1044-55 Accuracy of Three-Dimensional Echocardiographic Measurements of Mitral Valve Orifice Area Using Transthoracic Free-Hand Scanning

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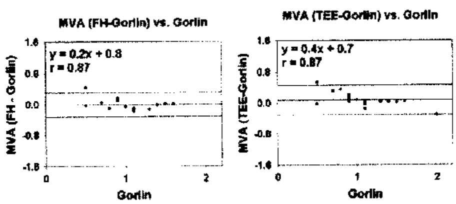
Although three-dimensional (3D) echocardiography has been used to measure mitral valve areas (MVA) in mitral stenosis from both transesophageal (TEE) and transthoracic (TTE) approaches, the accuracy of these techniques has not been compared. Accordingly, we compared the accuracy of mitral valve area measurements obtained with a 3D volumetric free-hand (FH) TTE approach to those acquired with a 3D TEE approach using invasive Gorlin mitral valve area as the "gold standard". Methods: 19 patients (49±16 yrs) with mitral stenosis were studied with TEE and free-hand TTE prior to valvuloplasty. During TEE, 2D images were acquired every 3° over 180° (SONOS 5500). Free-hand images were obtained in 80 planes gated to respiration and heart rate using magnetic tracking, and processed on Omniview (TomTec). Direct 3D mitral valve area measurements reconstructed from TEE and free-hand TTE were compared to invasive Gorlin mitral valve area. Results: Both 3D techniques, free-hand TTE and TEE, were in good agreement with invasive data (Bland-Altmann and correlation, figure). Conclusions. Mitral valve orifice area measurements obtained with free-hand TTE scanning are as accurate as those obtained with 3D TEE, with the advantages of being noninvasive and suitable for serial measurements.



1044-56 Quantification of Variable Geometry Laminar Flow Volumes Using Three-Dimensional Digital Color Doppler: An In Vitro Study

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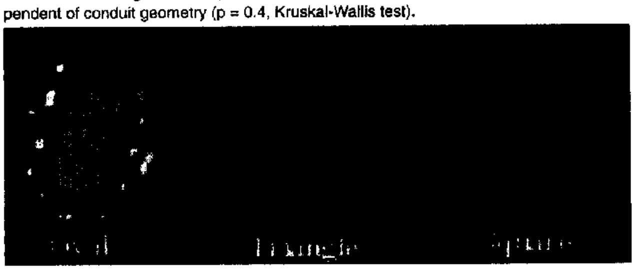
Background: Several methods are available for noninvasive quantification of laminar flow in cardiac structures, including the conventional combination of spectral Doppler and 2D derived area and 2D digital color Doppler based automatic cardiac output measures (ACM); but these methods are limited by geometric assumptions. A 3-dimensional (3D) digital color Doppler technique can potentially overcome these limitations. The current study evaluated whether flow quantitation in a 3D imaged tube system is genuinely independent of conduit geometry. **Methods:** Flow was assessed in 3 geometrically distinct tubes (oval, triangular and square; area 3 cm² each). Nine pulsatile flows (15-55 ml/beat) were generated for each shape. Acquisition was performed using a 7-4 MHz multiplane TEE probe interfaced to an ATL HDI 5000 system with the echo beam parallel to the direction of flow and rotated 180° in 9° increments. The raw scanline data were transferred to HDILab via an Ethernet link and integrated into 3D datasets. Cross-sectional flow area and velocity profile was then analyzed and quantified frame by frame using custom software. Independent confirmation of flow was provided by graduated cylinder measurement and an ultrasonic flowmeter. **Results:** The 3D Doppler digital results demonstrated excellent correlation with flowmeter derived stroke volumes (r = 0.99, 0.97, 0.99 for oval, triangular and square, respectively; p = 0.0001). Calculated flow was independent of conduit geometry (p = 0.4, Kruskal-Wallis test).



1044-57 Calculation of Cardiac Output by Measurement From Tricuspid Inflow Using a 3-D Digital Color Doppler Method: An In Vivo Validation Study

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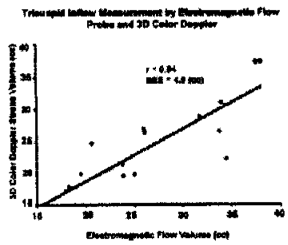
Background: Doppler methods for computing flow across the tricuspid valve have yielded the poorest results of any valve when pulsed Doppler is used. **Methods:** In this study, forward stroke volume (SV) was calculated across tricuspid inflow using a 3D digital color Doppler method and compared with flow recorded simultaneously from an aortic electromagnetic (EM) flow probe. Five open-chest sheep, with surgically induced pulmonary regurgitation but no significant TR, no shunt and no AR, were scanned epicardially using a 7MHz ATL multiplane TEE probe and HDI5000 ultrasound system. A 3D dataset for quantifying tricuspid flow was generated by a 180° acquisition at 6°-9° steps for each steady state; raw scanline data was transferred to a Pentium workstation. The Gaussian theorem was applied off-line to calculate tricuspid inflow (by temporal integration of the digital velocities over a curved 3D surface covering the tricuspid inlet at the level of the annulus). Thus, Doppler data was imaged from the apex parallel to flow and the analysis was performed perpendicular to the direction of flow in 3D space. Inspiration and expiration were averaged in these 3D acquisitions. **Results:** Multiple regression analysis showed that the 3D-derived flow rate for tricuspid inflow correlated well with the EM aortic SV (r = 0.84, SEE = 4.0 cc, mean difference = 2.45 cc/beat). **Conclusions:** This new method may be a noninvasive means of providing accurate flow quantitation for forward flow through the tricuspid valve.



1044-58 Validation of Real-Time Three-Dimensional Echocardiography for Quantifying Right Ventricular Volume: An In Vitro Study in Static and Pulsatile RV Models

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Background: The complicated geometry of the right ventricle (RV) hinders accurate assessment of right ventricular volume (RVV) and function by 2D methods. **Methods:** To validate the accuracy of real-time 3D echocardiography (RT3DE) for quantifying RVV, we developed 40 anatomically accurate static latex models based on 30 plaster casts from porcine hearts (range 24-97 ml) and 10 plaster casts from human hearts (range 65-204 ml) as well as 10 pulsatile latex models (human), which were studied in a water bath. These unique latex phantoms accurately represent the shape of the RV with its outflow tract. Real time 3D scanning was performed with a 3.5 MHz probe on the Volumetrics Model 1 scanner. For the dynamic models a pulsatile flow pump generated 2 different stroke volumes (SV= 29, 64 ml/beat). Static chamber volumes and SV were verified, using water displacement, which served as a reference standard. 3D echo RV volumes were determined by tracing derived B-scans and C-scans, using Simpson's rule. **Results:** There was excellent correlation between RT3DE determination and the static volumes (B-scan: r=0.99, C-scan: r=0.98; p< 0.001) as well as for the SV in the dynamic model (B-scan: r= 0.97, C-scan: r=0.92; p< 0.001). However the C-scans tended to underestimate cavity and SV more than the B-scans [static: 1.4 ± 9.8% (B-scan), -7.4 ± 8.0% (C-scan), p< 0.001; SV: 3.0 ± 19.1% (B-scan), -2.5 ± 20.9% (C-scan), p< 0.001)]. **Conclusions:** RT3DE can be used to quantify RVV without geometric assumptions and evaluate RV function.