台灣心臟超音波學會
(Taiwan Society of Echocardiography; TSE)
2026 年心臟超音波操作專業技師學術研討會與認證考試
時間:民國 115 年 4 月 12 日(星期日) 08:00~17:00
地點: 台北市北投區振興醫院第二醫療大樓 6 樓國際會議

時間	課程內容	主持人/講師
08:00-08:30	報到	
08:30-08:40	*Opening*	殷偉賢
08:40-09:10	超音波 B-mode 成像原理	林隆君
09:10-09:40	超音波 Doppler 成像原理	劉郡庭
09:40-10:10	醫用超音波的安全性;檢查的紀錄與標示	李三剛
10:10-10:20	*Coffee break*	
10:20-10:50	心臟超音波造影劑的臨床應用	王子林
10:50-11:20	基本原理、實用要點及臨床應用：評估左心室舒張功能	陳美綾
11:20-11:50	感染性心內膜炎及心肌症之超音波診斷	梁馨月
11:50-12:20	瓣膜性心臟病之超音波診斷	楊甯貽
12:20-13:00	*Lunch*	
13:00-13:30	心包膜疾病之超音波診斷	洪明銳
13:30-14:00	先天性心臟病之超音波診斷	張嘉侃
14:00-14:30	傳統杜卜勒、二維及三維指標：評估左心室收縮功能	洪崇烈
14:30-15:00	冠狀動脈心臟病之超音波診斷	簡韶甫
15:00-15:30	超音波常見的假影	林煥湫
15:30-16:00	組織超音波及微粒追蹤超音波的原理及臨床運用	林維文
16:00-16:10	*Closing*	殷偉賢
16:30-17:00	**專業技師認證考試**	

01、演講題目：超音波 B-Mode 成像原理

演講者：林隆君　現職：台大醫院心臟內科臨床副教授

簡歷：　Lung-chun Lin (林隆君) M.D., Ph.D.,

Clinical Associate Professor, 臨床副教授

Division of Cardiology, Department of Internal Medicine, 心臟內科

National Taiwan University Hospital, 臺大醫院

Taipei, Taiwan;

Education:

Ph.D., Graduate Institute of Clinical Medicine, National Taiwan University College of Medicine, 2005.

Concentrations: Cardiac imaging, Echocardiography.

Dissertation: Ultrasonic Integrated Backscatter Imaging Characterizing Myocardium: The Clinical Implications and Applications for Cellular Biology.

M.D., National Taiwan University College of Medicine, 1991.

摘要：

超音波 B-Mode 成像原理摘要：Multiple individual B-mode scan lines can be rapidly transmitted, received, and displayed in appropriate spatial orientation to construct a 2D image of the heart. The initial approach simply used a linear array of 20 piezoelectric crystals placed side by side, each of which transmitted and received signals independently. The resulting scan lines were displayed simultaneously to yield rectangular images.

Current 2D scanners use B-mode scan lines that are independently transmitted and received and are directed through a wedge-shaped sector of cardiac anatomy by means of mechanical or electrical beam steering. A variety of motorized devices are available that can mechanically direct multiple scan lines through a sector arc of the cardiovascular system. The position of the beam in space is derived by determining the orientation of the piezoelectric crystal. Most current 2D scanners use a phased-array approach, where multiple ultrasonic crystals are employed in concert to create individual B-mode scan lines. The piezoelectric crystals are activated in a closely coordinated temporal sequence, so that the individual wavelets produced by each element merge to form a single beam whose direction is determined by the sequence of crystal firing. The beam can be electrically swept throughout a 90-degree sector arc. Also, a firing sequence can be employed that results in dynamic focusing of the beam along its length to achieve minimal beam width and increased resolution. Phased-array 2D scanners employ small transducers with no moving parts that could require repair.

Originally, echocardiographic data were displayed in analogue form on a standard oscilloscope, transferred to a video monitor by a television camera, and hard-copied onto videotape or paper. Currently, computerized analogue-to-digital scan conversion is standard, so the polar signals of individual scan lines are converted to a series of numerical gray-level values for individual box-like picture elements (pixels) aligned along X-Y coordinates. The ability of a digital step-gradation technique to reproduce the continuous gradation of analog methods is a function of the density of pixels in the matrix and the gray level shades available. The digital format provides the opportunity for image processing, enhancement, and quantitation. Storage in digital format can avoid the image degradation inherent in videotape, provide random access and easy comparison of studies, enable rapid image transmission, and prevent deterioration with image copying and prolonged storage. Fully digital acquisition and storage of echocardiograms will be commonplace in the near future, replacing analog videotape recordings.

02、演講題目: 超音波 Doppler 成像原理

演講者： 劉郡庭　 台北振興醫院心臟醫學中心

Current Position:

Attending physician of Pediatric Cardiology, Heart Center, Cheng Hsin General Hospital

Memberships

2020 – present: Taiwan Pediatric Association

2022 – present: Taiwan Society of Cardiology (TSOC)

2023 – present: Taiwan Society of Echocardiography (TSE)

Editorial Board Member

Medical Training

2015 – 2016: Intern, Changhua Christian Hospital (CCH)

2016 – 2017: PGY, MacKay Memorial Hospital (MMH)

2017 – 2020: Resident, Department of Pediatric, MacKay Memorial Hospital (MMH)

2020 – 2022: Fellow of Pediatric Cardiology, Department of Pediatric, MacKay Memorial Hospital (MMH)

Award and Honor

2016 Best Intern, Changhua Christian Hospital (CCH)

Paper Presentations

1. April, 2020 – Taiwan Pediatric Association Annual Conference 2020, oral presentation: Efficacy of Palivizumab prophylaxis protocol for respiratory syncytial virus infection in congenital heart disease children with cardiomyopathy with reduced left ventricular ejection fraction.
2. Sep. 2020 – Taiwan Pediatric Association Annual Conference 2021, oral presentation: A baby girl with right renal artery stenosis, post balloon dilatation and stent implantation.
3. April, 2021 – Taiwan Pediatric Association Annual Conference 2021, oral presentation: A heart out of place: Case report of new-born ectopic cordis.

摘要：

超音波 Doppler 成像原理摘要：In this talk, we will describe basic principles of Doppler ultrasound. In particular, the applications of Doppler effects in detecting blood flows using ultrasound in real time will be introduced. We will start with a review of Doppler principles, the relation between Doppler frequency shift and the corresponding blood flow velocity will then be derived. We will subsequently discuss implementation and performance issues of the following major Doppler modes: CW, PW, Audio and Color.

03、演講題目：醫用超音波的安全性：檢查的紀錄與標示

演講者：李三剛　中山醫學大學醫學研究所兼任教授

現職：　童綜合醫院董事會策略長
臺中榮民總醫院特約醫師
中山醫學大學兼任教授
國防醫學院放射診斷學科兼任教授

簡歷：　國防醫學院醫學系畢業、美國國外醫師資格考試及格
童綜合醫院院長
臺中榮民總醫院院長
臺中榮總放射線部部主任
嘉義榮民醫院兼任灣橋榮民醫院院長
蘇澳榮民醫院兼任員山榮民醫院院長
三總放射診斷部超音波診斷科主任

摘要：

醫用超音波安全性 (Safety of Medical Ultrasound)

- 從開始使用超音波至今的過去四十年間，沒有任何證據顯示診斷用超音波會對病人產生危害
- 由於科技的進步，新的超音波機型不斷推出，新的探頭能產生更佳的解析力與更強的超音波能量
- 應該更謹慎地使用超音波以確保其安全性

安全使用醫用診斷超音波的國際指引與規定

- 超音波生物物理與生物效應
- 是否有危險 (風險)
- 安全指引與規定的發展
- 好處與風險 – ALARA (As Low As Reasonably Achievable)
- 國際標準及指引
- 結論

超音波生物物理與生物效應

- 當超音波穿過人體組織，潛在具有生物作用或生物效應
- 有許多文獻針對瞭解超音波基本機轉與評估對組織潛在傷害的深入研究
- 許多研究都是劑量效應的研究；超音波所引起的不良生物效應都是發生在較診斷用超音波為高的音波強

度

超音波強度(Ultrasound Intensity)

- 單位面積的音波瓦特數 millwatts/cm^2
- 醫學診斷用的音波強度為 1～40mW/cm^2
- 安全標準：連續波形為 1W/cm^2，脈衝波形為 240mW/cm^2 (1 watt = 1000 millwatts)
- 連續波形超音波強度 0.5~3W/cm^2 明顯影響周邊神經傳導
- 復健治療：超音波深部熱療法所使用的強度為 0.5~2W/cm^2
- 清潔器具使用 10~100W/ cm^2
- 在體內震碎結石需要 10W/cm^2
- 超音波熱治療(hyperthermia)：利用組織對超音波的吸收產生熱能，殺死癌細胞(10-1000W/cm2)
  功率單位： 1 瓦 (Watt)= 1 焦爾 / 秒 = 10^7 爾格 / 秒
  1 Watt (W) = 1 J/sec = 10^7 erg /sec (1 卡 = 4.186 焦爾)

超音波生物效應機轉

1.溫度影響：超音波在黏滯物質中傳遞，部份能量會經由物質分子或晶格相互摩擦和鬆弛作用程序而被吸收，此部份被吸收的能量會轉換成熱，並表現在物質的溫度升高。以生理組織來說，熱影響一方面可以幫助治療，另一方面則可能傷害組織，其間差異端賴使用時加在生理組織的超音波強度與時間。

2.非溫度影響：超音波造成之非熱影響可分為輻射壓力、輻射力、聲扭力、聲流作用及空化現象，這些作用的基本源在於超音波引發之周圍壓力變化，其中以空化現象影響最大，可使 DNA 結構斷裂、瓦解血小板或懸浮中的紅血球、或撕裂固態生理組織，在空化汽泡崩潰時所引起之高壓力及高溫度變化可造成生物化學變化而產出自由基。

3.其他影響：超音波所產生的機械性作用，輻射力造成的液體流動與組織表面的壓力。

生物醫學角度超音波的危險因子

(1) 熱效應，(2) 形成氣泡化(cavitation)的機械能，(3) 破壞細胞的應力

超因波非診斷性應用

（治療性超音波）

- 超音波的診斷功能較為人知，但超音波最初的研究與應用是在治療
- 1940 年代時，超音波被用於類似現代的放射與化學治療
- 超音波產生熱能可以在動物組織造成破壞作用摧毀惡性組織

超音波是否有危險 (風險)

超音波生物效應知識的三種來源

- 流行病學
- 實驗室體外(in vitro)細胞研究
- 動物試驗研究

安全指引與規定的發展

- FDA 對音波輸出採用 application-specific 限制
- 眼睛 (17 $mWcm^{-2}$, I_{SPTA})及胎兒(94 $mWcm^{-2}$, I_{SPTA})對於組織的傷害特別敏感，其暴露的允許限制最低
- AIUM 生物效應委員會
  - 沒有單獨的證據確認在哺乳類組織體內(in vivo)暴露在強度低於(100 $mWcm^{-2}$, I_{SPTA})會有明顯的不良生物效應

Safe Ultrasound Exposure

Interaction mechanisms between ultrasound and tissue

Safety Indices:

- Thermal Index (TI)熱量指數
  is a general estimate of the temperature rise
- Mechanical Index (MI) 機械指數
  is a predictive indicator for the potential of initiating inertial cavitation in rare cases where microbubbles of just the right size exist or where the beam is directed at the lung surface
  If the transducer is not capable of producing TI or MI greater than 1, the display of these two values is not required.

如何平衡好處與風險

- 謹慎的使用，可以運用簡單的 ALARA (*As Low As Reasonably Achievable 最低合理達成*)觀念
- 依據 ALARA 原理，當得到理想的診斷訊息時，我們保持最少的超音波暴露

安全的使用原則為：

1. 避免不必要之檢查

2. 在可獲得臨床資料之情形下使用最低之超音波強度
3. 儘可能減少超音波換能器在同一位置靜態檢視之時間

國際標準及指引

- World Federation for Ultrasound in Medicine and Biology (WFUMB)
- American Institute of Ultrasound in Medicine (AIUM)
- Australasian Society for Ultrasound in Medicine (ASUM)
- European Federation of Societies for Ultrasound in Medicine and Biology (EFSUMB)
- U.S. Food and Drug Administration (FDA)

結論

安全問題

- 沒有顯著的證據證實診斷超音波會引起不良的身體效應
- 流行病學的資料有一些限制
- 關於新型強力的診斷設備沒有足夠資料
  - 在 ODS 下操作
  - 脈衝都卜勒、諧波影像、對比劑
- 新趨勢—操作者要對好處與風險分析負責
- ODS 有其限制—只能作為指引
- 在組織/空氣介面或與對比劑發生空洞時，特別注意

04、演講題目：心臟超音波造影劑的臨床應用

演講者： 王子林 新光醫院心臟內科主治醫師

經歷：

2015.04~ 2016.05 英國牛津大學心臟醫學中心 Oxford Heart Center 進修

2015.07~ 迄今 歐洲心臟學院院士

2013.07~ 迄今 中華民國考選部國家醫師考試 OSCE 考官

2011.07~ 迄今 輔仁大學醫學院醫學系臨床助理教師

新光醫院心臟內科主治醫師

學歷：

國立陽明大學急重症醫學研究所碩士

中國醫藥大學醫學系醫學士

摘要：超音波對比劑為一種可被生物分解材質外殼所包覆直徑小於 10 微米的微氣泡，微氣泡是以脂質為殼層包覆氟碳化合物，可被生物體分解且無毒性及不易引起免疫反應。超音波對比劑可以流經肺循環進入左心房及左心室，達到心臟顯影的目的，且也可延長影像對比增強的效果。

目前超音波對比劑在心臟領域的應用包括心室顯影、心臟結構異常鑑別診斷、增強都卜勒訊號及心肌顯影等，可以更正確評估心臟的功能及是否有局部心肌收縮不良。此外，對於心臟腫瘤及心室血栓的鑑別診斷更是超音波對比劑的強項，心肌梗塞後的病人評估是否有心室破裂、心室瘤及心室假瘤形成提供良好的參考，在執行壓力性超音波檢查時，也可以提高冠狀動脈疾病的檢測率。

全世界對於超音波對比劑的共識而言，超音波對比劑是相當安全的劑型，發生過敏反應的比例約為萬分之一，並且超音波對比劑沒有腎毒性，在腎功能不好的病人也可以使用。

4. 演講題目：基本原理、實用要點及臨床應用：評估左心室舒張功能

演講者： 陳美綾 彰化基督教心臟內科主治醫師及心臟生理檢查室主任

學經歷： 2000.9~2008.7 慈濟大學醫學系

2020.02~彰化基督教心臟科主治醫師及心臟生理檢查室主任

2022.06~2023.12 美國加州大學舊金山分校心臟科研究員

2015.12~2019.12 台中慈濟心臟科主治醫師

2013.8~2015.11 花蓮慈濟心臟科主治醫師

2013.8~2015.7 花蓮慈濟內科重症加護病房主治醫師

2011.8~2013.7 花蓮慈濟心臟科研究員

2008.8~2011.7 花蓮慈濟內科住院醫師

摘要:

1. 心臟週期介紹
2. 左心室舒張功能評估參數：原理介紹及測量方法
3. 左心室舒張功能評估流程及臨床運用
4. 特殊狀況判讀流程及特殊參數之介紹
5. 個案分享
6. 總結

06、 演講題目：感染性心內膜炎及心肌症之超音波診斷

演講者： 梁馨月 中山醫學大學附設醫院心臟影像科主任

簡歷：

HOSPITAL

2017 May~: Heart Center, Chen-Hsin General Hospital, Taipei, Taiwan.

2015~2017 Apr: Department of Medicine, National Taiwan University Hospital, Jin-Shan Branch, New Taipei City, Taiwan.

2011~2015: Division of Cardiology, Department of Internal Medicine,
National Taiwan University Hospital, Taipei, Taiwan

EDUCATION

2003 September ~ 2009 June

Doctor of Medicine

Department of Medicine, College of Medicine, National Taiwan University

2016 September ~PhD program

Graduate Institue of Clinical Medicine

National Taiwan University College of Medicine

摘要：Background

- Microbial infection of the endothelial surface of heart (or the arteries)
- Febrile illness
- Persistent bacteremia
- It may involve one or more of four heart valves.
- It may also involve pacing wires or other indwelling catheters in the right heart.

The involving part of the heart

- Typically involves the valves and
    - Chordae tendinae
    - Sites of shunting
    - Mural lesions

The micro-organisms

- Gram positive organisms
  -- Streptococci; S. aureus; Coagulase negative staph.
- Gram negative organisms
    - P. aeruginosa most common
    - HACEK - slow growing, fastidious organisms that may need 3 weeks to grow out of culture
        - Haemophilus sp.; Actinobacillus; Cardiobacterium; Eikenella; Kingella
- Fungi

Epidemiology

- 7-25% of cases involve prosthetic valves
- 25-45% of cases predisposing condition can not be identified

Epidemiology (Adult population)

- MVP – prominent predisposing factor
    - High prevalence in population
        - 2-4%
        - 20% in young women
    - Relative risk in MVP ~3.5 – 8.2, largely confined to patients with murmur
    - Also increased in men and patients >45 y/o

Rheumatic Heart Disease

- 20 – 25% of cases of IE in 1970's & 80's; and 7 – 18% of cases recently
- Mitral site more common in women and Aortic site more common in men

Congenital Heart Disease

- 10 – 20% of cases in young adults and 8% of cases in older adults
- PDA, VSD, bicuspid aortic valve

Minimum diagnostic criteria

- Persistent fever
- Changing heart murmur
- Positive blood culture

Pathophysiology of endocarditis

- Hemodynamic effects
    - Acute valvular regurgitation
    - Valve obstruction
    - Heart failure
    - Intracardiac shunt
    - Tamponade
    - Perivalvular regurgitation

The detection of vegetations by echocardiography

- An abnormal echogenic, irregular mass
- Attachment on the upstream side of the valve leaflet
- Pattern on motion that is dependent on, but more chaotic than, normal valve motion
- Vegetations may be too small to be detected
- Lesions at coaptation line are most common, vegetations may attach to anywhere
- More than one valve can be affected
- Multiple acoustic windows and 2D views needed
- Slow scanning between the standard image planes
- Orthogonal views for further ensure
- The sensitivity of transthoracic echocardiography for vegetations ranges from 50% to 90%.
- Thin mobile strands-- can easily be confused with flail chordae.
- Vegetations may adhere along the surface of leaflet making it thickened.

The Roles of Transesophageal echocardiography

- When the TEE should be considered as the first examination
- Those patients in whom image quality on chest wall imaging is unacceptable
- Those with prosthetic valves
- Those in whom complications such as abscess formation are suspected on clinical grounds

Cardiomyopathy

- Cardiomyopathy represents a diverse group of disease intrinsic to the myocardium. They are a primary myocardial disorder and not related to the effects of conditions such as preexisting valve disease, hypertension, and coronary artery disease
- From a practical standpoint, severe dysfunction due to diffuse coronary disease and the effects of chronic ischemia is often considered a form of cardiomyopathy (ischemic cardiomyopathy)
- Clinically, cardiomyopathies share a constellation of symptoms that can be present to varying degrees, including congestive heart failure, low-output state, fatigue, dyspnea, arrhythmias, and sudden cardiac death
- Echocardiography serves as a definitive tool for establishing the presence and type of cardiomyopathy, may provide information regarding the specific etiology and used to accurately track the physiologic abnormalities associated with the cardiomyopathy

Classification of cardiomyopathy

- Dilated cardiomyopathy
- High-out put cardiomyopathy
- Hypertrophic cardiomyopathy
- Restricitive cardiomyopathy
- Other

Dilated cardiomyopathy

- Idiopathic cardiomyopathy
- Familial cardiomyopathy
- Noncompacted myocardium
- Postpartum cardiomyopathy
- Hemachromatosis
- Infection
  - Post viral myocarditis
  - HIV related
  - Legionella infection
  - Sepsis (gram negative)
- Toxic cardiomyopathy
  - Adriamycin
  - Alcohol
  - Carbon monoxide poisoning
  - Other chemotherapy
- Dilated cardiomyoapthies characterized by four-chamber enlargement with impaired systolic function of both ventricles
- Impaired left ventricular contractility
- Reduced cardiac output
- Elevated left ventricular end-diastolic pressure
- Patient may present with heart failure, range from symptoms of low pulmonary or venous congestion to symptoms of low forward cardiac output. Coexisting mitral regurgitation is present. In addition, pulmonary hypertension is usually exist
- Left ventricular dilatation：Increasing sephricity of left ventricular geometry
- Apical and lateral displacement of papillary muscles
- Function mitral regurgitation
- Left ventricular thrombus
- Left atrial dilation
- Atrial fibrillation
- Left atrial thrombosis/stasis of blood
- Pulmonary hyerpetnsion
- Tricuspid regurgitation
- Right Ventricular dilatation

Echocardiography approach

- Left ventricular systolic function
  - Quantitative of global and regional function
    - Qunatitaive end-diastolic and en-systolic dimensions or volumes
    - Ejection fraction
- Right ventricular systolic function
  - Quantitative size and systolic function
    - Pulmonary artery systolic pressure

07、演講題目：辦膜性心臟病之超音波診斷

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摘要：Aortic Stenosis

previous section on hemodynamics): Most commonly, aortic stenosis is caused by degenerative valvular calcification. Thickened and calcified cusps cause reduced systolic opening. The aortic valve is reliably visualized with 2D echocardiography, which differentiates noncalcific (doming of aortic cusps in bicuspid aortic valve) from calcific aortic stenosis. The 2D TTE parasternal short-axis view at the level of the aortic valve is used to visualize the number of aortic cusps. Additional delineation of cusp anatomy can be obtained by TEE and 3D echocardiography. Important ancillary information in patients with aortic stenosis readily obtained with echocardiography includes the degree of valvular calcification, aortic annulus and supravalvular ascending aorta size, degree of LV hypertrophy and the presence and degree of subvalvular obstruction, and aortic valve regurgitation.

The echocardiographic assessment of aortic stenosis severity relies on acquiring the following hemodynamic Doppler parameters: peak aortic valve velocity (v), mean pressure gradient, aortic valve area, and the ratio of the LVOT to the aortic valve velocity or TVI. As aortic stenosis severity increases, the valve area becomes smaller and flow velocity and pressure gradients increase. The modified Bernoulli equation (pressure gradient=4×vor [2×v]) is used to reliably measure the pressure gradient across the aortic valve. There may be a small difference between aortic valve pressure gradients obtained by Doppler and catheter methods because of the pressure recovery phenomenon. The pressure gradient depends on stroke volume; thus aortic valve area is a better measure to determine the severity of aortic stenosis, especially when stroke volume and cardiac output are decreased. Aortic valve area (AVA) is calculated from the continuity equation (see

$$\text{AVA} = (\text{LVOT area} \times \text{LVOT TVI})/\text{AV TVI}$$

LVOT area, LVOT TVI, and aortic valve (AV) TVI are reliably measured with 2D and Doppler echocardiography. All available transducer positions should be used to record the highest velocity from the aortic valve. When there is marked calcification of the aortic valve and annulus, it may be difficult to measure LVOT diameter and area. The continuity equation can be rearranged as:

$$\text{AVA}/\text{LVOT area} = \text{LVOT TVI}/\text{AV TVI}$$

The LVOT TVI and AV TVI ratio is inversely proportional to AVA and LVOT area ratio. Hence LVOT TVI/AV TVI of 0.25 indicates that AVA is 25 percent of the LVOT area. Because the LVOT area is usually 3 to 3.5cm^2, a ratio of less than 0.25 indicates AVA of 0.8cm^2 or less, consistent with severe aortic stenosis.

Aortic stenosis is usually severe when patients with normal LV systolic function and cardiac output demonstrate the following echo-Doppler hemodynamics: (a) peak aortic valve velocity is greater than or equal to 4.5 m/sec, (b) the mean pressure gradient is greater than or equal to 50 mm Hg, (c) LVOT/AV TVI less than or equal to 0.25, or (d) the aortic valve area is less than or equal to 0.75cm^2. ACC/AHA Guidelines recommendations selected a lower degree of stenosis with which to consider aortic valve replacement in patients with symptoms, LV dysfunction, or need for coronary artery bypass surgery. These criteria include a peak velocity of greater than 4.0 m/sec, a mean pressure gradient greater than 40 mm Hg, and an aortic valve area less than 1.0cm^2. The peak velocity threshold of 4 m/sec was selected because of natural history data indicating a high likelihood of symptoms or other indications for surgery at this degree of stenosis

The Doppler-derived aortic pressure gradient is generally higher, and the Doppler-derived aortic valve area is smaller than the catheter-derived aortic pressure gradient and aortic valve area. Thus the American Heart Association/American College of Cardiology recommendation that aortic valve area less than or equal to 1cm^2 is severe aortic stenosis overestimates the severity of aortic stenosis when aortic valve area is calculated with 2D Doppler echocardiography.

Determination of aortic valve hemodynamics depends on LV systolic function and cardiac output. The peak aortic velocity and mean aortic pressure gradient may be less than 4.5 m/sec and less than 50 mm Hg, respectively, in patients with severe aortic stenosis when LV function and stroke volume decrease. Conversely, aortic stenosis may not be severe even when the peak velocity is greater than or equal to 4.5 m/sec and the mean gradient is greater than or equal to 50 mm Hg when cardiac output is increased, as in aortic regurgitation or anemia. In these situations, the LVOT/aortic valve TVI (or velocity) ratio and aortic valve area are more helpful in determining the severity of aortic stenosis because of proportional change in velocities.

Aortic Regurgitation

Aortic regurgitation may be caused by an abnormal aortic valve such as a congenitally abnormal valve, endocarditis, drug-related valvulopathy, or degenerative calcific aortic valve. Ascending aorta causes of aortic regurgitation include a dilated aortic root and aortic dissection. Structural abnormalities causing aortic regurgitation are usually

detected on 2D echocardiography. In patients with chronic severe aortic valve regurgitation, the LV is dilated and pulsation of the aorta is evident.
Echo-Doppler methods of assessing aortic regurgitation include the following: (a) The aortic regurgitant jet area is assessed from the parasternal short-axis view relative to the short-axis area of the LVOT at the level of the aortic annulus. The width of the regurgitant jet at its origin relative to the dimension of the LVOT is also a good predictor of the severity of aortic regurgitation. (b) Pressure half-time measures the continuous wave Doppler signal, which corresponds to the pressure difference between the aorta and the LV. The pressure half-time of aortic regurgitation becomes significantly shorter with severe aortic regurgitation because of a rapid increase in LV diastolic pressure and decrease in aortic pressure. However, this velocity may also be shortened by increased LV diastolic pressure from other causes. (c) Holo-diastolic retrograde flow can be demonstrated in the descending thoracic aorta and in the abdominal aorta in severe aortic valve regurgitation. (d) In case of acute severe aortic regurgitation, LV diastolic pressure increases rapidly, resulting in a restrictive diastolic filling pattern in mitral inflow. (e) Regurgitant volume and orifice area can be quantified with the volumetric or PISA method. (f) The vena contracta is the smallest neck of the color flow region at the level of the aortic valve, immediately below the flow convergence region. The vena contracta is usually measured from the parasternal long-axis view, and a vena contracta greater than 6 mm is specific for severe aortic regurgitation. Severe aortic regurgitation by echocardiography:

1. Regurgitant jet width/LVOT diameter ratio greater than or equal to 60 percent
2. Vena contracta greater than 6 mm
3. Regurgitant jet area/LVOT area ratio greater than or equal to 60 percent
4. Aortic regurgitation pressure half-time less than or equal to 250 ms
5. Restrictive mitral flow pattern (usually in acute setting)
6. Holodiastolic flow reversal in the descending thoracic or abdominal aorta
7. Effective regurgitant orifice greater than or equal to 0.30cm2
8. Regurgitant volume greater than or equal to 60 mL
9. Regurgitant fraction greater than or equal to 50 percent

Mitral Regurgitation

Comprehensive echocardiography identifies the underlying cause of mitral regurgitation, which may be related to a cleft or other congenital mitral valve abnormality, mitral valve prolapse, mitral annulus calcification or dilatation, papillary muscle dysfunction or rupture, rheumatic valve involvement, drug-induced valvulopathy, endocarditis, or perforation.
Echo-Doppler methods of assessing mitral regurgitation include the following: (a) qualitative assessment using color flow imaging—the area of the regurgitant jet relative to the size of the LA has been shown to correlate well with regurgitant severity determined with angiography when the jet is not eccentric. However, color flow imaging of valvular regurgitation depends on technical machine settings, loading conditions, and jet geometry. A flow jet directed against the atrial wall appears smaller than a free jet of the same regurgitant volume (Coanda effect). (b) Antegrade flow (mitral inflow) velocity increases with severe regurgitation. (c) The continuous wave Doppler spectrum may have a characteristic configuration (due to the V wave) with increased intensity and reduced systolic velocity as the increase in LA pressure reduces the transmitral systolic gradient. (d) In severe mitral regurgitation, there may be systolic flow reversal in the pulmonary vein. (e) The vena contracta is the narrowest portion of the mitral regurgitation jet downstream from the orifice. It represents the physiological or effective orifice area of the regurgitant jet as opposed to the actual anatomical orifice area, and the vena contracta width correlates well with other quantitative measures of mitral regurgitation severity. (f) Regurgitant volume, fraction, and orifice area can be calculated with the volumetric or PISA method to assess the severity of mitral regurgitation. It should be emphasized that the determination of regurgitation severity should incorporate LV volume, which should increase with severe degrees of chronic aortic or mitral regurgitation. A normal LV volume is not consistent with severe chronic aortic or mitral regurgitation.

08、演講題目：心包膜疾病之超音波診斷

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摘要：心包膜疾病包含了

❶心包膜積液(可能併發心包填塞)，

❷心包膜發炎(可能併發窄縮性心包膜炎)，

❸併發左心室偽瘤。

這些年來心臟超音波的進展已經從傳統的二維及 M-mode 心臟超音波更進步到血流或是組織的都卜勒超音波來做鑑別診斷，這些診斷的標準已經在 2013 年美國心臟超音波學會及 2015 歐洲心臟醫學會已經做了更精進的修正。

09、演講題目：先天性心臟病之超音波診斷

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Licensure and certification

1982~ National Board of Medical Examination, Taiwan
1982~ ECFMG, medical part
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1987~ Certified Sub-Board in Pediatric Cardiology, Taiwan Society of Cardiology
1993~ Certified Board in Neonatology, Taiwan
1995~ Certified Board in Pediatric Emergency and Critical Care
1996~ Certified Instructor in Advanced Cardiac Life Support Course

摘要：Atrial Septal Defect
(1) secundum,
(2) primum or partial atrioventricular canal
(3) sinus venosus,
(4) coronary sinus atrial septal defect.

A complete TTE examination can detect most primum and secundum atrial septal defects, but sinus venosus defect is visualized in only about 70 percent of patients.

TEE is exquisitely sensitive for the identification of all types of atrial septal defect, as well as associated anomalous pulmonary venous connections.

Each form of atrial septal defect is normally associated with a left-to-right shunt, which eventually results in RA and RV volume overload.

It is not necessary or recommended to quantify shunt volume by Doppler measurements.

These assessments are often inaccurate because of the number of component measurements involved in the calculation of multiple stroke volumes.

The TTE finding of an atrial septal defect with associated right-heart enlargement is enough to warrant closure of the defect in the absence of pulmonary hypertension.

Pulmonary hypertension of a magnitude that would preclude surgical or device closure is rare and can be recognized on 2D and Doppler echocardiography studies.

Confirmation of fixed pulmonary hypertension requires cardiac catheterization and hemodynamic assessment.

Routine cardiac catheterization is not required to establish the diagnosis of atrial septal defect.

Ventricular Septal Defect (VSD)

Ventricular septal defects are common, occurring in approximately 20 to 25 percent of patients with congenital heart disease.

Often, they are small, isolated defects that cause no symptoms, but multiple ventricular septal defects may occur in the same patient.

Large ventricular septal defects cause a large left-to-right shunt and pulmonary hypertension.

Left-heart volume overload and RV hypertrophy are features that should suggest the presence of a large ventricular septal defect.

If unrepaired, large defects may cause irreversible pulmonary vascular obstructive disease, even in young children. These defects can occur in various locations in the ventricular septum.

There are four major categories of ventricular septal defect:

The most common type in adults is the membranous type.

These are located at the junction of the muscular, atrioventricular, and outlet portions of the septum.

They are adjacent to the aortic and tricuspid valves, which may eventually cause aortic or tricuspid valve regurgitation; thus, prolonged echocardiographic surveillance is recommended.

The most common ventricular septal defect in newborn is the muscular type.

They are most often located in the apical two thirds of the ventricular septum. Remote from any cardiac valve, they are not associated with progressive valve dysfunction.

Most of these defects are small and close spontaneously early in life.

A large muscular ventricular septal defect can cause a large left-to-right shunt, with eventual pulmonary hypertension.

The third most frequent type of ventricular septal defect is the one seen with complete atrioventricular septal defects.

This type usually occurs as part of a complete atrioventricular canal defect, but occasionally it may be seen in isolation.

Supracristal, or subarterial, ventricular septal defect

It is located in the outlet septum, immediately adjacent to both the aortic and pulmonary valve annulus at the base of the heart.

As a result, the right aortic cusp may be unsupported and prolapse into the ventricular septal defect.

Aortic cusp prolapse restricts the functional size of the defect but distorts the aortic valve and is associated with aortic valve regurgitation. Elective repair of this ventricular septal defect is usually recommended to prevent progressive aortic cusp prolapse and regurgitation.

A comprehensive TTE examination can identify a ventricular septal defect in more than 90 percent of cases.

Continuous wave Doppler echocardiography can measure the blood flow velocity and gradient across the defect.

A large ventricular septal defect will have a smaller pressure difference between the ventricles; conversely, a small defect would have a large gradient (i.e., velocity).

Rarely, TEE is used to improve imaging in patients with a known or suspected ventricular septal defect.

Patent Ductus Arteriosus

Patent ductus arteriosus is an arterial communication between the upper descending aorta and the distal main pulmonary artery, near the origin of the left pulmonary artery.

Echocardiographic diagnosis is based on demonstrating a persistent anatomical connection and flow between the descending thoracic aorta and the pulmonary artery.

The best imaging views include the high left parasternal long-axis scan of the RVOT and main pulmonary artery and the suprasternal view.

A patent ductus arteriosus associated with pulmonary hypertension may be difficult to visualize with TTE or TEE because of equalization of pressures between the two vessels.

High Doppler velocities across the patent ductus suggest low pulmonary artery pressure.

10、演講題目：評估左心室收縮功能：傳統杜卜勒、二維及三維指標

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摘要：Objective　To investigate the clinical value of real-time three-dimensional echocardiography(RT-3DE)for assessment of left ventricular systolic synchronicity.Methods　Thirty healthy volunteers and 62 patients with chronic heart failure were enrolled in this study.TDI and RT-3DE data was acquired with the iE33 systems then analyzed by the Qlab software (version 4.2).Synchrony indexes of TDI (Ts 12-SD) was calculated from each of these parameters as the SD from each of the 12 examined segments.The percentage of standard deviation and maximal difference of the time to minimal systolic volume in appointed segments (Tmsv) were standardized by cardiac cycle such Tmsv 16-SD%，Tmsv 12-SD%，Tmsv 6-SD%，Tmsv 16-Dif%，Tmsv 12-Dif% and Tmsv 6-Dif% as the indexes of left ventricular systolic synchronicity.Spearman coefficient was performed to investigate correlation between the indexes of systolic asynchrony obtained by two ways.The agreement of two ways was analyzed by Kappa value.Results　There were moderate postive correlation among Tmsv 16-SD%，Tmsv 12-SD%，Tmsv 16-Dif%，Tmsv 12-Dif%and Ts 12-SD respectively(r＝0.651，0.639，0.626，0.646，P＜0.01)，while lower postive correlation among Tmsv 6-SD%，Tmsv 6-Dif% and Ts 12-SD respectively(r＝0.332，0.347，P＜0.01).The agreement of two ways was analyzed by Kappa value，κ＝ 0.660，0.652，0.373，0.721，0.735 and 0.362 respectively(P＜0.01).Conclusions　The new method for the measurement of LV synchronicity by RT-3DE regional volumetric-time curves could quantify LV mechanical asynchrony in patients with chronic heart failure.Agreement among Tmsv 16-SD%，Tmsv 12-SD%，Tmsv 16-Dif%，Tmsv 12-Dif% and Ts 12-SD were more higher than Tmsv 6-SD% and Tmsv

11、演講題目：冠狀動脈心臟病之超音波診斷

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高血壓、糖尿病、高血脂、心臟衰竭、瓣膜性心臟病、心律不整、冠狀動脈疾病

摘要： Echocardiography is a non-invasive diagnostic technique which provides information for cardiac function and hemodynamics. In a patient with chest pain, transthoracic Echocardiography is essential for diagnosing acute coronary syndrome, evaluation of ventricular function and the presence of regional wall motion abnormalities.
Echocardiography also can rule out other etiologies of acute chest pain or dyspnea, including aortic dissection and pericardial effusion. Echocardiography is a versatile imaging modality for the management of patients with chest pain and assessment of left ventricular systolic function, diastolic function, and even myocardial and coronary perfusion and is, therefore, useful in the diagnosis and triage of patients with acute chest pain or dyspnea. This topic has focused on the current applications of echocardiography in patients with coronary artery disease and myocardial infarction.

12、演講題目：超音波常見的假影

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心導管冠狀動脈支架置入術

胸前及經食道超音波

複雜性結構性心臟病影像分析判讀(包括經導管瓣膜介入、先天及後天性心臟疾病)

摘要：An image artifact is any image attribute, which is not present in the original imaged object. It is sometime the result of an improper operation and technique of the image, and in other times a consequence of natural processes or properties of the human body. In addition to helpful artifacts, there are several that hinder proper interpretation and diagnosis. These must be avoided or properly handled when encountered. Artifacts in sonography occur and present as, not real, missing, improperly located, and oft improper brightness, shape, or size. Some artifacts are produced by improper equipment operation or settings(e.g. incorrect gain and compensation settings). Others are inherent in the sonographic and Doppler methods and can occur even with proper equipment and technique. The assumptions in the design of sonographic instruments are that sound travels in straight lines, echoes originate only from objects located on the beam axis, the amplitude of returning echoes is directly related to the reflecting or scattering properties of distant objects, and the distance to reflecting or scattering objects is proportional to the round-trip travel time (13 us/cm of depth). If any of these assumptions is violated, an artifact occurs. Several artifacts are encountered in Doppler ultrasound, such as aliasing, range ambiguity, spectrum mirror image, location mirror image, and speckle. Common artifacts that occur in sonography are listed in the following, included section thickness, speckle, reverberation, ring-down, mirror image, refraction, grating lobe, speed error, range ambiguity, shadowing, enhancement, etc.

Artifacts in diagnostic ultrasound are a reflection or an echo, which appears on the display and represents the real anatomical structure not correctly. An artifact can be a false, multiple or misleading information introduced by the imaging system or by interaction of ultrasound with the adjacent tissue.

13、演講題目：組織超音波及微粒追蹤的原理及臨床應用

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教育部定副教授

摘要：一般都卜勒超音波是利用紅血球的速度對音波頻率的影響來定量血流的速度而組織超音波乃是利用心肌收縮或舒張的速度對音波頻率的影響來定量心肌的速度。與一般都卜勒超音波相比，組織超音波的速度較低但強度較高。利用組織超音波可以定量局部心肌的收縮及舒張的速度，進而檢測局部心肌的收縮及舒張功能，目前已成為臨床上測量心肌不同步及左心室舒功能的重要工具。

微粒追踪超音波的發展利用微粒追蹤的技術(speckle tracking image)追踪心臟二維超音波的特異性迴音，使得心臟超音波可以定量整體及局部心肌功能。近年研究及發展顯示微粒追蹤超音波在分析左心室的不協調，預測心肌梗塞及心衰竭的預後上可以扮演一定的角色。

組織超音波與微粒追蹤超音波是心臟超音波較新發展的兩項重要技術，組織超音波有方向性的限制但有較高時間分辨力，而微粒追蹤超音波則無方向上的限制，兩者在評估心臟收縮及舒張功能上愈來愈重要，也是心臟超音波必須認識的兩技