

**Significance of Velocities in the Left Main and Anterior Descending Coronary Arteries**

*Sharif, Dawod<sup>1</sup>; Sharif-Rasslan, Amal<sup>2</sup>; Shahla, Camilia<sup>1</sup>; Khalil, Amin<sup>1</sup>; Rosenschein, Uri<sup>1</sup>*  
*<sup>1</sup>Bnai Zion Medical Center, Cardiology, Haifa, Israel; <sup>2</sup>Technion, Technology and Science, Haifa, Israel*

Internal elastic lamina is deficient at the transition zone between the main left (MLCA) and the left anterior descending (LAD) coronary arteries and may be related to hemodynamic alterations. At this transition zone, adaptive intimal eccentric thickening may develop and later may progress into more severe atheroma. Pressure gradient along the normal coronary artery is negligible. Considering the law of conservation of energy, as expected it was found that also the velocity gradient along the normal left anterior descending coronary artery (LAD) is negligible. Therefore, it is expected the main left coronary artery (MLCA) and LAD velocity difference is negligible.

**Aim:** Determine normal the velocity in the LAD and MLCA and evaluate clinical significance of MLCA-LAD velocity gradients.

**Methods:** First, normal velocities in the LAD were evaluated by trans-thoracic Doppler in 150 normal subjects. Next, trans-thoracic Doppler Sampling of MLCA and LAD velocities was performed in 62 subjects.

**Results:** LAD diastolic velocity in normal subjects was  $34\pm 7$ cm/sec. MLCA diastolic velocity was  $80\pm 28$ cm/sec higher than in the LAD,  $51\pm 31$ cm sec,  $p < 0.000001$ . Similarly, diastolic time velocity integral in the MLCA was significantly higher than in the LAD. In all subjects diastolic velocity was higher in MLAC than in the LAD, except in 4. In these 4 subjects, the diastolic velocity in the LAD was higher than that in MLCA and much higher than normal. Severe LAD stenosis was found in these subjects.

**Conclusions:** Transthoracic Doppler sampling of blood velocities in the MLCA and LAD is feasible. MLCA velocities and integrals are higher than those of the LAD, implying loss of kinetic energy and thus may be related to deficiency of internal elastic membrane at the MLCA-LAD transition zone. If higher LAD velocities are found, LAD stenosis should be considered.

## **Long-Term Follow-Up after Thrombolytic Therapy for Obstructive Prosthetic Heart Valve Thrombosis**

*Yaron, Shapira; Vaturi, Mordehai; Weisenberg, Daniel; Monakier, Daniel; Hasdai, David; Battler, Alexander; Sagie, Alex*  
*Rabin Medical Center, Cardiology, Petah-Tiqva, Israel*

Background: Thrombolytic therapy has become an alternative to re-do surgery in certain patients with obstructive prosthetic valve thrombosis (OPVT). We summarize our long-term single-center results.

Methods and Results: 67 patients were admitted with OPVT of mitral (42), aortic (16) or tricuspid (9) valves within a 15-year period (1996-2001). 50 of these patients (age  $55.8 \pm 15.0$ , male/female = 16/34) received thrombolytic therapy, after ruling-out high-risk thrombi by TEE. Major results are depicted in the table. Full response (FR) to thrombolysis was 34/50 (68%) – 65%, 70% and 70% for MVR, AVR and TVR, respectively. Additional 5 patients had partial response (PR). There were 6 (12%) neurological complications, one case of transient STEMI and 2 cases of major bleeding. There was no treatment-related mortality.

11 patients (22%) required a re-do to surgery after unsuccessful thrombolysis. Late reoperation was required in additional 7 patients (14%).

During a mean follow-up of  $7.4 \pm 4.5$  years, 22 patients (44%) died. These included 14/33 (42%) of initial responders, who died due to other valvular disease (3), CVA (2), CHF (1), malignancy (1), infection (2) or unknown causes (5). Repeated episodes of OPVT occurred in 14 patients.

Attempted re-administration of thrombolytics was successful in most cases. However, 7 patients with relapse were eventually referred for valve re-replacement after numerous recurrences. 15 of the 34 initial responders (44%) were alive with their original valves after  $7.4 \pm 3.9$  years (range 0.3-13.9 years). They were in NYHA class  $1.7 \pm 0.5$ .

Conclusions: Thrombolysis is an acceptable alternative to surgery in OPVT. Repeated episodes are not unusual, especially after TVR, but can usually be overcome with repeated thrombolysis. Late mortality was not related to the index stuck valve, but to associated cardiovascular diseases and other co-morbidities.

**Left Atrial Mechanics in Advanced Diastolic Dysfunction and Preserved Ejection Fraction**  
*Carasso, Shemy; Mutlak, Diab; Lessick, Jonathan; Aronson, Doron; Agmon, Yoram*  
*Rambam Healthcare Campus, Cardiology, Haifa, Israel*

Objective : To characterize left atrial (LA) mechanics in patients (pts) with advanced left ventricular (LV) diastolic dysfunction (ADD) and preserved LV ejection fraction (LVEF).

Methods: The study group included 60 consecutive pts admitted for dyspnea with preserved LVEF ( $\geq 50\%$ ) and ADD: pseudo-normal pattern (mitral E/A ratio 0.8-1.9, E deceleration time (Edt) 140-280ms) in 31 pts and restrictive pattern (E/A $>2$ , EDt  $<140$ ms) in 29 pts. All pts had evidence of high LA pressure (mitral E / annular E'  $\geq 14$  or pulmonary venous S/D ratio  $<1.0$ ). These were compared to 19 age-matched normal controls. Using 2D strain analysis peak positive longitudinal LA strain was measured. LA maximum, pre-A, and minimum volumes were also determined with the 2D strain software and LA phasic functional parameters (passive, conduit, and active) were calculated.

Results: Pts with ADD demonstrated low LA longitudinal strain, large LA volumes, and reduced passive and active LA emptying.

	Normal	Pseudonormal	Restrictive
n	19	31	29
LA Longitudinal strain (% stretching)	44 $\pm$ 17	21 $\pm$ 9*	20 $\pm$ 10*
LA Volumes			
Vmax (ml)	58 $\pm$ 11	114 $\pm$ 34*	107 $\pm$ 31*
Vpre-A (ml)	35 $\pm$ 10	83 $\pm$ 34*	75 $\pm$ 29*
Vmin (ml)	17 $\pm$ 9	56 $\pm$ 22*	59 $\pm$ 33*
Passive Emptying index (%)			
(Vmax - Vpre-A)/ Vmax	40 $\pm$ 14	29 $\pm$ 15*	31 $\pm$ 15*
Conduit Volume (ml)			
LV stroke volume - (Vmax-Vmin)	26 $\pm$ 16	11 $\pm$ 21*	22 $\pm$ 18**
Active Emptying index (%)			
(Vpre-A - Vmin )/ Vpre-A	44 $\pm$ 13	31 $\pm$ 16*	21 $\pm$ 13*,**

\* p $<0.05$  compared to normal, \*\* p $<0.05$  compared to pseudonormal

Conclusions: LA strain and phasic function parameters are abnormal in pts with ADD. These parameters may help in the diagnosis of ADD.

## **Impact of Focused Ultrasound Examination as an Extension of the Physical Cardiovascular Examination**

*Lerman, Tsahi Tsvi<sup>1</sup>; Novack, Victor<sup>2</sup>; Liel-Cohen, Noah<sup>3</sup>; Konstantino, Yuval<sup>3</sup>; Kobal, Sergio L.<sup>3</sup>*

*<sup>1</sup>Ben Gurion University of the Negev, The Joyce and Irving Goldman Medical School, Beer-Sheva, Israel; <sup>2</sup>Soroka University Medical Center, Clinical Research Center, Beer-Sheva, Israel; <sup>3</sup>Soroka University Medical Center, Cardiology Department, Ben Gurion University of the Negev, Beer-Sheva, Israel*

Background: Although guidelines for the use of the Pocket Ultrasound Device (PUD) as an extension of the physical examination have been published, the impact of the use of PUD for this purpose remains unclear. We aimed to study the impact of PUD in the evaluation of patients in different clinical settings performed by physicians with different levels of expertise in echocardiography.

Methods: Twelve physicians (4 cardiac fellows, 4 cardiologists, 4 experts in echocardiography) performed 106 physical examinations extended by focused ultrasound examination in 28 (26%) outpatients and in 78 (74%) hospitalized patients. The PUD prototype used was a GE V-Scan weighing 390 grams.

Physicians filled out a questionnaire immediately after performing the examination to assess the impact of PUD on the patient management and its contribution to patient's diagnosis, assessment and treatment.

Results: Cardiac fellows performed 44% of the examinations, cardiologists 22% and echocardiographers 34%. In 61 cases (58%; 95% confidence interval [CI], 48% to 67%) PUD's results effected patient's management (diagnostic plan and/or treatment was altered). There was no significant difference between the 3 different levels of expertise of the physicians who performed the exam ( $P=0.629$ ). PUD results altered the physicians' diagnosis in 20% of cases and supported it in 46%. Patient treatment was modified in 15% of the cases after undergoing PUD, including performance or cancellation of therapeutic procedures. Physicians reported that PUD provided information that contributed to patient assessment in 95% of the cases.

Conclusion: In a significant number of cases, extension of the physical examination by PUD altered the management of the patient (diagnostic plan and/or treatment plan) regardless of the level of expertise of the performer. According to our trial, the use of PUD contributed to the assessment of the patients in nearly all of the examinations performed.

## **Strain Relative to Baseline Enhance the Ability to Detect Non-Transmural Myocardial Infarction**

*Bachner-Hinenzon, Noa<sup>1</sup>; Ertracht, Offir<sup>2</sup>; Leitman, Marina<sup>3</sup>; Vered, Zvi<sup>3</sup>; Binah, Ofer<sup>2</sup>; Adam, Dan<sup>1</sup>*

*<sup>1</sup>Technion, Biomedical Engineering, Haifa, Israel; <sup>2</sup>Technion, Faculty of Medicine, Physiology, Haifa, Israel; <sup>3</sup>Assaf Harofeh Medical Center, Cardiology, Zerifin, Israel*

Detection of non-transmural myocardial infarctions (MI) by echocardiography is challenging even for experienced cardiologists. Thus, speckle tracking echocardiography (STE) method was developed to objectively evaluate the regional wall motion. Previous studies showed strong correlations between strain measurements and infarct size, however, the detection of small MI has been challenging.

The hypothesis of this study was that there is a natural heterogeneity of the strain values among the different segments of the normal myocardium. It is important to reveal this heterogeneity when studying the effect of MI on the strain measurements since it may enhance the ability to distinguish between non-transmural MI and non-infarct areas. The aim of the study was to measure this heterogeneity, and to check whether measuring the strain values relative to normal state improves the detection of the non-transmural MI.

In this study 13 rats underwent occlusion of the left anterior descending (LAD) artery for 30 minutes followed by reperfusion. Short-axis scans were obtained before occlusion and at 24 hours following reperfusion. Thereafter, the animal was sacrificed and the LV was stained by Triphenyltetrazolium Chloride (TTC), which defined the MI size. The short-axis scans were post-processed by a STE program, and the peak systolic circumferential (SC) strain was measured. The peak systolic SC and the values relative to baseline measurements were compared to the TTC results.

In the detection of non-transmural MI, peak systolic SC reached a sensitivity of 88% and specificity of 65% for detection of the MI at the apex, however, peak systolic SC relative to baseline enhanced the specificity to 84%.

Strain measurements, relative to normal values, improve the detection of non-transmural MI in regions which demonstrate heterogeneity of values at baseline. These findings may enhance the detection of non-transmural MI by Echocardiography, and may be useful during Stress-Echocardiography.

## **Stress Echocardiography with Transesophageal Atrial Pacing for Diagnosis of Coronary Artery Disease**

*Shturman, Alexander; Milchman, Smadar; Atar, Shaul  
Western Galilee Hospital, Cardiology, Nahariya, Israel*

**Background:** We evaluated the feasibility and safety of transesophageal atrial pacing combined with transthoracic stress echocardiography (TAPSE) as a potential alternative to exercise or pharmacologic stress echocardiography in patients with suspected or known coronary artery disease (CAD).

**Methods:** TAPSE was performed in 45 consecutive patients (27 men, 18 women; age  $60\pm 7$  years, range 34-82 years) with suspected or known CAD. The oropharynx was anesthetized with 10% lidocaine aerosol, and the 10F (3.3 mm diameter) flexible pacing catheter was introduced orally by instructing the patient to swallow. Catheter position was optimized by maximizing the size of the esophageal P wave on the electrocardiogram. Pacing was initiated at 10 beats/min above the patient's baseline heart rate (HR) and at 3 to 5 mA above the threshold for stable atrial capture. HR was increased by 20 beats/min every two min until 100% of the age-predicted maximum HR or another end point was reached. If Wenckebach second-degree heart block occurred, atropine was administered intravenously in 0.5-mg increments, to a maximum dose of 1 mg. Small intravenous doses of midazolam were administered in 41 of the patients. The diagnostic end point for the detection of myocardial ischemia was induction of a transient worsening in regional wall motion during stress.

**Results:** All patients reached 100% of target HR. One patient developed paroxysmal atrial fibrillation, which terminated spontaneously after 20 minutes. Echocardiographic images were of high-quality and easily interpretable in all patients. Diastolic function was assessed as routinely. The rate-pressure product was greater than 20,000 in all patients. Development of new regional wall motion abnormalities was the end point for TAPSE in 7 patients.

**Conclusions:** TAPSE is a simple, rapid, safe, and diagnostically efficient procedure in patients with suspected or known CAD.

## **Chest Pain Management in Israeli Emergency Departments Participating in the 2DSPER Multicenter Study**

*Shiran, Avinoam<sup>1</sup>; Blondheim, David S.<sup>2</sup>; Jabaren, Mohamed<sup>3</sup>; Shimoni, Sara<sup>4</sup>; Adawi, Salim<sup>1</sup>; Ashkar, Jalal<sup>5</sup>; Bloch, Lev<sup>3</sup>; Goland, Sorel<sup>4</sup>; Kobal, Sergio L.<sup>6</sup>; Leibowitz, David<sup>7</sup>; Rosenmann, David<sup>8</sup>; Sagie, Alex<sup>9</sup>; Leitman, Marina<sup>10</sup>; Beeri, Ronen<sup>11</sup>; Liel-Cohen, Noah<sup>6</sup>*

*<sup>1</sup>Lady Davis Carmel Medical Center, Cardiology, Haifa, Israel; <sup>2</sup>Hillel Yafe Medical Center, Cardiology, Hadera, Israel; <sup>3</sup>Ha'Emek Medical Center, Cardiology, Afula, Israel; <sup>4</sup>Kaplan Medical Center, Cardiology, Rehovot, Israel; <sup>5</sup>Hillel Yafe Medical Center, Emergency Department, Hadera, Israel; <sup>6</sup>Soroka University Medical Center, Cardiology, Beer Sheva, Israel; <sup>7</sup>Hadassah Har Hatzofim Hospital, Cardiology, Jerusalem, Israel; <sup>8</sup>Shaarei Tzedek Medical Center, Cardiology, Jerusalem, Israel; <sup>9</sup>Rabin Medical Center, Cardiology, Petah Tikva, Israel; <sup>10</sup>Assaf Harofeh Medical Center, Cardiology, Zrifin, Israel; <sup>11</sup>Hadassah-University Medical Center, Jerusalem, Israel*

**Background:** The 2D-Strain Echocardiography for Diagnosing Chest Pain (CP) in the Emergency Room (2DSPER) is a multicenter study (10 centers) organized by the Israeli Echocardiography Research Group. Patients presenting with CP to the emergency department (ED) with suspected acute coronary syndrome (ACS), non-diagnostic ECG and normal initial troponin levels had an echocardiogram within 24h of CP. Offline 2D-strain analysis is performed in attempt to predict unfavorable outcome (ACS and/or significant coronary artery disease). We present initial findings regarding current management of patients with suspected ACS in Israel. **Methods:** Data from the first 202 patients recruited from 9/2010 to 11/2011 (58±8y, 68% males) were analyzed. Seventy-one patients (35%) were recruited in primary care centers and 131 (65%) in referral centers.

**Results:** In referral centers 72/131pts (55%) were discharged directly from the ED compared to 4/71 (6%) in primary care centers (p<0.0001). Unfavorable outcomes occurred in 25/131pts (19%) in referral centers and in 12/71 (17%) in primary care centers (p=NS). Exercise tests were performed in 106pts (52%), radionuclide imaging studies in 5 (2%), stress/dobutamine echo studies in 2 (1%) and cardiac CTs in 32 (16%). Patients were more likely to undergo non-invasive testing in referral compared to primary care centers (80% vs. 41%, p<0.0001). TIMI score (1.6±1.9 vs. 1.6±1.1), use of invasive coronary angiography (21% vs. 28%) and revascularization (13% vs. 17%) rates were similar between centers (p=NS). Patients were more likely to be discharged without workup from primary care centers (41% vs. 15%, p=0.0001). **Conclusions:** Patients with suspected ACS admitted to EDs in primary care centers were less likely to undergo non-invasive tests, and more likely to require hospital admission and to be discharged without additional tests compared to referral centers. It is unclear from the preliminary data whether these findings affect long-term outcome.

## ECG Changes During a Normal Stress Echocardiography Study - Do They Have Any Significance?

Patchett, Matthew<sup>1</sup>; Novack, Victor<sup>2</sup>; Vodonos, Alina<sup>2</sup>; Wilkoff, Renana<sup>2</sup>; Slutzki, Osvaldo<sup>1</sup>; Liel-Cohen, Noah<sup>1</sup>; Kopal, Sergio L.<sup>1</sup>

<sup>1</sup>Soroka University Medical Center, Cardiology Department, Beer-Sheva, Israel; <sup>2</sup>Soroka University Medical Center, Clinical Research Center, Beer-Sheva, Israel

Background: It is uncertain whether patients who have ischemic changes in the electrocardiogram (ECG) but normal wall motion contractility during a stress echocardiography study (SES) have a worse prognosis than those patients in whom both, the ECG and the wall motion contractility are normal during SES. The aim of our study is to compare the cardiac outcome among populations with and without ECG changes during a normal SES.

Methods: Observational study on 3322 patients who underwent a SES. Primary endpoint was a composite of all cause mortality and myocardial infarction (MI). According to SES results, patients were stratified into three groups: normal SES and normal exercise ECG (n=2107), group II: normal SES and abnormal exercise ECG (n=868), group III: abnormal SES (n=347).

Results: Patients in group III were older than patients in group I and II (67±10 years and 57±12 years, respectively) and there was higher prevalence of males and risk factors. Group I and II patients had similar clinical characteristics. The figure depicts the MI free survival among Group III (abnormal SES) compared to group I and II patients (normal SES with or without ECG changes). In multivariate Cox proportional regression analysis with adjustment for baseline demographics and co morbidities, no difference was found in the outcome of group I (reference group) and II patients (hazard ratio 0.18, 95% CI 0.62-2.24. Abnormal SES was a significant parameter that impacted on the survival, increasing the risk for MI and/or death by 2.11 (95% CI 1.16-3.81, p=0.014).

Conclusion: A normal SES has high negative predictive value for MI and/or death, regardless of ECG changes during the test.

