

●133

CARDIAC PERFORMANCE, EXERCISE CAPACITY AND PULMONARY FUNCTION AFTER FONTAN SURGERY

David G. Ruschhaupt, Daniel J. Campbell, Otto G. Thilenius, Robert L. Replogle, Rene A. Arcilla, The University of Chicago Hospitals, Department of Pediatrics and Cardiac Surgery, Chicago, Illinois

Seven patients with congenital heart disease palliated by Fontan surgery (F) underwent cardiac catheterization (CC), treadmill exercise (TE), and pulmonary function (PF) tests. CC revealed absent right atrial-pulmonary pressure gradient, normal pulmonary pressures and mild arterial desaturation (82-93%). LV end-diastolic volume (cm³/M²), stroke volume (ml/M²), output (L/m²/M²) and ejection fraction pre/post surgery were: 90.6/78.3, 53.1/42.1, 4.94/3.78, and 0.59/0.53, respectively (all p=NS). TE protocol used steady rate (3 mph) and increasing grade (0% through 5, 10, 15, 20, 22.5, 25 and finally 27.5% at 4 mph) up to exhaustion (TE max). Minute ventilation (VE), tidal volume (TV), respiratory rate (RR), oxygen consumption (VO₂), blood pressure and heart rate (HR) were measured q 1 min and compared to those of 50 normal (NL) subjects. TE max by F was 20% incline. Although VO₂, TV and HR were appropriate for exercise level, RR and VE were outside 2 SD of NL at each workload. Values during TE max were lower than those of NL: VO₂=69%, TV=85%, HR=83%, RR=81%, VE=85%. PF tests revealed (% of NL): forced vital capacity=82%, peak expiratory flow=104%, forced expiratory volume=85%, pulmonary diffusing capacity=73%. F patients have abnormal PF and exercise capacity despite "good" resting hemodynamics. These may be related to inadequate cardiac function during effort and reduced pulmonary perfusion.

†134

LEFT VENTRICULAR SYSTOLIC AND DIASTOLIC FUNCTION AFTER TOTAL CORRECTION OF TETRALOGY OF FALLOT.** George G.S. Sandor, Michael W.H. Patterson, Marion A. Tipple, Phillip G. Ashaore,

Ruby Popv, Spon. by Judith G. Hall, University of British Columbia, Vancouver, BC.

Left ventricular (LV) systolic and diastolic function was assessed in 12 patients after total correction of tetralogy of Fallot (TOF) and compared with 8 normal patients (N). The mean age of TOF was 10.1 years (range 5-17.8 years) at catheterization and 3.5 years (range 0.3-8 years) at surgery. Only one had a shunt prior to surgery. At catheterization the standard indexed left ventricular parameters - end diastolic volume (EDV_i), end systolic volume (ESV_i), ejection fraction (EF), stroke volume (SV_i), end-diastolic pressure (EDP), peak systolic pressure (PSP), mass (M_i) and peak systolic pressure/end systolic volume ratio (PSP/ESV_i) were obtained. L.V. diastolic operant chamber stiffness (b) & myocardial stiffness (K_e) were calculated from simultaneous diastolic pressures and volumes using monoexponential formulae. The two groups were compared by unpaired "t" tests. There was no difference in EDP, SV_i, PSP, and M_i.

#		EDV _i	ESV _i	E.F.	PSP/ESV _i	b	K _e
TOF	12	93.1	29	69.1	3.63	0.038	17.25
	SD	+16.2	+7.7	+5.5	+1.73	+0.022	+8.05
N	8	72.9	16.0	77.9	7.63	-.032	10.04
	SD	+10.61	+6.4	+8.36	+3.53	+0.007	+2.02
		p=.001	p=.001	p=.02	p=.016	NS	p=.025

Thus, TOF had higher EDV_i, ESV_i, lower EF, PSP/ESV ratios than N. Chamber stiffness was normal but myocardial stiffness (K_e) was significantly higher in TOF. A number of TOF were normal, but further analysis showed no correlation between these parameters and age at surgery. Thus, as a group, TOF have residual systolic and diastolic abnormalities of LV function after total correction.

**Supported by the B.C. Heart Foundation.

135

CORRELATION OF PEAK SYSTOLIC PRESSURE/END SYSTOLIC VOLUME (PSP/ESV) AND END SYSTOLIC PRESSURE/END SYSTOLIC VOLUME (ESP/ESV) RATIOS.

George G.S. Sandor, Ruby Popv, Spon. by Judith G. Hall, Department of Paediatrics, University of British Columbia, Vancouver, B.C.

Sagawa's index of L.V. function, Emax, has been simplified to ESP/ESV ratio. The ratio PSP/ESV has been substituted enabling non-invasive measurement of this index. This study assessed the correlation of these ratios to determine the validity of the use of PSP/ESV ratios. At cardiac catheterization ESP, PSP & ESV were measured in 11 normal patients (N) (mean age 10.3, range 4-18 years), 10 aortic stenotic patients (AS) (mean age 8.9, range 5-16 years), with mean peak systolic gradient of 56.5 torr (range 20-120 torr) and 11 volume load (VL) patients (mean age 9.3, range 2.3-14 years), with aortic regurgitation (7), mitral regurgitation (2), PDA (1), & VSD (1). Analysis of variance & Bonferroni tests were used to compare the three groups & correlations were performed.

	N	AS	VL
	11	10	11
PSP/ESV	4.84 ± 1.3	11.47 ± 6.6	2.66 ± 1.03
N vs AS	p = .018	N vs VL p < .001	AS vs VL p = .003
ESP/ESV	4.46 ± 1.12	6.24 ± 2.29	2.35 ± .87
N vs AS	p = 0.42	N vs VL p < .001	AS vs VL p < .001

Plotting ESP/ESV vs PSP/ESV for

- 1) N - y = .853x + .33; r = .989, i.e., the slope neared unity.
 - 2) VL - y = .8164x + .17; r = .965, i.e., the slope also approached unity.
 - 3) AS - y = .3078x + 2.7; r = .887, i.e., poor correlation, however substituting systolic aortic pressure (SAP) for PSP & replotting ESP/ESV vs SAP/ESV for AS y = .745x + 1.27; r = .86, i.e., the slope approached unity again.
- Thus, in the absence of left ventricular outflow obstruction the simple ratio of PSP/ESV correlates well with ESP/ESV and may be used non-invasively.

136

COMPARISON BETWEEN M MODE AND DIGITIZED ECHOCARDIOGRAPHY IN THE DETECTION OF ANTHRACYCLINE CARDIOTOXICITY.** George G.S. Sandor, Paul C. Rogers, Ka-Wah Chan, Zubeda Sadaruddin, Marion A. Tipple,

Shirley Hazell, J. Mavis Teasdale, Spon. by Judith G. Hall, Department of Paediatrics, University of British Columbia, Vancouver, B.C.

This study compared standard m-mode echo (ME) and digitized echocardiography (DE) to detect anthracycline cardiotoxicity. 25 paediatric patients with leukaemias or solid tumors (13 male), mean age - 10.4 yr. (1.9-15.6) had ME before (PRE), at 200-300 mg/m² (MID), after maximum dosage (POST) of adriamycin or daunorubicin (mean 2.3 months, 0.3-6.5 m) and compared to 33 age matched normals (NORM). 14 had previous chemotherapy some with cyclophosphamide and/or radiation. Mean follow-up duration was 21.5 months (7.8-33.8 m), mean maximum dose was 409.6 mg/m² (300-582 mg/m²). None had cardiac failure. Left ventricular (LV) systolic time intervals (STI), shortening fraction (SF), mean velocity of shortening (VCF) were done on ME. Peak LV velocity in systole (PLVS) and diastole (PLVD), normalized L.V. velocity in systole (NLVS) and diastole (NLVD), peak posterior wall velocity in systole (NPWVS) and diastole (NPWVD) and similar-ly peak and normalized septal velocities (PSVS, PSVD, NSVS and NSVD) were obtained by tracing and digitizing the echo (DE). Bonferroni tests of significance were determined. ME showed a) declining VCF from PRE(1.43) to MID(1.23) and POST(1.2) (p=.0005 & .001) b) declining SF from PRE(36.9) to MID(32.7) to POST(32.0) (p=.0002 & .0014) c) STI's were not useful. DE showed a) greater PLVS for PRE(9.47) than NORM(8.21) (p=.0017) but no sig. fall. b) PRE NLVS(2.83) was greater than NORM(2.54) and fell at POST(2.26) (p=.0000 & .0013) c) PLVD & NLVD were normal. Posterior wall and septal motion in systole and diastole was normal except PRE PPWVD(6.85) was greater than NORM(5.17) and fell to normal at MID. Thus 1) ME is as useful for screening for LV dysfunction as DE, 2) DE showed hyperfunction in some parameters PRE. This did not correlate with age, haemoglobin, fever, heart rate, previous therapy or dose. The aetiology of this apparent hyperfunction is not known. **Supported by the BCHF.

137

ECHOCARDIOGRAPHY DOES NOT ACCURATELY PREDICT PA WEDGE PRESSURES IN SMALL SUBJECTS. Richard A. Schieber, Paul F. Braum (Spon. by William H. Neches)

Univ. of Pittsburgh School of Med. and Children's Hosp. of Pittsburgh, Depts. of Anesthesia/CCM and Pediatrics, Pittsburgh, PA

Adult studies indicate a strong correlation between PA wedge pressure (WEDGE) and the RATIO and difference (DIFF) of 2 echocardiographic (ECHO) mitral valve diastolic time intervals: Q-mitral valve closure (Q-MVC) and aortic valve closure-mitral E point (AVC-E). Effects of HR on these intervals and of respiratory phase on WEDGE were not considered.

We measured one ECHO-WEDGE data set from each of 24 young patients during routine cardiac catheterization. Mean age was 4.7 yrs (range 0.3-15.8). None had prolonged PR, mitral stenosis, or were intubated. WEDGE ranged from 4-22 mm Hg (mean 10.1). ECHO intervals were measured at end-inspiration and end-expiration and arithmetically adjusted for HR differences within and between patients. No significant correlation coefficient was found between WEDGE and RATIO or DIFF, regardless of RR adjustment or respiratory phase (-0.2 < r < 0.2, p > .05 for each).

Multiple data sets were then obtained from 6 neonatal piglets whose LVEDP was increased from 3-38 mm Hg by volume infusion. Again, no correlation between LVEDP and any derived ECHO function was large enough for predictive purposes (r < .40 by linear regression analysis).

No significant relationship was found between ECHO and WEDGE measurements in small subjects, unlike in adults. Confirmation studies are needed in adults.

138

CHANGING PATTERNS IN MANAGEMENT OF AORTIC VALVULAR STENOSIS IN INFANCY. Stuart Septimus, Fredrick Z. Bierman, Frederick O. Bowman, Jr., Ehud Krongrad.

College of Physicians & Surgeons, Columbia University, Department of Pediatrics, N.Y.C., New York 10032.

In the past, management of infants with critical isolated aortic (AO) valve (V) stenosis (AVS) was dependent on diagnosis by cardiac catheterization (cath). In critically ill infants this procedure is often associated with severe complications. As of 1981, 10 infants, ages 1 day to 18 weeks, were diagnosed as having critical AVS. Anatomic diagnosis was made by 2D Echocardiogram (Echo) in all patients (pts) showing a thickened AOV (10/10 pts) left ventricular hypertrophy (LVH) (10/10 pts), normal LV size (8/10 pts) LV dilatation and small LV (1 pt each). Left atrial dilatation, indirectly indicating increased LV end diastolic pressure, was present in 9/10 pts. Diagnosis was confirmed by cath in 4 pts, surgery in 5 pts, and autopsy in 1 pt. Aortic valvotomy was done in 5 pts without cath and 4 pts following cath. Prior to surgery the pts had clinical evidence of poor cardiac output (10/10 pts), LVH (10/10 pts) and strain (8/10 pts) on ECG and cardiomegaly on chest x-ray (10/10 pts). A 1 day old infant in persistent acidosis with a dilated LV died prior to surgery and a pt with a small LV on echo died postoperatively. 8 pts survived surgery. It is concluded that noninvasive clinical evaluation is adequate for precise diagnosis and estimation of severity prior to aortic valvotomy in infants. Cath is presently of limited value in such patients and should be reserved for infants with AVS and possible associated defects.