EAE Teaching Course
Sofia, 2012

Assessing LV Dyssynchrony

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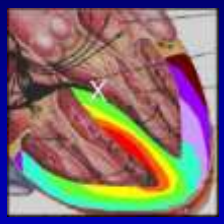
Left Bundle Branch Block



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Prinzen et al., 2000

Left Bundle Branch Block

intra-ventricular asynchrony

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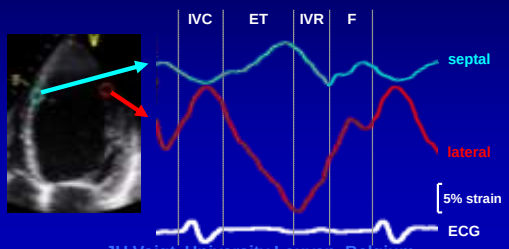
Left Bundle Branch Block

intra-ventricular asynchrony



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Left Bundle Branch Block

mechanical consequences

septal contraction without load
ejection due to lateral contraction
asymmetic hypertrophy
LV dilatation

→ LV – „remodelling“

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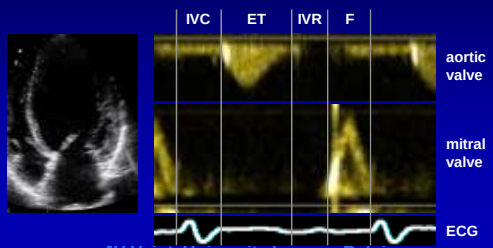
Left Bundle Branch Block

haemodynamic consequences



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Left Bundle Branch Block

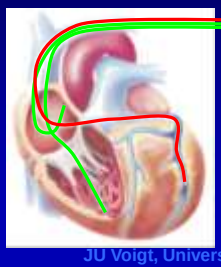
haemodynamic consequences

septal contraction stops filling
slow pressure rise
long IVCT, short ejection,
asynchronous relaxation
long IVRT

impaired LV function
even without cardiomyopathy !

CRT Principle

bi-ventricular stimulation



„Left ventricular pre-excitation to restore physiologic AV timing and contraction synchrony."

Leqlerc & Kass, JACC 2002

CRT Patient Selection

Patient Selection According to Guidelines

CRT Patient Selection

clinical criteria:
- symptomatic congestion NYHA III-IV*
- ischaemic oder non-ischaemic cardiomyopathy*

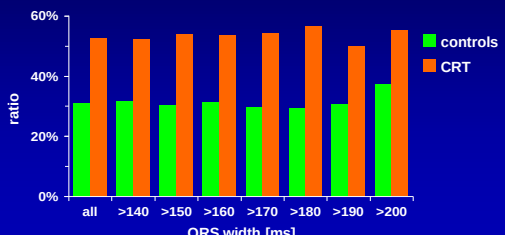
ECG criteria:
- QRS ≥ 130ms*
- sinus rhythm
- LBBB

echo criteria:
- LV end-diastolic diameter ≥ 55mm
- LV EF ≤ 35%
- mechanical criteria of LV asynchrony

*AHA/ACC/NASPE guidelines 2002, 2007

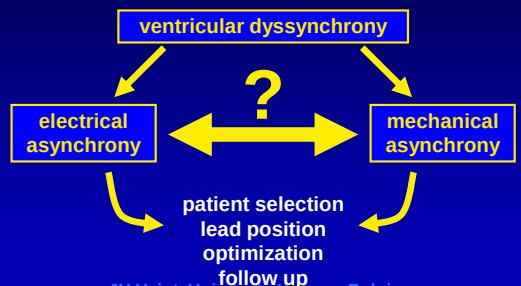
Selection by QRS Width ?

MIRACLE - study: CRT response vs. QRS width



nach Sogaard 2002

CRT Patient Selection



The New Guidelines

ESC GUIDELINES

2010 Focused Update of ESC guidelines on device therapy in heart failure

An update of the 2008 ESC guidelines for the diagnosis and treatment of acute and chronic heart failure and the 2007 ESC guidelines for cardiac and resynchronization therapy

Dickstein et al., Eur Heart J 2010

The New Guidelines

new selection criteria

ESC Guidelines

Considering limited resources, it would be prudent to target the population most likely to respond favourably. In patients with mild symptoms and a QRS width of 120–150 ms, clinicians may wish to assess other criteria associated with a favourable outcome such as dyssynchrony by echocardiography, LV dilatation, LBBB, non-ischaemic cardiomyopathy, or recent NYHA class III symptoms.

Dickstein et al., Eur Heart J 2010

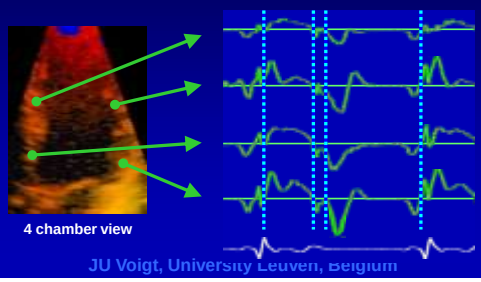
CRT Patient Selection

Assessing Mechanical Asynchrony

Tissue Velocity

Tissue Velocity Imaging

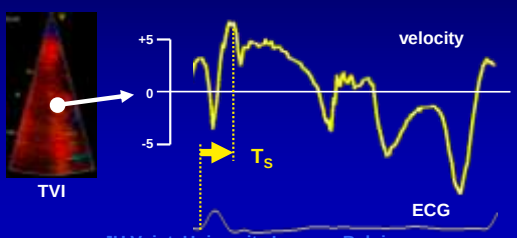
synchronous velocity patterns



4 chamber view

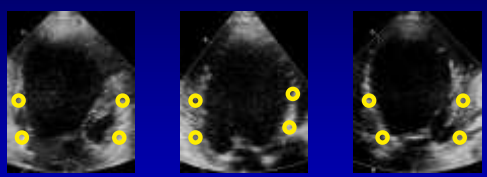
Asynchrony by TVI

onset QRS – peak velocity



Asynchrony by TVI

timing of max. syst. velocity

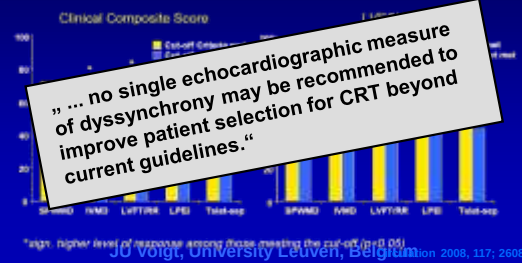


T_S-SD (12 segments)	Bax/Gorcsan (2 segments)	...
cut-off 34.4 ms	cut-off 65 ms	...
sens. 87%, spec. 81%	sens. 87%, spec. 100%	...

Yu, JACC 05; Gorcsan, AJC 04

PROSPECT Study

added predictive value of echo parameters



*sign. higher level of response among those meeting the cut-off (p<0.05)

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Circulation 2008, 117; 2608-2616

Assessing Asynchrony

Does peak systolic velocity tell us about contraction ?

When does the wall move fastest? → **When does the wall contract?**

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CRT Patient Selection

Assessing Mechanical Asynchrony

Deformation Imaging

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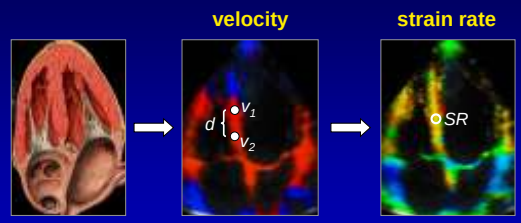
Strain Rate Imaging



$$v = \frac{\Delta f}{f_0} \cdot \frac{1}{2} c \qquad Strain\,Rate = \frac{v_1 - v_2}{d}$$

JU Voigt 1998

JU Voigt, University Leuven, Belgium

Typical LBBB

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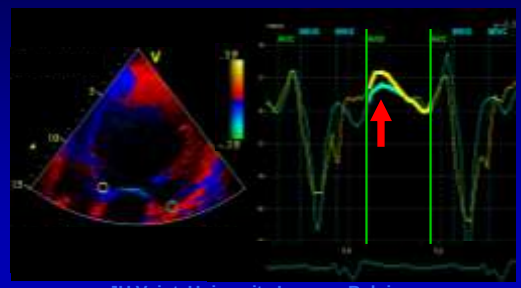
Synchronous Velocitiy Peaks



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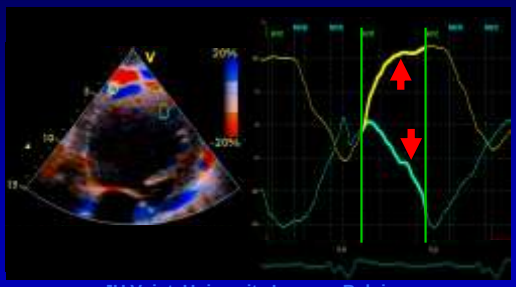
Asynchronous Deformation !



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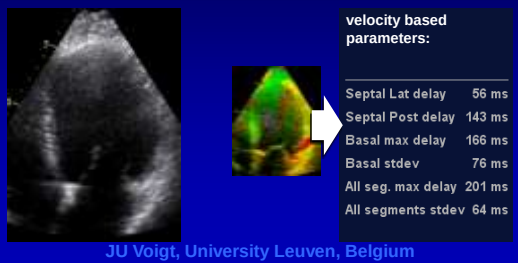
High Scar Burden

velocity based parameters



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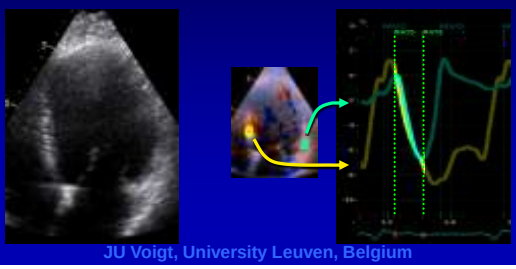
High Scar Burden

deformation measurement



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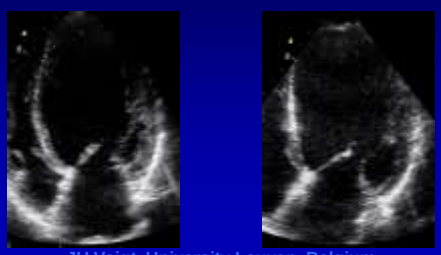
Selection by QRS Width ?

LSB, QRS 154ms

LSB, QRS 162ms



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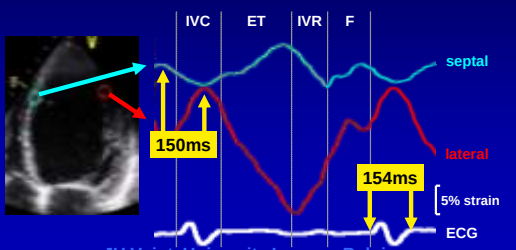
Selection by QRS Width ?

Pat.1: H_x myocarditis, no CAD



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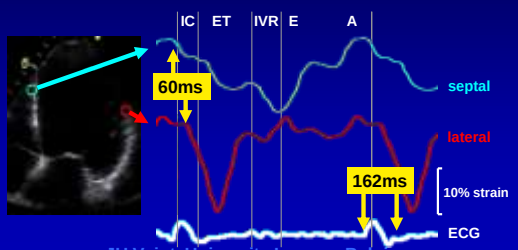
Selection by QRS Width ?

Pat.2: CAD, H_x anterior infarction



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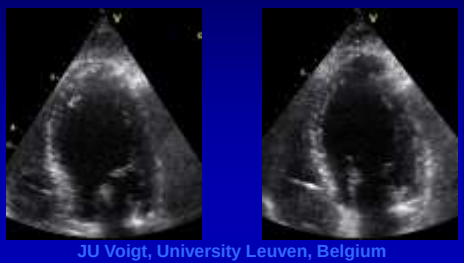
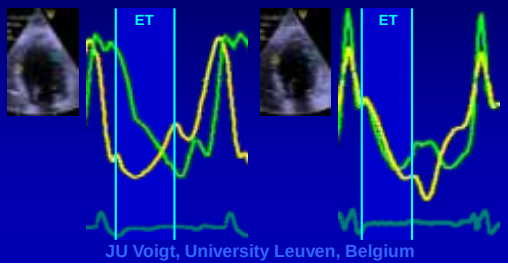
Deformation Imaging in CRT

CRT off | CRT on



Deformation Analysis for CRT

CRT on | CRT off



CRT Patient Selection

Assessing Mechanical Asynchrony

Other Approaches

Septal Flash

short septal bounce in early systole

Study:

52 patients

septal flash at rest

sensitivity 82%
specificity 88%

septal flash LD Dobu

sensitivity 97%
specificity 88%

Parsai / Sutherland et al, Eur Heart J 2009

Apical Rocking

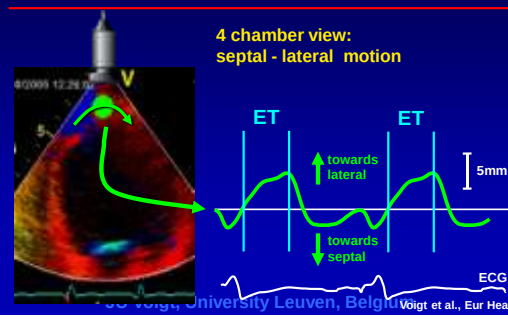
characteristic motion pattern in LBBB

typical features:

- reduced LV function
- early short septal motion
- lateral motion during ejection

Apical Rocking

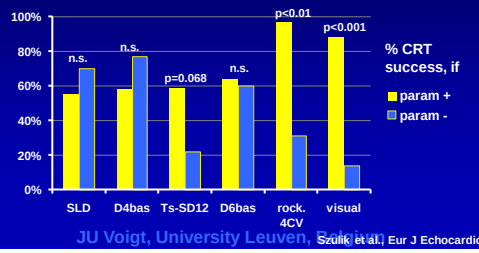
4 chamber view:
septal - lateral motion



Voigt et al., Eur Heart J 2009

Apical Rocking

added predictive value



Szulik et al., Eur J Echocardiogr 2010

Visual Asessment of Apical Rocking

baseline assessments
- apical rocking and septal flash (visual)
- scar burden (visual)
- prediction (responder/non-responder)
- LV volumes (modified Simpson's rule)

study design
n = 850
4 centers

response to CRT
- LV volumes (modified Simpson's rule)
- **response: ΔESV ≥ 15%**
- apical rocking and septal flash after CRT (visual)

I. Stankovic, Leuven

Visual Asessment of Apical Rocking

baseline

follow up

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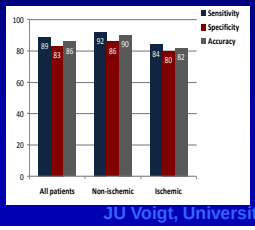
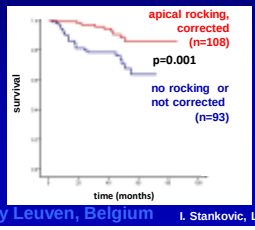
Visual Asessment of Apical Rocking

preliminary results (n = 201)

prediction of response



survival



I. Stankovic, Leuven

Summary

Echocardiography can analyze regional myocardial function in patients eligible for CRT.

Optimal parameters for patient selection are still subject to debate.

Dyssynchrony may be measured by tissue velocity based parameters which do not always mirror the true contraction sequence.

Preliminary study results indicate, that septal flash, apical rocking or deformation based parameters may be helpful alternative approaches.