1151-115 Rate of Mitral E Wave Propagation to the Left Ventricular Apex Is Dependant Upon the Left Atrial Pressure In Addition to the Rate of Left Ventricular Relaxation

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Mitral E wave propagation to the left ventricular (LV) apex is related to the rate of LV relaxation and promises to give insights into LV early diastolic function. However, the effect of left atrial pressure (LAP) on E wave propagation has not been evaluated. We investigated the impact of LAP on the mitral E wave transit time to the LV apex (T_E) in a pulsatile LV model with geometric and functional similarities to human LV and biphasic mitral inflow pattern. Thirty-five sets of experiments were conducted at a heart rate of 60 bpm and at a wide range of LAP (8–44 mmHg) at different rates of LV relaxation. Flow velocities were obtained using pulsed wave Doppler technique at the mitral leaflet tips and LV apex. T_E was measured from the onset of the E wave at mitral valve to the onset of the transmitted E wave at the LV apex. LV pressure was recorded using Millar catheters. Peak negative dP/dt and Tau were computed.

Results: T_E ranged from 80 to 178 ms and in the group as whole was significantly related to mean LAP ($r = 0.57$, $p = 0.0005$), Tau ($r = 0.48$, $p = 0.0038$), but not to LV peak negative dP/dt. A multiple linear regression model using the above variables accounted for 50% of the variability in T_E (cumulative $R = 0.71$). The effect of LAP on T_E was also a function of the rate of LV relaxation, being more pronounced at slower rates of LV relaxation. The slope of the LAP/T_E regression line was 0.92 ± 0.72 for the half of the settings with shorter Tau compared to 1.47 ± 0.38 for the rest of the half with longer Tau ($p < 0.05$). The regression coefficients for the LAP/T_E relation were 0.32 and 0.70 respectively for settings with shorter and longer Tau values.

Conclusions: This in vitro study indicates that 1) the mitral E wave transmission to the LV apex is affected by LAP in addition to the rate of LV relaxation, 2) this effect is most prominent at slower rates of LV relaxation and 3) factors other than LAP and relaxation rate may affect E wave transmission.

1151-116 The Impact of Power Weighted Mean Velocity on the Evaluation of Volumetric Flow in Small Vessels

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Current assessment of volumetric flow by Doppler ultrasound implies simplifications of flow dynamics, when the velocity-time-integral (VTI) is calculated by maximum velocities of the Doppler power spectrum. We hypothesized that the actual flow profile is better represented by calculation of a power weighted mean velocity (PWV). Therefore we performed an in vitro study to compare the measurements of stroke volume (SV) using two different methods: VTI x cross section area (equation 1) and PWV x cross section area (equation 2). In a pulsatile flow phantom SV was varied between 5 and 20 ml. PW Doppler recordings were obtained in straight and curved tubes (Ø: 3, 4, 6 and 8 mm) with variable stenoses and intravascular catheters. VTI was assessed by automatic tracing of the envelope of the Doppler spectra. A special software was developed to compute PWV from FFT data of a HP Sonos 1000 imager.

Results: In all flow settings both Doppler methods provided a strong linear correlation between the real and the measured SV ($R = 0.98$). In smooth straight tubes (Ø 6 and 8 mm) there were no significant differences of the absolute values. In smaller tubes (Ø: 3 and 4 mm) calculation of stroke volume by equation 1 resulted in an overestimation of the stroke volume up to 50% and 30%, respectively ($p < 0.001$). Up to 4 cm behind stenoses and intravascular probes a significant overestimation of stroke volume was observed, too. Using equation 2 Doppler measurements of SV were not significantly different from the real SV in all flow settings.

Conclusions: In small and curved tubes SV is overestimated by the VTI method. Under these conditions the power weighted mean velocity should be used for assessment of SV.

1151-117 Influence of Heart Rate on Left Ventricular Diastolic Transmitral Flow Velocity Patterns Assessed by Pulsed Doppler and Color M-Mode Doppler Echocardiography in Patients With LV Dysfunction

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Background: Doppler echocardiography has been used to estimate left ventricular (LV) function non-invasively. However, transmittal pulsed Doppler indices, including peak velocities of early (E) and late (A) filling and the E/A ratio have been shown to be influenced by heart rate (HR), preload and afterload. Recently, a modified index FPV/E (FPV: flow propagation velocity) measured by color M-mode Doppler echocardiography has been reported to be a relatively load-independent index of LV relaxation. The aim of this study was to distinguish the physiological change with the alteration of HR from the change in transmitral pulsed Doppler indices and FPV/E.

Methods: Transmitral flow was recorded during atrial pacing at HR of 60, 70 and 80 beats/min (bpm) in 8 patients with LV dysfunction (LV ejection fraction: 45 ± 10%). Hemodynamic indices [LV systolic pressure (LVSP), PCWP, $+dP/dt_{max}$, time constant of pressure decay (tau); obtained by cardiac catheterization] and Doppler indices [E, A, the E/A ratio, time velocity integral of E and A (VTIe and VTIa) and FPV/E] were compared to HR by linear regression analysis, and the influence of HR on Doppler indices was also compared with hemodynamic indices in stepwise multiregression analysis.

Results: (1) E, E/A and VTIe significantly decreased as HR increased, while A, VTIa, FPV/E, LVSP and tau remained unchanged. The physiological changes in E and VTIe per unit of HR were −1.4 ± 0.6 and −2.1 ± 0.6 (%/bpm, mean ± S.E.). (2) Stepwise multiregression analysis revealed that only HR and tau were independently associated with E ($p < 0.05$, $p < 0.05$) and VTIe ($p < 0.001$, $p < 0.05$). (3) FPV/E was associated not with HR but with only tau ($p < 0.001$).

Conclusion: In patients with LV dysfunction, transmitral pulsed Doppler indices were significantly affected by HR, while modified FPV (FPV/E) was not. FPV/E may provide a better estimate of LV relaxation.

1151-118 Effects of Physiological Load of Pregnancy on Left Ventricular Diastolic Characteristics

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Background: Pregnancy offers a unique physiologic model of transient increase in hemodynamic load, but the related effects on indices of diastolic function and interaction between preload, afterload and contractility are not well defined. Therefore, 30 healthy women were studied by serial echo and Doppler exams at 6 time periods: 10–12, 18–20, 28–30 wks gestation, 2–4 and 12–14 wks post-partum.

Results: Compared to the non-pregnant state, E velocity peaked at 18 weeks (0.7 ± 0.1 m/s to 0.9 ± 0.1 m/s), returning to normal levels during late pregnancy ($p = 0.0001$). A velocity peaked at 18 weeks (0.48 ± 0.12 to 0.60 ± 0.13 m/s, $p = 0.0001$), remaining high throughout the rest of pregnancy. Consequently E/A ratio fell significantly during late pregnancy from 1.9 ± 0.4 to 1.4 ± 0.3 ($p = 0.02$). In addition, mean acceleration fell from 18 weeks to term (7.4 ± 1.3 to 5.7 ± 1.4 m/s^2, $p = 0.0001$). Heart rate increased throughout gestation ($p = 0.0001$), preload peaked at 18 weeks, falling to normal levels at term ($p = 0.0001$). Deceleration time was unchanged throughout gestation. Multi-linear regression confirmed the influence of rising HR and mass-volume ratio on the A velocity ($R^2 = 0.35$, $p = 0.008$), and contractility and preload ($R^2 = 0.29$, $p < 0.001$) on E velocity.

Conclusion: During late gestation there is a transient alteration in mitral Doppler inflow velocities characterized by a shift from early to late filling with a decrease in acceleration, suggesting a transient decrease in LV relaxation. Changes in heart rate, preload, contractility and mass-volume ratio influence this alteration.

1152 Stress Echocardiography for Risk Stratification

Tuesday, March 31, 1998, 3:00 p.m.–5:00 p.m.
Georgia World Congress Center, West Exhibit Hall Level
Presentation Hour: 3:00 p.m.–4:00 p.m.

1152-119 Clinical and Dobutamine Echo Predictors of Early and Late Cardiac Events After Vascular Surgery

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Careful clinical evaluation has been recommended to reduce the number of studies for perioperative (OP) risk assessment in pts undergoing vascular surgery (VS). However, limiting OP testing might compromise prediction of late cardiac events (CE). We evaluated the interaction of clinical evaluation and dobutamine echo (DbE) for prediction of OP and late CE in VS pts.

Methods: From 1992–95, 237 consecutive pts had DbE prior to VS. Clinical risk was assessed with the Eagle score. A standard Db-atropine stress was used for DbE; ischemia (ISC) was identified in 39 (16%) by new/worse dysfunction with Db, scar (abnormal rest) was found in 37 (16%). Pts were followed during hospital stay (OP) for cardiac death, infarction and unstable angina; survivors were followed for 28 ± 13 m for late events. Pts (n = 7) undergoing intervention within 3 months of DbE were excluded.

TUESDAY POSTER