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**CLARIFICATION OF THE PATHOPHYSIOLOGY OF HYPERTROPHIC OBSTRUCTIVE CARDIOMYOPATHY BY TRANSESOPHAGEAL ECHOCARDIOGRAPHY**Leeanne E. Grigg, Lorretta B. Daniel, E. Douglas Wigle, William G. Williams, Harry Rakowski, Toronto Hospital, Toronto, Ontario, Canada

To better understand the pathophysiology of obstruction in hypertrophic cardiomyopathy (HCM) we performed transesophageal (TEE) studies in 32 consecutive patients (Pts) pre and post surgical myectomy for obstructive HCM.

There were 19 women and 13 men with a mean age of  $44 \pm 17$  years. The pre-op LV outflow tract (LVOT) gradient was  $82 \pm 37$  mmHg. Results were compared with TEE studies in 10 normal controls. TEE studies provided superb anatomic detail of the mitral leaflets (ML), ML length and systolic anterior motion (SAM).

**LEAFLET MORPHOLOGY AND COAPTATION:** Pts. with obstructive HCM had longer ML than normal controls with anterior leaflet length of  $31 \pm 4$  mm vs  $22 \pm 3$  mm and posterior leaflet length of  $20 \pm 4$  mm vs  $15 \pm 3$  mm. In all cases there was anterior ML-septal contact. The mitral regurgitation (MR) was almost always directed posteriorly through a funnel created by incomplete mid ML coaptation at the level of the bend in the anterior ML.

**POST OPERATIVE RESULTS:**

	IVS (mm)	LVOT (mm)	MR Jet Area cm <sup>2</sup>
Pre-op	$22 \pm 8$	$12 \pm 6$	$5.5 \pm 2.7$
Post-op	$9 \pm 5$	$22 \pm 6$	$2.1 \pm 2.3$

**CONCLUSIONS:** Pts. with obstructive HCM have longer ML with SAM of both leaflets but only anterior leaflet-septal contact. TEE studies provide anatomic confirmation that the MR is due to lack of coaptation of the ML leading to an eccentric posteriorly directed MR jet. Post-operatively with return of normal upper IVS and LVOT dimensions there is normalization of mitral leaflet motion and marked reduction or abolition of the MR.

2:45

**VALUE AND LIMITATIONS OF BIPLANE TRANSESOPHAGEAL ECHO IN THE ESTIMATION OF LEFT VENTRICULAR VOLUMES AND EJECTION FRACTION**

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Recent advances in transesophageal echo (TEE) have allowed biplane imaging of the LV in orthogonal views. However, no data are available regarding the relative accuracy of estimating LV biplane diastolic (EDV) and systolic (ESV) volumes and ejection fraction (EF) by TEE. Therefore, we studied 13 pts with coronary artery disease who had TEE with biplane imaging and in whom LV volumes and EF were obtained by ventriculography (CINE). Biplane TEE was performed in apical 4-chamber (4CH) and 2-chamber (2CH) equivalent views. TEE EDV and ESV were obtained by tracing endocardial borders from videotapes and applying a modified Simpson's rule algorithm. Biplane TEE volumes and EF were calculated as averages of 4CH and 2CH values. Single plane RAO CINE volumes were obtained using a calibrated grid. Correlations vs. CINE showed:

	EDV		ESV		EF	
	r	SEE(ml)	r	SEE	r	SEE
4CH	.80	21	.90	16	.86	8
2CH	.67	20	.66	18	.67	12
BP	.76	19	.88	13	.87	7

TEE volumes underestimated CINE volumes in all cases ( $p < .02$ ). Correlation of EDV, ESV and EF were higher for 4CH than 2CH views, possibly due to papillary muscle encroachment or image foreshortening. Thus, TEE underestimates angiographic LV volumes and EF, perhaps due to foreshortening of the long axis. Biplane averaging of 4CH and 2CH views appears to offer no advantage over standard TEE 4CH slices in estimating LV volumes and EF.

3:00

**DETERMINATION OF CARDIAC OUTPUT WITH SINGLE AND BIPLANE TRANSESOPHAGEAL ECHOCARDIOGRAPHY**

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A major application of transesophageal echocardiography (TEE) in the operating room is in the assessment of mitral regurgitation (MR). Quantification of MR with this technique remains elusive but might be possible if forward flow through the mitral valve assessed by Doppler-TEE were equivalent to that determined by thermodilution (TD) in pts without MR. We have, therefore, compared CO determined by Doppler (Dop) based on the cross-sectional area (CSA) at the mitral annulus using TEE with that determined by TD in 20 pts without significant MR undergoing vascular surgery. A major and minor diameter (D) of the annulus was measured where possible. Three Dop estimates of CO were determined:  $CO_{MAJ}$  and  $CO_{MIN}$  in which the CSA was derived as a circle based on the major and minor Ds respectively, and  $CO_{ELL}$  where CSA was determined as an ellipse using both Ds. Sixty conditions (con) were studied. Mean  $CO_{TD}$  was  $3.4 \pm 1.3$  l/min. In 20/36 con using single plane TEE, both major and minor Ds could be determined compared to 23/24 con with biplane TEE. The correlation (r) and agreement as assessed by mean difference (d) and standard deviation of differences (s) between each of the 3 Dop methods and  $CO_{TD}$  was:

	n	r	p	d(l/min)	s(l/min)
$CO_{MAJ}$	47	0.89	<0.001	0.59	0.66
$CO_{MIN}$	56	0.89	<0.001	-0.29	0.60
$CO_{ELL}$	43	0.91	<0.001	0.03	0.52

**CONCLUSION:** 1) CO determined by TEE correlates closely with TD. 2)  $CO_{TD}$  is best estimated by Dop when mitral CSA is calculated as an ellipse. 3) Biplane is superior to single plane TEE in obtaining both Ds of the mitral annulus. 4) MR volume should represent the difference between Dop derived mitral flow and TD.

3:15

**ASSESSMENT OF VENTRICULAR FUNCTION AND PREDICTION OF VENTRICULAR ASSIST DEVICE REMOVAL BY TRANSESOPHAGEAL ECHOCARDIOGRAPHY**

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The use of ventricular assist devices (VAD) in the treatment of cardiogenic shock following cardiac surgery has steadily increased. The timing for the removal of these devices is critical, and is guided by hemodynamic parameters and techniques such as transthoracic echocardiography and radionuclide imaging. Transesophageal echocardiography (TEE) has been found to be an effective technique for the real-time assessment of myocardial and valvular function. To determine the predictive value of TEE in the optimal timing for VAD withdrawal, we performed daily TEE at the bedside in 11 patients after insertion of VAD. Six left ventricular segments in the short axis view (papillary muscle level) were analyzed. A wall motion score was assigned to each segment based on a semiquantitative assessment of wall motion (1=normal, 2=hypo, 3=akinetic, 4=dyskinetic). The scores were added and the initial and last studies were compared in those patients weaned (W) to those who were not weaned (NW).

	TEE LV Wall Motion Score (mean $\pm$ SD)		
	Initial Study	Last Study	p value
Weaned (n=5)	$14.2 \pm 1.6$	$8.2 \pm 1.5$	<.001
Not weaned (n=6)	$15.0 \pm 2.1$	$14.2 \pm 1.6$	NS

**Results:** 1. The initial study mean score (W and NW) was comparable ( $p=NS$ ); 2. W had a greater improvement in score than NW; 3. Timing of VAD removal was based on hemodynamic and TEE findings; 4. Localized pericardial thrombus seen by TEE was compromising VAD flow in 2 patients; this improved after clot decompression. Thus, TEE is useful for the assessment of patients on ventricular assist device support and predicts successful weaning.