3D Echocardiography in Assessment of Cardiac Function
In this issue of our Journal, the ASE Position Paper on Three Dimensional Echocardiography is presented. This collaboration from some of the leaders in this field presents a balanced view of this rapidly evolving technology. The paper explains some of the methods for three dimensional acquisition and display, and the current clinical applications. It is always challenging to appraise a technology that continues to undergo improvements at a rapid pace. Updates to this position paper will be required in the future and these will show additional enhancements of, and uses for, the technology. However, one can conclude from the paper that three dimensional echocardiography is an important component to the cardiovascular ultrasound exam and its niche will continue to evolve and expand.

The latest three dimensional echocardiographic systems provide suitable images for clinical use. As with any new technology, users will benefit from a learning period when one gains familiarity with the three dimensional image acquisition, the image preparation, the image display, and image interpretation. We are in the fortunate situation that with only the addition of a specialized transducer, three dimensional images can be obtained with essentially the
Ultrasound technology has improved markedly in the past 10 to 15 years, prompting echocardiographers to extend its use in studying cardiac structure and function. New ultrasound equipment and techniques offer superior image quality, greater accuracy, and expanding capabilities. As a result, more and improved imaging modalities are available for evaluating cardiac anatomy, ventricular function, blood flow velocity, and valvular diseases. Three-dimensional (3D) echocardiography offers the ability to improve and expand the diagnostic capabilities of cardiac ultrasound. However, as with any emerging technology, the enthusiasm to embrace a new technique must be tempered by a critical

BACKGROUND

Attempts to record and display ultrasound images in 3D format were first reported in the 1960s. One of the earliest studies described the acquisition of a series of parallel scans of a human orbit to reconstruct 3D anatomy. Despite the limited technology of the day, these initial studies demonstrated that complex anatomic structures were ideally displayed using 3D techniques. Concerns about image quality and the computational power needed for storage and reconstruction greatly limited the early application of this methodology.

More than a decade later, investigators began to
Best current use for 3D Echo

- Volumetric Echocardiography in the Assessment and Treatment of Heart Failure
- Valve Pathologies
- Congenital Disease Detection
3D Echo in Treating Heart Failure

• Heart Failure #1 Killer
• Diastolic vs. Systolic
• Medical Therapies
• Device Therapies
Superior LV Imaging

TEE View

Nashville Heart Group

Contrast

Hypertrophic
Volumetric Echocardiography

- Fast & Accurate
- EF is not enough!
- Serial Volume Changes with Medical Therapy for Hypertension
- Regional Wall Motion
- Fast Analysis for Mechanical Dyssynchrony
- Validated
Who is using 3D Echo?

- Clinical Cardiology
  - Medical Therapy Guidance
  - Implantation Criteria for ICD and CRT
  - Correlative Imaging for Diagnosis

- CT Surgeons
  - Surgical Planning

- Electrophysiology
  - EF, Device Research, Optimization
Where is the Value?

- Immediately available, Lower cost

- Objective LV Volumetric and Functional Data with Regional Wall Motion

- Accurate LV Mass Serial Tracking of Increase or Reduction in Hypertrophic Disease

- Enhanced speed to diagnosis

- More effective medical management
What do we do with 3D Echo?

- **3D Volumetric Echocardiography**
  - Chamber Quantification
  - Regional Time/Volume Curves
  - Time and Kinetic Parametric Maps

- **Key Pathologies**
  - Hypertrophic Cardiomyopathy
  - Obstructive Cardiomyopathy
  - Systolic and Diastolic Dysfunction
  - Ischemic Heart Disease
Detecting LV Volume Overload
Normal LV Synchrony

Regions of Interest

Time

Volume
Mechanical Dyssynchrony by 3D Waveform

Variant Time to Peak Regional Excursion or TmSV
Timing and Wall Motion Abnormality

- **Timing**
  - R-R Time: 845 ms
  - Tm/s 16-SD: 8.83%

- **Excursion**
  - Excursion Avg: 2.68 mm
  - Excursion SD: 1.61 mm
  - Excursion Min: 0.13 mm
  - Excursion Max: 7.43 mm
  - Excursion Avg: 36.04%
  - Excursion SD: 21.68%

- **Parametric Imaging**

- **Calculation(s)**
  - EF = 16.2%
  - SV = 31.6 ml
The Endless Enigma: LV Remodeling

Heart Failure

Valve Dysfunction

Volume Loading
Comparison of Aortic VTI vs. Real-Time 3D Echocardiography in Determination of Stroke Volume for V-V Timing in CRT Optimization: An Outcomes Based Study

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The Ultimate Tool

- No LV Function assumptions
  - Wall motion over 3000 endocardial points
  - Higher Frame Rate Acquisitions
  - Fully Validated with Cardiac MRI in >16 Studies

- **Regional Comparative Time to Peak** versus Kinetic Parametric Mapping

- State of Art 3D Image Rendering Tools for Anatomical Measurements
Valvular Pathology and 3D Echo

- Mitral Valve
- Aortic Valve

- 3D Color Flow
  (Bidirectional / Isolated)
  - Shunts
  - Prolapse
  - Valve Area
  - Accurate En face Measurements
The Ultimate Tool

Electrophysiology
Heart Failure
CT Surgeons
Device Management

Diagnostic 3D Echo
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