributed AF individuals with and without acupuncture were included. After adjusting for risk factors, AF subjects with acupuncture conferred a lower risk of stroke (aHR = 0.46, 95% CI = 0.38-0.54), ischemic stroke (aHR = 0.47, 95% CI = 0.39-0.56) and hemorrhagic stroke (aHR = 0.35, 95% CI = 0.19-0.67), compared to the controls.

**Conclusions:** AF patients receiving acupuncture was associated with decreased risk of stroke.
Atrial Fibrillation in Patients with Congenital Heart Disease: Therapeutic Implications and Strategic Mapping

Wei-Syun Hu
China Medical University Hospital, Taiwan

Background: The objective was to compare the rate of onset of atrial fibrillation (AF) in patients with congenital heart disease (CHD) as compared with controls.

Methods: Using a large number of samples extracted from the nationwide cohort data in Taiwan, we used propensity-matching procedure and multivariable Cox models to assess the risk of AF by CHD. An age-, sex-, and comorbidity- stratified subgroup analysis was also performed to evaluate the risk of AF among CHD patients.

Result: A cohort of 19439 CHD patients and a propensity-matched cohort of 19439 control patients were included in this study. The cumulative incidence of AF was significantly higher in the CHD cohort than in the non-CHD cohort (p < 0.001). After controlling for the confounding factors, the adjusted hazard ratio (aHR) of AF was 4.23 (95% confidence interval [CI] = 3.31-5.41) in the CHD cohort compared with the non-CHD cohort and the risk were most likely in women (aHR = 4.64, 95% CI = 3.26-6.61), in 18-34 years of age (aHR = 23.5, 95% CI = 3.40-163.1) and in patients without comorbidities (aHR = 68.6, 95% CI = 9.59-490.8).

Conclusions: A significant association between CHD and risk of AF was found, and the risk ratio was higher among female patients, those 18-34 years of age, and those without other comorbidities.
ORAL 8
(SCD & OTHER)

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
Background: As the coronavirus disease (COVID-19) spreads worldwide, cardiac injury in patients infected with COVID-19 becomes a significant concern. Thus, this study investigates the impact of several electrocardiogram (ECG) parameters and disease severity in COVID-19 patients.

Methods: Seven medical centers in Daegu admitted 2311 patients with COVID-19 between February and April 2020. This study examined 267 patients among them who underwent an ECG test and evaluated their biochemical parameters like C-reactive protein (CRP), N-terminal pro-B-type Natriuretic Peptide (NT pro-BNP), cardiac enzyme, and ECG parameters (heart rate, PR interval, QRS interval, T inversion, QT interval, and Tpe (the interval between peak to end in a T wave)).

Result: The 267 patients were divided into groups of mild (100 patients, 62.8 years), moderate (89 patients, 69.2 years), and severe (78 patients, 73.2 years) according to clinical severity score. Severe patients had an increased level of CRP, NT pro-BNP, and creatinine kinase-myocardial band. Meanwhile, severe patients exhibited prolonged QT intervals (QTc) and Tpe (Tpe-c) compared to mild or moderate patients. Moreover, deceased patients (58; 21.7%) showed increased dispersion of QTc and Tpe-c compared with surviving patients (78.2 ± 41.1 vs 40.8 ± 24.6 msec and 60.2 ± 37.3 vs 40.8 ± 24.5 msec, both P < 0.05, respectively). The QTc dispersion of more than 56.1 msec could predict the mortality in multivariate analysis (Odd ratio 8.06, 95% Confidence Interval 2.843-25.750).

Conclusions: COVID-19 infections could involve cardiac injuries, especially cardiac repolarization abnormalities. A prolonged QTc dispersion could be an independent predictable factor of mortality.
Figure 2. Corrected QT and T peak to end dispersion according to mortality.

A

B

P < 0.001

P < 0.001
Quality Assessment of Timeliness in the Delivery of Electrocardiography Service in the Critical Areas of a Tertiary Hospital Using Time and Motion Analysis: A Systems Analysis

Aiza-Meriam Tahil, Jose Donato Magno, Felix Eduardo Punzalan
University of The Philippines-Philippine General Hospital, Philippines

Background: Quality of service is described by the World Health Organization as accessible, timely and appropriate delivery of health care service to a medical need. This study is an observational time and motion cross-sectional study with a primary aim of analyzing the quality of the Clinical and Operational delivery of ECG service at the Acute Care Unit (ACU) and Medical Intensive Care Unit (MICU) in a tertiary referral hospital.

Methods: The data set included ECGs of adult patients (≥19 years old) who were admitted the ACU and MICU. The observation began with the request for 12L ECG and ended with the official release of the ECG result in the hospital’s secure electronic medical record system.

Result: A total of 761 ECGs were included, of which 629 ECGS were ordered from the ACU and 132 from the MICU. The median total wait times for clinical service delivery took 565 (range 40 - 10290) minutes at the ACU and 1402.5 (range 60 - 7275) minutes at the MICU. The total elapsed period for operational service delivery were 16629.5 (range 1722 - 54822) minutes and 9063.5 (range 3412 - 30245) minutes in the ACU and MICU, respectively.

Conclusions: The median clinical and operational delivery times of the ECG service were significantly delayed. Attention to simplification of the multi-step process, digitalization, strict adherence to protocol, dedication of machines, personnel and training may improve timeliness of ECG service.
Impact of de Novo Tachyarrhythmias in Patients with Prior Acute Coronary Syndrome Patients

Youmi Hwang

The Catholic University of Korea, St. Vincent's Hospital, Republic of Korea

**Background:** The incidence of acute coronary syndrome (ACS) is increasing for decades, however, the overall prognosis is getting better with newer stents, tailored medication and better intervention technique. Atrial fibrillation and ventricular arrhythmia at the time of ACS diagnosis are known to have poor acute prognosis. But there is lack of long-term arrhythmic impact on mortality in ACS patients. This is a retrospective study sought to elucidate the impact of tachyarrhythmia on mortality during long term follow-up in prior ACS patients.

**Methods:** This was a single university hospital retrospective study, evaluating the clinical outcomes, especially regarding cardiovascular mortality and readmission. Enrolled patients underwent percutaneous coronary intervention (PCI) for ACS from February 2004 to March 2018. Clinical information was attained by a thorough chart review.

**Result:** We retrospectively analyzed 560 ACS patients. We reviewed all of electrocardiogram (ECG)s before, immediate after PCI, during hospitalization and within 3 months of index PCI. After 3 months of index PCI procedure, any Holter monitoring or ECG were also reviewed for arrhythmia diagnosis. During a mean 3.9 ± 3.2 years of follow up, there was 91 patients’ diagnosed atrial fibrillation (AF) and 36 patients diagnosed ventricular tachyarrhythmia (VA). Overall mortality was related to presence of anemia, low body mass index (BMI), low left ventricular ejection fraction (LVEF) after PCI, AF and VA during follow up. Readmission was higher in patients with chronic kidney disease and newly diagnosed AF during follow up.

**Conclusions:** Any tachyarrhythmia diagnosis during follow up increase mortality in post-ACS patients.
The 10-Year Trend of Out-of-Hospital Cardiac Arrests: A Korean Nationwide Population-Based Study

Seung-Young Roh¹, Jong-Il Choi¹, Sang Hyun Park², Yun Gi Kim¹, Jaemin Shim¹, Jin-Seok Kim¹, Kyung-Do Han³, Young-Hoon Kim¹

¹Korea University College of Medicine, Republic of Korea, ²Catholic University College of Medicine, Republic of Korea, ³Soongsil University, Republic of Korea

**Background:** It is crucial to understand the exact public health burden of out-of-hospital cardiac arrest, which is presently unknown since considerable episodes are not reported in registry studies. We aimed to evaluate the epidemiologic features and outcomes of non-traumatic out-of-hospital cardiac arrest.

**Methods:** During January 2008 to December 2017, we enrolled 387,665 patients who had been assigned a code for sudden cardiac arrest or had undergone cardiopulmonary resuscitation in the emergency room using Korean National Health Insurance Service database. Those whose arrest was of non-cardiac origin were excluded.

**Result:** The incidence of out-of-hospital cardiac arrest per 100,000 patients increased steadily from 48.2 in 2008, 53.8 in 2011, 60.1 in 2014, and 66.7 in 2017, with a 1-year survival rate of 8.2%. Age and sex-adjusted mortality rates have declined since 2009. The hazard ratio was 1.0015 in 2009, 0.9865 in 2012, 0.9769 in 2015, and 0.9629 in 2017 (p for trend <0.0001), with ischemia-related out-of-hospital cardiac arrest accounting for 59.7% of the total. Subgroups with ischemic-related out-of-hospital cardiac arrest were more likely to be older and have a higher prevalence of all comorbidities, excluding malignancy, than those with non-ischemic out-of-hospital cardiac arrest.

**Conclusions:** This nationwide population-based study showed that the incidence of out-of-hospital cardiac arrest in Korea had increased during the last decade. The post out-of-hospital cardiac arrest 1-year mortality rate showed a poor outcome but improved gradually.
Early Antiarrhythmic Efficacy of Noninvasive Cardiac Radioablation for Ventricular Tachycardia

Won Ick Chang¹, Ji Hyun Chang¹, Myung-Jin Cha²
¹Seoul National University Hospital, Republic of Korea, ²ASAN Medical Center, Republic of Korea

**Background:** Noninvasive cardiac radioablation has been reported to be effective and relatively safe for ventricular tachycardia (VT) in preclinical and clinical studies. However, previous studies implementing cardiac radioablation set a 6-12 weeks of blanking period and focused on long-term effects. In this prospective trial, we focused on the early antiarrhythmic effects within one month after cardiac radioablation.

**Methods:** Total Six patients (3 ischemic VTs and 3 non-ischemic VTs) were included in this trial and treated with stereotactic body radiotherapy (SBRT) with a single fraction of 25 Gy for intractable VT. Continuous monitoring was performed for all patients one month before and after SBRT.

**Result:** The number of total ventricular beats decreased by 58% and 60% within 24 hours and 48 hours after SBRT, respectively. It further decreased to 29% of pre-SBRT number of total ventricular beats at one month after SBRT. The decrease of total ventricular beats could be attributed to the decrease of VT burden rather than that of premature ventricular contractions (PVCs) because the burden of VT decreased earlier and more dramatically than that of PVC. After cardiac radioablation, the duration of the longest VT run was shortened. This indicated that cardiac radioablation decreases the VT burden by shortening the durations of VTs. Notably, the cardiac radioablation was more effective for ischemic VTs than non-ischemic VTs in that the VT burden decreased more markedly after SBRT. During one month after SBRT, there was no severe acute toxicity.

**Conclusions:** The noninvasive cardiac radioablation with a dose of 25 Gy was effective even in 1-month follow-up. The decrease of VT burden through shortening of VTs already began within 24 hours after the procedure and continued to decrease until one month after the radioablation. The treatment effect was more remarkable in ischemic than non-ischemic VT patients.
Artificial Intelligence Predicts Clinically Relevant Atrial High-Rate Episodes in Patients with Cardiac Implantable Electronic Devices

Min Kim\textsuperscript{1}, Younghyun Kang\textsuperscript{2}, Seng Chan You\textsuperscript{10}, Heung-Deuk Park\textsuperscript{2}, Sang-Soo Lee\textsuperscript{2}, Hee Tae Yu\textsuperscript{10}, Tae-Hoon Kim\textsuperscript{10}, Eue-Keun Choi\textsuperscript{4}, Hyoung-Seob Park\textsuperscript{2}, Junbeom Park\textsuperscript{6}, Young Soo Lee\textsuperscript{7}, Ki-Woon Kang\textsuperscript{8}, Jaemin Shim\textsuperscript{9}, Il-Young Oh\textsuperscript{4}, Jong Sung Park\textsuperscript{3}, Boyoung Joung\textsuperscript{10}

\textsuperscript{1}Chungbuk National University College of Medicine, Republic of Korea, \textsuperscript{2}Medtronic, Korea, Republic of Korea, \textsuperscript{3}Dong-A University College of Medicine, Republic of Korea, \textsuperscript{4}Seoul National University Hospital, Republic of Korea, \textsuperscript{5}Keimyung University School of Medicine, Republic of Korea, \textsuperscript{6}Ewha Womans University Medical Center, Republic of Korea, \textsuperscript{7}Daegu Catholic University Medical Center, Republic of Korea, \textsuperscript{8}Eulji University Hospital, Republic of Korea, \textsuperscript{9}Korea University College of Medicine, Republic of Korea, \textsuperscript{10}Yonsei University Health System, Republic of Korea

Background: To assess the utility of machine learning (ML) algorithms in predicting clinically relevant atrial high-rate episodes (AHREs), which can be recorded by a pacemaker. We aimed to develop ML-based models to predict clinically relevant AHREs based on the clinical parameters of patients with implanted pacemakers in comparison to logistic regression (LR).

Methods: We included 721 patients (median age: 73 years, women: 61.5%) without known atrial fibrillation or atrial flutter from a prospective multicenter (11 tertiary hospitals) registry comprising all geographical regions of Korea from September 2017 to July 2020. Clinically relevant AHREs were defined as the longest AHREs, in which the detection rate was programmed to >220 beats/min for >6 min during regular follow-up. Predictive models of clinically relevant AHREs were developed using the random forest (RF) algorithm, support vector machine (SVM) algorithm, and extreme gradient boosting (XGB) algorithm with five repeated 10-fold cross validations. Model prediction training was conducted by seven hospitals, and model performance was evaluated using data from four hospitals. The synthetic minority oversampling technique (SMOTE) was employed to overcome class imbalance.

Result: During a median follow-up of 18 months (interquartile range: 926 months), clinically relevant AHREs were noted in 104 patients (14.4%). The three ML-based models improved the discrimination of the AHREs (area under the receiver operating characteristic curve: RF: 0.742, SVM: 0.675, and XGB: 0.745 vs. LR: 0.669). The XGB model had a greater resolution in the Brier score (RF: 0.008, SVM: 0.008, and XGB: 0.021 vs. LR: 0.013) than the other models.

Conclusions: The use of the ML-based models in patient classification was associated with improved prediction of clinically relevant AHREs after pacemaker implantation.
**ORAL 9 (CIED)**

**OR9-02**


Hye Bin Gwag\(^1\), Su Hyun Lee\(^1\), June Soo Kim\(^2\), Kyoung-Min Park\(^2\), Young Keun On\(^2\), Gyo-Seung Hwang\(^3\), Sang Weon Park\(^4\), Sung Ho Lee\(^5\), Seung-Jung Park\(^2\)

\(^1\)Samsung Changwon Hospital, Republic of Korea, \(^2\)Samsung Medical Center (Samsung Seoul Hospital), Republic of Korea, \(^3\)Ajou University Medical Center, Republic of Korea, \(^4\)Sejong General Hospital, Republic of Korea, \(^5\)Samsung Medical Center (Kangbuk Samsung Hospital), Republic of Korea

**Background:** A single-lead implantable cardioverter-defibrillator (ICD) with a floating atrial dipole has been developed to enhance discriminating ability and ultimately to reduce inappropriate therapy without the additional effort required for atrial lead insertion. However, there have been concerns about the long-term reliability of atrial sensing.

**Methods:** We enrolled patients with the single-chamber ICD with atrial-sensing electrodes from 4 tertiary university hospitals in Korea. Both minimal and maximal amplitudes were collected as well as mean amplitude to assess the sensing variability at 3 - 6 months, 6 - 12 months, and 12 - 24 months after implantation. The difference between the minimal and maximal sensing amplitudes was calculated as an indicator of the variability of atrial sensing.

**Result:** A total of 86 patients were included for analysis. The variability of atrial sensing amplitudes significantly decreased at 12 - 24 months compared to 3 - 6 months (p = 0.01), while mean, minimal, and maximal atrial amplitudes were stable throughout the mean follow-up duration of 17.4 months. Nine patients (10.5%) experienced inappropriate ICD therapy mostly due to misclassification of supraventricular tachycardia.

**Conclusions:** Under the hypothesis that sensing stability can be guaranteed as the variability decreases with time, we suggest that the concern about long-term sensing stability of a floating dipole can be abated with an ICD that has been implanted for over 2 years.

![Graph showing atrial sensing variability over time](image-url)
Survival among Ischemic and Non-Ischemic Heart Failure Patients with Primary Implantable Cardioverter Defibrillator Therapy in Korea: A Nationwide Cohort Study

Pil-Sung Yang¹, Younghyun Kang², Jung-Hoon Sung¹, Hyung-Deuk Park², Boyoung Joung³
¹CHA University, Republic of Korea, ²Medtronic Korea Ltd., Republic of Korea, ³Yonsei University College of Medicine, Republic of Korea

Background: Concerns still exist about the efficacy of prophylactic implantable electrocardiogram defibrillators (ICD) in patients with non-ischemic heart failure (HF). We evaluated the mortality and predictors of mortality in patients with prophylactic ICD implantation for ischemic and non-ischemic HF.

Methods: From 2008 to 2017, 1097 patients (667 non-ischemic; 430 ischemic) with prophylactic ICD implantation who were aged 19 years or older were identified from the Korean National Health Insurance Service database. We used propensity score overlap weighting to correct for differences between two groups.

Result: Compared with non-ischemic HF patients, ischemic HF patients were older (67.0 ± 10.1 years vs. 61.8 ± 14.2), more often male (71.4% vs. 63.7%), and had more comorbidities. During a median follow-up of 37.3 months (interquartile range [IQR], 14.2–53.8 months), all-cause death was higher in unweighted ischemic than non-ischemic HF patients (10.9 and 6.4 per 100 person-years, hazard ratio [HR] 1.74, 95% confidence interval [CI] 1.38–2.20, p<0.001). However, after weighting, annual all-cause mortality rate was similar in both groups (9.5 vs. 8.8 per 100 person-years) without difference in the risk of all-cause death (HR 1.08, 95% CI 0.68–1.71, p=0.755). Older age and chronic kidney disease were independent predictors of all-cause mortality in both groups. There was also no difference in cardiac and non-cardiac mortality between weighted non-ischemic and ischemic HF groups.

Conclusions: All-cause, cardiac and non-cardiac mortality were similar between non-ischemic and ischemic HF patients undergoing prophylactic ICD implantation. Our findings support the current guidelines recommendation for primary-prevention ICD in HFrEF patients with ischemic and non-ischemic HF.
The incidence rate of all-cause death in patients with non-ischemic and ischemic HF receiving ICD

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<th>Ischemic HF</th>
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<th>Hazard ratio (95% CI)</th>
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<td>Number of events</td>
<td>Event rate (/100 person-years)</td>
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<td>1-year follow-up</td>
<td>46</td>
<td>7.2</td>
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<td>Overall</td>
<td>151</td>
<td>6.4</td>
<td>136</td>
<td>10.9</td>
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<td>5-year follow-up</td>
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<tr>
<td>Overall</td>
<td>35</td>
<td>8.8</td>
<td>37</td>
<td>9.5</td>
<td>0.70 (-3.48 – 4.89)</td>
</tr>
</tbody>
</table>

CI, confidence interval; HF, heart failure; ICD, implantable cardioverter defibrillator.
Risk Factor, Prognosis of Pacemaker Associated Heart Failure: PS-Matched Cohort Study

Young Jun Park¹, Seung-Jung Park²
¹Yonsei University Wonju College of Medicine, Republic of Korea, ²Samsung Medical Center (Samsung Seoul Hospital), Republic of Korea

Background: Long-term right ventricular (RV) pacing cause electrical and mechanical LV desynchrony which lead to progressive left ventricular (LV) dilatation, systolic dysfunction and clinical heart failure (HF). This heart failure with deterioration of LV ejection fraction (EF) has been defined as pacemaker associated heart failure (PaHF). This study aimed to evaluate risk factors, and prognosis of PaHF using the Korean nationwide cohort database.

Methods: We identified adult patients (≥18years) who underwent PPM implantation between January 1, 2010, and October 31, 2017, using the procedure and device codes for claims reimbursement. PaHF was defined as a new diagnosis HF using ICD code and medication code without other HF causes such as myocardial infarction (MI) after implantation of PPM. A propensity score (PS) was derived using logistic regression to model the probability of PaHF or without PaHF.

Result: The incidences of PaHF in patients with PPM was 1.6/100 person-years. The number of death was 274 in 7,057 person-years (3.9 per 1,00 person-years) in the PaHF group and 1,472 in 81967 person-years(1.8 per 1,00 person-years) in the non-PaHF group. Older age, HTN, CKD was associated with poor prognosis. Heart failure medications (ACEi or ARB, BB, MRA) did not improve the prognosis.

Conclusions: Pacemaker-associated HF is associated with poor prognosis in patients with pacemakers. In PaHF patients, CRT upgrade could improve prognosis.
YIA COMPETITION

KHRS 2021
The 13th Annual Scientific Session
of the Korean Heart Rhythm Society
YIA-01

Fully Automated GPU-Based Framework for 3D Left Atrial Wall Thickness Measurement

Oh-Seok Kwon, Jisu Lee, Je-Wook Park, So-Hyun Yang, Inseok Hwang, Hee Tae Yu, Tae-Hoon Kim, Jae-Sun Uhm, Boyoung Joung, Moon-Hyoung Lee, Hui-Nam Pak
Yonsei University Health System, Republic of Korea

Background: Despite the advent of automated technology for left atrial (LA) wall segmentation using artificial intelligence (AI), additional methods for epicardium (Epi) and endocardium (Endo) boundaries detection is required for the calculation of Laplace wall thickness (WT). Therefore, we proposed a fully automated GPU-based framework including a novel method of detecting Epi and Endo boundaries for 3D LAWT computation and tested its feasibility.

Methods: The Epi and Endo boundaries, which are topologically indistinguishable due to the open geometry by the pulmonary veins and mitral valve, were detected using the combined method of the Convex-hull and Poisson solver. The Laplace equation for WT measurement was solved by a partial differential equation combined between the two detected boundaries of the myocardium. Each procedure was designed with a GPU-based architecture to support real-time analysis. We demonstrate the robustness of our algorithm in mask images of wall chamber separated from computed tomography images of 20 patients and phantom model (PhM).

Result: The accuracy of the automatically detected Epi and Endo boundaries was Dice coefficient=0.979 compared to the manually extracted from the PhM model. The 3D WT calculated with our method showed an excellent correlation (R=0.92±0.11, P<0.001) when compared to previously proven software in 20 patients. The computational time was about 2 minutes per 1 person due to the pipeline designed to be GPU-friendly.

Conclusions: We proposed a fully automated framework for calculating 3D WT from the open geometry of the LA wall mask images and verified the accuracy. Our approach can efficiently improve the labor-intensive WT measurement procedures performed for anatomical clinical diagnosis prior to ablation therapy for patients with atrial fibrillation.

Figure 1. Validation of epicardium and endocardium boundaries auto-detected from closed and open geometry of a phantom model.
Figure 2. Comparison regional left atrial wall thickness between the automatic and manual methods in 20 patients.
Left Atrial Wall Stress and the Outcome of Catheter Ablation for Atrial Fibrillation: Artificial Intelligence-Based Prediction of Clinical Outcome

Jae-Hyuk Lee1, Oh-Seok Kwon1, Jaemin Shim2, Hee Tae Yu1, Tae-Hoon Kim1, Jae-Sun Uhm1, Moon-Hyung Lee1, Young-Hoon Kim1, Tae-Hoon Kim1, Boyoung Joung1, Moon-Hyoung Lee1, Young-Hoon Kim2, Hui-Nam Pak1

1Severance Hospital, Republic of Korea, 2Korea University Anam Hospital, Republic of Korea

Background: Atrial stretch may contribute to the mechanism of atrial fibrillation (AF) recurrence after atrial fibrillation catheter ablation (AFCA). We tested whether left atrial (LA) wall stress (LAW-stress[measured]) could be predicted by artificial intelligence (AI) using non-invasive parameters (LAW-stress[AI]) and whether rhythm outcome after AFCA could be evaluated by LAW-stress[AI] in an independent cohort.

Methods: Cohort 1 included 2223 patients, and Cohort 2 included 658 patients who underwent AFCA. The LAW-stress [measured] was calculated using the Law of Laplace using LA diameter, peak LA pressure, and LA wall thickness. The highest quartile (Q4) LAW-stress[measured] was predicted and validated by AI using non-invasive clinical parameters, including AF type, age, presence of hypertension, diabetes, vascular disease, and heart failure, left ventricular ejection fraction, and E/Em. We tested rhythm outcomes after AFCA using LAW-stress [measured] and LAW-stress [AI] in Cohort 1 and LAW-stress [AI] in Cohort 2.

Result: LAW-stress [measured] was independently associated with persistent AF (p<0.001), diabetes (p=0.012), vascular disease (p=0.002), body mass index (p=0.001), E/Em (p<0.001), and mean LA voltage (p<0.001). The best performing AI-model had acceptable prediction power for Q4-LAW-stress [measured] (area under the curve 0.734). During 26.0 (12.0-52.0) months follow-up, AF recurrence was significantly higher in Q4-LAW-stress [measured] group (log-rank p=0.001, hazard ratio 2.43 [1.21-4.90], p=0.013) and Q4-LAW-stress [AI] group (log-rank p=0.039) in Cohort 1. In Cohort 2, Q4-LAW-stress [AI] group consistently had worse rhythm outcomes (log-rank p<0.001).

Conclusions: Higher LAW-stress was associated with poorer rhythm outcomes after AFCA. AI could predict this complex but useful prognostic parameter using non-invasive parameters with moderate accuracy.
Treatment Timing and the Effects of Rhythm-Control Strategy in Patients with Atrial Fibrillation: A Nationwide Cohort Study

Daehoon Kim, Pil-Sung Yang, Seng Chan You, Jung-Hoon Sung, Eunsun Jang, Hee Tae Yu, Tae-Hoon Kim, Hui-Nam Pak, Moon-Hyoung Lee, Gregory Lip, Boyoung Joung

1Yonsei University College of Medicine, Republic of Korea, 2CHA Medical Center, Republic of Korea, 3University of Liverpool and Liverpool Heart & Chest Hospital, United Kingdom

Background: To investigate whether the results of rhythm-control therapy differ according to the timing of treatment initiation among patients with atrial fibrillation (AF).

Methods: Using a nationwide claim database of the Korean National Health Insurance Service, we identified 22635 adults with AF and cardiovascular conditions newly treated with rhythm-control (antiarrhythmic drugs or ablation) or rate-control therapy between July 28, 2011 and December 31, 2015. Propensity score overlap weighting was used to correct for differences between the groups. The primary composite outcome was a composite of death from cardiovascular causes, stroke, hospitalization for heart failure, or acute myocardial infarction.

Result: Of the study population, 53.9% were male, the median age was 70 years, and the median follow-up duration was 2.1 years. Among patients with early AF treatment (initiated within 1 year since diagnosis), compared with rate control, rhythm control was associated with a lower risk of the primary composite outcome (7.42 in rhythm control vs. 9.25 per 100 person-years in rate control; hazard ratio [HR] 0.81; 95% confidence interval [CI] 0.71 to 0.93; P=0.002). There was no difference in the risk of the primary composite outcome between rhythm and rate control (8.67 vs. 8.99 per 100 person-years; HR 0.97, 95% CI 0.78 to 1.20; P=0.760) in patients with late AF treatment (initiated after 1 year since diagnosis). Regarding safety outcomes, no significant differences were found between the strategies of rhythm and rate control across different treatment timings. Earlier initiation of treatment was linearly associated with more favorable cardiovascular outcomes of rhythm control compared with rate control.

Conclusions: Early initiation of rhythm-control therapy was associated with a lower risk of adverse cardiovascular outcomes than rate-control therapy in patients with recently diagnosed AF. However, the association was not observed in patients who had AF for more than 1 year.
A. Overall

Figure. Relation between treatment timing and risk of clinical outcomes for rhythm control or rate control in (A) overall period and (B) within 1 year after the first diagnosis of atrial fibrillation.
Efficacy and Safety of Cryoballoon Pulmonary Vein Isolation for Paroxysmal and Persistent Atrial Fibrillation: A Comparison with Radiofrequency Ablation

Ji-Hoon Choi, Young Keun On
Samsung Medical Center (Samsung Seoul Hospital), Republic of Korea

**Background:** Cryoballoon ablation was established as an effective and safe modality to achieve pulmonary vein isolation (PVI) in paroxysmal atrial fibrillation (PAF). However, its role in persistent atrial fibrillation (PersAF) remains unclear. This study aimed to evaluate the efficacy and safety of cryoballoon PVI in PAF and PersAF comparing conventional radiofrequency catheter ablation (RFCA).

**Methods:** Two hundred patients undergoing cryoballoon ablation for symptomatic AF were consecutively enrolled in this retrospective study. For comparison, 210 patients undergoing RFCA in the same period were included. The primary outcome was a recurrence of any atrial tachyarrhythmias (ATas) after the index ablation. 12-lead ECG and 24-hour Holter monitoring were obtained at 1, 3, 6 and 9-12 months.

**Result:** PVI by cryoablation alone was achieved in 197 patients (98.5%). ATas-free survival at 12 months post-ablation was 72.7% in the cryoablation and 80.6% in the RFCA group (P = 0.123), respectively. The cryoablation showed comparable efficacy maintaining sinus rhythm compared with RFCA in PAF (P = 0.539), whereas in PersAF, ATas-free survival was significantly lower in cryoablation (P = 0.039). PV reconnection was observed in the majority of patients (14/16, 87.5%) who receive redo-RFCA. Complications were encountered in 10 patients, including femoral arteriovenous fistula (n = 1), transient phrenic nerve palsy (n = 8), and minimal amount pericardial effusion (n = 1).

**Conclusions:** The efficacy of cryoballoon PVI is comparable with conventional RFCA in PAF, whereas PVI alone using cryoballoon may not be insufficient to maintaining sinus rhythm in PersAF. The safety of cryoballoon PVI is tolerable.
Inhibition of Late Sodium Current via PI3K/Akt Signaling Prevents Cellular Remodeling in Tachypacing-Induced HL-1 Myocyte for Atrial Fibrillation

Tae Hee Ko¹, Daun Jeong¹, Byeongil Yu¹, Ji Eun Song¹, Qui Anh Le², Sun-Hee Woo², Jong-II Choi¹

¹Korea University College of Medicine, Republic of Korea, ²Laboratory of Pathophysiology, College of Pharmacy, Chungnam National University, Republic of Korea

Background: Mutation in cardiac sodium channel conducted by late sodium current (\(I_{Na,Late}\)) has emerged a contributor of electrical remodeling, leading to susceptibility of atrial fibrillation (AF). However, the molecular mechanism underlying that negatively regulate \(I_{Na,Late}\) in AF remains unclear and potential therapeutic approaches are required.

Methods: In this study, we constructed a tachypacing-induced cellular model to induce AF-like models with rapid electrical stimulation at 1.5 V/cm, 4 ms, 10 Hz for 6-hour using HL-1 myocytes and \(Ca^{2+}\) imaging, action potential (AP), and sodium current (\(I_{Na}\)) properties were tested.

Result: We found that 6-hour tachypacing revealed irregular \(Ca^{2+}\) release, delayed afterdepolarizations, prolonged AP duration, aberrant \(I_{Na}\) properties, and reduction in phosphoinositide-3-kinase (PI3K)/Akt signaling. These detrimental effects were related to increased pathogenic \(I_{Na,Late}\), and were significantly recovered by \(I_{Na,Late}\) blocker ranolazine treatment. We further showed that decreased PI3K/Akt signaling by PI3K inhibition also displayed increase in \(I_{Na,Late}\) and subsequent aberrant myocyte excitability, which were abolished by \(I_{Na,Late}\) inhibition, suggesting that PI3K/Akt signaling is responsible for regulating pathogenic \(I_{Na,Late}\).

Conclusions: These results suggest that PI3K/Akt signaling is critical for regulating \(I_{Na,Late}\) and electrical remodeling, supporting the use of PI3K/Akt-mediated pathogenic \(I_{Na,Late}\) as a therapeutic target for AF.
Antiarhythmic Effect of Artemisinin in Canine Experimental Model of Brugada Syndrome

Hyungki Jeong¹, Namsik Yoon², Ki Hong Lee², Hyung Wook Park², Jeong Gwan Cho²
¹Wonkwang University School of Medicine & Hospital, Republic of Korea, ²Chonbuk National University Medical School, Republic of Korea

Background: Brugada syndrome is an inherited arrhythmia syndrome which presents sudden cardiac death (SCD) without structural heart diseases. One of the mechanisms of SCD has been suggested that uneven dispersion of Ito channel between epicardium and endocardium induces ventricular arrhythmia. Artemisinin is used as antimalarial drug widely. Its antiarrhythmic effect which included suppression of Ito channel was reported previously. We investigated the effect of Artemisinin for suppression of Brugada syndrome in canine experimental model.

Methods: Transmural pseudo-ECG and epicardial/endocardial action potentials were recorded from coronary-perfused canine right ventricular wedge preparation (N=5). To mimic the Brugada syndrome model, acetylcholine (3 M), calcium channel blocker verapamil (1 M), Ito agonist NS5806 (710 M) were used and waited until ventricular arrhythmia induction. Then, Artemisinin 100 M was perfused to ameliorate the ventricular arrhythmia. Action potential duration, J wave area, notch index and T wave dispersion were measured.

Result: In all sample models (n=5), ventricular arrhythmia was induced. The Artemisinin suppressed ventricular arrhythmia and recovering the action potential dome of RV epicardium after provocation of ventricular arrhythmia in all preparations (n=5). J wave area and epicardial notch index were also decreased after Artemisinin perfusion. Action potential duration prolonged as the ventricular arrhythmia provocation and recovered after Artemisinin perfusion.

Conclusions: Our findings suggest that Artemisinin alleviate the Brugada syndrome in the wedge preparation model by inhibition of Ito channel and it suppressed the development of phase 2 reentry and ventricular tachycardia/ventricular fibrillation.
**YIA-07**

**Intracardiac Echocardiographically Guided Permanent Pacemaker Implantation is a Feasible Imaging Tool with Comparable Procedural Efficacy and Safety**

Moonki Jung¹, Kyung-Taek Park¹, Hyue Mee Kim¹, Jun Hwan Cho¹, Hoyoun Won¹, Wang-So Lee¹, Kwang Je Lee¹, Sang Wook Kim¹, Tae Ho Kim¹, Chee Jeong Kim¹, Gregory Lip², Seung Yong Shin¹

¹Chung-Ang University Hospital, Republic of Korea, ²Liverpool Centre for Cardiovascular Science, United Kingdom

**Background:** Amongst cardiovascular interventions, pacemaker implantation procedure is one of the most hazardous in terms of radiation exposure due to its proximity and unprotected radiation exposure. In order to reduce radiation hazards, alternative imaging tool to guide pacemaker implantation should be sought. The aim of this study is to investigate the feasibility, efficacy, and safety of intracardiac echocardiographically (ICE) guided pacemaker implantation.

**Methods:** We retrospectively investigated pacemaker implantation with ICE guidance. ICE catheter was placed in right atrium (RA). Right ventricular (RV) lead was placed in RV apex within home view (low RA, 2~4 Oclock). Then RA lead was placed in RA appendage within mid RA 1~2 Oclock view. Fluoroscopy was used only for verifying lead redundancy (2 or 3 second duration before pocket closure). Other procedure steps were similarly performed as in conventional fluoroscopic method. Radiation dosage, patient safety, total procedure time, and lead parameters were assessed and compared.

**Result:** From January 2019 to March 2021, a total of 113 patients underwent pacemaker implantation either with ICE or with fluoroscopy. Amongst them, ICE guided implantation was attempted in 35 patients. In order to exclude potential bias caused by the operators learning curve, we excluded early 5 cases out of ICE group. Radiation exposure was markedly decreased within ICE group (2.3±4.4 Gy · cm² in ICE group vs. 26.9±47.0 Gy · cm² in fluoroscopy group, P<0.001). The total procedure time and complication rate showed no significant difference between groups. In ICE group, atrial lead parameters were better than those of fluoroscopy group (impedance 454±57 Ω vs. 512±128 Ω, P=0.003, pacing threshold 0.8±0.3 V vs. 1.0±0.3 V, P=0.061).

**Conclusions:** In 30 patients with ICE guided pacemaker implantation, radiation exposure was markedly decreased without any trade-offs in terms of patients safety and procedural success. Furthermore, operation team members physical stress reduction also might be potentially guaranteed.
# YIA Competition

<table>
<thead>
<tr>
<th>Table. Comparison of ICE guided pacemaker implantation and fluoroscopic pacemaker implantation.</th>
</tr>
</thead>
</table>

<table>
<thead>
<tr>
<th></th>
<th>ICE guided pacemaker implantation</th>
<th>Conventional pacemaker implantation</th>
<th>P value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female - no. (%)</td>
<td>18 (60.0)</td>
<td>45 (57.7)</td>
<td>0.828</td>
</tr>
<tr>
<td>Age - yr</td>
<td>75.6 ± 8.4</td>
<td>77.1 ± 9.5</td>
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</tr>
<tr>
<td>Hypertension - no. (%)</td>
<td>25 (83.3)</td>
<td>55 (70.5)</td>
<td>0.173</td>
</tr>
<tr>
<td>Diabetes mellitus - no. (%)</td>
<td>11 (36.7)</td>
<td>28 (35.9)</td>
<td>0.941</td>
</tr>
<tr>
<td>Atrial fibrillation - no. (%)</td>
<td>15 (50.0)</td>
<td>51 (65.4)</td>
<td>0.142</td>
</tr>
<tr>
<td>Coronary artery disease - no. (%)</td>
<td>4 (13.3)</td>
<td>9 (11.5)</td>
<td>0.797</td>
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<tr>
<td>Cerebrovascular accident - no. (%)</td>
<td>4 (13.3)</td>
<td>16 (20.5)</td>
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</tr>
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<td>Chronic kidney disease - no. (%)</td>
<td>8 (26.7)</td>
<td>16 (20.5)</td>
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</tr>
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<td>Syncope - no. (%)</td>
<td>6 (20.0)</td>
<td>22 (28.2)</td>
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</tr>
<tr>
<td>Dizzy spells - no. (%)</td>
<td>7 (23.3)</td>
<td>33 (42.3)</td>
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</tr>
<tr>
<td>Bradycardia - no. (%)</td>
<td>19 (63.3)</td>
<td>36 (46.2)</td>
<td>0.110</td>
</tr>
<tr>
<td>Heart failure - no. (%)</td>
<td>13 (43.3)</td>
<td>24 (30.8)</td>
<td>0.218</td>
</tr>
<tr>
<td>Diagnosis - no. (%)</td>
<td></td>
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<td>0.016</td>
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<tr>
<td>Complete AV block</td>
<td>13 (43.3)</td>
<td>18 (23.1)</td>
<td></td>
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<tr>
<td>2nd degree AV block</td>
<td>0 (0.0)</td>
<td>1 (1.3)</td>
<td></td>
</tr>
<tr>
<td>High degree AV block</td>
<td>4 (13.3)</td>
<td>7 (9.0)</td>
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<tr>
<td>Symptomatic bradycardia</td>
<td>2 (6.7)</td>
<td>0 (0.0)</td>
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<tr>
<td>Tachy-bradycardia syndrome</td>
<td>4 (13.3)</td>
<td>9 (11.5)</td>
<td></td>
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<tr>
<td>Sick sinus syndrome</td>
<td>7 (23.3)</td>
<td>43 (55.1)</td>
<td></td>
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<tr>
<td>Pacing model - no. (%)</td>
<td></td>
<td></td>
<td>0.669</td>
</tr>
<tr>
<td>DDDDR</td>
<td>28 (93.3)</td>
<td>74 (94.9)</td>
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<tr>
<td>VVIR</td>
<td>2 (6.7)</td>
<td>4 (5.1)</td>
<td></td>
</tr>
<tr>
<td>Echocardiogram</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ejection fraction - %</td>
<td>59 ± 10</td>
<td>62 ± 8</td>
<td>0.131</td>
</tr>
<tr>
<td>LAVI - ml/m²</td>
<td>49 ± 5</td>
<td>47 ± 20</td>
<td>0.207</td>
</tr>
<tr>
<td>LVEDd - mm</td>
<td>45 ± 10</td>
<td>50 ± 5</td>
<td>0.510</td>
</tr>
<tr>
<td>LAd - mm</td>
<td>54 ± 28</td>
<td>44 ± 7</td>
<td>0.841</td>
</tr>
<tr>
<td>Dose Area Product - GY-cm²</td>
<td>2.3 ± 4.4</td>
<td>26.9 ± 47.0</td>
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</tr>
<tr>
<td>Total air kerma - mGy</td>
<td>15.8 ± 32.6</td>
<td>372.0 ± 569.0</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Radiation exposure time - sec</td>
<td>54 ± 93</td>
<td>524 ± 306</td>
<td>&lt;0.001</td>
</tr>
<tr>
<td>Total procedure time - min</td>
<td>73 ± 22</td>
<td>67 ± 21</td>
<td>0.203</td>
</tr>
<tr>
<td>Convert to fluoroscopic procedure</td>
<td>3 (10.0)</td>
<td>-</td>
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<tr>
<td>Postprocedural parameter</td>
<td></td>
<td></td>
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<tr>
<td>Atrial pacing threshold - V</td>
<td>0.8 ± 0.3</td>
<td>1.0 ± 0.3</td>
<td>0.061</td>
</tr>
<tr>
<td>Atrial sensing threshold - mV</td>
<td>2.5 ± 1.1</td>
<td>2.4 ± 1.3</td>
<td>0.980</td>
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<tr>
<td>Ventricular pacing threshold - V</td>
<td>0.6 ± 0.2</td>
<td>0.7 ± 0.2</td>
<td>0.607</td>
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<tr>
<td>Ventricular sensing threshold - mV</td>
<td>8.7 ± 3.2</td>
<td>7.7 ± 3.2</td>
<td>0.172</td>
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<tr>
<td>Atrial lead impedance - Ω</td>
<td>454 ± 57</td>
<td>512 ± 129</td>
<td>0.003</td>
</tr>
<tr>
<td>Ventricular lead impedance - Ω</td>
<td>650 ± 122</td>
<td>684 ± 177</td>
<td>0.259</td>
</tr>
<tr>
<td>Periprocedural complications - no. (%)</td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Death</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
<tr>
<td>Pneumothorax</td>
<td>0 (0.0)</td>
<td>1 (1.3)</td>
<td>1.000</td>
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<tr>
<td>Wound infection</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
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<tr>
<td>Hematoma</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
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<tr>
<td>Chylocele</td>
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<td>1.000</td>
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<tr>
<td>Atrial lead displacement</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
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<tr>
<td>Ventricular lead displacement</td>
<td>0 (0.0)</td>
<td>0 (0.0)</td>
<td>1.000</td>
</tr>
</tbody>
</table>

Abbreviations: ICE, intracardiac echocardiography; LAVI, left atrial volume index; LVEDd, left ventricular end-diastolic dimension; LAd, left atrial diameter.
JOINT SYMPOSIUM
WITH OVERSEAS SOCIETY 1

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
Incessant Ventricular Fibrillation after VDD Pacemaker Implantation

Hyungki Jeong\textsuperscript{2}, Sung Soo Kim\textsuperscript{1}, Hyun Kuk Kim\textsuperscript{1}

\textsuperscript{1}Chosun University College of Medicine, Republic of Korea, \textsuperscript{2}Wonkwang University School of Medicine & Hospital, Republic of Korea

**Background:** The occurrences of QT interval prolongation and torsade de pointes (TdP) are serious complications of complete atrioventricular block (CAVB). Patients with CAVB have a bradycardia-sensitive repolarization abnormality, and this characteristic remains even after pacemaker implantation. VDD pacing could result in long short cycles interval in these patients with a slow atrial contraction rate, acting as a trigger for the initiation of TdP.

**Methods:** A 78-Year-old woman arrived at the emergency department complaining of recurrent syncope. Because 12 lead ECG showed complete atrioventricular block, she underwent a dual chamber pacemaker implantation (VDD mode with a lower rate limit of 50 bpm). Twelve hours after the pacemaker implantation, the patient collapsed suddenly. Incessant polymorphic VT appeared just after a further QT interval prolongation following short-coupled premature ventricular contractions. VDD pacing in patients with slow atrial contraction rate, generates a difference between the VV and AA intervals. When the spontaneous atrial signal was within the PVARP initially, but gradually went out of the PVARP, subsequent ventricular pacing following the first atrial signal beyond the PVARP induced long short cycle pacing, further triggering polymorphic VT.

**Result:** In our patient, after reprogramming the device by increasing the lower rate limit to 90 bpm in DDD mode and lengthening the PVARP, no further episodes of polymorphic VT occurred.

**Conclusions:** More careful pacemaker programming is needed in patients with QT interval prolongation by appropriate pacemaker mode, increasing the lower rate limit, or lengthening the PVARP.
Ablation of Ventricular Arrhythmias Originated from Cardiac Crux Region

Pichmanil Khmao¹, Hui-Nam Pak²
¹Khmer Soviet Friendship Hospital, Cambodia, ²Yonsei University Health System, Republic of Korea

**Background:** The idiopathic ventricular tachycardia is a form of VT that occurs in the patients with structurally normal heart and the localization is originated in the majority from the outflow tract (OT) while less common site such as cardiac crux region is increasingly recognized by identifying the ECG characteristics of this arrhythmia. Ablation of VT in the cardiac crux is one of the challenging procedures due to an anatomical complex structure where the four chambers of the heart are crossed.

**Methods:** A 21-year-old female complained of palpitations associated with dizziness and presented monomorphic VT. The standard ECG during VT showed left bundle branch block (LBBB) QRS morphology with left superior axis and Rs wave in V6. Abrupt precordial transition in V2 with R wave amplitude greater than in V1 and V3 as well as maximum deflection index (MDI) of 0.57 were also noted. The patient underwent electrophysiological study (EPS) and clinical VT was induced by rapid right ventricular (RV) pacing. Right ventriculography was performed in right anterior oblique (RAO) and left anterior oblique (LAO) view. Endocardial 3D electro-anatomical mapping (Biosense Webster, CA, USA) of right ventricle was performed with a PentaRay (Biosense Webster, CA, USA) catheter during both sinus rhythm and VT. Earliest ventricular activation was observed at basal inferior ventricular septum and preceded the onset of QRS complex by 35ms during VT. PASO showed scoring of 98%.

**Result:** The ablation catheter tip was firmly contacting with basal inferior ventricular septum presenting small atrial and ventricular signal at distal mapping catheter via RA approach. Radiofrequency energies were applied at the target site resulted in complete elimination and non-inducible VT without complications. There was no acute recurrent VT as well as during follow-up.

**Conclusions:** The abrupt precordial transition in V2 with R wave amplitude greater than in V1 and V3 in addition to the characteristic ECG of basal crux ventricular arrhythmias can suggest the ablation site at endocardial aspect of basal inferior ventricular septum.
Brugada Syndrome Unmasked by Thyroid Storm

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Philippine General Hospital, Philippines

**Background:** Brugada syndrome (BS) is an electrocardiogram pattern of pseudo-right bundle branch block pattern with persistent ST segment elevation in anteroseptal precordial leads resulting from mutation of subunits of a cardiac sodium channel. It is associated with ventricular arrhythmias that leads to sudden cardiac death. Thyroid storm is an endocrine emergency associated with high morbidity and mortality. Its diagnosis is based on clinical findings supported by deranged thyroid function tests. The most common cardiac rhythm disturbance related to thyroid storm is sinus tachycardia. Uncommonly, ventricular arrhythmias are also reported. Association with Brugada Syndrome is exceptionally rare with only published case report.

**Methods:** We presented a 37-year old female, Filipino, who had sudden cardiac arrest due to ventricular arrhythmia in a state of thyroid storm. However, an underlying Brugada Syndrome was uncovered post resuscitation (see Figure). She was advised for an Implantable Cardioverter-Defibrillator Device as class I recommendation. To the best of our knowledge, our patient is the 1st reported female case of a Brugada Syndrome associated with thyroid storm.

**Result:** Not applicable

**Conclusions:** Treatment of an underlying disease that can be corrected is of primary importance in patients with Brugada Syndrome. As for this case, control of her hyperthyroidism.
The First Manifestation of Incessant Tachycardia in Elderly: A Rare Form of Supra Ventricular Tachycardia

Mohammad Iqbal
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**Background:** Supraventricular tachycardia (SVT), particularly caused by bypass tract, is the “common” arrhythmia in young age. One of the rare form of bypass tract was permanent junctional reciprocating tachycardia (PJRT). The first manifestation of PJRT usually occur during infant or childhood. However, the first manifestation of PJRT may occur during elderly. The manifestation in elderly may mistaken this tachycardia with other form of SVT.

**Methods:** A 62-year-old male presented to our emergency department with persistent palpitation since 2 weeks ago. She was referred from another hospital with medication amiodarone, diltiazem, and bisoprolol. The ECG showed SVT with long RP tachycardia. The SVT was persistent despite high dose of antiarrhythmic drugs. The patient was undergo EP study and ablation.

**Result:** The V pacing showed eccentric pattern with earliest retrograde A, near the CS ostium. The V pacing showed VA decremental properties. The SVT easily induced by atrial or ventricular pacing without antegrade or retrograde jump. The SVT showed long RP tachycardia. EP study maneuver showed: V entrainment VA response with PPI-TCL 93 ms, VA pacing - VA tachycardia 60 ms and V reset terminated the tachycardia. Ablation was performed during SVT and terminated the tachycardia. RV pacing after ablation showed VA dissociate. No inducible SVT after ablation with aggressive pacing from HRA and RV.

**Conclusions:** PJRT is a rare form of bypass tract and it may be incessant. The first manifestation in elderly may mistaken with other form of SVT. The maneuver in EP study, which resemble to AVRT but with retrograde decremental properties is the key to confirm the PJRT.
Antifibrillatory Effects of Pulmonary Vein Isolation and Antiarrhythmic Drugs on Atrial Fibrillation: A Computational Modeling Study
Ze Jin, Inseok Hwang, Byounghyun Lim, Oh-Seok Kwon, Ji-Soo Lee, Je-Wook Park, Hee Tae Yu, Tae-Hoon Kim, Boyoung Joung, Moon-Hyung Lee, Hui-Nam Pak
Yonsei University Health System, Seoul, Republic of Korea

Background: Both catheter ablation and antiarrhythmic drugs (AAD) are effective rhythm control methods in patients with atrial fibrillation (AF). However, it is not clear how different their mechanisms are and what is the mechanism of AF recurrences. We tested AF wave-dynamic changes after circumferential pulmonary vein isolation (CPVI) and AAD effects in realistic human left atrial computational modeling.

Methods: We tested virtual CPVI and AADs (flecainide and dronedarone) in 3D computational modeling of AF reflecting patients anatomy (computed tomography), histology (electroanatomical voltage map), fiber orientation (local activation map), and electrophysiology (conduction velocity [CV] and activation time) of 25 patients (88% male, 59.8±9.8 years old, 32.0% paroxysmal type). CPVI was done at the level of PV antrum with or without two small gaps (each 5mm size). AAD effects were simulated by ion current changes based on the previous publications. We measured termination or defragmentation rates and changes of dominant frequency (DF), phase singularities (PS) and persistent rotational reentries (PRR).

Result: Compared to baseline, total PVIs and AADs exhibited higher defragmentation (p=0.001) and termination rates (p=0.025), lower mean DF (p<0.001), lower peak DF (p<0.001) and lower PRR incidence (p<0.001), CPVI exhibited higher defragmentation rates (p=0.012), lower mean DF (p<0.001), lower peak DF (p=0.021) and lower PRR incidence (p<0.001), AADs exhibited higher defragmentation (p=0.004) and termination (p=0.024) rates, lower mean DF (p<0.001), lower peak DF (p<0.001) and lower PRR incidence (p<0.001). Compared to CPVI with gap, CPVI exhibited lower mean DF (p<0.001), lower PS number (p<0.001) and PRR incidence (p=0.005). Compared to CPVI, CPVI exhibited lower mean DF (p=0.032), higher peak DF (p=0.043).

Summary: Compared to baseline, reduction of mean DF and PRR incidence result in a higher defragmentation and termination rates of AADs or PVIs. AADs showed obvious lower PRR incidence when compared to PVIs, but there was no significant difference on defragmentation rates. While CPVI decreased mean DF and PRR incidence significantly compared to PVI with gap, no difference was found in defragmentation and termination rates. CPVI showed significant lower mean DF compared to AADs but no significant difference occurred in defragmentation or termination rates.

Conclusions: CPVI and AADs play complementary anti-fibrillatory effects in patients with AF. In AF computational modeling based on human atrial mapping data, CPVI showed a lower mean DF compared to AADs, but there was no significant difference in termination rates. It was concluded that CPVI play an anti-AF role through trigger rather than maintenance mechanism.
JOINT SYMPOSIUM WITH OVERSEAS SOCIETY 2

KHRS 2021
The 13th Annual Scientific Session of the Korean Heart Rhythm Society
Recurrent Syncope following Heart Transplantation: A Case Report and Literature Review

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Samsung Medical Center (Samsung Seoul Hospital), Republic of Korea

Background: Coronary vasospasm in a patient with heart transplantation has been described to be rare. The etiology of coronary vasospasm in transplanted heart remains poorly understood and hypothetic.

Methods: We discuss the peculiarity of our case and provide a possible explanation for the early presentation of vasospasm in heart transplant recipients. We also review the existing literature with a focus on clinical manifestation, diagnosis, and treatment.

Result: A 63 years old man with end-stage ischemic cardiomyopathy underwent orthotopic heart transplantation six months ago: the donor was a 56 years old man with no history of cardiac disease. He presented with recurrent syncope. The typical syncopal episode was precipitated by nausea and diaphoresis, followed by a one-minute loss of consciousness without postictal confusion. The 24hr-Holter monitoring revealed complete atria-ventricular (AV) block with junctional ventricular rhythm. However, he was taking bisoprolol 2.5mg for complaining of palpitation. After discontinuing beta-blocker, admission vitals were within normal limits, and he discharged without further symptoms. One week later, the patient experienced recurrent syncope and readmitted. There were no signs of vascular rejection, hemodynamic instability, while left and right systolic function was normal without pulmonary hypertension. The loop recording system was implanted because of unexplained recurrent syncope. The day after implant, he suffered loss of consciousness with complete AV block. The emergent coronary angiography revealed severe spasm of right coronary artery during ergonovine test reversible with intracoronary nitroglycerin. He was discharged home on loop record and noted to have transient complete AV block for which a permanent pacemaker was placed to allow for further up-titration of variant angina medication, after which he had no further episodes of syncope.

Conclusions: Although rarely, coronary vasospasm can occur by complete AV block without typical anginal pain in early post-transplanted hearts, and can be treated by permanent pacemaker even if recurrent symptom after appropriate medication.

Table 1. Review of coronary spasm-induced arrhythmic events after heart transplantation

<table>
<thead>
<tr>
<th>Recipient</th>
<th>Donor</th>
<th>HTx to event</th>
<th>Symptom</th>
<th>ECG</th>
<th>Treatment</th>
<th>Rejection or vasculopathy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Piston &amp; al. 2009</td>
<td>M/62</td>
<td>M/51</td>
<td>3 weeks</td>
<td>Dizziness and confusion</td>
<td>AF and short run VT, CAVB</td>
<td>Diltiazem 180mg/day</td>
</tr>
<tr>
<td>Pagnoni et al. 2019</td>
<td>M/46</td>
<td>F/54</td>
<td>4 weeks</td>
<td>No symptom</td>
<td>Sustained VT with 150 bpm</td>
<td>-</td>
</tr>
<tr>
<td>Cottan et al. 1986</td>
<td>M/33</td>
<td>M/30</td>
<td>4 months</td>
<td>Syncope</td>
<td>ST elevation</td>
<td>Netifdfpine 60mg/day</td>
</tr>
<tr>
<td>Frantz et al. 1994</td>
<td>M/62</td>
<td>M/65</td>
<td>12 months</td>
<td>No symptom</td>
<td>BP drop and ST elevation during treadmill test</td>
<td>Diltiazem 240mg/day</td>
</tr>
<tr>
<td>Bisognano et al. 2005</td>
<td>M/48</td>
<td>M/50</td>
<td>13 months</td>
<td>Chest pain</td>
<td>ST elevation with RBBB</td>
<td>Amidipine 7.5mg/day</td>
</tr>
<tr>
<td>Onomdo et al. 2018</td>
<td>M/37</td>
<td>M/31</td>
<td>8 years</td>
<td>Transient dizziness</td>
<td>No change</td>
<td>Netifdfpine 120mg/day</td>
</tr>
</tbody>
</table>

HTx, heart transplantation; ECG, echocardiogram; AF, atrial fibrillation; VT, ventricular tachycardia; CAVB, complete atrio-ventricular block; BP, blood pressure; RBBB, right bundle branch block.
Joint Symposium with Overseas Society 2

JS2-02

Evaluation of the Pattern Use of Anti-Thrombotic in Stroke Patients with Atrial Fibrillation

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¹Tugurejo General Hospital, Indonesia, ²Sanata Dharma University, Indonesia, ³Duta Wacana Christian University, Indonesia

Background: Atrial fibrillation can cause ischemic strokes through the formation of emboli which clog the blood vessels of the brain. The CHA2DS2-Vasc index is useful for predicting stroke risk. If the CHA2DS2-Vasc score $\geq 2$ indicates administration of anticoagulant. Score CHA2DS2-Vasc $\geq 2$ and patients get an oral anticoagulant so the therapy was said to be appropriate. This study evaluates the accuracy of the antithrombotic treatment pattern in ischemic stroke patients with atrial fibrillation at Bethesda Hospital Yogyakarta.

Methods: The type of this study was descriptive observational with a cross-sectional study design using retrospective data from electronic medical records at Bethesda Hospital Yogyakarta. The accuracy of the antithrombotic treatment pattern in ischemic stroke patients with atrial fibrillation was analyzed based on the guidelines from the Indonesian Cardiology Association (2014) and the Indonesian Neurologist Association (2011).

Result: Data of 53 ischemic stroke patients with atrial fibrillation consisted of 24 men (45.3%) and 29 women (54.7%). The most antiplatelet prescribed is aspirin at 41.5%; clopidogrel at 22.6%. The anticoagulant prescribed is warfarin 17.0%. The accuracy of treatment of ischemic stroke patients with atrial fibrillation based on the CHA2DS2-Vasc score of 11 (20.8%) patients and not as many as 42 (79.2%) patients.

Conclusions: Most treatment of ischemic stroke patients with atrial fibrillation based on the CHA2DS2-Vasc score is not appropriate at Bethesda Hospital Yogyakarta.
A Case of AVNRT Pediatric with Recurrent Three-Time Hospitalized: What Should We Do to Acute and Long Term Management of Pediatric Arrhythmia?

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¹Tugurejo General Hospital, Indonesia, ²Wahidin Sudirohusodo Hospital, Indonesia, ³Gadjah Mada University Hospital, Indonesia

Background: A 6 years old girl with a weight 18 kg was admitted with sudden onset palpitation after playing bicycle. Patient had a history of syncope three-time which initiation palpitation previously. She was stable, pulse rate was >228/minute, the physical examination was normal. ECG showed narrow complex SVT with AVNRT pattern. The vagal maneuver was given and rhythm reverted to sinus. Echocardiography showed Interatrial septal and Interventricel septal Intak. Electrolit laboratory and thyroid function tests were normal results. The patient was started on propranolol 3×5 mg and was discharged on maintenance propranolol and advised follow up. One month later she was readmitted with a recurrence of stable AVNRT, vagal maneuver failed to change the heart rate because adenosine was not available in our hospital then IV amiodarone 90 mg in 40 minutes was administered to terminate AVNRT and discharged on maintenance propranolol. One month later she was readmitted with stable AVNRT and this time vagal maneuvers failed and IV amiodarone 90 mg in 40 minutes was given again to reverted sinus. She was commenced on oral amiodarone 2x100 mg and discharged home. She did not have any recurrence of symptoms or AVNRT episode. The patient was planned to Radiofrequency-ablation (RFA) if weighs more than 25 kg for long-term management.

Methods: -

Result: -

Conclusions: The Acute treatment for stable AVNRT is vagal maneuvers as the first-line treatment. Adenosine,-blocker, Amiodarone are treatment choices in children. Intravenous CCB is generally prohibited because of the risk of asystole and cardiovascular collapse. Synchronized cardioversion is reserved for acute unstable AVNRT. B-blocker more preferred than amiodarone for long-term management because it is not disturbing the function of the thyroid but the previous case reported that amiodarone could stop recurrent AVNRT episodes. Intravenous amiodarone is the treatment of choice to terminate an acute episode that does not respond to vagal stimulation if adenosine is unavailable.
Joint Symposium with Overseas Society 2

JS2-04

Bradydcardia-Related Atrial Noncapture during Dual-Chamber Pacemaker Implantation

Sze Man Fiona Yuen
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Background: A 72-year-old lady was admitted for dizziness and shortness of breath. She had the history of hypertension and multiple myeloma. Electrocardiogram showed severe sinus bradycardia with junctional escape at 30 bpm. Dual-chamber pacemaker was implanted.

Methods: Atrial active lead implantation was attempted at several positions, all resulted in noncapture at 5V output at AAI 50 bpm pacing despite optimal P wave sensing and impedance. We repeated the threshold test at the same lead position while pacing at AAI 100 bpm, the capture threshold surprisingly improved to 0.7V@0.4ms.

Result: The dual-chamber pacemaker was programmed to DDD 80 bpm, which achieved an optimal capture threshold, in order to maintain atrioventricular synchronisation immediately after implantation. Four weeks later, the atrial pacing threshold improved to 0.7V@0.4ms at 60 bpm.

Conclusions: Atrial pacing rate during de novo pacemaker implantation might affect the atrial capture threshold especially in patients with sick sinus syndrome. Identification of this phenomenon may avoid unnecessary reintervention.
Catheter Ablation of Ventricular Tachycardia in a Case of Arrhythmogenic Right Ventricular Tachycardia with Multiple ICD Shocks

Anupam Jena, Saurav Das, Nelson Ghosh, Sunanda Mohanty, Binayananda Padhee, Suryakant Jena, Subasis Mishra, Panchana Sahoo
Kalinga Institute of Medical Sciences, India

Background: A 55 yrs male was diagnosed with Arrhythmogenic right ventricular cardiomyopathy (ARVC) 4 years back, when he presented with multiple episodes of VT. A dual chamber ICD was implanted. Now the patient presented with frequent ICD shocks. ECG showed RBBB with QRS duration >150 msec in V1. Echo showed dilated right atrium and ventricle with severe low pressure tricuspid regurgitation. ICD interrogation revealed more than 60 episodes of ventricular arrhythmia requiring therapy with ATP or defibrillation. The patient was taken up for VT ablation. The procedure was done under general anesthesia. A large curve Agilis NxTTM was placed at tricuspid valve. Epicardial access was taken upfront as ECG was suggestive of epicardial substrate. Epicardial puncture was done with Tuohy Epidural needle and SL1 sheath was placed in pericardial cavity. Endocardial RV geometry was created with the use of Advisor HDgrid catheter. All endocardial late potentials (LP) were mapped. LPs were mapped in RV basal anterior and inferior areas. Unipolar voltage map also correlated to those areas. Then epicardial mapping was done, which also showed preponderance of LPs in RV basal inferior and anterior areas. Isochronal late activation maps (ILAM) were created. All the LPs were targeted. Ablation was done with Flexibility™ catheter, with power and temp setting of 30W/450C aiming for an impedance drop of 10. Flow rate was kept at 14 ml. The areas showing LAVA were validated point by point with ablation catheter. Ablation was given point by point up to 120 sec at one place till ablation of abnormal electrograms. Endocardial and Epicardial ablations were done. The pericardial sheath was frequently aspirated to avoid cardiac tamponade. After ablation, the level of anesthesia was reduced and VT induction was tried. VT was noninducible with three extrastimuli.

Methods: NA

Result: NA

Conclusions: Catheter ablation of endocardial and epicardial substrate is necessary in some cases of ARVC
POSTER

KHRS 2021
The 13th Annual Scientific Session
of the Korean Heart Rhythm Society
Circulating Exosomal Long Non-Coding RNAs as Diagnostic Biomarkers for Atrial Fibrillation
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1Yonsei University College of Medicine, Republic of Korea, 2Yonsei University, Republic of Korea

Background: Atrial fibrillation (AF) is the most common arrhythmia of clinical significance; thus, it is necessary to develop an effective diagnostic biomarker. Exosomes, small membrane vesicles (30-150 nm), are known to mediate cellular communication by transmitting various forms of RNAs. Long non-coding RNAs (lncRNAs) with a minimum length of more than 200 nucleotides have been reported to play critical roles in pathophysiology of cardiovascular diseases. Interestingly, exosomal lncRNAs, which exhibit both high specificity and stability of lncRNAs, are expected to be an ideal noninvasive diagnostic biomarker for detecting various diseases. However, serum-derived exosomal lncRNAs as diagnostic biomarkers for AF have remained largely unexplored. Therefore, we aimed to identify exosomal lncRNAs as useful tools for improving AF diagnosis.

Methods: First, we successfully isolated serum exosomes by a polymer-based exosome precipitation kit and characterized by TEM, NTA and western blot analysis. Next, serum exosomal lncRNA expression profiles were examined between AF and SVT-control groups using RNA-sequencing analysis. In addition, the expression levels of selective exosomal lncRNAs were assessed by qRT-PCR in training set (n = 15 per group) and validation set (n = 60 per group). Finally, we evaluated the diagnostic sensitivity and specificity of exosomal lncRNAs for AF by ROC curve analysis.

Result: In this study, isolated exosomes exhibited the morphology, size distribution, and marker protein expression of typical exosomes, thereby indicating that exosomes were successfully isolated from human serum. In addition, we identified 26 differentially expressed lncRNAs (i.e., 15 up-regulated and 11 down-regulated lncRNAs with p-value < 0.05) in serum exosomes from AF compared with SVT-control groups. Among them, we confirmed that two candidate exosomal lncRNAs were significantly differentially expressed in AF serum by two independent sets and were found to exhibit significant diagnostic validity for AF.

Conclusions: Our study suggests that circulating exosomal lncRNAs may serve as promising biomarkers for AF diagnosis.
Exosomes Derived from Patients with Atrial Fibrillation Exacerbate Arrhythmogenesis via miR-30-5p
Dasom Mun, Hyoeun Kim, Ji-Young Kang, Boyoung Joung
Yonsei University College of Medicine, Republic of Korea

Background: Circulating exosomes are nanometer-sized membranous vesicles that contribute to the pathogenesis of Atrial fibrillation (AF); however, the underlying mechanisms are still unknown.

Methods: Circulating exosomes were isolated from patients with persistent AF (FEXO) and non-AF (NEXO) and their roles were compared using an experimental AF model of pacing-induced atrial cardiomyocytes. Characterization and functional validation of exosomes were identified with a transmission electron microscope (TEM), nanoparticle tracking analysis (NTA), and western blot. HL-1 atrial cardiomyocytes were cultured in the presence of tachypacing. Exosomes were treated in HL-1 cells 24 h before the initiation of tachypacing. To investigate Sarcoplasmic reticulum (SR) Ca2+ leak, measurements of diastolic SR Ca2+ spark was measured by confocal microscopy using Fluo-4 AM. To evaluate the components of defective exosomes, quantitative reverse transcriptase-polymerase chain reaction (qRT-PCR) analyses were performed to validate the expression levels of exosomal miRNAs.

Result: First, we evaluated the pathological effects of exosomes derived from the peripheral blood of patients with persistent AF (FEXO) and without AF (NEXO) on atrial cardiomyocytes. FEXO treatment reduced cell viability, caused abnormal Ca2+ handling, induced reactive oxygen species (ROS) production, and led to increased CaMKII activation of non-paced and paced cardiomyocytes. Next, we analyzed the exosomal miRNA profile of FEXO and selected 6 miRNAs correlated with CaMKII activation to investigate which components of FEXO promote arrhythmogenesis. Quantitative RT-PCR experiment showed miR-30-5p was significantly downregulated in FEXO, paced cardiomyocytes, and atrial tissues of AF. Finally, we evaluated the effects of miR-30-5p on paced cardiomyocytes and validated miR-30-5p as a proarrhythmic signature of FEXO. Consequently, FEXO-loaded with miR-30-5p treatment attenuated pacing-induced Ca2+-handling abnormalities, whereas the change was reversed by FEXO-loaded with anti-miR-30-5p treatment in paced cardiomyocytes.

Conclusions: Taken together, the regulation of CaMKII by miR-30-5p revealed that miR-30-5p is a major mediator for FEXO-mediated AF pathogenesis. Therefore, these findings suggest that miR-30-5p-deficient exosomes derived from persistent AF patients exacerbate arrhythmogenesis.
Background: Atrial fibrillation (AF) is the most common arrhythmia which needs treatment for stroke prevention and cardiac morbidity. Its medical cost and burden has increased last decades. Therefore, there has emphasized screening for general population to detect AF earlier. We conducted screening for AF in the Chonbuk regional community.

Methods: This study examined the 3488 general population in the Chonbuk regional community who were older than 18 years old. Screening test was used single lead ECG (KardiaBand, AliveCor, USA). AF was confirmed by electrophysiologists, if the single lead ECG demonstrated AF more than 30 seconds. We analyzed the prevalence of AF and the characteristics of newly detected AF patients.

Result: A total number of 3488 participants, 160 participants had already diagnosed AF before. The number of screening positive for AF was 57. Among them, 42 patients were confirmed AF by electrophysiologists by review of the ECG, otherwise, premature beats or sinus rhythm. Male gender was the independent risk factor for AF among the screening positive patients. Most of newly detected AF patients were high risk for stroke which had over 2 points of CHA2DS2-VASc score. We followed up those patients and encourage visiting hospital, therefore, 33 (78.6%) patients started to manage AF in the hospital.

Conclusions: The AF prevalence was 5.8% which had added 1.2% by the screening in the Chonbuk area. Most of populations did not have concept of AF and its potential risk of stroke. Considering most newly detected AF by screening was high risk for stroke, AF was still undertreated. Therefore, simple screening device might be useful for early detection of AF.
Autonomic Dysregulation and Intradialytic Hypotension in End-Stage Renal Disease Patients with Hemodialysis

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Background: End-stage renal disease (ESRD) is an important global health issue and leads to cardiovascular diseases (CVD). Patients with ESRD undergoing hemodialysis are at greater risk of morbidities and mortality compared with the general population. Among them, intradialytic hypotension (IDH) is one of the most common complications during hemodialysis sessions and associated with CVD mortality. We hypothesize that patients with intradialytic hypotension have impaired autonomic nervous system (ANS) reserve and subsequently, the risk of further CVD morbidities and mortality, which is highly associated with ANS dysregulation.

Methods: NeuECG is a new method of using equipment with high sampling rate to record the electrical signals from the skin for measuring the electrocardiogram (band pass 0.5 - 150 Hz) and skin sympathetic nerve activity (SKNA) (band pass 500 - 1000 Hz) simultaneously in human. During the full course of conventional hemodialysis, neuECG is used to measure the electrocardiogram, SKNA and heart rate variability (HRV) in a non-invasive way. We compare the changes of blood pressure and the ANS parameters between hemodialysis patients with and without IDH.

Result: Total 102 ESRD patients with hemodialysis are enrolled. The baseline and hourly measured SKNA-N during hemodialysis, respectively, are 0.94 microvolt, 1.33 microvolt, 0.63 microvolt, 0.88 microvolt and 1.00 microvolt in the IDH group and are significant lower than 1.84 microvolt, 2.35 microvolt, 2.09 microvolt⁴, 2.05 microvolt⁴ and2.41 microvolt⁴, respectively, in the non-IDH group (* p<0.05 by Mann-Whitney U test). We also find that other ANS parameters including RMSSD, HF and LF/HF are significant difference between IDH and non-IDH groups (* p<0.05 by Mann-Whitney U test).

Conclusions: Patients in the IDH group have more ANS dysregulation when compared with those in the non-IDH group, demonstrated by the novel and non-invasive method - neuECG. The ANS dysregulation in the IDH group might lead to further CVD morbidities and mortality.
Background: Edoxaban is approved for the prevention of stroke or systemic embolic events in patients with atrial fibrillation (AF) based on the phase 3 ENGAGE AF-TIMI 48 trial. In ETNA-AF registry, compared with patients outside of East Asia, the East Asian patients were more likely to be used edoxaban 30 mg. There is not enough data for the East Asian patients who are prescribed 30mg edoxaban at a recommended dose under routine clinical practice. The aim of this analysis is to report the baseline characteristics of patients with atrial fibrillation who are applicable to any out of three dose reduction criteria (15 \leq \text{CrCl} \leq 50 \text{ mL/min}, \text{weight} \leq 60 \text{ kg}, \text{or use of P-gp inhibitor}) under routine clinical practice and to understand the factors associated with dose reduction.

Methods: LEDIOS is a multi-centre, prospective, non-interventional, observational study conducted in 50 sites in South Korea from 2018 to 2020(NCT03554837). Patients will be followed up for 1 year.

Result: Overall, 2587 patients were enrolled of which 126 patients were excluded from the analysis. 67.4% of enrolled patients were female. Mean age was 74.9 years with an average creatinine clearance of 51.7 mL/min. The calculated CHA2DS2-VASc and HAS-BLED mean scores were 3.6 and 2.2, respectively. For 60.5% of patients edoxaban was their first anticoagulant prescription. Among the three criteria for the dose reduction, 86.5% was low body weight and 52.9% was creatinine clearance of 15-50mL/min, and 6.03% was concomitant use of P-glycoprotein inhibitors.

Conclusions: Edoxaban dose of 30mg was mainly prescribed in older, female, and patients with low body weight. Among the edoxaban dose reduction criteria, low body weight \leq 60 kg is the most frequently applied criterion in Korean patients with NVAF in regular clinical care.
Cardiac Fibrosis Induces Electrophysiologic Abnormalities via Na\textsubscript{v}1.5 Dysregulation in β-Adrenergic Stimulated KK/HIJ Mice

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Korea University College of Medicine, Republic of Korea

**Background:** Cardiac fibrosis is characterized by excessive accumulation of extracellular matrix and contribute to the dysregulation of ion channel properties. Specially, mutation in cardiac voltage-gated sodium channel (Na\textsubscript{v}1.5) is a key contributor of cardiac fibrosis, thereby susceptibility to arrhythmia. However, the underlying pathophysiological mechanism of Na\textsubscript{v}1.5-mediated cardiac fibrosis is still unclear.

**Methods:** To examine the impact of Na\textsubscript{v}1.5 on cardiac fibrosis, KK/HIJ mouse, which is induced severe cardiac fibrosis by β-adrenergic responses, were intraperitoneally implanted osmotic pump treated with isoproterenol. After 3 weeks, trichrome staining and electrocardiogram (ECG) were performed to evaluate cardiac fibrosis and electrical activity, respectively. For electrophysiological properties, patch clamp technique was used from isolated mouse cardiomyocytes.

**Result:** Mouse treated with isoproterenol developed cardiac hypertrophy, cardiac fibrosis, and prolonged QT interval related to increase Na\textsubscript{v}1.5 expressions. These detrimental effects were significantly more exacerbated in KK/HIJ mouse heart with isoproterenol treatment. Further, isoproterenol treatment from KK/HIJ mouse cardiomyocytes displayed prolonged action potential duration and increased Na\textsubscript{v}1.5 current density compared with wild type (C57BL/6J) mouse cardiomyocytes.

**Conclusions:** These results reveal the critical role of Na\textsubscript{v}1.5 property on cardiac fibrosis and its regulation may be responsible for the modulating cardiac fibrosis.
Out-of-Hospital Cardiac Arrest Survivors and Approach for Secondary Prevention in Korea

Kyongjin Min, Jong-Il Choi, Yun Young Choi, Yun Gi Kim, Seung-Young Roh, Jaemin Shim, Jin Seok Kim, Su-Jin Kim, Sung-Woo Lee, Young-Hoon Kim

Korea University Medical Center, Republic of Korea

Background: Out-of-hospital cardiac arrest (OHCA) is fatal and still major cause of death all over the world. It is occurred due to various reasons and it is often difficult to determine. The OHCAs often accompany ventricular arrhythmia (VA), such as ventricular fibrillation and ventricular tachycardia. Whether VAs occur or not and identifying cause of OHCAs are important in that it is related with post-care after return of spontaneous circulation (ROSC). We sought to investigate etiologies and prognoses of patients who experienced aborted OHCA in Korea in terms of occurrence of VAs.

Methods: This prospective observational study was performed based on nation-wide OHCA registry data between October 2015 and June 2018. The patients were divided and analyzed according to whether they died or survived, and whether VA developed during rescue and hospital stay periods. The data from patients who showed VAs and discharged alive were further analyzed.

Result: Among total 7577 patients, 2328 achieved ROSC and 2066 were hospitalized, VA was detected 912 patients and we defined these patients as VA group, and the others as non-VA group. 67.1% of patients was discharged alive in VA group, while only 30.8% of patients discharged alive in non-VA group. The cause of OHCA was revealed in 70.3% of patients in VA group but only 32.1% in non-VA group and in both groups, most of them were coronary artery disease. Belonging to VA group was an independent predictor of survival rate after discharge and good neurologic outcomes when discharge. Younger age, witnessed arrest was also related with good neurologic outcomes. Patients who were diagnosed with diabetes and whose cause of OHCA not proven showed worse neurologic outcomes.

Conclusions: The prevalence of SUDS was high in OHCA, thus, further evaluation should be carried out in patients whose cause of OHCAs are unknown especially who showed VAs which suggest better outcomes.
**POSTER**

**PO-08**

Shank3 Overexpression Causes Cardiac Arrhythmia by Enhancing Cardiac L-Type Ca\(^{2+}\) Channel

**Tae Hee Ko, Ji Eun Song, Chunmei Jin, Kihoon Han, Jong-Il Choi**

*Korea University College of Medicine, Republic of Korea*

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**Background:** Ca\(^{2+}\) influx through L-type Ca\(^{2+}\) channel (LTCC) is essential for initiating cardiac excitation-contraction coupling and disruption of LTCC is an important key contributor of pathophysiology of cardiac disease including arrhythmia. Shank3, a core-scaffolding protein, is organizing macromolecular complexes at the postsynaptic density and is associated with LTCC function. Although recent study revealed the impact of cardiac function by Shank3, the molecular mechanism of Shank3 that negatively regulate cardiac function is still largely unknown.

**Methods:** To test the role of Shank3 in the heart, we developed transgenic mice overexpressing Shank3 and echocardiography and electrocardiogram were performed in the heart in vivo. Isolated cardiomyocytes were used to record electrophysiological properties by patch clamp technique.

**Result:** Adult mouse model overexpressing Shank3 (Shank3 TG) displayed severe cardiac fibrosis, sustained ventricular tachycardia, prolonged QT interval, and reduction in cardiac contraction. Further, isolated cardiomyocyte from Shank3 TG mouse exhibited prolongation of action potential duration and increased LTCC current density. Specially, Shank3 TG myocyte displayed upregulation of LTCC and higher LTCC surface expression.

**Conclusions:** These results demonstrate that Shank3 is crucial role in LTCC regulation in the heart. Our results support Shank3 as a novel therapeutic target for treatment of arrhythmia.
Is the Apical Hypertrophic Cardiomyopathy Benign in Terms of Sudden Cardiac Death Indeed?
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¹Gachon University Gill Medical Center, Republic of Korea, ²Korea University Anam Hospital, Republic of Korea, ³Sejong General Hospital, Republic of Korea

Background: Apical hypertrophic cardiomyopathy (HCM) is considered to have a benign prognosis in terms of cardiovascular mortality until now. Prevalence of sudden cardiac death and current status of implantable cardioverter-defibrillator (ICD) implantation in patients with apical HCM remain to be elucidated.

Methods: Between July 2001 and February 2020, 37 HCM patients who had undergone ICD implantation from two tertiary hospital were reviewed. We evaluated the prevalence of apical HCM and indication for ICD implantation.

Result: Eleven patients (29.7%) were apical HCM and 26 patients (70.3%) were septal HCM. Eighteen patients (48.6%) received ICD implantation for the primary prevention and 19 patients (51.4%) received for the secondary prevention. Among apical HCM, six patients (54.5%) presented with aborted sudden cardiac death and documented VF, therefore received ICD implantation for the secondary prevention.

Conclusions: Clinical outcomes in patients with apical HCM are not always as benign as previously thought. ICD implantation should be considered in high risk patients with apical HCM as the same manner with septal HCM according to the guideline recommendations.
**PO-10**

**Clinical Characteristics of Long QT Syndrome in Korean Population**

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**Background:** There are not many data on the clinical characteristics of Korean long QT syndrome patients. The aim of this study is to investigate the clinical characteristics of LQTS in Korean population.

**Methods:** We retrospectively reviewed the medical records of probands diagnosed with LQTS at the Korean Inherited Arrhythmia Registry and Korea University Anam Hospital from January 2013 to February 2021.

**Result:** A total of 61 patients were enrolled, of which 13(21.3%) were male and 48(79.7%) were female. The mean age at diagnosis was 36.3±17.3. The aborted cardiac arrests were more frequent in men (male vs. female; 84.6 vs. 35.4 %, p=0.003). The syncopes events were more frequent in women (male vs. female; 7.7 vs. 37.5 %, p=0.047). Ventricular arrhythmia was documented in 34 patients (55.7%). The average LQTS score was 4.5±1.4 and there was no significant difference according to sex (male vs. female: 4.1±1.1 vs. 4.7±1.4, p=0.216). The age of LQTS diagnosis was median 48.5[29-79] years for asymptomatic patients and 26[17-66] years for symptomatic patients (p=0.002). The most common symptom at LQTS diagnosis was aborted cardiac arrest in 28 patients (54.9%), followed by syncope in 19 (37.3%), dizziness in 2 (3.9%), seizure and palpitation in each 1 (2%). 47 patients (77.0%) were taking beta-blocker. A total of 38 patients (62.3%) were implanted intracardiac defibrillator. On multivariable Cox proportional hazard analysis, younger diagnosis age (hazard ratio [HR]: 0.818; 95% confidence interval [CI]: 0.752 to 0.889; p<0.001) and higher LQTS score (HR 1.317; 95% CI: 1.026 to 1.691; p=0.031) were independent risk factors for the occurrence of ventricular arrhythmia. Men showed borderline significance for the occurrence of ventricular arrhythmia compared to women (HR 2.055; 95% CI 0.920 to 4.591; p=0.079).

**Conclusions:** In Koreans, LQTS patients show various clinical symptoms from asymptomatic to aborted cardiac arrest, and treatment needs to be individualized according to individual risk.
Hypertension and Abnormal Renal Function Increased the Risk of Ischemic Stroke in Anticoagulated EHRA type-1 Valvular Atrial Fibrillation

Rena Winanti, Sunu Budhi Raharjo, Rina Ariani, Dicky Armein Hanafy, Celly Anantaria Atmadikoesoemah, Prima Almazini, Yoga Yuniadi

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Background: Atrial fibrillation (AF) increases the risk of stroke substantially, therefore many scores have been developed to risk stratify these patients. However, most of the previous studies have focused on non-valvular AF. The most widely used risk stratification score is the CHA2DS2-VASC score. Unfortunately, the validation of this score in valvular AF is poor. This study aimed to evaluate the clinical factors and echocardiographic parameters related to the incidence of ischemic stroke in anticoagulated EHRA (Evaluated Heartvalves, Rheumatic or Artificial) type-1 valvular AF patients.

Methods: We conducted a retrospective cohort study based on data from the Indonesian Registry on Atrial Fibrillation (OneAF). Patients with type-1 EHRA valvular AF between January 2015 and December 2019 were analysed. The clinical outcome was an ischemic stroke that occurred during the monitoring period of January 2015 - December 2019.

Result: Among 329 AF patients with mitral stenosis or prosthetic mechanical valves, we found the incidence of ischemic stroke was 17 (5.2%). Multivariate logistic regression analysis showed that two clinical factors, i.e., history of hypertension (OR 5.59; 95% CI: 1.93-16.15; p = 0.001) and estimated Glomerular Filtration Rate (eGFR) ≤ 59 mL/min/m² (OR 3.62; 95% CI: 1.30-10.02; p = 0.013) were independently associated with the incidence of ischemic stroke. No echocardiographic parameters were associated with the incidence of ischemic stroke in this population.

Conclusions: We observed that two clinical factors i.e., history of hypertension and abnormal renal function, were markedly associated with stroke incidence in anticoagulated EHRA type-1 valvular AF patients.
Background: Chronic implantable electronic device (CIED) in elderly patients is increasing worldwide because of patients longer life expectancy. In parallel, the need for transvenous lead extraction (TLE) in this population is also increasing. However, the efficacy and safety of TLE in very elderly patients (≥80 years) are not well known.

Methods: We retrospectively evaluated patients over 80 years of age undergoing TLE procedures between June 2014 to March 2021.

Result: A total of 25 leads (17 right ventricular, 7 atrial, and one defibrillator) in 21 patients were extracted for lead malfunction (n = 9, 42.9%), device upgrade (n = 8, 38.1%), and CIED-related infection (n = 3, 14.3%), or chronic pain (n = 1, 4.8%). The mean age of patients was 83.8 ± 4.5 (range, 80.0 95.0) years. The median lead age was 117.0 (39.0 160.0) months (range, 11.0 261.0). Clinical and complete procedural success of TLE were achieved in 19 (90.5) and 18 (85.7%) using powered sheath (TightRailTM, n = 7, 28.0%), Byrd dilator sheath (n = 5, 20.0%). Three leads (lead age, 14, 31, and 41 months respectively) in three patients were completely removed using simple traction without any specialized tool. Complication were encountered in 3 patients including death (n = 1), cardiac tamponade due to right atrial tear (n = 1), and severe TR due to chordae rupture (n = 1).

Conclusions: The TLE can be performed safely and effectively even in patients over 80 years old, especially with a lead age under 10 years.
Efficacy and Safety of Combined Electroanatomical Mapping and Cryoablation in Adult Patients with Right-Sided Septal Accessory Pathways - A Single Center Experience

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Cardiovascular Center, Taichung Veterans General Hospital and Chiayi Branch, Taichung and Chiayi, Taiwan

Background: Radiofrequency catheter ablation with two-dimensional fluoroscopy for the right-sided septal accessory pathways (APs) might potentially be harmful due to their proximity to the AV node. Combined use of electroanatomical mapping and cryoablation in patients with right-sided septal APs might improve the safety. Furthermore, the efficacy and safety of such approach in adult patients remains unclear. This study was to assess the efficacy and safety of combined electroanatomical mapping and cryoablation in adult patients with right-sided septal APs.

Methods: The Ensite NavX system was used for catheter positioning and mapping. A decapolar electrode was placed in the coronary sinus, and three quadripolar catheters were positioned in the right ventricular apex, the His bundle, and the high right atrium, respectively. Standard protocols depending on the arrhythmic substrate were used for all ablation procedures. Cryoablation was performed by using a 7F 6-mm-tip catheter (Freezor Xtra, Medtronic CryoCath, Canada).

Result: Case 1 and 2 were 26 and 24 year-old females of orthodromic atrioventricular re-entrant tachycardia (AVRT) using a retrograde para-Hisian AP and a right-sided antero-septal AP, respectively. These 2 septal APs were abolished with cryoablation during ventricular pacing. Case 3 was a 19 years-old male with ventricular pre-excitation using both a left-sided AP and a right-sided mid-septal APs. The left-sided AP was treated with radiofrequency energy, while the right-sided mid-septal AP treated with cryoablation. No immediate AV block was observed during the cryoablation procedures. After a mean follow-up of 58±27 days, no recurrence of AVRT or ventricular pre-excitation was observed.

Conclusions: Combined electroanatomical mapping and cryoablation in adult patients with right-sided septal APs is safe without immediate complication. The long-term efficacy with this approach remains to be investigated.
Background: Oral anticoagulation (OAC) of atrial fibrillation (AF) using warfarin or non-vitamin K oral anticoagulants (NOAC) prevents two-thirds of ischemic stroke or systemic embolism (SSE). This study investigated the incidence of SSE according to the CHA2DS2-VASc score in contemporary Korean patients with AF.

Methods: For the analysis of contemporary incidence of SSE, we used 9653 nonvalvular AF patients aged ≥20 years enrolled between June 2016 and May 2020 in a prospective, multicenter outpatient registry (COmparison study of Drugs for symptom control and complication prEvention of atrial fibrillation [CODE-AF] registry). For comparison, we used 5855 OAC-naive nonvalvular AF patients aged ≥20 years who were enrolled in the Korean National Health Insurance Service Sample cohort from 2002 to 2008.

Result: In contemporary AF patients, the usage rate of OAC and antiplatelet agents was 73.5% (NOAC 56.5%, warfarin 17.0%) and 23.8%, respectively. During the follow-up period of over 2 years, 165 (0.78 per 100 person-years) patients had SSE. The incidence rates (per 100 person-years) of ischemic stroke were 0.71 in the total population, being 0.29 in low-risk (CHA2DS2-VASc score 0 [male] or 1 [female]) and 0.81 in high-risk patients (CHA2DS2-VASc score ≥2). In comparison, the Korean National Health Insurance Service Sample cohort incidence rates (per 100 person-years) of ischemic stroke were 3.32 in the total population, being 0.23 in low risk and 4.59 in high-risk patients. Contemporary AF patients had a stroke rate that was about one-third of OAC-naive AF patients stroke rate. Incidence rates of SSE showed a clear increase with increasing CHA2DS2-VASc score in both cohorts.

Conclusions: OAC was properly used in 73.5% of contemporary AF patients. Contemporary AF patients had a stroke rate that was about one-third of the OAC-naive AF patients stroke rate. This finding demonstrates that increasing OAC usage can clearly lower the rate of SSE in contemporary AF patients.
Catheter Ablation of Left Atrial Flutter in a Patient with Prior Surgery for Unroofed Coronary Sinus Syndrome and Maze Procedure

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Background: Unroofed coronary sinus syndrome is a rare clinical entity. Left atrial flutter can occur after surgery for congenital heart disease and concomitant surgical atrial fibrillation ablation. Here we report a case of catheter ablation of left atrial flutter in a patient with a history of surgery for unroofed coronary syndrome and surgical atrial fibrillation ablation.

Methods: N/A

Result: A 51-year-old man with a prior history of congenital heart disease was referred for catheter ablation of atrial flutter. He developed dyspnea on exertion (New York Heart Association functional class III) 2.5 years prior to admission, and cardiac workup revealed atrial fibrillation. Very severe tricuspid regurgitation and coronary sinus type atrial septal defect without persistent left superior vena cava (A). Two months later, he underwent an uneventful atrial septal defect closure operation, tricuspid annuloplasty, and a biatrial maze procedure; he was discharged with sinus rhythm. Ten months after the operation, he developed asymptomatic persistent tachycardia. Electrophysiological study was performed: 3 D activation mapping with reference catheter placed along the left atrial floor via the transspetal catheterization suggested perimital flutter as a mechanism of tachycardia. However, the catheter displaced during the mapping preventing full mapping of the tachycardia. We found the orifice between the left atrium and coronary sinus using an intracardiac echocardiography (B) and angiography using a deflectable sheath (C). Under guidance of the multimodality imaging we inserted the reference catheter in the coronary sinus (D). Activation mapping was consistent with perimital flutter (E) and successful ablation of the mitral isthmus with bidirectional conduction block was achieved (E).

Conclusions: Here we report a case of successful catheter ablation of perimital flutter in a patient with a history of surgical closure of unroofed coronary sinus syndrome and maze operation.
Diagnostic Value of Implantable Loop Recorder in Patients with Unexplained Syncope

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Korea University College of Medicine, Republic of Korea

Background: In substantial proportion of syncope, exact cause is not identified because it is difficult to document ECG correlated with event. Thus, an implantable loop recorder (ILR) was introduced for diagnosing with hidden arrhythmia, however, its clinical use is still limited number. We aimed to assess the diagnostic value of ILR for unexplained syncope.

Methods: Between May 2016 to January 2020, all consecutive patients who underwent ILR implantation were studied. We analyzed the electrocardiogram stored in the device.

Result: Among 70 patients (43 male, mean age 50.23 ± 20.31 years old) with unknown causes of syncope, during two years follow-up, significant arrhythmia was detected in twenty three patients (32.9%). Seventeen (24.3%) patients received permanent pacemaker implantation due to symptomatic bradycardia, and all of the arrhythmia was detected between 1 months and 21 months. Thirteen patients (48.1%) showed sick sinus syndrome (7 long pause; 6 tachycardia-bradycardia syndrome). Five patients (8%) had paroxysmal atrioventricular block. Two of the patients with permanent pacemaker implantation was positive in the tilt table test. Three patients underwent radiofrequency catheter ablation for paroxysmal supraventricular tachycardia and atrial fibrillation. The mean duration of the first event was 168.3 days.

Conclusions: This study showed that ILR monitoring detected substantial number of significant bradycardia in patients with unexplained syncope, suggesting that it is an effective diagnostic method that allows to shorten the time for identifying arrhythmic causes.

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