an independent noninvasive measure in subjects not undergoing catheterization. Endocardial borders in parallel cross-sections derived from the voxel data set were traced and volumes calculated as Σ (cavity area × slice height). Stroke volumes were compared with Doppler values (mean of mitral inflow and aortic outflow in the absence of regurgitation).

Results: In 13/18 (72%) of subjects, the inflow, outflow and apical portions of the RV could be included in a rotational scan. In these individuals, 3D echo visually reproduced the crescentic RV shape, and 3D stroke volumes agreed well with Doppler values ($y = 0.87x + 1.1$, $r = 0.95$, SEE = 5.1 ml, mean error = −5.7 ml, related to mild apical foreshortening).

Conclusions: 3D volumetric reconstruction using a rotating transducer can be applied to the human RV and provides convenient gated acquisition and ready spatial appreciation from multiple perspectives, subject to the need for visualizing the RV from a fixed point. It is also quantitatively accurate for RV stroke volume and therefore cardiac output by the transthoracic approach.

11:15

743-4 Dynamic Three-dimensional Reconstruction of Flow Acceleration Towards Regurgitant Orifices in a Pulsatile Flow Model

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To investigate 3-D reconstruction imaging of dynamically accelerating flow convergence (FC) phenomena for quantitating regurgitant flow rates, we used an in vitro pulsatile flow model (Harvard piston pump, model 1423) for two types of regurgitant orifices: rectangular (RECT, length = 8 × width, orifice area = 0.24 cm^2), and an oblique mitral valve prolapse (MVP, orifice area = 0.28 cm^2). Four different dynamic flows were imaged using a Interspec echo system with 3 Nyquist limits (9, 17, 35 cm/sec). These color Doppler FC images were three dimensionally reconstructed with a TomTech computer for each flow. Simulated ECG signals were obtained from an electromagnetic devise attached to the pulsatile pump to synchronize echo Doppler images and TomTech ECG gating (16 gates/beat). Instantaneous peak flow rates were measured using a transonic flow probes and meters attached to the flow models and these reference data were compared with FC data. Over peak flow rates 4.0–18 l/min, the FC method using the 3D measured hemispherical isovelocity assumption showed variable underestimation for both RECT and MVP, especially for low flow rates and higher Nyquist limits (up to 78%, $r = 0.56$). Hemielliptical FC data derived from three 3D reconstructed orthogonal axes demonstrated a good correlation with actual flow rates with slight underestimation for RECT (18%, $r = 0.92$) but for MVP showed more variable underestimation for all conditions (27%, $r = 0.86$). Three dimensional reconstruction of dynamic FC estimated with a hemielliptic model showed better estimation of flow rates for a flat RECT orifice compared to the simple hemispherical model but for more geometrically complicated orifices with flow changing dynamically and variable constraint effects, projection axis measurements are insufficient for the accurate flow rate estimation and surface reconstruction and direct 3D implemented surface area measurements are required.

11:30

743-5 Evaluation of the Accuracy of New Quantitative Image Processing Methods in Measuring the Size of Ventricular Septal Defects Directly on Three-dimensional Echocardiograms and Factors Influencing its Reliability

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Volume-rendered 3-D echocardiography (3DE) can display the shape and size of various ventricular septal defects (VSD). Quantitation of VSD size directly from 3DE images has not been possible and measurements (M) could be performed only in 2DE slices derived from 3DE and required tedious efforts to obtain the correct 2DE slice orientation. Newly developed image processing (IP) algorithms permit *direct M on 3DE images* but the reliability of this method in sizing VSDs is unclear. Also, the effects of operator-dependent IP factors such as thresholding (TH) and opacification (OP) on quantitation are unknown. In this study, we examined the accuracy of *direct 3DE quantification* of VSDs and the influence of TH and OP. We created 17 VSDs of various types and shapes in 9 pig hearts and acquired 2-D images with a transducer mounted on a parallel scanning device (216 image slices over 60 mm distance). 3DE reconstructions were accomplished and *en-face views* of the VSDs were derived. Using the new quantitation tool, we measured the maximum and minimum diameters (Max D and Min D), directly on the 3DE image under optimal IP settings and compared them to independent direct M from the anatomic specimens. M were also performed with changes in TH and OP. *Results:* The VSD site, shape and size on 3DE corresponded well with anatomic specimens. Max D (Mean ± SD) by anatomy was 10 ± 4 mm (range 4–16), and by 3DE was 10±4 (range 4–15); Min D by anatomy was 9 ± 3 mm (range 4–15), and by 3DE was 8 ± 4 (range 5–19). The correlations between 3DE (y) and anatomy were: Max D: $y = 1.0x + 0.3$, $r = 0.88$, $p < 0.001$; Min D: $y = 1.0x - 1.4$, $r = 0.89$, $p < 0.001$. Increased TH by 10 units led to overestimation of the VSD size by 6 ± 18%, while TH decrease by 10 units resulted in 8 ± 13% under-estimation. Increased OP by 10 and 20 units led to overestimation of VSD size by 11 ± 29% and 17 ± 23%. *Conclusion:* 3DE provides unique en-face views of VSDs unavailable by 2DE. VSD size can be measured directly on the 3D image. Inappropriate processing steps can result in unreliable data, however with optimal processing VSDs can be quantified accurately.

11:45

743-6 Three-dimensional Echocardiographic Reconstruction of Congenital Cardiac Septation Defects

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Two-dimensional echocardiography (2DE) and angiography are sensitive and specific when assessing septation defects but provide limited information regarding defect shape and relationships to intracardiac structures. Dynamic 3-D echocardiography (3DE) may provide a unique ability to define and present defect shape and relationship to intracardiac structures. To assess this, we performed 3DE dynamic reconstruction of 25 septation defects in 19 sedated infants and children. Each patient had a computer-driven subxiphoid rotating scan at 1° intervals through 180°. Data were processed into a cubic 3-D data set from which cut planes were defined. A rotating 3DE reconstruction of the intracardiac anatomy sliced at a given plane was displayed. Dynamic 3DE images were compared with: 2-D in all, angiography in 18, and videotaped surgical views in 7. Septal defect identification was as follows:

	VSD (n=16)	ASD (n=9)
2DE	◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆◆	◆◆◆◆◆◆◆◆◆
Angiography	◆◆◆◆◆◆◆◆◆◆☆◆◆◆◆◆	☆☆◆☆☆☆--☆☆
3DE	○●●●○●●●○●●●○●○●	●●○●●●☆●●

For all septation defects completely defined by 3DE (11 VSD; 7 ASD) defect shape, breadth and spatial relationships were clearly displayed in a single projection. With 2DE and angiography, on the other hand, multiple views were necessary to reconstruct a limited mental idea of septal defect characteristics. Of the 5/16 VSDs and 2/9 ASDs not completely appreciated with 3DE: 5 had suboptimal 3DE due to poor 2-D image quality and motion artifact; 1 was a shallow inlet VSD obscured by AV valve tissue; and 1 was a moderate size posterior secundum ASD partially imaged from a 4-chamber 3DE projection. Septation defect 3DE reconstructions closely resembled surgical images in 7/7. *Conclusion:* Though less sensitive than 2DE/angiography, subxiphoid rotational 3DE provided: (1) improved understanding of septation defect shape and spatial relationships; and (2) a unique ability to display septation defects using right heart surgical projections.

TUESDAY AM