Tissue Doppler imaging for regional myocardial function

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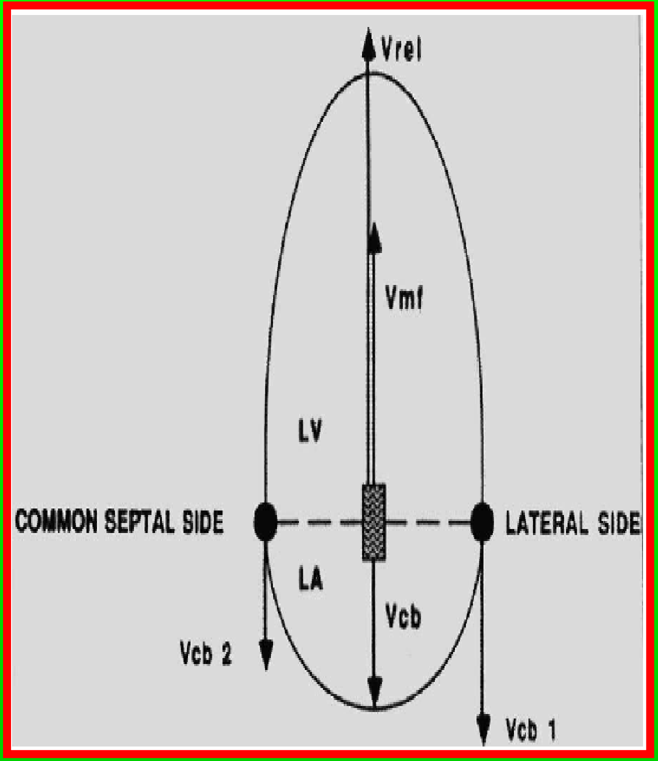
Introduction

- Quantitative New Method (Myocardium)
- Long axis myocardial function
- Systolic and diastolic myocardial function

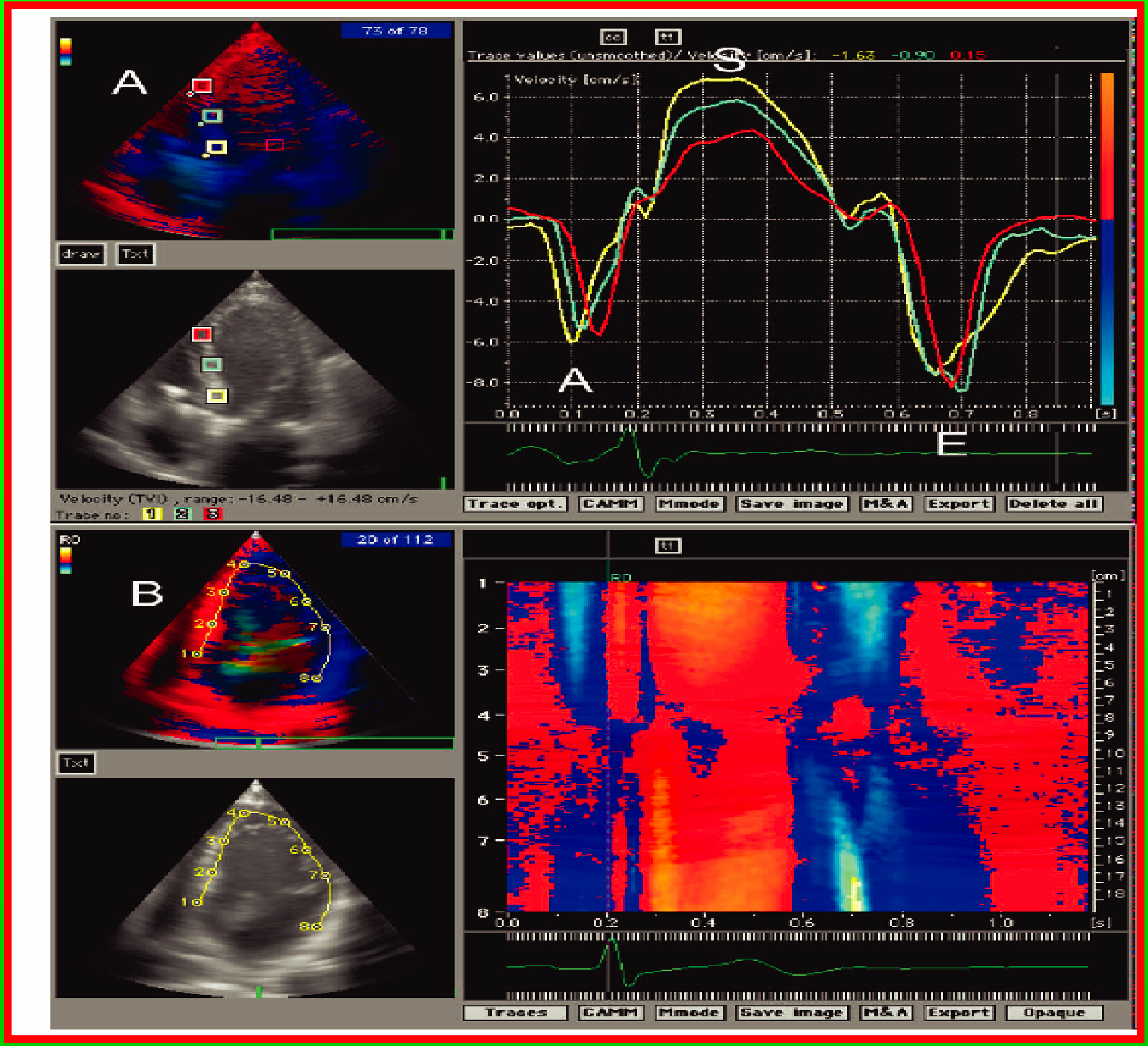


Principles and Limitations of TDI

- By bypassing the high-pass filter
  - Detect high amplitude, low frequency movement of myocardium
- Pulsed mode TDI
- Color coded 2-D
- Color-coded M-mode

Mitral annular velocities obtained with pulsed TDI in a normal volunteer

Mitral annular velocities obtained with color-coded TDI in a normal volunteer



Main applications of TDI in cardiology

- Assessment of overall (longitudinal)LV systolic function
- Assessment of regional LV systolic function
- Diagnosis of myocardial ischemia
- Identification of reversible and irreversible myocardial dysfunction
- Assessment of global and regional LV diastolic function
- Assessment of the function of other cardiac chambers (e.g.,left atrium,right ventricle)
- Differential diagnosis between constrictive pericarditis and restrictive cardiomyopathy
- Noninvasive estimation of pressures in cardiac chambers and pulmonary artery
- Localization of accessory conduction pathways
- Diagnosis of cardiac transplant rejection
- Identification of intraventricular and interventricular dyssynergy

Regional Systolic LV Function

- Ejection phase indices
- Preejection indices
- Postejection indices
- TDI as an Integral part of Stress Echocardiography
- Transmyocardial velocity gradients(endocardium-pericardium)

Ejection phase indices

- Peak systolic ejection velocity(Sm)

  - most widely used TDI measure for quantifying regional function in suspected CAD

  - Sm show more variability between segments,age and sex

- Ischemic regions ; decrease in Sm, Em

Mitral annular velocities:Age difference

Table 2 Mitral annular velocities

		20–39 y	40–59 y	60–79 y	≥80 y	F (ANOVA)
L	S_m, cm/s	7.15 ± 1.23	6.59 ± 1.86	6.07 ± 1.55	4.77 ± 1.15	9.49†
	E_m, cm/s	11.64 ± 2.71	7.66 ± 2.89	5.70 ± 2.22	3.63 ± 1.32	50.79†
	A_m, cm/s	4.27 ± 1.36	6.74 ± 1.86	7.27 ± 1.73	6.96 ± 2.74	17.02†
	E_m/A_m ratio	3.26 ± 2.15	1.24 ± 0.67	0.84 ± 0.43	0.59 ± 0.34	32.79†
S	S_m, cm/s	5.65 ± 1.01	5.58 ± 1.28	5.22 ± 1.05	4.30 ± 1.56	5.54*
	E_m, cm/s	8.21 ± 2.30	6.02 ± 1.75	4.79 ± 1.56	3.24 ± 1.53	33.63†
	A_m, cm/s	4.90 ± 1.50	7.78 ± 1.75	7.02 ± 1.61	6.20 ± 1.66	17.19†
	E_m/A_m ratio	1.83 ± 0.76	0.83 ± 0.38	0.72 ± 0.30	0.54 ± 0.33	42.46†
A	S_m, cm/s	6.83 ± 1.55	5.60 ± 1.79	5.18 ± 1.69	3.85 ± 0.86	13.42†
	E_m, cm/s	10.63 ± 2.54	6.94 ± 2.39	5.24 ± 2.32	3.47 ± 1.20	46.75†
	A_m, cm/s	4.67 ± 1.54	6.81 ± 2.00	6.87 ± 1.76	5.52 ± 1.79	11.36†
	E_m/A_m ratio	2.59 ± 1.29	1.14 ± 0.62	0.79 ± 0.48	0.64 ± 0.23	39.33†
I	S_m, cm/s	6.04 ± 1.31	5.96 ± 1.31	5.65 ± 1.34	4.60 ± 1.23	5.03*
	E_m, cm/s	9.06 ± 2.57	6.21 ± 1.96	5.22 ± 1.78	2.99 ± 1.30	38.48†
	A_m, cm/s	4.90 ± 1.74	8.20 ± 2.46	7.61 ± 1.67	7.30 ± 2.62	15.08†
	E_m/A_m ratio	2.16 ± 1.13	0.87 ± 0.61	0.72 ± 0.31	0.47 ± 0.32	35.84†
P	S_m, cm/s	5.95 ± 1.15	6.35 ± 1.82	5.40 ± 1.69	4.69 ± 1.52	4.72*
	E_m, cm/s	9.52 ± 2.92	6.65 ± 2.43	5.09 ± 2.05	3.29 ± 1.53	32.63†
	A_m, cm/s	3.76 ± 1.86	6.47 ± 2.28	6.84 ± 1.99	6.64 ± 2.51	14.37†
	E_m/A_m ratio	3.40 ± 2.43	1.22 ± 0.85	0.82 ± 0.49	0.54 ± 0.27	28.86†
AS	S_m, cm/s	5.42 ± 1.39	4.78 ± 1.55	4.40 ± 1.27	3.55 ± 1.29	7.25†
	E_m, cm/s	8.17 ± 2.48	5.06 ± 1.72	4.11 ± 1.86	2.78 ± 1.52	35.89†
	A_m, cm/s	3.86 ± 1.72	5.85 ± 2.13	5.67 ± 1.46	4.71 ± 1.53	8.95†
	E_m/A_m ratio	2.64 ± 1.61	0.96 ± 0.48	0.83 ± 0.76	0.57 ± 0.29	27.65†

A, Anterior site; A_m, late diastolic velocities; *AS*, anteroseptal site; E_m, early diastolic velocities; *I*, inferior site; *L*, lateral site; *P*, posterior site; *S*, septal site; S_m, systolic velocities.

*$P < .01$.

†$P < .001$ between age-groups (analysis of variance).

Nikitin NP et al.J Am Soc Echocardiogr 2003;16:906-21

Quantitative DTI for assessment of regional myocardial velocities during transient ischemia and reperfusion

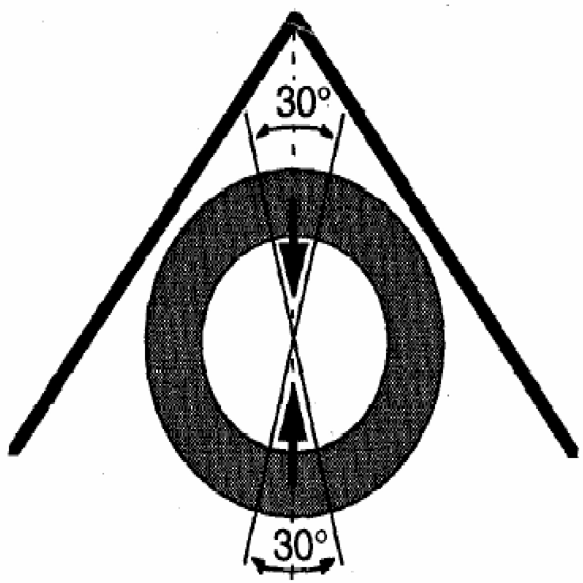


Fig. 1. Parasternal short-axis view used during quantitative DTI. Transducer was angled, and representative myocardial regions of interest were chosen to fall within 15 degrees on each side of axis of Doppler interrogation. *Arrows*, Direction of systolic myocardial thickening.

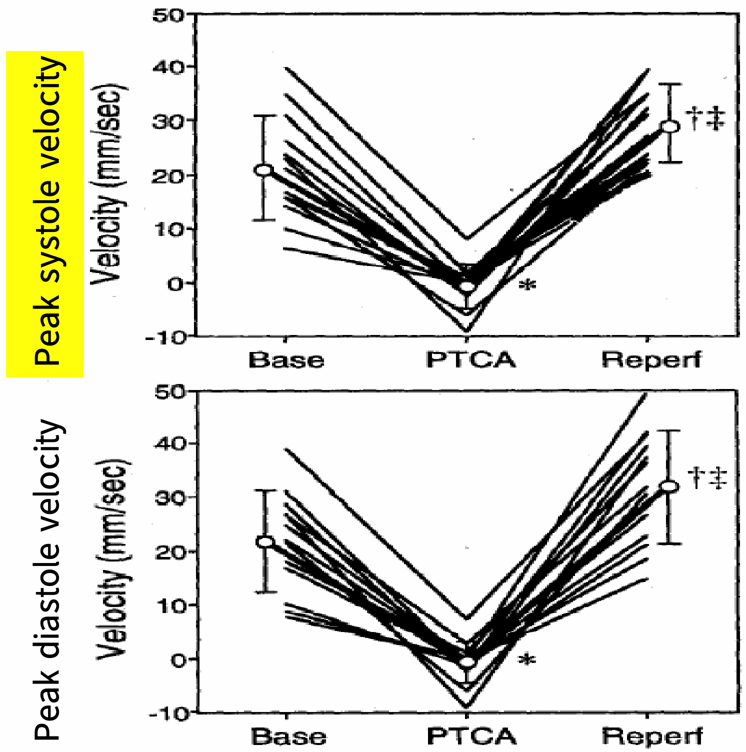
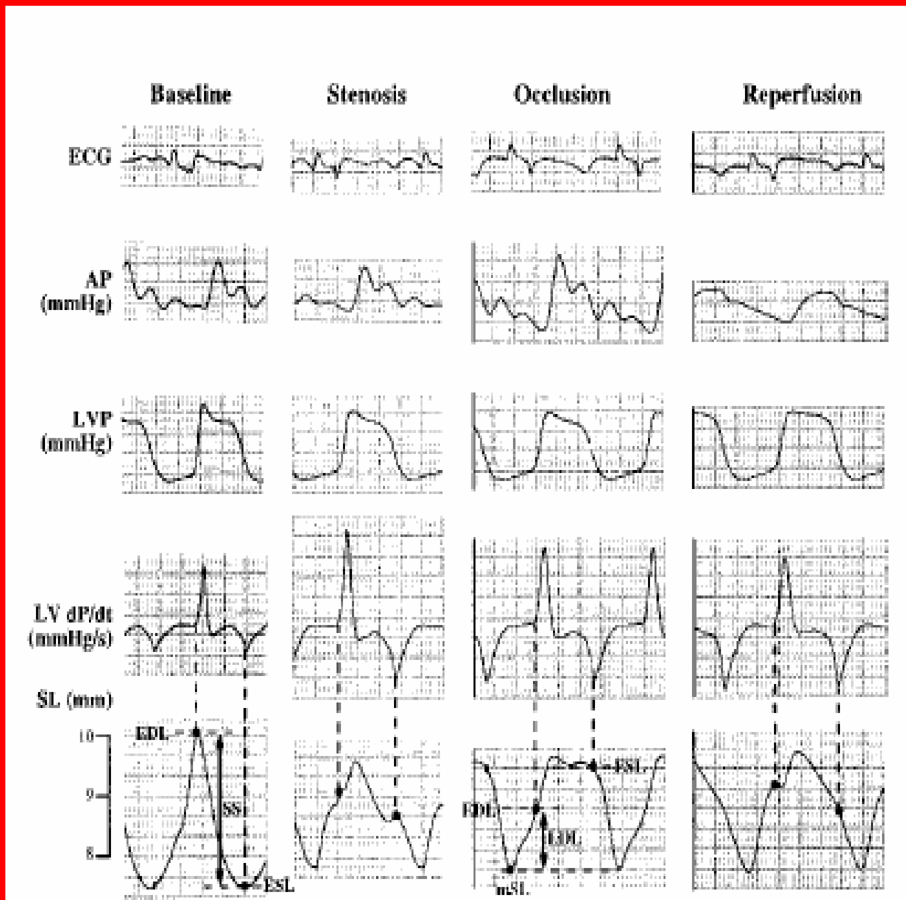
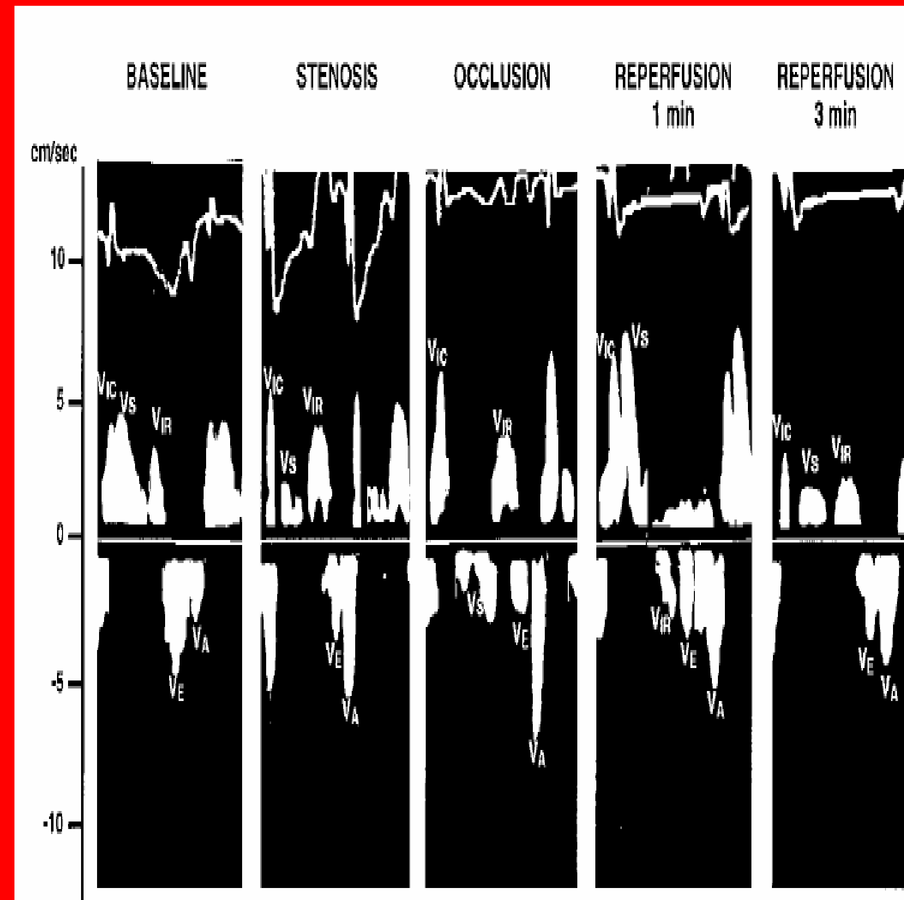


Fig. 2. Individual responses of peak velocities in myocardium supplied by angioplasty vessel during ischemia and reperfusion. *Top*, Peak systolic velocities. *Bottom*, Peak diastolic velocities. Velocities decreased to near 0 mm/sec during occlusive balloon inflation and increased to values greater than those at baseline during early reperfusion. *Base*, Baseline; *PTCA*, occlusive coronary angioplasty balloon inflation; *Reperf*, reperfusion. *$p < 0.001$ versus baseline. †$p < 0.001$ versus ischemia. ‡$p = 0.003$ versus baseline.

Bach DS et al. Am Heart J 1996;132:721-25.

TDI Quantitates Regional Wall Motion During Myocardial Ischemia and Reperfusion





Derumeaux et al. Circulation. 1998;97:1970-1977

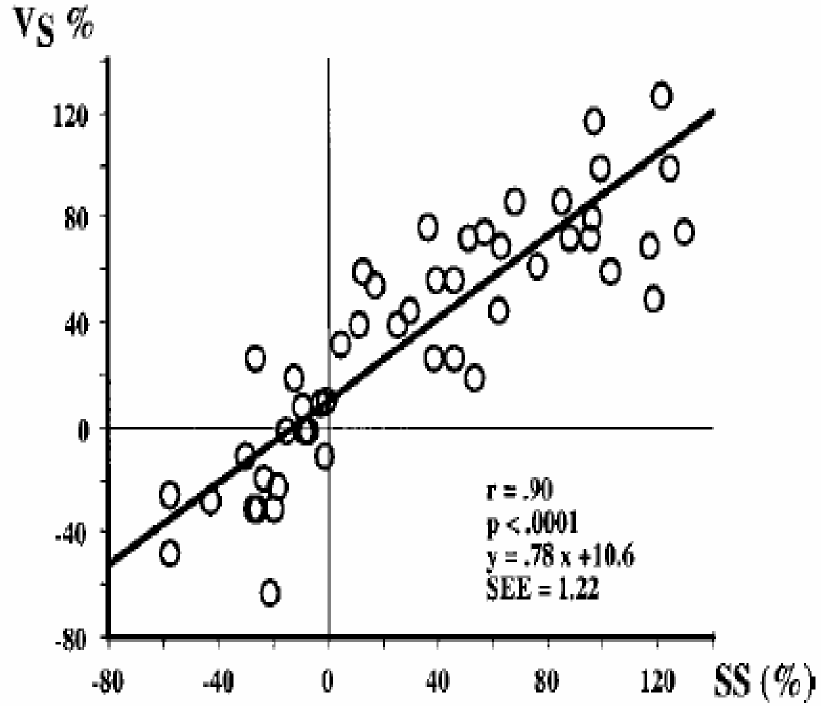


Figure 5. Linear relationship between percent decrease in regional segment length shortening (SS%) (abscissa) and % decrease in systolic velocities (Vs%) (ordinate). There is a significant correlation between systolic velocities and segment shortening.

Derumeaux et al. Circulation. 1998;97:1970-1977.

Relation of Tissue Doppler Derived Myocardial Velocities to Myocardial Structure and Beta-Adrenergic Receptor Density in Humans

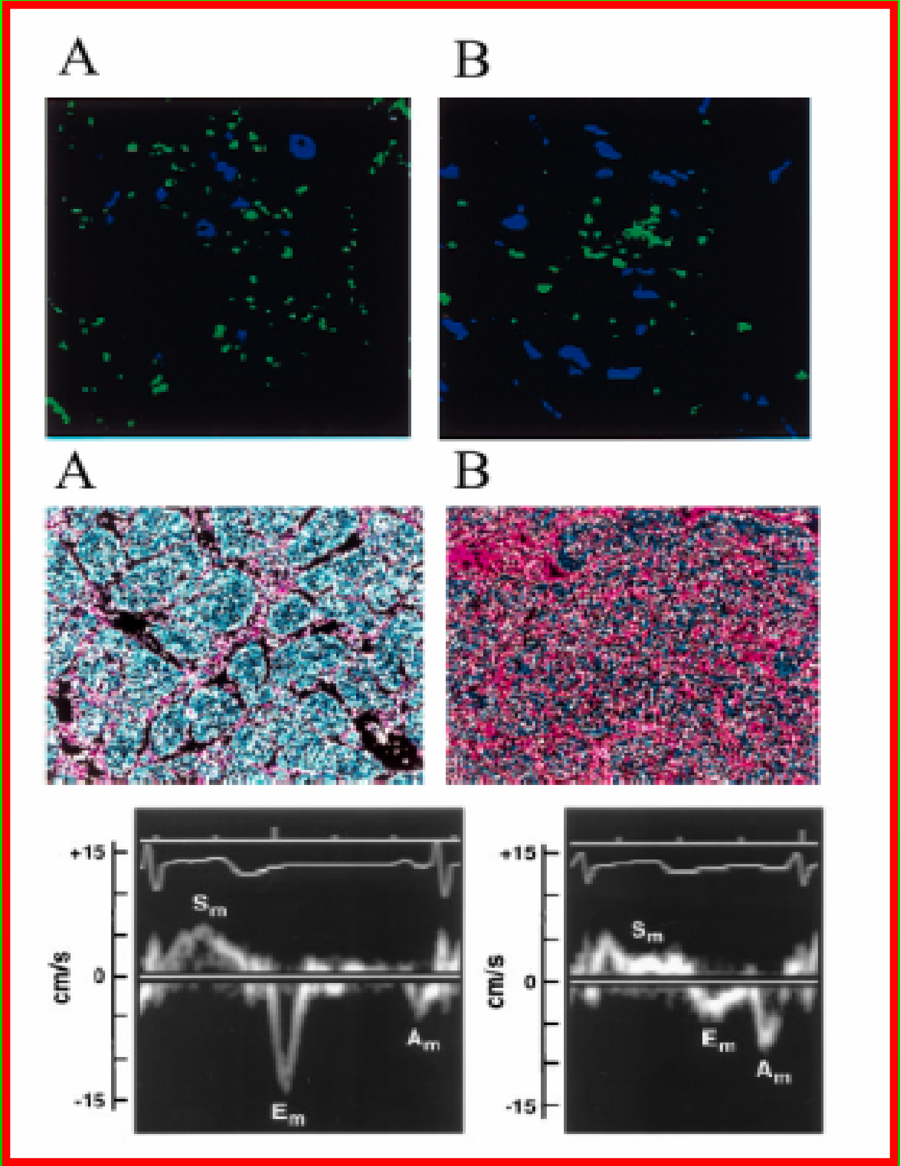
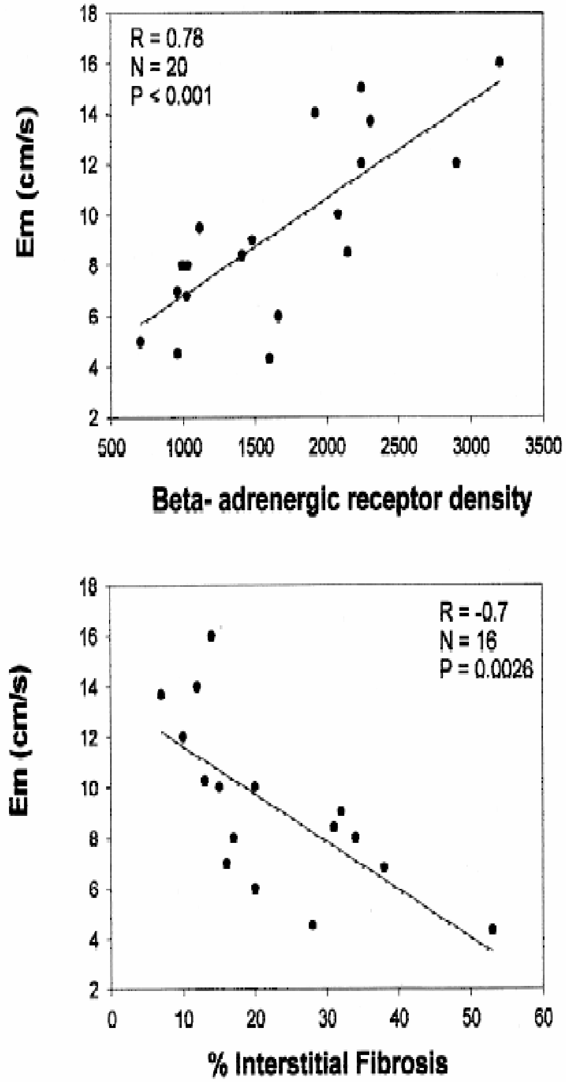


Figure 1. (Top panel) Fluorescent labeling of beta-adrenoreceptors **(green)** and nuclei **(blue with 4′6′-diamidino-2-phenylindole chloride, 0.1 g/ml). (A)** Normal segment **(B)** Dysfunctional segment. **(Middle panel)** Mallory's trichrome stain for interstitial fibrosis. **(A)** Normal segment; **(B)** Dysfunctional segment. **(Lower panel)** Tissue Doppler velocities. Am = late diastolic myocardial velocity; Em = early diastolic myocardial velocity; Sm = systolic myocardial velocity; from normal **(A)** and dysfunctional **(B)** segments. Notice the higher beta-adrenergic receptor density, the lower amount of interstitial fibrosis and the preserved Sm and Em velocities in the normal segment.

Shan K et al. J Am Coll Cardiol 2000;36:891-6



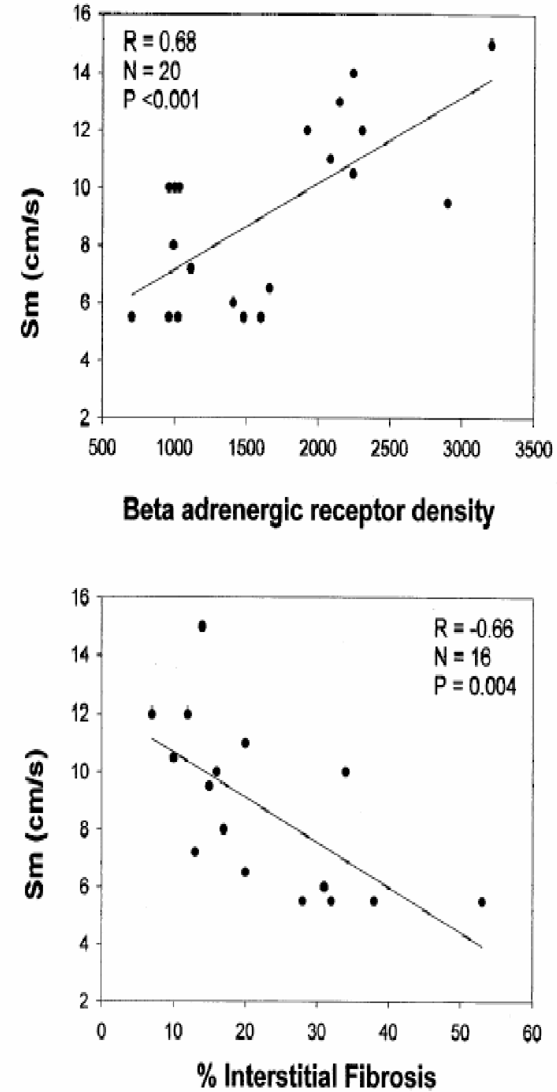


Figure 2. **(Upper panel)** Relation of Em to beta-adrenoreceptor density. **(Lower panel)** Relation of Em to the percent of interstitial fibrosis. Em = early diastolic velocity.

Figure 3. **(Upper panel)** Relation of Sm to beta-adrenoreceptor density. **(Lower panel)** Relation of Sm to the percent of interstitial fibrosis. Sm = myocardial systolic velocity.

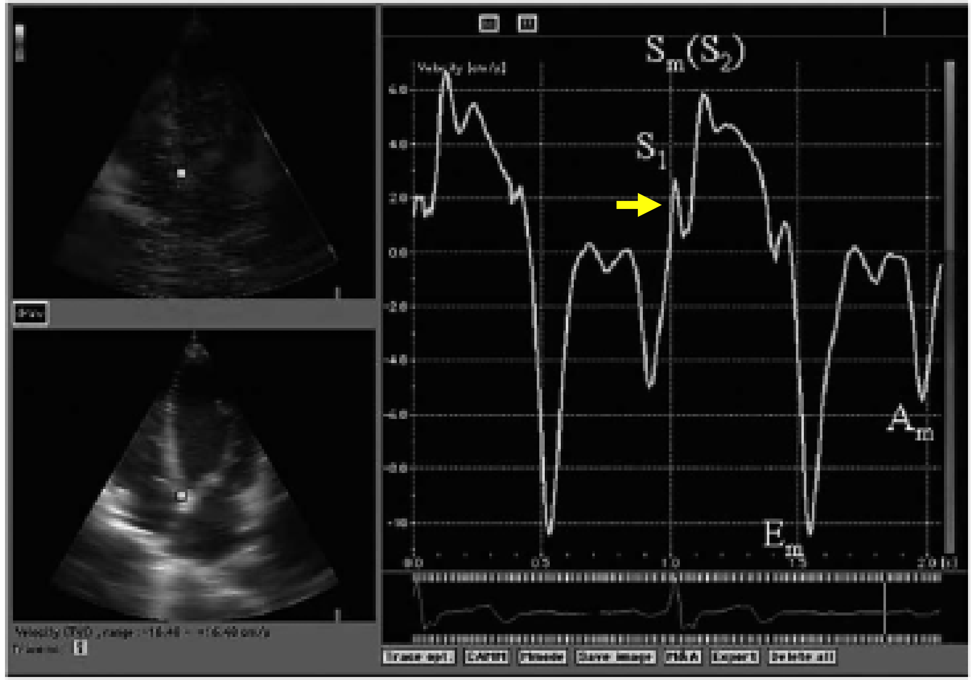
Shan K et al. J Am Coll Cardiol 2000;891-6

Regional Systolic LV Function

- Ejection phase indices
- Preejection indices
- Postejection indices
- TDI as an Integral part of Stress Echocardiography
- Transmyocardial velocity gradients(endocardium-pericardium)

Preejection indices

- Isovolumic contraction(IVC) velocity



Positive IVC velocity predict recovery of myocardial function after PCI in MI

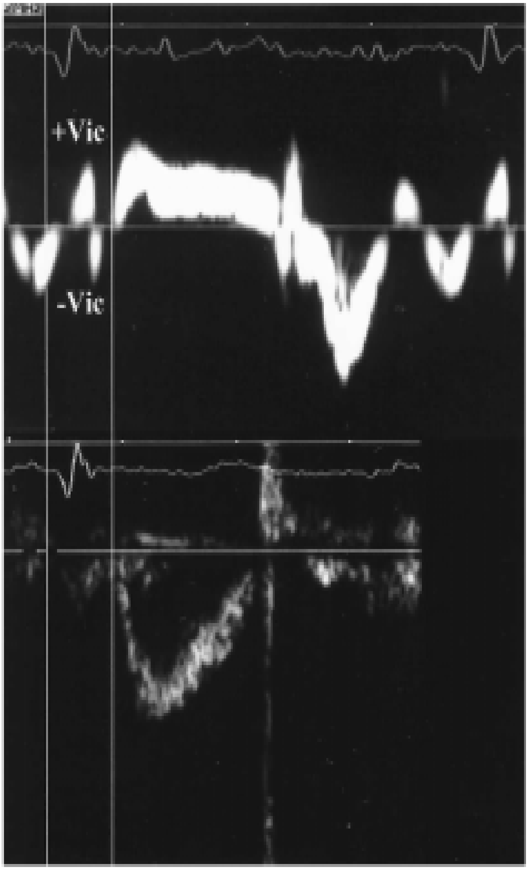


Figure 1. Normal myocardial velocity pattern during the preejection period (i.e., before the opening of the aortic valve). +VIC = positive preejection velocity; −VIC = negative preejection velocity.

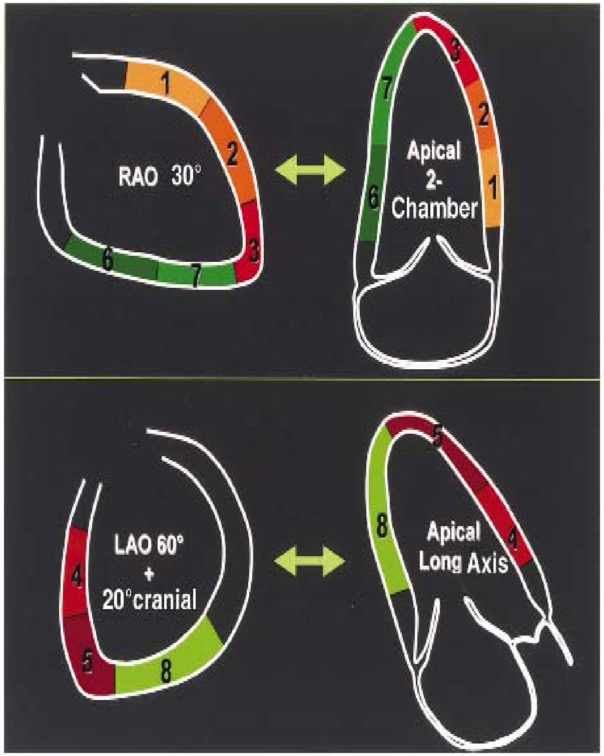


Figure 2. Correspondence between the myocardial segments analyzed on the biplane left ventricular angiogram (analysis of myocardial wall motion, **left panels**) and the two apical echocardiographic views (analysis of tissue Doppler imaging-derived preejection velocities, **right panels**): myocardial segments 1, 2, 3, 6, and 7 were analyzed on the right anterior oblique (RAO) projection and in the apical two-chamber view, respectively. Myocardial segments 4, 5, and 8 were analyzed in the left anterior oblique (LAO) projection plus 20° cranial inclination and the apical long-axis view, respectively. Myocardial segments 1, 2, 3, 4, and 5 were considered to belong to the perfusion territory of the left anterior descending coronary artery; myocardial segments 6, 7, and 8 were considered to belong to the perfusion territory of the dominant right coronary artery (15,16).

Penicka M et al.J Am Coll Cardiol 2004;43:85–91.

Positive IVC velocity predict recovery of myocardial function after PCI in MI

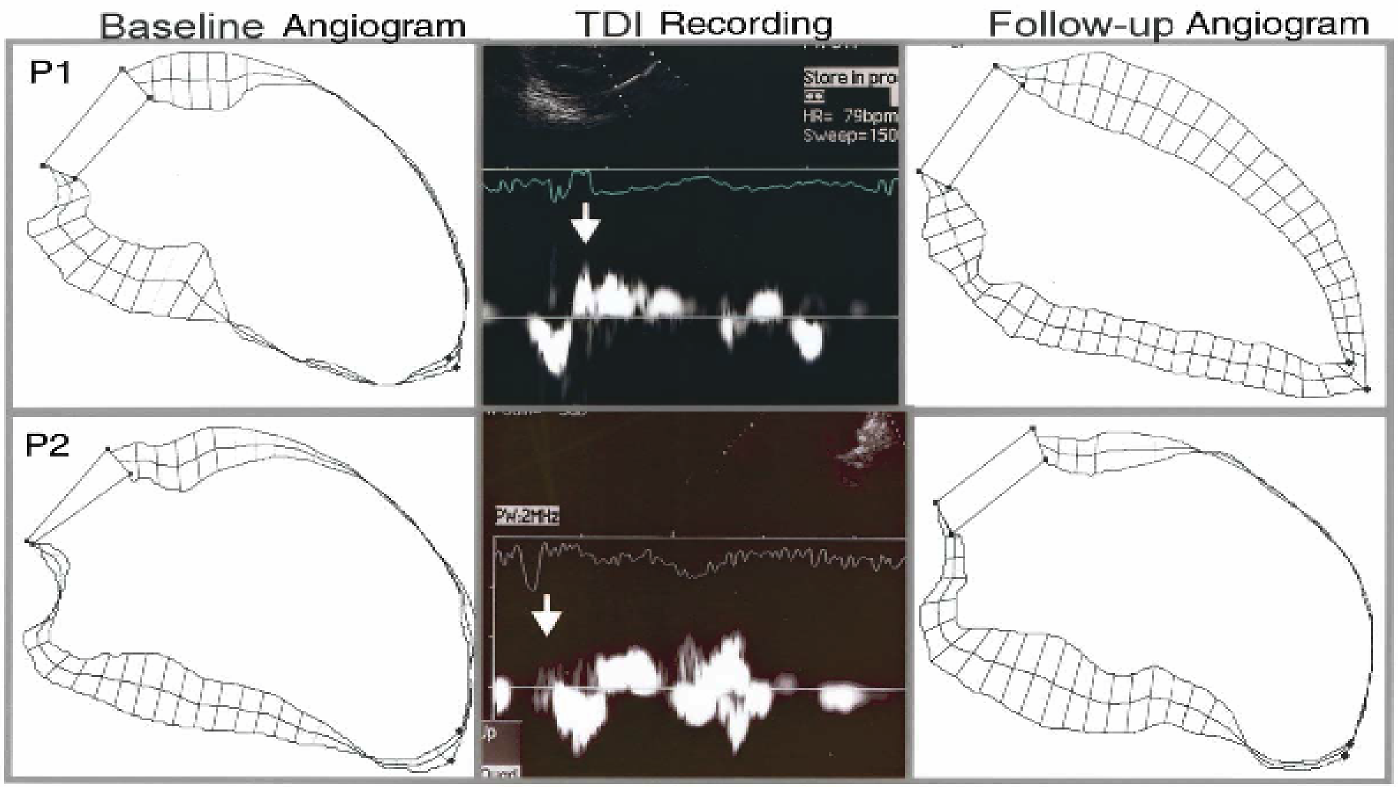
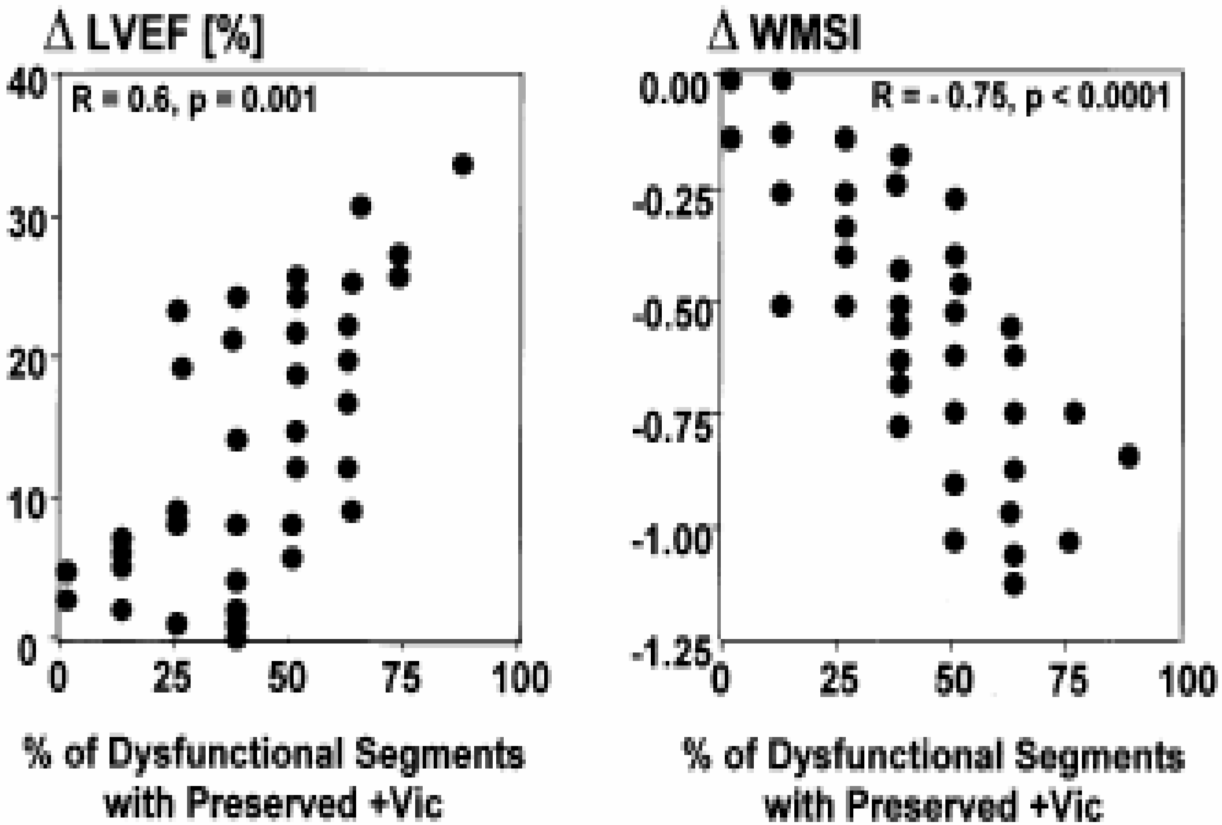


Figure 3. Representative tissue Doppler imaging (TDI) tracing from akinetic anterior segments in two patients with large anterior infarction, one with marked recovery of segmental shortening at follow-up (P1) and one without significant improvement (P2). In P1, presence of the positive preejection velocity (+VIC) **(arrow)** in reperfused anterior segments was predictive of a recovery of contractile function at follow-up. In P2, absence of +VIC indicated nonrecovery despite revascularization. A large negative wave can be seen suggesting paradoxical outward bulging of this segment during preejection and early ejection.

Penicka M et al.J Am Coll Cardiol 2004;43:85–91.



Penicka M et al.J Am Coll Cardiol 2004;43:85–91.

Preejection tissue velocity and myocardial viability

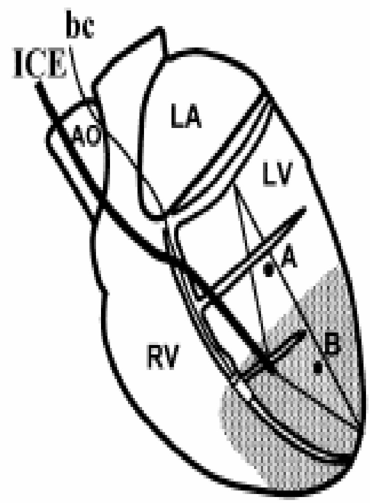
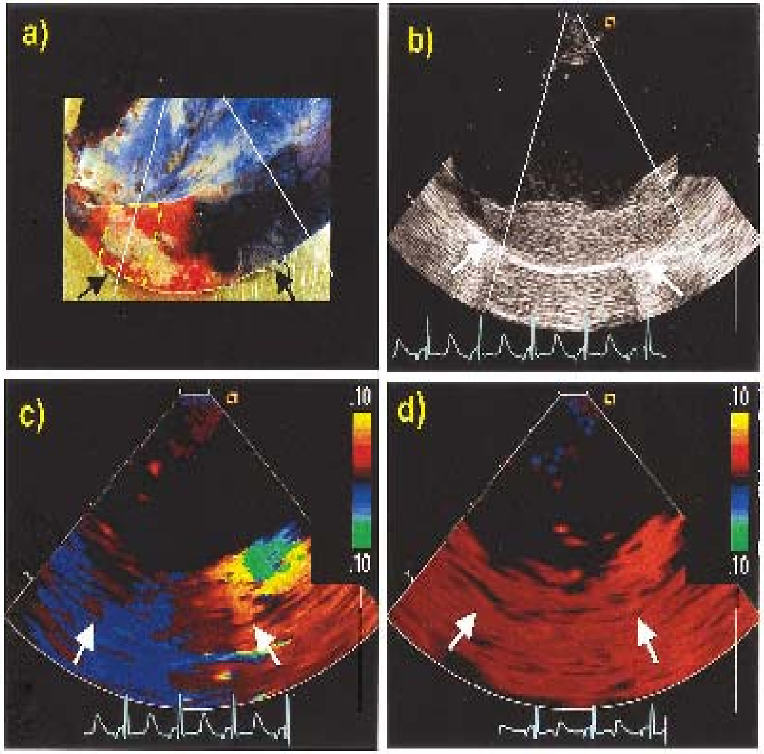


Figure 1. Schematic representation of the placement of the epicardial markers and intracardiac ultrasound interrogation plane. A and B = epicardial markers; AO = aorta; bc = percutaneous transluminal coronary angioplasty balloon catheter; ICE = intracardiac ultrasound catheter; LA = left atrium; LV = left ventricle; RV = right ventricle.



Pislaru C et al. J Am Coll Cardiol2001;38:1748 –56.

Preejection tissue velocity in a small anterior infarct

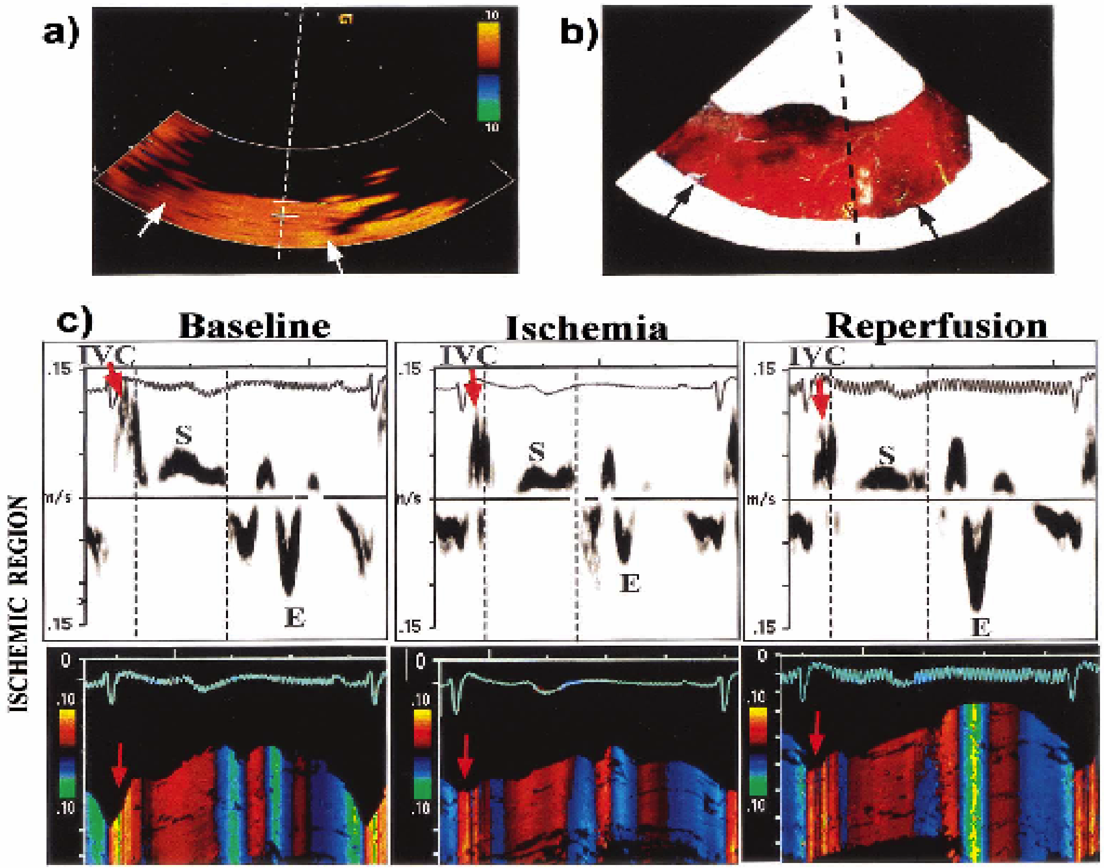
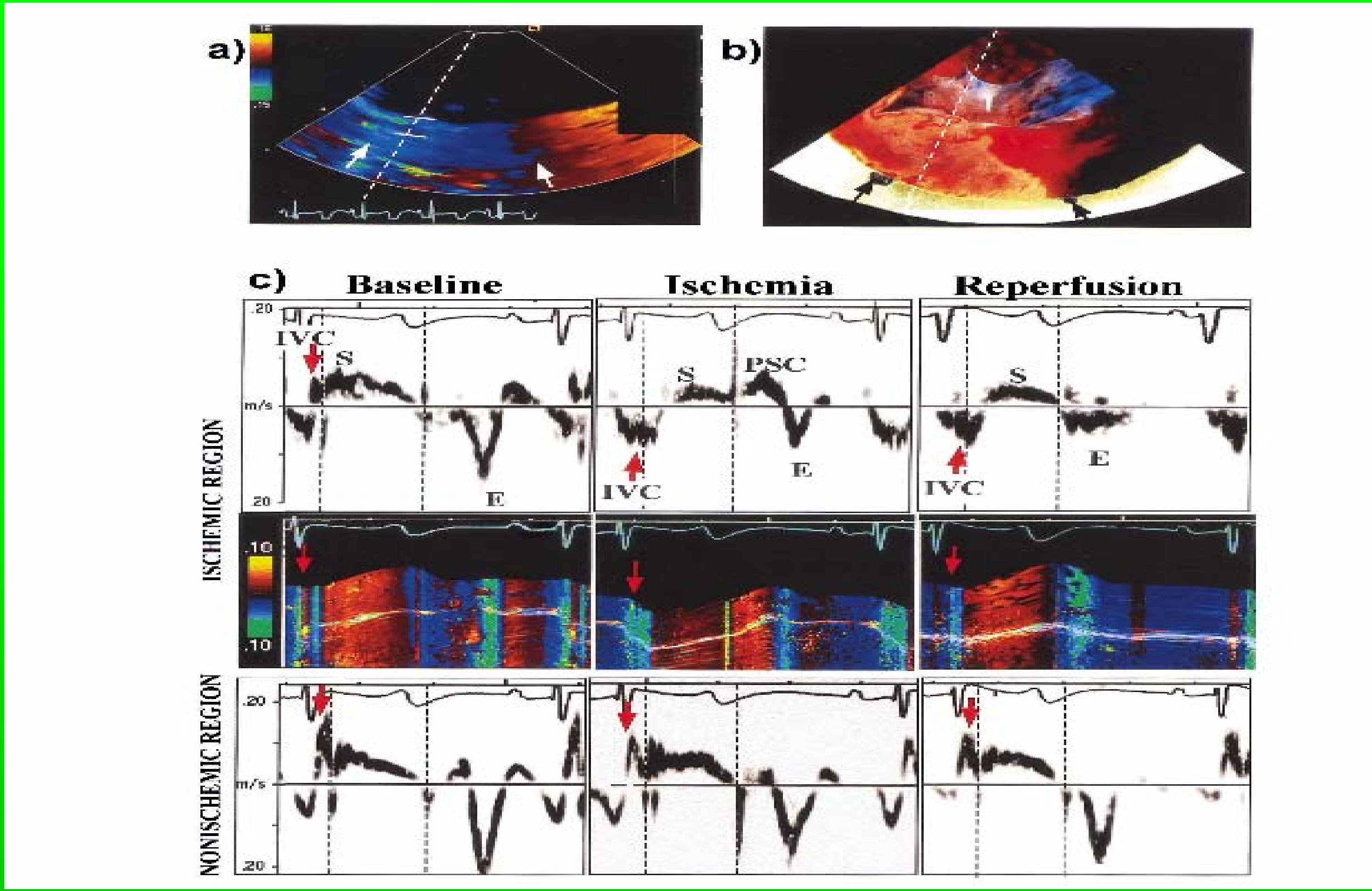


Figure 3. Data from one animal with a small anterior infarct. **(a)** A color Doppler myocardial imaging (DMI) frame during isovolumic contraction phase and showing the location of sample in pulsed DMI mode; epicardial markers are located at the **tip of the arrows. (b)** Shows a corresponding stained cardiac specimen image. The transmural extent of necrosis measured at the location of the sample gate was 6%. **(c)** Pulsed and color M-mode DMI at baseline, at the end of the occlusion (60 min) and after reperfusion (30 min). Note the reduced systolic (S) velocities during the ejection phase but the presence of high positive isovolumic contraction (IVC) velocity **(red arrows)**, identifying ischemic, but viable, myocardium. The **dashed vertical lines** indicate the time of the aortic valve opening and closure.

Pislaru C et al. J Am Coll Cardiol2001;38:1748 –56.

Preejection tissue velocity in transmural anterior infarct



Pislaru C et al. J Am Coll Cardiol2001;38:1748 –56.

Regional Systolic LV Function

- Ejection phase indices
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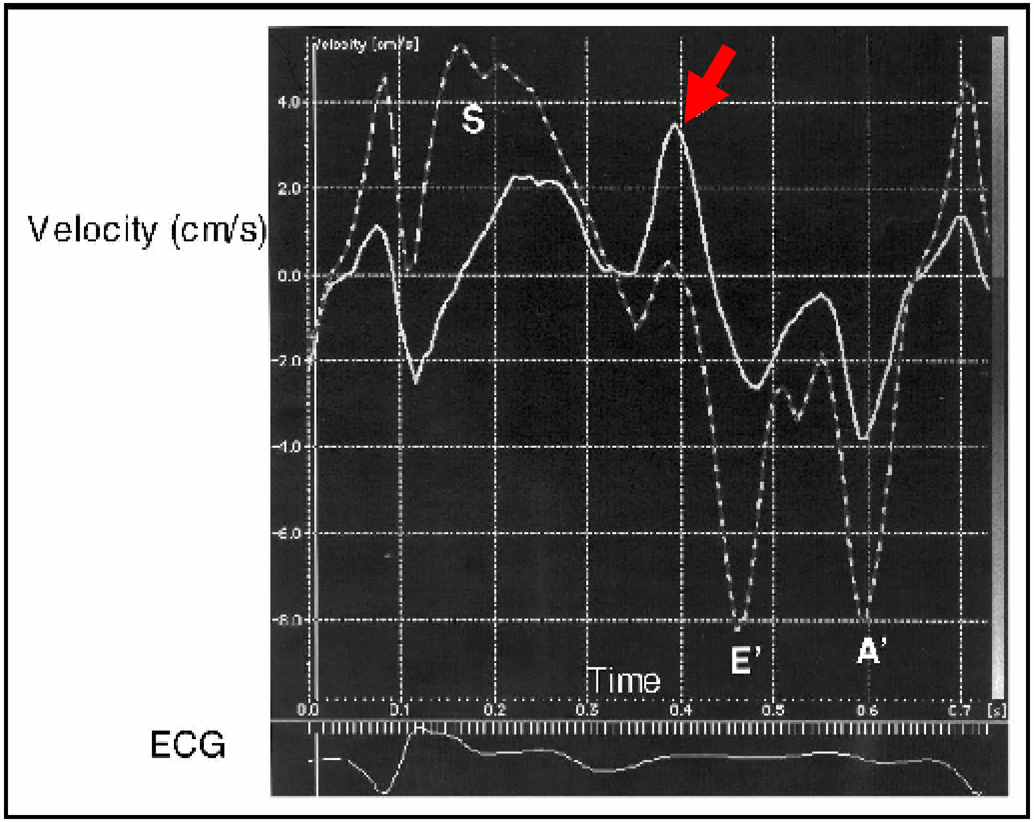
- Transmyocardial velocity gradients(endocardium-pericardium)

Postejection indices

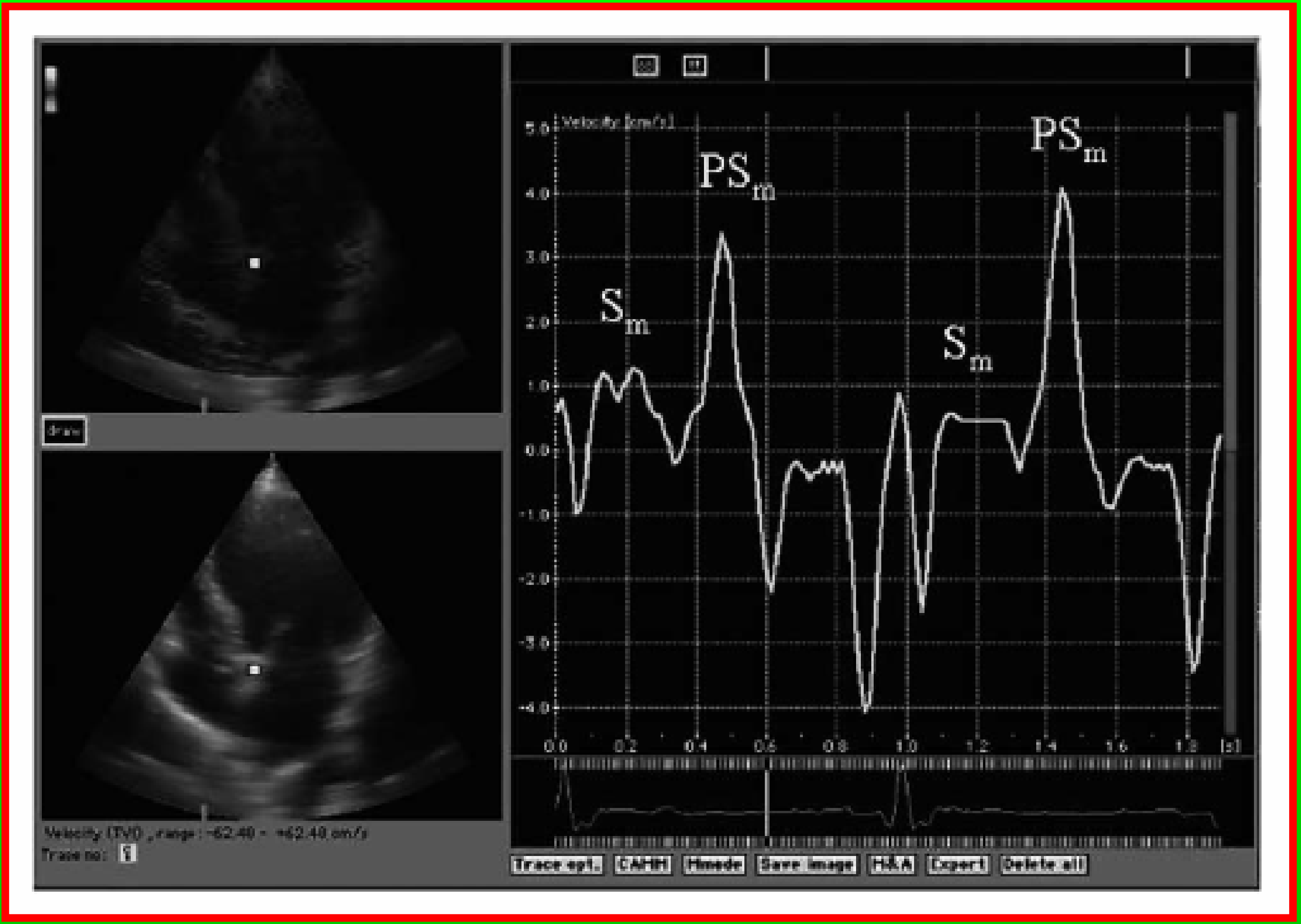
Figure 4. Postsystolic shortening in ischemic myocardium

Myocardial velocity curves from a patient with significant stenosis of the left anterior descending coronary artery. The dashed curve shows longitudinal velocity in a normal lateral segment. The continuous curve shows velocity in an ischemic segment in mid septum. This ischemic segment has reduced systolic velocity, and during early diastole there is a marked positive velocity (arrow), which represents postsystolic shortening. S, systolic velocity; E', early-diastolic velocity; A', late-diastolic velocity.



Smiseth OA et al.Curr Opin Cardiol 19:421–429.

Postsystolic wave (PSm) of mitral annular motion detected in a patient after anterior MI

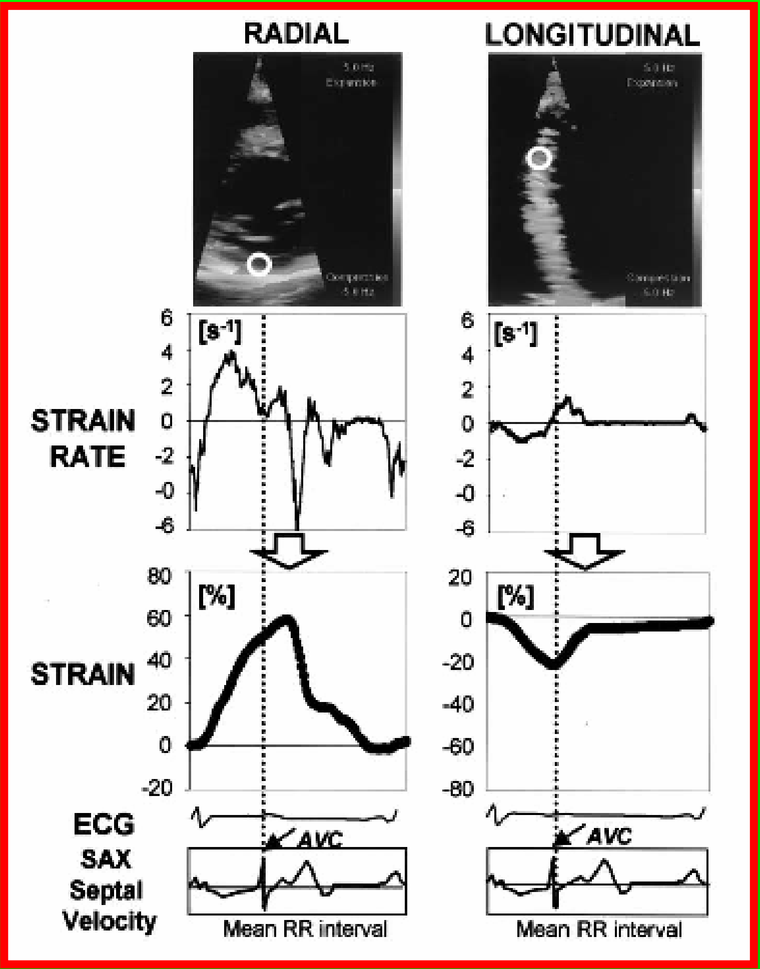


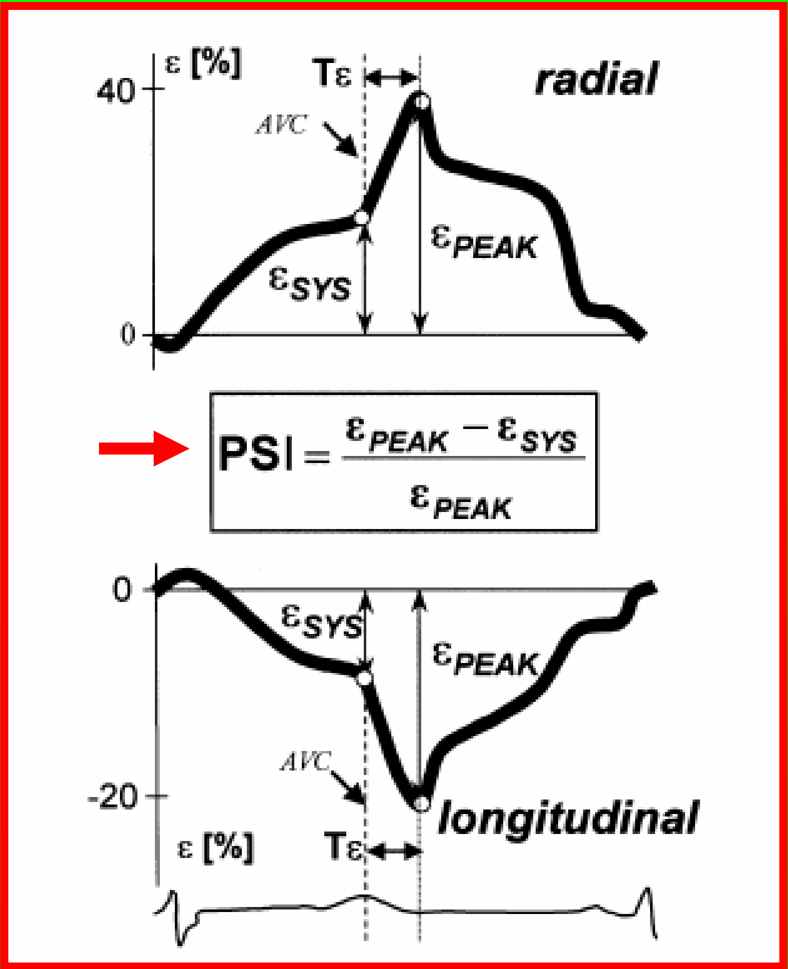
Postsystolic shortening and viability in acute myocardial infarction

- Postsystolic shortening(PSS)

- marker of myocardial viability during acute coronary occlusion
- Passive or necrotic myocardium
- If postsystolic shortening occurs in the absence of systolic lengthening: passive recoil can be excluded→ delayed active contracion
- When a segment is dyskinetic, but the postsystolic shortening far exceeds the systolic lengthening in magnitude: active contraction contributes to postsystolic shortening

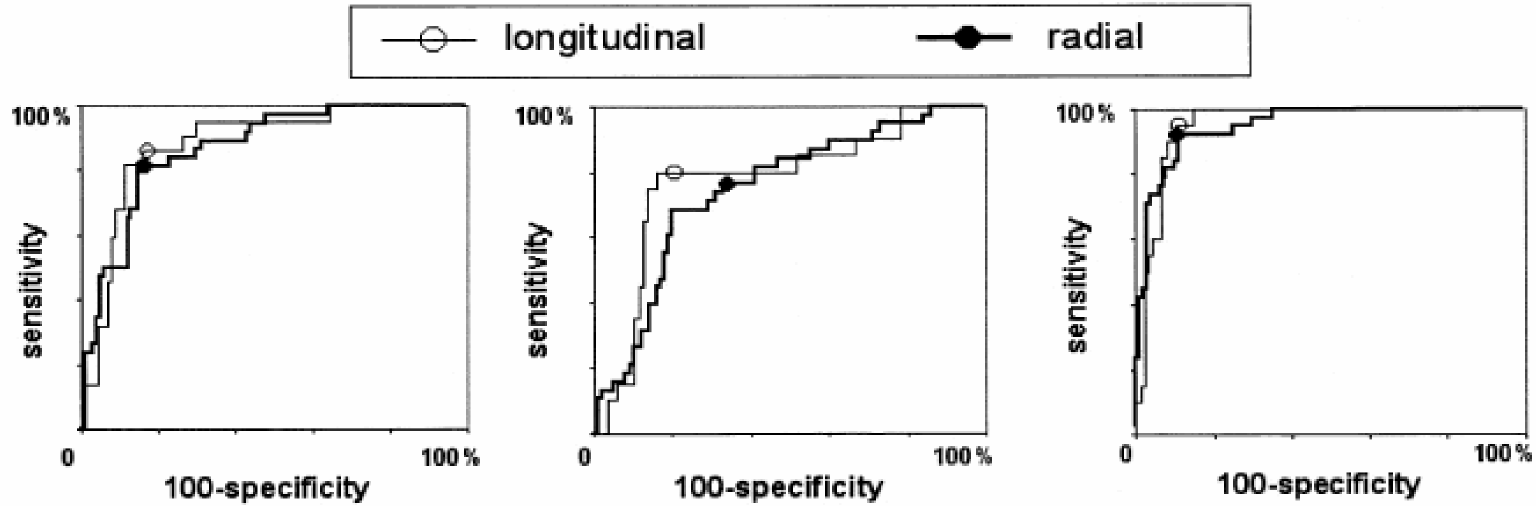
Postsystolic strain index(PSI)





Kukulski T et al. J Am Coll Cardiol 2003;41:810 –9)

PSI: highly sensitive and specific marker of myocardial dysfunction during acute myocardial ischemia



End-systolic strain

	radial	longitudinal
Cut off value	25%	-10%
Sensitivity	82%	86%
Specificity	84%	83%
ROC area	0.82	0.84

Peak strain

	radial	longitudinal
Cut off value	42%	-14%
Sensitivity	76%	81%
Specificity	67%	79%
ROC area	0.72	0.78

Post-systolic strain Index

	radial	longitudinal
Cut off value	0.22	0.25
Sensitivity	92%	95%
Specificity	89%	89%
ROC area	0.94	0.95

Figure 5. Receiver operating characteristic (ROC) curves testing the diagnostic value of end-systolic, peak strain, and post-systolic strain index in the identification of acutely ischemic segments during coronary occlusion. Optimal cutoff values are represented by **closed and open circles**.

Kukulski T et al. J Am Coll Cardiol 2003;41:810 –9

Pre- and Postejection Velocities in Ischemia

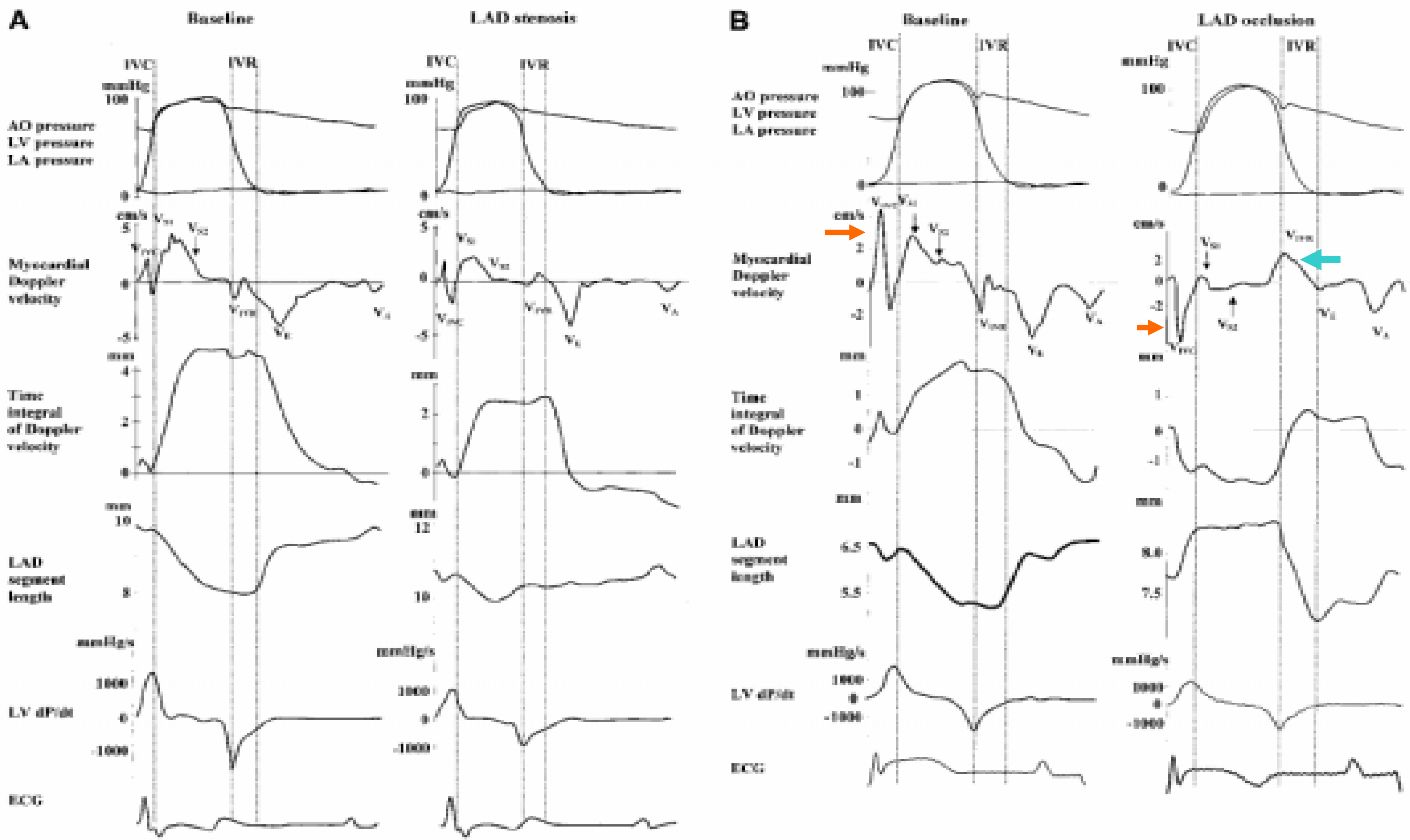


Figure 2. Representative traces at baseline and LAD stenosis (A, group with moderate ischemia) and baseline and LAD occlusion (B, group with severe ischemia), showing myocardial Doppler velocities along with other hemodynamic variables and ECG. V_{S1} indicates peak velocity during early systole; V_{S2}, tissue velocity during midsystole; V_{IVC}, peak velocity during IVC; V_{IVR}, peak velocity during IVR; V_E, early diastolic velocity; V_A, late diastolic velocity; and AO pressure, aortic pressure.

Edvardsen T et al. *Circulation*. 2002;105:2071-2077.

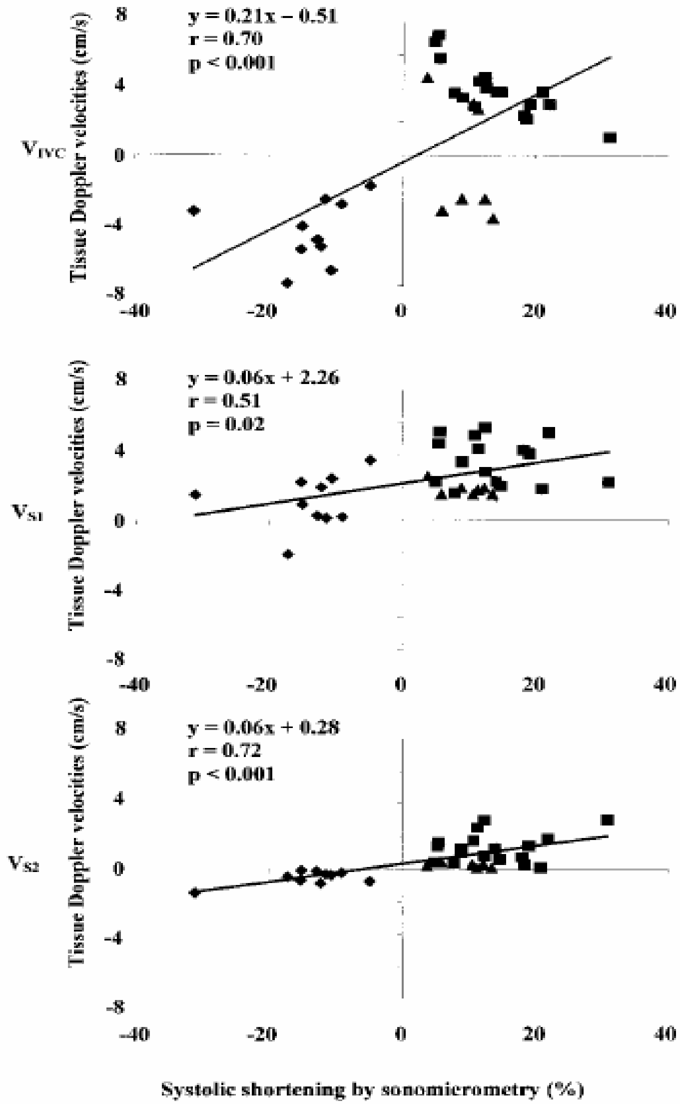


Figure 3. Regression between tissue Doppler velocities in different systolic phases and systolic shortening by sonomicrometry. Abbreviations as in Figure 2. ■ indicates baseline; ▲, LAD stenosis; and ◆, LAD occlusion.

Edvardsen T et al. *Circulation*. 2002;105:2071-2077.

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MYDISE(Myocardial Doppler In Stress Echocardiography)

- Feasible in 90% of examined segments in 92 normal

- Reproducibility;

  - basal segment;18% (coefficients of variation)
  - midwall segments; 28% (coefficients of variation)

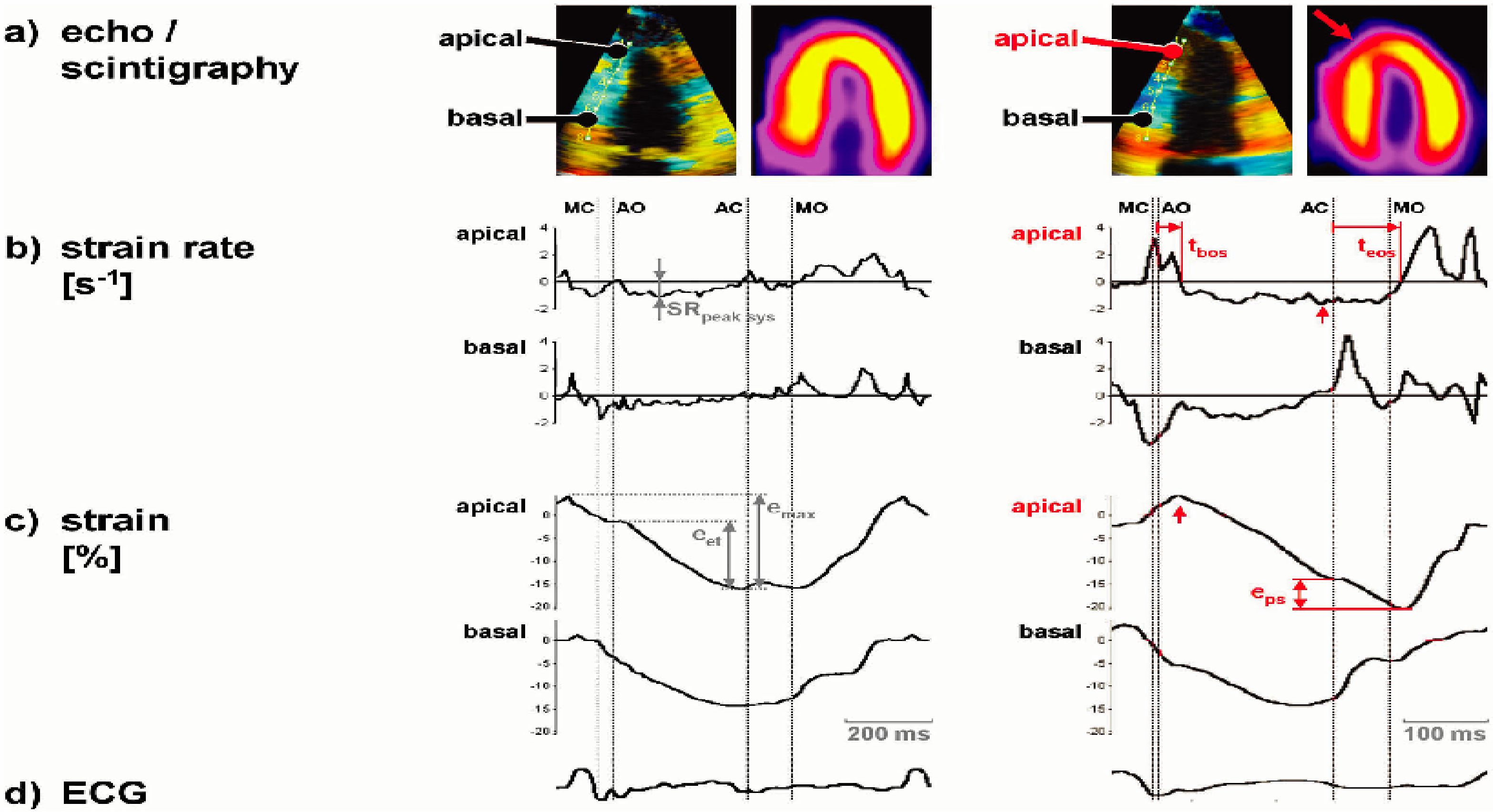
- Peak systolic velocity at peak stress; best discriminator of disease

- Regression model(age,gender, and peak heart rate) - sensitivity/specificity increased from 80/80 to 93/82%

Fraser AG et al. Eur J Echocardiogr 2003;4:43-53 Madler CF et al. Eur Heart J 2003;24:1584-1594

Strain and strain rate responses during stress echo

Figure 6. Strain and strain rate responses during stress echo



This figure displays LV two-chamber perfusion scintigraphic images and color-coded strain rate images (a), and strain rate (b), strain (c), and ECG (d) traces prior to and at peak dobutamine stress. The arrow in the upper right panel points to a perfusion defect. Strain and strain rates are recorded from the ischemic region and a nonischemic region. During peak stress the strain trace from the ischemic apical region demonstrates early-systolic lengthening and postsystolic shortening. $SR_{peak\ sys}$ indicate peak systolic strain. T_{bos} and t_{eos} indicate beginning and end of shortening, respectively. E_{max}, E_{et}, and E_{ps} indicate max strain during the heart cycle, strain during ejection and postsystolic strains, respectively. Reproduced from Voigt *et al.* [28].

Voigt JU et al. Circulation. 2003;107:2120-2126

Strain-rate curved M-mode

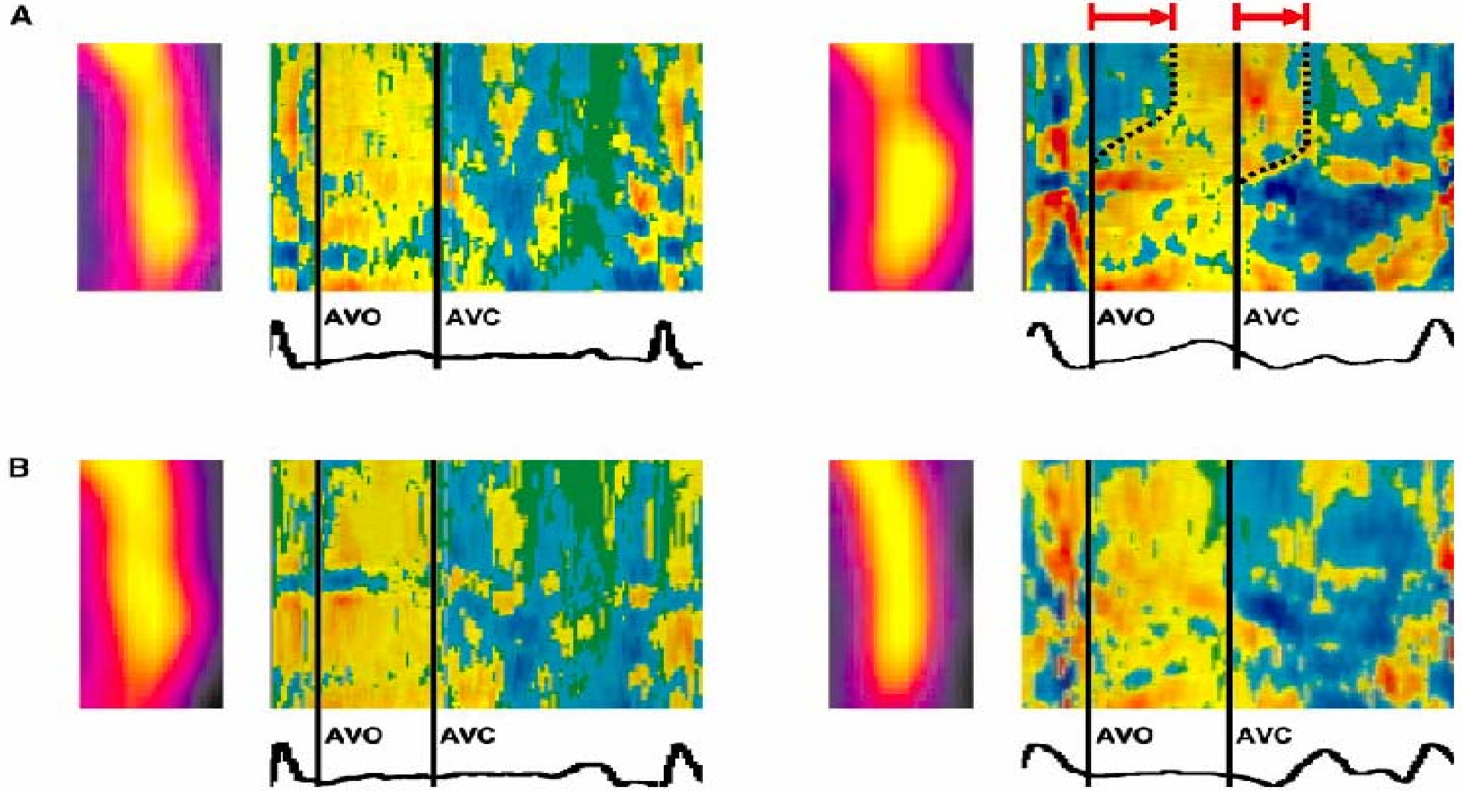


Figure 2. Perfusion scintigrams and color-coded strain-rate curved M-modes of a patient's anteroseptal wall at baseline (left) and during dobutamine stress (right). a, Ischemic response. Note normal strain-rate patterns at rest and delayed onset of myocardial shortening and marked PSS in apical region at peak stress (red arrows). b, Same patient after successful revascularization of the left anterior descending coronary artery. Normal strain-rate patterns both at rest and at peak stress. Middle of lower left curved M-mode shows a typical artifact, identifiable by its band-like shaped color inversion (yellow/blue).

Voigt JU et al. Circulation. 2003;107:2120-2126

Time to onset of regional relaxation

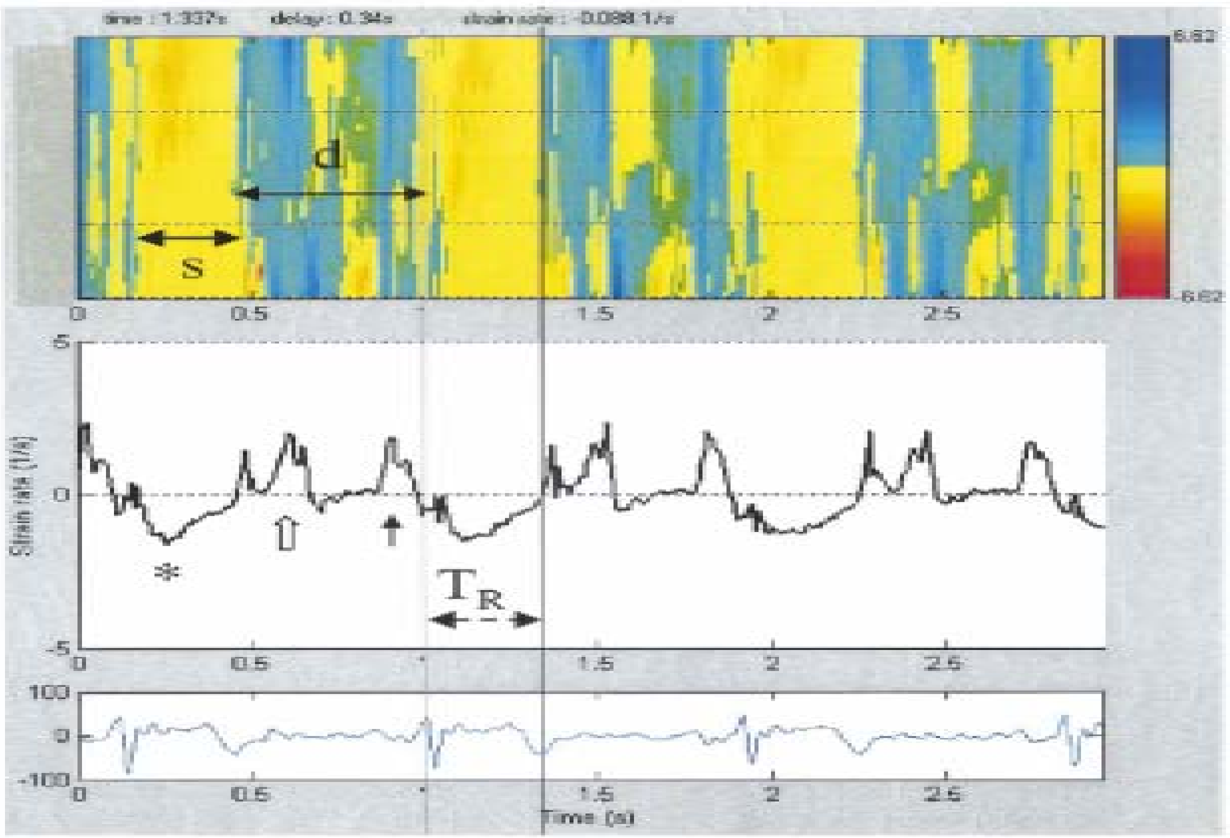


Figure 1. **Top panel** illustrates the color M-mode image, with **yellow** indicating systolic shortening (s) and **blue-white** indicating diastolic lengthening (d) in strain rate imaging. The time point of transition from shortening to lengthening (contraction to relaxation) is indicated by the **solid black line**. The **middle panel** shows the strain rate tracing, * = systolic wave; **solid arrow** = late diastolic wave; **open arrow** = early diastolic wave. The **lower panel** is the electrocardiogram trace. An example of the time to onset of relaxation (electrocardiogram R-wave to the transition point) is illustrated at the bottom of the strain rate tracing (T_R). The **dotted lines** separate the septum into apical **(top)**, mid and basal segments.

Abraham TP et al. J Am Coll Cardiol 2002;39:1531–7

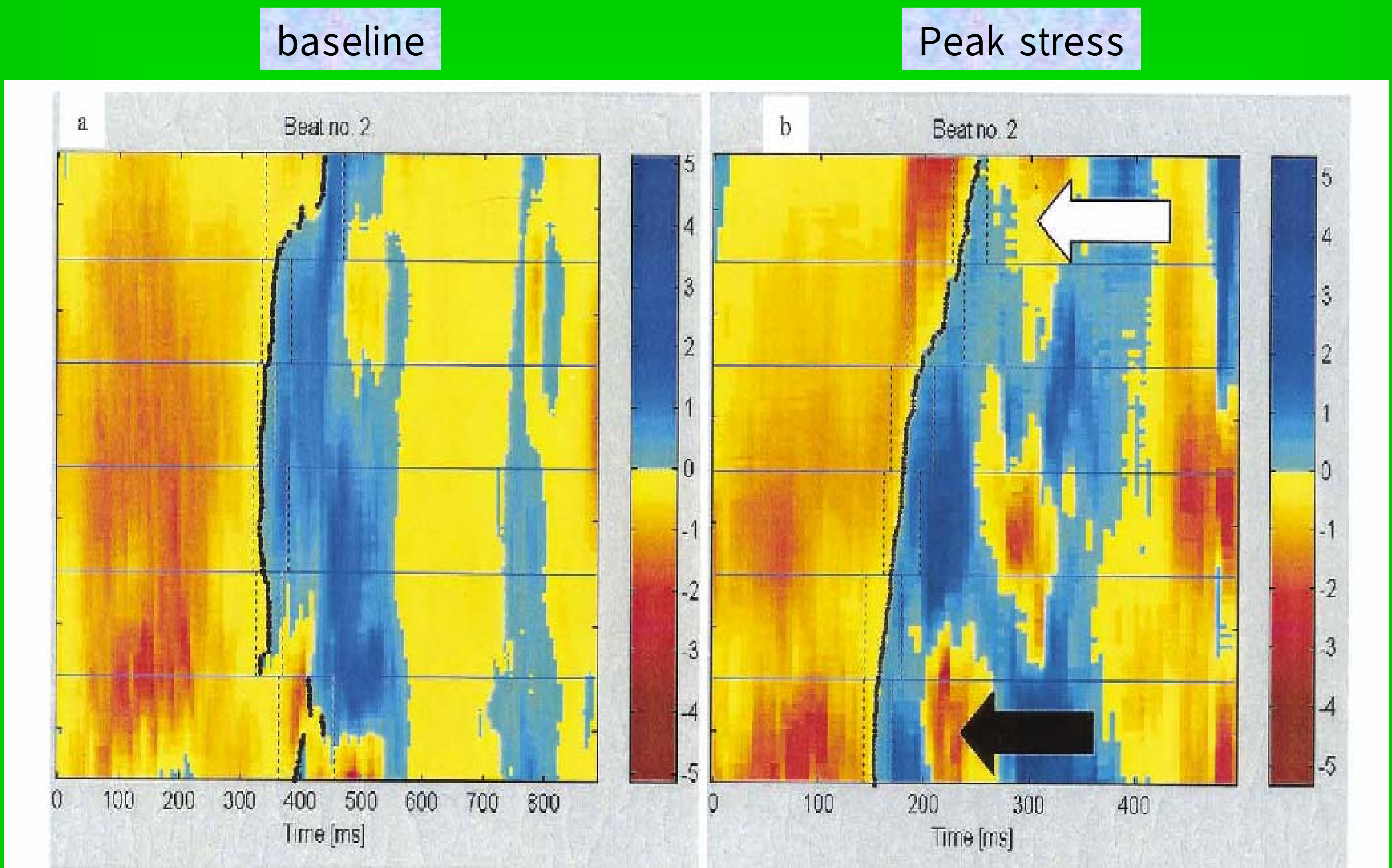


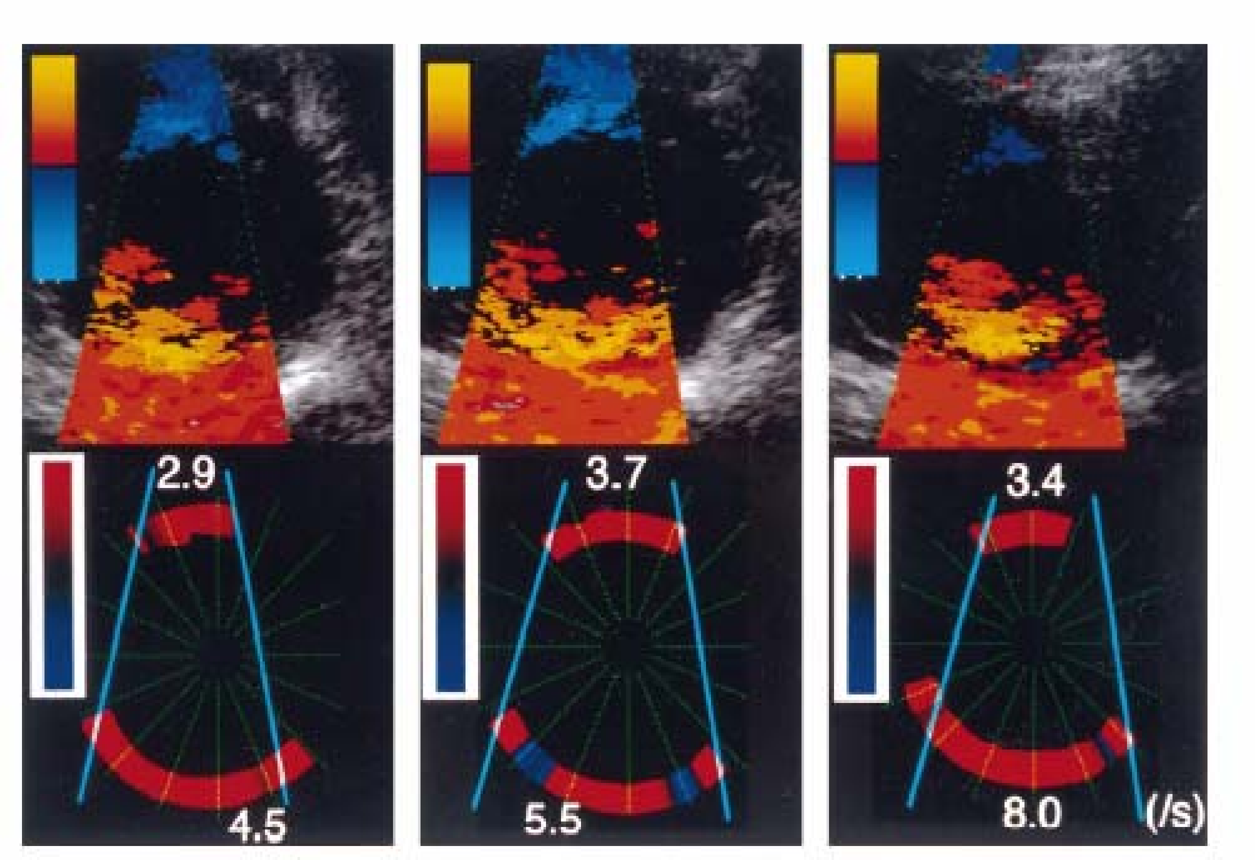
Figure 2. Strain rate color M-mode image illustrating a decrease in T_R from baseline **(a)** to peak stress **(b)** in the nonischemic basal segment **(black arrow)**, and minimal T_R change in the ischemic apical segment **(white arrow)**. T_R = time to onset of regional relaxation.

Abraham TP et al. J Am Coll Cardiol 2002;39:1531–7

Regional Systolic LV Function

- Ejection phase indices
- Preejection indices
- Postejection indices
- TDI as an Integral part of Stress Echocardiography
- Transmyocardial velocity gradients(endocardium - pericardium)

Transmyocardial velocity gradients(MVG)



control

Low dose Dobutamine (10 mg/kg per min)

high dose Dobutamine (30 mg/kg per min)

Tsutsui H et al. J Am Coll Cardiol 1998;31:89 –93

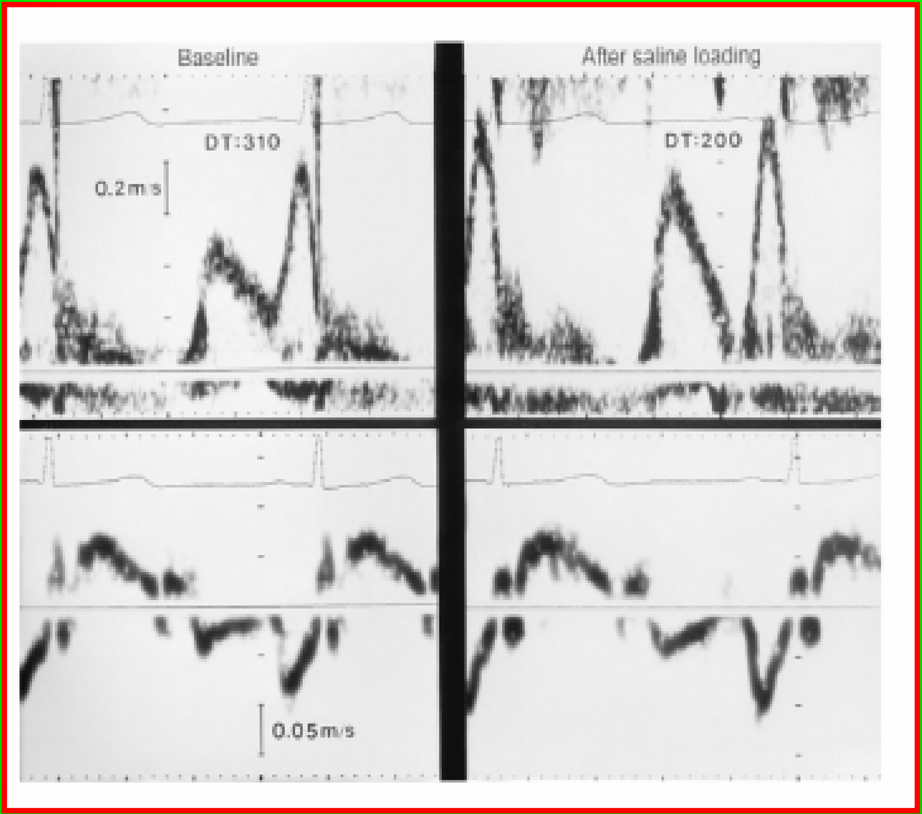
LV Diastolic Function

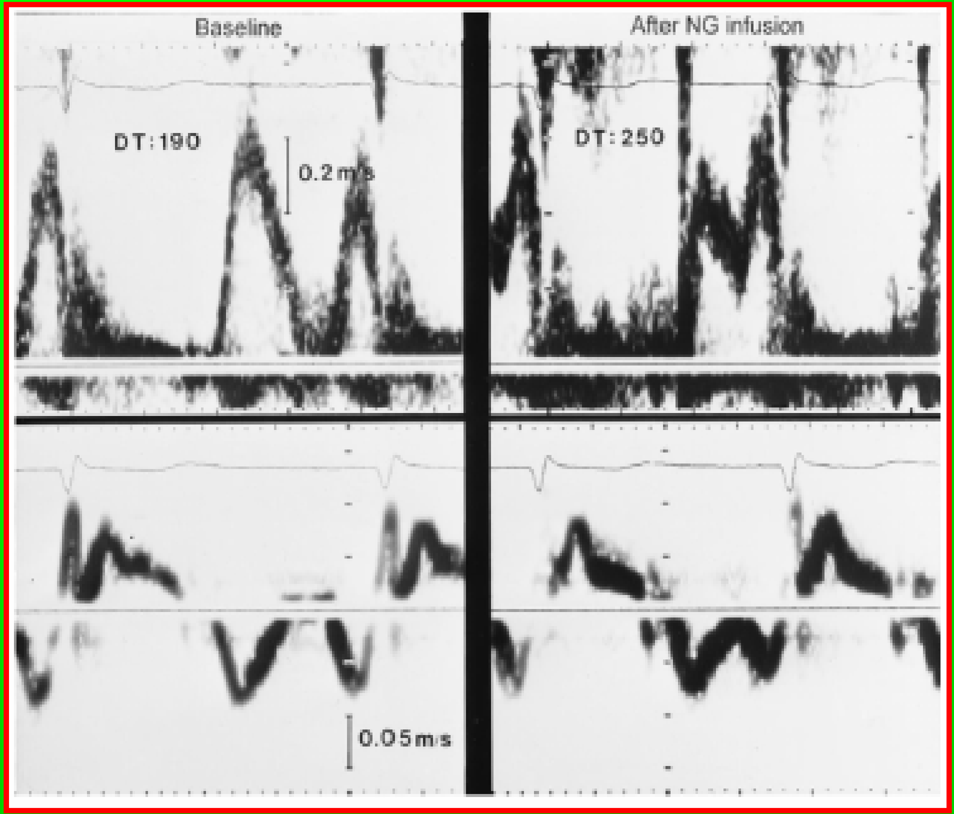
- Ea(early peak diastolic velocity)
  - Preload independent
  - active relaxation

- Ea/Aa ratio

- T_{Ea-E}(time interval between onset of Ea and onset of mitral inflow)

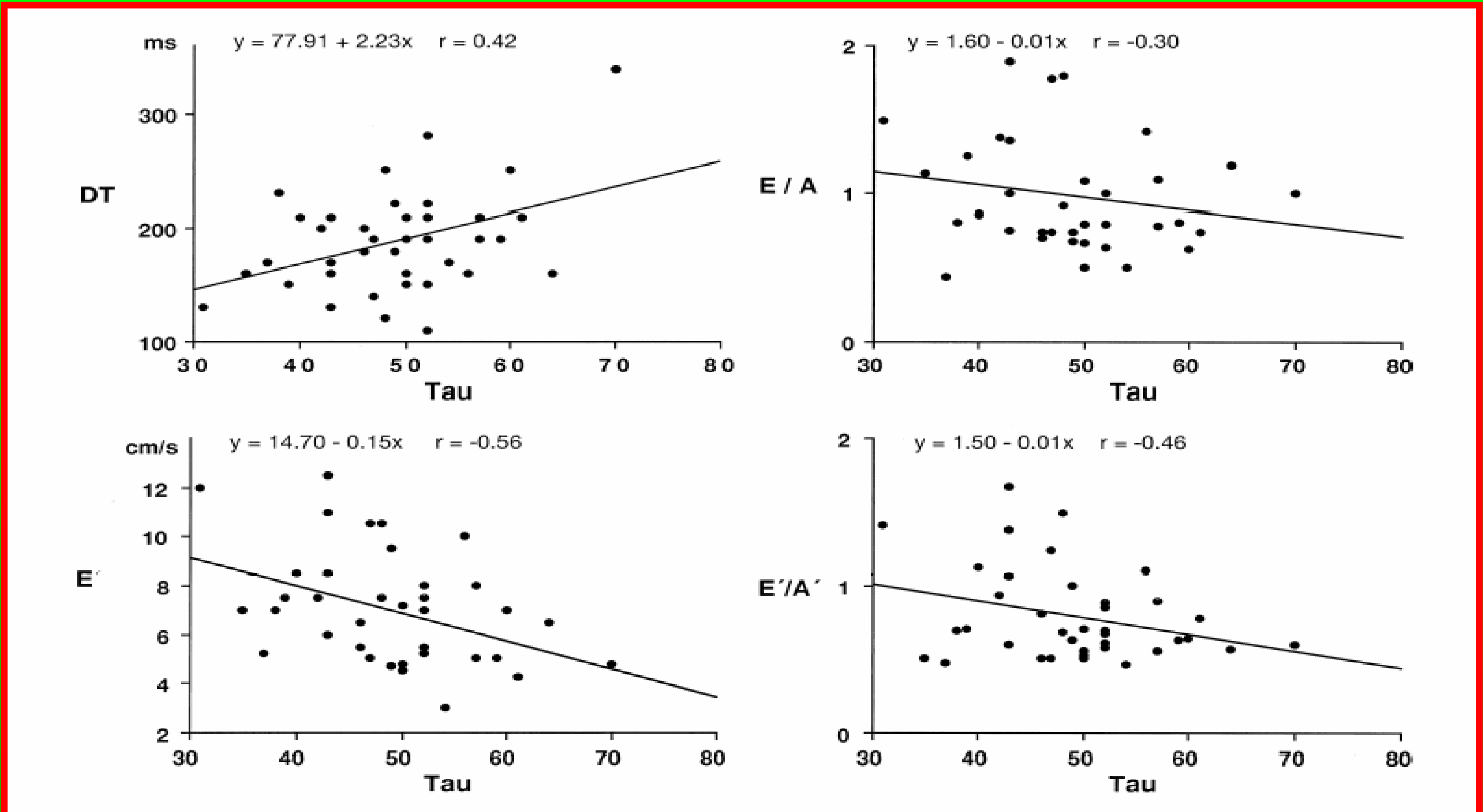
Ea: Preload independent



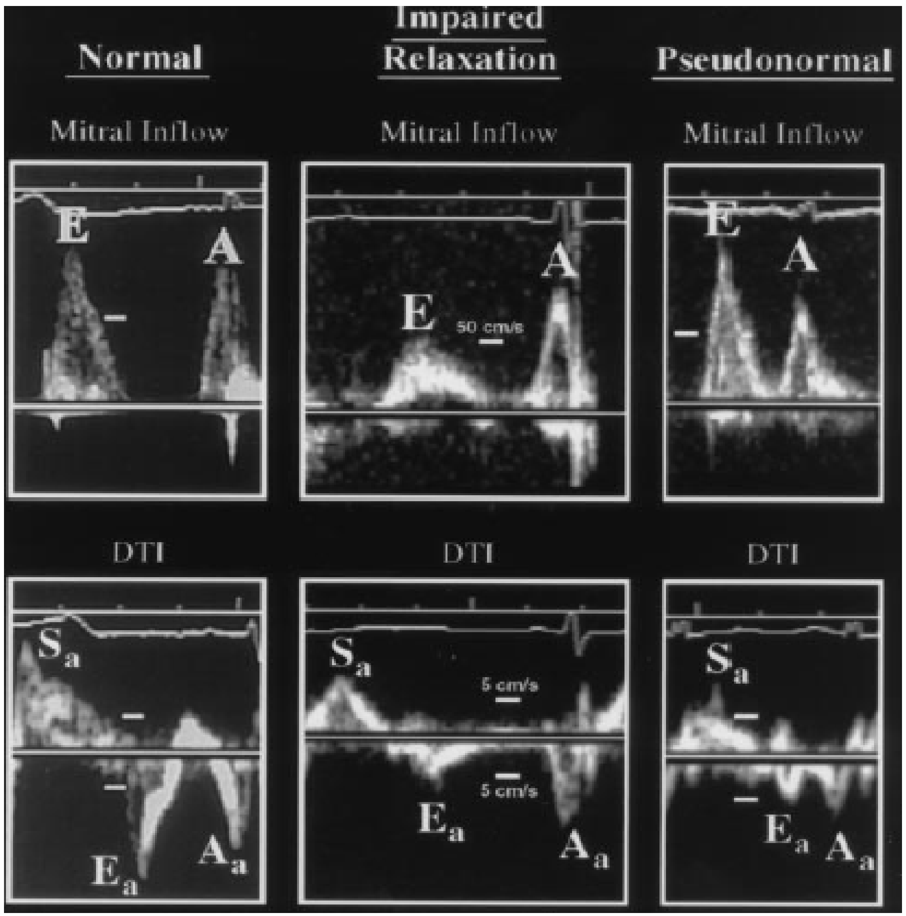


Sohn et al. J Am Coll Cardiol 1997;30:474 –80

Correlation between Tau and deceleration time of early mitral inflow (DT), E/A ratio, peak E' velocity and E'/A' ratio.



Sohn et al. J Am Coll Cardiol 1997;30:474 –80



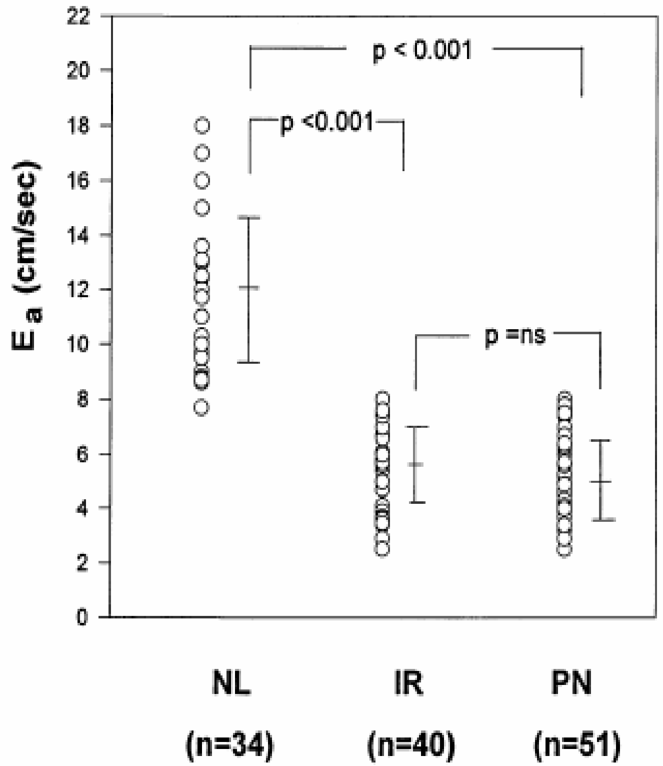


Figure 2. Comparison of E_a among the three study groups. NL = normal.

Nagueh SF et al.J Am Coll Cardiol 1997;30:1527–33.

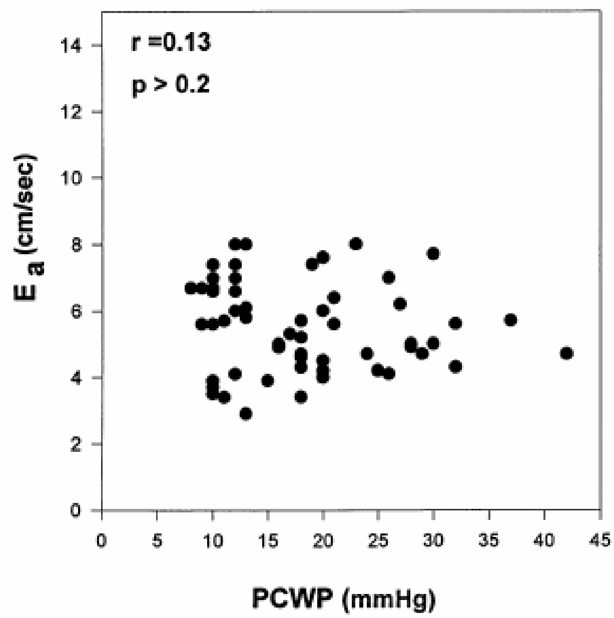


Figure 3. Plot of E_a versus mean PCWP. Note the lack of relation between the two variables.

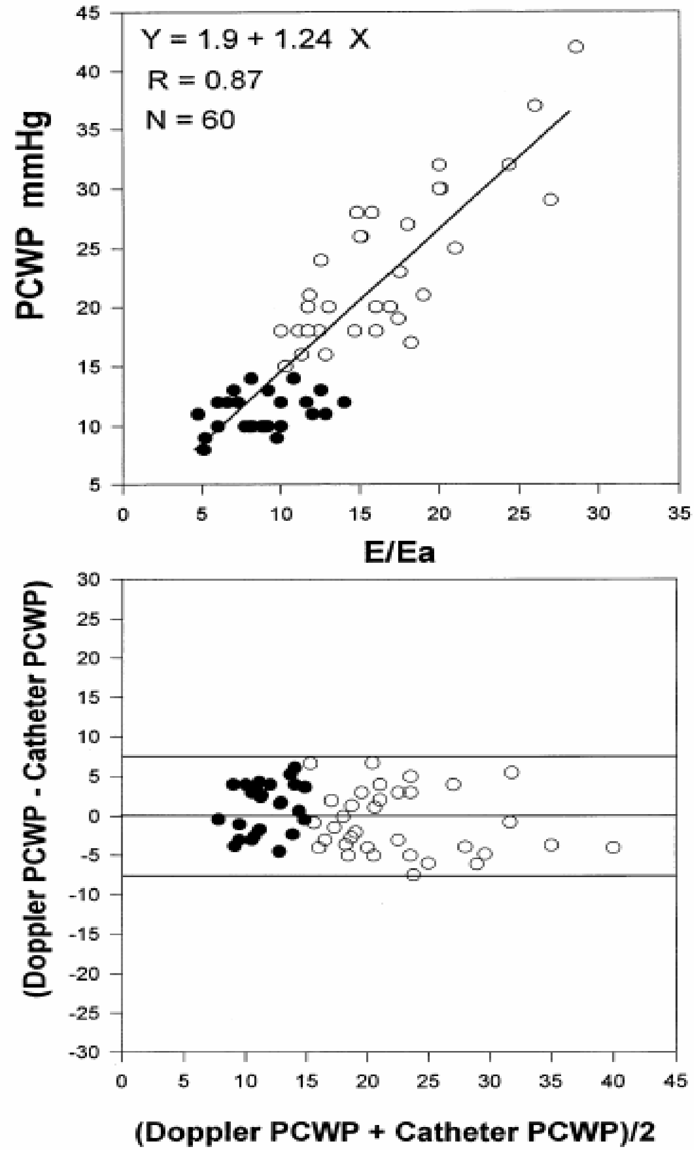
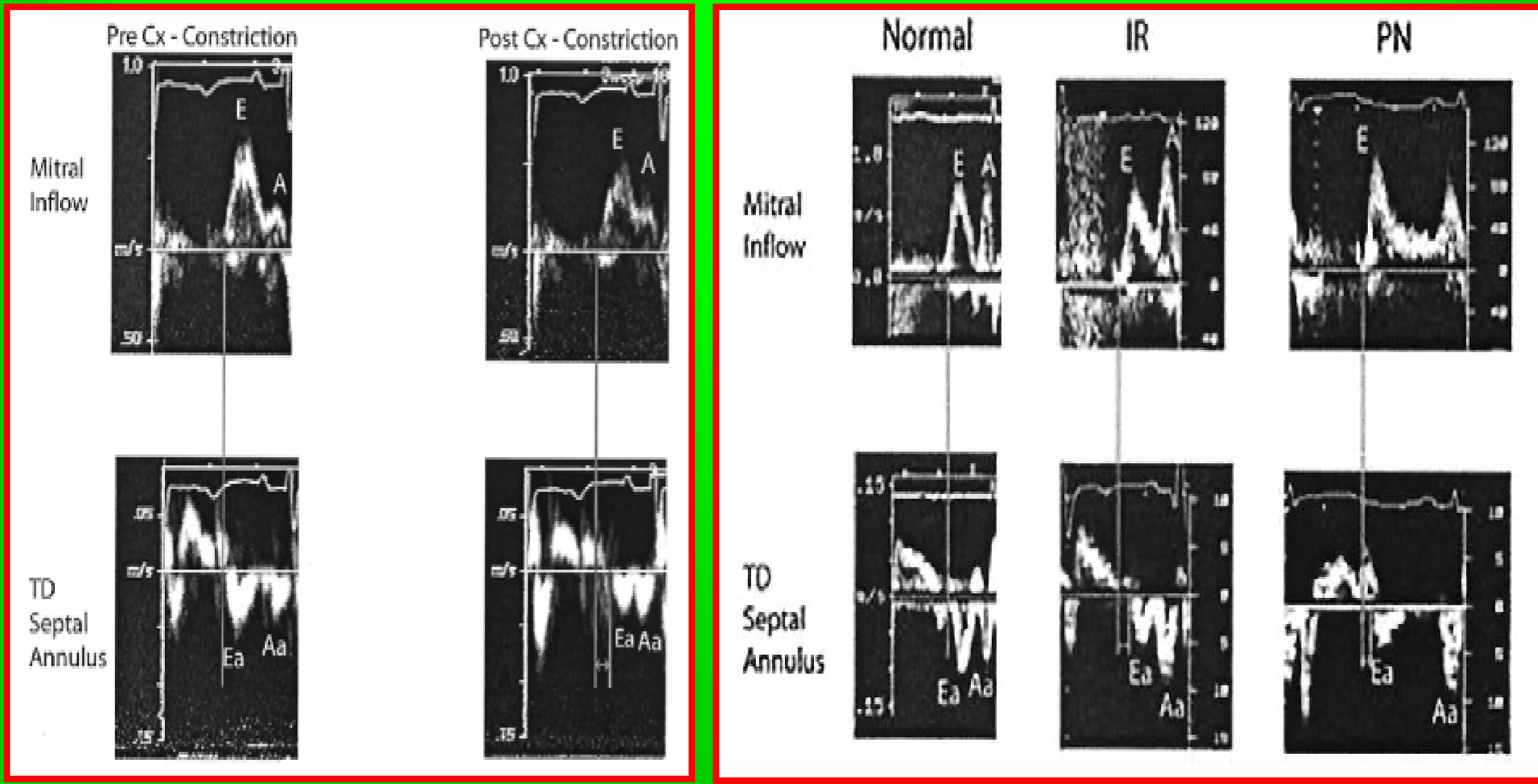


Figure 4. Top, Relation of E/E_a to PCWP. **Bottom,** Plot of the difference between Doppler-estimated and catheter-measured PCWP versus the average of both observations. **Solid circles** = patients with impaired relaxation; **open circles** = patients with a PN mitral inflow pattern.

Nagueh SF et al.J Am Coll Cardiol 1997;30:1527–33.

T_{Ea-E}: New index



animal

human

Rivas-gotz C et al. J Am Coll Cardiol 2003;42:1463–70)

Quantitative DTI for assessment of regional myocardial velocities during transient ischemia and reperfusion

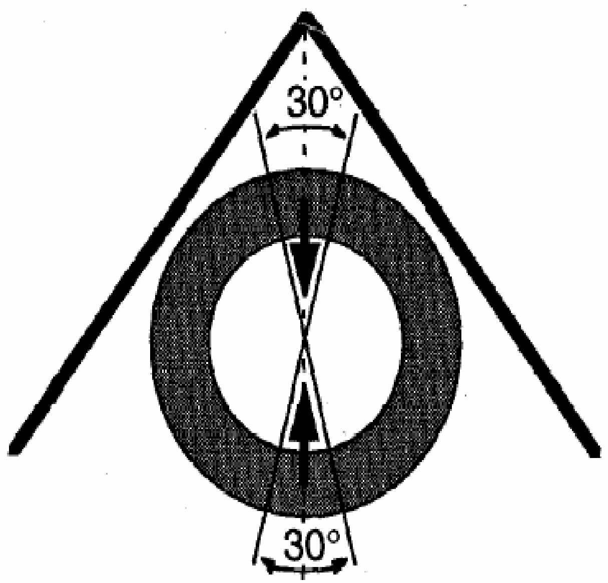


Fig. 1. Parasternal short-axis view used during quantitative DTI. Transducer was angled, and representative myocardial regions of interest were chosen to fall within 15 degrees on each side of axis of Doppler interrogation. *Arrows*, Direction of systolic myocardial thickening.

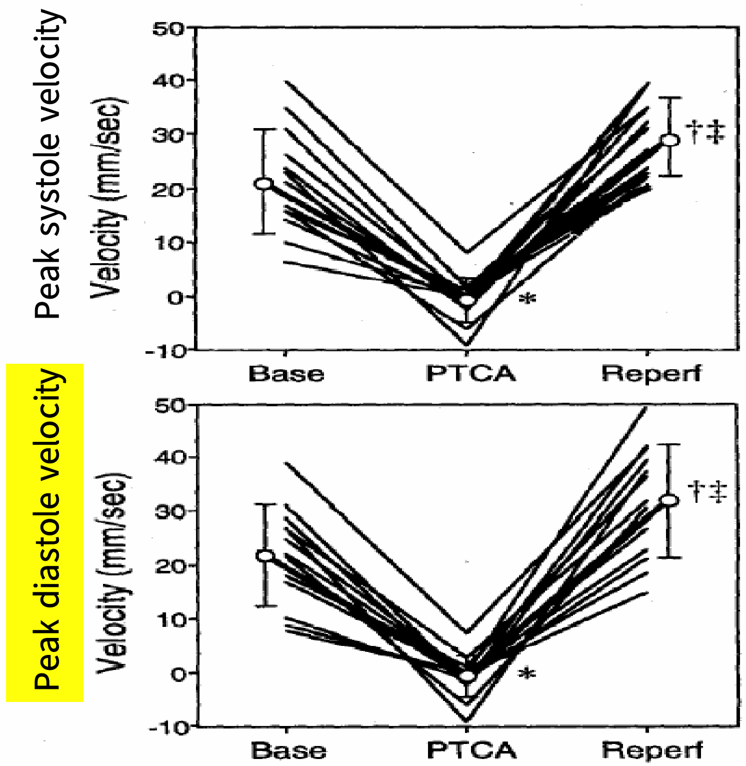


Fig. 2. Individual responses of peak velocities in myocardium supplied by angioplasty vessel during ischemia and reperfusion. *Top*, Peak systolic velocities. *Bottom*, Peak diastolic velocities. Velocities decreased to near 0 mm/sec during occlusive balloon inflation and increased to values greater than those at baseline during early reperfusion. *Base*, Baseline; *PTCA*, occlusive coronary angioplasty balloon inflation; *Reperf*, reperfusion. *$p < 0.001$ versus baseline. †$p < 0.001$ versus ischemia. ‡$p = 0.003$ versus baseline.

Bach DS et al. Am Heart J 1996;132:721-25.

Regional LV Diastolic Function

- Patients (pulsed wave E/A<1,Group 1) had more left ventricular segments with an abnormal left ventricular relaxation (pulsed wave TDI Em/am<1) than patients with a normal diastolic left ventricular inflow profile (pulsed wave E/A>1,Group 2)

Group 1; 10·3±3·0 vs Group 2: 3·7±2·7

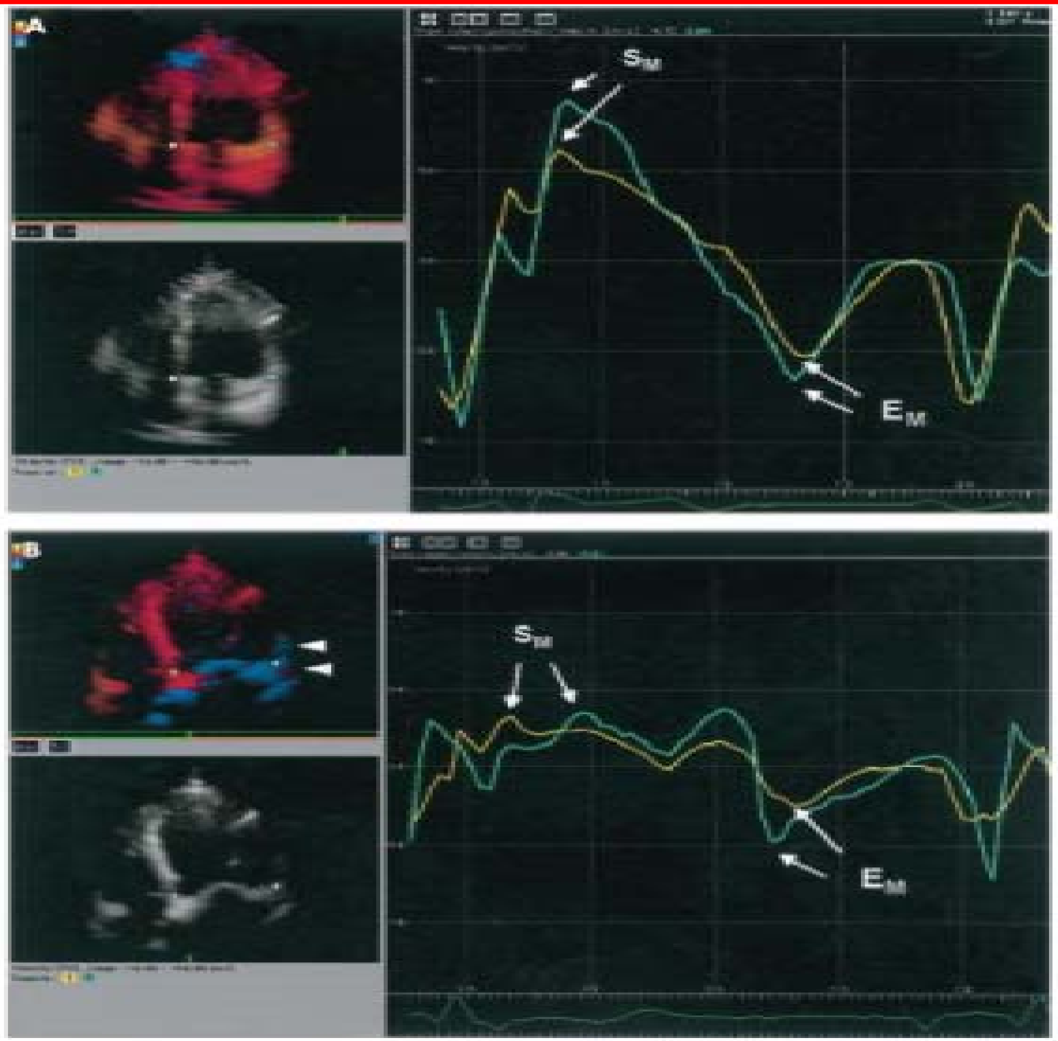
Garcia-Fernandez MA et al. Eur Heart J 1999; 20: 496–505

TDI as a guide to Cardiac Resynchronization therapy(CRT)

- TDI: precise measurement of time to peak regional systolic velocity(Sm)
- Crucial for the assessment of cardiac synchronicity
- Assessment of systolic asynchrony forms the basis for predicting responders of cardiac resynchronization therapy(CRT)
- Even selecting the appropriate patient for CRT

A. Normal

B. Heart failure normal QRS



2 criteria :1.maximal intersegmental difference in TS of > 100 ms

2.TS - SD of > 32.6 ms

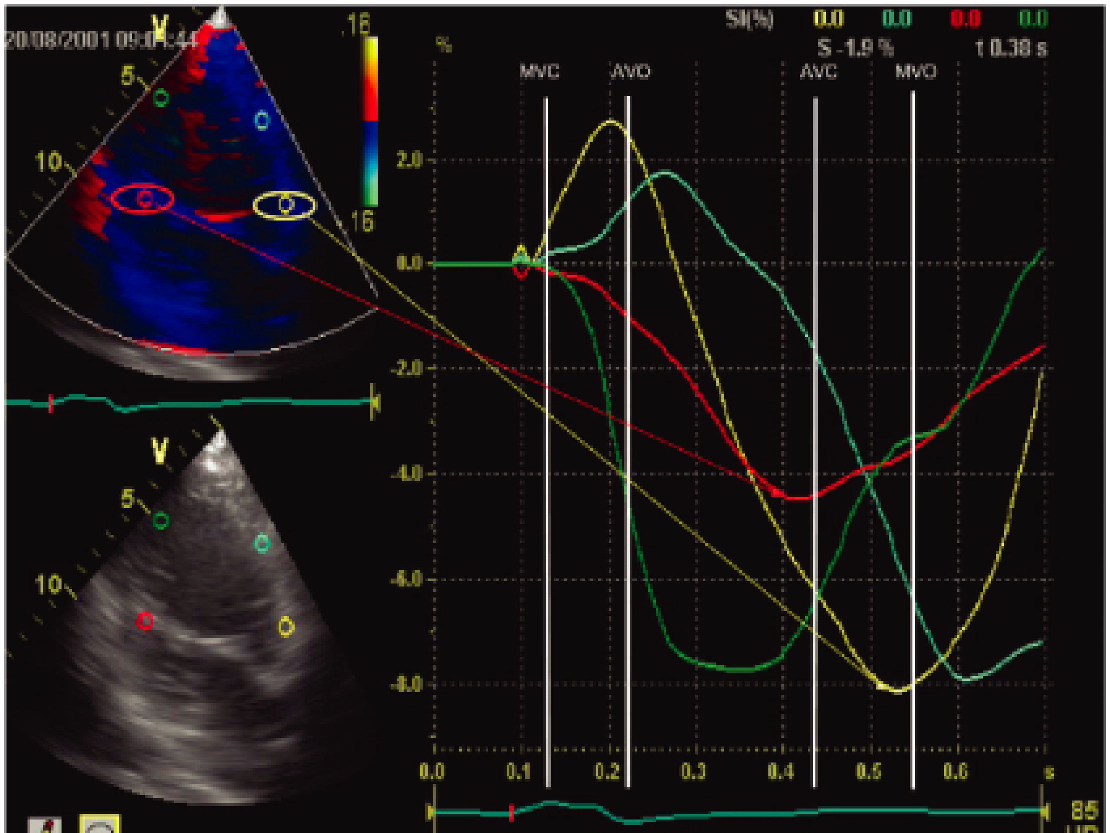
significant systolic asynchrony occurred in > 40% of patients with narrow QRS

at least 3/4 of those with wide QRS

Yu C-M et al. Heart 2003;89:54–60

Strain

Figure 3. Deformation analysis (strain) from two chamber view in a patient with left branch bundle block

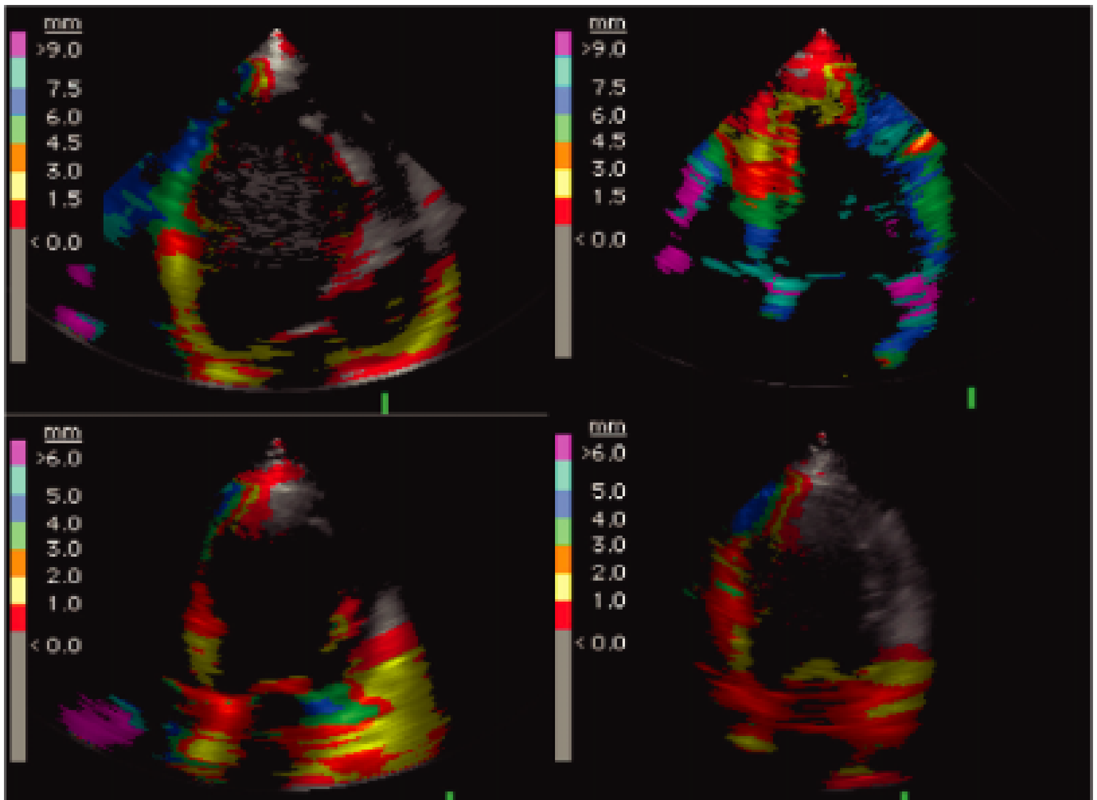


The solid lines indicates mitral valve closure (MVC), aortic valve opening (AVO), aortic valve closure (AVC), and mitral valve opening (MVO). The red and dark green cursers are positioned in the inferior wall and start to contract on time whereas the anterior wall segments (yellow and light green cursors) are late activated and thus initially stretched (positive strain) before they start to contract late and reach their peak strain after AVC. Consequently, isovolumic contraction time is prolonged, ejection time shortened, and isovolumic relaxation time prolonged with impaired systolic and diastolic performance.

Søgaard P et al. Curr Opin Cardiol 19:447–451.

Tissue tracking

Figure 4. Upper left and lower left corner show tissue tracking images during systole of two patients with severely impaired left ventricular function and left branch bundle block



Both patients presented with the longest mechanical delay in the lateral wall, where the grey scaling in the lateral wall indicates no or only limited contraction in a substantial part of the lateral wall; in both patients deformation analysis documented delayed contraction in the entire lateral wall. Right panels represent the postimplant situation. The top right images represent outcome to a lead implant "covering" the most delayed region (*ie*, the lateral wall with significant resynchronization efficacy). Lower right panel represent outcome with the lead implanted in an anterior position; resynchronization is not obtained and indeed lateral wall contractile performance declined.

Søgaard P et al. Curr Opin Cardiol 19:447–451.

Summary

- A renaissance of interest in longitudinal ventricular activity.; more sensitive index of myocardial contractility than conventional echocardiographic parameters.→ early diagnosis of systolic dysfunction
- TDI in combination with strain echo is extremly encouraging solution to the problem of quantitative anaysis of regional LV systolic function(preejection, ejection, postejection indices)
- New possibilities in the noninvasive assessment of LV diastolic function
- Other application for CRT guide, assessment for pressure in heart chamber and pulmonary artery, cardiac transplantation and constictive pericarditis.

Conclusion

Tissue Doppler imaging(TDI) is an accurate method for quantitative evaluation of regional myocardial function.