H-01

Beyond Reality— New Way to Instruct Echocardiography Learning

Kai-Sheng Hsieh, FACC, FESC
Professor
Structural/Congenital Heart Disease and Ultrasound Center, China Medical University Children's Hospital, Taichung, Taiwan

Ultrasound, including echocardiography, has been introduced into clinical practice for about 70 years. It is currently one of the most important non-invasive clinical examinations in the medical field. With echocardiography, cardiovascular structure and functional can be thoroughly elucidated and give lights for clinicians to evaluate the patio physiology of various congenital/acquired heart diseases. The conduction of echocardiography is now shared by many different medical and peri-medical fields. Thus, the role of instruction for echocardiography is getting widespread importance. Initially, the instruction of echocardiography relied on real-patient practice. Gradually such instruction mode was replaced by mutual role play among the learning team members because the general population's non-willingness to be experimental subjects in the hospital. Gradually and up to now, it is very common for participants in the echocardiogram instruction courses to mutual play as models for peer participants to practice hands-on feeling to learn echocardiography probe-handling. Of course, the echocardiography course director may hire volunteers to serve as models for participants to practice probe-hands on experience. In recent years, echocardiography simulators were commercially available. However, all the above-mentioned ways for echocardiographic learners to get hands on experience are either inconvenient or expensive.

We have thus developed a novel echocardiography hands-on instruction-platform based on head-mounted device and immersive reality environment. I will share the experience of echocardiography instruction system based on this unique platform.

H-02

Intraoperative Echocardiographic Evaluation in Transcatheter Aortic Valve Implantation

Ming-Chon Hsiung
Heart Center, Cheng-Hsin General Hospital, Taipei, Taiwan

Optimal imaging is key in preventing complications during high-risk TAVR procedures. Simultaneous imaging during ongoing fluoroscopy is only possible with TEE at the time of TAVR. "Poking" or protrusion of calcium during valve deployment can be visualized, and the interventionalist is alerted of this finding. For sinotubular calcification, the goal may be to land just below the hunk of calcification, which is also easily done with TEE guidance. The decision to postdilate the implanted TAVR valve in cases of moderate or more PVL and underexpanded valves is also made instantaneously, and this can be performed in a safe manner with continuous imaging. Inability to visualize acute complications may lead to delay in diagnosis and intervention leading to grim consequences. Figure 2 demonstrates the various high-risk features, TAVR complications, and use of TEE during intraprocedural imaging for high-risk TAVR anatomy.

H-03

Value of Transesophageal Echocardiography for Transcatheter Mitral Valve-in-Valve and Valve-in-Ring Implantation

Huan Chiu Lin
Heart Center, Cheng Hsin General Hospital

Transesophageal echocardiography (TEE) has proven to be an invaluable imaging modality for guiding transcatheter mitral valve-in-valve (TMViV) and valve-in-ring (TMViR) implantation procedures.

TEE provides detailed, real-time images, allowing for precise visualization of the mitral valve's structure and function. During TMViV and TMViR procedures, TEE aids in assessing the anatomical suitability of the mitral bioprosthesis, guiding the accurate positioning of the transcatheter devices, and ensuring the proper seating of the new valve within the existing prosthetic valve or annuloplasty ring. The real-time feedback provided by TEE enables immediate intraoperative adjustments, reducing the risk of complications and improving procedural outcomes. This imaging technique enhances the safety and efficacy of TMViV and TMViR interventions, making it an essential tool in transcatheter intervention.

H-04

Update of Echocardiographic Assessment in Infective Endocarditis

Kuang-Tso Lee, MD.
Supervisor of Non-invasive Cardiac Center, Cardiologic Department, Chang Gung Memorial Hospital, Taoyuan, Taiwan.

Infective endocarditis is a condition of direct invasion of the endocardium by pathogenic microorganisms and sequential systemic inflammation. It commonly affects heart valves, leading to the formation of vegetations containing thumb and these microorganisms. Common symptoms of infective endocarditis include fever, petechiae, heart murmurs, fatigue, and anemia. Complications can include valvular insufficiency, heart failure, mechanical cardiac defects, stroke, systemic embolism, kidney dysfunction, and mortality in severe cases. The most typical pathogens are bacterial, with streptococci and staphylococci being the main culprits, but fungal infection could happen in immunocompromised patients. To prevent the complications, early diagnosis and precise treatment could not be emphasized more.

Establishing the diagnosis relies on symptoms, blood cultures, and ultrasound findings. Transthoracic echocardiography, as an initial tool, provides good imaging clarity and diagnostic accuracy. Transesophageal echocardiography can detect even tiny vegetations, and better target the left-sided valves or structures near the left atrium. Moreover, three-dimensional echocardiography has shown superior performance over traditional two-dimensional echocardiography in the decades. It is an essential technique in almost all structural heart interventions.

In 2023, the European Society of Cardiology updated the guideline for diagnosing and managing infective endocarditis, reflecting advancements in the field over the past eight years since 2015. Today, we'll discuss the latest concepts related to this disease and share impressive cases highlighting the role of three-dimensional echocardiography.

H-05

Implementation of Computer Vision in Echocardiography

Lung-Chun Lin
National Taiwan University Hospital

Echocardiography is an essential tool in cardiology, providing real-time imaging of cardiac structures and function. The introduction of computer vision technology marks a transformation in the field, promising improved accuracy, efficiency, and diagnostic capabilities. The integration of computer vision into echocardiography has brought about significant changes, including:

1. Automated Image Acquisition and Quality Assessment: Computer vision can optimize image capture and ensure high-quality images, reducing operator dependency and variability.
2. Segmentation and Quantification: Automatic segmentation of cardiac structures (e.g., chambers and valves) plays a role in precise quantification of parameters in anatomy and function.
3. Diagnostic Assistance and Decision Support: AI systems assist in detecting and diagnosing

pathologies such as cardiomyopathies, valvular diseases, and congenital heart defects through pattern recognition and anomaly detection.

4. Workflow Efficiency: Computer vision can streamline echocardiography workflows, including reducing the time required for image interpretation and report generation.
5. Training and Education: Computer vision can enhance training programs by providing real-time feedback and advanced simulation environments for practitioners.

The automation of routine tasks in cardiology enhances diagnostic accuracy and efficiency. This allows cardiologists to focus on complex decision-making and patient care, ultimately boosting overall productivity and reducing the time burden on healthcare professionals. Computer vision reduces operator dependency and variability, promoting standardization in echocardiographic assessments. This ensures consistent and high-quality care regardless of the operator's experience level. Real-time decision support enables timely and informed clinical decisions, enhancing the responsiveness of cardiac care. Computer vision solutions are scalable and make advanced echocardiographic analysis accessible to a wider range of healthcare settings, including remote and underserved areas, thereby democratizing access to high-quality cardiac imaging.

However, we still face challenges and limitations in the technical, ethical, and regulatory aspects of implementing computer vision. These include concerns about data privacy, algorithmic biases, and the necessity for thorough validation.

The incorporation of computer vision into echocardiography is a major advancement in cardiovascular imaging. It has the potential to improve diagnostic accuracy, patient outcomes, and clinical workflows. Continued research and collaboration are crucial for fully utilizing its capabilities and overcoming implementation challenges.

H-06

Clinical Applications of Coronary Flow Velocity Reserve and Left Atrial Function

Ming-Jui Hung
Section of Cardiovascular Imaging, Division of Cardiology, Department of Internal Medicine, Chang Gung Memorial Hospital at Keelung, Chang Gung University College of Medicine, Keelung City, Taiwan.

Normal coronary arteries, under vasodilatory stimulus, can increase coronary blood flow by up to four times. Resting coronary flow does not change until coronary artery stenosis is over 85%, but under hyperemic conditions, even in 30% to 45% stenosis, coronary flow begins to reduce. After 88% to 93% stenosis, the ability of coronary arteries to increase flow over resting basal levels disappears. The extent to which coronary flow velocity increases over resting basal levels in response to a vasodilatory stimulus is a measure of coronary flow velocity reserve (CFVR). The normal response is a CFVR > 2.0. A reduced CFVR is a strong predictor of all-cause mortality in chronic coronary syndromes, independent and incremental over resting global longitudinal strain and regional wall motion abnormality. A similar prognostic value for major adverse cardiovascular events is observed in ischemia and no obstructive coronary arteries, hypertrophic cardiomyopathy, non-ischemic-dilated cardiomyopathy, and heart transplant recipients. CFVR is suggested as a part of stress echocardiography.

Alterations in left atrium (LA) size and function are associated with cardiovascular outcomes. LA volumes should be measured using LA-focused views and reported indexed to body surface area. Two-dimensional echocardiographic methods for measuring LA volumes are recommended. LA strains changes are associated with heart failure with preserved ejection fraction and elevated left ventricular filling pressures in patients with left ventricular systolic dysfunction. Finally, it was found that adequate therapy can cause reverse remodeling of the LA with improvement in size and function. Therefore, LA is a future therapeutic target in cardiovascular disease.

H-07

Right Heart Assessment and Pulmonary Hypertension

Shao-Fu Chien
Cardiovascular Center, Cathay General Hospital, Taipei, Taiwan

Quantification of right heart parameters is important in a variety of clinical scenarios including diagnosis, prognostication, and monitoring response to therapy. This report revealed the quantification of chamber dimensions and function, as well as assessment of pulmonary hypertension. The complex anatomy of the right ventricle requires special considerations and echocardiographic techniques, which are set out in this document. The clinical relevance of right ventricular systolic function is introduced, with practical guidance for its assessment. Finally, the pulmonary artery(PA) hemodynamics of PA systolic pressure, PA diastolic pressure, mean PA pressure and pulmonary vascular resistance are described. These techniques holding considerable promise, issues relating to the differential diagnosis of pulmonary hypertension.

H-08

Important Echocardiographic Issues in Tricuspid Valve Academic Research Consortium Definitions for Tricuspid Regurgitation and Trial Endpoints

Chia-Hsiu Chang [1,2]
[1]Cardiovascular center, Cathay General Hospital, Taipei, Taiwan
[2]Advisory Committee Member, Food and Drug Administration, Ministry of Health and Welfare.

Interest in the pathophysiology, etiology, management, and outcomes of patients with tricuspid regurgitation (TR) has grown in the wake of multiple natural history studies showing progressively worse outcomes associated with increasing TR severity, even after adjusting for multiple comorbidities. Historically, isolated tricuspid valve surgery has been associated with high in-hospital mortality rates, leading to the development of transcatheter treatment options. The aim of this first Tricuspid Valve Academic Research Consortium document is to standardize definitions of disease etiology and severity, as well as endpoints for trials that aim to address the gaps in our knowledge related to identification and management of patients with TR. Standardizing endpoints for trials should provide consistency and enable meaningful comparisons between clinical trials. A second Tricuspid Valve Academic Research Consortium document will focus on further defining trial endpoints and will discuss trial design options.

H-09

Echocardiography in Percutaneous Intervention for Tricuspid Regurgitation

Su-Chan Chen
Taipei Veterans General Hospital

Secondary tricuspid regurgitation (TR) is prevalent in over 90% of cases, often due to dilation of the right ventricle (RV) or tricuspid annulus (TA), which impairs valve function. According to the 2022 European Society of Cardiology guidelines, surgical treatment is recommended primarily when TR is severe and occurs alongside left heart surgery or in symptomatic patients with RV dilatation, unless there is severe RV dysfunction. Isolated TR surgery poses significant risks and complications due to associated comorbidities. To offer alternatives for high-risk patients, various transcatheter treatments have been developed. Currently, transcatheter edge-to-edge repair (TEER) is the most widely used and supported by extensive evidence.

Transthoracic echocardiography (TTE) is the first-line imaging technique for assessing TR

candidates. It provides initial insights into tricuspid valve (TV) morphology, quantifies regurgitation, evaluates TR mechanisms, assesses RV function, and performs a non-invasive evaluation of pulmonary circulation. TTE is also essential for evaluating left ventricle function and related valve diseases.

Transesophageal echocardiography (TEE) is crucial for detailed assessment of severe TR, particularly in patients with good acoustic windows. It offers a comprehensive view of TV morphology and allows precise evaluation of TR's severity and mechanism. TEE is used to determine the feasibility of TV repair and to choose among various interventions such as TEER, annuloplasty, TV replacement, or lead extraction.

TEER aims to improve valve leaflet coaptation and reduce the regurgitant orifice, usually targeting the commissures with an anteroseptal clipping approach. Clover technique can provide inward pull force on the TA and RV free wall counteracting the typical septo-mural dilation of the TA. The selection of the target area and the number of devices used depend on valve anatomy and jet location, requiring effective collaboration between the interventional cardiologist and echocardiographer.

.