analysed by 2 separate observers. TOE and RT-3DE images were acquired digitally on the Philips IE33 ultrasound machine and stored for off-line analysis. The RT-3DE datasets were analysed with Philips Qlab software (version 4.0). Leaflet segments and commissures were displayed in short axis en-face and long axis views. Echocardiographic results were validated intraoperatively.

Results - patients did not have image quality suitable for analysis with RT-3DE and were excluded from analysis. This left a sample size of 39 patients (mean age 52±11 years, 19 male). Twenty - five patients had mitral valve repair and 9 mitral valve replacement. In total, 54 out of 334 analysed mitral valve segments were diseased. Prolapse of a single mitral valve segment was present in 25 patients. 14 patients had complex disease involving 2 or more segments. Sensitivity, specificity and accuracy for TOE in identification of diseased segments were 94%, 100% and 96% respectively. The same value for RT-3DE was 91%, 100% and 94% respectively. The difference was not statistically significant. Accuracies were not significantly different according to segment location. Ruptured chordae was confirmed at surgery in 20 patients. Sensitivity for the diagnosis of ruptured chordae was 90% for TOE and 72% for RT-3DE (p<0.03). Specificity was comparably by both techniques (89% TOE vs 83% RT-3DE). Interobserver agreement was 92% (for TOE (k=0.85) and 86% for RT-3DE (k=0.83), p=non significant). The mean procedure time for TOE was 27 ± 6 minutes. This was significantly longer than the procedure time for RT-3DE (7.3 ± 3 minutes, p=0.3). The mean 3D reconstruction time was 15 ± 2 minutes.

Conclusions: RT-3DE is feasible with comparative accuracy to TOE for preoperative evaluation of prolapsing mitral valve segments. However, the technique is limited by poor image quality in a small proportion of patients. TOE remains superior for diagnosis and localisation of chordal rupture.

3-D ECHO

406 Volumetric Blood Flow Measurement by three-dimensional transoeosophageal Doppler-echocardiography

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Background: Currently, non-invasive methods for quantification of cardiac output (CO) do not account for the three-dimensional velocity profile and are angle-dependent, thus providing inaccurate results. In collaboration with TomTec Munich, we have developed a new software, which has the potential to overcome these limitations as it is angle-independent and allows assessment of velocity profiles by using three-dimensional colour-coded transoesophageal Doppler-echocardiography (3D-Doppler). We have validated CO as assessed by 3D-Doppler versus invasive measurements.

Methods: Twenty-one early postoperative cardiac surgical patients were included in the study. An ultrasound system (Sequoia, Acuson, CA) was used. To acquire 3D velocity distribution in the left ventricular inflow tract, the ultrasound probe rotated synchronous with the pulse in five degree steps by 180 degree around the axis of the ultrasound beam. The volume was reconstructed and displayed three-dimensionally from the obtained data (TomTec 4D Cardio scan) and the data were analysed offline (TomTec 4D Echoview). The results were compared with those obtained simultaneously by pulmonary artery thermodilution.

Results: Three patients could not be evaluated by echocardiography due to poor image quality because of postoperative air between the ultrasound probe and the inflow tract. In the remaining 18 patients, 5 had only sufficient image quality for 13 and 12 heart cycles, respectively. The cross sectional area (CSA) of a regurgitant jet represents a quantitative measure of regurgitation severity. Although the PISA method may be used for this purpose, there are limitations regarding eccentric jets, multiple jets and jets with a complex geometry. Measuring the regurgitant CSA directly from 3D-color-flow images is an alternative to the PISA method. The CSA of the vena cava region, the segment with near-laminar flow just below orifice, has previously been shown to correlate well with the actual orifice area. Using a VE Vigmed Vivid 7 ultrasound scanner and a matrix array probe we measured the CSA of the vena cava region in 2 patients with mitral regurgitation and in a phantom with a circular orifice. The 4D colorflow data was acquired over 6 heart cycles, and stitched to gather to form a full volume based on ECG triggering.

The phantom uses a steady-state flow of a blood-mimicking fluid and it uses orifices with arbitrary size and geometry. For this study we used three circular orifices with area 0.13, 0.28 and 0.58 cm2 and a pressure gradient producing a jet velocity of 4 m/s. The vena cava region was found using high pulse repetition frequency (HPRF) PW doppler by manually searching for a region with maximum velocity and minimum bandwidth. A "banana-shaped" orifice with cross sectional area of 0.39 cm2 was also used to evaluate the performance of the method for a more clinically realistic shape. The recorded data was processed offline using Matlab for high-pass filtering and calculation of power doppler images. The images were visualized using VolumeView, and the diameter of the vena cava region below the orifice was measured. Preliminary results from the circular orifice with area 0.39 cm2 was found to have a circular vena cava orifice with CSA of 0.36 cm2. The vena cava orifice region is known to be more narrow than the opening orifice. Some examples of in-vivo 3D-color-flow images of mitral regurgitation and corresponding cross sectional areas will be presented, as well as images obtained in vitro using the banana-shaped and circular orifices.

Conclusions: Cross sectional area of orifices directed using 3D ultrasound does not have the limitations of the PISA method when it comes to jet location and geometry. We have shown that using a recent ultrasound scanner with 4D color doppler capabilities the CSA of an in vitro severe regurgitation can be measured directly in the vena contracta region.

409 Mechanism of residual regurgitation following a mitral valve repair. A three-dimensional echocardiographic study

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Background: 3D echocardiography extends the scope of 2D echocardiography and enables to evaluate anatomy of complex cardiac structures, i.e. congenital abnormalities, ventricular septal defects or native mitral valve. The aim of this work was determine the mechanism of late failure of mitral valve repair using transoesophageal 3D echocardiography.

Methods and results: Seventeen consecutive patients with significant residual mitral regurgitation on transthoracic echocardiography following repair underwent multiple transoesophageal echocardiography. In addition to Doppler and two-dimensional echocardiography, data for three-dimensional echocardiography reconstruction were obtained. Etiology of residual regurgitation comprised prolapse of a mitral cusp with dehiscence of an annuloplasty ring (82%), isolated progression of the disease (12%) and malposition of annuloplasty ring with progression of the disease (6%). The most common dehiscence site was at the posterior part of mitral annulus (P3) and the rate was gradually decreasing to the anterior leaflet at ante-