dissipation. The former is deleted from the simplified Bernoulli equation, but more importantly, the latter is not characterized by *any* form of the Bernoulli equation. A Reynolds number based approach characterizes the relative importance of these effects and could lead to reconciliation of Doppler and catheter gradients in the clinical setting.

970-7 In Vivo Comparison of Simultaneous Doppler and Hemodynamic Transvalvular Pressure Gradients Across Bileaflet Mechanical Valves in the Mitral Position

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Continuous wave Doppler (CW) is routinely used clinically to measure pressure gradients across bileaflet mechanical mitral valves; however discrepancies with catheter (CATH) gradients have been recognized. Recently it has been hypothesized that inertial and viscous forces, which are partially affected by valve size and orifice geometry, may control pressure recovery and thus play a role in these discrepancies. Therefore, in this study we examined the accuracy of CW derived pressure gradients us a function of valve size and orifice position in an attempt to determine the clinical utility of this technique. In 10 sheep with chronically implanted (anatomic orientation) St. Jude mitral valves (23, 25, 27 mm), 76 hemodynamic states (3 to 14 per sheep) were studied using Millar® catheters in the LA and LV. Peak gradient (PG) range = 2.0–23.0 mmHg; mean gradient (MG) range = 1.9–18.7 mmHg. Simultaneously, a Vingmed 775 with a port for transfer of digital data was used to obtain CW velocities across the three valve orifices: central (C), LV septal (S), and LV free wall (FW). Regression analysis for the 25 mm valve, for which the largest number of studies was available (n = 40), showed CW PG and MG correlated with CATH (PG: $y = 1.28x - 0.16$, $r = 0.89$, SEE = 2.9; MG: $y = 1.05x + 0.03$, $r = 0.88$, SEE = 2.1) but with consistent overestimation. In addition, considerable CW scatter was seen in the moderate range of CATH gradients. Analysis of the 25 mm valve orifices revealed the following % overestimation:

PG (S)	PG (C)	PG (FW)	MG (S)	MG (C)	MG (FW)
27%	32%	19%	4%	8%	0%

The 23 mm (n = 21) valves demonstrated significantly greater overestimation than either the 25 or 27 mm (n = 15) valves for both PG ($p < 0.02$) and MG ($p < 0.05$). *Conclusions:* There is good correlation of CW derived and CATH measured pressure gradients across bileaflet mechanical mitral valves. For a given CATH gradient, the CW derived pressure gradients vary for different valve sizes and their individual orifices. CW overestimated CATH gradients particularly in the smallest valve tested. For all valve sizes and individual orifice CW scatter was noted particularly in the mid range of gradients tested. Therefore, simplified Bernoulli calculations using CW velocities from any specific valve/orifice, although useful, are limited as accurate clinical predictors of CATH gradients.

971 Quantitative Assessment of Perfusion

Tuesday, March 21, 1995, 3:00 p.m.–5:00 p.m.
Ernest N. Morial Convention Center, Hall E
Presentation Hour: 4:00 p.m.–5:00 p.m.

971-54 A Non-invasive Method of Visually Assessing Renal Perfusion Using a Newly Developed Intravenous Ultrasound Contrast

Thomas R. Porter, Feng Xie, Karen L. Kilzer. *University of Nebraska Medical Center, Omaha, Nebraska*

Present methods of quantifying renal artery blood flow (RABF) in renovascular disease require either radionuclide techniques or invasive delivery of radiographic or ultrasound contrast. Perfluoropropane is a gas routinely used for intraocular injections which, when sonicated with dextrose albumin (PESDA), produces microbubbles with prolonged survival in blood. We hypothesized, therefore, that this prolonged ultrasound contrast effect could be utilized to non-invasively evaluate RABF and perfusion. Accordingly, we gave intravenous injections (IVI) of PESDA (0.06 cc/kg) to seven dogs while imaging with an external 4.5 MHz linear array transducer. RABF was monitored using a Transonic Doppler probe placed around the renal artery. Contrast two-dimensional enhancement was quantified off-line. Both echo and color Doppler enhancement were also qualitatively graded as 0 = no enhancement, 1+ = mild, 2+ = marked enhancement.

Following all 36 (100%) IVI of PESDA, there was 2+ contrast ultrasound enhancement of the renal cortex. A linear correlation existed between Doppler renal artery flow and peak renal cortex videointensity following IV PESDA ($r = 0.65$, $p < 0.001$). Color Doppler signals were also enhanced following IV PESDA, and resulted in excellent visualization of the main renal artery as well as segmental and lobar arteries. When renal artery stenosis was induced to decrease RABF to less than 10% of baseline, the segmental and lobar arteries were not visualized with color Doppler following IV PESDA, and peak renal cortex videointensity was reduced from 26 ± 10 to 15 ± 8 units ($p < 0.05$). These data demonstrate that renal artery and cortical blood flow abnormalities can be detected using intravenous PESDA. This ultrasound contrast agent could be a new non-invasive method to detect renal artery stenosis or abnormal renal perfusion.

971-55 Can Regional Myocardial Tissue Blood Flow be Measured in Terms of ml/min/g Using Contrast Echocardiography?

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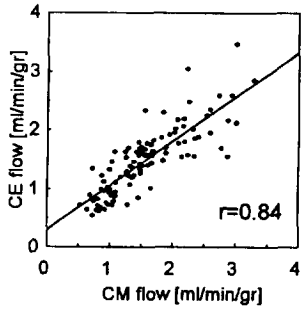
Absolute quantification of regional myocardial tissue blood flow (RMBF) based on contrast echocardiography has not yet been achieved. The aim of this study was to validate of our recently proposed algorithm for the quantification of RMBF and examine its reproducibility. This approach evaluates RMBF as the intravascular volume fraction (ratio of the areas under myocardial time intensity curve and a curve obtained from a reference region of interest) divided by mean transit time (obtained using deconvolution of impulse response). Experiments were carried out using an isolated rabbit heart model (N = 8), wherein coronary blood flow was controlled by varying perfusion pressure. Factors confounding in-vivo experimentation, such as cardiac translation and limited image quality, were eliminated in this setup. Aortic root injections of FS069, a new stable contrast solution (MBI, 1:200 in saline, filtered using a 8 μm-pore filter) and colored microspheres, used as the "gold" standard for reference, were performed at different levels of coronary flow. During contrast injections, end-diastolic images of the heart and an extracardiac reference chamber were acquired using a 7.5 MHz transducer and digitized on-line and processed using the above algorithm. Contrast echocardiographic measurements of RMBF highly correlated with microsphere flow (figure). Bland-Altman analysis revealed an insignificant bias of 0.07 ml/min/gr, with 95% limits of agreement at 0.69 ml/min/g. Using this algorithm, repeated evaluations of RMBF were highly reproducible ($r = 0.92$). In summary, the use of this new algorithm in conjunction with stable contrast agents, such as FS069, allows accurate and reproducible quantification of RMBF.



971-56 Myocardial Contrast Echocardiography can be Used to Assess Dynamic Changes in Microvascular Function In-Vivo

Suad Ismail, William Spotnitz, Ananda Jayaweera, Norman Goodman, Danny Skyba, Sanjiv Kaul. *University of Virginia, Charlottesville, VA*

The transit rate of sonicated albumin microbubbles (Albunex®, mean size = 4.3 μ) has been shown to correlate with that of radiolabelled red blood cells in the blood perfused beating heart. We have previously demonstrated that the transit rate of these microbubbles is decreased during hyperthermia-induced microvascular injury. In this study, we hypothesized that microbubble transit rate could be used as a marker of reversible endothelial injury during myocardial contrast echocardiography (MCE).

We produced endothelial injury by inducing different degrees of myocardial hypoxia. This was accomplished by perfusing an arrested heart with either arterial blood, venous blood, or blood diluted to different degrees with a crystalloid cardioplegia solution. The flow rate into the cross-clamped aorta was held constant in each dog (mean = 170 ml), as was the perfusate temperature (mean = 27°C). Perfusate hematocrit varied from 0–27%, while perfusate pO_2 ranged from 15–600 mmHg. MCE was performed by injecting 2 ml of a 1:1 dilution of Albunex® into the perfusate line and im-

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