心臟科 Cardiology

October 19, 2025 (Sun)
Room 103

Symposium: AI and Cutting-Edge Echocardiography

時間 Time	題目 Topic	演講者 Speaker
09:00-09:10	Opening Remarks	徐粹烈 Tsui-Lieh Hsu 振興醫院
Moderator:	常敏之 Min-Ji Charng 新光醫院	
09:10-09:30 H-S01	Artificial Intelligence-Enabled Model for Early Detection of Left Ventricular Hypertrophy and Mortality Prediction in Young to Middle-Aged Adults	胡瑜峰 Yu-Feng Hu 臺北榮民總醫院
Moderator:	褚柏顯 Pao-Hsien Chu 林口長庚醫院	
09:30-09:50 H-S02	Predicting Mortality and Hospitalization in Heart Failure with Preserved Ejection Fraction by Using Machine Learning	張捷宇 Chieh-Yu Chang 林口長庚醫院
Moderator:	林芬瓊 Fen-Chiung Lin 林口長庚醫院	
09:50-10:10 H-S03	Deep Learning Significantly Boosts Cardiac Resynchronization Therapy Response Prediction Using Synthetic Longitudinal Strain Data: Training on Synthetic Data and Testing on Real Patients	顏琨麒 Kun-Chi Yen 林口長庚醫院
10:10-10:20	Q & A	演講者及主持人
10:20-10:40	Coffee Break	
Moderator:	郭任遠 Jen-Yuan Kuo 馬偕醫院	
10:40-11:00 H-S04	AI-Assisted Echocardiographic Prescreening of Heart Failure With Preserved Ejection Fraction on the Basis of Intrabeat Dynamics	洪崇烈 Chung-Lieh Hung 馬偕醫院
Moderator:	秦志輝 Chih-Hui Chin 國泰醫院	
11:00-11:20 H-S05	Clinical Applications of Bulls Eye Strain Imaging Case Sharing	鄭凱鴻 Kai-Hung Cheng 七賢脊椎外科醫院
Moderator:	熊名琛 Ming-Chon Hsiung 振興醫院	
11:20-11:40 H-S06	Echocardiography in the Detection of Bioprosthetic Valve Degeneration after Transcatheter Aortic Valve Replacement	殷偉賢 Wei-Hsian Yin 振興醫院
11:40-11:50	Q & A	演講者及主持人
11:50-14:00	Lunch	

H-S01

Artificial Intelligence-Enabled Model for Early Detection of Left Ventricular Hypertrophy and Mortality Prediction in Young to Middle-Aged Adults

Yu-Feng Hu, M.D., Ph.D.
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Concealed left ventricular hypertrophy (LVH) is common in young to middle-aged adults and is strongly associated with adverse cardiovascular outcomes, highlighting the need for early identification. We developed an artificial intelligence (AI) – enabled model using deep learning on 12-lead ECGs from 28,745 patients aged 20–60 years with echocardiography-confirmed LVH and validated performance in independent cohorts, including 225 patients from Japan. The AI model outperformed cardiologists applying conventional ECG criteria (AUC 0.89 vs. 0.64; sensitivity 90.3%, specificity 69.3%) and maintained robust accuracy in external validation (AUC 0.86; sensitivity 85.4%, specificity 67.0%). During a median 6-year follow-up, AI-predicted LVH was independently associated with higher risks of cardiovascular and all-cause mortality (HR 1.91 and 1.54, respectively), with consistent prognostic value across age, sex, and comorbidity subgroups. External validation confirmed generalizability (AUC 0.83). This AI-enabled ECG approach enables accurate, early detection of LVH and effective risk stratification, providing an opportunity for timely intervention to reduce adverse outcomes.

H-S02

Predicting Mortality and Hospitalization in Heart Failure with Preserved Ejection Fraction by Using Machine Learning

Chieh-Yu Chang, MD
Division of Cardiology, Chang Gung Memorial Hospital, Linkou, Taiwan

Few studies have incorporated echocardiography and laboratory data to predict clinical outcomes in heart failure with preserved ejection fraction (HFpEF), prompting our study to use machine learning to identify predictors of heart failure hospitalization and cardiovascular death in HFpEF patients. We analyzed 6,092 HFpEF patients from the Chang Gung Research Database in Taiwan, identified between 2008 and 2017 (2,898 derivation cohort, 3,194 validation cohort) and followed until 2019. We developed a random survival forest model incorporating 58 variables to predict the composite outcome of HF hospitalization and cardiovascular death. During the 2.9-year follow-up period, 37.7% of our derivation cohort and 36.0% of our validation cohort experienced HF hospitalization or cardiovascular death. Our machine learning analysis identified 15 key predictive indicators: age ≥65 years, B-type natriuretic peptide level ≥600 pg/mL, left atrium size ≥46 mm, atrial fibrillation, frequency of HF hospitalization within 3 years, body mass index <30 kg/m², moderate or severe mitral regurgitation, left ventricular posterior wall thickness of <10 or ≥13 mm, dysnatremia, left ventricular end-diastolic dimension of <40 or ≥56 mm, uric acid level ≥7 mg/dL, triglyceride level of <70 or ≥200 mg/dL, blood urea nitrogen level ≥20 mg/dL, interventricular septum thickness of <11 or ≥20 mm, and glycated hemoglobin level of <6% or ≥8%. Our random survival forest model demonstrated robust external generalizability with an 86.9% area under curve in the validation cohort. These findings provide clinicians with evidence-based predictors to identify high-risk HFpEF patients for tailored treatment strategies, potentially improving patient outcomes through more targeted clinical management.

H-S03

Deep Learning Significantly Boosts Cardiac

Resynchronization Therapy Response Prediction Using Synthetic Longitudinal Strain Data: Training on Synthetic Data and Testing on Real Patients

Ying-Feng Chang[1], Kun-Chi Yen[2, 3], Chun-Li Wang[2, 4], Sin-You Chen1, Jenhui Chen[5, 6], Pao-Hsien Chu[2, 4, 7], Chao-Sung Lai[8]

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Cardiac resynchronization therapy (CRT) plays a pivotal role in managing heart failure patients with dyssynchronous contraction. However, predicting CRT response remains a clinical challenge. In this study, we proposed a novel deep learning framework that significantly enhances CRT response prediction using synthetically generated longitudinal strain data. Synthetic training data were created using SMOTE-based algorithms on feature-extracted echocardiographic strain signals. Deep neural networks (DNN) and 1D convolutional neural networks (1D-CNN) were developed, achieving over 90% accuracy when using 4-chamber view data. The model achieved promising performance, indicating that synthetic data can bridge data scarcity and support robust AI model development in cardiology. Our results suggest potential applications of deep learning in improving patient selection and treatment outcomes in CRT.

H-S04

AI-Assisted Echocardiographic Prescreening of Heart Failure with Preserved Ejection Fraction on the Basis of Intrabeat Dynamics

Chung-Lieh Hung

Institute of Biomedical Sciences, MacKay Medical, University

Objectives:

The aim of this study was to establish a rapid prescreening tool for heart failure with preserved ejection fraction (HFpEF) by using artificial intelligence (AI) techniques to detect abnormal echocardiographic patterns in structure and function on the basis of intrabeat dynamic changes in the left ventricle and the left atrium.

Background:

Although diagnostic criteria for HFpEF have been established, rapid and accurate assessment of HFpEF using echocardiography remains challenging and highly desirable.

Methods:

In total, 1,041 patients with HFpEF and 1,263 asymptomatic individuals were included in the study. The participants' 4-chamber view images were extracted from the echocardiographic files and randomly separated into training, validation, and internal testing data sets. An external testing data set comprising 150 patients with symptomatic chronic obstructive pulmonary disease and 315 patients with HFpEF from another hospital was used for further model validation. The intrabeat dynamics of the geometric measures were extracted frame by frame from the image sequence to train the AI models.

Results:

The accuracy, sensitivity, and specificity of the best AI model for detecting HFpEF were 0.91, 0.96, and 0.85, respectively. The model was further validated using an external testing data set, and the accuracy, sensitivity, and specificity became 0.85, 0.79, and 0.89, respectively. The area under the receiver-operating characteristic curve was used to evaluate model classification ability. The highest

area under the curve in the internal testing data set and external testing data set was 0.95.

Conclusions:

The AI system developed in this study, incorporating the novel concept of intrabeat dynamics, is a rapid, time-saving, and accurate prescreening method to facilitate HFpEF diagnosis. In addition to the classification of diagnostic outcomes, such an approach can automatically generate valuable quantitative metrics to assist clinicians in the diagnosis of HFpEF.

H-S05

Clinical Applications of Bulls Eye Strain Imaging Case Sharing

Kai-Hung Cheng, M.D., Ph.D.
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Bulls Eye Strain Imaging is a critical tool in cardiology and cardio-oncology for early detection of cardiac dysfunction. Learned from Marille Scherrer-Crosbie (MSC) at Harvard and MGH, global longitudinal strain (GLS) surpasses ejection fraction (EF) in assessing myocardial deformation and effectively monitors cancer therapy-related cardiac toxicity, such as from anthracyclines. A novel finding, developed with MSC, demonstrates that corrected contraction time with increased time-to-peak/ejection time (TP/ET) reflects period changes (inverse of natural frequency), indicating structural damage. The first cardio-oncology meeting in the Asian Pacific Society of Cardiology (APSC), supported by TSOC, was initiated by the author, applying MSC's teachings, now widely recognized across Asia. Recommended protocols combine GLS, biomarkers (e.g., troponin, BNP), and follow-up imaging to manage treatment-induced cardiotoxicity, also applicable to cardio-obstetrics, underscoring its role in early intervention and personalized cardiac care. Using Bulls Eye Imaging, a 45-year-old asymptomatic male was identified during a health exam, with CT angiography revealing occluded coronary arteries and significant coronary artery disease (CAD).

H-S06

Echocardiography in the Detection of Bioprosthetic Valve Degeneration after TAVR

Wei-Hsian Yin
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The rapid expansion of transcatheter aortic valve replacement (TAVR) into younger and lower-risk populations has heightened the importance of long-term valve durability and the timely detection of bioprosthetic degeneration. Echocardiography remains the cornerstone imaging modality for surveillance, offering a comprehensive, non-invasive assessment of prosthetic valve structure and function.

Bioprosthetic valve dysfunction after TAVR can arise from structural valve deterioration, including leaflet thickening, calcification, and restricted mobility, or from non-structural causes such as paravalvular regurgitation, prosthesis–patient mismatch, pannus formation, and valve thrombosis.

Transthoracic echocardiography (TTE) is the first-line technique, with baseline imaging within 30 days after implantation serving as the critical reference point. Key Doppler parameters include peak transvalvular velocity, mean pressure gradient, effective orifice area, and Doppler velocity index, with a new gradient rise (>10 mmHg) or DVI <0.25 raising concern for obstruction. Serial comparison enables detection of subtle hemodynamic changes suggestive of degeneration. Morphologic evaluation using two- and three-dimensional echocardiography allows direct visualization of leaflet thickening, restricted excursion, and regurgitant jets. Transesophageal echocardiography (TEE) offers higher spatial resolution and is particularly useful in evaluating suspected leaflet thrombosis or complex regurgitant lesions.

Echocardiographic surveillance is complemented by multimodality imaging, particularly cardiac computed tomography, which improves detection of hypoattenuated leaflet thickening and reduced leaflet motion. Nonetheless, echocardiography remains the most practical and widely applicable modality for routine follow-up. Current guidelines recommend TTE at baseline, one year, and annually thereafter, with earlier evaluation if symptoms, new murmurs, or abnormal gradients arise.

In conclusion, echocardiography is essential for the early recognition and longitudinal monitoring of bioprosthetic degeneration after TAVR. Accurate and systematic use of echocardiography not only guides clinical decision-making but also provides critical insights into long-term valve performance in an era of expanding TAVR indications.