Assessment of sudden cardiac death by myocardial strain imaging

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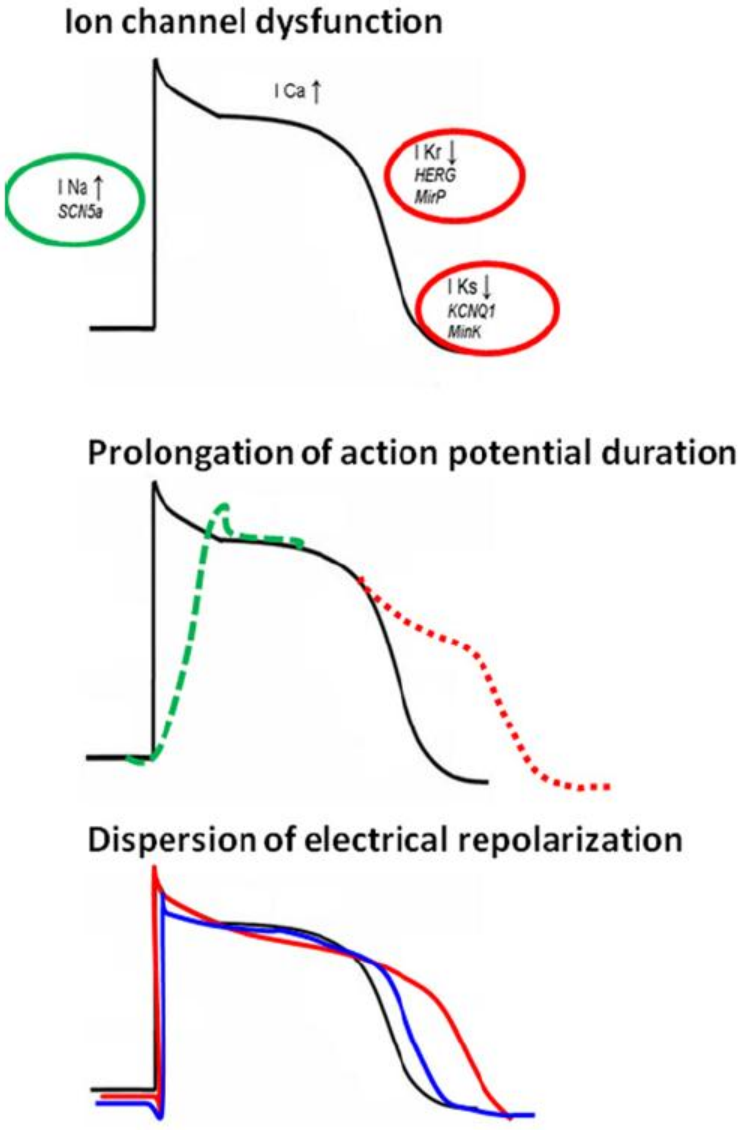
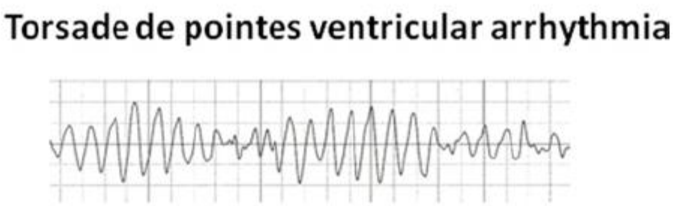
Conflicts of interest

- None

Team 2010: Integrated Cardiovascular Function, Oslo University Hospital, Oslo, Norway

Long QT Syndrome





Haugaa, Edvardsen, Trends 2011;21:65-69.

Effect of Calcium Channel Block on the Wall Motion Abnormalit of the Idiopathic Long QT Syndrome.

Gaetano M. De Ferrari, MD; Filippo Nador, MD; Gabriella Beria, MD; Sergio Sala, MD; Antonio Lotto, MD; Peter J. Schwartz, MD

Circulation. 1994;89.2126-2132.

”Echocardiographic AnalysisAll LQTS patients had a marked abnormality in baseline conditions and, specifically, a prolonged plateau”

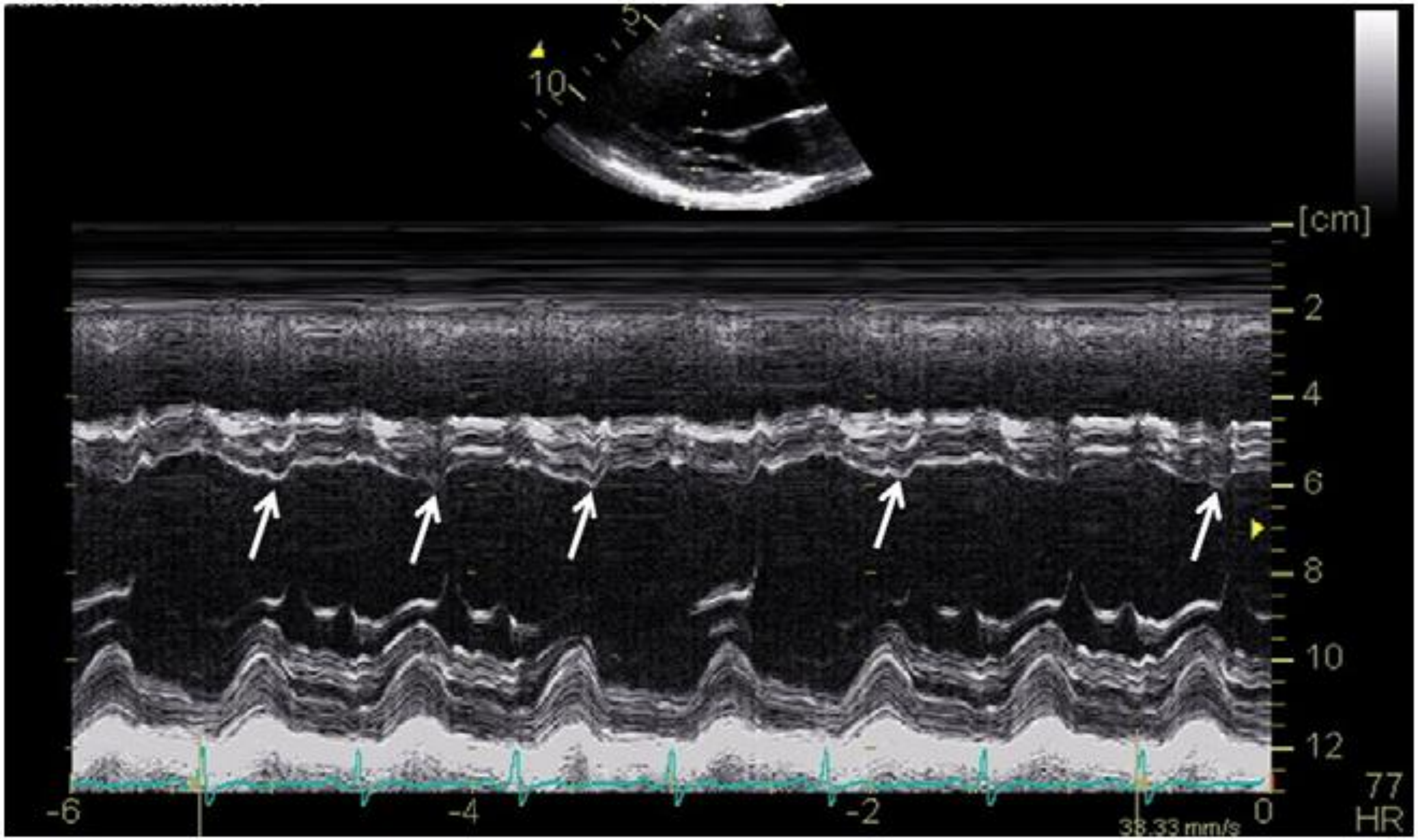
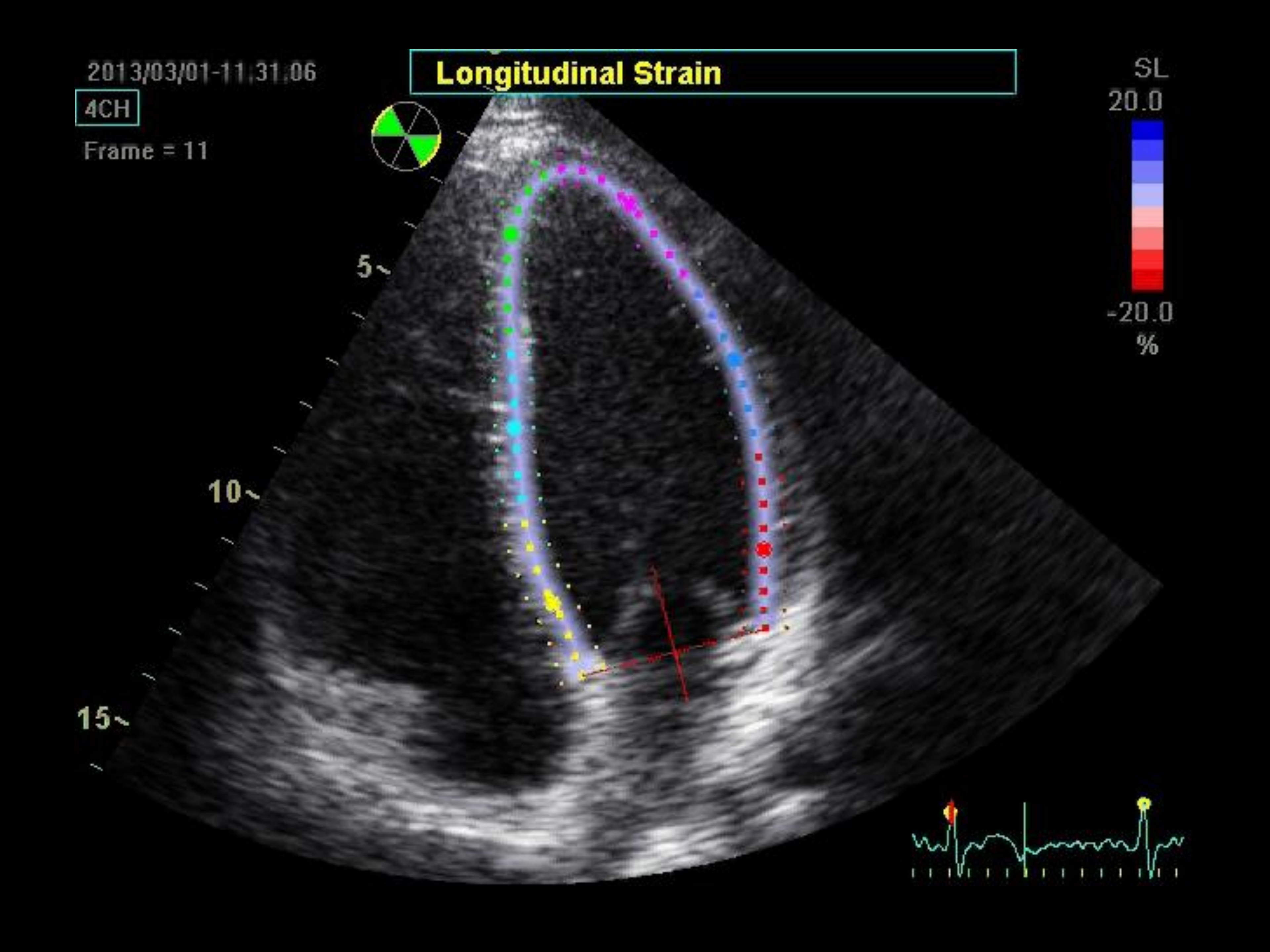


Figure 2: M-mode from a patient with LQTS. *White arrows* indicate the double peak pattern in septal contraction.

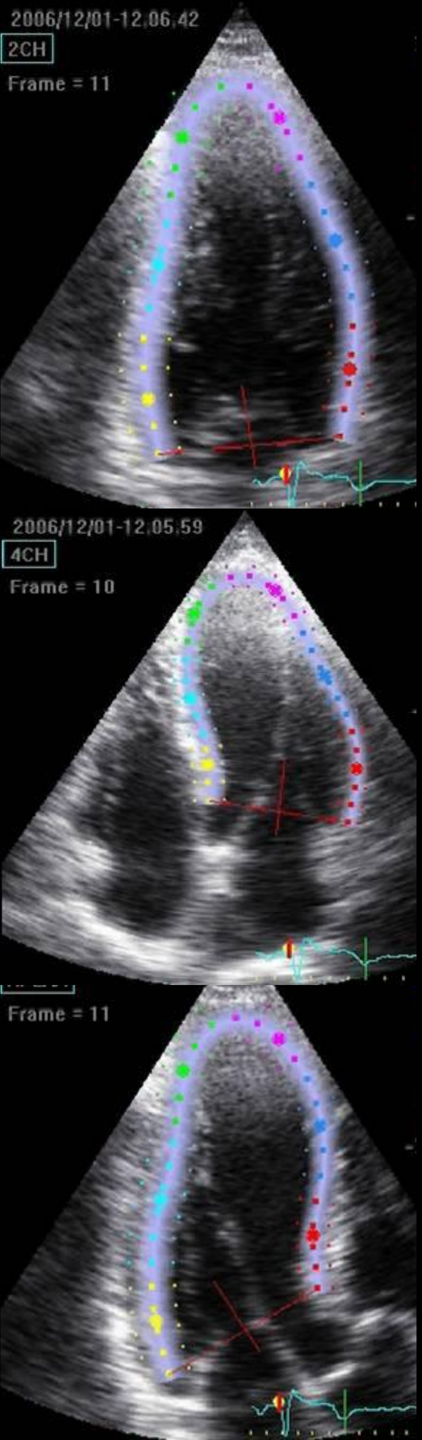
Haugaa, Edvardsen, Trends 2011;21:65-69.

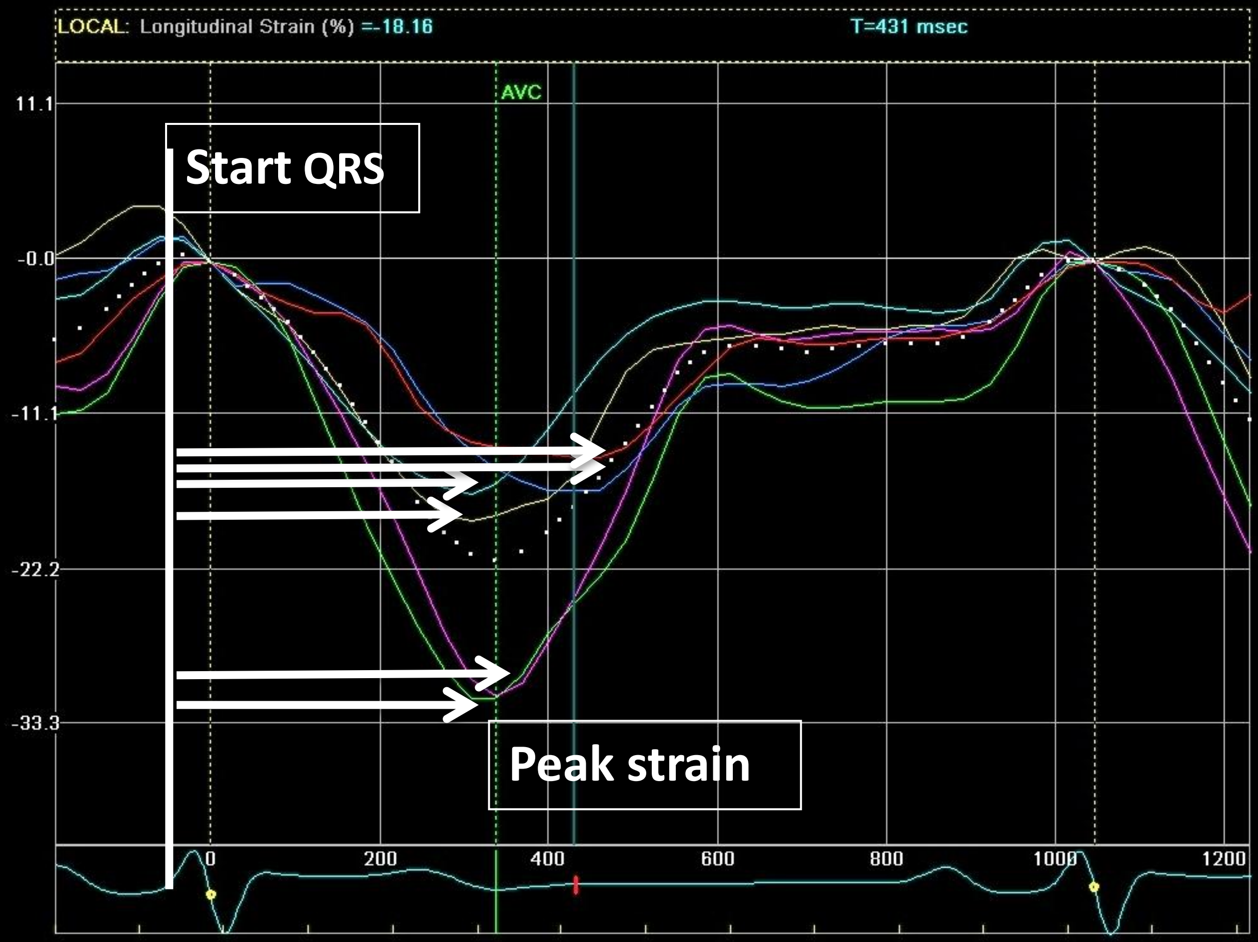


2013/03/01-11:31:06
Longitudinal Strain
4CH
Frame = 11
SL
20.0
-20.0
%
5
10
15

Mechanical dispersion

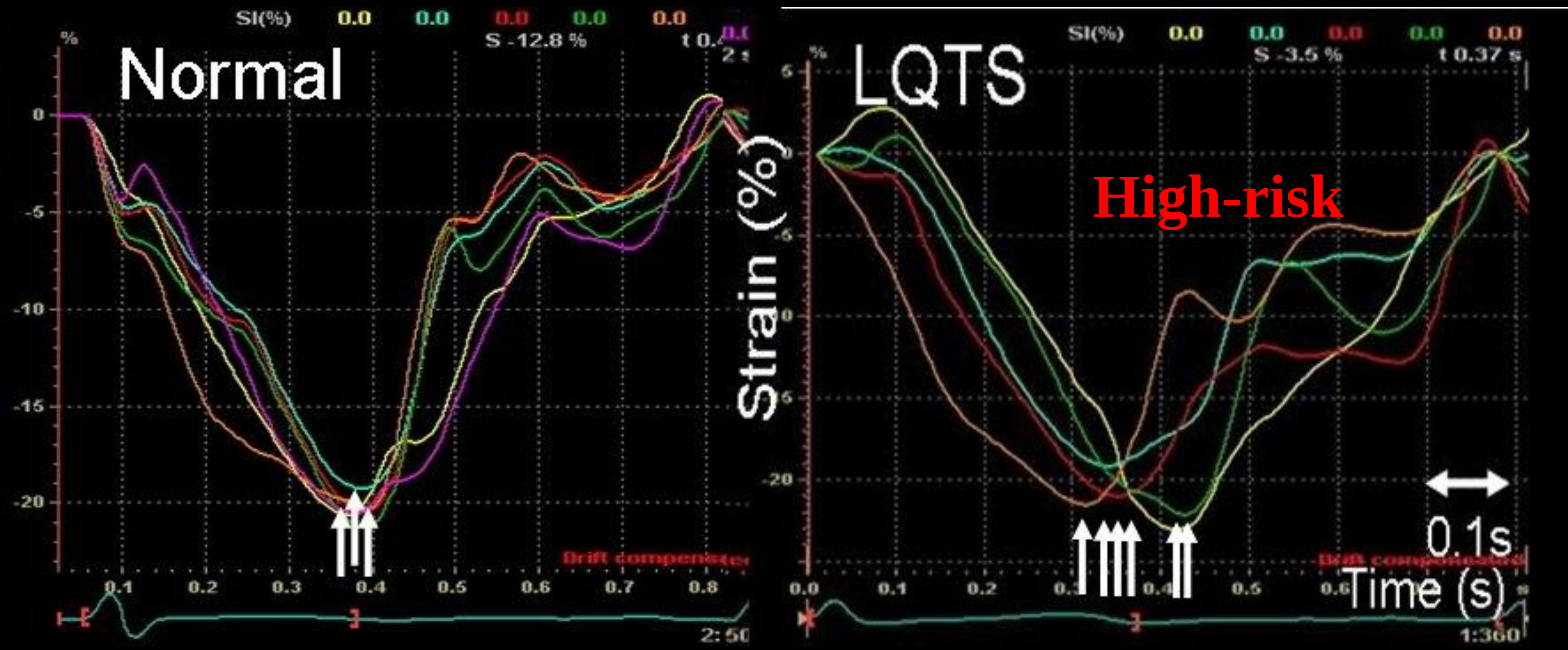
Standard deviaton of time to peak longitudinal strain in 16 LV segments





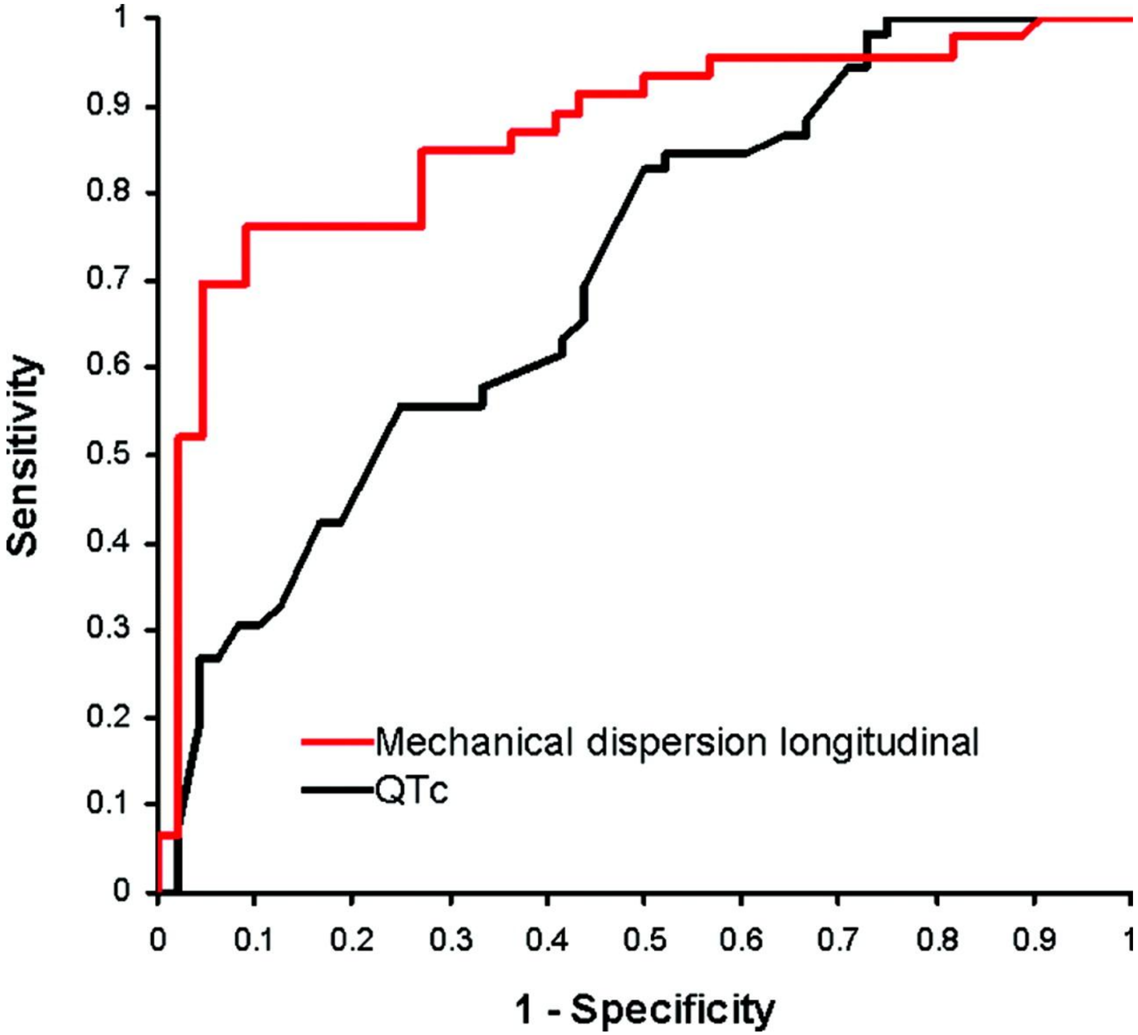
Mechanical Dispersion

Standard deviation of time to peak strain in 16 LV segments



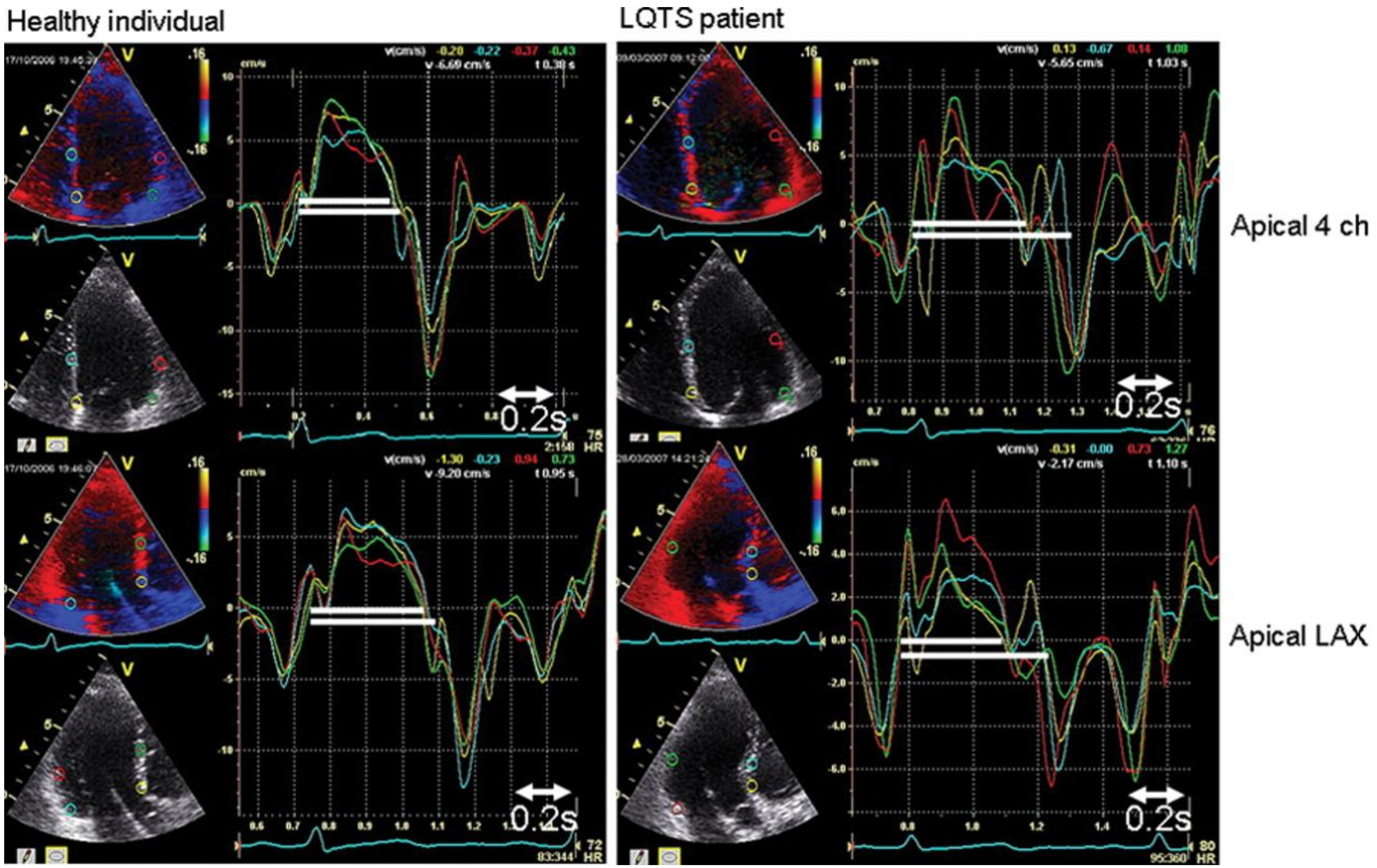
K. Haugaa et al., Circulation 2010; 122: 1355-63.

ROC curves of cardiac events in 101 LQTS mutation carriers.



K. Haugaa et al., Circulation 2010; 122: 1355-63.

Myocardial mechanical dispersion by tissue Doppler imaging.

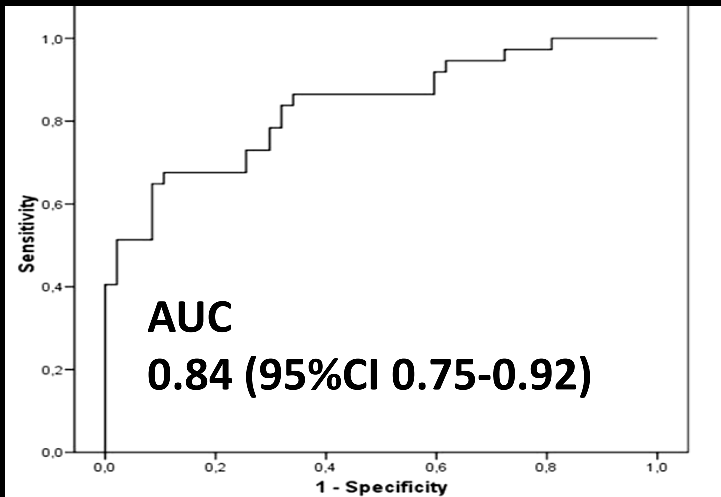


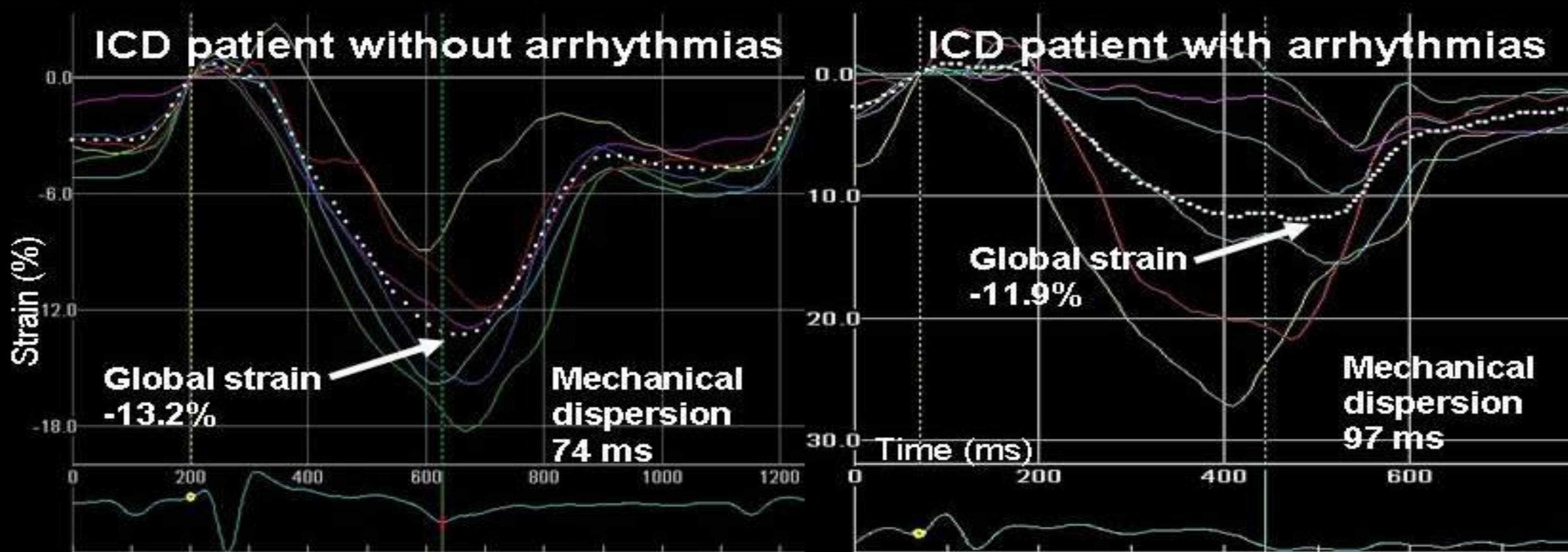
Haugaa K H et al. Eur Heart J 2009;30:330-337

European Heart Journal

Mechanical dispersion predicted appropriate ICD therapy in 85 patients after mycardial infarction over 2 years of follow up

Ability of mechanical dispersion to identify patients with ventricular arrhythmias





K Haugaa et al. JACC Cardiovasc Imaging 2010

Major problem
Selection of post-MI patients for ICD therapy

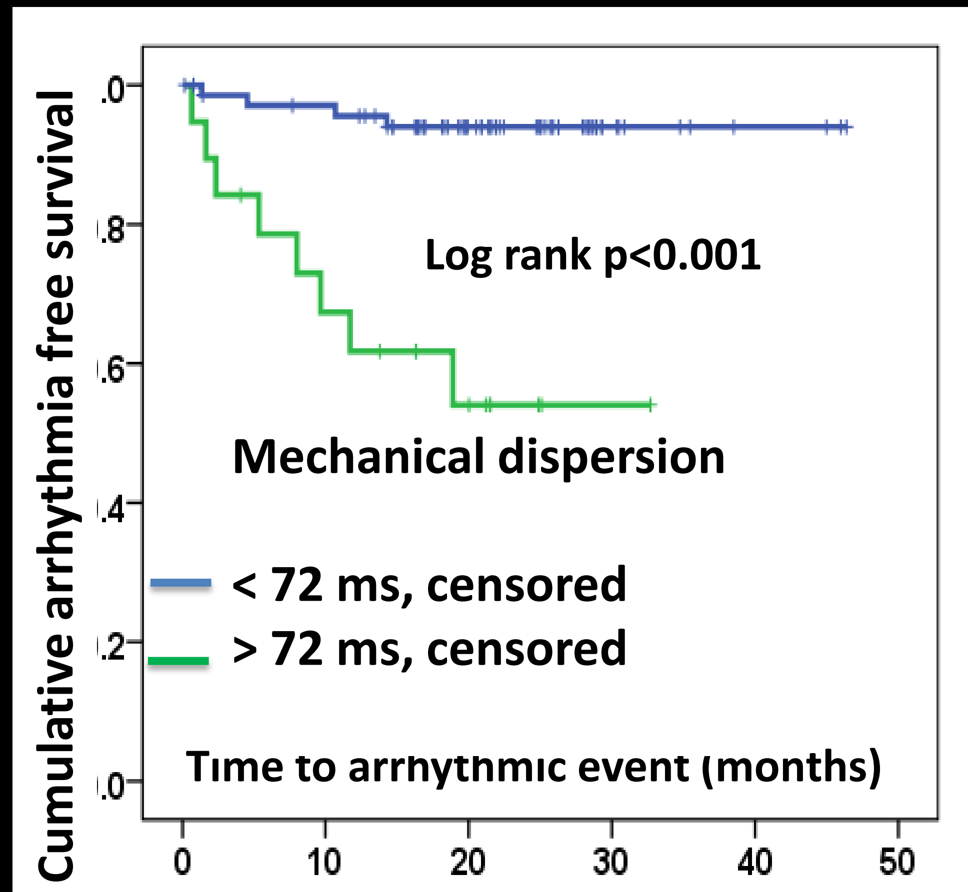
The majority of patients who die suddenly after myocardial infarction do not fulfill current ICD indications (EF<35%).

AF Buxton et al., JACC 2007

Risk Assessment of Ventricular Arrhythmias in Patients with Nonischemic Dilated Cardiomyopathy by Strain Echocardiography

Kristina H. Haugaa, MD, PhD, Björn Goebel, MD, Thomas Dahlslett, MD, Kathleen Meyer, MD, Christian Jung, MD, Alexander Lauten, MD, Hans R. Figulla, MD, PhD, Tudor C. Poerner, MD, PhD, and Thor Edvardsen, MD, PhD, *Oslo, Norway; Jena, Germany*

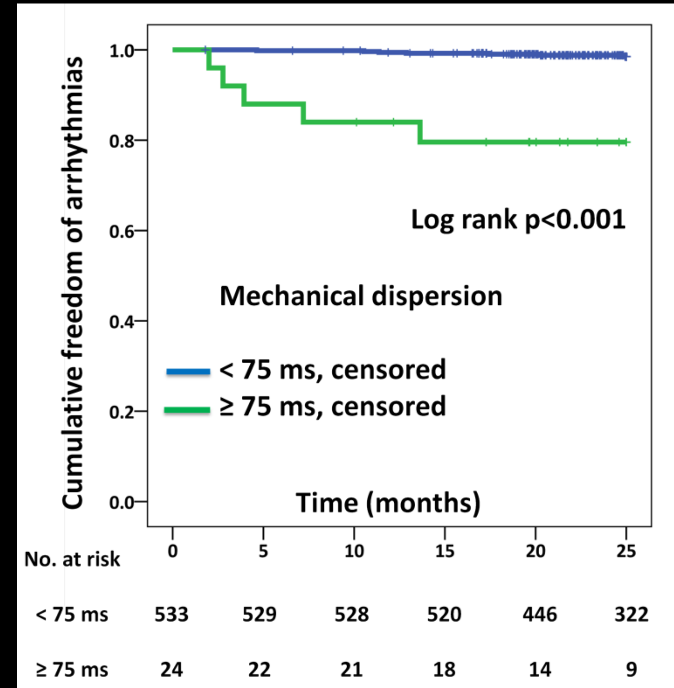
Mechanical dispersion predicted ventricular arrhythmias in patients with non- ischemic cardiomyopathy independently of EF

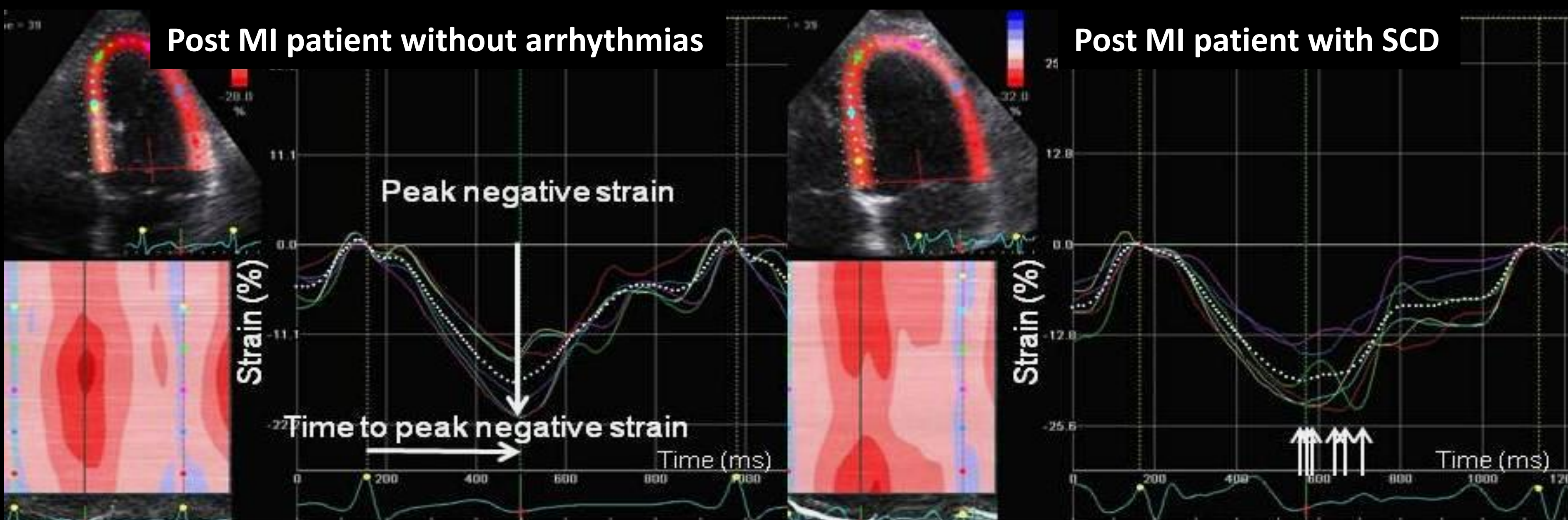


K Haugaa et al J Am Soc Echocardiogr 2012

Mechanical dispersion in 569 patients 40 days after myocardial infarction

- Prospective multi center study
- Mechanical dispersion was a marker of ventricular arrhythmias during 2 years of follow up





K Haugaa et al. JACC Cardiovasc Imaging 2013

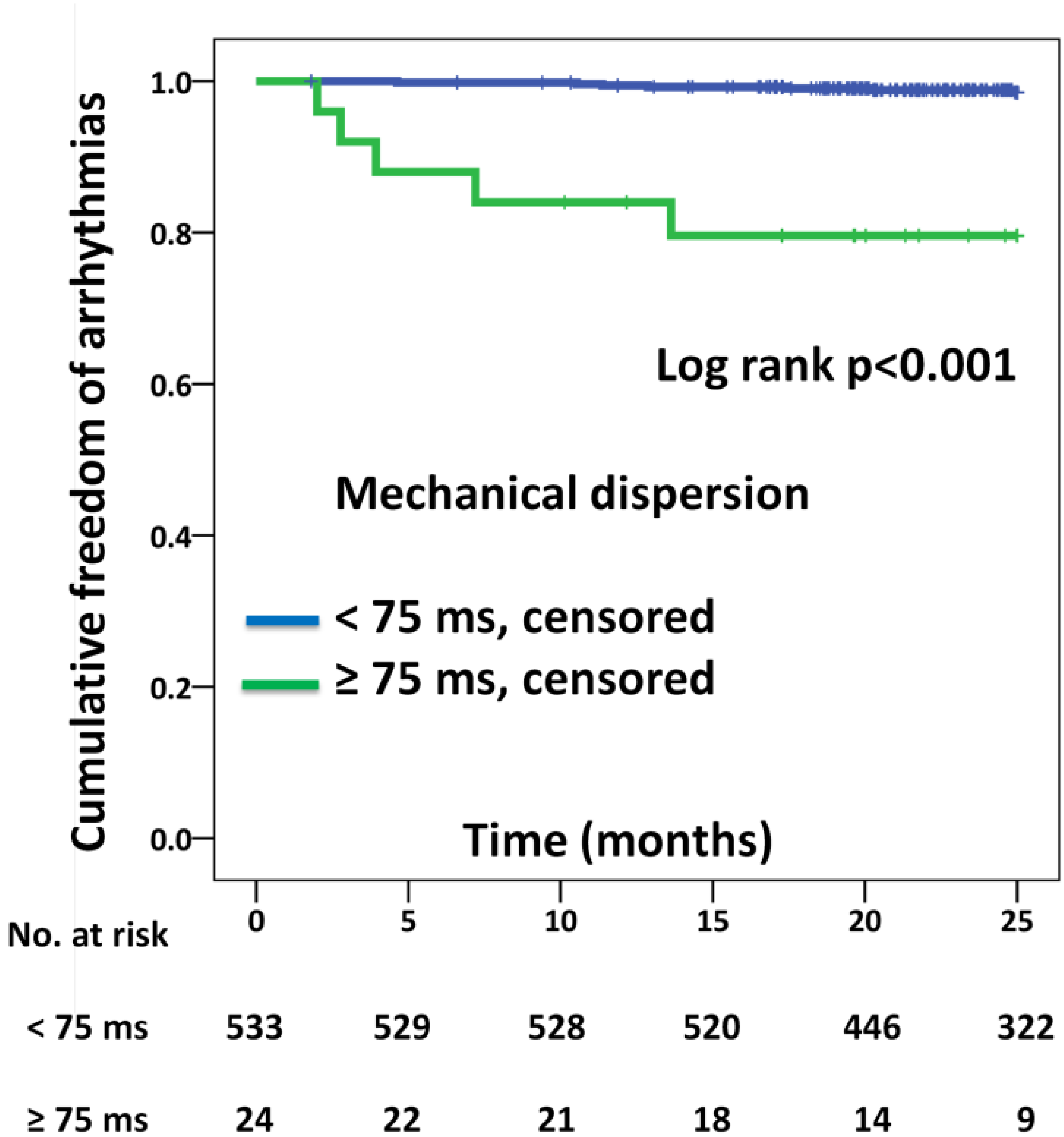
Table 2. Echocardiographic and ECG Findings in 569 Patients After MI

	Post-MI Patients Without Arrhythmias (n = 554)	Post-MI Patients With Arrhythmias (n = 15)	p Value
Echocardiographic findings			
LVEDV, ml	103 ± 32	126 ± 51	0.011
LVESV, ml	47 ± 22	73 ± 46	<0.001
LVEF, %	55 ± 11	48 ± 17	0.009
GLS, %	−18.2 ± 3.7	−14.8 ± 4.7	0.001
Mechanical dispersion, ms	42 ± 17	63 ± 25	<0.001
PSSI	0.049 ± 0.73	0.142 ± 0.135	<0.001
ECG findings			
QRS duration, ms	95 ± 16	97 ± 14	0.67
QTc interval, ms	421 ± 39	429 ± 33	0.49
STEMI/NSTEMI	260/294	8/7	0.79
Troponin T	1.8 (4.9)	0.5 (7.6)	0.53

Values are mean ± SD or n. The p values are from Student unpaired *t* tests, Fisher exact tests, and Mann-Whitney *U* tests.

ECG = electrocardiographic; GLS = global longitudinal strain; LVEDV = left ventricular end-diastolic volume; LVEF = left ventricular ejection fraction; LVESV = left ventricular end-systolic volume; NSTEMI = non–ST-segment elevation myocardial infarction; PSSI = post-systolic strain index; QTc = corrected QT; other abbreviations as in Table 1.

K Haugaa et al. JACC Cardiovasc Imaging 2013



Cumulative freedom of arrhythmias
1.0
0.8
0.6
0.4
0.2
0.0
Log rank p<0.001
Mechanical dispersion
< 75 ms, censored
≥ 75 ms, censored
Time (months)
0
5
10
15
20
25
No. at risk
< 75 ms 533 529 528 520 446 322
≥ 75 ms 24 22 21 18 14 9

Even when excluding patients with LVEFs <35% ($n = 28$), mechanical dispersion remained an excellent and independent predictor of arrhythmic events ($p < 0.01$), indicating that mechanical dispersion may serve as a risk marker in the vast majority of post-MI patients currently not fulfilling primary ICD indications. Mechanical dispersion was increased in those with arrhythmic events compared with those without also when excluding all patients with QRS durations >120 ms ($n = 17$) (60 ± 21 ms vs. 41 ± 17 ms, $p < 0.001$).

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Conclusions

- **Myocardial mechanical dispersion by strain imaging is a promising marker of risk in patients with normal or mildly impaired LV function**
- **Furthere testing in larger prospective trials are needed.**