plasty (PTCA) during the same hospitalization was highly predictive of ECS (OR 20.6, 13.1–32.3).

From 1970 to 1990 patients undergoing ECS showed increasing proportions of recent MI (30% vs. 50%; p = 0.02), increasing age (56 vs. 65 years; p < 0.001), increasing number of diseased vessels (2.0 vs. 2.2; p < 0.001), and decreasing LMCA disease (45% vs. 19%; p = 0.06). There were no significant trends in functional class, anginal status, or left ventricular dysfunction.

We conclude that ECS is increasingly used on severely ill patients and those with failed PTCA. Mortality with ECS remains high.

11:45

742-6 Prognostic Significance of Change in Resting Left Ventricular Ejection Fraction Early After Successful Coronary Artery Bypass Surgery: A Long-term Follow-up Study

Arnold F. Jacobson, Diane Lapsley, Donald E. Tow, Shukri Khuri. *Veterans Affairs Medical Centers, Seattle, WA; West Roxbury, MA*

Although resting left ventricular ejection fraction (LVEF) is routinely determined as part of the preoperative evaluation of patients undergoing coronary artery bypass graft (CABG) surgery, the value of repeating the LVEF determination after the surgery has not been established. To investigate whether the change in LVEF between pre- and early post-CABG had long-term prognostic significance, records for all 303 patients who underwent successful CABG surgery (no peri- or 30 day post-operative mortality) between 1982–1984 at our institution (WR) and had both pre- and postoperative first-pass radionuclide ventriculography were reviewed. The survival status of 255 patients (254 male) was determined from responses to mailed questionnaires, telephone interviews, and reviews of medical records and computerized death registries. Pre-CABG (mean 8.8 days) and predischarge (mean 7.4 days post-CABG) LVEFs were tabulated, with an absolute change of ≥5% (increased or decreased) considered significant. Long-term survival probability was examined using Kaplan-Meier curves for three patient groups based upon pre-CABG LVEF: Normal (Nl): ≥47% (long-established value with camera used); Moderately reduced (Mod): 35–46%; Severely reduced (Sev): <35%. *Results* were as follows:

Pre-CABG LVEF	Number of Patients with Change in LVEF			
(Mean ± 1 std dev)	Increased	No Change	Decreased	Total
N1 (52.8 ± 8.1%)	66	46	18	130(52%)
Mod (40.9 ± 3.6%)	54	34	5	93(36%)
Sev (30.0 ± 3.6%)	20	11	1	32(12%)
Total	140(55%)	91(36%)	24(9%)	255

Patients ranged in age from 34–77 (mean 58), with no difference in mean age for the nine subgroups. Ten-year survival probabilities relative to pre-CABG LVEF were:

Pre-CABG LVEF	LVEF Increased	LVEF No Change	LVEF Decreased
N1	79.2%	77.3%	70.8%
Mod	69.2%*	42.8%	40.0%
Sev	47.6%	36.4%	–

*p < 0.05 versus Mod/No Change or Decreased

Conclusion: Among patients with Mod LVEF pre-CABG, early postoperative improvement was associated with a significant long-term survival advantage, a finding not seen among patients with Nl and Sev pre-CABG LVEF. Early post-CABG LVEF determination appears of value in patients with Mod LVEF to identify the two prognostic groups as an aid for planning follow-up monitoring.

743 Three Dimensional Echocardiography: Clinical Applications

Tuesday, March 21, 1995, 10:30 a.m.–Noon
Ernest N. Morial Convention Center, Room 24

10:30

743-1 Quantitative Transthoracic Three-dimensional Voxel Imaging of the Left Ventricle: Clinical Validation

Myung-Yong Lee, Gordon S. Huggins, Leng Jiang, Michael J.A. Williams, Mark D. Handschmacher, Mark S. Adams, Henry Gewirtz, Richard M. Derman, Arthur E. Weyman, Robert A. Levine. *Massachusetts General Hospital, Boston, MA*

Recent computational advances have permitted 3-dimensional (3D) reconstruction of echo intensities over the cardiac volume from rotated 2D echo views gated to ECG and respiration. Unlike approaches using selected 2D views, such automated voxel acquisitions conveniently provide rapid spatial appreciation in animated views from multiple perspectives. However, only limited data are available regarding the *accuracy* of such reconstructions in patients, particularly using the *transthoracic* approach without the need for TEE. We therefore reconstructed the left ventricles of 10 consecutive patients referred for cardiac gated blood pool scan (GBPS) by transthoracic apical rotation, 5 with abnormal wall motion. LV volume was calculated by summing endocardial areas in parallel cross-sections derived from the voxel data, and compared to GBPS values by validated techniques to normalize counts for attenuation and counts/volume of blood sample.

Results: Reconstructed volumes (vol) agreed well with those from GBPS:

	y =	r	SEE	Mean Error
End-diastolic vol	0.85x + 17.2	0.98	8.66 cc	1.4%
End-systolic vol	0.89x + 9.42	0.99	5.29 cc	4.6%
Stroke vol	0.93x + 0.64	0.95	6.01 cc	2.4%
Ejection fraction	0.94x – 0.23	0.99	2.59%	5.5%

Conclusion: 3D volumetric reconstruction of the LV not only provides convenient gated acquisition and ready spatial appreciation from multiple perspectives, but is also quantitatively accurate for LV size and function in patients by the transthoracic approach. This study supports the use of this technique to address clinical and research questions.

10:45

743-2 Superiority of 3D Echo vs 2D Echo for Quantitating Wall Motion Abnormality as an Index of Myocardial Infarction Size

Peter M. Sapin, Gregory B. Clarke, Aasha S. Gopal, Mikel D. Smith, William S. O'Connor, Klaus M. Schröeder, Donald L. King. *University of Kentucky, Lexington Kentucky; Free University of Berlin, Germany; Columbia Unversity, New York*

Two-dimensional echo estimations of the fraction of myocardium showing abnormal wall motion (AWM) are often used as an index of infarct size, to establish prognosis and guide therapy. However 2D echo methods rely on image plane and geometric assumptions which may not be valid when infarction affects ventricular shape. 3D echo reconstruction of the endocardial surface can eliminate the need for these assumptions. *Purpose:* To use 3D echo and 2D echo to quantitate AWM in experimental acute infarction, and to correlate the extent of AWM with the pathologic determination of infarct size. *Methods:* Coronary ligation was performed in 14 open chest dogs, and echo imaging performed after 6 hours. 3D echo used 7–8 spatially registered short axis cross-sections to measure % of endocardial surface showing AWM. Two 2D echo methods using multiple, non-spatially registered images were evaluated. Both compared summed endocardial length showing AWM to the total of the endocardial circumferences, expressed as %. Method #1 used 7–8 short-axis slices. Method #2 used basal, mid, apical short axis + apical 4- and 2-chamber views. Percent LV mass (% mass) infarcted was determined by a standard technique.

Results: regression of [x = echo %AWM] vs [y = %mass infarcted]

Echo Method	r value	Standard Error of the Estimate	Equation	p value
3D	0.94	±2.6%	$y = 0.71x - 1.81\%$	<0.0001
2D-#1	0.82	±4.3%	$y = 0.50x - 0.66\%$	0.0015
2D-#2	0.74	±5.1%	$y = 0.47x - 1.25\%$	0.0058

Conclusion: Three-dimensional echocardiography is a more accurate means of non-invasively estimating myocardial infarct size in this animal model, compared to 2D echo methods.

11:00

743-3 Initial Quantitative Application of Three-dimensional Voxel Imaging with a Rotating Transducer to the Human Right Ventricle

Leng Jiang, Mary Etta King, Myung-Yong Lee, Dan Gilon, Michael J.A. Williams, Stella V. Brili, Mark D. Handschumacher, Richard M. Derman, Arthur E. Weyman, Robert A. Levine. *Massachusetts General Hospital, Boston, MA*

Three-dimensional echo measurement of right ventricular (RV) volume has recently been validated in experimental models using automated voxel acquisition from rotated 2D echo views. This technique conveniently provides rapid and animated spatial appreciation from multiple perspectives. However, its feasibility and reliability for reconstructing and quantitating RV volume and function in humans is not known, given limitations of acoustic access and the need for ECG and respiratory gating; also, no other method for RV volume by 3D echo has been tested quantitatively in patients. We therefore imaged the RV from a parasternal or subcostal rotation in 18 normal subjects (6–19 years old) in order to compare calculated stroke volumes with