tory, electrophysiologic features were consistent with NV conduction. In both cases maximal preexcitation was seen only after a sudden prolongation of the H_1H_2 interval, indicating a switch of AV nodal conduction from fast to slow pathway. Late atrial extrastimuli during wide-QRS tachycardia never advanced the subsequent ventricular beat. In one case, His bundle activation occurred always retrogradely during preexcited tachycardia, with sudden changes in cycle length due to retrograde dual AV nodal physiology, suggestive of a macro-reentrant circuit. In the other case, the His bundle was exclusively activated in antegrade direction, indicating that the NV fiber was only used as a bystander. A distinct Mahaim potential was recorded in both cases at the ventricular insertion of the fibers in the the mid- to posteroseptal region of the AV annulus. RF current delivery to these sites abolished Mahaim fiber conduction without altering AV nodal physiology. In the case with the NV fiber as a bystander, AV nodal reentrant tachycardia was still inducible with a narrow QRS complex. It was subsequently abolished by slow pathway ablation. *Conclusions:* Nodoventricular accessory pathways represent a rare subset of Mahaim fibers. They are related to slow AV nodal pathway conduction, but must not necessarily be part of the reentrant circuit. Ablation of the NV Mahaim fiber can be selectively performed without ablation of the slow AV nodal pathway.

948-83 Does Radiofrequency Ablation Induce a Prethrombotic State?

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Although thromboembolism is an uncommon complication of radiofrequency ablation (RFA), it has been suggested that RFA results in activation of the coagulation (COAG) system possibly increasing this risk. We hypothesized that it is the catheter insertion and prolonged catheter placement rather than RFA that causes COAG system activation. In order to explore this issue, 2 groups were studied: Grp I ($n = 17$) during RFA and Grp 2 ($n = 14$) during routine EPS. Groups were similar in clinical characteristics and recent invasive procedures. Specimens were drawn for COAG studies following the insertion of venous sheaths (T1) and 1 hr post RFA or EPS (T2). Prothrombin to thrombin conversion was measured using thrombin antithrombin complex (TAT) and prothrombin activation peptide (F1.2).

Results:

	TAT (mcg/l)		F1.2 (nmol/l)	
	T1	T2	T1	T2
Grp I	24.5 ± 21.2	58.2 ± 49.6	1.9 ± 1.2	3.0 ± 1.9
Grp II	43.0 ± 58.0	82.4 ± 90.8	2.5 ± 2.3	2.6 ± 1.4

Levels were elevated throughout *both* the RFA *and* the EPS procedures relative to normal values of TAT (1.0–4.1 μg/l and F1.2 (0.44-1.1 nmol/l). These elevations in COAG parameters were not different (p = ns) between Grp I and Grp II at T1 and T2. In a subset of RFA and EPS pts ($n = 15$), specimens sampled just prior to catheter insertion confirmed time dependent increases in TAT ($p = 0.06$) and F1.2 ($p < 0.0001$) from insertion to completion of procedures.

Conclusion: During RFA, activation of the COAG cascade, as assessed by sensitive assays, is a consequence of catheter insertion and placement rather than RF delivery. Moreover, COAG activation is of a similar magnitude for RFA and diagnostic EPS. Thus COAG activation is an unlikely mechanism for potentiating risk of thromboembolism specifically for RFA procedures.

948-84 Lack of Acute Echocardiographic Change With Radiofrequency Catheter Ablation: A Prospective Study of 158 Patients

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Radiofrequency catheter ablation (RFA) treats a variety of arrhythmias. This involves catheter manipulations traversing cardiac valves, transseptal puncture, and endocardial energy delivery. Potential complications include valvular damage, creation of intracardiac shunts, and cardiac perforation. To quantify acute effects of RFA on cardiac anatomy and function, we prospectively compared echocardiograms (2-dimensional and Doppler) obtained prior to and within one week post ablation on 158 adults (mean age = 44 ± 16 years, 82 men, 76 women). Patients underwent 187 procedures for 202 arrhythmia substrates (119 accessory pathways (AP's), 53 AV node modifications, 15 AV node ablations, 4 ventricular tachycardias, 5 atrial flutters, and 6 ectopic atrial tachycardias). All but one AP were ablated on the atrial side of the annulus; 85 transseptals were performed. Any reported echocardiographic changes were reviewed by a single investigator in a blinded fashion. Echo changes were seen in six patients. These included: 3 pericardial effusions (1 of which was clinically evident as tamponade; 2 required no treatment); 1 normalization of septal motion after AP ablation; 1 new septal wall motion abnormality not associated with a change in overall function; and 1 decrease in ejection fraction without clinical correlation, seen on a technically limited study. There were no acute intracardiac shunts or valvular changes. In this adult population, we conclude: 1) acute changes post ablation were rare; 2) transseptal puncture did not create intracardiac shunts; 3) acute valvular lesions were not created; and 4) relevant pericardial effusions were rare and clinically evident.

949 Echo Assessment of Right Ventricular and Aortic Root Function

Tuesday, March 26, 1996, 9:00 a.m.–11:00 a.m.
Orange County Convention Center, Hall E
Presentation Hour: 9:00 a.m.–10:00 a.m.

949-116 Echocardiography for Right Ventricular Volume Determination: A Comparative Study With Magnetic Resonance Imaging

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Various geometrical models have been used for right ventricular volume (RVV) determination using echocardiography (echo). However the RV anatomy defies simple geometrical assumption. Models taking into consideration the crescentic aspect of the RV on cross-section might be more appropriate for RVV determination.

The purpose of this study was to compare previously proposed geometrical models describing the RV as a pyramid (Pyr), an ellipsoid (Ellip) or a tapering figure (Tap) with 2 new models (Cm 1, Cm2) based on the crescentic aspect of the RV cross-section. Echo derived RV volumes were compared to magnetic resonance imaging (MRI) derived volumes. Ten subjects, 8 normal volunteers and 2 patients with dilated RV were studied. Standard echo views were obtained from the parasternal short axis and the apical 4 chamber. MRI RVV was obtained from short axis plan using the Simpson's rule. Statistical analysis was performed by regression analysis and the Bland-Altman method.

	Cm1	Cm2	Pyr.	Ellip	Tap
Coefficient correlation	0.99	0.94	0.94	0.90	0.94
Mean difference* (cc)	10.2	10.4	89.6	63.8	50.0
Intraclass correl.	0.97	0.91	0.13	0.25	0.47

*mean difference between MRI RVV and RVV derived from other echo methods.

Conclusion: models for RVV determination based on RV anatomical landmarks gave higher coefficient of correlation and higher intraclass correlation than the geometric models when compared to MRI. Although a small underestimation persists, those models should be recommended for clinical setting.

949-117 On Line Assessment of Right Ventricular Function in Patients With Chronic Congestive Heart Failure by Echocardiographic Automated Boundary Detection — Comparison With Tricuspid Annular Plane Systolic Excursion and Gated Blood Pool Ventriculography

Giovanni Forni, Massimo Pozzoli, Giorgio Cannizzaro, Giuseppe Calsamiglia, Egidio Traversi, Mariella Franchini, Davide Rossi, Soccorso Capomolla, Luigi Tavazzi. *Salvatore Maugeri Foundation — IRCCS — Montescano (PV) Italy*

In patients with chronic heart failure, right ventricular dysfunction is an important determinant of global cardiac performance and is related to exercise tolerance and prognosis. The accuracy of time-area curves generated by echocardiographic automated boundaries detection (EABD) in evaluating right ventricular function still needs to be defined. Accordingly, we investigated 22 sinus rhythm patients (mean age 51 ± 7 years) with chronic heart failure due to dilated cardiomyopathy, using two different echocardiographic methods: the two-dimensional right ventricular fractional area change (FAC) obtained by EABD and the systolic excursion of the tricuspid annular plane (TAPSE). Results were compared with right ventricular ejection fraction (RVEF) evaluated by gated blood pool ventriculography, considered as the reference technique. After optimizing the gain control to detect the most continuous EABD and the maximal cavity size, end-diastolic, end-systolic areas and FAC were automatically displayed. Ten consecutive cycles were averaged. Combining M-mode and two-dimensional echocardiography, TAPSE was calculated as the distance between the insertion of the tricuspid valve in the right ventricular free wall in diastole and the annular plane in systole.

Radionuclide images were acquired in the LAO best septal projection, on a 64 × 64 pixels matrix. The examinations were performed within one hour and the results were blindly reviewed in two laboratories and compared by linear regression analysis. *Results:* mean EABD right ventricular FAC was 31 ± 6%; mean TAPSE 18 ± 4 mm and mean radionuclide RVEF 33 ± 5.

	r	SEE	p value
FAC vs. radionuclide RVEF	0.87	0.34	<0.0001
TAPSE vs. radionuclide RVEF	0.76	0.36	<0.0005

Conclusions: In patients with chronic heart failure, right ventricular function can be accurately estimated by on-line FAC generated by EABD. This method is more accurate than TAPSE. Compared with the radionuclide technique, the absence of radiation exposure and the real time display are potential advantages of ultrasound in the noninvasive assessment of right ventricular function.

949-118 Assessment of Right Atrial Pressure by Hepatic Vein Doppler Echocardiography: A Simultaneous Catheterization/Doppler Echocardiographic Study

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The non-invasive assessment of right ventricular systolic pressure from Doppler and tricuspid regurgitant velocity requires an accurate assumption of right atrial pressure (RAP). The 2D echo appearance of the inferior vena cava(IVC) has been used but may not reliably predict significant elevation of RAP. Therefore, 21 patients were studied in the cardiac catheterization laboratory comparing simultaneous RAP (measured at mid-systole) to on-line simultaneous Doppler recordings of the hepatic vein systolic (S) and atrial reversal(AR) velocities. The simultaneous IVC dimension was measured from 2D echo. There was a direct correlation of IVC dimension with RAP ($r = 0.64$; $P < 0.01$), but the sensitivity and specificity of the IVC ≥ 20 mm for a RAP ≥ 20 mmHg was 67% and 80% respectively. There was a significant inverse correlation of the(S-AR) velocity difference and RAP ($r = 0.74$; $P < 0.001$). A (S-AR) velocity difference < 0 cm/s was 94% sensitive and 100% specific for a RAP ≥ 20 mm Hg. *Conclusion:* The hepatic vein (S-AR) velocity difference is a sensitive and specific Doppler echocardiographic index for assessment of RAP and a better predictor of elevated RAP than the IVC diameter.

949-119 Respiratory Variation of Superior Vena Cava Doppler in Patients With Severe Emphysema: Correlation With Intrapleural and Intraabdominal Pressure.

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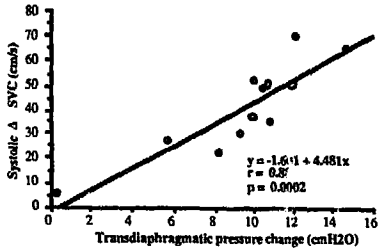
In normal subjects, superior vena cava flow is augmented by inspiration. In pts with chronic obstructive lung disease, the magnitude of change of SVC forward flow velocity with respiration (ΔSVC) is reported to be increased. Since the patient with severe emphysema may also have abnormal diaphragmatic motion, we hypothesized that Δ SVC magnitude is related to transdiaphragmatic pressure change rather than intrapleural pressure change alone. *Methods:* Echocardiography with SVC Doppler was performed in emphysema pts who had intrapleural (Ppl) and intraabdominal (Pab) pressure measurement by balloon manometry. ΔSVC was correlated with changes in Ppl and Pab. Transdiaphragmatic pressure was defined as Pab – Ppl. *Results:* 12 pts (age 65 ± 5 yr, 7 M, 5 F) with severe emphysema (% FEV_1 20 ± 8) were studied. Mean ± SD of SVC systolic forward flow velocity (inspiration vs expiration) was 65 ± 17 vs 24 ± 10 cm/s. Diastolic forward flow velocity was 41 ± 12 vs 9 ± 12 cm/s. The correlation between Ppl and systolic or diastolic ΔSVC did not show statistical significance. However, systolic ΔSVC was highly correlated with transdiaphragmatic pressure change: $r = 0.88$, $p = 0.0002$, $R^2 = 0.77$ (figure).



Conclusion: In pts with emphysema transdiaphragmatic pressure is an important determinant of systolic ΔSVC. Therefore, diaphragmatic function must be taken into account in the interpretation of augmented systolic ΔSVC.

949-120 Echocardiographic Predictors of Exercise Capacity in Primary Pulmonary Hypertension

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Primary pulmonary hypertension (PPH) is associated with abnormalities in right heart structure and function which contribute to the morbidity and mortality of this disease. To assess the relation of cardiac abnormalities to exercise capacity in patients with severe PPH, we compared findings on two-dimensional and Doppler echocardiograms to results of a six-minute walk in patients with Class III or Class IV symptoms.

The 81 study subjects averaged 39 ± 3 years of age; 73% were female. All were treated with conventional medical therapy, including oral vasodilators if tolerated. The distance walked in six minutes was inversely correlated with the following: a) right ventricular diastolic area indexed by height ($r = -0.25$, $p < 0.04$), a measure of right ventricular size; b) diastolic eccentricity index ($r = -0.37$, $p < 0.001$), a measure of septal deformity which reflects the abnormal interaction between left and right ventricles; c) tricuspid regurgitation jet area ($r = -0.36$, $p < 0.001$), an estimate of the severity of tricuspid regurgitation; and d) pericardial effusion size ($r = -0.49$, $p < 0.001$).

In summary, in patients with severe PPH, poor exercise capacity is associated with right ventricular dilatation, an abnormal interaction between left and right ventricles, tricuspid regurgitation, and presence of a pericardial effusion. These findings suggest that abnormalities in right heart structure and function which can be measured by echocardiography are important determinants of exercise capacity in PPH.

949-121 Reconciliation of Doppler Predicted and Actual Pressure Gradients in Modified Blalock-Taussig Shunts

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Accurate knowledge of the pressure gradient (PG) across a modified Blalock-Taussig shunt (BTS) is critical in surgical planning for staging to a cavopulmonary anastomosis. While it is common to estimate the aortopulmonary pressure gradient (PG) using the modified Bernoulli equation (MBE), the accuracy of this technique is limited due to viscous energy losses in the BTS which are unaccounted for in the MBE. *Methods:* We studied the relationship between PG predicted by MBE and aortopulmonary PG using a pulsatile flow model with Gore-Tex BTS connecting systemic and pulmonary circuits with variable compliance and resistance to generate 5 peak PG's, 20–100 mmHg, and a range of mean PG from 5–88 mmHg. Effect of BTS length (L) and diameter (D) were investigated by varying L from 3 to 9 cm and D from 4 to 6 mm. The velocity (v) of the blood analog fluid within each BTS was measured by continuous wave Doppler for each condition, and the MBE was tested as a predictor of the PG across the BTS. An equation for peak PG was derived using established formulae for fluid contraction into a tube, $PG = 1/2\ \rho v^2\ [1.5 + fL/D]$, which incorporates a Reynolds number-dependent friction factor f. *Results:* The slope of the regression line ($y = 0.80x$, $r = 0.97$) reflected the tendency for underestimation of peak PG by MBE and was significantly different from unity ($p = 0.01$). The average error was 21% for all BTS and flow conditions ($r = 0.97$). The mean PG predicted by the MBE also significantly underestimated the mean tranducer PG, with an average underestimation of 24% ($y = 0.74x$, $r = 0.98$). Using the f equation, the mean error of peak PG decreased to 5%, and the slope of the regression line relating Doppler predicted to PG ($y = 1.04x$;) was not significantly different from the line of unity ($p > 0.05$). *Conclusions:* The MBE should be applied to BTS with caution because of its consistent underestimation of PG. Application of fluid dynamic theory may yield a truly accurate predictor of PG across BTS which is critical in surgical decision making.

949-122 Dynamic Elastic Properties of Ascending Aorta in Coronary Artery Disease Evaluated by Dobutamine Stress Echocardiography

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Aortic distensibility is decreased in coronary artery disease (CAD) at rest. However its dynamic changes during dobutamine infusion and the implications for the relevant ventriculo-arterial coupling have not been clarified.

Forty CAD patients (10 with 1, 12 with 2 and 18 with 3 vessel disease-VD, age 58 ± 12) and 10 normals were studied during low dose dobutamine

TUESDAY POSTER