Heart Confessions in the Palm
Point-of-care Echocardiography in the Hospital

Jose Donato A. Magno, MD
Clinical Associate Professor
Section of Cardiology, Department of Medicine
UP College of Medicine – Philippine General Hospital

Jose Donato Acuna Magno, MD
Internist - Cardiologist

• Clinical Associate Professor, UP College of Medicine
• Training Officer, Angeles University Foundation Section of Cardiology
• Director, Philippine Society of Echocardiography
Industry Disclosures

- I have previous and current CME/CPD engagements (Speakers Bureau, Lectures and Focused Group Discussions, Clinical Trials, Research Grants, Creative learning platforms) with various industry partners (GE, Biosolutions, Servier, LRI-Therapharma, Merck, Menarini, Sandoz, Astra Zeneca, Takeda, Innogen, Bayer, Jannsen, Corbridge, Pfizer/Bristol-Myers Squibb, Torrent, GX)

Conflict of Interest

- None
Commonality of Interest

ASE. ASEAN. PSE
Engendering Excellence in Echocardiography

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Point-of-care Echocardiography in the Hand

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Learning Objectives

- Recognize the current dilemmas in cardiac imaging
- Identify the important imaging issues that matter to both patient and clinician
- Appreciate the incremental benefit of portable technology
- Realize the cardiac conditions that can be readily recognized by handheld echo
- Formulate strategies to incorporate point-of-care imaging in real-world workflow and practice
- Realize the potential role of handheld imaging in current and future management of heart disease

1 Point of Order

- What are the current dilemmas in cardiac imaging?
- Which imaging issues truly matter to both patient and clinician?
Dilemmas in cardiac imaging

• The science of echocardiography is dynamic.
• The demand for echo is unceasing and continuously growing.
• Resources are maldistributed in some regions of the world.
• Interpretation of echo studies can be subjective and variable.

Dilemmas in cardiac imaging

• Incorrect measurements lead to incorrect assumptions and conclusions
• Echo reports can greatly affect the end-users’ (physician, sonographer, laboratory, patient, community) decisions and behavior
• Non-harmonized and inaccurate techniques create variability and hinder capability for comparison
Issues that matter

- Cardiac size is “important” to the lay
- Heart function is crucial to the physician
- Cardiomegaly may be the first clue to pathology
- Chamber size and function reflect hemodynamics and overall cardiac physiology
- Chamber dimensions on echo usually serve as reference standard for basic non-invasive imaging tests (e.g. electrocardiogram, chest radiograph)

Issues that matter

- **Left ventricular mass (LVM)** can independently predict adverse cardiovascular events and premature death.\(^1\)\(^-\)\(^3\)
- **LA size** is a powerful prognosticator independent of left ventricular systolic dysfunction during stress echo\(^4\) and in patients with preserved ejection fraction\(^5\)
- **LV ejection fraction** is a powerful predictor of mortality among patients with LV systolic dysfunction.

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Process of Investigation

History  Physical Exam  Testing  Treatment

JDAM's Decision Ramp of Uncertainty in Diagnostic Medicine

**2Point of View**

- What is the incremental benefit of portable technology in the diagnosis and management of heart disease?
- Which cardiac conditions that can readily be recognized by handheld echocardiography?
Incremental benefit of miniaturization

- Speed and safety
- Portability
- Accessibility
- Compactness
- Elegance

Image Source: JDAM Echo Library
Conditions that can be diagnosed

- LV Systolic dysfunction
- Cardiomyopathy/cardiomegaly
- Rheumatic heart disease
- Valvular heart disease
- Congenital heart disease
- Effusions
Conditions that can be diagnosed

- LV Systolic dysfunction
- Cardiomyopathy/cardiomegaly
- Rheumatic heart disease
- Valvular heart disease
- Congenital heart disease
- Effusions

2-Dimensional vs. Doppler Echo

<table>
<thead>
<tr>
<th>Parameter</th>
<th>2D Echo</th>
<th>Doppler Echo</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ultrasound target</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Goal of diagnosis</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Type of information</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Mitral stenosis

Miniaturization of Technology

“Capability for cardiac imaging literally and figuratively in the palm of your hands.”

Image Sources:
JDAM Echo Library
UP PGH Noninvasive Cardiac Lab
3 Point of Care

• How can we incorporate point-of-care imaging in real-world workflow and practice?
• Where will handheld imaging find itself in the current and future map of heartcare in the world?

Point-of-care imaging template

• Checklist-type
• Customized worksheet
Echocardiographic Screening for the detection of Cardiac Anomalies in the general population (E-SCAN)

(A heart disease screening tool using handheld echocardiography)

E-SCAN SCREENING WORKSHEET

<table>
<thead>
<tr>
<th>Patient ID#</th>
<th>Age</th>
<th>Sex</th>
<th>HI</th>
<th>Wt</th>
<th>BP</th>
<th>HR</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sono ID#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Machine ID#</td>
<td></td>
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</tr>
<tr>
<td>Venue ID#</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Duration (ss)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Component of screening

Sonographer/Reader’s echo findings

Put a check mark (✓) in the box corresponding to your answer. If the “normal” box is checked, the adjacent column for abnormal findings should be left unanswered.

**CHAMBER AND GREAT VESSELS SITE**

<table>
<thead>
<tr>
<th>Left ventricle</th>
<th>Normal</th>
<th>Remodeling</th>
<th>LVEF</th>
<th>LVH</th>
<th>Calcific</th>
<th>Aneurysmal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Right ventricle</td>
<td>Normal</td>
<td>Dilated</td>
<td></td>
<td></td>
<td></td>
<td>Aneurysmal</td>
</tr>
<tr>
<td>Left atrium</td>
<td>Normal</td>
<td>Dilated</td>
<td></td>
<td></td>
<td></td>
<td>Aneurysmal</td>
</tr>
<tr>
<td>Right atrium</td>
<td>Normal</td>
<td>Dilated</td>
<td></td>
<td></td>
<td></td>
<td>Aneurysmal</td>
</tr>
<tr>
<td>Aorta</td>
<td>Normal</td>
<td>Dilated</td>
<td></td>
<td></td>
<td></td>
<td>Aneurysmal</td>
</tr>
<tr>
<td>Pulmonary artery</td>
<td>Normal</td>
<td>Dilated</td>
<td></td>
<td></td>
<td></td>
<td>Aneurysmal</td>
</tr>
</tbody>
</table>

HEMODYNAMICS

<table>
<thead>
<tr>
<th>LV systolic function</th>
<th>Normal</th>
<th>Abnormal; estimated EF: ____</th>
</tr>
</thead>
<tbody>
<tr>
<td>RV systolic function</td>
<td>Normal</td>
<td>Abnormal</td>
</tr>
</tbody>
</table>

**INTRACARDIAC MASSES / STRUCTURES**

<table>
<thead>
<tr>
<th>ASD</th>
<th>PDA</th>
<th>Patent ductus arteriosus</th>
<th>VSD</th>
<th>PFO</th>
<th>Patent foramen ovale</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ASD: atrial septal defect
PDA: patent ductus arteriosus
PFO: patent foramen ovale
VSD: ventricular septal defect
LVH: left ventricular hypertrophy
LVEF: left ventricular ejection fraction
HI: height
Wt: weight
HI: height
BP: blood pressure
HR: heart rate
LVEF: left ventricular ejection fraction
LVH: left ventricular hypertrophy

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## Indications for Urgent Echocardiography

**2015 Urgent Indications for Transthoracic 2-dimensional Echocardiography**

<table>
<thead>
<tr>
<th>AUC Code</th>
<th>Shortcut Label</th>
<th>Description of test indication</th>
<th>AUC Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>A1</td>
<td>HEMODYNAMIC INSTABILITY</td>
<td>Investigate possible cardiac cause of hemodynamic instability</td>
<td>A9</td>
</tr>
<tr>
<td>A2</td>
<td>ACUTE CORONARY SYNDROME</td>
<td>Evaluate cardiac function in the setting of suspected or documented acute coronary syndrome</td>
<td>A8</td>
</tr>
<tr>
<td>A3</td>
<td>ACS COMPLICATION</td>
<td>Evaluate potential or confirmed complication of myocardial ischemia or acute coronary syndrome</td>
<td>A9</td>
</tr>
<tr>
<td>A4</td>
<td>RESP FAILURE</td>
<td>Evaluate cardiac status in the setting of respiratory failure of uncertain etiology</td>
<td>A8</td>
</tr>
<tr>
<td>A5</td>
<td>INTRACARDIAC THROMBOM</td>
<td>Investigate presence of intracardiac thrombus to guide therapy</td>
<td>A9</td>
</tr>
<tr>
<td>A6</td>
<td>PULMO EMBOLISM</td>
<td>Re-assess RV function and PA pressure in patients with known pulmonary embolism</td>
<td>A7</td>
</tr>
<tr>
<td>A7</td>
<td>CHEST TRAUMA</td>
<td>Investigate possible cardiac injury in the setting of chest trauma</td>
<td>A9</td>
</tr>
<tr>
<td>A8</td>
<td>ANEURYSM</td>
<td>Evaluation of the ascending aorta in the setting of suspected aneurysm/dissection</td>
<td>A9</td>
</tr>
<tr>
<td>A9</td>
<td>ANEURYSM SURVEILLANCE</td>
<td>Re-evaluation of known ascending aorta dilatation or history of dissection to establish rate of expansion or reassess in the setting of a change in clinical status</td>
<td>A9</td>
</tr>
</tbody>
</table>


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## Integration of handheld imaging in various scenarios: Filling in the gaps

- Triaging at the emergency department
- Community-based screening
- Mass-imaging of special populations
- Streamlining of laboratory workflow
  - Focused imaging for inpatients
  - Preliminary staging of outpatients
- Bridging for full echo study
Recap of Learning Objectives

5 Cardiac Imaging Issues that Matter
- Strength
- Chamber size
- Regurgitation/stenosis
- Effusions, Extra/intracardiac masses
- Shunts and Anomalies

5 Benefits of Handheld Imaging
- Speed and Safety
- Portability
- Accessibility
- Compactness
- Elegance

5 Areas for Integration of Point-of-Care Echo
- ER triaging
- Community screening
- Labflow streamlining
- Mass imaging
- Pre-Full study bridging
“Excellence without virtue can be a dangerous thing.”
- JDAM