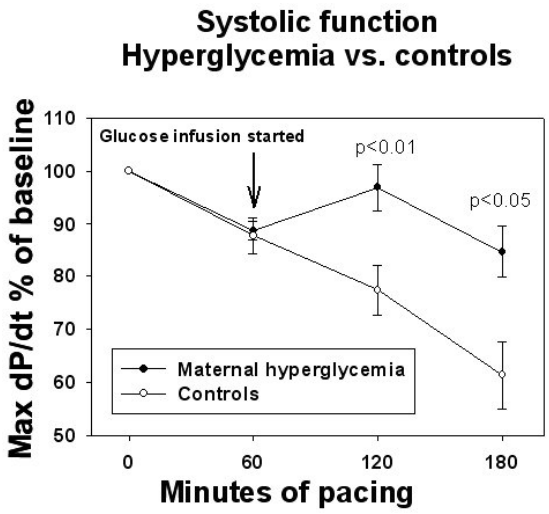
group; dP/dt_{max} was 999±253 mmHg/s at 120 min (p=0.016) and 854±209 mmHg/s at 180 min (p=0.054).
Conclusion: Induced maternal hyperglycemia improves fetal cardiac function during fetal tachycardia.



1057-201 Fetal Aortic Stenosis With Apex-Forming Left Ventricle at Time of Diagnosis: Determinants of Biventricular Repair

Masaki Nii, Rajiv Chaturvedi, Kevin Roman, Edgar T. Jaeggi, The Hospital for Sick Children, Toronto, Canada

Background: Aortic stenosis (AS) may result in impaired and preserved growth of the left heart. Potential for biventricular repair is critical in counseling and management.
Objectives: To assess the value of markers in predicting suitability for biventricular (BV) versus single ventricular (SV) repair in fetal AS.
Methods: Review of all cases of fetal AS, diagnosed at our center since 1995. Inclusion criteria were 1) apex-forming left ventricle (LV) at time of diagnosis, 2) intact ventricular septum, and 3) serial follow-up studies to birth. The following parameters were assessed at diagnosis: Ventricular dimensions and systolic functions, orientation of aortic and foraminal flows, and presence/absence of endocardial fibroelastosis. Analysis of the pulmonary venous flow to assess diastolic function included peak velocity of reversed flow during atrial systole (PVA), integrated time velocity ratio of early diastolic to ventricular systolic forward flow (D/S), and the ratio of reversed to forward pulmonary venous flow (A/(S+D)). Depending on the type of postnatal intervention, 2 patient groups were created and the parameters compared.
Results. The baseline characteristics of 16 fetuses included in the study are shown.

	SV Repair (n = 8)	BV Repair (n = 8)	P-Values
Age at diagnosis	21.4±4.3 weeks	21.8± 5.7 weeks	NS
Increase in LV diameter	5/8 (63%)	4/8 (50%)	NS
Endocardial fibroelastosis	7/8 (88%)	4/8 (50%)	NS
LV shortening fraction	4.0±8.1 %	18.2±17.8 %	0.04
Retrograde aortic flow	3/8 (38%)	0/8 (0%)	NS
Left-right atrial shunting	8/8 (100%)	5/8 (63%)	NS
PVA reversal	35.4±9.8 cm/s	10.1±0.5 cm/s	0.0001
D/S TVI	0.3±0.3	1.1±0.5	0.007
A/(S+D) TVI	0.52±0.24	0.09±0.07	0.003

Conclusion: In AS with apex-forming LV at time of diagnosis functional indices (LV shortening; pulmonary vein flow) provide useful information in predicting left ventricular growth potential and suitability for biventricular repair.

1057-202 Changing Indications for Fetal Echocardiography in a University Center Population

Mark K. Friedberg, Norman H. Silverman, Stanford University, Stanford, CA

Background
Technical advances and obstetrical education have greatly increased the use of Fetal Echocardiography (FE) over the past 10 years. Earlier studies showed that the major indications for FE included a family history of congenital heart disease (CHD), maternal diabetes and arrythmia. We hypothesized that the increased utilization of FE is associated with a change in indications and yield of FE.
Methods
We reviewed 300 consecutive FE performed at Stanford University between 12/2002 and 8/2003. Major anomaly was defined as that affecting prognosis.
Chromosomal anomaly was defined either as suspected (based on ultrasound (US) findings) or proven (chromosomal analysis).
Results
Indications for FE and their yield are presented in the table.

Indication	No. of FE	% of FE	No. of Major anomalies	No. of Minor anomalies	Yield (%)
Family history of CHD*	68	23	1	2	4
Maternal diabetes	55	18	2	2	7
Abnormal obstetrical US (Suspicious for CHD)	46	15	15	1	35
Arrythmia	35	12	2	3	14
Extracardiac congenital anomalies	29	9	3	0	10
SLE/ +SSA/SSB	21	7	1	2	14
Chromosomal anomaly	18	6	5	4	50
Teratogen Exposure	14	5	0	0	0
Other	9	3	4	1	5
Advanced maternal age	4	1	0	0	0
Not ascertained	1	0.3	0	0	0
Total	300	99.3	33	15	16

Mean maternal age was 31±6 (range 16-44) years. Of 7 cases with increased nuchal thickening, 1 (14%), showed PA/IVS. No cardiac anomalies were found in the presence of an abnormal umbilical cord.
Conclusions
Indications for FE have changed over the last 10 years. An obstetrical US suspicious for CHD has become a prominent indication for FE, indicating an increased awareness of cardiac anomalies by obstetricians. This indication, together with chromosomal anomalies, accounts for a large percentage of positive FE. Thus, the yield of FE depends to a large extent on the skills of the obstetrician. Common indications that continue to have relatively low yield include maternal diabetes, arrhythmia and especially a family history of CHD and exposure to a teratogen.

1057-203 Ventricular Function in Fetal Congestive Heart Failure and Predictors of Perinatal Outcome

Masaki Nii, Mary van der Velde, Edward N. Marcus, Wendy Tsang, Lisa K. Hornberger, The Hospital for Sick Children, Toronto, ON, Canada, Children's Hospital, Boston, MA

Background: Although the types of primary cardiac lesions associated with fetal congestive heart failure (CHF) are well recognized, there is a paucity of data which defines the associated abnormalities of ventricular function and predictors of outcome. We sought to determine the specific abnormalities of ventricular function and to identify ventricular functional parameters that may assist in predicting outcome in a large cohort of affected fetuses. **Methods:** We reviewed the initial fetal echocardiograms (mean age 25.2±5.2 weeks) and clinical histories of 87 fetuses with CHF due to structural heart disease (n=41), primary dysrhythmias (n=22) or primary myocardial disease (n=24). LV and RV shortening fraction (SF), and Tei indices were assessed where possible and compared to previously published normal data. Diastolic dysfunction was considered to be present when 1 or more of the following indices were abnormal: A/E ratio, deceleration time, LV-IVRT, IVC, DV and UV flow pattern. In continued pregnancies with known outcome, parameters were compared between those with fetal or neonatal demise (n=38) versus survivors (n=26). **Results:** In the 87 cases of CHF, LV and RV SF were abnormal in 49.4% and 64.9%, respectively and significantly decreased compared to normal (LV=27.4±11.7, RV=23.8±11.8,p<0.05). LV and RV Tei-indices were abnormal in 53.1% and 58.8%, respectively and overall were significantly increased (LV=0.64±0.42, p<0.01; RV=0.65±0.45, p<0.01). RV SF was significantly lower than the LV (p=0.02) but the RV and LV Tei-indices were not different. A/E ratio of both ventricles did not differ significantly from normal (LV=1.31±0.48, RV=1.46±0.62), and RV and LV A/E ratios were not different. Diastolic dysfunction was present in 39 of 50 cases with CHF assessed. Of all the functional parameters compared, only LV SF was significantly decreased in fetuses with fetal or neonatal demise versus survivors (28.4±10.5 vs 21.5±12.3, respectively, p=0.03). **Conclusion:** In fetuses with CHF, RV and LV systolic dysfunction is present in 50-60% and diastolic dysfunction in 78%. While RV systolic dysfunction is more common in CHF, the presence of LV systolic dysfunction may further contribute to outcome.

1057-204 Outcome Following Prenatal Identification of Structural Heart Disease: A Seven-Year Experience

Geoffrey A. Forbus, Andrew M. Atz, Scott M. Bradley, Girish S. Shirali, Medical University of South Carolina, Charleston, SC

Background: This study evaluates outcome in a series of consecutive patients who were diagnosed prenatally with structural heart defects (SHD) and identifies factors associated with mortality in this cohort.
Methods: Fetal echo reports at a single institution from August 1995 through November 2002 were reviewed. The following outcomes for fetuses with SHD were evaluated: families opting for no active management, hospital survival following surgery at initial admission, and survival at most recent follow up. Variables evaluated for potential association with these outcomes included cardiac diagnosis, gestational age at diagnosis and at birth, gender, birth weight, extracardiac and/or chromosomal anomalies, ethnicity, insurance status (a marker of socioeconomic status), surgery at initial admission, and univentricular versus biventricular management pathway. Univariate and multivariate analysis were performed.
Results: We identified 168 fetuses with SHD, of whom 126 (75%) chose active treatment.

Of these 126 patients, 99 patients (79%) survived to hospital discharge, including 63 of 80 patients (79%) who underwent neonatal cardiac surgery. There were 9 additional late postoperative deaths. Of the 46 patients who did not undergo neonatal surgery, 36 (80%) are still alive. Chromosomal abnormalities (p<0.0005), gestational age < 35 weeks at birth (p<0.0005) and < 24 weeks at diagnosis (p<0.0005) were independently associated with families opting for no active management. No independent predictors of hospital survival following neonatal surgery were identified. Seventy-eight of these 126 patients (62%) are currently alive. Birth weight > 2.5 kg (p=0.01) and absence of extracardiac anomalies (p=0.014) were associated with survival at last known follow up.
Conclusions: Patients who are diagnosed prenatally with SHD constitute a cohort that is subject to significant mortality. Chromosomal abnormalities, prematurity, low birth weight and extracardiac anomalies are independently associated with mortality in these patients. The specific type of SHD does not appear to affect measured outcomes.

1057-205 Current Diagnostic Accuracy of Fetal Echocardiography: A Cardiac Segment-Specific Analysis

Erik C. Michelfelder, William M. Gottliebson, Cheri M. Franklin, Richard A. Meyer, Thomas R. Kimball, Cincinnati Children's Hospital Medical Center, Cincinnati, OH

Background: Advancing ultrasound technology has led to significant improvements in both temporal and spatial cardiac image resolution. Our purpose was to assess the current diagnostic accuracy of fetal echocardiography (ECHO) specific to individual cardiac segments. **Methods:** All fetal ECHO (n=769) performed between 1/01 and 6/03 were reviewed. 58 studies were identified where complete postnatal ECHO was available for comparison. Studies were not systematically excluded for late gestational age or quality of acoustic windows. Studies were performed with an experienced cardiologist using available 2D, M-mode, and Doppler modalities. An independent observer, using standards of accuracy expected of postnatal ECHO, assessed accuracy of fetal ECHO for the following cardiac segments: abdominal situs, systemic venous return (VR), pulmonary VR, atria, atrioventricular valves (AVV), ventricular septum, ventricular hypoplasia, ventricular morphology, semilunar valves, great arterial relation, and aortic arch. Sensitivity, specificity, and positive and negative predictive values (PV) were calculated for each segment. **Results** (Table)**:**

	Sensitivity	Specificity	Positive PV	Negative PV
Abdominal Situs	100	98	75	100
Systemic VR	44	98	80	90
Pulmonary VR	100	96	33	100
Atria	92	100	100	94
AVV	88	88	91	84
Ventricular Septum	84	81	88	74
Vent Hypoplasia	100	100	100	100
Vent Morphology	100	98	89	100
Semilunar Valves	75	93	91	79
Great Arterial Relation	100	95	86	100
Aortic arch	79	90	73	93

Conclusions: Fetal ECHO has excellent diagnostic accuracy in describing intracardiac anatomy. Despite both technological advances and improved physician awareness, assessment of systemic VR, pulmonary VR, and aortic arch anatomy remains challenging. False negative findings also impact accuracy of semilunar valve, AVV, and ventricular septal findings.

1057-206 Fetal Pulmonary Venous Doppler Patterns in Hypoplastic Left Heart Syndrome: Relationship to Atrial Septal Restriction

Kavitha Chintala, Zhiyun Tian, Denise D. Donaghue, Ronald L. Thomas, Jack Rychik, Chidren's Hospital of Michigan, Wayne State University, Detroit, MI, The Fetal Heart Program at the Cardiac Center of the Children's Hospital of Philadelphia, Philadelphia, PA

Background: Abnormal pulmonary venous Doppler (PVD) patterns have been demonstrated in fetuses with hypoplastic left heart syndrome (HLHS) in association with restrictive atrial septal defect (rASD).
Objective: We hypothesize that PVD patterns are abnormal in fetuses with HLHS even in the absence of rASD. We sought to compare the relationship of PVD patterns to the degree of rASD.
Methods: Twenty-seven fetuses with HLHS and 70 healthy fetuses underwent pulsed Doppler echocardiography of pulmonary veins between 19 and 38 weeks gestation. The peak systolic (S), diastolic (D) and atrial reversal (A) velocities were measured. The S/D ratio, velocity time integral of forward (VTI_f) and reversed (VTI_r) flows and VTI_r expressed as percentage of VTI_f (%R) were calculated. Independent examiners reviewed neonatal echocardiograms to categorize HLHS into HLHS-A (no rASD), HLHS-B (mild-moderate rASD) and HLHS-C (severe rASD or intact atrial septum). Analysis of covariance was performed with gestational age as co-variate and Bonferroni correction was employed.
Results: Compared to controls, HLHS group as a whole showed increase in all PVD indexes except VTI_f and D. Four subjects were excluded from subgroup analysis due to termination of pregnancy (n=2) continuing pregnancy (n=1) and fetal atrial septostomy (n=1). HLHS-A (n=11) when compared to controls, had higher S (36.6 ± 2.9 vs. 21.4 ± 0.9 cm/s [mean ± S.E]; p<0.001), S/D (2.2 ± 0.2 vs. 1.2 ± 0.06; p<0.001), A (16.1 ± 2.8 vs. 0.37 ± 0.9 cm/s; p< 0.001), VTI_r (1.3 ± 0.3 vs. 0.05 ± 0.08 cm; p<0.001) and %R (18.4 ± 4.0 % vs.0.8 ± 1.3%; p<0.001). D and VTI_f showed no difference. Pair-wise comparison showed trend towards increase in S, S/D, A, VTIr and %R and decrease in D from HLHS-A to HLHS-C, with only A and S/D achieving statistical significance.
Conclusions: PVD flow patterns are abnormal in HLHS even in the absence of restrictive ASD, suggesting that factors other than impaired left atrial egress play a role. The A velocity and S/D ratio correlate best with the degree of restriction, the latter being clinically most useful due to its independence from insonation angle. Further study of PVD patterns can provide important insights into fetal pulmonary vascular development in HLHS.

POSTER SESSION

1076 Interventional Catheterization in Pediatric and Congenital Heart Disease

Monday, March 08, 2004, 9:00 a.m.-11:00 a.m.
Morial Convention Center, Hall G
Presentation Hour: 9:00 a.m.-10:00 a.m.

1076-199 Coil Occlusion of Patent Ductus Arteriosus in Small Infants (Less Than or Equal to 5 Kg)

Bhava Ramalingam J. Kannan, Sivadasan R. Anil, Krishna Kumar, Amrita Institute of Medical Sciences and Research Center, Cochin, India

Background: Occlusive devices for closure of patent ductus arteriosus (PDA) can protrude into the descending aorta in small infants. Coils can fit into the duct ampulla better but coil occlusion can be technically demanding. We present our experience in coil occlusion ducts in infants weighing less than or equal to 5kg.
Methods: We reviewed our 5-year institutional database of all children undergoing catheter closure of PDA at our institution and identified all infants with weighing 5 Kg or lesser. Case selection was through echocardiography. Duct diameter of less than 5 mm and adequate size of ampulla were prerequisites
Results: Forty-five (6%) of 752 children who underwent transcatheter occlusion of PDA were identified (median weight: 4.5 Kgs, range: 0.96-5 Kg; median age: 4 months; range: 18 days – 12 months). The mean duct size was 3.2 ± 0.8 mm. Four infants were mechanical ventilated for heart failure with pneumonia. The procedure was successful in all (1.8±1.1 coils used /patient; fluoroscopy time: 11.4±8.5min). Bioptome assistance was used in 27 (60%) infants (multiple coils were delivered simultaneously in 14). Coil turns were cut to “fit the ampulla” in 20 (44%) patients. Arterial puncture was avoided in 25 (55%) patients. There were 6 episodes of embolization (all coils retrieved). Seven (16%) had small residual flow at the end of the procedure. All 4 infants on mechanical ventilation were successfully weaned off over 48-72 hours. On follow-up, 3 (6.6%) had a new-onset Doppler gradient (24-32 mm Hg) across the LPA and 4 had trivial residual flow. There was no hemolysis or vascular complication.
Conclusions: Coil occlusion of PDA is feasible as a less invasive option to surgery in selected small infants. The limitations of the procedure include the potential for embolization and occurrence of LPA stenosis in a small proportion of patients.

1076-200 Differences in Pulmonary Artery Angioplasty by Proximal Versus Distal Dilation Sites

Lisa Bergersen, Barry Keane, Kimberlee Gauvreau, James Lock, Kathy Jenkins, Children's Hospital, Boston, MA

Introduction: We sought to determine the acute efficacy, late efficacy, and adverse event rate for modern balloon technology and explore differences in procedure, techniques, and outcomes by dilation site, proximal vs. distal pulmonary artery (PA).
Methods: Angiograms and medical records were reviewed in a random sample of 104 PA dilation procedures between 1/96 and 12/00. Differences in technique, adverse event rate, and acute and follow-up changes in lumen diameter were analyzed by dilation site.
Results: Of 100 patients (diagnosis TOF 11, TOF/PA 35, PPS 16, Truncus 12, other 26) undergoing 104 procedures (proximal 55, distal 39, both 10), 203 vessels were dilated, 78 (38%) proximal (R or LPA) and 125 (62%) distal. High pressure balloons were more commonly used in distal angioplasty procedures (p<0.001). Median balloon size relative to minimum lumen diameter was larger for distal dilations, 2.7 vs 2.0 (p<0.001) for the first balloon and 2.9 vs. 2.7 (p=0.09) for the second balloon. Elimination of a waist with the first balloon angioplasty was more likely when dilating proximal vessels (78 vs 63%, p=0.03), but recoil was more frequent, requiring stent placement in 19 of 78 (24%) vs 2 of 125 (2%), p<0.001. For the 92 vessels with follow-up angiography, 9 (10%), CI [5%, 18%], experienced restenosis, defined as a return to pre-dilation diameter. Vessel trauma occurred in 11% of dilations (intravascular tear with flow obstruction in 11, confined tear in 8, and unconfined tear in 2) with no differences based on location. Other adverse events were also similar between the 2 groups, including cardiac arrest (1), hypotension (3), arrhythmias (5), and pulmonary edema (6). Vessel rupture occurred in 2 of 203 dilations (1%) and was successfully managed with coil embolization; no patients died.
Conclusion: Distal vs Proximal PA angioplasty procedures differ in technique employed and expected outcome. Distal dilation sites required larger balloon to vessel ratios and were more often resistant to low pressure angioplasty. Proximal sites were more likely to experience recoil and require stent placement. Despite these differences, no differences in restenosis, vessel trauma or other adverse events were observed.